THE

DISPENSATORY

OF THE

UNITED STATES OF AMERICA

BY

DR. GEO. B. WOOD AND DR. FRANKLIN BACHE.

NINETEENTH EDITION.

THOROUGHLY REVISED, LARGELY REWRITTEN, AND BASED UPON THE EIGHTH DECENNIAL REVISION OF THE UNITED STATES PHARMACOPŒIA.

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PHILADELPHIA

J. B. LIPPINCOTT COMPANY

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ELECTROTYPED AND PRINTED BY J. B. LIPPINCOTT COMPANY, PHILADELPHIA, U.S.A.

PREFACE TO THE NINETEENTH EDITION.

THE Nineteenth Edition of the United States Dispensatory is issued at a time in American history when the public mind has been thoroughly aroused to the necessity of demanding purity in drugs and honesty in purveying them. The future is therefore crowded with possibilities of the greatest advance in medicine and pharmacy that has occurred within a century of progress. In 1833 the authors of this work placed before the professions the result of their labors, stating in their preface that "it is desirable that there should be a Dispensatory of the United States, which, while it embraces all that is useful in European pharmacy, may accurately represent the art as it may exist in this country and give instruction adapted to our peculiar wants." That "they builded wiser than they knew" is now a matter of history, for the work has grown to be a standard authority as it enters upon its 74th year of existence.

For the first time in the history of the United States our National Government has adopted the United States Pharmacopœia as a standard, and this work, which has for nearly ninety years relied upon its merit for general acceptance, has at last received *full legal recognition.*

The editors of the Dispensatory, appreciating their increased responsibility, determined to institute some radical changes and improvements, which they sincerely trust will meet with the approval of the many readers of the book. The change which will first attract attention is the use of the double column throughout the text. The great increase in the number of "new remedies" in the last twenty years and the necessity for limiting the size of the book presented a problem which was not easy to solve to the satisfaction of the editors. By widening the pages of the Seventeenth and Eighteenth Editions their number was diminished, but the difficulty experienced by the reader, when consulting the pages, in quickly reading the following line, was recognized, and inasmuch as the work had in seventy-four years advanced to the importance of an encyclopedia, it was decided to change the style of the old book and use the double column. This has been done without sacrificing any of the features which have been recognized as valuable in the previous editions.

The introduction of synonyms of the drugs and preparations has been continued and the number increased, but it should be remembered, in consulting these, that they do not usually represent equivalent preparations; they are inserted for the information of the reader, to indicate drugs and preparations of greater or less similarity to those represented by the titles, and they are in no case intended to be construed as legal equivalents.

A new feature in this edition is the insertion at the end of the articles of a list of the preparations which are official in the United States and British Pharmacopœias. It is believed that these will be of service by indicating to the physician the preparations of a drug which are available for his use in prescribing, and to familiarize all with the unabbreviated official titles, which have been grouped alphabetically.

Quantities are indicated, as heretofore, in the metric system, and it was confidently hoped that by this time the metric system would have made so much progress in this country that the use of the alternative formulas expressed in old-form terms could be discontinued. These were first used in this work in 1883, and since then the method has been adopted by the British Pharmacopœia and the National Formulary. Until the use of the metric system is made compulsory by legal enactment, it would seem to be necessary to express quantities in both systems. It should be remembered, however, that the metric and old-form quantities are not interchangeable, and in using the formulas in the book either the metric quantities must be used exclusively, or the old-form quantities alone.

The custom which has been so long established in revising this work, of citing "journal references" to the abstracts and comments, has been continued, because it enables a reader to consult an article *in extenso* from the journal or book, when he finds the abstract insufficient for his needs. To save space, a system of abbreviation is used, and a table explaining the abbreviation and giving the name of the journal in full will be found in the preliminary pages. A glance at the table will show that this feature has been greatly enlarged in the Nineteenth Edition, as there are 185 titles compared with 54 in the previous one.

An asterisk preceding each preparation of the United States Pharmacopœia, Eighth Revision, followed by alternative quantities in brackets, indicates that the United States Pharmacopœia is not responsible for the correctness of these quantities, because, as is well known, the metric system is used exclusively in the latter book.

While the Board of Trustees of the United States Pharmacopœial Convention have permitted commentaries and text-books to use the text of the Pharmacopœia upon payment of a money consideration, the American Pharmaceutical Association resolved to withhold permission from any books to use the full text of the National Formulary. They have, however, permitted the use of a part of the text of this book, which will be found in Part III, Section II, with comments.

The pronunciation of the official titles is indicated, as heretofore, by the use of diacritical marks. This feature has commended itself to students and teachers, and it is an assistance in rendering the pronunciation of the Latin titles more uniform throughout the country.

Part II, as in the previous edition, is devoted to unofficial drugs, and the custom of using smaller type serves a useful purpose by differentiating official from unofficial substances. It also permits more extended comments than would otherwise be possible, as the saving of space must constantly be kept in mind.

The Food and Drugs Act with Rules and Regulations is printed in full in the preliminary pages with the object of placing this in a permanent form for easy reference.

The editorial staff remains unchanged since the Fifteenth Edition was published in 1883. Professor H. C. Wood has, as heretofore, revised the botany and materia medica, with the uses of the drugs and preparations; Professor Joseph P. Remington has had charge of the pharmacy and pharmaceutical chemistry of the work; and Professor Samuel P. Sadtler has revised the theoretical chemistry and toxicology. But at the outset of the revision of this edition it was realized that assistance should be secured, and the editors were fortunate in obtaining the services of Dr. Albert B. Lyons of Detroit, and Dr. Horatio C. Wood, Jr., of Philadelphia. The former is well known as an author on chemical and botanical subjects, and his excellent work on the assay of alkaloidal drugs is widely known and appreciated. Dr. H. C. Wood, Jr., has prepared the index of diseases, and the thanks of the editors are due to both of these gentlemen for the careful revision of the proof-sheets of the work. To M. J. Rosenau, M.D., Director of the Hygienic Laboratory of the U. S. Public Health and Marine Hospital Service, who contributed the article on Serum Antidiphthericum, especial thanks are extended. Acknowledgements are also due to M. S. Renshaw and Prof. E. Fullerton Cook, for their assistance in proof reading, and to the latter has fallen the task of preparing the enlarged index.

The Nineteenth Edition is issued from entirely new plates, and it is confidently believed that the new dress will be acceptable to all of its readers. More labor and greater care have been expended upon this edition than upon any previous one. The enactment of the Food and Drugs Law has awakened, to a greater extent than ever before in this country, an interest in authoritative books, and the editors, while sensible of many shortcomings, sincerely hope that this edition will prove a most worthy successor to those which have preceded it, and they trust that the book will merit the approbation which has been so freely granted to its predecessors.

PREFACE TO THE FIRST EDITION.

THE objects of a Dispensatory are to present an account of medicinal substances in the state in which they are brought into the shops, and to teach the modes in which they are prepared for use. The importance of these objects, and the general value and even necessity of a work of this nature, will not be disputed. It may, however, be a question, how far the wants of the medical and pharmaceutical community in this country are supplied by the Dispensatories already in circulation; and whether such a deficiency exists as to justify the offer of a new one to the public attention. The great merits of the works severally entitled "The Edinburgh New Dispensatory" and "The London Dispensatory," the former edited by the late Andrew Duncan, M.D., the latter by Anthony Todd Thomson, M.D., are well known wherever the English language is spoken. Founded, as they both are, upon the excellent basis laid by Lewis, they are nevertheless entitled, from the great addition of valuable materials, and the distinctive character exhibited in the arrangement of these materials, to be considered as original works; while the style in which they have been executed speaks strongly in favor of the skill and industry of their authors. But they were calculated especially for the sphere of Great Britain, and are too deficient in all that relates exclusively to this country, to admit of being received as standards here. In the history of our commerce in drugs, and of the nature, growth, and collection of our indigenous medical plants; in the chemical operations of our extensive laboratories; and in the modes of preparing, dispensing, and applying medicines, which have gradually grown into use among us; there is much that is peculiar, a knowledge of which is not to be gained from foreign books, and is yet necessary to the character of an accomplished American pharmaceutist. We have, moreover, a National Pharmacopœia, which requires an explanatory commentary, in order that its precepts may be fully appreciated, and advantageously put into practice. On these accounts, it is desirable that there should be a Dispensatory of the United States, which, while it embraces whatever is useful in European pharmacy, may accurately represent the art as it exists in this country, and give instruction adapted to our peculiar wants. It appears due to our national character that such a work should be in good faith an American work, newly prepared in all its parts, and not a mere edition of one of the European Dispensatories, with here and there additions and alterations, which, though they may be useful in themselves, cannot be made to harmonize with the other materials so as to give to the whole an appearance of unity, and certainly would not justify the assumption of a new national title for the book. Whether, in the Dispensatories which have been published in the United States, these requisites have been satisfactorily fulfilled, it rests with the public to determine. That valuable treatises on Materia Medica and Pharmacy have been issued in this country, no candid person, acquainted with our medical literature, will be disposed to deny. In offering a new work to the medical and pharmaceutical professions, the authors do not wish to be considered as undervaluing the labors of their predecessors. They simply conceive that the field has not been so fully occupied as to exclude all competition. The Pharmacy of continental Europe is ground which has been almost untouched; and much information in relation to the natural history, commerce, and management of our own drugs, has lain ungathered in the possession of individuals, or scattered in separate treatises and periodicals not generally known and read. Since the publication of the last edition of our National Pharmacopœia, no general explanation of its processes has appeared, though required in justice both to that work and to the public. The hope of being able to supply these deficiencies may, perhaps, be considered a sufficient justification for the present undertaking.

The Pharmacopœia of the United States has been adopted as the basis of this Dispensatory. It is followed both in its general division of medicines, and in its alphabetical arrangement of them under each division. Precedence is, in every instance, given to the names it recognizes, while the explanations by which it fixes the significance of these names are inserted in immediate connection with the titles to which they severally belong. Every article which it designates is more or less fully described; and all its processes, after being literally copied, are commented on and explained wherever comment and explanation appeared necessary. Nothing, in fine, has been omitted, which, in the estimation of the authors, could serve to illustrate its meaning, or promote the ends which it was intended to subserve. This course of proceeding appeared to be due to the national character of the Pharmacopœia, and to the important object of establishing, as far as possible, throughout the United States, uniformity, both in the nomenclature and preparation of medicines. In one particular, convenience required that the plan of the Pharmacopœia should be departed from. The medicines belonging to the department of MATERIA MEDICA, instead of being arranged in two divisions corresponding with the *Primary and Secondary Catalogues* of that work, have been treated of indiscriminately in alphabetical succession; and the place which they respectively hold in the Pharmacopœia is indicated by the employment of the term *Secondary*, in connection with the name of each of the medicines included in the latter catalogue.

But, though precedence has thus been given to the Pharmacopœia of the United States, those of Great Britain have not been neglected. The nomenclature adopted by the different British Colleges, and their formulas for the preparation of medicines, have been so extensively followed throughout the United States, that a work intended to represent the present state of pharmacy in this country would be imperfect without them; and the fact that the writings of British physicians and surgeons, in which their own official terms and preparations are exclusively employed and referred to, have an extensive circulation among us, renders some commentary necessary in order to prevent serious mistakes. The Pharmacopœias of London, Edinburgh, and Dublin have, therefore, been incorporated, in all their essential parts, into the present work. Their official titles are uniformly given, always in subordination to those of the United States Pharmacopœia, when they express the same object; but in chief, when, as often happens, no corresponding medicine or preparation is recognized by our national standard. In the latter case, if different names are applied by different British Colleges to the same object, that one is generally preferred which is most in accordance with our own system of nomenclature, and the others are given as synonymes. The medicines directed by the British Colleges are all described, and their processes either copied at length, or so far explained as to be intelligible in all essential particulars.

Besides the medicinal substances recognized as official by the Pharmacopœias alluded to, some others have been described, which, either from the lingering remains of former reputation, from recent reports in their favor, or from their important relation to medicines in general use, appear to have claims upon the attention of the physician and apothecary. Opportunity has, moreover, been taken to introduce incidentally brief accounts of substances used in other countries or in former times, and occasionally noticed in medical books; and, that the reader may be able to refer to them when desirous of information, their names have been placed with those of the standard remedies in the Index.

In the description of each medicine, if derived immediately from the animal, vegetable, or mineral kingdom, the attention of the authors has been directed to its natural history, the place of its growth or production, the method of collecting and preparing it for market, its commercial history, the state in which it reaches us, its sensible properties, its chemical composition and relations, the changes which it undergoes by time and exposure, its accidental or fraudulent adulterations, its medical properties and application, its economical uses, and the pharmaceutical treatment to which it is subjected. If a

chemical preparation, the mode and principles of its manufacture are indicated in addition to the other particulars. If a poison, and likely to be accidentally taken, or purposely employed as such, its peculiar toxicological effects, together with the mode of counteracting them, are indicated; and the best means of detecting its presence by reagents are explained.

The authors have followed the example of Dr. A. T. Thomson, in giving botanical descriptions of the plants from which the medicines treated of are derived. In relation to all indigenous medicinal plants, and those naturalized or cultivated in this country, the advantages of such descriptions are obvious. The physician may often be placed in situations in which it may be highly important that he should be able to recognize the vegetable which yields a particular medicine; and the apothecary is constantly liable to imposition from the collectors of herbs, unless possessed of the means of distinguishing, by infallible marks, the various products presented to him. A knowledge of foreign medicinal plants, though of less importance, will be found useful in various ways, independently of the gratification afforded by the indulgence of a liberal curiosity in relation to objects so closely connected with our daily pursuits. The introduction of these botanical notices into a Dispensatory appears to be peculiarly appropriate; as they are to be considered rather as objects for occasional reference than for regular study or continuous perusal, and therefore coincide with the general design of the work, which is to collect into a convenient form for consultation all that is practically important in relation to medicines. The authors have endeavored to preserve a due proportion between the minuteness of the descriptions, and their value as means of information to the student; and, in pursuance of this plan, have generally dwelt more at length upon our native plants than upon those of foreign growth; but, in all instances in which they have deemed a botanical description necessary, they have taken care to include in it the essential scientific character of the genus and species, with a reference to the position of the plant in the artificial and natural systems of classification; so that a person acquainted with the elements of botany may be able to recognize it when it comes under his observation.

In preparing the Dispensatory, the authors have consulted, in addition to many of the older works of authority, the greater number of the treatises and dissertations which have recently appeared upon the various subjects connected with Pharmacy, and especially those of the French writers, who stand at present at the head of this department of medical science. They have also endeavored to collect such detached facts, scattered through the various scientific, medical, and pharmaceutical journals, as they conceive to be important in themselves, and applicable to the subjects under consideration; and have had frequent recourse to the reports of travellers in relation to the natural and commercial history of foreign drugs. The occasional references in the body of the work will indicate the sources from which they have most largely drawn, and the authorities upon which they have most relied. In relation to our own commerce in drugs, and to the operations of our chemical laboratories, they are indebted for information chiefly to the kindness of gentlemen engaged in these branches of business, who have always evinced, in answering their numerous inquiries, a promptitude and politeness which merit their warm thanks, and which they are pleased to have this opportunity of acknowledging.[1]

It has not been deemed necessary to follow the example of the British Dispensatories, by inserting into the work a treatise upon chemistry, under the name of Elements of

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[1] The authors deem it proper to state that they are peculiarly indebted for assistance to Mr. Daniel B. Smith, president of the Philadelphia College of Pharmacy, to whom, besides much important information in relation to the various branches of the apothecary's business, they owe the prefatory remarks on Pharmacy, which are placed at the commencement of the second part of the work, and the several articles, in the Materia Medica, upon *Leeches*, *Carbonate of Magnesia*, and *Sulphate of Magnesia*.

Pharmacy. Such a treatise must necessarily be very meagre and imperfect, and, as systems of chemistry are in the hands of every physician and apothecary, would uselessly occupy the place of valuable matter of less easy access.

The authors may, perhaps, be permitted to observe, in relation to themselves, that they have expended much time and labor in the preparation of the work; have sought diligently for facts from every readily accessible source; have endeavored, by a comparison of authorities, and a close scrutiny of evidence, to ascertain the truth whenever practicable; and have exerted themselves to the extent of their abilities to render the Dispensatory worthy of public approbation, both for the quality and quantity of its contents, and the general accuracy of its statements. They are conscious, nevertheless, that in so great a multiplicity of details, numerous errors and deficiencies may exist, and that the faults of undue brevity in some cases, and prolixity in others, may not have been entirely avoided; but they venture to hope that a candid public will make all due allowances; and they take the liberty to invite, from all those who may feel interested in the diffusion of sound pharmaceutical knowledge, the communication of friendly suggestions or criticisms in relation to the objects and execution of the work.

PHILADELPHIA, January, 1833.

ABBREVIATIONS.

Ait.—W. Aiton.
Arab.—Arabic.
Aubl.—Aublet.
B.—Baumé's Hydrometer.
B. et H.—Bentham and Hooker.
B. & T.—Bentley & Trimen's Medicinal Plants.
Baill.—Baillon.
Bart.—Barton.
Benth.—Bentham.
Bl.—Blume.
Boehm.—Boehmer.
Boiss.—Boissier.
Br.—Braun.
Br.—The British Pharmacopœia, 1898.
Br. Add.—Indian and Colonial Addendum (1900) to the British Pharmacopœia (1898).
Britt.—Britton.
Brot.—Brotero.
C. et S.—Chamisso and Schlechtendal.
Carr.—Carriere.
Cav.—Cavaniles.
Cerv.—Cervantes.
Cc.—Cubic centimeter.
Cham.—Chamisso.
Chois.—Choisey.
Cm.—Centimeter.
Cod.—Codex Medicamentarius. The French Pharmacopœia.
Coult.—Coulter.
Coult. et R.—Coulter and Rose.
DC.—De Candolle.
Desf.—Desfontaines.
Desr.—Desroussaux.
Dry.—Dryander.
Duh.—Duhamel.
E. et P.—Engler and Prantl.
Ell.—Elliott.
Engl.—Engler.
F. Muell.—Ferdinand von Müller.
Fam.—Family.
Fisch.—Fischer.
Fr.—French.
Fr. Cod.—The French Pharmacopœia.
Froel.—Froelich.
G.—German.
Gaert.—Gaertner.
Griseb.—Grisebach.
H. B. K.—Humboldt, Bonpland, and Kunth.
Hassk.—Hasskarl.
Hook.—W. J. Hooker.
Hook. f.—J. D. Hooker.
Houtt.—Houttyn.
Gm.—Gramme.
It.—Italian.
Jacq.—Jacquin.
Juss.—Jussieu.
Kze.—Kunze.
Labill.—Labillardière.
Lam.—Lamarck.
Lindl.—Lindley.
Linn.—Linnæus (Linné).
Michx.—Michaux.
Miq.—Miquel.
Mm.—Millimeter.
Moench.—Moenchausen.
Mol.—Molecule.
N. F.—National Formulary.
Nat. Ord.—Natural Order.
Nutt.—Nuttall.
Off. Prep.—Official Preparations.
P. G.—The German Pharmacopœia. Arzneibuch für das Deutsche Reich (1900).
Pav.—Pavon.
Port.—Portuguese.
Raf.—Rafinesque.
Roxb.—Roxburgh.
Schlecht.—Schlechtendal.
Sonn.—Sonnerat.
Sp.—Spanish.
Sp. Gr.—Specific Gravity.
Sw.—Swartz.
T. et G.—Torrey and Gray.
Thunb.—Thunberg.
Tul.—Tulasne.
U. S.—The Pharmacopœia of the United States, 8th Rev. Older editions have date attached thus: *U. S.* (1890).
Vaill.—Vaillant.
Var.—Variety.
Willd. Sp. Plant.—Willdenow's edition of the Species Plantarum of Linnæus.
Woodv. Med. Bot.—Woodville's Medical Botany, 2d edition.

TABLE OF ABBREVIATED TITLES OF JOURNALS AND BOOKS REFERRED TO IN THIS WORK.

A. de P.—Archives de Physiologie normale et pathologique.
A. E. P. P.—Archiv für Experimentelle Pathologie und Pharmakologie.
A. G. M.—Archives générales de Médecine.
A. I. B.—Archives Italiennes de Biologie.
A. I. P.—Archives internationales de Pharmacodynamique.
A. J. P.—American Journal of Pharmacy.
A. M. S. J.—Atlanta Medical and Surgical Journal.
A. Pharm.—Archiv der Pharmacie.
A. Phys.—Archiv für Anatomie und Physiologie, physiologisches Abteilung.
Aerzt. Rund.—Aerztliche Rundschau.
All. W. M. Z.—Allgemeine Wiener medicinische Zeitung.
Am. Chem. J.—American Chemical Journal.

Am. Drug.—American Druggist (continuation of New Remedies).
Am. J. M. S.—American Journal of Medical Sciences.
Am. J. Sci.—American Journal of Science (and Arts).
Am. Med.—American Medicine.
Am. Pract. and News.—American Practitioner and News.
An.—The Analyst.
Ann. Ch. Ph.—Annalen der Chemie und Pharmacie.
Ann. Ch. Phys.—Annales de Chimie et de Physique.
Ann. Pharm.—Annalen der Pharmacie.
Ann. Thér.—Annuaire de Thérapeutique.
Ap. Ztg.—Apotheker Zeitung.
Apoth.—Apothecary.
Arch. I. C. M.—Archivio Italiano di Clinica Medica.
B. A. M.—Bulletin de l'Académie de Médecine de Paris.
B. C. D.—British and Colonial Druggist.
B. D. A. J.—Bulletin Department of Agriculture, Jamaica.
B. F. M. R.—British and Foreign Medical Review.
B. G. T.—Bulletin général de Thérapeutique, médicale et chirurgicale.
B. K. W.—Berliner klinische Wochenschrift.
B. M.—Le Bulletin Médicale.
B. M. J.—British Medical Journal.
B. M. N.—Bulletin Médicale du Nord.
B. M. S. J.—Boston Medical and Surgical Journal.
B. P. G.—Berichte der Deutschen Pharmaceutischen Gesellschaft.
B. S. Ph. Br.—Bulletin de la Société Royale de Pharmacie de Bruxelles.
B. Sc. Pharm.—Bulletin de la Société Pharmacologique.
B. Thier. W.—Berliner Thierärztliche Wochenschrift.
Ber. d. Chem. Ges.—Berichte der Deutschen Chemischen Gesellschaft.
Boston J. Chem.—Boston Journal of Chemistry.
Br.—British Pharmacopœia.
Br. Add.—British Pharmacopœia, Indian and Colonial Addendum.
Bull. Pharm.—Bulletin of Pharmacy.
Bull. Soc. Chim.—Bulletin de la Société Chimique de Paris.
C. D.—Chemist and Druggist.
C. R. A. S.—Comptes-rendus de l'Académie de Science de Paris.
C. R. S. B.—Comptes-rendus de le Société de Biologie de Paris.
Can. Drug.—Canadian Druggist.
Can. Pharm. Journ.—Canadian Pharmaceutical Journal.
Cb. B.—Centralblatt für Bacteriologie.
Cb. G. T.—Centralblatt für die gesammte Therapie.
Cb. I. M.—Centralblatt für Innere Medicin.
Cb. M. W.—Centralblatt für medicinische Wissenschaften.
Cb. Phys.—Centralblatt für Physiologie.
Ch. Ph.—Chicago Pharmacist.
Chem. Cb.—Chemisches Centralblatt.
Chem. Gaz.—Chemical Gazette.
Chem. News.—Chemical News.
Chem. Soc. Journ.—Journal of the Chemical Society.
Chem. Ztg.—Chemiker Zeitung.
D. C.—Druggists Circular.
D. M. W.—Deutsche medecinische Wochenschrift.
D. M. Ztg.—Deutsche medecinische Zeitung.
Derm. Cb.—Dermatologisches Centralblatt.
Derm. Zeit.—Dermatologische Zeitschrift.
Dublin Q. J.—Dublin Quarterly Journal of Medical Science.
Ed. M. J.—Edinburgh Medical Journal.
Ephem.—Ephemeris (Squibb).
Fort. Med.—Fortschritte der Medicin.
France Méd.—La France Médicale.
G. H. M. C.—Gazette Hebdomadaire de Médecine et de Chirurgie.
G. M. P.—Gazette Médicale de Paris.
In. Dis.—Inaugural Dissertation.
Ind. Ann. Med. Sci.—Indian Annals of Medical Science.
Ind. L.—Indian Lancet.
Ind. Med. Jour.—Indiana Medical Journal.
Int. M. J.—Intercolonial Medical Journal.
J. A. C.—Journal of Applied Chemistry.
J. A. M. A.—Journal American Medical Association.
J. A. P.—Journal of Anatomy and Physiology.
J. Am. C. S.—Journal of the American Chemical Society.
J. Chem. S.—Journal of the Chemical Society of London.
J. F. I.—Journal of the Franklin Institute.
J. M. S.—Journal of Mental Science.
J. P.—Journal of Physiology.
J. P. A.—Journal de Pharmacie d'Anvers.
J. P. C.—Journal de Pharmacie et de Chimie (Paris).
J. P. L.—Journal de Pharmacie de Liège.
J. Pr. Chem.—Journal für Praktische Chemie.
J. Soc. Chem. Ind.—Journal of the Society of Chemical Industry.
Jahresb.—Jahresberichte (Dragendorff's).
K. T. W.—Klinisch-therapeutische Wochenschrift.
L. L.—The London Lancet.
L. M. R.—London Medical Recorder.
London Med. Gaz.—London Medical Gazette.
Lyons Méd.—Lyons Médicale.
M. A.—Merck's Archives.
M. B. D.—Meyer Brothers' Druggist.
M. Bull.—Merck's Bulletin.
M. Chem.—Monatshefte für Chemie.
M. H. S. A.—Monatsschrift der Harn und Sexual-Apparat.
M. M.—Medicinische Monatsschrift.
M. M. J.—Maryland Medical Journal.
M. M. W.—Münchner medicinische Wochenschrift.
M. News.—Medical News.
M. R.—Merck's Market Report and Pharmaceutical Journal.
M. S. Rep.—Medical and Surgical Reporter.
M. T. G.—Medical Times and Gazette.
Med. Chron.—Medical Chronicle.
Med. Mod.—La Médicine Moderne.
Med. Rec.—Medical Record.
Mont. Pharm. Jour.—Montreal Pharmaceutical Journal.
N. I.—New Idea.
N. J. Med. Rep.—New Jersey Medical Reporter.
N. O. M. S. J.—New Orleans Medical and Surgical Journal.
N. P.—New Preparations.
N. R.—New Remedies.
N. R. Pharm.—Neues Repertorium für Pharmacie.

N. Y. J. Pharm.—New York Journal of Pharmacy.
N. Y. M. J.—New York Medical Journal.
N. Y. M. R.—New York Medical Record.
Nat. Drug.—National Druggist.
Nouv. Rem.—Les Nouveaux Remèdes.
O. Z.—Oesterreichische Zeitschrift, 1903.
P. G.—German Pharmacopœia.
P. J.—Pharmaceutical Journal, London.
P. M. T.—Philadelphia Medical Times.
Pac. Drug.—Pacific Druggist.
Ph. Archiv.—Pharmaceutical Archives.
Ph. Cb.—Pharmaceutisches Centralblatt.
Ph. Centralh.—Pharmaceutische Centralhalle.
Ph. Era.—Pharmaceutical Era.
Ph. Post.—Pharmaceutische Post.
Ph. Rec.—Pharmaceutical Record.
Ph. Rev.—Pharmaceutical Review.
Ph. Rund.—Pharmaceutisches Rundschau.
Ph. Z. R.—Pharmaceutische Zeitschrift für Russland.
Ph. Ztg.—Pharmaceutische Zeitung.
Pharm.—The Pharmacist.
Philos. Mag.—Philosophical Magazine.
Pr. M. W.—Präger medicinische Wochenschrift.
Pract.—Practitioner.
Pract. Drug.—Practical Druggist.
Proc. A. Ph. A.—Proceedings of the American Pharmaceutical Association.
Proc. Am. Med. Ass.—Proceedings of American Medical Association.
Proc. Chem. Soc.—Proceedings of the Chemical Society.
Proc. Roy. Soc. N. S. W.—Proceedings of the Royal Society of New South Wales.
Prog. M.—Le Progrès Médicale.
R. C. C.—Revue des Cultures Coloniale.
R. M. Est.—Revue Médicale de l'Est.
R. T.—Revue de Thérapeutique Médicale et Chirurgicale.
Rif. M.—La Riforma Medica.
S. Jb.—Schmidt's Jahrbücher der in- und auslandischen gesammten Medicin.
S. W. P.—Schweizerische Wochenschrift für Pharmacie.
S. M.—La Semaine Médicale.
Schim. Rep.—Schimmel & Co.'s Semi-annual Report.
St. L. M. S. J.—St. Louis Medical and Surgical Journal.
St. P. M. W.—St. Petersburger medicinische Wochenschrift.
T. G.—Therapeutic Gazette.
T. Mod.—Terapia Moderna.
Ther. Geg.—Die Therapie der Gegenwart.
Th. M.—Therapeutische Monatshefte.
Ther. Prog.—Therapeutic Progress.
Ther. Woch.—Therapeutische Wochenschrift.
Tr. Col. State. Med. Soc.—Transactions of the Colorado State Medical Society.
Tr. Linn. Soc.—Transactions of the Linnæan Society.
Ungar. Med. Presse.—Ungarische medicinische Presse.
Union Méd.—L'Union Médicale.
U. P. M. B.—University of Pennsylvania Medical Bulletin.
U. S.—United States Pharmacopœia.
V. A. P. A.—Virchow's Archiv für Pathologische Anatomie und Physiologie.
W. J. M. S.—Western Journal of Medicine and Surgery.
W. K. R.—Wiener klinische Rundschau.
W. K. W.—Wiener klinische Wochenschrift.
W. M. Bl.—Wiener medicinische Blätter.
W. M. P.—Wiener medicinische Presse.
West. Drug.—The Western Druggist.
Y. B. P.—Year-book of Pharmacy and Transactions of British Pharmaceutical Conference.
Z. B.—Zeitschrift für Biologie.
Zeit. An. Chem.—Zeitschrift für Analytische Chemie.
Zeit. angew. Chem.—Zeitschrift für angewandte Chemie.
Zeit. Anorg. Chem.—Zeitschrift für anorganischen Chemie.
Zeit. Oest. Apoth. Ver.—Zeitschrift des Allgemeinen Oesterreichischen Apotheker-Vereines.
Zeit. T. M.—Zeitschrift für thierische Medicin.

EXPLANATORY KEY TO THE PRONUNCIATION.

The introduction of diacritical marks to indicate the pronunciation of the official titles in this work requires the insertion of a key to make them intelligible. The system in use in Worcester's Dictionary has been adopted.

ā..long, as in fāte.
ă..short, as in făt.
ạ..obscure, as in ạbide.
à..long before *r*, as in fàre.
ä..Italian or grave, as in färr.
å..intermediate, as in fåst.
â..broad, as in fâll.

ē..long, as in mēte.
ĕ..short, as in mĕt.
ẹ..obscure, as in otherr.
ê..like à, as in hêir.
ë..obtuse, as in hër.

ī..long, as in pīne.
ĭ..short, as in pĭn.
į..obscure, as in perįl.
ı..like long ē, as in mıen.
ï..obtuse, as in sïr.

ō..long, as hōpe.
ŏ..short, as in nŏt.
ọ..obscure, as in arbọr.
ô..long and close, as in môve.
ö..broad, as in nör.
o..like short ŭ, as in sôn.

ū..long, as in tūbe.
ŭ..short, as in bŭt.
ụ..obscure, as in sụppose.
ù..as in annùal.
ü..short and obtuse, as in bür.
û..long and close, as in rûle.

ç..soft, like s.
ģ..hard, like k.
ǧ..like j.
ş..like z.
ÿ..like ĭ.

GLOSSARY.

In the following Glossary will be found short definitions of many of the terms employed in the Dispensatory to designate the medical properties of the remedies; most of the words are commonly employed as nouns, and sometimes as adjectives.

Absorbents.—Drugs used to produce absorption of exudates or diseased tissues.
Abstergents.—Detergents.
Alteratives.—Medicines used to so modify nutrition as to overcome morbid processes.
Anæsthetics.—Medicines used to produce anæsthesia or unconsciousness.
Analeptics.—Restorative medicines, or food.
Analgesics.—Medicines used to allay pain.
Anaphrodisiacs.—Medicines used to allay sexual feeling.
Anodynes.—Medicines used to allay pain.
Antacids.—Medicines used to neutralize acid in the stomach and intestines.
Anthelmintics.—Medicines used to destroy intestinal worms.
Antiarthritics.—Medicines used for the relief of gout.
Antihydropics.—Medicines used for the relief of dropsy.
Antilithics.—Medicines used for the relief of calculous affections.
Antiperiodics.—Medicines used for the relief of malarial fevers.
Antipyretics.—Medicines used for the reduction of bodily temperature in fevers.
Antiseptics.—Substances which have the power of preventing putrefaction.
Antispasmodics.—Medicines used for the relief of nervous irritability and minor spasms.
Antisyphilitics.—Medicines used for the relief of syphilis.
Antizymotics.—Substances which have the power of killing disease-germs.
Aperients.—Mild purgatives.
Aphrodisiacs.—Substances used to increase sexual power or excitement.
Aromatics.—Medicines characterized by a fragrant or spicy taste and odor, and stimulant to the gastro-intestinal mucous membrane.
Aromatic Bitters.—Medicines which unite the properties of the aromatics and the simple bitters.
Astringents.—Medicines having the power of influencing vital contractility, thereby condensing tissues.
Bitters—Simple.—Medicines which have a bitter taste and have the power of stimulating the gastro-intestinal mucous membrane, without affecting the general system.
Blisters.—Medicines which when locally applied cause inflammatory exudation of serum from the skin, and are used as revulsants.
Calefacients.—Medicines used externally to cause a sense of warmth.
Cardiac Depressants.—Medicines used to lower the heart's action.
Cardiac Stimulants.—Medicines used to increase the heart's action.
Carminatives.—Medicines containing a volatile oil used to excite intestinal peristalsis and provoke an expulsion of flatus.
Cathartics.—Purgatives.
Caustics.—Medicines used to destroy living tissues.
Cholagogues.—Medicines which provoke a flow of bile.
Constringents.—Astringents.
Convulsants.—Medicines which cause convulsions.
Correctives.—Medicines used to correct or render more pleasant the action of other remedies, especially purgatives.
Corrigents.—Correctives.
Demulcents.—Mucilaginous principles which are used in solution to soothe and protect irritated mucous membranes or other tissues.
Deobstruents.—(Term obsolete and not very definite.) Medicines which overcome obstruction; aperients.
Deodorants.—Substances which destroy or hide foul odors.
Depilatories.—Substances used to remove hair.
Depressants.—Sedatives.
Depresso-Motors.—Medicines which lessen motor activity.
Depurants.—Medicines which act upon the emunctories so as to cause excretion and thereby purify the system.

Detergents.—Medicines which cleanse wounds, ulcers, etc.
Diaphoretics.—Medicines which produce sweating.
Digestants.—Ferments and acids which have the power of aiding in the solution of food.
Diluents.—Medicines which dilute secretions and excretions.
Disinfectants.—Substances which have the power of destroying disease-germs or the noxious properties of decaying organic matter.
Diuretics.—Medicines which increase the secretion of urine.
Drastics.—Purgatives which cause much irritation.
Ecbolics.—Medicines which produce abortion.
Eccoprotics, or Ectoprotics.—Laxatives.
Emetics.—Medicines which cause vomiting.
Emmenagogues.—Medicines which stimulate menstruation.
Emollients.—Substances used to mechanically soften and protect tissues.
Epispastics.—Blisters.
Errhines.—Medicines which increase the nasal secretions.
Escharotics.—Caustics.
Evacuants.—Medicines which evacuate: chiefly applied to purgatives.
Excitants.—Stimulants.
Excito-Motors.—Medicines which increase motor activity.
Expectorants.—Medicines which act upon the pulmonic mucous membrane and increase or alter its secretions.
Febrifuges.—Medicines which dissipate fever.
Galactagogues.—Medicines which increase the secretion of milk.
Hæmostatics.—Medicines which arrest hemorrhages.
Hydragogues.—Purgatives which cause large watery discharges.
Hypnotics.—Medicines which cause sleep.
Laxatives.—Mild purgatives.
Local Anæsthetics.—Medicines which when applied locally destroy sensation.
Mydriatics.—Medicines which cause *mydriasis*, or dilatation of the pupil.
Myotics.—Medicines which cause *myosis*, or contraction of the pupil.
Narcotics.—Powerful anodyne hypnotics.
Neurotics.—Medicines which act upon the nervous system.
Nutriants.—Medicines which modify the nutritive processes.
Nutrients.—Substances which nourish.
Oxytocics.—Medicines which stimulate uterine contractions.
Peristaltics.—Medicines which increase peristalsis.
Prophylactics.—Medicines which prevent the taking or development of disease.
Protectives.—Medicines which protect a part when applied to it.
Ptyalagogues.—Sialagogues.
Purgatives.—Medicines which produce copious discharges from the bowels.
Refrigerants.—Medicines which lessen the bodily temperature.
Revulsants.—Medicines which by causing irritation draw nervous force and blood from a distant diseased part.
Rubefacients.—Medicines which cause irritation and redness, and are used as revulsants.
Sedatives.—Medicines which lower functional activity.
Sialagogues.—Medicines which excite the salivary glands to secretion.
Somnifacients.—Soporifics.
Soporifics.—Medicines which cause sleep.
Sorbefacients.—Medicines which cause absorption.
Specifics.—Medicines which have a direct curative influence on certain individual diseases.
Stimulants.—Medicines which increase functional activity.
Stomachics.—Stimulants to the stomach.
Styptics.—Hæmostatics.
Sudorifics.—Medicines which produce sweating.
Tænicides.—Medicines which kill the tapeworm.
Tonics.—Medicines which permanently increase the systemic tone by stimulating nutrition.
Vermicides.—Medicines which kill intestinal worms.
Vermifuges.—Medicines which cause the expulsion of intestinal worms.
Vesicatories.—Blisters.

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THE FOOD AND DRUGS ACT.

In force and effect from and after January 1, 1907.

THE Food and Drugs Act, passed by the Congress of the United States, June 30th, 1906, is of such vital importance to the readers of the United States Dispensatory that it is reproduced here, in order that every manufacturer, wholesale, jobbing, or retail druggist, dealer, or other interested party, may have in permanent form a copy of the Act, together with the official regulations for the enforcement of the same, as published by the United States Department of Agriculture in their official circular. It is as follows:

AN ACT For preventing the manufacture, sale, or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines, and liquors, and for regulating traffic therein, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be unlawful for any person to manufacture within any Territory or the District of Columbia any article of food or drug which is adulterated or misbranded, within the meaning of this Act; and any person who shall violate any of the provisions of this section shall be guilty of a misdemeanor, and for each offense shall, upon conviction thereof, be fined not to exceed five hundred dollars or shall be sentenced to one year's imprisonment, or both such fine and imprisonment, in the discretion of the court, and for each subsequent offense and conviction thereof shall be fined not less than one thousand dollars or sentenced to one year's imprisonment, or both such fine and imprisonment in the discretion of the court.

SEC. 2. That the introduction into any State or Territory or the District of Columbia from any other State or Territory or the District of Columbia, or from any foreign country, or shipment to any foreign country of any article of food or drugs which is adulterated or misbranded, within the meaning of this Act, is hereby prohibited; and any person who shall ship or deliver for shipment from any State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, or to a foreign country, or who shall receive in any State or Territory or the District of Columbia from any other State or Territory or the District of Columbia, or foreign country, and having so received, shall deliver, in original unbroken packages, for pay or otherwise, or offer to deliver to any other person, any such article so adulterated or misbranded within the meaning of this Act, or any person who shall sell or offer for sale in the District of Columbia or the Territories of the United States any such adulterated or misbranded foods or drugs, or export or offer to export the same to any foreign country, shall be guilty of a misdemeanor, and for such offense be fined not exceeding two hundred dollars for the first offense, and upon conviction for each subsequent offense not exceeding three hundred dollars or be imprisoned not exceeding one year, or both, in the discretion of the court: *Provided*, That no article shall be deemed misbranded or adulterated within the provisions of this Act when intended for export to any foreign country and prepared or packed according to the specifications or directions of the foreign purchaser when no substance is used in the preparation or packing thereof in conflict with the laws of the foreign country to which said article is intended to be shipped; but if said article shall be in fact sold or offered for sale for domestic use or consumption, then this proviso shall not exempt said article from the operation of any of the other provisions of this Act.

SEC. 3. That the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor shall make uniform rules and regulations for carrying out the provisions of this Act, including the collection and examination of specimens of foods and drugs manufactured or offered for sale in the District of Columbia, or in any Territory of the United States, or which shall be offered for sale in unbroken packages in any State other than that in which they shall have been respectively manufactured or produced, or which shall be received from any foreign country, or intended for shipment to any foreign country, or which may be submitted for examination by the chief health, food, or drug officer of any State, Territory, or the District of Columbia, or at any domestic or foreign port through which such product is offered for interstate commerce, or for export or import between the United States and any foreign port or country.

SEC. 4. That the examinations of specimens of foods and drugs shall be made in the Bureau of Chemistry of the Department of Agriculture, or under the direction and supervision of such Bureau, for the purpose of determining from such examinations whether such articles are adulterated or misbranded within the meaning of this Act; and if it shall appear from any such examination that any of such specimens is adulterated or misbranded within the meaning of this Act, the Secretary of Agriculture shall cause notice thereof to be given to the party from whom such sample was obtained. Any party so notified shall be given an opportunity to be heard, under such rules and regulations as may be prescribed as aforesaid, and if it appears that any of the provisions of this Act have been violated by such party, then the Secretary of Agriculture shall at once certify the facts to the proper United States district attorney, with a copy of the results of the analysis or the examination of such article duly authenticated by the analyst or officer making such examination, under the oath of such officer. After judgment of the court, notice shall be given by publication in such manner as may be prescribed by the rules and regulations aforesaid.

SEC. 5. That it shall be the duty of each district attorney to whom the Secretary of Agriculture shall report any violation of this Act, or to whom any health or food or drug officer or agent of any State, Territory, or the District of Columbia shall present satisfactory evidence of any such violation, to cause appropriate proceedings to be commenced and prosecuted in the proper courts of the United States, without delay, for the enforcement of the penalties as in such case herein provided.

SEC. 6. That the term "drug," as used in this Act, shall include all medicines and preparations recognized in the United States Pharmacopœia or National Formulary for internal or external use, and any substance or mixture of substances intended to be used for the cure, mitigation, or prevention of disease of either man or other animals. The term "food," as used herein, shall include all articles used for food, drink, confectionery, or condiment by man or other animals, whether simple, mixed, or compound.

SEC. 7. That for the purposes of this Act an article shall be deemed to be adulterated:

In case of drugs:

First. If, when a drug is sold under or by a name recognized in the United States Pharmacopœia or National Formulary, it differs from the standard of strength, quality, or purity, as determined by the test laid down in the United States Pharmacopœia or National Formulary official at the time of investigation: *Provided*, That no drug defined in the United States Pharmacopœia or National Formulary shall be deemed to be adulterated under this provision if the standard of strength, quality, or purity be plainly stated upon the bottle, box, or other container thereof although the standard may differ from that determined by the test laid down in the United States Pharmacopœia or National Formulary.

Second. If its strength or purity fall below the professed standard or quality under which it is sold.

In the case of confectionery:

If it contain terra alba, barytes, talc, chrome yellow, or other mineral substance or poisonous color or flavor, or other ingredient deleterious or detrimental to health, or any vinous, malt, or spirituous liquor or compound or narcotic drug.

In the case of food:

First. If any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

Second. If any substance has been substituted wholly or in part for the article.

Third. If any valuable constituent of the article has been wholly or in part abstracted.

Fourth. If it be mixed, colored, powdered, coated, or stained in a manner whereby damage or inferiority is concealed.

Fifth. If it contain any added poisonous or other added deleterious ingredient which may render such article injurious to health: *Provided*, That when in the preparation of food products for shipment they are preserved by any external application applied in such manner that the preservative is necessarily removed mechanically, or by maceration in water, or otherwise, and directions for the removal of said preservative shall be printed on the covering or the package, the provisions of this Act shall be construed as applying only when said products are ready for consumption.

Sixth. If it consists in whole or in part of a filthy, decomposed, or putrid animal or vegetable substance, or any portion of an animal unfit for food, whether manufactured or not, or if it is the product of a diseased animal, or one that has died otherwise than by slaughter.

SEC. 8. That the term "misbranded," as used herein, shall apply to all drugs, or articles of food, or articles which enter into the composition of food, the package or label of which shall bear any statement, design, or device regarding such article, or the ingredients or substances contained therein which shall be false or misleading in any particular, and to any food or drug product which is falsely branded as to the State, Territory, or country in which it is manufactured or produced.

That for the purposes of this Act an article shall also be deemed to be misbranded:

In case of drugs:

First. If it be an imitation of or offered for sale under the name of another article.

Second. If the contents of the package as originally put up shall have been removed, in whole or in part, and other contents shall have been placed in such package, or if the package fail to bear a statement on the label of the quantity or proportion of any alcohol, morphine, opium, cocaine, heroin, alpha or beta eucaine, chloroform, cannabis indica, chloral hydrate, or acetanilide, or any derivative or preparation of any of such substances contained therein.

In the case of food:

First. If it be an imitation of or offered for sale under the distinctive name of another article.

Second. If it be labeled or branded so as to deceive or mislead the purchaser, or purport to be a foreign product when not so, or if the contents of the package as originally put up shall have been removed in whole or in part and other contents shall have been placed in such package, or if it fail to bear a statement on the label of the quantity or proportion of any morphine, opium, cocaine, heroin, alpha or beta eucaine, chloroform, cannabis indica, chloral hydrate, or acetanilide, or any derivative or preparation of any such substances contained therein.

Third. If in package form, and the contents are stated in terms of weight or measure, they are not plainly and correctly stated on the outside of the package.

Fourth. If the package containing it or its label shall bear any statement, design, or device regarding the ingredients or the substances contained therein, which statement,

design, or device shall be false or misleading in any particular: *Provided*, That an article of food which does not contain any added poisonous or deleterious ingredients shall not be deemed to be adulterated or misbranded in the following cases:

First. In the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food, under their own distinctive names, and not an imitation of or offered for sale under the distinctive name of another article, if the name be accompanied on the same label or brand with a statement of the place where said article has been manufactured or produced.

Second. In the case of articles labeled, branded, or tagged so as to plainly indicate that they are compounds, imitations, or blends, and the word "compound," "imitation," or "blend," as the case may be, is plainly stated on the package in which it is offered for sale: *Provided*, That the term blend as used herein shall be construed to mean a mixture of like substances, not excluding harmless coloring or flavoring ingredients used for the purpose of coloring and flavoring only: *And provided further*, That nothing in this Act shall be construed as requiring or compelling proprietors or manufacturers of proprietary foods which contain no unwholesome added ingredient to disclose their trade formulas, except in so far as the provisions of this Act may require to secure freedom from adulteration or misbranding.

SEC. 9. That no dealer shall be prosecuted under the provisions of this Act when he can establish a guaranty signed by the wholesaler, jobber, manufacturer, or other party residing in the United States, from whom he purchases such articles, to the effect that the same is not adulterated or misbranded within the meaning of this Act, designating it. Said guaranty, to afford protection, shall contain the name and address of the party or parties making the sale of such articles to such dealer, and in such case said party or parties shall be amenable to the prosecutions, fines, and other penalties which would attach, in due course, to the dealer under the provisions of this Act.

SEC. 10. That any article of food, drug, or liquor that is adulterated or misbranded within the meaning of this Act, and is being transported from one State, Territory, District, or insular possession to another for sale, or, having been transported, remains unloaded, unsold, or in original unbroken packages, or if it be sold or offered for sale in the District of Columbia or the Territories, or insular possessions of the United States, or if it be imported from a foreign country for sale, or if it is intended for export to a foreign country, shall be liable to be proceeded against in any district court of the United States within the district where the same is found, and seized for confiscation by a process of libel for condemnation. And if such article is condemned as being adulterated or misbranded, or of a poisonous or deleterious character, within the meaning of this Act, the same shall be disposed of by destruction or sale, as the said court may direct, and the proceeds thereof, if sold, less the legal costs and charges, shall be paid into the Treasury of the United States, but such goods shall not be sold in any jurisdiction contrary to the provisions of this Act or the laws of that jurisdiction: *Provided, however*, That upon the payment of the costs of such libel proceedings and the execution and delivery of a good and sufficient bond to the effect that such articles shall not be sold or otherwise disposed of contrary to the provisions of this Act, or the laws of any State, Territory, District, or insular possession, the court may by order direct that such articles be delivered to the owner thereof. The proceedings of such libel cases shall conform, as near as may be, to the proceedings in admiralty, except that either party may demand trial by jury of any issue of fact joined in any such case, and all such proceedings shall be at the suit of and in the name of the United States.

SEC. 11. The Secretary of the Treasury shall deliver to the Secretary of Agriculture, upon his request from time to time, samples of foods and drugs which are being imported into the United States or offered for import, giving notice thereof to the owner or consignee, who may appear before the Secretary of Agriculture, and have the right to intro-

duce testimony, and if it appear from the examination of such samples that any article of food or drug offered to be imported into the United States is adulterated or misbranded within the meaning of this Act, or is otherwise dangerous to the health of the people of the United States, or is of a kind forbidden entry into, or forbidden to be sold or restricted in sale in the country in which it is made or from which it is exported, or is otherwise falsely labeled in any respect, the said article shall be refused admission, and the Secretary of the Treasury shall refuse delivery to the consignee and shall cause the destruction of any goods refused delivery which shall not be exported by the consignee within three months from the date of notice of such refusal under such regulations as the Secretary of the Treasury may prescribe: *Provided*, That the Secretary of the Treasury may deliver to the consignee such goods pending examination and decision in the matter on execution of a penal bond for the amount of the full invoice value of such goods, together with the duty thereon, and on refusal to return such goods for any cause to the custody of the Secretary of the Treasury, when demanded, for the purpose of excluding them from the country, or for any other purpose, said consignee shall forfeit the full amount of the bond: *And provided further*, That all charges for storage, cartage, and labor on goods which are refused admission or delivery shall be paid by the owner or consignee, and in default of such payment shall constitute a lien against any future importation made by such owner or consignee.

SEC. 12. That the term "Territory" as used in this Act shall include the insular possessions of the United States. The word "person" as used in this Act shall be construed to import both the plural and the singular, as the case demands, and shall include corporations, companies, societies and associations. When construing and enforcing the provisions of this Act, the act, omission, or failure of any officer, agent, or other person acting for or employed by any corporation, company, society, or association, within the scope of his employment or office, shall in every case be also deemed to be the act, omission, or failure of such corporation, company, society, or association as well as that of the person.

SEC. 13. That this Act shall be in force and effect from and after the first day of January, nineteen hundred and seven.

Approved, June 30, 1906.

RULES AND REGULATIONS FOR THE ENFORCEMENT OF THE FOOD AND DRUGS ACT.

GENERAL.

Regulation 1. Short Title of the Act.

The act, "For preventing the manufacture, sale, or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines, and liquors, and for regulating traffic therein, and for other purposes," approved June 30, 1906, shall be known and referred to as "The Food and Drugs Act, June 30, 1906."

Regulation 2. Original Unbroken Package.

(Section 2.)

The term "original unbroken package" as used in this act is the original package, carton, case, can, box, barrel, bottle, phial, or other receptacle put up by the manufacturer, to which the label is attached, or which may be suitable for the attachment of a label, making one complete package of the food or drug article. The original package contemplated includes both the wholesale and the retail package.

Regulation 3. Collection of Samples.

(Section 4.)

Samples of unbroken packages shall be collected only by authorized agents of the Department of Agriculture; or by the health, food, or drug officer of any State, Territory, or the District of Columbia, when commissioned by the Secretary of Agriculture for this purpose.

Samples may be purchased in the open market, and if in bulk the marks, brands, or tags upon the package, carton, container, wrapper, or accompanying printed or written matter shall be noted. The collector shall also note the names of the vendor and agent thru whom the sale was actually made, together with the date of purchase. The collector shall purchase representative samples.

A sample shall be divided into three parts, and each part shall be labeled with the identifying marks. All samples shall be sealed by the collector with a seal provided for the purpose. If the package be less than four pounds, or in volume less than two quarts, three packages of approximately the same size shall be purchased and the marks and tags upon each noted as above. One sample shall be delivered to the party from whom purchased or to the party guaranteeing such merchandise. One sample shall be sent to the Bureau of Chemistry, or to such chemist or examiner as may be designated by the Secretary of Agriculture, and the third sample shall be held under seal by the Secretary of Agriculture.

Regulation 4. Methods of Analysis.

(Section 4.)

Unless otherwise directed by the Secretary of Agriculture, the methods of analysis employed shall be those prescribed by the Association of Official Agricultural Chemists and the United States Pharmacopœia.

Regulation 5. Hearings.

(Section 4.)

(*a*) When the examination or analysis shows that the provisions of the food and drugs act, June 30, 1906, have been violated, notice of that fact, together with a copy of the findings, shall be furnished to the party or parties from whom the sample was obtained or who executed the guaranty as provided in the food and drugs act, June 30, 1906, and a date shall be fixt at which such party or parties may be heard before the Secretary of Agriculture, or such other official connected with the food and drug inspection service as may be commissioned by him for that purpose. The hearings shall be had at a place, to be designated by the Secretary of Agriculture, most convenient for all parties concerned. These hearings shall be private and confined to questions of fact. The parties interested therein may appear in person or by attorney and may propound proper interrogatories and submit oral or written evidence to show any fault or error in the findings of the analyst or examiner. The Secretary of Agriculture may order a reexamination of the sample or have new samples drawn for further examination.

(*b*) If the examination or analysis be found correct the Secretary of Agriculture shall give notice to the United States district attorney as prescribed.

(*c*) Any health, food, or drug officer or agent of any State, Territory, or the District of Columbia who shall obtain satisfactory evidence of any violation of the food and drugs act, June 30, 1906, as provided in section 5 thereof, shall first submit the same to the Secretary of Agriculture, in order that the latter may cause notice to be given to the guarantor or to the party from whom the sample was obtained.

Regulation 6. Publication.

(Section 4.)

(*a*) When a judgment of the court shall have been rendered there may be a publication of the findings of the examiner or analyst, together with the findings of the court.

(*b*) This publication may be made in the form of circulars, notices, or bulletins, as the Secretary of Agriculture may direct, not less than thirty days after judgment.

(*c*) If an appeal be taken from the judgment of the court before such publication, notice of the appeal shall accompany the publication.

Regulation 7. Standards for Drugs.

(Section 7.)

(*a*) A drug bearing a name recognized in the United States Pharmacopœia or National Formulary, without any further statement respecting its character, shall be required to conform in strength, quality, and purity to the standards prescribed or indicated for a drug of the same name recognized in the United States Pharmacopœia or National Formulary, official at the time.

(*b*) A drug bearing a name recognized in the United States Pharmacopœia or National Formulary, and branded to show a different standard of strength, quality, or purity, shall not be regarded as adulterated if it conforms to its declared standard.

Regulation 8. Formulas—Proprietary Foods.

(Section 8, last paragraph.)

(*a*) Manufacturers of proprietary foods are only required to state upon the label the names and percentages of the materials used, in so far as the Secretary of Agriculture may find this to be necessary to secure freedom from adulteration and misbranding.

(*b*) The factories in which proprietary foods are made shall be open at all reasonable times to the inspection provided for in Regulation 16.

Regulation 9. Form of Guaranty.

(Section 9.)

(*a*) No dealer in food or drug products will be liable to prosecution if he can establish that the goods were sold under a guaranty by the wholesaler, manufacturer, jobber, dealer, or other party residing in the United States from whom purchased.

(*b*) A general guaranty may be filed with the Secretary of Agriculture by the manufacturer or dealer and be given a serial number, which number shall appear on each and every package of goods sold under such guaranty with the words, "Guaranteed under the food and drugs act, June 30, 1906."

(*c*) The following form of guaranty is suggested :

I (we) the undersigned do hereby guarantee that the articles of foods or drugs manufactured, packed, distributed, or sold by me (us) [specifying the same as fully as possible] are not adulterated or misbranded within the meaning of the food and drugs act, June 30, 1906.

(Signed in ink.)

_____ _____.

[Name and place of business of wholesaler, dealer, manufacturer, jobber, or other party.]

(*d*) If the guaranty be not filed with the Secretary of Agriculture as above, it should identify and be attached to the bill of sale, invoice, bill of lading, or other schedule giving the names and quantities of the articles sold.

ADULTERATION.

Regulation 10. Confectionery.

(Section 7.)

(*a*) Mineral substances of all kinds (except as provided in Regulation 15) are specifically forbidden in confectionery whether they be poisonous or not.

(*b*) Only harmless colors or flavors shall be added to confectionery.

(*c*) The term "narcotic drugs" includes all the drugs mentioned in section 8, food and drugs act, June 30, 1906, relating to foods, their derivatives and preparations, and all other drugs of a narcotic nature.

Regulation 11. Substances Mixt and Packed with Foods.

(Section 7, under "Foods.")

No substance may be mixt or packed with a food product which will reduce or lower its quality or strength. Not excluded under this provision are substances properly used in the preparation of food products for clarification or refining, and eliminated in the further process of manufacture.

Regulation 12. Coloring, Powdering, Coating, and Staining.

(Section 7, under "Foods.")

(*a*) Only harmless colors may be used in food products.

(*b*) The reduction of a substance to a powder to conceal inferiority in character is prohibited.

(*c*) The term "powdered" means the application of any powdered substance to the exterior portion of articles of food, or the reduction of a substance to a powder.

(*d*) The term "coated" means the application of any substance to the exterior portion of a food product.

(*e*) The term "stain" includes any change produced by the addition of any substance to the exterior portion of foods which in any way alters their natural tint.

Regulation 13. Natural Poisonous or Deleterious Ingredients.

(Section 7, paragraph 5, under "Foods.")

Any food product which contains naturally a poisonous or deleterious ingredient does not come within the provisions of the food and drugs act, June 30, 1906, except when the presence of such ingredient is due to filth, putrescence, or decomposition.

Regulation 14. External Application of Preservatives.

(Section 7, paragraph 5, under "Foods," proviso.)

(*a*) Poisonous or deleterious preservatives shall only be applied externally, and they and the food products shall be of a character which shall not permit the permeation of any of the preservative to the interior, or any portion of the interior, of the product.

(*b*) When these products are ready for consumption, if any portion of the added preservative shall have penetrated the food product, then the proviso of section 7, paragraph 5, under "Foods," shall not obtain, and such food products shall then be subject to the regulations for food products in general.

(*c*) The preservative applied must be of such a character that, until removed, the food products are inedible.

Regulation 15. Wholesomeness of Colors and Preservatives.

(Section 7, paragraph 5, under "Foods.")

(*a*) Respecting the wholesomeness of colors, preservatives, and other substances which are added to foods, the Secretary of Agriculture shall determine from chemical or other examination, under the authority of the agricultural appropriation act, Public 382, approved June 30, 1906, the names of those substances which are permitted or inhibited in food products; and such findings, when approved by the Secretary of the Treasury and the Secretary of Commerce and Labor, shall become a part of these regulations.

(*b*) The Secretary of Agriculture shall determine from time to time, in accordance with the authority conferred by the agricultural appropriation act, Public 382, approved June 30, 1906, the principles which shall guide the use of colors, preservatives, and other substances added to foods; and when concurred in by the Secretary of the Treasury and the Secretary of Commerce and Labor, the principles so established shall become a part of these regulations.

Regulation 16. Character of the Raw Materials.

(Section 7, paragraph 1, under "Drugs;" paragraph 6, under "Foods.")

(*a*) The Secretary of Agriculture, when he deems it necessary, shall examine the raw materials used in the manufacture of food and drug products, and determine whether any filthy, decomposed, or putrid substance is used in their preparation.

(*b*) The Secretary of Agriculture shall make such inspections as often as he may deem necessary.

MISBRANDING.

Regulation 17. Label.

(Section 8.)

(*a*) The term "label" applies to any printed, pictorial, or other matter upon or attached to any package of a food or drug product, or any container thereof.

(*b*) The principal label shall consist, first, of all words which the food and drugs act, June 30, 1906, specifically requires, to wit, the name of the substance or product; the name of place of manufacture in the case of food compounds or mixtures; words which show that the articles are compounds, mixtures, or blends; the words "compound," "mixture," or "blend;" or words designating the substances or their derivatives and proportions required to be named in the case of drugs and foods. All these required words shall appear upon the principal label with no intervening descriptive or explanatory reading matter. Second, if the name of the manufacturer and place of manufacture are given, they shall also appear upon the principal label. Third, elsewhere upon the principal label other matter may appear in the discretion of the manufacturer.

(*c*) The principal label on foods or drugs for domestic commerce shall be printed in English (except as provided in Regulation 19), with or without the foreign label in the language of the country where the food or drug product is produced or manufactured. The size of type shall not be smaller than 8-point (brevier) caps: *Provided*, That in case the size of the package will not permit the use of 8-point cap type the size of the type may be reduced proportionately.

(*d*) The form, character, and appearance of the labels, except as provided above, are left to the judgment of the manufacturer.

(*e*) Descriptive matter upon the label shall be free from any statement, design, or device regarding the article or the ingredients or substances contained therein, or quality thereof, or place of origin, which is false or misleading in any particular.

(*f*) An article containing more than one food product or active medicinal agent is misbranded if named after a single constituent.

In the case of drugs the nomenclature employed by the United States Pharmacopœia and the National Formulary shall obtain.

(*g*) The term "design" or "device" applies to pictorial matter of every description, and to abbreviations, characters, or signs for weights, measures, or names of substances.

(*h*) The use of any false or misleading statement, design, or device shall not be justified by any statement given as the opinion of an expert or other person, appearing on any part of the label, nor by any descriptive matter explaining the use of the false or misleading statement, design, or device.

(*i*) The regulation regarding the principal label will not be enforced until October 1, 1907, in the case of labels printed and now on hand, whenever any statement therein contained which is contrary to the food and drugs act, June 30, 1906, as to character of contents, shall be corrected by a supplemental label, stamp, or paster. All other labels now printed and on hand may be used without change until October 1, 1907.

Regulation 18. Name and Address of Manufacturer.

(Section 8.)

(*a*) The name of the manufacturer or producer, or the place where manufactured, except in case of mixtures and compounds having a distinctive name, need not be given upon the label, but if given, must be the true name and the true place. The words "packed for ————," "distributed by ————," or some equivalent phrase, shall be added to the label in case the name which appears upon the label is not that of the actual manufacturer or producer, or the name of the place not the actual place of manufacture or production.

(*b*) When a person, firm, or corporation actually manufactures or produces an article of food or drug in two or more places, the actual place of manufacture or production of each particular package need not be stated on the label except when in the opinion of the Secretary of Agriculture the mention of any such place, to the exclusion of the others, misleads the public.

Regulation 19. Character of Name.

(Section 8.)

(*a*) A simple or unmixt food or drug product not bearing a distinctive name shall be designated by its common name in the English language, or, if a drug, by any name recognized in the United States Pharmacopœia or National Formulary. No further description of its components or qualities is required, except as to content of alcohol, morphine, etc.

(*b*) The use of a geographical name shall not be permitted in connection with a food or drug product not manufactured or produced in that place, when such name indicates that the article was manufactured or produced in that place.

(*c*) The use of a geographical name in connection with a food or drug product will not be deemed a misbranding when by reason of long usage it has come to represent a generic term and is used to indicate a style, type, or brand; but in all such cases the State or Territory where any such article is manufactured or produced shall be stated upon the principal label.

(*d*) A foreign name which is recognized as distinctive of a product of a foreign country shall not be used upon an article of domestic origin except as an indication of the type or style of quality or manufacture, and then only when so qualified that it can not be offered for sale under the name of a foreign article.

Regulation 20. Distinctive Name.

(Section 8.)

(*a*) A "distinctive name" is a trade, arbitrary, or fancy name which clearly distinguishes a food product, mixture, or compound from any other food product, mixture, or compound.

(*b*) A distinctive name shall not be one representing any single constituent of a mixture or compound.

(*c*) A distinctive name shall not misrepresent any property or quality of a mixture or compound.

(*d*) A distinctive name shall give no false indication of origin, character, or place of manufacture, nor lead the purchaser to suppose that it is any other food or drug product.

Regulation 21. Compounds, Imitations, or Blends Without Distinctive Name.

(Section 8.)

(*a*) The term "blend" applies to a mixture of like substances, not excluding harmless coloring or flavoring ingredients used for the purpose of coloring and flavoring only.

(*b*) If any age is stated, it shall not be that of a single one of its constituents, but shall be the average of all constituents in their respective proportions.

(*c*) Coloring and flavoring can not be used for increasing the weight or bulk of a blend.

(*d*) In order that colors or flavors may not increase the volume or weight of a blend, they are not to be used in quantities exceeding 1 pound to 800 pounds of the blend.

(*e*) A color or flavor can not be employed to imitate any natural product or any other product of recognized name and quality.

(*f*) The term "imitation" applies to any mixture or compound which is a counterfeit or fraudulent simulation of any article of food or drug.

Regulation 22. Articles without a Label.

(Section 8, paragraph 1, under "Drugs;" paragraph 1, under "Foods.")

It is prohibited to sell or offer for sale a food or drug product bearing no label upon the package or no descriptive matter whatever connected with it, either by design, device, or otherwise, if said product be an imitation of or offered for sale under the name of another article.

Regulation 23. Proper Branding not a Complete Guaranty.

Packages which are correctly branded as to character of contents, place of manufacture, name of manufacturer, or otherwise, may be adulterated and hence not entitled to enter into interstate commerce.

Regulation 24. Incompleteness of Branding.

A compound shall be deemed misbranded if the label be incomplete as to the names of the required ingredients. A simple product does not require any further statement than the name or distinctive name thereof, except as provided in Regulations 19 (a) and 28.

Regulation 25. Substitution.

(Sections 7 and 8.)

(*a*) When a substance of a recognized quality commonly used in the preparation of a food or drug product is replaced by another substance not injurious or deleterious to health, the name of the substituted substance shall appear upon the label.

(*b*) When any substance which does not reduce, lower, or injuriously affect its quality or strength, is added to a food or drug product, other than that necessary to its manufacture or refining, the label shall bear a statement to that effect.

Regulation 26. Waste Materials.

(Section 8.)

When an article is made up of refuse materials, fragments, or trimmings, the use of the name of the substance from which they are derived, unless accompanied by a statement to that effect, shall be deemed a misbranding. Packages of such materials may be labeled "pieces," "stems," "trimmings," or with some similar appellation.

Regulation 27. Mixtures or Compounds with Distinctive Names.

(Section 8. First proviso under "Foods," paragraph 1.)

(*a*) The terms "mixtures" and "compounds" are interchangeable and indicate the results of putting together two or more food products.

(*b*) These mixtures or compounds shall not be imitations of other articles, whether simple, mixt, or compound, or offered for sale under the name of other articles. They shall bear a distinctive name and the name of the place where the mixture or compound has been manufactured or produced.

(*c*) If the name of the place be one which is found in different States, Territories, or countries, the name of the State, Territory, or country, as well as the name of the place, must be stated.

Regulation 28. Substances named in Drugs or Foods.

(Section 8. Second under "Drugs;" second under "Foods.")

(*a*) The term "alcohol" is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of drugs except as specified in the United States Pharmacopœia or National Formulary.

(*b*) The words alcohol, morphine, opium, etc., and the quantities and proportions thereof, shall be printed in letters corresponding in size with those prescribed in Regulation 17, paragraph (c).

(*c*) A drug, or food product except in respect of alcohol, is misbranded in case it fails to bear a statement on the label of the quantity or proportion of any alcohol, morphine, opium, heroin, cocaine, alpha or beta eucaine, chloroform, cannabis indica, chloral hydrate, or acetanilide, or any derivative or preparation of any such substances contained therein.

(*d*) A statement of the maximum quantity or proportion of any such substances present will meet the requirements, provided the maximum stated does not vary materially from the average quantity or proportion.

(*e*) In case the actual quantity or proportion is stated it shall be the average quantity or proportion with the variations noted in Regulation 29.

(*f*) The following are the principal derivatives and preparations made from the articles which are required to be named upon the label:

ALCOHOL, ETHYL: (*Cologne spirits, Grain alcohol, Rectified spirits, Spirits, and Spirits of wine.*)

Derivatives—

Aldehyde, Ether, Ethyl acetate, Ethyl nitrite, and Paraldehyde.

Preparations containing alcohol—

Bitters, Brandies, Cordials, Elixirs, Essences, Fluidextracts, Spirits, Sirups, Tinctures, Tonics, Whiskies, and Wines.

MORPHINE, ALKALOID:

Derivatives—

Apomorphine, Dionine, Peronine, Morphine acetate, Hydrochloride, Sulphate, and other salts of morphine.

Preparations containing morphine or derivatives of morphine—

Bougies, Catarrh Snuff, Chlorodyne, Compound powder of morphine, Crayons, Elixirs, Granules, Pills, Solutions, Sirups, Suppositories, Tablets, Triturates, and Troches.

OPIUM, GUM:

Preparations of Opium—

Extracts, Denarcotized opium, Granulated opium, and Powdered opium, Bougies, Brown mixture, Carminative mixtures, Crayons, Dover's powder, Elixirs, Liniments, Ointments, Paregoric, Pills, Plasters, Sirups, Suppositories, Tablets, Tinctures, Troches, Vinegars, and Wines.

Derivatives—

Codeine Alkaloid, Hydrochloride, Phosphate, Sulphate, and other salts of codeine.

Preparations containing codeine or its salts—

Elixirs, Pills, Sirups, and Tablets.

COCAINE, ALKALOID:

Derivatives—

Cocaine hydrochloride, Oleate, and other salts.

Preparations containing cocaine or salts of cocaine—

Coca leaves, Catarrh powders, Elixirs, Extracts, Infusion of coca, Ointments, Paste pencils, Pills, Solutions, Sirups, Tablets, Tinctures, Troches, and Wines.

HEROIN:

Preparations containing heroin—

Sirups, Elixirs, Pills, and Tablets.

ALPHA AND BETA EUCAINE:

Preparations—

Mixtures, Ointments, Powders, and Solutions.

CHLOROFORM:

Preparations containing chloroform—

Chloranodyne, Elixirs, Emulsions, Liniments, Mixtures, Spirits, and Sirups.

CANNABIS INDICA:

Preparations of cannabis indica—

Corn remedies, Extracts, Mixtures, Pills, Powders, Tablets, and Tinctures.

CHLORAL HYDRATE (*Chloral*, U. S. Pharmacopœia, 1890):

Derivatives—

Chloral acetophenonoxim, Chloral alcoholate, Chloralamide, Chloralimide, Chloral orthoform, Chloralose, Dormiol, Hypnal, and Uraline.

Preparations containing chloral hydrate or its derivatives—

Chloral camphorate, Elixirs, Liniments, Mixtures, Ointments, Suppositories, Sirups, and Tablets.

ACETANILIDE (*Antifebrine, Phenylacetamide*):

Derivatives—

Acetphenetidine, Citrophen, Diacetanilide, Lactophenin, Methoxy-acetanilide, Methylacetanilide, Para-Iodoacetanilide, and Phenacetine.

Preparations containing acetanilide or derivatives—

Analgesics, Antineuralgics, Antirheumatics, Cachets, Capsules, Cold remedies, Elixirs, Granular effervescing salts, Headache powders, Mixtures, Pain remedies, Pills, and Tablets.

Regulation 29. Statement of Weight or Measure.

(Section 8. Third under "Foods.")

(*a*) A statement of the weight or measure of the food contained in a package is not required. If any such statement is printed, it shall be a plain and correct statement of the average net weight or volume, either on or immediately above or below the principal label, and of the size of letters specified in Regulation 17.

(*b*) A reasonable variation from the stated weight for individual packages is permissible, provided this variation is as often above as below the weight or volume stated. This variation shall be determined by the inspector from the changes in the humidity of the atmosphere, from the exposure of the package to evaporation or to absorption of water, and the reasonable variations which attend the filling and weighing or measuring of a package.

Regulation 30. Method of Stating Quantity or Proportion.

(Section 8.)

In the case of alcohol the expression "quantity" or "proportion" shall mean the average percentage by volume in the finished product. In the case of the other ingredients required to be named upon the label, the expression "quantity" or "proportion" shall mean grains or minims per ounce or fluid ounce, and also, if desired, the metric equivalents therefore, or milligrams per gram or per cubic centimeter, or grams or cubic centimeters per kilogram or per liter; provided that these articles shall not be deemed misbranded if the maximum of quantity or proportion be stated, as required in Regulation 28 (*d*).

EXPORTS AND IMPORTS OF FOODS AND DRUGS.

Regulation 31. Preparation of Food Products for Export.

(Section 2.)

(*a*) Food products intended for export may contain added substances not permitted in foods intended for interstate commerce, when the addition of such substances does not conflict with the laws of the countries to which the food products are to be exported and when such substances are added in accordance with the directions of the foreign purchaser or his agent.

(*b*) The exporter is not required to furnish evidence that goods have been prepared or packed in compliance with the laws of the foreign country to which said goods are intended to be shipped, but such shipment is made at his own risk.

(*c*) Food products for export under this regulation shall be kept separate and labeled to indicate that they are for export.

(*d*) If the products are not exported they shall not be allowed to enter interstate commerce.

Regulation 32. Imported Food and Drug Products.

(Section 11.)

(*a*) Meat and meat food products imported into the United States shall be accompanied by a certificate of official inspection of a character to satisfy the Secretary of Agriculture that they are not dangerous to health, and each package of such articles shall bear a label which shall identify it as covered by the certificate, which certificate shall accompany or be attached to the invoice on which entry is made.

(*b*) The certificate shall set forth the official position of the inspector and the character of the inspection.

(*c*) Meat and meat food products as well as all other food and drug products of a kind forbidden entry into or forbidden to be sold, or restricted in sale in the country in which made or from which exported, will be refused admission.

(*d*) Meat and meat food products which have been inspected and passed thru the customs may, if identity is retained, be transported in interstate commerce.

Regulation 33. Declaration.

(Section 11.)

(*a*) All invoices of food or drug products shipped to the United States shall have attached to them a declaration of the shipper, made before a United States consular officer, as follows:

I, the undersigned, do solemnly and truly declare that I am the ——— ——— of the merchandise herein mentioned and described, and that it consists of food or drug products which contain no added substances injurious to health.
(Manufacturer, agent, or shipper.)

These products were grown in ——— and manufactured in ——— by ——— ——— during the year ———, and are exported from ——— and consigned to ——— The products bear no false labels or marks, contain $\overset{\text{no}}{\text{some}}$ added coloring matter or preservative ———, and are not of a character to cause prohibition or restriction in the country where made or from which exported.
(Country.) (Country.) (Name of manufacturer.) (City.) (City.) (Name of added color or preservative.)

Dated at —— this —— day of ——, 19 —.

(Signed): —— —— ——.

(*b*) In the case of importations to be entered at New York, Boston, Philadelphia, Chicago, San Francisco, and New Orleans, and other ports where food and drug inspection laboratories shall be established, this declaration shall be attached to the invoice on which entry is made. In other cases the declaration shall be attached to the copy of the invoice sent to the Bureau of Chemistry.

Regulation 34. Denaturing.

(Section 11.)

Unless otherwise declared on the invoice or entry, all substances ordinarily used as food products will be treated as such. Shipments of substances ordinarily used as food products intended for technical purposes must be accompanied by a declaration stating that fact, and must be so denatured as to prevent their use as foods.

Regulation 35. Bond, Imported Foods, and Drugs.

(Section 11.)

Unexamined packages of food and drug products may be delivered to the consignee prior to the completion of the examination to determine whether the same are adulterated or misbranded upon the execution of a penal bond by the consignee in the sum of the invoice value of such goods with the duty added, for the return of the goods to customs custody.

Regulation 36. Notification of Violation of the Law.

(Section 11.)

If the sample on analysis or examination be found not to comply with the law, the importer shall be notified of the nature of the violation, the time and place at which final action will be taken upon the question of the exclusion of the shipment, and that he may be present, and submit evidence, which evidence (Form 15), with a sample of the article, shall be forwarded to the Bureau of Chemistry at Washington, accompanied by report card (Forms 16, 17, 18, 19, and 20).

Regulation 37. Appeal to the Secretary of Agriculture and Remuneration.

(Section 11.)

All applications for relief from decisions arising under the execution of the law should be addrest to the Secretary of Agriculture, and all vouchers or accounts for remuneration for samples shall be filed with the chief of the inspection laboratory, who shall forward the same, with his recommendation, to the Department of Agriculture for action.

Regulation 38. Shipment beyond the jurisdiction of the United States.

(Section 11.)

The time allowed the importer for representations regarding the shipment may be extended at his request to permit him to secure such evidence as he desires, provided that this extension of time does not entail any expense to the Department of Agriculture. If at the expiration of this time, in view of the data secured in inspecting the sample and such evidence as may have been submitted by the manufacturers or importers, it appears that the shipment can not be legally imported into the United States, the Secretary of Agriculture shall request the Secretary of the Treasury to refuse to deliver the shipment in question to the consignee, and to require its reshipment beyond the jurisdiction of the United States.

Regulation 39. Application of Regulations.

These regulations shall not apply to domestic meat and meat food products which are prepared, transported, or sold in interstate or foreign commerce under the meat-inspection law and the regulations of the Secretary of Agriculture made thereunder.

Regulation 40. Alteration and Amendment of Regulations.

These regulations may be altered or amended at any time, without previous notice, with the concurrence of the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor.

The above rules and regulations are hereby adopted.

LESLIE M. SHAW,
Secretary of the Treasury.
JAMES WILSON,
Secretary of Agriculture.
VICTOR H. METCALF,
Secretary of Commerce and Labor.

WASHINGTON, D. C., *October 17, 1906.*

ADDITIONS AND CORRECTIONS, U. S. PHARMACOPŒIA (8th Rev.)

MAY 1st, 1907.

The passage of the National Food and Drugs Act, June 30, 1906, made the U. S. Pharmacopœia (8th Rev.) the standard for official substances and forced a compliance with its requirements, and in consequence many communications were received by the Committee of Revision of the U. S. Pharmacopœia requesting modifications in the official text. The following printed list of additions and corrections was issued May 1, 1907, and is inserted here, in order that the readers of the United States Dispensatory may consult it with advantage.

Page **lviii** insert

Products and Preparations Made on a Large Scale.—In the manufacture of products and preparations on the large scale, deviation from the official processes may be necessary, but the products must conform to the official requirements as determined by the tests of the U. S. Pharmacopœia, 8th Revision, and the finished preparations must be identical with those made by the official processes.

Tests for Diluted Acids and Exsiccated Salts.—Where a requirement is made in official descriptions quoted from the U. S. Pharm. 8th Rev., that a diluted acid "shall respond to the reactions and tests" given under the corresponding stronger acid, or where similar language is employed, it is understood that the diluted acid shall be brought to the strength of the stronger acid before testing, or that the quantities used in testing the diluted acid be so adjusted that it will conform to the same standards as those established for the stronger acid. In the official descriptions of dried or exsiccated salts, where similar language is employed, it is understood that the exsiccated salt, before testing, shall have the proper allowance made for the water it has lost during the process of exsiccation.

Solubility Tests.—In the solubility tests quoted from the U. S. Pharm., 8th Rev., slight mechanical impurities, fragments of filter paper, fibre and minute traces of allowable insoluble impurities, permitted by other tests for the same substance, but which interfere with the transparency of the solution, are not to be construed as vitiating the test for solubility.

Page **9,** line 32, 2nd col., insert "**about**" before "0.790" and in line 36, 2nd col., change "at 56.5° C. (133.7° F.)" to "**from 56° to 57° C. (132.8° to 134.6° F.)**"

Page **21,** line 49, 1st col., change "121.4° C. (250.5° F.)." to "**from 120° to 122° C. (248° to 251.6° F.).**"

Page **24,** lines 1, 2, 3, and 4, 1st col., change to "**(1 in 20) should not at once become more than slightly cloudy after the addition of barium chloride T.S. (limit of sulphates); nor immediately more than opalescent by the addition of silver nitrate T.S. with nitric acid (limit of chlorides); it should not be precipitated by ammonium oxalate T.S. (absence of calcium);**"

Page **27,** omit lines 11 to 15, 2nd col., inclusive, and lines 59 to 63, 2nd col., inclusive, change from "No." to "*iron*)." inclusive, to read: "**No. 121), omitting the subsequent addition of ammonia water.**" Line 56, 2nd col., change "10" to "**20**"

Page **29,** line 58, 2nd col., change "83.7" to "**from 83 to 86**"

Page **31,** lines 44, 45, and 46, 1st col., change "Barium" to "*acid*)" inclusive, to "**Ten Cc. of the Acid should not be rendered more than slightly cloudy by the addition of 1 Cc. of barium chloride T.S. (limit of sulphuric acid)**" Line 52, 1st col., change "1" to "**8.3**"

Page **33,** lines 21 and 22, 2nd col., replace by "**Ten Cc. of the Acid should not be rendered more than slightly cloudy by the addition of 1 Cc. of barium chloride T.S. (limit of sulphuric**"

Page **45,** lines 22 to 30 inclusive, 2nd col., from "If" to "*acids*)." inclusive, replace by "**If 10 Cc. of the Acid be neutralized with ammonia water, not more than a slight precipitate should result, and after filtering, the filtrate should not become turbid upon the addition of potassium sulphate T.S. (limit of barium).**"

Page **48,** line 16, 2nd col., after "tralization" insert "**at boiling temperature**" Line 54, 1st col., change "10" to "**20**"

Page **57,** line 5, 2nd col., change "about 4° C. (39.2° F.)" to "**from 9° to 4° C.((48.2° to 39.2° F.)**" Line 14, 2nd col., change "the ordinary temperature" to "**25° C. (77° F.)**"

Page **59,** lines 47 and 48, 2nd col., omit "barium chloride T.S. (absence of *sulphuric acid*), or by" Line 55, 2nd col., between "*acids*)." and "If" insert: **If 0.1 Cc. of the Acid be diluted with water to 7 Cc. and 1 Cc. of barium chloride T.S. be added, no cloudiness or precipitate should appear within 30 seconds (limit of sulphuric acid).**" Line 58, 2nd col., change "10 Cc. of a cold saturated solution of sodium chloride" to "**a cold, saturated aqueous solution, containing 5 Gm. of sodium chloride**"

Page **63,** line 19, 2nd col., change "potassium" to "**sodium**"

Page **76,** line 2, 1st col., change "several minutes," to "**four hours,**"

Page **80,** 2nd col., bottom line and Page **81,** 1st col., lines 1, 2 and 3, from "Soluble" to "alcohol;" inclusive, change to: "**Very soluble in water and alcohol at 25° C. (77° F.), and in boiling water and boiling alcohol;**"

Page **81,** line 10, 1st col., change "0.2" to "**0.6**"

Page **84,** line 19, 1st col., change "135° C. (275° F.)" to "**from 168° to 170° C. (334.4° to 338° F.**")

Page **85,** line 18, 1st col., change "remain unaffected" to "**show but a faint turbidity**" and Line 19, 1st col., change "absence" to "**limit**" Line 30, 1st col., change "10" to "**20**"

Page **92,** 1st col., line 34, change "Hematoxylin" to "**Cochineal**" Line 52, change "10" to "**25**" Line 55, change "40" to "**25**" Second col., line 3, change "hematoxylin" to "**cochineal**" Line 6, change "violet" to "**pink**" Lines 7, 8 and 9, omit "the transition stages being as follows: first yellow, then green, finally passing into violet."

Page **101,** line 28, 1st col., change "0.885" to "**0.895**" Line 29, 1st col., change "7" to "**9**" Line 32, 1st col., change "about 72° C. (161.6° F.)" to "**from 72° to 77° C. (161.6° to 170.6° F.)**"

Page **102,** line 23, 2nd col., change "0.918" to "**0.911 to 0.916**"

Page **117,** lines 34 to 39 inclusive, 2nd col., from "Aloin" to "F.)." inclusive change to "**Aloin from Curacao Aloes is almost completely soluble in 120 parts of water, 15 parts of alcohol, and 55 parts of acetone.**" Lines 39 to 42 inclusive, 2nd col., omit from "The" to "F.)."

Page **121,** lines 27 to 30 inclusive, 2nd col., omit from the word "and" to "*alum*)." Line 37, 1st col., change "20" to "**150**"

Page **123,** line 60, 2nd col., after "acid" insert "**and 130 Cc. of water**"

Page **125,** 1st col., line 23, change "10" to "**20**" Line 30, change "20" to "**150**"

Page **128,** line 29, 1st col., change "25" to "**28**"

Page **129,** line 59, 1st col., change "100" to "**150**"

Page **133,** 1st col., line 3, change "2" to "3" and "50" to "80" Line 7, omit "completely" Lines 31 and 32, change "more strongly heated, should be volatilized (absence" to "**ignited should yield not more than 0.0005 Gm. of non-volatile residue (limit**" Line 24, 1st col., change "20" to "**150**"

Page **134,** line 29, 2nd col., change "100" to "**150**"

Page **140,** lines 58 and 59, 2nd col., omit sentence beginning "It boils"

Page **148,** line 16, 2nd col., after "(230° F.)" insert "**in a vacuum**"

Page **149,** line 8, 1st col., change "Two Gm." to "**If 0.1 Gm.**" Line 9, 1st col., change the word "when" to "be" Line 10, 1st col., insert before "should" the words "**the solution**"

Page **159,** line 60, 2nd col., omit "and melts at 263° C. (507° F.)."

Page **170,** lines 2 to 10 inclusive, 1st col., from "On" to "*substances*)." inclusive, change to "**If 0.1 Cc. of tenth-normal potassium permanganate V.S. be added to 10 Cc. of ammonia water, which has been slightly supersaturated with diluted sulphuric acid, the pink color should not be completely destroyed within ten minutes (limit of readily oxidizable substances).**" Omit lines 10 to 14 inclusive, 1st col., from "If" to "*acid*)."

Page **177,** line 56, 2nd col., change "0.075" to "**0.050**"

Page **180,** lines 35 and 36, 1st col., omit "to" and "1 Cc. of ammonia water be added and the mixture"

Page **189,** lines 8 and 9, 2nd col., change "no residue should be left (absence of *foreign salts*)." to "**not more than 0.1 percent. of residue should remain (limit of foreign salts).**"

Page **193,** line 40, 1st col., omit "and completely" and line 42, omit "or *chloride*" and insert before the word "When": "**If 0.2 Gm. of the Oxide be dissolved in a mixture of 1 Cc. of nitric acid and 2 Cc. of distilled water, 10 Cc. of ammonia water added, and the liquid diluted to 60 Cc., then 10 Cc. of this solution should not immediately become cloudy upon the addition of 1 Cc. of nitric acid (limit of chloride).**"

Page **197,** lines 10 and 11, 2nd col., change "has a yellow color, is neutral to litmus paper" to "**should be colorless to yellow**"

Page **208,** line 38, 2nd col., change "10" to "**15**"

Page **225,** line 42, 2nd col., change "0.35" to "**0.3**"

Page **226,** line 14, 1st col., change "0.5" to "**0.45**"

Page **228,** line 13, 1st col., change "Hematoxylin" to "**Cochineal**" Line 59, change "hematoxylin" to "**cochineal**"

Page **229,** line 44, 2nd col., change "phenolphthalein" to "**rosolic acid**" Lines 54 and 55, 2nd col., change "phenolphthalein" to "**rosolic acid**"

Page **237,** line 47, 2nd col., change "58" to "**56**" and "60" to "**58**"

Page **238,** lines 29 and 30, 1st col. omit "and permanent in the air." Lines 44 to 49, 1st col., to the word "*nitrate*)." inclusive, replace by "**If 0.01 Gm. of the salt be mixed with 1 Cc. of water, 5 Cc. of sulphuric acid added, the mixture cooled and then 5 Cc. of ferrous sulphate T.S. carefully poured over it, without mixing, no red or brown zone should appear within 5 minutes (limit of nitrate).**" Line 3, 2nd col., change "0.58" to "**0.56**" Line 4, 2nd col., change "0.6" to "**0.58**" Line 14, 2nd col., change "48" to "**46 percent. nor more than 50**"

Page **238,** three bottom lines, 2nd col., and—
Page **239,** lines 1 to 4, 1st col., inclusive, replace by "**If 0.01 Gm. of the salt be dissolved in 1 Cc. of water, 5 Cc. of sulphuric acid added, the mixture cooled and then 5 Cc. of ferrous sulphate T.S. carefully poured over it, without mixing, no red or brown zone should appear within 5 minutes (limit of nitrate).**" Line 24, change "0.48" to "**0.46 Gm., nor more than 0.50**"

Page **241,** line 29, 2nd col., after "acid" insert "**and**" Line 30, 2nd col., change "added, and this mixture" to "**the mixture filtered, and the filtrate**"

Page **243,** lines 58 and 59, 2nd col., change "2.990 to 3.000 at 15° C. (59° F.)." to "**about 3.016 at 25° C. (77° F.).**" Line 59, 2nd col., after "Boiling point," insert "**about**"

Page **244,** line 38, 2nd col., change "64" to "**66**"

Page **245,** 2nd col., line 4, change "five minutes" to "**one minute**" Line 5, change "absence" to "**limit**" Line 17, change "0.2" to "**0.05**" Line 18, change "0.3" to "**0.1**" Line 36, change "0.64" to "**0.66**"

Page **247,** line 30, 1st col., change "a" after "produce" to "**more than a slight**" Line 31, change "absence" to "**limit**"

Page **253,** line 34, 1st col., insert before "Its" "**when dried at 100° C. (212° F.), to constant weight.**"

Page **257,** lines 58 to 61, 1st col., from "Soluble" to "tures." inclusive, change to "**Very soluble in water and alcohol.**"

Page **258,** line 63, 1st col., change "absence" to "**limit**"

Page **259,** 1st col., line 10, change "absence" to "**limit**" Line 14, change "a trace" to "**0.1 percent.**"

Page **260,** lines 4 to 8, 2nd col., from "The" to "acid." inclusive, change to "**The aqueous solution (1 in 20) yields with ammonium oxalate T.S. a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid. One Gm. of the salt dissolved in 20 Cc. of water, should not require the addition of more than 1 Cc. of tenth-normal potassium hydroxide V.S. to produce a pink color (phenolphthalein being used as indicator).**"

Page **261,** lines 56 and 57, 2nd col., change "Two Gm. of Calcium Phosphate" to "**Five Cc. of a solution (1 in 10) of Calcium Phosphate, in diluted hydrochloric acid**"

Page **270,** line 48, 2nd col., change "60" to "**55**"

Page **271,** 1st col., line 50, change "2.08" to "**1.9**" Line 57, change "60" to "**55**"

Page **318,** 1st col., line 22, change "0.938" to "**0.935**" Line 24, change "45°" to "**42°**" and "113°" to "**107.6°**"

Page **324,** 2nd col., line 61, after "Chloral" insert "**(1 in 20)**" Line 65, before "acidulated" insert "**slightly**"

Page **325,** lines 2 to 9, omit from "If" to "*alcoholate*)."

Page **327,** line 41, 1st col., change "glass-" to "**well-**"

Page **331,** line 23, 1st col., change "twenty" to "**five**"

Page **357,** 2nd col., line 38, change "200" to "**400**" Line 39, change "125" to "**250**" change "25" to "**50**" Line 51, change "100" to "**200**"

Page **363,** 2nd col., line 36, before "solidify," insert "**partially**" Line 54, change "phenolphthalein" to "**rosolic acid**" Line 64, change "phenolphthalein" to "**rosolic acid**"

Page **371,** line 52, 1st col., change "Hematoxylin" to "**Cochineal**" Line 30, 2nd col., change "hematoxylin" to "**cochineal**"

Page **378,** line 5, 2nd col., change "88" to "**120**"

Page **380,** line 13, 2nd col., before "is" insert "**(1 in 20)**" and before "to" insert "**or faintly acid**"

Page **381,** line 6, 1st col., change "0.55" to "**0.45**"

Page **384,** line 23, 1st col., change "nitric" to "**hydrochloric**"

Page **399,** 1st col., line 33, change "2.8" to "**3.2**" Line 38, change "4 drops" to "**1 drop**" Line 39, change "1 Cc." to "**3 Cc.**"

Page **403,** line 23, 1st col., change "1.072" to "**1.078**" Lines 13 to 17, 2nd col., from "On" to "*oils*)." change to "**Two Cc. of Creosote should require not less than 10 Cc., nor more than 18 Cc. of normal sodium hydroxide V.S. to produce a clear, pale yellow liquid, which remains unclouded on diluting with 50 Cc. of water (absence of neutral oils).**"

Page **406,** 1st col., line 22, insert "**from 1.036 to**" Line 27, change "It boils from" to "**When distilled, 90 percent. of the Cresol should boil between**" Lines 32 to 37, omit from "If" to "*phenol*)." inclusive.

Page **413,** line 27, 2nd col., before "a" insert "**and ignition**"

Page **438,** line 60, 1st col., change "Hematoxylin" to "**Cochineal**" Line 39, 2nd col., change "hematoxylin" to "**cochineal**"

Page **454,** line 29, 1st col., change "0.925" to "**from 0.921 to 0.923**"

Page **470,** line 33, 2nd col., change "Hematoxylin" to "**Cochineal**"

Page **471,** line 14, 1st col., change "hematoxylin" to "**cochineal**"

Page **486,** line 38, 1st col., after "Erlenmeyer flask," insert "**add a little more sand to the dish and, by rubbing, remove any adherent extract, which transfer to the flask,**"

Page **488,** 1st col., lines 50 and 55, change "1.4" to "**1.0**"

Page **493,** lines 2 to 10, 2nd col., from "If" to "bonate." inclusive, change to "**If 1.15 Gm. of Saccharated Ferrous Carbonate be dissolved in 10 Cc. of diluted sulphuric acid (1 to 5) and the solution diluted with water to about 100 Cc. it should require not less than 15 Cc. of tenth-normal potassium dichromate V.S. for complete oxidation, potassium ferricyanide T.S. being used as indicator (corresponding to not less than 15 percent. of ferrous carbonate).**"

Page **498,** line 43, 1st col., change "a slightly" to "**an**"

Page **499,** line 14, 1st col., change "neutral" to "**acid**"

Page **511,** 1st col., line 30, change "2" to "**8**" Line 32, change "1" to "**2**"

Page **519,** line 14, 2nd col., after "acid" insert "**in a test-flask (see page 1707),**"

Page **520,** 1st col., line 11, change "slowly add" to "**add a few drops of starch T.S. followed by**" Line 12, before "with" insert "**added slowly,**" Lines 12 and 13, change "last trace of brown color" to "**blue or greenish color**"

Page **526,** 1st col., line 47, change "Hematoxylin" to "**Cochineal**" Line 54, change "10" to "**25**" Line 56, change "40" to "**25**" Second col., Line 12, change "hematoxylin" to "**cochineal**" Line 14, change "violet" to "**pink**" Lines 15 to 17, omit "the transition stages being as follows: first yellow, then green, finally passing into violet."

Page **528,** 1st col., line 32, change "0.5" to "**0.4**" Line 40, change "Hematoxylin" to "**Cochineal**" Second col., lines 6 and 7, change "hematoxylin" to "**cochineal**"

Page **533,** line 57, 1st col., change "120° C. (248° F.)" to "**110° C. (230° F.)**"

Page **534**, line 43, 2nd col change "Hematoxylin" to "**Cochineal**"

Page **535**, line 15, 1st col., change "hematoxylin" to "**cochineal**" Line 31, change "0.5" to "**0.4**"

Page **546**, 2nd col., line 2, change "1.75" to "**1.5**" Line 9, change "Hematoxylin" to "**Cochineal**" Line 15, after "V.S." insert "**and 20 Cc. of distilled water**" Line 39, change "hematoxylin" to "**cochineal**" Lines 41 to 43, change "to just cause the yellow color of the solution to turn purple" to "**until a pink color is produced**"

Page **564**, line 57, 1st col., change "0.35" to "**0.25**"

Page **603**, 1st col., line 11, change "1.140" to "**from 1.110 to 1.114**" Line 21, before "Turbidity" insert "**Permanent**" Line 24, change "7 Cc. of sodium hydroxide T. S." to "**2 Cc. of potassium hydroxide solution (15 percent.)**" Line 26, insert "**nearly**" before "white mass." and insert "**Much**" before "Coloration" Line 27, omit "white" Lines 29 to 33, omit from "One" to "*creosote*)." inclusive.

Page **624**, line 48, 2nd col., after "évaporation" insert "**and gentle ignition**"

Page **626**, line 55, 2nd col., change "99.5" to "**98.5**"

Page **629**, line 48, 2nd col., change "no appreciable" to "**not more than 0.05 percent. of**"

Page **633**, lines 12 to 14, 1st col., from "and" to "solutions." inclusive, change to "**soluble in diluted nitric acid, forming a clear solution, or in hydrochloric acid (1 in 10) with faint opalescence.**"

Page **639**, lines 39 to 43, 1st col., from "If" to "*oxide*)." inclusive, change to "**If 0.1 Gm. of the powder be digested with 20 Cc. of warm diluted hydrochloric acid, the filtrate should not be affected by hydrogen sulphide T.S. (limit of mercuric oxide).**"

Page **645**, 2nd col., line 33, change "179.7° C. (355.5° F.) to "**from 191° to 192° C. (375.8° to 377.6° F.)**" Line 62, change "no" to "**but a faint yellow**"

Page **647**, 1st col., lines 26 to 30, change to "**white prismatic crystals having an acrid, nauseous, and bitter taste; deliquescent on exposure to the air.**" Line 61, change "no" to "**but a faint yellow**"

Page **660**, line 34, 2nd col., change "0.1" to "**0.2**"

Page **667**, line 33, 2nd col., change "2" to "**1.75**"

Page **674**, 2nd col., line 21, change "Hematoxylin" to "**Cochineal**" Line 64, change "hematoxylin" to "**cochineal**"

Page **675**, 2nd col., line 46, change "8" to "**7**" Line 46, change "but not more than 1.5 percent. of resin" to "**of which not more than 15 percent. should be**"

Page **714**, line 14, 2nd col., change "about 1.282" to "**from 1.280 to 1.290**"

Page **719**, line 36, 2nd col., change "about 1.432" to "**from 1.430 to 1.450**"

Page **720**, line 47, 1st col., change "cool" to "**moderately warm**" Line 50, 2nd col., change "1.075 to 1.078" to "**from 1.075 to 1.081**"

Page **721**, 1st col., lines 13 and 14, from "should" to "*impurities*." inclusive, change to "**should leave not more than 0.05 percent. of residue (limit of fixed impurities).**" Line 18, change "0.5" to "**1**" Line 19, change "0.1" to "**0.2**" Second col., line 43, change "ten" to "**thirty**"

Page **742**, line 4, 2nd col., change "absence" to "**limit**"

Page **743**, line 48, 1st col., change "absence" to "**limit**"

Page **744**, line 12, 2nd col., change "absence" to "**limit**"

Page **745**, 2nd col., lines 21 and 22, change "is neutral" to "**(1 in 20) is faintly alkaline**" Line 45, omit "anhydrous" After "Citrate" insert "**dried at 150° C. (302° F.)**" Line 60, change "absence" to "**limit**"

Page **746**, line 41, 2nd col., change "slightly reddens blue" to "**(1 in 20) should be neutral or slightly acid to**"

Page **747**, line 24, 1st col., change "absence" to "**limit**"

Page **752**, line 61, 1st col., change "0.001" to "**0.01**" Line 6, 2nd col., after "acid" insert "**and 130 Cc. of water**"

Page **754**, 2nd col., line 46, change "0.005" to "**0.04**" Line 60, after "acid" insert "**and 100 Cc. of water**"

Page **757**, line 38, 1st col., change "0.85" to "**1.1**"

Page **761**, line 8, 2nd col., change "neutral" to "**acid**"

Page **763**, 1st col., line 11, change "20" to "**100**" Line 15, change "absence" to "**limit**"

Page **779**, 1st col., lines 9 to 13 inclusive, omit "a bulky, white, crystalline precipitate will be produced; then, if the test-tube, loosely corked, be allowed to stand in boiling water for about five minutes, with occasional agitation, the precipitate should dissolve, and form" Line 14 after "solution" insert "**should result**"

Page **786**, 1st col., line 12, after "heated" insert "**slowly**" Line 14, change "then" to "**when heated rapidly it**" Line 65, omit "colorless"

Page **792**, lines 4 and 5, 1st col., omit "and the remaining two at 130° C. (266° F.)"

Page **833**, 2nd col., line 40, change "0.985" to "**0.988**" Line 41, after "being" insert "**up to**"

Page **839**, line 20, 1st col., change "0.905 to 0.915" to "**0.900 to 0.910**"

Page **841**, lines 18 to 23, 1st col., omit from "Specific" to "F.)"

Page **843**, line 7, 2nd col., omit "Soluble in 2 volumes of alcohol."

Page **844**, line 54, 2nd col., change "about +50°" to "**not below +45°**"

Page **846**, line 59, 1st col., change "—5° C. (23° F.)" to "**—3° C. (26.6° F.)**"

Page **849**, lines 48 and 49, omit from "Soluble" to "alcohol." inclusive.

Page **850**, line 61, 2nd col., change "0.880 to 0.892" to "**0.875 to 0.910**"

Page **851**, 2nd col., line 24, change "+ 60°" to "**+58°**" Lines 40 and 41, change "phenolphthalein" to "**rosolic acid**" Line 51, change "phenolphthalein" to "**rosolic acid**"

Page **853**, line 19, 2nd col., change "8" to "**6**"

Page **854**, line 11, 1st col., change "—25°" to "**—20°**"

Page **868**, 2nd col., line 36, change "180" to "**183**" Line 47, change "86" to "**84**"

Page **872**, 1st col., line 29, change "5" to "**2.5**" Line 31, change "15" to "**10**"

Page **875**, lines 40, 41 and 42, 2nd col., omit from "Soluble" to "paper." inclusive.

Page **886**, 2nd col, line 6, change "212 to 218" to "**203 to 215**" Line 17, change "102" to "**103**" and "105" to "**109**"

Page **903**, line 32, 2nd col., change "six" to "**sixteen**" and omit "or over night"

Page **911**, line 25, 1st col., after "percentage" insert "**powdered sugar of milk or acacia**"

Page **912**, line 39, 1st col., after "test-tube" insert "**diluted with three times its volume of water,**" Line 35, 2nd col., change "120" to "**200**" Line 47, 2nd col., change "2" to "**4**"

Page **915**, 1st col., line 33, change "123° C." to "**121° C.**" Line 34, change "253.4°" to "**249.8°**"

Page **924**, lines 26 to 33, 1st col., omit from "If" to "*impurities*)." inclusive.

Page **927**, 2nd col., line 5, change "40° C. (104° F.)" to "**39° C. (102.2° F.)**" Lines 5 to 9, from "Phenol" to "Phenol." inclusive, change to "**Phenol should have a boiling point from 178° to 182° C. (352.4° to 359.6° F.).** Line 48, omit "which is permanent."

Page **965**, line 22, 2nd col., omit "0.1 Gm. of"

Page **967**, line 7, 2nd col., change "soluble in" to "**miscible with**" and omit "or solutions of potassium or sodium hydroxide"

Page **969**, 2nd col., lines 23 to 25, from "be" to "*iron*)." inclusive, change to "**upon the addition of ammonia water yield more than a slight precipitate (limit of zinc and iron.)**" Lines 26 and 27, change "should leave no residue (absence" to "**should not leave more than a slight residue (limit**"

Page **974**, 1st col., line 22, after "salt" insert "**(1 in 10)**" Lines 26 to 28, from "be" to "*iron*)." inclusive, change to "**yield more than a slight precipitate upon the addition of ammonia water (limit of zinc and iron)**" Line 30, change "a weighable" to "**more than a slight**"

Page **1003**, line 28, 1st col., after "white" insert "**or nearly white**"

Page **1005**, line 22, 1st col., before "The" insert "**One Gm. of the dried salt, dissolved in about 10 Cc. of water should not require more than 1.5 Cc. of tenth-normal hydrochloric acid V.S. for neutralization (methyl orange T.S. being used as indicator).**"

Page **1014,** lines 25 to 31, 2nd col., from "If" to "V.S." inclusive, change to "**If 0.1 Gm. of Potassium Permanganate be dissolved in 100 Cc. of distilled water, to which 1 Cc. of sulphuric acid and 35 Cc. of tenth-normal oxalic acid V.S. have been previously added, then the addition of not more than 3.5 Cc. of tenth-normal potassium permanganate V.S. should be required to impart a permanent pink tint.**"

Page **1046,** lines 6 to 31, 1st col., change the "*Test for Other Cinchona Alkaloids.*" to read: "**Dry Quinine Sulphate at 50° C. (122° F.) for two hours. If 1.8 Gm. of this Dry Quinine Sulphate (which should be neutral or slightly alkaline to test paper) be agitated with 20 Cc. of water, at 65° C. (149° F.) for half an hour, then allowed to cool to 15° C. (59° F.) and be macerated at this temperature for two hours, with occasional shaking of the test tube, the liquid filtered through filter paper of 8 to 10 Cm. diameter, then if 5 Cc. of the filtrate be transferred to a test-tube, and gently mixed (without shaking) with 7 Cc. of ammonia water which must be of official strength, have a temperature of 15° C. (59° F.), and be all added at once, a clear liquid should be produced. If the temperature during the maceration has been 16° C. (60.8° F.) 7.5 Cc. of ammonia water may be added. If 17°C. (62.8° F.), 8 Cc. may be added (limit of allowable foreign cinchona alkaloids.)**"

Page **1052,** line 25, 1st col., change "**10**" to "**15**"

Page **1053,** line 54, 1st col., change "**110°**" to "**109°**" and "**230°**" to "**228.2°**"

Page **1055,** lines 10 to 13, 1st col., omit from "Sulphuric" to "*rosin*)." inclusive.

Page **1077,** lines 11 to 18, 2nd col., from "If" to "*sugar*)." inclusive, change to "**If 1 Gm. of Sugar of Milk be digested for half an hour with 10 Cc. of diluted alcohol, with occasional shaking, and the liquid filtered, the filtrate should remain clear after admixture with an equal volume of absolute alcohol, and this liquid, if evaporated on a water-bath, should leave not more than 0.03 Gm. of residue (absence of cane sugar).**" Line 19, 2nd col., change "**10**" to "**20**"

Page **1130,** line 22, 1st col., change "**36.9**" to "**36.5**"

Page **1133,** line 48, 1st col., change "**20.4**" to "**17**"

Page **1146,** lines 4 to 7, 1st col., from "dry" to "odorless," inclusive, change to "**Dry, white or nearly white flakes, powder, fused masses or translucent or opaque white pencils, odorless,**"

Page **1147,** line 49, 1st col., between the words "paper." and "The" insert "**One Gm. of the dried salt, dissolved in about 10 Cc. of water, should not require more than 1.5 Cc. of tenth-normal hydrochloric acid V.S. for neutralization (methyl-orange T.S. being used as indicator).**"

Page **1150,** line 50, 1st col., after "white" insert "**or nearly white**"

Page **1152,** lines 30 to 32, 2nd col., from "No" to "etc.)." inclusive, change to "**Not more than a slight turbidity should appear on dissolving 1 Gm. of the salt in 20 Cc. of water (limit of calcium, aluminum, etc.).**"

Page **1154,** line 18, 1st col., between the words "and" and "conforms" insert "**which, after allowance is made for the loss of 60.3 percent. of water of crystallization,**"

Page **1157,** line 25, 2nd col., change "**96**" to "**94**"

Page **1158,** lines 24 to 26, 1st col., change "the solution allowed to stand for about one hour, and shaken at frequent intervals, not more than 11.65 Cc. of tenth-" to "**and after solution has taken place, not more than 12.45 Cc. of tenth-**"

Page **1166,** 1st col., line 16, change "the original" to "**one-tenth the**" Line 17, after "Ether" insert "**taken.**"

Page **1179,** lines 29 to 34, 2nd col., omit from "If" to "*coloring*)." inclusive.

Page **1184,** line 50, 1st col., change "0.35" to "**0.25**" Line 20, 2nd col., insert after "deliquescent" "**and also occasionally efflorescent**"

Page **1185,** line 55, 1st col., after "plates" "insert" **or white granular powder, or crystalline crusts**"

Page **1191,** lines 58 and 59, 2nd col., change "should not produce more than a faintly pink color" to "**may produce a yellow but not a red or reddish color**"

Page **1196,** lines 11 and 12, 1st col., change "should not produce more than a faintly yellow color" to "**may produce a yellow but not a red or reddish color**" Lines 37 and 38, 2nd col., change "should not produce more than a faintly yellow color" to "**may produce a yellow but not a red or reddish color**"

Page **1198,** 1st col., line 19, change "70" to "**60**" Line 23, change "insoluble" to "**partially soluble**"

Page **1201,** line 38, 1st col., after "crystals" insert "**or crystalline powder**"

Page **1224,** line 26, 1st col., after "green" insert "**or yellowish green**"

Page **1242,** 1st col., line 5, change "about 0.850" to "**from 0.860 to 0.865**" Lines 7 and 8, change "155° to 165° C. (311° to 329° F.)" to "**160° to 170° C. (320° to 338° F.)**" Line 17, omit "very"

Page **1251,** line 52, 1st col., before "45" insert "**when dried over sulphuric acid**" Second col., line 42, change "0.5" to "**0.1**" Line 43, change "10" to "**20**" Lines 46 and 47, change "(absence of *iodides*)" to ("**limit of halogen salts**)"

Page **1255,** line 58, 2nd col., change "0.035" to "**0.03**"

Page **1263,** line 36, 2nd col., change "0.05" to "**0.04**"

Page **1287,** line 53, 2nd col., change "0.03" to "**0.025**"

Page **1349,** line 7, 2nd col., after "white" insert "**or nearly white**"

Page **1351,** line 18, 2nd col., after "white" insert "**or nearly white**"

Page **1353,** line 39, 1st col., after "white" insert "**or nearly white**"

Page **1354,** line 5, 1st col., change "99.5" to "**99**" Line 22, change "5.4" to "**5.5**" Line 26, change "about 4" to "**4.04**"

Page **1359,** line 28, 2nd col., change "remain clear" to "**show but a faint cloudiness**"

Page **1713,** line 60, insert reference to following foot-note "[1]" after "(1 in 20)." and the following foot-note at bottom of page: "[1] **The dilution (1 in 20) has been extended, except as stated below, by the Committee of Revision to a total dilution of 1 in 100; for iron the total dilution is extended to 1 in 300. Exception: For chemical substances to be tested for antimony, arsenic and lead, the dilution has not been extended, but remains at 1 in 20.**" Line 69, after "viewed" insert "**crosswise**"

Page **1715,** after line 50, insert "**131a. Rosolic Acid Test Solution. Dissolve 1 Gm. of commercial rosolic acid (chiefly methylaurin, $C_{20}H_{16}O_3$) in 10 Cc. of diluted alcohol, and add enough water to make 100 Cc. Of this solution, about 0.5 Cc. is used for 100 Cc. of solution to be titrated. Ammoniacal solutions should be highly diluted when titrated with this indicator. In place of rosolic acid, commercial pæonin (aurin R) may be employed. This indicator gives a yellow color with acids and violet-red with alkalies.**"

Page **1728,** line 10, insert reference to following foot-note "[1]" after "solvent" and the following foot-note at bottom of page: "[1] **If extraction is incomplete, the processes must be repeated with additional solvent. The completion of the 'shaking out' processes may be tested by evaporating a small portion of the solution, dissolving the residue in acidulated water and adding mercuric potassium iodide T.S., when the absence of turbidity indicates exhaustion.**" Line 23, after "not" insert "**strongly**" Before "hematoxylin" insert "**either**"

Page **1757,** above line 15 from bottom insert "[1] **In the alcohol tables the words 'abs. alc.' (absolute alcohol), mean 100 percent. alcohol, not the official (99 percent.) absolute alcohol.**"

THE DISPENSATORY

OF

THE UNITED STATES

PART I

THE United States Dispensatory may very properly be considered as a commentary upon the United States and British Pharmacopœias, while such preparations of the German Pharmacopœia and French Codex as are used generally in the United States are also commented upon. As was explained in the fifteenth edition, the changes in the arrangement of the 1880 edition of the United States Pharmacopœia necessitated corresponding alterations in the United States Dispensatory. PART I. of the present volume contains the discussion of all the remedies recognized by either of the two Pharmacopœias used by English speaking people. In PART II. non-official drugs and preparations are treated, as heretofore, by themselves; the type is smaller than that used for official substances, it being deemed judicious to adhere to a plan which has given so much satisfaction in the previous editions. In PART III. are considered the Tests and Test-Solutions of the two Pharmacopœias, Weights and Measures, the Art of Prescribing Medicines, and cognate miscellaneous matters.

There can be no question as to the superiority of the alphabetical arrangement of drugs in a book of reference of an encyclopedic character. Their scientific classification belongs to works which treat of them rather in their relations than their essential properties; and different systems have been adopted, according to the set of relations towards which the mind of the author has been especially directed. Thus, the naturalist classifies them according to the affinities of the several objects in nature from which they are derived; the chemist, according to their composition; the practitioner of medicine, according to their effects upon the system in a state of health and disease.

ACACIA. U. S. (Br.)

ACACIA [Gum Arabic]

(ą-cā'cī-ą)

"A gummy exudation from *Acacia Senegal* Willdenow, and other species of *Acacia* (Fam. *Leguminosæ*)." *U. S.* "A gummy exudation from the stem and branches of Acacia Senegal, *Willd.*, and of other species of Acacia, *Willd.*" *Br.*

Acaciæ Gummi, *Br.;* Gummi Africanum; Gummi Mimosæ; Gum Acacia; Galam Gum; Gomme Arabique Vraie, *Fr.;* Gummi Arabicum, *P. G.;* Arabisches Gummi, *G.;* Gomma Arabica, Gomma del Cordofan, *It.;* Goma Arabiga, *Sp.;* Samagh Arabee, *Arab.*

For ACACIÆ CORTEX, *Br. Add.*, see PART II.

The name *Acacia* was employed by the ancient Greeks to designate the gum tree of Egypt, and has been appropriately applied to the genus in which that plant is included.

The most important of the gum yielding Acacias are *A. arabica*, Willd., and the official *A. Senegal*, Willd.

A. Senegal, Willdenow. *A. Verek*, Guillemin and Perottet, *Flore de Sénégambie*, 1830, 246; *B. & T.* 1877. *Mimosa Senegal*, L.—This is a small tree with a grayish bark, the inner layers of which are strongly fibrous, bipinnate leaves, dense spikes of small yellow flowers longer than the leaves, and broad pods 3 to 4 inches long, containing 5 or 6 seeds. It rarely exceeds 20 feet in height, forms large forests in Western Africa, north of the river Senegal, and is abundant in Eastern Africa, Kordofan, and Southern Nubia. It is known by the natives as *Verek* or *Hashab*.

Acacia arabica, Willd., *Sp. Plant.* iv. 1805. *A. vera*, Willd.; Hayne, *Darstel. und Beschreib.* x. 34. *Acacia nilotica*, Del., *Illust. Flor. de l'Egypte*, p. 79. *A. Adansonii*, Guill. & Per., *Flore de Sénégambie*. *A. Verek*, Ibid.—This is a tree of middle size. The leaves are alternate and bipinnate, with two pairs of pinnæ, of which the lower are usually furnished with ten pairs of leaflets, the upper with eight. The leaflets are very small, oblong-linear, smooth,

and supported upon very short footstalks. On the common petiole is a gland between each pair of pinnæ. Both the common and partial petioles are smooth in typical specimens of *A. vera,* Willd., but in the form originally described by Willdenow as *A. arabica* are downy; by most botanists the distinction is not thought sufficient to be specific. The flowers are yellow, inodorous, small, and collected in globular heads, supported upon slender peduncles which rise from the axils of the leaves, in number from two to five together. The fruit is a smooth, flat, two-valved legume, divided, by contractions occurring at regular intervals, into several roundish portions, each containing one seed. This species flourishes in Southern Nubia, Egypt, and Senegal, and is probably scattered over the whole intervening portions of Africa; it is also abundant in Hindostan.

Besides the species above described, the following afford considerable quantities of gum:—*A. horrida,* Willd. (*A. Karroo,* Hayne), of the Cape of Good Hope; *A. spirocarpa,* Hochst. (*A. gummifera,* Del.), seen by Broussonet in Morocco near Mogador; *A. ehrenbergiana,* Hayne, a shrub six or eight feet high, named in honor of the German traveller Ehrenberg, who observed it in the deserts of Libya, Nubia, and Dongola; *A. Seyal,* Del. (*A. fistula,* Schweinfurth), growing in the same region, and also in upper Egypt and Senegambia; and *A. tortilis,* Hayne, which attains the height of sixty feet, and inhabits Arabia Felix, Nubia, Dongola, and the Libyan Desert; these are all said to contribute to Senegal gum. According to Schweinfurth, *A. stenocarpa,* Hochst., yields the brownish gum of the Soudan sometimes known as the "*taleh*" *gum.*[1] *A. glaucophylla,* Steud., of the mountains of Abyssinia, is said to yield a gum, as do also various Australian acacias.

The gum bearing acacias are all hard-wooded, more or less thorny trees, usually small and dwarfish in the dry sandy soil of desert regions, but along river banks and other moist places becoming luxuriant and beautiful.

The bark and unripe fruit of the acacia contain both tannic and gallic acids. The dried juice of the pod was used by the ancient Greeks; and an extract is still sold in the bazaars of India under the name of *Akakia.* This extract is heavy, hard, of an agreeable odor, varying in color from greenish to dark-reddish, or when seen in bulk, blackish. It has a sweet, astringent taste, and yields a mucilaginous infusion. A similar preparation, *acacia nostras,* has been prepared in Europe by expression and inspissation from the unripe fruit of *Prunus spinosa,* or wild plum tree.

The gum of the acacias exudes spontaneously from the bark, and hardens on exposure; but incisions are sometimes made in order to facilitate the exudation. The gum is said also to be found immediately under the bark, where it is sometimes collected in regular cavities. It is probably due to changes produced in starch and cellulose by a peculiar species of bacterium.[2] It is stated by Jackson that, in Morocco, the greatest product is obtained in the driest and hottest weather, and from the most sickly trees. An elevated temperature appears to be essential, for in cooler climates, though the tree may flourish, it yields no gum. It is probable that some species of acacia yield finer gum than others, but it is also certain that the same tree will often yield some gum of the finest quality in regular tears or globular masses, and some irregular shaped, dark colored fragments of inferior value. Thus, from the same tree it will exude frothy or thick, and clear or dark colored, and will assume, upon hardening, different shapes and sizes; so that the pieces, when collected, require to be assorted before being delivered into commerce. Schweinfurth and other observers state, however, that the finest gum is obtained only from the *A. vera,* and perhaps one or two other species.

Commercial History and Varieties.—The most common varieties of this drug are the *Turkey* or *Egyptian,* the *Barbary,* the *Senegal,* and the *India gums.*

TURKEY GUM. (*Egyptian Gum.*)—Gum arabic formerly entered commerce almost exclusively through Egypt, being collected in Upper Egypt, Nubia, Kordofan, Darfur, and other regions of the Upper Nile, and carried to Alexandria, from whence it passed directly into the world's commerce or entered the latter through Smyrna, Trieste, or some other Mediterranean entrepôt. At one time the more or less colored varieties were known as *gum gedda,* while the white and fine drug was known as *gum turic,* names derived from Jiddah and Tor, Red Sea ports, through which the varieties were supposed to be respectively exported. More recently three chief commercial varieties of Turkish or Egyptian gums were recognized. *Hashabi* or *Kordofan gum,* the finest of these varieties, was collected in the country westward of the White Nile; formerly it constituted the bulk of the superior gum arabic of commerce.

[1] For further information in regard to gum bearing trees of Northern Africa, see *P. J.,* Aug. 1873; *C. R. A. S.,* t. lxxix. p. 1175; *Toxicologie Africaine,* Vol. ii.

[2] In the lower forms of life the inner cell contents or protoplasm is often set free by the rapid conversion of the cellulose wall into a substance soluble in water, and in the higher plants, cells can be seen with one-half of their walls still cellulose, the other gum. According to Wigand, arabin is the result of a further change in bassorin, but F. von Höhnel (*Ber. d. Chem. Ges.,* 1888) believes that while tragacanth is formed out of the cell wall, arabin is formed from the cell contents. According to the independent researches of Beijerinck and of Wiesner (*P. J.,* xvi. 284), the change of the cell wall is provoked by a peculiar ferment (*P. J.,* 1886, 840), which seems to be of bacterial origin. Various species of bacteria have been isolated from the diseased portion of gum producing plants by R. Greig Smith, who was enabled with them to produce a gum from saccharose, potato juice, and other vegetable substances. For details see *P. J.,* lxxii. p. 469. For general information concerning gum formation consult Hofmeister, *Handbuch der physiolog. Botanik,* Bd. iv. p. 368, 1865; Müller, *Sitzb. Akad. Wiss. Wien,* ii. Juni, 1875; Mercadante, *Gaz. Chim.; Ber. d. Chem. Ges.,* 1876, p. 581; Giraud, *A. J. P.,* 1878, p. 27; Prillieux, *C. R. A. S.,* t. lxxvii. p. 135; *Toxicologie Africaine,* vol. ii, p. 288.

Sennari or *Gehzirah gum* was an inferior variety, yielding a mucilage which turned sour more quickly than that produced by Kordofan gum. It was collected in a country eastward of the White Nile, and in the region of the Blue Nile. Still farther to the eastward was collected the Suakin or Talca gum.

Formerly, *Egyptian gum* was collected in all parts of the Soudan and Upper Egypt, and forwarded on the backs of camels to Assouan, at the head of the Nile navigation, often being many months en route. The closure of the Soudan by the Mahdi caused Egyptian gum almost to disappear from commerce, but the reopening of the region by the British government has resulted in large quantities of the gum being brought by rail to Assouan, whence after being sorted into three varieties it is put in palm-leaf sacks and sent down the Nile. The finest Egyptian gum consists of large roundish or smaller more or less irregular fragments, transparent but usually rendered opaque upon the surface by innumerable minute fissures. The inferior gum varies from yellow to dark-reddish as the quality deteriorates, and often contains impurities.[1] *Gedda gum,* sometimes spoken of as an Egyptian gum, enters commerce through Geddah, or Jiddah, on the Arabian side of the Red Sea. It seems to be the same as *Mecca* or *El Wisch* or *Aden gums,* which are sometimes spoken of as Egyptian gums, but are probably produced in the triangular peninsula which forms the eastern extremity of Africa.

Suakin gum, Talca or *Talha gum,* from *A. stenocarpa* and *A. Seyal,* is exceedingly brittle, and usually semi-pulverulent. It is a mixture of nearly colorless and brownish gums, is exported at Alexandria, and is sometimes termed *gum savakin.*

Barbary Gum. (*Mogador gum, Morocco gum.*)—Mogador, a port of Morocco, is the chief entrepôt of the trade. The gum is probably derived, in part at least, from *A. nilotica.* According to Jackson, the natives call the tree which affords it *attaleh.* They gather it in July and August, when the weather is hot and very dry. Two kinds are brought to Mogador, one from the neighboring provinces, the other by caravans from Timbuctoo. This may account for the fact that Barbary gum in part resembles the Turkey, in part the Senegal. When first deposited in the warehouses, it has a faint odor, and makes a crackling noise, occasioned by rupture of small masses as they become more dry. Barbary gum is usually in tears, somewhat brownish, roundish or vermiform, wholly soluble in water. It reaches the United States in casks through English commerce.

Senegal Gum.—This variety was introduced into Europe by the Dutch. The French afterwards planted a colony on the western coast of Africa, and took possession of the trade. St. Louis, at the mouth of the Senegal, and Portendic, considerably farther north, are the ports in which the commerce in gum chiefly centres. Immense forests exist in the interior, containing many species of the genus Acacia, all of which are said to yield gum, as is affirmed do also various trees belonging to other genera. The chief harvest begins in October and ends in December, although gum is also collected in March. The dry winds, which prevail after the rainy season, cause the bark to crack; the juice flows out and hardens in masses, which are often as large as a pigeon's egg, and sometimes as that of an ostrich. It is affirmed that the exudation is also largely caused by a parasitic plant, *Loranthus senegalensis,* the gummy exudation freely oozing out at the point where the parasite penetrates the bark. (*Ph. Centralh.,* Aug. 1895.) Senegal gum is usually in roundish or oval unbroken pieces, or in straight or curled cylindrical pieces of various sizes, in the finest grades whitish or colorless, but generally yellowish, reddish, or brownish red. The pieces are larger than those of Turkey gum, less brittle and pulverizable, and breaking with a more conchoidal fracture.[2] According to L. Liebermann, "gum Senegal" can be distinguished from Turkey gum arabic by heating the solutions for some time with potassium hydroxide. The "gum Senegal" does not alter in color, or becomes only very faintly yellow, while the Turkey gum arabic solution changes to an amber-yellow color (as do solutions of dextrin). (*A. J. P.,* 1891.)

India Gum.[3]—*India gum* is not produced in India but reaches Bombay from Aden and the Red Sea ports, and is almost certainly the product of the Soudan, being therefore identical with Egyptian gum. It occurs in India in two

[1] H. C. Wood found that the gum arabic comes into Assouan in sacks or mats which are simply piled in rectangular roofless spaces surrounded by walls about ten feet high, made of dry mud. He was informed by the traders that the gum is gathered during the months of January, February and March by collectors having vested rights in a certain portion of the forests. Long incisions are made vertically through the bark and the exuding gum allowed to harden, the trees not being injured by the process, the collections going on from year to year.

[2] A. Corre divides "gum Senegal" into the hard gums, which are of firm consistence, with a large, clear, shining fracture, and the soft or friable gums. *Galam* gum (*Gommes haut-du-fleuve*) is that coming from Galam, Podor, Bakel, and Medina; it is sometimes hard, sometimes soft; see 14th ed. U. S. D. *Gommes bas-du-fleuve* are from the deserts of Bounou and the country of the Braknas.

Brittle gum, Salabreda, or *Sadra-beida,* is supposed to be obtained from *A. albida* of the Flora of Senegambia, which is much smaller than *A. Verek,* and characterized by its white bark. The gum is usually in small, irregular pieces, like coarse salt, probably the fragments of larger lumps, but sometimes in vermicular pieces about as thick as a goose-quill and of variable length. It is dull and often wrinkled externally, of a vitreous fracture, and of different tints of color, white, green, yellow, or orange. It is always somewhat bitter. Very easily soluble in its weight of water, it affords a mucilage of little consistence, which has but a slight effect on the tincture of litmus. When the solution is evaporated to the consistence of a paste, it absorbs moisture so as to become viscid; this property detracts much from its value. It is much less esteemed than is the Galam gum.

[3] *Persian gum,* which is said to be sent from Persia to Assouan to be packed as genuine gum arabic, can be distinguished from the latter, which it closely resembles, by its not dissolving in water. Sickenberger thinks that it is the product of *Prunus bokharensis* or of *P. puddum.*

forms, *"Maklai,"* in large round tears or vermicular pieces, white, yellow or reddish, and much fissured; and *"Maswai,"* in fragments and vermicular pieces similar in color and fissuring to the other variety. It is often crudely adulterated before reaching Europe, especially with *Bassora gum,* distinguished by its insolubility in water. Of recent years various India gums have come into commerce in increasing quantities as substitutes for true gum arabic. India gum is brought to this country partly from Calcutta or Bombay, and partly by way of England. It usually comes in large cases. We have seen a parcel said to have come directly from the Red Sea, enclosed in large sacks made of a kind of matting, and bearing a close resemblance to the gum from Calcutta, except that it was more impure, and contained numerous large, irregular, very brittle masses, not much less than the fist in size.[1]

EAST AFRICAN GUM.—Under the names of *Cape gum* and *East African gum,* a brittle, almost pulverulent gum enters commerce from

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[1] SUBSTITUTES FOR GUM ARABIC.—According to A. Mander, the East India gums appearing in the London market are:

Glassy Amrad Gum.—A dark gum consisting of more or less rounded and some stalactitic pieces, with smooth shining surface and free from internal cracks. Color varying from dark brown to pale yellow. Viscosity of mucilage (acacia being 1), 2.

East India Amrad Gum.—A dark brittle gum of a reddish tint, composed chiefly of transparent angular fragments with a few rounded masses having a conchoidal fracture. Viscosity of mucilage, 0.15.

Pale Amrad Gum.—This somewhat resembles "gum acacia sorts," being in broken angular pieces or small tears, and these more or less cracked internally; some pieces may be noticed having an opaline surface. Viscosity of mucilage, 0.156.

Amra or *Oomra Whatti Gum.*—A dark gum, in irregularly-shaped and stalactiform pieces, clear internally, but surface dull; color from reddish to pale yellow. Viscosity of mucilage, 1.8.

Ghatti Gum.—A pale gum consisting of rounded or vermiform pieces varying in size, clear internally, but dull and roughened on the surface, apparently caused by shrinkage in drying; from brownish-yellow to perfectly colorless and transparent. According to the *Pharmacographia Indica,* this gum is readily distinguished from all others by its dull white, roughened surface and glassy fracture free from cracks; it possesses about double the viscosity of gum arabic, and forms with water a nearly colorless mucilage which has a faint characteristic odor, and is gelatinized by basic acetate of lead and by borax, but not affected by ferric chloride or neutral lead acetate.

Of these gums (India gums of the London market) the first four varieties yield mucilages which are so dark-colored that they cannot be used in practical pharmacy. One part of ghatti gum rubbed up with three parts of distilled water and strained, yields a mucilage which is tasteless, odorless, colorless, and which is superior to the emulsion of gum arabic in its adhesive power, and even in its emulsive power, the emulsion made with it being almost of snowy whiteness. Ghatti gum would therefore seem to be thoroughly adapted for the purposes of pharmacy, and its extreme cheapness has led to its extensive use.

The studies of J. G. Prebble, of Bombay, throw much light upon the gums just spoken of. Through Oomrawuttee, or Amravti, the chief town of the Hyderabad assigned districts known as the Beras, two gums enter the world's commerce, which are respectively known in India as *Amrad* or *Babool* gum, and *Ghatti* gum. The babool gum is apt to be dark, and is said to be a product of the *Acacia arabica.* It is without much doubt the *amra whatti* gum of Mander. *Amra* is the native name for a gum derived from *Spondias mangifera,* which gum, however, is said to resemble tragacanth rather than gum arabic. The Arabic word *hamrâ* means red, and possibly the term *amrad* is derived from it. The amrad gums of London appear to be made in Bombay by mixing babool gum with other gums collected in various parts of India or imported into Bombay from the Red Sea coast.

Ghatti gum is said to be obtained from *Anogeissus latifolia,* Wallich, in enormous quantities, to be much used in India, and to be exported from Bombay in the pure state.

Small quantities of gum are produced in India by a large number of trees often having no botanical relations with the acacias. For an account of these gums see *Pharmacographia Indica,* vol. i.

Cape gums are imported into London in large quantities. Two varieties are recognized. The *glassy hard Cape gum,* the product of *Acacia horrida,* occurs in amber-brown-colored, irregular pieces, occasionally fissured, usually hard, soluble in water, giving a dark-colored viscid mucilage free from odor but with an unusual flavor. This gum is said to be bleached and mixed with a pale gum. The *soft Cape gum* is believed to be derived from *Acacia giraffæ,* Willd. Its inferior grades are dark brown and yield a bitter mucilage; the finest samples, however, so closely resemble in their physical properties and the mucilage which they yield, the Kordofan gums, that some authorities believe that they are true gum arabic which has been deflected southward by the closure of the Soudan, opened again.

Australian gum, or *Wattle gum,* is the product of *A. pycnantha,* Benth.; *A. decurrens,* Willd.; *A. homalophylla,* A. Cunn. and probably other species of Acacia. It is said that gums obtained near the coast and those procured in the interior do not contain metarabin. It occurs in hard pieces, elongated or globular; rough, varying in color from dark amber to pale yellow; entirely soluble in water, and yielding a very adhesive mucilage, which, when dry, is said not to crack. It sometimes contains tannin, and appears not to be suitable for pharmaceutical purposes. The wood of *A. homalophylla* is known as *violet wood,* on account of its pleasant odor. (*Am. Drug.,* 1884.)

Under the names of *Brazilian gum, Para gum,* and *gum angico,* large quantities of a gum occurring in large dark-amber or dark-brown glossy drops, soluble in water, are yearly thrown into commerce. It is said to be the product of *Acacia angico.* Its mucilage is very adhesive, but usually too dark in color for pharmaceutical purposes. It must be distinguished from the gum resin often known as *Brazilian gum,* which is said to be obtained from *Hymenæa courbaril,* and is used in making varnishes.

Chagual or *Maguey gum* of Chili occurs in hollow cylindrical pieces from 0.2 to 1.5 Cm. in thickness, occasionally having the form of stalactites or irregular tubers, but in nearly all cases showing the impression of the epidermis to which they have been attached. On their inner surface they are longitudinally streaked, while their outer surface is usually numerously fissured, the fissures penetrating deeply toward the interior. In the absence of these, the pieces are of glassy brightness, transparent, and of very dense structure internally. The color varies from colorless, through yellowish and brownish to a tolerably deep brown, isolated pieces being almost black. Maceration in water is said to reduce the dark pieces to a granular mass, while the transparent pieces dissolve almost entirely; the whole of the commercial sample yielding about five or six per cent. to cold water. The amount dissolved is greatly increased by the use of boiling water. According to the experiments made by Guehm, the commercial drug is scarcely fitted for technical use as a gum, but the clear pieces when made into a concentrated mucilage by prolonged heating answer the purposes of the calico printer well. *Puya chilensis, P. lanuginosa,* and *P. lanata* are commonly said to be the sources of the gum, though the researches of Hartwich make this uncertain. The exudation is asserted to be the result of the bite of a caterpillar, *Kastina elegans.* (*Zeit. Oest. Apoth. Ver.,* Aug. 1, 1896.)

Thos. Maben gives the following method of testing mucilage obtained from various gums sold for gum arabic as the best that he has been able to devise after much experimentation. Two or three drops of the mucilage prepared from the gum are placed on a glass or porcelain slab, and one or two drops of the following reagents added; these are then stirred together with a glass rod and the results compared. In the case of borax, acacia mucilage at once agglutinates or hardens into a gummy mass, similarly with basic lead acetate and ferric chloride, while it gelatinizes or forms a softer mass with potassium silicate. Similar reactions are given by the Senegal gums, the Indian Amrad gums, white Barbary, white and brown Cape, and Geddah

German East Africa. It is the product of various species of the genus Acacia. According to C. Mannich, gum yielded by *A. Verek* and *A. Kirkii* contains no bassorin, while that which is derived from *A. Seyal, A. arabica,* and *A. stenocarpa* contains more or less of the bassorin. The gum from *A. usambarensis* occurs in brown masses of agglomerated tears, and contains so much bassorin that it forms a gelatinous mucilage.

General Properties.—Gum arabic is "in roundish tears of various sizes, or broken into angular fragments; whitish or yellowish-white, translucent; very brittle, with a glass-like, sometimes iridescent fracture; nearly inodorous; taste insipid, mucilaginous; insoluble in alcohol; slowly and completely soluble in water, forming an odorless, mucilaginous liquid, which shows an acid reaction with blue litmus paper, yields a gelatinous precipitate with basic lead acetate T.S., ferric chloride T.S., and concentrated solution of sodium borate. It is not colored blue (absence of *starch*) or red (absence of *dextrin*) by iodine T.S., nor does it yield a brownish-black precipitate with ferric chloride T.S., or reduce alkaline cupric tartrate V.S. The powder contains few, or no starch grains or fragments of vegetable tissues, and yields not more than 4 percent. of ash." *U. S.* "When dissolved in an equal weight of *water,* the solution should neither form a glairy mucilage nor, after admixture with more water, should it yield a gummy deposit on standing. The aqueous solution forms with *solution of lead subacetate* an opaque, and with *solution of borax* a more or less translucent, white jelly; it gives no precipitate with *solution of lead acetate;* is not colored blue or brown by a small quantity of *solution of iodine* (absence of starch or of ordinary 'dextrin' of commerce) nor bluish-black by *test-solution of ferric chloride* (absence of tannic acid); and does not give a red precipitate when boiled with *solution of potassio-cupric tartrate* (absence of certain sugars). Gum Acacia should not yield more than 4 per cent. of ash." *Br.* The commercial gum arabic contains 17 per cent. of water and 3 per cent. of ash, consisting almost entirely of calcium, potassium and magnesium carbonates.

The gum dissolves at ordinary temperature slowly, in an equal weight of water, forming a thick glutinous liquid of distinctly acid reaction. It is insoluble in alcohol, ether, and the oils. 100 parts of diluted alcohol containing 22 per cent. of alcohol by volume dissolve 57 parts of gum, diluted alcohol containing 40 per cent. alcohol takes up 10 parts, and 50 per cent. alcohol only 4 parts (Flückiger). On adding hydrochloric acid to the aqueous solution and precipitating with alcohol, a colorless amorphous substance is obtained. This is *arabic acid.* On hydrolysis, it yields *galactose, arabinose,* and a pentabiose named *arabinon.* The *arabin* (or arabic acid) may also be prepared by placing a solution of gum, acidulated with hydrochloric acid, on a dialyzer, when calcium chloride will diffuse out, leaving behind solution of arabin.

Arabic acid dried at 100° C. (212° F.) has the composition $2C_5H_{10}O_5 + H_2O$; the water separates when it unites with bases. It has a decided tendency to form acid salts. Concentrated nitric acid forms with it nitro-compounds; diluted nitric acid, on the other hand, gives rise to mucic and saccharic acids, together with oxalic and a little tartaric acid. Diluted sulphuric acid on prolonged boiling gives rise to *arabinose,* or *arabin sugar* (*pectinose,* or *pectin sugar*), $C_5H_{10}O_5$, which reduces alkaline copper solution and turns the plane of polarization 121° to the right. Kiliani (*Ber. d. Chem. Ges.,* 1887, 339) first established the formula as given above, and it is now recognized as belonging to the class of *pentoses.* They are not fermentable, and on prolonged boiling with diluted hydrochloric acid, lose the elements of water and yield *furfurol,* $C_5H_4O_2$. Neutral lead acetate does not precipitate an aqueous solution of gum arabic, but the basic acetate forms, even in a very diluted solution, a precipitate.

Prolonged heating of the dry gum causes it to change readily into *metarabic* (*metagummic*) acid, which is identical with the *cerasin* found in the beet and in cherry gum. Sulphuric acid will also change arabic into metarabic acid. 25 Gm. pure gum arabic are covered with 50 Cc. strong alcohol, 10 Cc. water, and 5 Cc. sulphuric acid, and allowed to stand 24 hours. On pouring off the fluid, and washing the residue with alcohol and with water, metarabic acid remains behind as a voluminous mass, which dries to a white, tasteless, and odorless powder of acid reaction. (Graeger, *Jahresbericht der Chem.,* 1872, 781.) The *metapectic acid* which is prepared by Scheibler from the sugar beet is identical with metarabic acid.

The principle separated by cold water from the soluble arabin proves to be the same as metarabic (metagummic) acid prepared direct from the pure gum arabic by heating, or by the action of sulphuric acid. It is also identical with gum extracted from the sugar beet by Scheibler. In the normal and sound beet this gum is insoluble in water, and merely swells up like metarabic acid, while in altered beets there is found a portion (arabin) soluble in water. (Scheibler, *Ber. d. Chem. Ges.,* 1873, p. 612.)

gums. Barbary brown and Amrad give a jelly only with borax, otherwise they react as acacia. Australian gum agglutinates with borax, but only gelatinizes with basic lead acetate, and has no reaction with ferric chloride and potassium silicate. Brazilian gum has no reaction with potassium silicate, but gelatinizes with borax and ferric chloride and slightly with basic lead acetate. Ghatti gum gelatinizes with all four reagents, but in a slight degree only with potassium silicate. Oomra gum reacts similarly to acacia, except that it is entirely unaffected by basic lead acetate, and forms a softer jelly with ferric chloride. There are, of course, shades of difference in the various reactions which cannot be indicated by these terms, but, generally speaking, a fair idea is given of the nature of the gum. (*P. J.,* March 1, 1890, 717 to 721.)

The similarity of the reactions and composition of *arabinose* and *galactose* (from sugar of milk by inversion) led Kiliani to assert the identity of these two varieties of sugar, but later studies by himself, Claesson, and Scheibler have shown that they are distinct. Thus, galactose is fermentable, while arabinose is not; galactose yields mucic acid when oxidized with nitric acid, and dulcite when reduced with sodium amalgam, while arabinose does not yield either; the fusing point of the crystallized galactose is given at 142° to 144° C., while that of arabinose is 160° C.; galactose yields with phenylhydrazin a light yellow compound, fusing at 170° to 171° C., while arabinose forms a brownish-yellow compound, fusing at 157° to 158° C. (Scheibler, *Ber. d. Chem. Ges.*, 17, 1731.) Arabinose is said to be obtainable only from those varieties of gum arabic that yield no mucic acid when treated with nitric acid. (Claesson, *Ber. d. Chem. Ges.*, 14, 1271.)

Gum arabic undergoes no change by age, when kept in a dry place. Its concentrated aqueous solution remains for a considerable time unaltered, but ultimately becomes sour, from the production of acetic acid. The disposition to sour is increased by employing hot water in making the solution. The tendency of a weak solution to become mouldy is said to be obviated by adding a few drops of sulphuric acid, and decanting from the calcium sulphate deposited. (*A. J. P.*, 1872, 353.) Solution of gum arabic does not ferment upon the addition of yeast, saliva, or gastric juice; the addition of chalk and cheese, however, starts a fermentation which gives rise to lactic acid and alcohol, but not to mannite or glycerin. The addition of a solution of gum to an acidified albumin solution causes a precipitate, which disappears on further addition of gum, but the solution will then curdle and become flocculent on application of heat. Gum may be distinguished from dextrin by the following tests: 1. Gum contains no dextroglucose, which, however, is present in dextrin, and may be recognized by the copper test. (See *Alkaline Cupric Tartrate Volumetric Solution*, PART III.)[1] 2. Gum contains a lime compound; hence its solution is rendered milky by oxalic acid, while a solution of dextrin remains almost clear. 3. Gum gives a slimy, yellow deposit when its solution is mixed with a neutral ferric salt.

The properties above enumerated belong to gum arabic generally. There are, however, varieties with differences which deserve notice. 1. *Gum that is transparent and readily soluble.* This constitutes by far the greater portion of the commercial varieties distinguished by the names of Turkey and Senegal gum. It is characterized by its transparency, ready solubility, and the comparatively slight degree of thickness and viscidity of its solution. Under this head may be included the *gomme blanche fendillée* of Guibourt. It is distinguished by the whiteness and deficient transparency of the pieces, attributable to the minute cracks or fissures with which they abound, and which render them very brittle and easily pulverizable. This peculiar structure is generally ascribed to the influence of solar heat and light, but is conjectured by Hayne to arise from the exudation of the juice in the frothy state noticed by Ehrenberg. Though the unbroken pieces are somewhat opaque, each minute fragment is perfectly transparent and homogeneous. This variety, in consequence of its prompt and entire solubility, is usually preferred for medicinal use, and for most purposes in pharmacy. 2. *Gum less transparent and less soluble.* Guibourt has proposed for portions of this gum the name of *gomme pelliculée*, from the circumstance that the masses are always apparently covered, on some part of their surface, by a yellowish opaque pellicle. Other portions of it have a mammillary appearance on the surface. It is less transparent than the former variety, is less freely and completely dissolved by water, and forms a more viscid solution. It dissolves with difficulty in the mouth, and adheres tenaciously to the teeth. It is found in all the commercial varieties of gum, but least in that from Egypt. Its peculiarities have been ascribed to variable proportions of *bassorin* or *cerasin* associated with the soluble *arabin*. Between these two varieties there are insensible gradations, so that it is not always very easy to classify specimens.

E. Bourquelot (*J. P. C.*, 1904 [6], 19, 473, 474) states that acacia contains an active oxidizing ferment which renders it unsuitable for use in many pharmaceutical preparations, and that, notwithstanding the wide use of acacia as an excipient, it is possible that certain active ingredients may become altered in its presence. Nor is acacia the only gum which contains a ferment; myrrh, frankincense and bdellium also contain an oxydase. Among the substances stated as being incompatible with acacia are pyrogallol, morphine, vanillin, ordinary phenol, cresylol, ortho- and meta-xylol, thymol, carvol, *a*- and *b*-naphthol, pyrocatechol, guaiacol, phenols, lysol, cresols, acetylguaiacol, veratrol, creosol, eugenol, acetyleugenol, methylaniline, ethylaniline, paratoluidine, crude aniline, xylidine,

[1] J. Henry Schroeder examined twelve specimens of powdered acacia, and states that dextrin is not frequently used as an adulterant, and that if in using the alkaline cupric tartrate test the heat be prolonged during twenty minutes, a well-defined reduction was produced even when pure Senegal gum was used. This fact should be remembered in testing gums by the official method. (*A. J. P.*, 1897, 195.) R. G. Shoults (*A. J. P.*, 1900, 267) supplemented the conclusions of Schroeder and proposed to use the difference in rotatory power of acacia and dextrin as a test. He found a solution of pure acacia to have a lævorotatory power of −18°, while one of dextrin was dextrorotatory varying to the extent of from +120° to +138°. See also Kebler's paper (*Am. Drug.*, 1901, 343.) The following test is given in the *Ph. Post*, 1894, 563. Add 3 Cc. of a solution consisting of 15 drops of solution of ferric chloride, 15 drops of a saturated solution of potassium ferrocyanide, 5 drops of HCl (1–125), and 60 Cc. of water to a 20 per cent. solution of the gum. If the gum arabic is pure, it will remain a clear yellow for from eight to ten hours. If there is dextrin present, the color changes to a blue.

a-naphthylamine, pyramidon apomorphine, eserine, adrenaline, isobarbaloin, caffeotannic acid, gallic acid and tannin. Paraxylenol, hydroquinone, resorcinol, anisol and phenetol do not appear to be affected. Nor is the action confined to chemical substances; acacia is incompatible with the opium and Calabar bean products, suprarenal extract, aloetic preparations, and all substances flavored with vanillin; tannin-containing extracts such as those of rhatany, catechu, and rhubarb; fluidextract of viburnum prunifolium, and kola preparations. Obviously, in cases where mucilage of acacia is concerned, this oxidizing action may be eliminated by heating the liquid to 100° C., and thus destroying the ferment.

Specimens of gum arabic are sometimes found in commerce which are soluble in water with difficulty. According to Köchlin, if ten parts of such gum, fifty parts of water, and three parts of a 12 per cent. solution of hydrogen peroxide be heated together for two or three hours, the gum is rendered easily soluble. (*Nat. Drug.*, 1894, 176.) Related to the acacia gums are *wood gum*, from the wood of foliage trees, yielding xylose on hydrolysis: *cherry gum*, the gum of cherry and almond trees, yielding *b*-arabinose on hydrolysis; *peach gum*, from the peach tree, yielding arabinose and galactose on hydrolysis; *barley gum*, obtained in the nitrogen-free extractive material of cereals, yielding galactose and xylose. Martina examined twenty-seven varieties of gum, and the composition of some of the principal ones is given in the above table.

Origin.	Source.	Ash.	Lime.	Mucic Acid.	Galactose.	Furfurol.	Penta-glucose.	Total Glucoses.
Gum Arabic	Arabia	3.60	1.84	22.98	30.66	13.57	27.14	58.3
	Senegal	3.25	0.90	19.72	26.29	12.97	25.94	57.58
	Gezireh	2.75	0.94	12.42	17.89	19.32	36.62	60.66
	Aden	3.70	1.33	18.68	24.90	15.26	30.52	56.90
	Mogador	3.50	0.78	18.10	24.13	13.90	27.80	50.31
	N. Holland	0.50	. . .	45.82	61.09	10.85	21.70	43.75
	Indies	4.16	0.97	14.75	19.66	17.98	35.96	56.52
Mimosa nilotica	Egypt	2.80	1.36	5.91	7.88	21.44	42.88	49.13
Acacia dealbata	Van Diémen	0.65	. . .	39.09	52.12	8.89	17.68	73.93
Acacia angico	Brazil	2.89	. . .	1.23	1.63	40.35	80.70	74.22
Gum of Apricot	. . . . .	4.20	1.85	9.16	12.21	17.27	34.52	43.48
Gum of Plum	. . . . .	2.15	1.07	5.19	6.92	31.03	62.06	66.47
Gum of Cherry	. . . . .	2.50	1.00	6.13	8.17	23.07	46.14	56.38

Impurities and Adulterations.—In parcels of gum arabic there are sometimes pieces of a dark color, opaque, and incorporated with ligneous, earthy, or other impurities. The inferior are often mixed with, or substituted for, the better kinds, especially in powder; and portions of insoluble gum, bdellium, and other concrete juices of unknown origin, are found among the genuine. Flour or starch is sometimes fraudulently added to the powder, but is easily detected by the blue color which it produces with tincture of iodine. In consequence of the impurities and difference in quality, gum arabic should generally be garbled. A foreign substance sometimes adheres to its surface, giving it a bitter taste, from which it may be freed by washing in water. Various adulterations of gum arabic have been practised, and substitutes offered for sale either honestly or with false labels. The high price of the genuine gum of late years has greatly stimulated the exploiting of these products. Starch, especially rice starch, which is difficult of detection on account of the small size of its granules, dextrin and inferior gums, are often added to powdered gum arabic. These foreign substances can usually be detected by the microscope or by appropriate tests for starch or dextrin even in powdered gum. (See page 6.) It has been proposed to change the arabinic acid of the sugar beet, by the method of Scheibler, into metarabinic acid, as the foundation of a true artificial gum arabic, but the *artificial* gums of the market have no such close chemical relation with the natural gum; many of them are mixtures of various substances, others are produced from starch by the action of sulphuric acid or by other means. *Universal Gum*, a patented product obtained from potato starch, has been highly commended for the permanency and adhesiveness of its mucilage, but is said not to act well as an emulsifier. A substitute has also been made from Irish moss. (See *Chondrus.*) Gelatin is sometimes added to acacia as an adulterant; formaldehyde has been recommended by Trillet (*Ph. Post*, 1899, 629) as an agent for its detection. (See also *Proc. A. Ph. A.*, 1900, 643.)

Uses.—Acacia is used in medicine chiefly as a demulcent. Hence it is advantageously employed in catarrhal affections and irritation of the fauces, by being held in the mouth and allowed to dissolve slowly. It has been used as a food, but has very little if any nutritive value. In pharmacy, gum arabic is extensively used for the suspension of insoluble substances in water, and for the formation of pills and troches. Two kinds of powdered gum arabic are used, one a coarse powder called *granulated*, the other *finely dusted*. The granulated dissolves more readily in water, according to Hager, because it has lost during desiccation only two per cent. of moisture, while in pre-

paring the "finely dusted" powder the high heat necessarily used to thoroughly dry it, drives off ten per cent. of water. Its easy solubility and absence of tendency to form "lumps" cause the coarse powder to be preferred for solutions, emulsions, etc.

Off. Prep.—Mucilago Acaciæ, *U. S.*, *Br.*; Syrupus Acaciæ, *U. S.*

ACETANILIDUM. U. S., Br.

ACETANILIDE

(ăç-ē-tăn-ĭl-ĭl'dŭm)

$C_8H_9NO = 134.09$

"The monacetyl derivative [$C_6H_5NH(CH_3.CO)$] of aniline." *U. S.* "Acetanilide, $CH_3.CO.NH.C_6H_5$, may be obtained by the interaction of glacial acetic acid and aniline." *Br.*

Acetylamidobenzene, Phenylacetamide; Acetanilid, Antifebrin; Acétanilide, *Fr. Cod.*; Acetanilidum, *P. G.*; Acetanilide, Antifebbrina, *It.*; Acetanilida, *Sp.*

Acetanilide was introduced into the Pharmacopœia of 1890, and its very extensive use caused it to be retained in the U. S. P. (8th Revision). The process for its manufacture is not patented.

Preparation.—Acetanilide is made, according to Yvon, as follows: 372 grammes of pure aniline and 240 grammes of glacial acetic acid are heated for four hours, to the boiling point, in a flask provided with a reversed condenser; the excess of both ingredients is then distilled off on a sand bath, this being completed when the temperature reaches 260° C. (500° F.). The cooled, congealed residue is crude acetanilide, which may be purified by sublimation, or better, by repeated crystallization from water. The yield is about 400 Gm. It may also be prepared by acting on aniline with acetyl chloride (Gerhardt), or by heating aniline with acetamide (Kolbe). The sublimed salt is whiter and lighter than that obtained by crystallization from water, which has the appearance of boric acid. For Walters' method of preparing acetanilide, on a small scale, see *Bull. Pharm.*, 1899, 53.

Properties.—Acetanilide is described by the U. S. Pharmacopœia as in "colorless, shining, micaceous, crystalline laminæ, or a crystalline powder; odorless, having a slightly burning taste, and permanent in the air. Soluble in 179 parts of water and in 2.5 parts of alcohol at 25° C. (77° F.); in 18 parts of boiling water, and in 0.4 part of boiling alcohol; also soluble in 12 parts of ether and 5 parts of chloroform at 25° C. (77° F.). When heated to 113° C. (235.4° F.) Acetanilide melts, and at 295° C. (563° F.) it boils without decomposition. Upon ignition it is consumed without leaving a weighable residue. Solutions of Acetanilide in simple solvents are neutral to test-paper. If 0.5 Gm. of Acetanilide be agitated with 5 Cc. of colorless sulphuric acid in a clean test-tube, it dissolves without imparting color to the liquid. On heating 0.1 Gm. of Acetanilide with 5 Cc. of concentrated solution of potassium hydroxide (1 in 4), the characteristic odor of aniline becomes noticeable. On now adding 1 Cc. of chloroform, and again heating, the disagreeable odor of phenyl isocyanide (a poisonous product) is evolved (distinction from *methylacetanilide* or *antipyrine*). On boiling 0.1 Gm. of Acetanilide for several minutes with 2 Cc. of hydrochloric acid, a clear solution results, which, when mixed with 3 Cc. of an aqueous solution of phenol (1 in 20), and afterwards with 5 Cc. of a filtered, saturated solution of chlorinated lime, acquires a brownish-red color, becoming deep blue upon supersaturation with ammonia water. On heating 0.1 Gm. of Acetanilide with 10 Cc. of water, filtering the solution when cold, and adding bromine T.S., drop by drop, to the filtrate, a whitish precipitate of *parabromacetanilide* is formed (distinction from *antipyrine* or *acetphenetidin*). A cold saturated, aqueous solution of Acetanilide added to ferric chloride T.S. should not affect the color of the latter (absence of *aniline salts* and *various allied substances*)." *U. S.* "Melting point, when dry, 236.5° F. (113.5° C.). It is soluble in 200 parts of cold or 18 parts of boiling *water*, and in 4 parts of *alcohol* (90 per cent.), freely soluble in *ether*, *benzol*, and *chloroform*. On boiling with *test-solution of ferric chloride* a reddish-brown color is produced, and this is almost entirely discharged by *hydrochloric acid*. If Acetanilide be heated with *solution of potassium hydroxide* until the odor of aniline is given off, and the liquid be then warmed with a few drops of *chloroform*, the unpleasant and penetrating odor of phenyl-isonitrile (isocyanide) is developed; and an aqueous solution mixed with *solution of bromine* gives a yellowish-white precipitate (distinctions from phenacetin). Heated with free access of air it burns, leaving no residue. With *sulphuric acid* or with cold *nitric acid* it forms a colorless solution. A cold saturated aqueous solution does not affect *solution of litmus* (absence of free acid), and is not affected by *test-solution of ferric chloride* (absence of acetone, phenazone, and salts of aniline)." *Br.*

Ritsert (*Ph. Ztg.*, 1890, 306) believes that the difference in melting point of acetanilide given by various writers is due to the almost constant presence of toluidine in aniline, and the production of acettoluids which have the following melting points: *ortho*, 107° C.; *meta*, 65.5° C.; and *para*, 147° C. A very important reaction, by which the presence of acettoluid may be detected in acetanilide, is in the use of a boiling solution of potassium permanganate. If the acetanilide be pure, it is not altered, and does not reduce the permanganate, but acettoluid, if it be present, is oxidized to acetamidobenzoic acid with reduction of the permanganate. Of a number of samples of acetanilide examined, in only one was the reduction slight, while all the others showed a decided reduction.

Uses.—The effects of acetanilide upon man are very similar to those produced by antipyrine,—namely, after small doses, quietness; after very large doses, malaise, a little headache, singing in the ears, weakness, and a peculiar cyanosis, with some tendency to somnolence, mydriasis, and, if there has been fever, marked fall of temperature usually accompanied by, but not dependent upon, a profuse sweat. After enormous doses complete coma and collapse have been noted. It has in rare instances caused collapse and cardiac failure, and a peculiar measles-like eruption is not very uncommon. Large toxic doses have caused in animals and in man anæsthesia, loss of reflex activity, tremors, irregular failing respiration, convulsions, coma, and general paralysis. The cyanosis is due to the formation of methæmoglobin in the blood. In the animal system acetanilide appears to break up into acetic acid and aniline, the aniline in turn undergoing oxidation into *paramidophenol,* which unites with sulphuric acid to be eliminated as paramidophenol sulphate.

Death has, in a number of cases, been produced by acetanilide when used for medicinal purposes. Five grains (0.32 Gm.) are alleged to have caused fatal heart failure (*Ind. Med. Jour.,* Sept. 1890); but there have been instances of recovery after the dose of an ounce (31 Gm.). Sixty grains (3.9 Gm.) have frequently been followed by serious collapse and in some cases by death. It is also necessary to exercise some care in the external use of the drug, for various cases of severe poisoning have been reported as caused by such use.

There is a wide spread but perhaps not well-grounded belief in the profession that accidents are more rare after acetanilide than after antipyrine, but the medicinal application of acetanilide seems to be identical with that of antipyrine, save only as it is modified by the insolubility of acetanilide. It is also somewhat more powerful than antipyrine, its full dose being ten grains (0.65 Gm.), repeated if necessary; preferably administered in capsules or wafers. For details of medicinal use, see *Antipyrina.* Acetanilide is germicidal, and seems to be especially active in inhibiting the growth of pathogenetic organisms. It is also analgesic, and affords a very useful dressing for wounds and ulcers. The drug itself may be used in the form of a fine powder, or an ointment may be employed in the strength of from 10 to 50 per cent. In certain mucous inflammations, as *vaginitis* and *urethritis,* a local application (20 to 40 grains to the fluidounce) has been found very effective. Acetanilide may be given in the form of powder, suspended in mucilage of acacia and syrup, or in the form of tablets or capsules.

Dose, from five to eight grains (0.32 to 0.5 Gm.).

Off. Prep.—Pulvis Acetanilidi Compositus, *U. S.*

ACETONUM. U. S.

ACETONE

(ăç-ẹ-tō′nŭm)

"A liquid containing not less than 99 per cent., by weight, of absolute Acetone [Dimethylketone, $CH_3.CO.CH_3 = 57.61$]. It should be kept in well-closed vessels in a cool place, remote from lights or fire." *U. S.*

Pyroacetic Spirit, Dimethyl Ketone; Acétone, Ether (Esprit) pyroacétique, *Fr.;* Aceton, Essiggeist, Mesitalkohol, *G.;* Acetone, Chetone, Metilacetone, *It.*

Preparation.—Acetone is found in small amount in normal urine, in blood, etc., and in larger amount in certain pathological conditions. Acetone is produced by the dry distillation of sugar, gum, cellulose, etc., and therefore is always contained in crude wood naphtha.

E. R. Squibb has also prepared it on a large scale by passing acetic acid vapor through a rotating iron cylinder heated to from 500° to 600° C. and containing pumice stone with precipitated barium carbonate. (*J. Am. C. S.,* 1895, 197.) Prepared commercially by the dry distillation of calcium acetate, it boils at 56° C., and has a peculiar ethereal odor and sharp, burning taste.

Properties.—The official description is as follows: "A transparent, colorless, mobile and volatile liquid of a characteristic ethereal odor and a pungent, sweetish taste. Specific gravity: 0.790 at 25° C. (77° F.). Miscible with water in all proportions, without cloudiness, also miscible with alcohol, ether, chloroform, and volatile oils. It volatilizes at low temperatures and boils at 56.5° C. (133.7° F.). It is inflammable and burns with a luminous non-sooty flame. It should not affect the color of blue or red litmus paper previously moistened with water. If 50 Cc. of Acetone be evaporated in a clean glass vessel no weighable residue should remain. If 20 Cc. of Acetone contained in a clean glass-stoppered vial be mixed with 0.1 Cc. of tenth-normal potassium permanganate V.S., the pink tint produced by the admixture should not wholly disappear in less than 15 minutes (limit of *empyreumatic substances*)." *U. S.*

Distilled with water and chlorinated lime, it yields nearly 200 per cent. of its weight in chloroform, and is hence largely used in the manufacture of this substance, both in this country and in Germany. In the presence of an alkali, iodine converts it into iodoform, so that a trace of acetone in methyl alcohol can be detected by iodoform formation (Kraemer's test).

Schlagdenhauffen asserts that commercial acetone contains an alkaloidal substance. (*P. J.,* 1884, 163.) For a method of detecting acetone in urine, see *A. J. P.,* 1889, 175. See also *Proc. A. Ph. A.,* 1894, 281; 1897, 690; *Ephem.,* 1895, 1653; *Chem. News,* 1899, 252, 262.

Acetone oil, largely a mixture of higher ketones, obtained as a by-product in the manufac-

ture of acetone and suggested by Lang as an addition to alcohol and spirits to denaturize them, cannot be used on a large scale as pointed out by Klar, as the commercial supply would probably be insufficient. (*Chem. News*, 1899, 205.)

Uses.—Acetone is rarely used in medicine, but has been introduced into the U. S. Pharmacopœia (8th Rev.) mainly as a menstruum in making oleoresins (see *Oleoresina*). It is used largely as a solvent for fats, resins, and camphors.

ACETPHENETIDINUM. U. S. (Br.)

ACETPHENETIDIN

(ăç-ĕt-phẹn-ĕt-ĭ-dĭ'nŭm)

$C_{10}H_{13}NO_2 = 177.79$

"A phenol derivative [Acetparaphenetidin, $C_6H_4(OC_2H_5).NH.CH_3.CO$ 1:4], the product of the acetylization of para-amidophenetol." *U. S.* "Para-acet-phenetidin, $C_2H_5O.C_6H_4.NH$ $COCH_3$, or Phenacetin, is produced by the interaction of glacial acetic acid and para-phenetidin, a body obtained from para-nitrophenol." *Br.*

Phenacetinum, *Br., P. G.;* **Para-acetphenetidin**, Para-ethoxyacetanilide; Phenacetin; Acet-Phénétidine, *Fr. Cod.;* Phénacetine, Para-acétophénétidine, Amide Acetique de l'amido-phénétol, *Fr.;* Fenacetina, *It., Sp.*

The chemical relationship of this body to phenol is seen by an examination of its formula and the formulas of the intermediate compounds obtained as stages in its preparation.

Phenol, $C_6H_5.OH$, is converted into *nitrophenol*, $C_6H_4(NO_2)OH$. Only the paranitrophenol is available, and this is separated by distilling off the ortho-nitrophenol by steam distillation. The residual *paranitrophenol*, in the form of the sodium compound, is treated with ethyl bromide, when ethyl paranitrophenol or *paranitrophenetol*, $C_6H_4(NO_2)OC_2H_5$, is produced. This is now reduced by the action of hydrochloric acid and iron turnings to *paraphenetidin*, $C_6H_4(NH_2)OC_2H_5$. Glacial acetic acid then serves to introduce the acetyl group, and *para-acetamidophenetol* (phenacetin), $C_6H_4(NHC_2H_3O)OC_2H_5$, is obtained.

Properties.—Acetphenetidin occurs in "white, glistening, crystalline scales or fine crystalline powder, odorless and tasteless. It is soluble in 925 parts of water, 12 parts of alcohol, 63 parts of ether, and 20 parts of chloroform, at 25° C. (77° F.); in 70 parts of boiling water and in 2 parts of boiling alcohol. Heated to between 134° and 135° C. (273.2° and 275° F.) it melts, and at a higher temperature burns without leaving a weighable residue. It dissolves without color in sulphuric acid, but if shaken with nitric acid it is colored yellow, which color persists when heated. If 0.1 Gm. of Acetphenetidin be boiled for one minute with 1 Cc. of concentrated hydrochloric acid and the solution diluted with 10 Cc. of water, cooled and filtered, it should yield on the addition of 3 drops of an aqueous solution of chromium trioxide (1 in 30) a ruby red color. On heating 0.1 Gm. of Acetphenetidin with 5 Cc. of a concentrated solution of potassium hydroxide (1 in 4), the odor of aniline should not be perceptible. If 0.1 Gm. of Acetphenetidin be boiled with 10 Cc. of water it should yield a solution which, when cooled and filtered, should not become turbid upon the addition of bromine T.S. in slight excess (absence of *acetanilide*). If 0.1 Gm. of Acetphenetidin be boiled for one minute with 3 Cc. of solution of sodium hydroxide (1 in 2), the solution cooled, and then agitated with 5 Cc. of a solution of chlorinated soda, there should be produced a clear yellow liquid, and not a purplish-red or brownish-red cloudy liquid or precipitate (absence of *acetanilide*). A mixture of 0.3 Gm. of Acetphenetidin with 1 Cc. of 90 percent. alcohol should not acquire a red tint when diluted with three times its volume of water and boiled with one drop of tenth-normal iodine V.S. (absence of *paraphenetidin*)." U. S. The British Pharmacopœia gives the following tests for phenacetin. "0.1 gramme boiled with 2 cubic centimetres of *hydrochloric acid* for half a minute yields a liquid which, diluted with ten times its volume of *water*, cooled, and filtered, assumes a deep-red coloration on the addition of *solution of chromic acid*. Heated with free access of air it burns, leaving no residue. *Sulphuric acid* dissolves it without color. A cold saturated aqueous solution should not become turbid on the addition of *solution of bromine* (absence of acetanilide). A mixture of 0.3 gramme of Phenacetin with 1 cubic centimetre of *alcohol* (90 per cent.) should not acquire a red tint when diluted with three times its volume of *water*, and boiled with one drop of *volumetric solution of iodine* (absence of paraphenetidin)." *Br.* The test with chromic acid will serve to distinguish it from acetanilide and exalgin; that with bromine water will indicate the absence of phenol and acetanilide, both of which will show a white turbidity, owing to the formation of difficultly soluble bromine derivatives. The presence of unchanged paraphenetidin may be detected by melting 2.5 Gm. of hydrated chloral in a test tube and adding 0.5 Gm. of the acetphenetidin to be tested. If pure, it will remain colorless; if paraphenetidin be present, it will become violet or reddish blue in tint. For further information see a paper in *Proc. A. Ph. A.*, 1903, 180, on an examination of samples of commercial phenacetin by G. M. Beringer, and *Proc. A. Ph. A.*, 1903, 365, for a paper by L. F. Kebler on its history, methods of manufacture, and chemical constitution.

Uses.—Acetphenetidin was first introduced as an antipyretic by Hinsberg and Kast, who found that in order to produce toxic effects in the lower animals enormous doses are required. These cause vomiting, staggering, hurried respiration, somnolence, cyanosis, and methæmoglobinization of the blood. In man no fatal

cases of poisoning have been reported, but Hollopeter saw twenty-two and a half grains produce in a woman collapse, with cyanosis. Acetphenetidin would seem to be one of the safest, as it certainly is one of the most efficient, drugs of its class. It is asserted that its antipyretic action is more gradual, more prolonged, and less apt to be attended with disagreeable symptoms than that of antipyrine and other allied drugs. The experiments of Ott and of Cerna and Carter appear to prove that the fall of temperature produced by acetphenetidin is due to a lessened production of animal heat caused by a direct influence of the drug upon the thermogenetic centres, and is not necessarily accompanied by any distinct alteration of the circulation. H. C. Wood, Jr., (*Univ. Med. Mag.*, July, 1900) found that when it is given intravenously it has no effect on blood pressure, but that in enormous doses it paralyzes respiration. It seems also to be a depressant to the spinal cord. As an *antipyretic* and as an *analgesic,* acetphenetidin appears to cover in its usefulness the same range as does antipyrine. In *nervous headache* the combination of it with caffeine (twelve grains to three) is often singularly advantageous. By many, acetphenetidin is believed to be less depressing than is antipyrine. Urticaria has been noted after its use, but it seems not to produce any characteristic eruption. According to Reuter, *paraphenetidin,* which is liable to occur in commercial phenacetin, is a dangerous poison, especially acting upon the kidneys.

Dose, from five to fifteen grains (0.32 to 1 Gm.).

ACETUM CANTHARIDIS. Br.

VINEGAR OF CANTHARIDES

(ą-cē′tŭm cąn-thăr′į-dīs)

Vinaigre cantharidé, *Fr.;* Canthariden-Essig, *G.*

"Cantharides, bruised, 2 *ounces* (Imperial) or 100 grammes; Glacial Acetic Acid and Distilled Water, mixed in equal volumes, a sufficient quantity. Macerate the Cantharides in *eighteen fluid ounces* (Imp. meas.) or nine hundred cubic centimetres of the mixture of Glacial Acetic Acid and Distilled Water for twenty-four hours; transfer to a percolator: when the liquid ceases to pass, pour sufficient of the menstruum in successive portions over the contents of the percolator to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Vinegar of Cantharides." *Br.*

This preparation was formerly official in all the Pharmacopœias of the British Islands; but it was omitted in the first British Pharmacopœia, to be resumed in the last two revisions. The mode of preparation differs mainly in the partial substitution of percolation for maceration and expression. Glacial acetic acid is now directed to be mixed with an equal volume of distilled water as the menstruum. This is better than the former method of mixing two kinds of acetic acid of different strengths.

Procter found that, by digestion at a temperature of 100° C. (212° F.), the active principle of the flies is readily taken up by official acetic acid, though a portion of the cantharidin is deposited upon cooling. (*A. J. P.*, xxiv. 299.) It would seem, therefore, that the vinegar of Spanish flies would be best prepared with the aid of heat; and, to a certain extent, this advantage is enjoyed in the present process. Greenish and Wilson (*P. J.*, 1898, 259) propose to make this preparation directly from the active principle, by dissolving 1 Gm. of cantharidin in 200 Cc. of glacial acetic acid and adding sufficient diluted acetic acid to make 2000 Cc.[1]

Uses.—This preparation is intended exclusively for external use, as a speedy epispastic. It is said, when lightly applied by a brush, to act as a rubefacient; and, when rubbed freely upon the skin for three minutes, to be followed in two or three hours by full vesication. The pain produced by the application, though more severe, is also more transient than that occasioned by the blistering cerate.

ACETUM IPECACUANHÆ. Br.

VINEGAR OF IPECACUANHA

(ą-cē′tŭm īp-ę-căc-ū-ăn′hæ)

Vinaigre d'Ipecacuanha, *Fr.;* Brechwurzel-Essig, *G.*

"Liquid Extract of Ipecacuanha, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Diluted Acetic Acid, 17 *fl. ounces* (Imp. meas.) or 850 cubic centimetres. Mix; filter, and if necessary add sufficient Diluted Acetic Acid to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Vinegar of Ipecacuanha." *Br.*

The process for this vinegar was changed materially in the last revision of the British Pharmacopœia, liquid extract of ipecacuanha

[1] The *Vinegar of colchicum* (*acetum colchici*) was omitted in the U. S. Pharmacopœia 1870, although a very active preparation. The following is the article on it in the 14th edition of the U. S. Dispensatory. "Take of Colchicum Root, in fine powder, *two troy ounces;* Diluted Acetic Acid *a sufficient quantity.* Moisten the powder with a fluidounce of Diluted Acetic Acid, allow it to stand for half an hour, pack it firmly in a conical glass percolator, and gradually pour upon it Diluted Acetic Acid until the filtered liquid measures two pints. Vinegar of Colchicum may also be prepared by macerating the Colchicum Root, in moderately fine powder, with two pints of Diluted Acetic Acid, in a close glass vessel, for seven days; then expressing the liquid, and filtering through paper." *U. S.*

Vinegar is an excellent solvent of the active principle of colchicum, and the alkaloid of the latter loses none of its efficacy by combination with the acetic acid of the former. Of the two formulas above given, the first, directing percolation, is much preferable to the second, permitting maceration, if performed by competent hands; and the same remark will apply to all the medicated vinegars in which an alternative formula is given. This preparation is effective in doses of thirty drops to two fluidrachms (1.9 to 7.5 Cc.).

diluted with a mixture of alcohol and diluted acetic acid replacing the old method of percolating the drug with diluted acetic acid. It will be found, however, that after the vinegar has been made a few months the odor of acetic ether will be developed; this is sometimes objectionable. The words in the process "if necessary" might have been omitted, as slight loss in filtration always occurs. Diluted Acetic Acid is a good menstruum for ipecacuanha, and this vinegar will doubtless prove effective as an expectorant.

Dose, five to forty minims (0.3 to 2.5 Cc.).

ACETUM OPII. U. S.

VINEGAR OF OPIUM

(ą-cē'tŭm ō'pī-ī)

Black Drop; Vinaigre d'Opium, *Fr.;* Opium-Essig, *G.*

* "Powdered Opium, *one hundred grammes* [or 3 ounces av., 231 grains]; Myristica, in No. 30 powder, *thirty grammes* [or 1 ounce av., 25.5 grains]; Sugar, *two hundred grammes* [or 7 ounces av., 24 grains]; Diluted Acetic Acid, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fl. oz., 6½ fluidrachms]. Macerate the Opium and Myristica in *five hundred cubic centimeters* [or 1 pint] of Diluted Acetic Acid during seven days, frequently stirring; then strain through muslin of close texture, and express the liquid. Mix the residue with *two hundred cubic centimeters* [or 7 fluidounces] of Diluted Acetic Acid until a uniform magma is produced, then strain and express again. Mix and filter the strained liquids, dissolve the Sugar in the filtrate, and pass enough Diluted Acetic Acid through the filter to make the product measure *one thousand cubic centimeters* [or 33 fl. oz., 6½ fluidrachms]." *U. S.*

The U. S. P. 1890 directed this vinegar to be tested to show its alkaloidal value as follows: "To assay this preparation, transfer 100 Cc. of it to a small capsule, add 4 Gm. of precipitated calcium carbonate, or such a quantity as will be sufficient to neutralize the free acid, and then proceed further as directed under *Tinctura Opii.* It should yield from 1.3 to 1.5 Gm. of crystallized morphine." *U. S.* 1890. The U. S. P. (8th Rev.) dropped the assay process, because the presence of sugar and the other ingredients rendered such a process unreliable. (See *A. J. P.,* 1894, 136.) The maintenance of a uniform standard strength is secured through the use of an assayed powdered opium in this preparation.

Many will doubtless prefer to make vinegar of opium entirely by maceration. This may be done by placing the powder in a suitable bottle and pouring on the diluted acetic acid, agitating frequently, after allowing the maceration to proceed seven days, expressing, and filtering. The vinegar of opium was introduced into the Pharmacopœias for use as an imitation of *Lancaster* or *Quaker black drop,* or simply *black drop.*

The formula of the first edition of the U. S. P. was so deficient in precision, and so uncertain in its results, that it was abandoned in the second edition; but, as these objections were obviated in a process by Charles Ellis (*A. J. P.,* vol. ii. p. 202), it was deemed proper to restore it to its official rank at the subsequent revision of the Pharmacopœia. The advantages of the black drop over laudanum are, probably, that disturbing principles contained in opium and soluble in alcohol are left behind by the aqueous menstruum employed, while the morphine meconate is converted by the acetic acid into the acetate. In the original process, published by Armstrong, who found it among the papers of a relative of the proprietor in England, *verjuice,* or the juice of the wild crab, was employed instead of vinegar. Other vegetable acids also favorably modify the narcotic operation of opium; and lemon juice has been employed in a similar manner to vinegar. For the process official in the first ed. U. S. P., see 14th edition U. S. Dispensatory.

Vinegar of opium may sometimes be advantageously used when opium itself, or the tincture, occasions headache, nausea, or nervous disorder. Formerly this preparation was double the strength of laudanum; now it has the same strength. The smallness of the dose was one of its great advantages, but since the weakening, first authorized by the U. S. Pharmacopœia of 1880, this preparation has almost entirely gone out of use.

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

ACETUM SCILLÆ. U. S., Br.

VINEGAR OF SQUILL

(ą-cē'tŭm sĭl'læ)

Aceticum scillitieum; Meerzwiebel-Essig, *G.;* Vinaigre de scille, *Fr. Cod.;* Vinaigre scillitique, *Fr.;* Aceto scillitico, *It.;* Vinagre de escila, *Sp.*

* "Squill, in No. 20 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Acetic Acid, *a sufficient quantity,* to make *one thousand cubic centimetres* [or 33 fl. oz., 6½ fluidrachms]. Macerate the Squill with *nine hundred cubic centimeters* [or 30 fluidounces] of Diluted Acetic Acid during seven days, frequently stirring; then strain through muslin, and wash the mass on the strainer with enough Diluted Acetic Acid to make the strained liquid measure nearly *one thousand cubic centimeters* [or 33 fl. oz., 6½ fluidrachms]. Heat this liquid to boiling, filter while hot, and when cooled add sufficient Diluted Acetic Acid to make the product measure *one thousand cubic centimeters* [or 33 fl. oz., 6½ fluidrachms]." *U. S.*

"Squill, bruised, 2½ *ounces* (Imperial) or 125 grammes; Diluted Acetic Acid, 1 *pint* (Imp. meas.) or 1000 cubic centimetres or a sufficient quantity. Exhaust the squill by the process of maceration as directed for Tinc-

tures. The resulting Vinegar of Squill should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

Vinegar of Squill may also be prepared by percolating the Squill with the Diluted Acetic Acid after previous maceration with an equal bulk of the Diluted Acetic Acid (this precaution being necessary in order to satisfy thoroughly its tendency to swell) and filtering through paper.

The process now official differs from that of the U. S. Pharm. of 1890 in directing the heating of the strained liquid to coagulate albuminous matter and filtering, so that when the vinegar is mixed with sugar and water, in making syrup of squill, a transparent syrup may be secured.

This was formerly official in the Lond., Ed. and Dub. Colleges, but was omitted as a distinct preparation in the first British Pharmacopœia, reintroduced in 1874 and since retained. As vinegar of squill is apt to be injured by keeping, it should be prepared in small quantities, as wanted for use. The British preparation is a trifle stronger than that of the U. S. P. (8th Rev.). As was shown by E. Gregory (*Can. Pharm. Journ.*, Oct., 1875), the spirit added to it in the former British formula was of no use as a preservative. In the German Pharmacopœia 5 parts of squill are macerated in a mixture of 9 parts of acetic acid (30 per cent.), 36 parts of water, and 5 parts of alcohol, for three days, with frequent shaking, strained without forcible expression, allowed to stand 24 hours, and then filtered. In the Codex, 12 parts of white vinegar are used to macerate 1 part of squill for eight days. Vinegar of squill is employed chiefly in preparing the syrup.

Uses.—This preparation has all the properties of the squill in substance, and is occasionally prescribed, but the syrup is usually and properly preferred. It should be given in cinnamon water, mint water, or other aromatic liquid.

Dose, from fifteen minims to a fluidrachm (0.9 to 3.75 Cc.), but the latter quantity would be apt to nauseate.

Off. Prep.—Syrupus Scillæ, *U. S.*, *Br.*

ACIDUM ACETICUM. U. S., Br.

ACETIC ACID

(ăç'ĭ-dŭm ą-cĕt'ĭ-cŭm)

"A liquid composed of not less than 36 percent., by weight, of absolute Acetic Acid [$CH_3.COOH = 59.58$], and about 64 percent. of water, and obtained by the oxidation of ethyl alcohol or by the destructive distillation of wood." *U. S.* "Acetic acid is a product of the destructive distillation of wood, and of the oxidation of ethylic alcohol. 100 parts by weight should contain 33 parts of hydrogen acetate, $CH_3.COOH$, and 67 parts of water." *Br.*

Acetum Concentratum; Acide acétique, *Fr. Cod.;* Acidum Aceticum Dilutum, *P. G.;* Essigsaure, *G.;* Acido acetico, *It., Sp.*

Off. Prep.—Acidum Aceticum Dilutum, *U. S.*, *Br.;* Liquor Ammonii Acetatis, *Br.;* Oxymel, *Br.;* Oxymel Scillæ, *Br.* Acetic Acid is also used officially, as a menstruum, diluted to various strengths.

ACIDUM ACETICUM DILUTUM. U. S., Br.

DILUTED ACETIC ACID

(ăç'ĭ-dŭm ą-cĕt'ĭ-cŭm dī-lū'tŭm)

"It should contain not less than 6 percent., by weight, of absolute Acetic Acid [$CH_3.COOH = 59.58$], and about 94 percent. of water." *U. S.* "100 parts by weight should contain 4.27 parts of hydrogen acetate, $CH_3.COOH$." *Br.*

Acetum Destillatum; Acide acétique dilué, *Fr.;* Acetum, *P. G.;* Reiner Essig, Verdünnte Essigsaure, *G.*

ACIDUM ACETICUM GLACIALE. U. S., Br.

GLACIAL ACETIC ACID

(ăç'ĭ-dŭm ą-cĕt'ĭ-cŭm glā-cĭ-ā'lē)

$HC_2H_3O_2 = 59.58$

"A liquid containing not less than 99 percent., by weight, of absolute Acetic Acid [$CH_3.COOH = 59.58$], and not more than 1 percent. of water." *U. S.* "100 parts by weight should contain 99 parts of hydrogen acetate, $CH_3.COOH$." *Br.*

Acidum Aceticum Concentratum; Acidum Aceticum, *P. G.;* Acide acétique crystallisable, *Fr. Cod.;* Acide acétique concentré, Vinaigre glacial, Esprit de vinaigre, *Fr.;* Essigsaure, Eisessig, *G.;* Acido acetico concentrato, *It.*

Three strengths of acetic acid are now official in the U. S. and Br. Pharmacopœias. These are *Acidum Aceticum Glaciale,* of sp. gr. 1.049 at 25° C. (77° F.), *U. S.* and 1.058 at 15.5° C. (60° F.), *Br.;* *Acidum Aceticum,* of sp. gr. 1.045, *U. S.*, and 1.044, *Br.*, and *Acidum Aceticum Dilutum,* sp. gr. 1.009, *U. S.*, and 1.006, *Br.*

We shall consider these grades separately, in the order of their strength.

Acidum Aceticum Glaciale.—A process for this preparation was given in the British Pharmacopœia of 1864, which consisted in first heating sodium acetate so as to drive off all its water of crystallization, then, after cooling, distilling it with concentrated sulphuric acid, and, finally, if the resulting acetic acid, upon being tested with a mixture of solution of potassium iodate and a little mucilage of starch, was found to contain sulphurous acid, agitating the distilled acid with perfectly dry black manganese oxide, and again distilling. The object of the process was to furnish an acid of the maximum strength. But, on trial, it was not found to be satisfactory, as the resulting acid was not truly glacial, and always contained sul-

Percentage of Absolute Acetic Acid in Acetic Acid of different densities. U. S. P.

Per cent. absolute acetic acid.	Specific gravity.		Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
	25° C. / 25° C.	15° C. / 15° C.				
1	1.0015	1.0015	0.00017	0.067	0.17	0.059
2	1.0030	1.0030	0.00018	0.071	0.34	0.059
3	1.0044	1.0045	0.00019	0.067	0.51	0.063
4	1.0059	1.0060	0.00020	0.071	0.67	0.059
5	1.0073	1.0075	0.00021	0.071	0.84	0.059
6	**1.0087**	**1.0090**	**0.00022**	**0.071**	**1.01**	**0.059**
7	1.0101	1.0105	0.00023	0.077	1.18	0.059
8	1.0114	1.0120	0.00024	0.071	1.35	0.056
9	1.0128	1.0135	0.00025	0.071	1.53	0.059
10	1.0142	1.0150	0.00026	0.071	1.70	0.059
11	1.0156	1.0165	0.00027	0.077	1.87	0.059
12	1.0169	1.0179	0.00028	0.071	2.04	0.056
13	1.0183	1.0193	0.00028	0.071	2.22	0.059
14	1.0197	1.0208	0.00029	0.077	2.39	0.059
15	1.0210	1.0222	0.00030	0.077	2.56	0.056
16	1.0223	1.0236	0.00031	0.077	2.74	0.059
17	1.0236	1.0250	0.00032	0.077	2.91	0.056
18	1.0249	1.0264	0.00033	0.077	3.09	0.059
19	1.0262	1.0278	0.00034	0.077	3.26	0.056
20	1.0275	1.0292	0.00035	0.083	3.44	0.056
21	1.0287	1.0306	0.00037	0.083	3.62	0.059
22	1.0299	1.0319	0.00038	0.083	3.79	0.056
23	1.0311	1.0332	0.00039	0.083	3.97	0.056
24	1.0323	1.0345	0.00041	0.091	4.15	0.059
25	1.0334	1.0358	0.00042	0.083	4.32	0.056
26	1.0346	1.0371	0.00044	0.091	4.50	0.056
27	1.0357	1.0384	0.00045	0.100	4.68	0.056
28	1.0367	1.0396	0.00047	0.091	4.86	0.056
29	1.0378	1.0408	0.00048	0.100	5.04	0.056
30	1.0388	1.0420	0.00050	0.100	5.22	0.056
31	1.0398	1.0432	0.00051	0.100	5.40	0.056
32	1.0408	1.0444	0.00053	0.100	5.58	0.056
33	1.0418	1.0455	0.00055	0.100	5.76	0.056
34	1.0428	1.0467	0.00057	0.111	5.94	0.056
35	1.0437	1.0478	0.00059	0.100	6.12	0.056
36	**1.0447**	**1.0489**	**0.00060**	**0.111**	**6.30**	**0.056**
37	1.0456	1.0500	0.00062	0.125	6.48	0.056
38	1.0464	1.0510	0.00064	0.111	6.66	0.056
39	1.0473	1.0521	0.00066	0.125	6.84	0.056
40	1.0481	1.0531	0.00068	0.111	7.02	0.056
41	1.0490	1.0541	0.00069	0.125	7.20	0.056
42	1.0498	1.0551	0.00070	0.111	7.38	0.056
43	1.0507	1.0560	0.00071	0.111	7.56	0.056
44	1.0516	1.0570	0.00072	0.125	7.74	0.053
45	1.0524	1.0579	0.00073	0.125	7.93	0.056
46	1.0532	1.0588	0.00074	0.125	8.11	0.056
47	1.0540	1.0597	0.00074	0.111	8.29	0.056
48	1.0549	1.0606	0.00075	0.125	8.47	0.053
49	1.0557	1.0615	0.00076	0.143	8.66	0.056
50	1.0564	1.0623	0.00077	0.125	8.84	0.056
51	1.0572	1.0631	0.00078	0.143	9.02	0.056
52	1.0579	1.0639	0.00078	0.143	9.20	0.053
53	1.0586	1.0646	0.00079	0.143	9.39	0.056
54	1.0593	1.0654	0.00080	0.167	9.57	0.053
55	1.0599	1.0661	0.00081	0.167	9.76	0.056

Percentage of Absolute Acetic Acid in Acetic Acid of different densities. U. S. P.
(*Continued.*)

Per cent. absolute acetic acid.	Specific gravity. $\frac{25°\text{ C.}}{25°\text{ C.}}$	Specific gravity. $\frac{15°\text{ C.}}{15°\text{ C.}}$	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
56	1.0605	1.0668	0.00081	0.167	9.94	0.056
57	1.0611	1.0674	0.00082	0.167	10.12	0.053
58	1.0617	1.0681	0.00083	0.167	10.31	0.056
59	1.0623	1.0687	0.00083	0.200	10.49	0.056
60	1.0628	1.0693	0.00084	0.200	10.67	0.053
61	1.0633	1.0699	0.00084	0.200	10.86	0.056
62	1.0638	1.0705	0.00085	0.200	11.04	0.056
63	1.0643	1.0710	0.00086	0.250	11.22	0.056
64	1.0647	1.0715	0.00087	0.250	11.40	0.053
65	1.0651	1.0720	0.00088	0.250	11.59	0.056
66	1.0655	1.0725	0.00088	0.250	11.77	0.056
67	1.0659	1.0729	0.00089	0.333	11.95	0.056
68	1.0662	1.0733	0.00090	0.250	12.13	0.053
69	1.0666	1.0737	0.00090	0.333	12.32	0.056
70	1.0669	1.0741	0.00091	0.333	12.50	0.056
71	1.0672	1.0745	0.00091	0.500	12.68	0.056
72	1.0674	1.0748	0.00092	0.500	12.86	0.056
73	1.0676	1.0750	0.00093	1.000	13.04	0.056
74	1.0677	1.0752	0.00093	1.000	13.22	0.056
75	1.0678	1.0754	0.00094	....	13.40	0.056
76	1.0679	1.0755	0.00095	....	13.58	0.056
77	1.0679	1.0756	0.00095	....	13.76	0.056
78	1.0679	1.0756	0.00096	....	13.94	0.056
79	1.0678	1.0756	0.00096	....	14.12	0.056
80	1.0678	1.0756	0.00097	1.000	14.30	0.056
81	1.0677	1.0755	0.00097	0.500	14.48	0.056
82	1.0675	1.0754	0.00098	0.333	14.66	0.059
83	1.0672	1.0752	0.00099	0.333	14.83	0.059
84	1.0669	1.0750	0.00099	0.333	15.00	0.059
85	1.0666	1.0747	0.00100	0.250	15.17	0.059
86	1.0662	1.0744	0.00100	0.200	15.34	0.059
87	1.0657	1.0739	0.00101	0.200	15.51	0.059
88	1.0652	1.0734	0.00101	0.143	15.68	0.059
89	1.0645	1.0728	0.00102	0.143	15.85	0.059
90	1.0638	1.0721	0.00102	0.111	16.02	0.059
91	1.0629	1.0713	0.00103	0.111	16.19	0.063
92	1.0620	1.0704	0.00103	0.091	16.35	0.063
93	1.0609	1.0694	0.00104	0.077	16.51	0.063
94	1.0596	1.0682	0.00104	0.071	16.67	0.067
95	1.0582	1.0668	0.00105	0.059	16.82	0.067
96	1.0565	1.0652	0.00105	0.050	16.97	0.067
97	1.0545	1.0633	0.00106	0.045	17.12	0.071
98	1.0523	1.0612	0.00106	0.042	17.26	0.077
99	1.0499	1.0588	0.00107	0.037	17.39	0.077
100	**1.0472**	**1.0562**	**0.00108**	....	**17.52**	....

[1] Add if the temperature is above, subtract if the temperature is below, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

NOTE.—If the specific gravity $\left(\frac{25°\text{ C.}}{25°\text{ C.}}\right)$ of the acid be greater than 1.045, mix with some of the acid an equal weight of water before taking the specific gravity, and multiply the percentage taken from the table by two. It is better, however, to determine the strength of any sample of Acetic Acid by its "normality."

To find the weight in grammes of absolute Acetic Acid in 100 Cc., multiply the specific gravity by the per cent. of absolute acid.

To find the volume per cent. of official Acetic Acid, multiply the "normality" by 15.87. For the volume per cent. of Glacial Acetic Acid, multiply the "normality" by 5.71. For the volume per cent. of official Diluted Acetic Acid, multiply the "normality" by 99.

phurous acid. (C. H. Wood, *P. J.*, 1867, 17.) The following modification of the process does, however, yield a pure product. After the crystallized salt has been fused in an iron dish in its own water of crystallization, and has dried out, it is again brought to fusion by increased heat, whereby, if the heat applied be not too strong, no acid is decomposed or vaporized. The anhydrous salt is then treated with half a molecule of sulphuric acid (for 82 parts anhydrous acetate 49 parts of strongest sulphuric acid), which according to Mohr and Buchner, suffices, instead of twice the amount, usually employed. No sulphurous acid is liberated in this case. A process to be followed on a large scale, practically the counterpart of this, is given in a foot-note, page 18, 14th ed. U. S. Dispensatory.

Acetic acid of maximum strength may also be obtained by distilling dried potassium acetate at a heat between 199° C. (390° F.) and 299° C. (570° F.). One molecule of monohydrated acetic acid distils over, and neutral potassium acetate is left. The acid acetate may be formed by evaporating a mixture of the neutral acetate with an excess of aqueous acetic acid. In this process, the same potassium acetate serves repeatedly for conversion into acid acetate, and subsequent decomposition. This process is said to be employed by manufacturers on a large scale in some parts of the continent of Europe. It originated with Melsens.

Acidum Aceticum.—*U. S., Br.* (sp. gr. 1.045, *U. S.*, 1.044, *Br.*). *Acetic Acid.*—This is the acid resulting from the purification of the crude acetic acid obtained by the destructive distillation of wood. It is the acid most useful to the apothecary, and is employed in making numerous pharmaceutical preparations. As this grade of acid has its source in the impure acetic acid it will be proper to premise some account of the crude acid, called *pyroligneous acid.*

Wood, when charred, yields many volatile products, among which are an acid liquor, an empyreumatic oil, and tar containing creosote and some other proximate principles. When the carbonization is performed in closed vessels, these products, which are lost in the ordinary process of charring, may be collected, and, at the same time, a large amount of charcoal be obtained.

Senff has furnished some comparative results in respect to the dry distillation of wood. The points worked out are a comparison of the products of distillation under similar conditions yielded by wood from various parts of the same trees, and from the same wood in a healthy and in an unsound state; also a comparison of the products from one and the same wood distilled slowly or rapidly. It has been found that when similarly distilled the yield by weight of crude acid, tar, charcoal, and gas from the most diverse species of wood does not essentially differ, but that the percentage of real acid in the crude acid obtained varies considerably, and in this respect the wood from ordinary foliage trees compares favorably with that from needle-leaved trees; also that stem-wood yields more acid than branch-wood, that wood yields more acid than bark, and that sound wood yields more acid than unsound wood. (*Ber. d. Chem. Ges.*, xviii. p. 60; *P. J.*, 1885, p. 696.)

Crude pyroligneous acid, sometimes called *pyroligneous vinegar,* is a dark brown liquid, having a strong smoky odor, and consists of acetic acid, diluted with more or less water, and holding in solution some creosote and empyreumatic oil, with methyl alcohol. It is from this crude acid that the U. S. and British acetic acid, corresponding to the acetic acid of commerce, is obtained. The purification is effected as follows: the acid is saturated with milk of lime, whereby calcium acetate is formed in solution, and thus most of the tarry matter is precipitated. The solution of calcium acetate is then mixed with a concentrated solution of sodium sulphate, and, by double decomposition, sodium acetate is formed in solution, and calcium sulphate precipitated. The solution of sodium acetate is next subjected to evaporation, during which further impurities that separate on the surface are skimmed off. The solution, being duly concentrated, is set aside to crystallize, and the impure salt thus obtained, after having been partially purified by solution and recrystallization, is fused in an iron vessel, stirred until it dries, and, the heat being carefully raised, subjected to incipient carbonization, whereby remaining empyreumatic matters are carbonized, with little damage to the salt. The mass is then dissolved in water, and the solution, being strained and recrystallized, furnishes pure sodium acetate. (See *Sodii Acetas.*) Finally, this salt, distilled with from 34 to 35 per cent. of its weight of sulphuric acid, yields the acetic acid of commerce, the residue being sodium sulphate, which is reserved for decomposing fresh portions of calcium acetate. The acid has still an empyreumatic flavor, which is removed by filtering it through animal charcoal or rectifying with potassium dichromate. The odor is due to *furfurol,* $C_5H_4O_2$, which, as Victor Meyer has shown, can be detected even in glacial acetic acid by the red coloration it gives with aniline. It may be removed from pyroligneous acid by agitating the liquid with 2 or 3 per cent. of benzene. The aqueous layer, after separation from the benzene, is stated to give, by a single distillation, a palatable table vinegar.

Acetic acid, according to E. R. Squibb, improves very much by age, and a sample examined for odor when freshly distilled would not be recognized as the same three months afterward.

An excellent quality of acetic acid was made by E. R. Squibb by an improvement on the process of Schwartz, the principal feature being the careful regulation of the heat, whereby the excessive charring of the wood is prevented and the formation of the tarry substances so

reduced as to leave the acetic acid almost entirely free from empyreuma. The retorts, which are rectangular in shape, are supported by wheels secured to shafts, rotating in bearings connected with the sides, and are run upon car tracks into the ovens, after they have been loaded with some billets of oak wood from the transfer car, in an ingenious and simple manner. In the construction of the ovens, care is taken to economize the fuel and to secure control of the temperature by the use of corrugated bottoms to the retorts and dampers in the flues; when necessary, the vapors are condensed in earthenware air condensers. Experience has shown that the production and liberation of acetic acid take place at a considerably lower temperature than that sufficient to convert the wood into charcoal, Squibb having proved that wood begins to char at 218.3° C. (425° F.); indeed, the wood which is removed from the retorts after the operation is over is sold as kindling wood, and has the color of black walnut. The crude acetic acid does not require the tedious method of purification usually employed, but is treated with soda ash, forming sodium acetate, which is decomposed by sulphuric acid, and the acetic acid recovered in a purified condition by distillation.

The sp. gr. of the different acetic acids increases with their strength up to the density of 1.0679 at $\frac{25°C.}{25°C.}$ (maximum), after which it decreases until it reaches 1.0472 at $\frac{25°C.}{25°C.}$, the density of the strongest acid (*glacial acid*).

It will be noticed, however, upon an examination of the official table (pp. 14–15) that the specific gravities of the glacial (100 per cent.) and the 39 per cent, acid are practically the same, and that the 74 and 81 per cent. and the 76, 77, and 78 per cent. acids have exactly the same density, the variations between 71 and 83 per cent. being very slight. It will thus be seen that specific gravity cannot be relied upon as a criterion for strength. The glacial acid may, however, be distinguished from the 39 per cent. acid by adding 10 per cent. of water, when, if the density increases, the specimen is the stronger acid.

Acidum Aceticum Dilutum.—*U. S., Br. Diluted Acetic Acid.*—* "Acetic Acid, *one hundred grammes* [or 3 ounces av., 231 grains]; Distilled Water, *five hundred grammes* [or 17 ounces av., 279 grains], to make *six hundred grammes* [or 21 ounces av., 72 grains]. Mix them. Specific gravity; about 1.009 at 25° C. (77° F.). It should respond to the tests of purity given under *Acidum Aceticum.* To neutralize 23.8 Gm. of Diluted Acetic Acid should require not less than 24 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 0.25 percent. of absolute Acetic Acid), phenolphthalein T.S. being used as indicator." *U. S.*

"Acetic Acid, 2½ *fl. ounces* (more exactly, 2.49, Imperial measure) or 1137 *grains,* or 124.7 cubic centimetres or 130.2 grammes; Distilled Water, a sufficient quantity. Dilute the Acetic Acid with sufficient Distilled Water to form *one pint* (Imp. meas.) or one thousand cubic centimetres of Diluted Acetic Acid." *Br.*

"Specific gravity 1.006. Each gramme should require for neutralization 7.1 cubic centimetres of a *decinormal volumetric solution of sodium hydroxide.* It must be free from the impurities indicated under 'Acidum Aceticum.'" *Br.*

Properties.—*Glacial Acetic Acid.* This acid, sometimes called *radical vinegar,* is "a clear, colorless liquid, of a strong, vinegar-like odor, and a very pungent, acid taste. Specific gravity; not above 1.049 at 25° C. (77° F.)." *U. S.* The U. S. and Br. acids are identical in strength (99 per cent.) but the temperature at which the sp. gr. is taken is 25° C. in the U. S. and 15° C. in the Br. It possesses the property of dissolving a number of substances, such as volatile and fixed oils (*P. J.,* Sept. 11, 1875), camphor, resins and gum resins, fibrin, albumin, etc. As it attracts humidity from the atmosphere, it should be preserved in well-stoppered bottles. Its combinations with salifiable bases are called acetates. "At a temperature somewhat below 15° C. (59° F.), the Acid becomes a crystalline solid. At 117° to 118° C. (242.6° to 244.4° F.) it boils, evolving inflammable vapors." *U. S.*

"Glacial Acetic Acid should respond to the tests of purity given under *Acidum Aceticum;* but the tint produced by the addition of 2 drops of tenth-normal potassium permanganate V.S. to 2 Cc. of the Acid diluted with 10 Cc. of water, contained in a clean, glass-stoppered bottle, should not be changed to brown within two hours. Introduce into a stoppered weighing-bottle 3 Cc. of Glacial Acetic Acid and weigh accurately. Dilute the Acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using phenolphthalein T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 5.958, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Acetic Acid in the latter." *U. S.* "It crystallizes when sufficiently cooled, and remains crystalline until the temperature rises above 60° F. (15.5° C.). Specific gravity 1.058 at 60° F. (15.5° C.), and this is increased by the addition of 10 per cent. of *water* (distinction from a diluted acid of 46 per cent., which has the same specific gravity). Each gramme diluted with 50 cubic centimetres of *water* should require for neutralization 16.6 cubic centimetres of the *volumetric solution of sodium hydroxide.* It must be free from the impurities indicated under 'Acidum Aceticum.'" *Br.* The anhydride was first isolated by C. Gerhardt, who found it to be a limpid liquid, heavier than water, and having the constant boiling point of 138° C. (279° F.). Glacial acetic acid should be kept in carefully stoppered glass containers, as it otherwise loses strength. The test of the British Pharmacopœia for oil of turpentine, which requires that it shall form a clear solu-

tion with an equal volume of glacial acetic acid, seems to be reliable only when the acid has been carefully kept and the test carried out at a temperature varying between 14.4° C. and 16.6° C. (58° F. and 62° F.). (See *P. J.*, 1902, 42, 345, 512.)

Acetic Acid is officially described as "a clear, colorless liquid, having a strong, vinegar-like odor, a purely acid taste, and a strongly acid reaction. Specific gravity: about 1.045 at 25° C. (77° F.). Miscible with water or alcohol in all proportions. When heated, the Acid is volatilized without leaving a residue. On adding to Acetic Acid enough ammonia water to neutralize it or to leave the Acid in slight excess, and then ferric chloride T.S., the liquid will acquire a blood-red color, which is discharged by strongly acidulating with sulphuric acid. When the Acid is slightly supersaturated with ammonia, the liquid should not have a bluish tint (absence of *copper*), nor should any residue be left after evaporating the alkaline liquid on a water-bath (absence of *other fixed impurities*). Acetic Acid diluted with 20 volumes of water should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Acetic Acid diluted with 10 volumes of water should not yield a precipitate or turbidity with barium chloride T.S. (absence of *sulphuric acid*), or with silver nitrate T.S. (absence of *hydrochloric acid*). If 5 Cc. of the Acid be supersaturated with 10 Cc. of ammonia water, and 5 Cc. of tenth-normal silver nitrate V.S. be added, and the mixture boiled for one or two minutes, no dark deposit should be produced (absence of *formic* or *sulphurous acids*). When the Acid is slightly supersaturated with potassium hydroxide T.S., the liquid should not develop a smoky odor or taste. If 5 drops of tenth-normal potassium permanganate V.S. be mixed with 2 Cc. of the Acid, previously diluted with 10 Cc. of water, and contained in a clean, glass-stoppered vial, the pink tint should not change to brown at once, and should not become entirely brown, or free from pinkish-brown, in less than half a minute (limit of *empyreumatic substances*). If 10 Gm. of Acetic Acid be diluted with water to measure 100 Cc., then 59.6 Cc. of this solution should require not less than 36 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Acetic Acid), phenolphthalein T.S. being used as indicator." *U. S.*

The British Pharmacopœia requires that "each gramme should require for neutralization 5.5 cubic centimetres of the *volumetric solution of sodium hydroxide*. It should yield no residue on evaporation, and no characteristic reaction with the tests for lead, copper, arsenium, chlorides, nitrates, sulphates, and sulphites. It should not darken in color when exactly neutralized with *solution of ammonia* and warmed with *solution of silver nitrate* (absence of formates). 2 cubic centimetres of Acetic Acid diluted with 10 cubic centimetres of *water* should not immediately discharge the color of one drop of *solution of potassium permanganate*, but at the end of half a minute the mixture should retain a shade of crimson (limit of empyreumatic matter)." *Br.*

Of the British acid (sp. gr. 1.044) the strength in hydrogen acetate is 33 per cent. The U. S. official acid is somewhat stronger than the British. In the arts *Acetic Acid No. 8* (sp. gr. 1.040) has long been used; it derives its name from the fact that one part added to sufficient water to make eight parts, by measure, constitutes so-called distilled vinegar, used in pickling; the latter is not equal to the official diluted acetic acid in strength (one-fifth weaker). See *Acidum Aceticum Dilutum*, page 17. Calcium phosphate has been frequently detected in acetic acid sold as pure and was copiously precipitated by ammonia added in excess. (Bruchner, *A. J. P.*, Sept. 1870, p. 389.) Victor Meyer has met with glacial acetic acid contaminated with 0.108 Gm. furfurol in a liter. (*Ber. d. Chem. Ges.*, 1878, p. 1870.)

It is difficult to ascertain the strength of acetic acid by saturating it with the carbonated alkalies, when the operator depends upon litmus paper for ascertaining the point of its neutralization. The difficulty is caused by the fact that the potassium and sodium acetates, though neutral in composition, are alkaline to litmus paper. Hence the liquid begins to be alkaline to litmus paper while some free acid yet remains, but insufficient to overcome the alkaline reaction of the salt formed. It follows, therefore, that by the use of litmus paper the strength of the acetic acid will be underrated. The degree of inaccuracy, where litmus paper is used, is much diminished by saturating the acetic acid with a solution of pure calcium saccharate of a known strength, as proposed by C. G. Williams. (*P. J.*, May, 1854, p. 594.) A still better way is to add to the acid a weighed excess of barium carbonate, and to calculate its strength by the amount of the carbonate decomposed, ascertained by deducting the undissolved from the total used. (Redwood.) Equally accurate results may be obtained by the use of calcium carbonate in a similar manner. (E. C. Nicholson and D. S. Price, *Chem. Gaz.*, Jan. 15, 1856.)

Charles F. Squibb has made numerous experiments proving the value of many strengths of acetic acid as menstrua for exhausting the valuable organic principles of drugs by percolation; he found even diluted acetic acid a reliable menstruum. J. P. Remington preferred a 10 per cent. acetic acid, and suggested a class of preparations termed "*acetracts*" to replace solid extracts. Acetic acid is a powerful solvent and can frequently be made to take the place of the more expensive alcoholic menstrua. (*A. J. P.*, 1897, p. 121.)

Uses.—*Crude Pyroligneous Acid.* This acid having been incidentally described as the source of the acetic acid of commerce, it may be

proper in this place to notice its uses. It has been employed as an application to *gangrene* and ill-conditioned *ulcers*. It acts on the principle of an antiseptic and stimulant, the former property being mainly due to the presence of creosote.

The crude acid is advantageously applied to the preservation of animal food. William Ramsey made some interesting experiments with it for that purpose. Herring and other fish, simply dipped in the acid and afterwards dried in the shade, were effectually preserved, and when eaten were found very agreeable to the taste. Herring, slightly cured with salt by being sprinkled with it for six hours, then drained, next immersed in pyroligneous acid for a few seconds, and afterwards dried in the shade for two months, were found by Ramsey to be of fine quality and flavor. Fresh beef, dipped in the acid in summer for a minute, was perfectly sweet in the following spring. Silliman states that one quart of the acid, added to the common pickle for a barrel of hams, at the time they are laid down, will impart to them the smoked flavor as perfectly as if they had been smoked in the ordinary way.

Glacial Acetic Acid.—This acid is used only externally, and acts as a rubefacient, a vesicant, or a caustic, according to the length of time it is applied. Its application requires caution. It is sometimes employed as a substitute for cantharides, when a speedy blister is desired. It may be applied by means of blotting paper or cambric moistened with the acid. It is a good corrosive for the destruction of *warts* and *corns*.

Acetic Acid.—This acid is very rarely used internally, but is refrigerant and astringent when sufficiently diluted. Owing to its volatility and pungency, its vapor is frequently applied to the nostrils as an excitant in *syncope, asphyxia,* and *headache*. When employed for this purpose, it is generally added to a small portion of potassium sulphate, so as to moisten the salt, and the mixture is put into small glass bottles with ground stoppers.

It is a mild caustic, and has been used in cancer, by injection into the diseased tissue, but the general result has not been favorable. Two or three ounces of it taken internally undiluted very nearly caused death in an adult. (*L. L.*, July, 1867.) The prominent symptoms were, at first, slight collapse, and asphyxia from closure of the glottis. Recovery was secured by tracheotomy; after the reaction, great thirst, salivation, pain in the fauces, and inability to swallow were present, but without serious gastric, pulmonary, or cardiac disturbances.

Dilūted Acetic Acid.—The object of making diluted acetic acid official is to possess a weak solution of *pure* acetic acid which may be substituted for distilled vinegar in all formulas in which nicety is required. For a long period diluted acetic acid has been made by mixing one part of acetic acid with seven parts of water by measure. The official diluted acid was made considerably stronger in the U. S. P. 1880, and the strength was not altered in the U. S. P. 1890, nor in the 8th Revision. Distilled vinegar contains a little organic matter, which is always darkened or precipitated when its acid is saturated with an alkali, a change which does not take place when diluted acetic acid is employed.

Dose, of diluted acetic acid, twenty to forty minims (1.3 to 2.5 Cc.)

Off. Prep.—*From Glacial Acetic Acid,* Acetum Cantharidis, *Br.;* Linimentum Terebinthinæ Aceticum, *Br.;* Liquor Ferri Acetatis, *Br.;* Liquor Morphinæ Acetatis, *Br.*

Off. Prep.—*From Diluted Acetic Acid,* Acetum Ipecacuanhæ, *Br.;* Acetum Opii, *U. S.;* Acetum Scillæ, *U. S., Br.;* Liquor Ammonii Acetatis, *U. S.;* Liquor Ferri et Ammonii Acetatis, *U. S.*

ACIDUM BENZOICUM. U. S., Br.

BENZOIC ACID

(ăç′ĭ-dŭm bĕn-zō′ĭ-cŭm)

$HC_7H_5O_2 = 121.13$

"An organic acid [$C_6H_5.COOH$], obtained from benzoin by sublimation, or prepared artificially. It should be kept in dark amber-colored, well-stoppered bottles, in a cool place." *U. S.* "Benzoic Acid, $C_6H_5.COOH$, is obtained from benzoin by sublimation. It may also be obtained from toluene, from hippuric acid, and from other organic compounds." *Br.*

Acidum Benzoicum Sublimatum, Flores Benzoes (Flowers of Benzoin); Acide benzoïque, Fleurs de Benjoin, *Fr.;* Acidum Benzoïcum, *P. G.;* Benzoesaure, Benzoeblumen, *G.;* Acido benzoico, *It., Sp.*

Both the U. S. and Br. Pharmacopœias have omitted processes for the preparation of benzoic acid.

Formerly the benzoin before sublimation was mixed with sand; but this is now usually omitted, as not only useless, but probably injurious by favoring the production of empyreumatic substances. The acid, which exists in the benzoin combined with resin, is volatilized by the heat, and condensed in the upper part of the apparatus. Unless the temperature be very carefully regulated, a portion of the resin is decomposed, and an oily substance generated, which rises with the acid, and gives it a brown color, from which it cannot be entirely freed by bibulous paper; and this result, even with the greatest caution, sometimes takes place. The process for subliming benzoic acid may be conducted in a glazed earthenware vessel, capped by a cone of paper, or by another vessel with a small opening at the top, and a band of paper pasted round the place of junction. After the heat has been applied for an hour, the process should be suspended until the sublimed acid is removed from the upper vessel or paper cone, when it may be renewed, and the acid again removed, and thus alternately until colored vapors rise. Mohr, after experimenting, recom-

mended the following plan as unobjectionable. In a round cast iron vessel, eight or nine inches in diameter and two inches deep, a pound or less of coarsely powdered benzoin is placed, and uniformly strewed over the bottom. The top of the vessel is closed by a sheet of bibulous paper, which is secured to the sides by paste. A cylinder of thick paper in the form of a hat, just large enough to fit closely around the sides of the pot, is then placed over it, and in like manner secured by paste. A moderate heat is now applied by means of a sand bath, and continued for three or four hours. The vapors pass through the bibulous paper, which absorbs the empyreumatic oil, and are condensed within the hat in brilliant white flowers, having an agreeable odor of benzoin. (*Ann. Pharm.*, xxix. 178.) The process official in U. S. P. 1870 was based upon Mohr's, but it frequently happens that the sublimed crystals, after they have formed in the cap, and while the sublimation is still going on, fall upon the bibulous paper, and if this paper should happen to be heated to only 120° C. (248° F.) the crystals will melt, and soon stop up the pores of the paper. If coarse muslin be substituted for the bibulous paper, it serves the purpose of retaining any empyreumatic substances, and yet permitting the vapors to pass through without becoming glazed by a deposit of melted acid. Strips of paper passed at irregular intervals across the cap prevent the falling back of crystals. The remaining acid of the benzoin may be extracted, if deemed advisable, by treating the residue of the balsam with lime or sodium carbonate. From the mode of preparing benzoic acid by sublimation, it was formerly called *flowers of benzoin.*

Another mode of separating the acid from benzoin is by combining it with a salifiable base and precipitating with an acid. Such is the process of Scheele. It consists in boiling the powdered benzoin with calcium hydroxide and water, filtering the solution of calcium benzoate thus obtained, and precipitating the benzoic acid with hydrochloric acid. In order to get the benzoic acid in the ordinary form, it has been proposed to sublime the acid after its precipitation.

Several other modes of extracting the acid have been recommended. The following is the process of Stolze. One part of the benzoin is dissolved in three parts of alcohol, the solution filtered and introduced into a retort, and the acid saturated by sodium carbonate dissolved in a mixture of eight parts of water and three of alcohol. The alcohol is distilled off and the sodium benzoate contained in the residuary liquid is decomposed by sulphuric acid, which precipitates the benzoic acid. This is purified by solution in boiling water, which lets fall the acid when it cools. By this process Stolze obtained 18 per cent. of acid from benzoin containing 19.425 per cent. By the process of Scheele he obtained 13.5 per cent.; by the agency of sodium carbonate, 12 per cent.; by sublimation, only 7.6 per cent. Scharling prepared benzoic acid by means of heated steam, and obtained 8 per cent. (*A. J. P.*, xxiv. 236.)

The acid is manufactured very cheaply by synthetic methods. The two most commonly employed are those which start either with *toluene,* $C_6H_5CH_3$, or *naphthalene,* $C_{10}H_8$. In the first method the toluene is changed to benzotrichloride, $C_6H_5.CCl_3$, and this, heated with water to 150° C. (302° F.) in closed vessels, generates benzoic acid according to the reaction:

$$C_6H_5.CCl_3 + 2H_2O = C_6H_5.COOH + 3HCl$$

By the second method naphthalene is changed first into naphthalene tetrachloride, and this by the action of nitric acid into phthalic acid, $C_6H_4(COOH)_2$. This is converted into a calcium phthalate and strongly heated with calcium hydroxide, whereby the phthalate is converted into calcium carbonate and benzoate; this latter salt is then treated with hydrochloric acid, and the benzoic acid thus set free. This acid is frequently resublimed in contact with benzoin, in order to give it the vanilla-like odor of the acid sublimed from the gum. A method of making benzoic acid from tannin or gallic acid is described in *Ph. Era,* 1892, 172. P. Schulze produced benzoic acid by heating benzal chloride or benzotrichloride in the presence of ferric benzoate or metallic iron. The process is patented. (*Ph. Centralh.*, 1896, 221.)

Under the name of *German benzoic acid,* there was at one time imported into the United States benzoic acid prepared from the urine of cattle and horses by treating it with milk of lime and boiling the calcium hippurate with hydrochloric acid. By boiling the hippuric acid thus separated, with hydrochloric acid, it is split into benzoic acid and glycocoll, according to the reaction:

$$C_9H_9NO_3 + H_2O = C_2H_5NO_2 + C_7H_6O_2$$

It is white, has a fine lustre, and is said to be very pure, but sometimes has a slight urinous odor indicative of its origin. (*A. J. P.*, xxvii. 23; *P. J.*, July, 1875.) Owing to the scarcity in the market of benzoin yielding paying quantities of benzoic acid, it was asserted that the English manufacturers used certain varieties of Botany Bay gum (*Gum acroides*), and obtained a larger yield of an acid which was at one time regarded as cinnamic, but has been shown to be benzoic acid. (*N. R.*, Feb. 1879.)

Properties.—Sublimed benzoic acid is in "white, or yellowish-white, lustrous scales or friable needles, nearly odorless, or having a slight characteristic odor resembling that of benzoin, and an acid, pungent taste; somewhat volatile at a moderately warm temperature, and acquiring a yellow color on exposure to light." *U. S.* From solution the acid crystallizes in transparent prisms. When quite pure it is inodorous; but prepared by sublimation from the balsam it has a peculiar, agreeable, aromatic odor, dependent on the presence of an oil, which may be separated by dissolving the acid in alcohol and precipitating it with water. Its taste is

warm, acrid, and acidulous. It is unalterable in the air, but at 121.6° C. (251° F.) melts, and at a somewhat higher temperature rises in suffocating vapors. Sp. gr. 1.29. The Br. Pharmacopœia gives as its melting point 121.4° C. (250.5° F.); "but when obtained from benzoin, it melts at about 248° F. (120° C.), forming a yellowish liquid which becomes brownish but not red as the temperature rises (absence of hippuric acid), and boils at about 462° F. (238.9° C.). When heated to the last-named temperature, it passes off in vapor which burns with a bright-yellow flame, and leaves only a slight residue." *Br.* It is inflammable, burning without residue. One hundred parts of 90 per cent. alcohol dissolve about forty parts, while the same quantity of pure ether will dissolve about thirty parts. (Bourgoin.) The addition of borax or sodium phosphate increases its solubility. It is readily dissolved by alcohol, and by concentrated sulphuric and nitric acids, from which it is precipitated by water. "Soluble in 281 parts of water and in 1.8 parts of alcohol at 25° C. (77° F.); in 15 parts of boiling water, and in 1 part of boiling alcohol; also soluble in 3 parts of ether, 7 parts of chloroform, and readily soluble in carbon disulphide, benzene, fixed and volatile oils; sparingly soluble in petroleum benzin." *U. S.* "It is soluble in 400 parts of cold or 17 parts of boiling *water,* in its own weight of *absolute alcohol,* in 3 parts of *alcohol* (90 per cent.), in 2.5 of *ether,* in 7 of *chloroform,* and in the fixed and volatile oils; also in solutions of the alkalies and of *calcium hydroxide,* forming benzoates, and it is precipitated from these on the addition of *hydrochloric acid* unless the solutions are very dilute." *Br.* It is entirely soluble in solutions of potassium, sodium, or ammonium hydroxides, from which it is precipitated by hydrochloric acid. On carefully neutralizing any of these solutions and adding solution of ferric sulphate previously diluted with water, a flesh-colored precipitate is produced. Its solution reddens litmus paper, and with salifiable bases it forms salts called benzoates.

"Benzoic Acid volatilizes freely with the vapor of water. On heating it to 100° C. (212° F.), it begins to sublime. At 121.4° C. (250.5° F.) it melts, and at a higher temperature it is consumed without leaving a residue. The acid sublimed from benzoin has a lower melting point, and a greater solubility in water, than that prepared artificially. An aqueous solution of Benzoic Acid colors blue litmus paper red. On heating Benzoic Acid gradually with 3 parts of freshly slaked lime in a dry test-tube, benzene is evolved. Benzoic Acid is freely soluble in solutions of alkali hydroxides. On carefully neutralizing such a solution, and adding ferric chloride T.S., previously diluted with 2 volumes of water, and neutralized, if necessary, by ammonia water, a flesh-colored precipitate of ferric benzoate is produced. A solution of Benzoic Acid in pure, cold sulphuric acid, when gently warmed, should not turn darker than light brown; if it is then poured into water, the Benzoic Acid should separate as a white precipitate, and the liquid should be colorless (absence of *readily carbonizable, organic matters*). If 0.5 Gm. of the Acid and 0.8 Gm. of calcium carbonate be mixed with a little distilled water in a crucible, the mixture dried, gently ignited, and then dissolved in 20 Cc. of distilled water, with the aid of nitric acid in slight excess, and filtered, the addition of silver nitrate T.S. should not produce much more opalescence than is produced by the same quantity of the same reagent in a solution measuring 20 Cc., prepared by dissolving 0.8 Gm. of the same calcium carbonate in distilled water with the aid of nitric acid (absence of more than traces of *chlorine*). On warming 0.5 Gm. of the Acid with 5 Cc. of water, and 0.5 Gm. of potassium permanganate in a test-tube, loosely stoppered, and placing it in a water-bath heated to about 45° C. (113° F.) for about ten minutes, then tightly stoppering, and cooling the test-tube with cold water, upon removing the stopper, no odor of oil of bitter almond should be discernible (absence of *cinnamic acid*)." *U. S.* "When 0.5 gramme is heated in a closed crucible with twice its weight of *calcium carbonate,* the mass dissolved in *diluted nitric acid,* and *solution of silver nitrate* added, only the slightest cloudiness should result (absence of chlorobenzoic acid). It should yield no characteristic reaction with the tests for oxalates. It should not develop the odor of benzaldehyde when warmed with its own weight of *potassium permanganate* and ten times its weight of *diluted sulphuric acid* (absence of cinnamic acid). 0.2 gramme suspended in 10 cubic centimetres of *water* should not immediately discharge the color of two drops of *solution of potassium permanganate* (absence of hippuric and cinnamic acids)." *Br.*

Benzoic acid is a characteristic constituent of the balsams, and has been found in vegetable and animal products. When heated, it should sublime without residue; but the Br. Pharm. allows a slight residue for impurities.

Potassium permanganate has been depended upon more than any other reagent to distinguish between benzoic acids as obtained from different sources. Schacht proposes the following test: if 3 grains of benzoic acid be dissolved in 96 minims of solution of potassium hydroxide, sp. gr. 1.777, diluted with 96 minims of distilled water, and 10 drops of a solution made by dissolving 1 grain of potassium permanganate in 200 grains of water be added to it and the whole heated to boiling, dark green liquids (in which brown precipitates gradually appear) are produced if the benzoic acid be obtained from urine, from toluene, or from commercial benzoin, while if the benzoic acid be from Siam benzoin (sublimed or made by wet process) decoloration of the liquids and brown precipitates are produced, due to the presence of cinnamic acid. (*Ph. Centralh.,* 1881, 565.)

The odor of bitter almonds confirms the presence of cinnamic acid. Essell (*Ph. Ztg.*, 1904, 272) modifies this test to secure greater accuracy as follows: 0.2 Gm. of the *finely* powdered benzoic acid and 5 Cc. of tenth-normal permanganate solution are mixed in a test tube of wide diameter and securely corked. When the red color is discharged (usually after a few minutes) 5 Cc. more of tenth-normal permanganate solution are added, and the tube is set aside from 15 to 30 minutes, with frequent shaking. If then the cork be removed the odor of benzaldehyde will be strongly perceptible in the presence of 5 per cent. of cinnamic acid, and distinctly recognizable if only 1 per cent. is present. It is claimed that benzoic acid from benzoin can be distinguished from that from other sources by adding resorcinol and sulphuric acid to the alcoholic solution of the acid; the benzoin-benzoic acid gives a beautiful red color, due probably to a trace of vanillin or other aldehyde in the natural product. (Göldner, *Ph. Ztg.*, 1892, 697.)

Uses.—Benzoic acid is irritant to the alimentary mucous membrane, and as a stimulant expectorant is of some value in *chronic bronchitis* and the later stages of the acute disorder. Led by his belief that it has the power of converting uric acid into hippuric acid, Alexander Ure many years ago proposed benzoic acid as a remedy for the dissolving of deposits of the urates, but it is now proved that the hippuric acid which appears in the urine of those taking benzoic acid is formed out of the benzoic acid itself. This conversion would appear to take place in the kidneys, since, after the exhibition of large doses, benzoic and not hippuric acid can be detected in the blood, while even small amounts of hippuric acid injected into the blood produce violent poisoning. Moreover, Bunge and Schmiedeberg have succeeded in converting benzoic acid into hippuric acid by passing blood containing benzoic acid slowly through the kidneys immediately after their removal from the body. In rare cases, according to Meissner and Shepard, the benzoic acid is converted into succinic instead of hippuric acid. When it is given very freely a portion of the benzoic acid escapes unchanged. Where the nitrogen necessary for the conversion of the benzoic into hippuric acid comes from, is at present unknown. *A priori* it would seem probable that the source of this nitrogen was the urea, but the testimony as to the effect of the injection of benzoic acid upon the urea and uric acid of the urine is entirely contradictory. Investigators are about equally divided in their findings that the uric acid is very much diminished, and that it remains normal; a fact which is also true of urea. In our own experience benzoic acid has seemed to be a very useful remedy in the treatment of *uric acid gravel*, though without specific influence on the uric acid diathesis.

The urine is always strongly acidified by the free administration of benzoic acid, so that the remedy is useful in *phosphatic gravel* and in *ammoniacal cystitis* with a tendency to a deposit of the phosphates. Its beneficial influence, of course, continues only during its administration, and it is necessary to give it in very large doses—up to a drachm a day. It has been strongly recommended in *nocturnal incontinence*, and has also sometimes been given with advantage in various forms of *cystitis* and even in acute *gonorrhœa*. As first pointed out by Dougall in 1872, benzoic acid is a powerful antiseptic. Bucholz found that 0.2 per cent. of it has a decided influence upon the development of the organisms of putrefaction; and F. Baden Benger (*P. J.*, 1875, p. 211) states that one-fourth of a grain of it added to a fluidounce of infusion of orange, buchu, or gentian will cause the infusion to keep unchanged for at least one month.

Benzoic acid and benzoates (notably sodium benzoate) are ingredients in many antiseptic preparations. Patented preservative mixtures containing benzoic acid are numerous. A maximum (one-fourth of one per cent.) of sodium benzoate is now allowed by law in the State of Pennsylvania for use as a preservative in fruit juices and syrups. Benzoic acid may be administered in pill, using soap as an excipient. It is an ingredient in some cosmetic washes, and has been employed by way of fumigation as a remedy in affections of the skin. It has also been employed as a local hæmostatic, in connection with alum, with considerable asserted success; but there can be little doubt that alum is the more efficient ingredient.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Liquor Antisepticus, *U. S.*; Tinctura Opii Ammoniata, *Br.*; Tinctura Opii Camphorata, *U. S.* (*Br.*); Trochiscus Acidi Benzoici, *Br.*

ACIDUM BORICUM. U. S., Br.

BORIC ACID [Boracic Acid]

(ăç′ĭ-dŭm bō′rĭ-cŭm)

$H_3BO_3 = 61.54$

"It should contain not less than 99.8 per cent. of pure Boric Acid [$B(OH)_3$]." *U. S.*
"A weak acid having the formula H_3BO_3. Obtained by the interaction of sulphuric acid and borax, and by the purification of native boric acid." *Br.*

Hydrogen Borate; Acidum Boracicum; Boracic Acid; Acide Borique Cristallisé, *Fr. Cod.*; Acidum Boricum, *P. G.*; Borsaure, *G.*; Acido borico, *It., Sp.*

Boric acid occurs in small amount, most probably in combination as a magnesium salt, in sea water and in certain mineral waters, as the hot springs of Wiesbaden, Aix-la-Chapelle, and Vichy; in certain mineral substances, such as the *borocalcite* which occurs in considerable quantities in the nitre beds of Chili; in the natural borax or *tincal*, first found in the basins of dried-up lagoons in Central Asia, and afterwards in large amount in Clear Lake, Cali-

fornia; in *ulexite* (sodium and calcium borate) and *colemanite* (calcium borate). The last of these minerals now yields by far the largest amount of the boric acid obtained on the Pacific coast. It is found in a large vein deposit in San Bernardino County, California, where it is mined and shipped to the works of the Borax Consolidated Co. (Limited), at Alameda, California. Boric acid itself is extracted, under the name of *sassolin,* from the lagoons of the volcanic districts of Tuscany, and from the crater of Vulcano, one of the Lipari Islands.

Preparation.—In the neighborhood of Monte Rotondo, Lago Zolforeo, Sasso, and Larderello are found numerous hillocks and fissures, the latter of which emit hot aqueous vapor containing boric acid and certain gases. Around one or several of these fissures, called *suffioni,* a circular basin of masonry is built, which is filled with water and called a lagoon. By the jets of vapor constantly breaking through it, the water becomes gradually impregnated with boric acid and heated. A series of such lagoons are made to communicate with each other on the declivity of a hill, and the lowest to discharge itself into a reservoir, where the solution is allowed to rest and deposit mechanical impurities. From this reservoir the solution is made to pass into leaden evaporating pans, heated by the natural vapor, where it is sufficiently concentrated to fit it for being conducted into wooden tubs, where it is allowed to cool and crystallize. The crude acid thus obtained contains from 74 to 84 per cent. of boric acid, the impurities consisting chiefly of alum, the double ammonium and magnesium sulphate, and calcium sulphate. The production of Tuscan boric acid for the year 1902 was stated to be 2763 metric tons, while that for 1903 amounted to 2583 metric tons.

About 9000 metric tons of a calcium borate known as *pandermite* were produced in Turkey in 1903, while Chili is credited with having exported 15,734 tons of calcium borate in the same year.

The native borax minerals of California supply, at present, the entire American demand for boric acid. The American production of refined borax including boric acid for the year 1902 was 18,152 metric tons, valued at $2,536,614. The production of crude borax in the United States for the year 1904 was 41,422 metric tons.

Properties.—"Transparent, colorless scales, of a somewhat pearly lustre, or six-sided, triclinic crystals, or a light, white, very fine powder, slightly unctuous to the touch; odorless, having a faintly bitter taste, and permanent in the air. Boric Acid is soluble in 18 parts of water, 15.3 parts of alcohol, and 4.6 parts of glycerin at 25° C. (77° F.); in 3 parts of boiling water and 4.3 parts of boiling alcohol. The addition of hydrochloric acid decreases its solubility in water." *U. S.* "Soluble in 30 parts of cold *water,* in 4 of *glycerin,* in 30 of *alcohol* (90 per cent.), and in 3 of boiling *water.*" *Br.* Boric acid has a sp. gr. of 1.434, dissolves in three parts of boiling water and in volatile oils, but is insoluble in ether. On evaporation of the alcoholic solution, the boric acid volatilizes even more readily than from the aqueous solution. Glycerin, when heated, dissolves a very large quantity of boric acid. (See *Glyceritum Boroglycerini;* also *Boroglyceride,* PART II.) Its aqueous solution tastes somewhat acid, colors litmus paper a wine red, and changes turmeric paper to a brown color, analogous to that produced by alkalies, even when hydrochloric acid is present. On moistening the paper so browned and then dried with caustic alkali solution, it turns first blue and then a dirty gray color. Cassol and Gerraus (*Chem. News,* 1903, 27) use *curcumin* with oxalic acid for determining the presence of boric acid when used as a preservative for foods. "When heated to 100° C. (212° F.), Boric Acid loses water, forming metaboric acid (HBO_2), which slowly volatilizes at that temperature. Heated to 160° C. (320° F.), it fuses to a glassy mass of tetraboric (or pyroboric) acid ($H_2B_4O_7$); at a higher temperature the fused mass swells up, loses all of its water, and becomes boron trioxide (B_2O_3), which fuses into a transparent, hygroscopic, non-volatile mass. Boric acid readily volatilizes from a boiling aqueous solution. Its solution in alcohol or glycerin, when ignited, burns with a flame enveloped with a green-colored mantle. An aqueous solution of Boric Acid (1 in 50) colors blue litmus paper red, and yellow turmeric paper brownish-red after drying, even when the solution has been acidulated with hydrochloric acid; this brownish-red color is changed to bluish-black by ammonia water. If 1 Gm. of Boric Acid be added to 10 Cc. of boiling alcohol in a test-tube, complete solution should result." *U. S.* "It changes the color of *litmus* to wine-red in the cold, a hot saturated solution giving a bright red color; *turmeric paper* moistened with an aqueous solution, even when slightly acidulated with *hydrochloric acid,* becomes brownish-red on gently drying, and this color changes to a greenish-black, if *solution of potassium hydroxide* be added. The solution in *alcohol* burns with a flame tinged with green, especially when the solution is acidulated with *sulphuric acid.* Boric Acid liquefies when warmed, and on careful heating loses 43.6 per cent. of its weight, the product solidifying, on cooling, to a brittle glass-like mass. It should yield no characteristic reaction with the tests for lead or copper, and only the slightest reactions with the tests for iron, calcium, magnesium, potassium, sodium, ammonium, chlorides, and sulphates." *Br.*

Boric acid is a weak acid, or may even act as a base. Thus, with sulphuric and phosphoric acids it forms compounds which may be considered as salts. Its compounds with bases, when in solution, are readily decomposed by other acids, but at red heat boric oxide will displace many of the stronger but more volatile acids. "The aqueous solution of the Acid

(1 in 25) should not be precipitated by barium chloride T.S. (absence of *sulphates*); by silver nitrate T.S. with nitric acid (absence of *chlorides*); by ammonium oxalate T.S. (*calcium*); or by sodium phosphate T.S. and ammonia water (*magnesium*), or respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). 5 Cc. of the saturated aqueous solution should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). In a solution of 1 Gm. of Boric Acid in a mixture of 1 Cc. of hydrochloric acid and 49 Cc. of water, 0.5 Cc. of potassium ferrocyanide T.S. should not at once produce a blue color (limit of *iron*). One Gm. of Boric Acid, when dissolved in 50 Cc. of distilled water, after the addition of 50 Cc. of glycerin, should require not less than 16.2 Cc. of normal sodium hydroxide V.S., for neutralization (corresponding to at least 99.8 percent. of Boric Acid), phenolphthalein T.S. being used as indicator." *U. S.* Schäuffele of Paris, has drawn attention to a commercial boric acid containing lead. (*N. R.*, July, 1877).

Boric acid requires 18 parts of cold water to dissolve it, and this fact has led to many attempts to increase its solubility without interfering with its usefulness. The use of glycerin has been officially sanctioned. Scholz and Mansier recommend the use of magnesium carbonate (11 per cent.), but such an addition is not always permissible. When equal parts of boric acid and borax are dissolved in boiling water a crystalline mass separates on cooling, which has been termed *boro-borax*. Its advantages are increased solubility and neutral reaction. The remarkable volatility of boric acid when in alcoholic solution has been observed by Schneider and the fact utilized in its quantitative determination. (*Zeit. Oest. Apoth. Ver.*, 1896, 791.)

Uses.—The physiological action of boric acid and its salts is feeble, yet severe and even fatal cases of poisoning from it have been reported. The symptoms have been great depression of spirits, fall of bodily temperature, a pulse which is either rapid or slow but always very feeble, nausea, violent vomiting, hiccough, sometimes an erythematous eruption accompanied with much œdematous swelling, ecchymoses, disturbance of respiration, and, very late in the poisoning, coma followed by death. The acid escapes rapidly from the system, and to some extent through all the secretions, but especially by the urine. It has been demonstrated by E. T. Stewart and H. C. Wood to act as a depressant upon the spinal centres, and also to have a depressant influence upon the heart itself.

Boric acid and its salts are usually poisonous to the lower forms of life, and have considerable antiseptic power, but the experiments of Sternberg and of Andrews have shown that this influence is too feeble to be depended upon against pathogenetic germs. The acid acts upon mucous membranes as a soothing detergent, is nearly free from irritating properties, and is much used as a local application in mucous membrane inflammations, such as *conjunctivitis, aphthous ulceration of the mouth,* and even *diphtheria.*

In antiseptic surgery the remedy has been tried, but has failed to take rank with more powerful agents. Lint saturated with an aqueous solution, or an ointment produced by melting one part each of spermaceti and white wax with six parts of vaseline and adding while hot two to four parts of a saturated glycerite of boric acid, may be used. In treating wounds, it is often desirable to use a solution containing more than 4 per cent. of boric acid (about the extent of its solubility in water). Jaenicke proposes for this purpose a mixture of equal parts of boric acid and borax, of which 16 per cent. is soluble in water at ordinary temperature. It is said to be non-irritating, non-poisonous, and efficacious; being soluble to the extent of 30 per cent. in water at the temperature of the blood, the solution can be applied to the interior of organs; on cooling, the crystals of the acid salt separate. (*A. J. P.*, 1892, 97.) In *ammoniacal cystitis* boric acid may be given internally, and the washing out of the bladder with a saturated solution of the acid or of borax often acts most happily.

Of the acid, ten grains (0.65 Gm.) may be given three times a day; strength of the solution for use on the conjunctiva or other mucous membrane, from five grains to the ounce up to saturation. Fatal cases of boric acid poisoning have been produced by the immoderate use of its solution in washing out internal cavities. Two ounces of boric acid in the vagina produced violent poisoning, but the patient recovered. The question of the use of boric acid as a food preservative has been the cause of a good deal of dispute and is as yet hardly definitely determined. It has certainly been proven that very large doses of boric acid may be taken without serious poisoning. Maass indeed affirms that common salt is twice as toxic, at least for the frog. Cyon found that borax may be given to a dog up to 180 gr. a day without disturbing the general nutrition. On the other hand the statements of Liebreich, that it is without harmful influence upon the kidney, has been denied by Harrington. As the result of an elaborate study under the auspices of the United States Department of Agriculture, H. A. Wiley concluded that while small quantities of boric acid or borax up to a half gramme daily can be taken for a short period of time without detriment to health, the long continued use of even a small dose causes disturbances of appetite and digestion. There was also constantly a loss of weight which Wiley attributed to failure in assimilation on account of digestive disturbances. The habitual use of any preserved food is certainly not advantageous, but that boric acid is distinctly more deleterious than saltpetre does not seem to be demonstrated.

For the detection of boric acid in food products see *Chem. News,* 1903, 27; *A. Pharm.,* 1904, 194; *J. Am. C. S.,* 1904, 91.

The tendency of the crystals of boric acid to slip from under the pestle renders the process of pulverization very tedious. It is essential that the acid be in an impalpable powder when it is desired to make an ointment. The gradual addition of ether to the acid has been suggested as a valuable aid to trituration. Manufacturers at the present time supply boric acid made by precipitation in an impalpable powder. Boric acid ointment (Lister's) is made from one part each of boric acid and white wax, and two parts each of oil of sweet almond and paraffin.

Dose, of boric acid, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Cataplasma Kaolini, *U. S.;* Glyceritum Boroglycerini, *U. S.* (*Br.*); Liquor Antisepticus, *U. S.;* Unguentum Acidi Borici, *U. S., Br.*

ACIDUM CAMPHORICUM. U. S.

CAMPHORIC ACID

(ăç'ĭ-dŭm căm-phōr'ĭ-cŭm)

$H_2C_{10}H_{14}O_4 = 198.62$

"A dibasic organic acid [$C_8H_{14}(COOH)_2$], obtained by the oxidation of camphor." *U. S.*

Acide camphorique, *Fr.;* Acidum camphoricum, *P. G.;* Kamphorsaure, Kamphylsaure, Kamphersaure, *G.*

This acid is obtained by the oxidation of camphor by heating it with nitric acid, and purifying the crystals so obtained On further oxidation it is changed into *camphoronic acid,* $C_9H_{14}O_6$. It has been made synthetically by Komppa (*P. J.,* 1904, 77).

Properties.—It occurs in "colorless, odorless, monoclinic prismatic crystals or plates; melting at 187° C. (368.6° F.); at a higher temperature yielding an anhydride, and ultimately decomposing without leaving any weighable residue. Soluble in 125 parts of water at 25° C. (77° F.), and in 10 parts of boiling water; readily soluble in alcohol, less soluble in ether and chloroform; soluble in fatty oils. Camphoric Acid is dextro-rotatory, showing, in 10 percent. alcoholic solution, the value $[a]_D = +47.8°$. The aqueous solution reddens blue litmus paper. If 2 Cc. of a saturated aqueous solution of Camphoric Acid be mixed with 2 Cc. of sulphuric acid in a test tube, and 1 Cc. of a solution made by dissolving 1 Gm. of ferrous sulphate in 2 Cc. of diluted sulphuric acid be poured carefully upon it, no dark-colored zone should develop at the line of contact (absence of *nitric acid.*)" *U. S.*

Uses.—Camphoric acid, when taken internally, is rapidly absorbed and eliminated from the kidneys. When given in overdose it is capable of producing both gastric and renal irritation. Originally proposed by Fürbringer as an intestinal disinfectant in *tubercular* and other *intestinal catarrhs,* it has been used to some extent in *cystitis,* but is especially employed in the treatment of *night sweats;* thirty to forty-five grains (2 to 3 Gm.) of it may be administered in twenty-four hours if necessary.

Dose, five to fifteen grains (0.32 to 1.0 Gm.).

ACIDUM CITRICUM. U. S., Br.

CITRIC ACID

(ăç'ĭ-dŭm cĭt'rĭ-cŭm)

$H_3C_6H_5O_7 + H_2O = 208.50$

"A tribasic organic acid [$C_3H_4(OH)(COOH)_3 + H_2O$], usually prepared from the juice of limes or lemons. It should contain not less than 99.5 percent. of pure Citric Acid." *U. S.* "Citric Acid, or hydrogen citrate, $C_3H_4.OH.(COOH)_3,H_2O$, may be obtained from the juice of the fruit of various species of Citrus." *Br.*

Acidum Citri, s. Limonis, s. Limonum, s. Limonorum; Acidum citricum, *P. G.;* Citronensaure, Citronsaure, *G.;* Acide citrique, *Fr. Cod.;* Acide du Citron, *Fr.;* Acido citrico, *It., Sp.*

Citric acid is the peculiar acid to which limes and lemons owe their sourness. It is present also in the juice of other fruits, such as the cranberry, the red whortleberry, the berry of the bittersweet, the red gooseberry, the currant, the strawberry, the raspberry, the tamarind, and the red elderberry (fruit of *Sambucus racemosa rubra*). The latter berry contains citric acid so abundantly that it has been proposed as a source of the acid by Thibierge, of Versailles. It is contained also largely in the fruit of *Cyphomandra botacea,* a solanaceous plant, indigenous in Mexico, Peru, and other parts of South America, where it is called *tomato de la paz.* The commercial source of citric acid is lime, lemon, and bergamot juice; large quantities of *lime juice* are made in Sicily, concentrated, and exported to England and the United States.[1] Citric acid, which was formerly imported in large quantities from Great Britain, is now made extensively in the United States.

The acid is extracted from lemon or lime juice by a very simple process, for which we are indebted to Scheele; it is one requiring some careful manipulation. The boiling juice is first completely saturated with calcium car-

[1] The composition of some of these commercial lime juices is given by Allen (*Com. Org. Anal.,* 2d ed., vol. i., 459), as follows:

	Density.	Oz. Free Acid per gallon.	Oz. Combined Org. Acid per gallon.
Lime juice:			
Raw Sicilian	. . . .	6 to 9	0.85
Raw English	1.04 to 1.05	11 to 13	0.3
Concentrated	1.20 to 1.25	56 to 72	6 to 8
Bergamot juice:			
Concentrated	1.22 to 1.25	47 to 55	7 to 8
Lemon juice:			
Raw	1.035 to 1.04	10.6 to 13.5	0.4 to 0.7
Concentrated	1.25 to 1.38	82 to 112	8.6

See *Limonis Succus* and also paper by D. H. Hassler, *A. J. P.,* 1886, p. 14.

bonate (chalk or whiting) in fine powder, and the calcium citrate thus formed is allowed to subside. This is then washed repeatedly with water, and decomposed by diluted sulphuric acid. An insoluble calcium sulphate is precipitated, and the disengaged citric acid remains in solution. This is carefully concentrated in leaden boilers until a pellicle begins to form, when it is transferred to other vessels to cool and crystallize.

The commercial lemon juices contain free citric acid; free acids other than citric; citrates, salts of organic acids other than citric; salts of inorganic acids; and albuminous, mucilaginous, saccharine, and other indifferent bodies. Spirit is frequently added as a preservative, and mineral acids are not uncommonly employed as adulterants. Verjuice has also been used for the purpose (Allen). See *Limonis Succus*, also *Montserrat lime juice, P. J.*, 1883, p. 606, and notes on manufacture, *N. R.*, 1883, 47.

Preparation.—In the U. S. Pharmacopœia, very properly, no process is given for making citric acid, as it is always purchased from the manufacturing chemist. The former British Pharmacopœia gave the following process for preparing it:

"Take of Lemon Juice *four pints* [Imperial measure]; Prepared Chalk *four ounces and a half* [avoirdupois]; Sulphuric Acid *two fluidounces and a half;* Distilled Water *a sufficiency.* Heat the Lemon Juice to its boiling point, and add the Chalk by degrees till there is no more effervescence. Collect the deposit on a calico filter, and wash it with hot water till the filtered liquor passes from it colorless. Mix the deposit with a pint [Imp. meas.] of Distilled Water, and gradually add the Sulphuric Acid previously diluted with a pint and a half [Imp. meas.] of Distilled Water. Boil gently for half an hour, keeping the mixture constantly stirred. Separate the acid solution by filtration, wash the insoluble matter with a little Distilled Water, and add the washings to the solution. Concentrate this solution to the density of 1.21, then allow it to cool, and after twenty-four hours decant the liquor from the crystals of sulphate of calcium which will have formed; further concentrate the liquor until a film forms on its surface, and set it aside to cool and crystallize. Purify the crystals, if necessary, by recrystallization." *Br.*

On the large scale the juice is placed in a wooden vat, closed at top, and is saturated with whiting (calcium carbonate). Carbonic acid gas is thus evolved, which passes out by an exit pipe, and may be used in the manufacture of sodium bicarbonate, while calcium citrate precipitates. The supernatant liquor, containing much extractive matter, is drawn off, and the calcium citrate is decomposed by diluted sulphuric acid, liberating the citric acid, and precipitating the lime as a sulphate. The mixture of citric acid and calcium sulphate is run off into a wooden filter-back, lined with lead, furnished with a perforated false bottom, and lined throughout with stout twilled flannel. The solution of citric acid passes off through a pipe leading from the bottom of the back to suitable reservoirs.

The sulphate is washed until it becomes tasteless, and the washings are run off into the same reservoirs. The filtered acid solution is then concentrated by evaporation in wooden vessels lined with lead, through which steam is made to pass by means of coiled lead pipes. As citric acid is liable to decomposition if subjected to a very high temperature, the use of the vacuum pan is highly advantageous in concentrating the solution. When the liquor is sufficiently concentrated, it is transferred to cylindrical sheet-lead vessels, placed in a warm situation, to crystallize. The crystals at first obtained are colored. In order to purify them, they are redissolved in a small quantity of water, with the assistance of heat, and the solution is digested with purified animal charcoal, filtered, evaporated, and the crystals, after having been washed and drained, are dried on wooden trays lined with sheet-lead, in a room heated by steam.

The calcium citrate of the above process should be decomposed without any delay; for, if kept, it will undergo fermentation, with the effect of destroying the citric acid. According to Personne, the products of this fermentation are acetic and butyric acids, carbon dioxide and hydrogen being evolved. It is desirable to have a slight excess of sulphuric acid, as this rather favors than otherwise the crystallization of the citric acid. It is found necessary, also, to add occasionally a small proportion of sulphuric acid to the citric acid liquor, during the progress of its concentration. According to J. Carter Bell (*N. R.*, 1880, p. 274), the concentrated juice contains from sixty-four to ninety-six ounces of citric acid to the imperial gallon. The more recent the juice the better the quality. That which is stale will sometimes be quite sour, without containing any citric acid, in consequence of having undergone the acetous fermentation.

Citric acid by fermentation of carbohydrates is claimed by German patent No. 72,957 of 1893, and species of citromyces (*Citromyces pfefferienus* and *C. glaber*) are especially mentioned as bringing about this fermentation. This patent was supplemented by a German patent 91,891 of 1897, based upon the discovery that the same result may be obtained by means of *Mucor pyroformis.* The latter fungus is found on putrefying fruit, especially on pears and apples; its spore carriers grow only in a moist atmosphere and form long white filaments, terminated by brownish-black heads. It can be readily obtained in pure culture by sowing the spores in a suitable medium, such as sugar solutions, beer wort, steamed rice, starch paste, etc., the ordinary room temperature being favorable for its growth. The solution becomes acid from the formation of citric acid. (*J. Soc. Chem. Ind.*, June 30, 1897; see also *P. J.*, 1893, 182; 1894, 893; 1902, 551.)

Ohley (*Ph. Era,* 1901, 706) has devised a process which consists in diluting fresh concentrated lemon juice with twice its volume of water, filtering after standing over night to remove albumen, then adding a calculated quantity of calcium chloride, followed by solution of sodium hydroxide, gradually added, until the solution is exactly neutral, when, upon stirring, a magma of calcium citrate is quickly deposited. From this the sodium chloride formed is readily removed by hot water, and the calcium citrate is then decomposed by the calculated quantity of sulphuric acid. The main advantages of the new process are: convenience, a yield approximating to theoretical figures, and decidedly superior purity of product.

Properties.—"Colorless, translucent, right-rhombic prisms; odorless; having an agreeable, purely acid taste; efflorescent in warm air, and deliquescent when exposed to moist air." *U. S.* Its sp. gr. is 1.6. When heated, it dissolves in its water of crystallization, and at a higher temperature undergoes decomposition, becoming yellow or brown, and forming a very sour syrupy liquid, which is uncrystallizable. By destructive distillation it gives rise at first to water and *aconitic acid,* $C_6H_6O_6$, and on further heating it is decomposed into carbon dioxide, acetone, and *itaconic* and *citraconic acids,* both of the formula $C_5H_6O_4$. "When heated to about 75° C. (167° F.), the Acid begins to lose its water of crystallization; at about 135° C. (275° F.) it becomes anhydrous, and melts between 152° and 153° C. (305.6° and 307.4° F.). When slowly ignited, it is gradually decomposed without emitting an odor resembling burning sugar (difference from *tartaric acid*), and is finally consumed without leaving more than 0.05 percent. of residue." *U. S.*

Citric acid is "soluble in 0.54 part of water, and in 1.55 parts of alcohol at 25° C. (77° F.); in about 0.4 part of boiling water and in 1.43 parts of boiling alcohol; also soluble in 18 parts of ether." *U. S.* "Soluble in three-fourths of its weight of cold or in half its weight of boiling *water,* somewhat less soluble in *alcohol* (90 per cent.), and soluble to a slight extent in *ether.* The aqueous solution made by dissolving 35 grains of the Acid in 1 ounce (or 1 gramme in 12½ cubic centimetres) of *water* resembles, in acidity, an average specimen of Lemon Juice." *Br.* It is nearly insoluble in chloroform, benzene and petroleum benzin. A weak solution of it has an agreeable taste, but cannot be kept, as it undergoes spontaneous decomposition. It is incompatible with alkaline solutions, whether pure or carbonated, converting them into citrates; also with the earthy and metallic carbonates, most acetates, the alkaline sulphides, and soaps. It is characterized by its taste, by the shape of its crystals, and by forming an insoluble salt with lime water when heated, and a deliquescent one with potassium hydroxide. If sulphuric acid be present the acid will be hygroscopic, and the precipitate by lead acetate will not be entirely soluble in nitric acid, the insoluble portion being lead sulphate. "An aqueous solution of Citric Acid reddens blue litmus paper. On adding 1 Cc. of an aqueous solution of the Acid (1 in 10) to 50 Cc. of calcium hydroxide T.S. (or sufficient of the latter to render the mixture alkaline) the liquid remains clear. Upon boiling this for about one minute, it becomes opaque through the precipitation of calcium citrate, which redissolves on cooling. If 1 Gm. of the powdered Acid be dissolved in 5 Cc. of a cold solution of potassium acetate (1 in 3), the liquid should remain clear, even after the addition of an equal volume of alcohol (absence of *tartaric* or *oxalic acid.*)" *U. S.* (See Spiller, *J. Chem. Soc.,* x. 110.)

Sometimes crystals of tartaric acid are substituted for or mixed with the citric, or the two acids may be mixed in powder, a fraud which is detected by adding a solution of potassium acetate to that of the suspected acids, when, if tartaric acid be present, a crystalline precipitate of potassium bitartrate will be formed. Pusch's method of determining the presence of tartaric acid in citric acid is as follows: 1 Gm. of powdered citric acid is added to 10 Gm. of strong, pure, colorless, sulphuric acid in a dry test tube, and the tube is then immersed in boiling water for an hour. The citric acid dissolves with frothing and evolution of gas, and a lemon-colored liquid is formed, which undergoes no change within half an hour if the sample be pure; but if as much as one-half per cent. of tartaric acid be present, the color is brownish and reddish-brown an hour afterward. (*A. Pharm.,* xxii. 316.) Another delicate method of detecting tartaric acid is to digest the suspected acid with ferric hydroxide in a test tube, afterwards to raise the heat slowly to the boiling point, and, having allowed the excess of hydroxide to subside, to decant the clear liquid, and evaporate it to a syrupy consistence. If the acid be pure, the liquid remains limpid, and of a fine red color; if contaminated with tartaric acid, even to the extent of only one per cent., it becomes cloudy, and deposits tartrate. Another test is potassium permanganate, of which an alkaline solution is without action on citric acid, while under the influence of tartaric acid the manganese peroxide is deposited.

"On mixing 5 Cc. of an aqueous solution of the Acid (1 in 10) with a quantity of ammonia water insufficient to neutralize it completely, and adding to this liquid 1 Cc. of ammonium oxalate T.S., it should remain clear (absence of *calcium*). The aqueous solution (1 in 10), mixed with a few drops of hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see Part III, Test No. 121), nor, upon the subsequent addition of ammonia water in slight excess, to the solution, should the liquid acquire more than a faint tint (limit of *iron*). If to 10 Cc. of the aqueous solution of the Acid (1 in 100) a few drops of hydrochloric acid be added, followed by 1 Cc. of barium chloride T.S., no turbidity should re-

sult within five minutes (limit of *sulphuric acid*). If 5 Gm. of Citric Acid be dissolved in sufficient water to measure 100 Cc., then 34.75 Cc. of this solution should require not less than 24.87 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 4 percent. of pure Citric Acid), phenolphthalein T.S. being used as indicator." *U. S.* "Each gramme dissolved in *water* should require for neutralization 14.3 cubic centimetres of the *volumetric solution of sodium hydroxide.* It should yield no characteristic reaction with the tests for copper or iron, and only very slight reactions with those for calcium or sulphates. Its solutions should not contain any metallic particles. 10 grammes dissolved in 20 cubic centimetres of *water,* neutralized with *solution of ammonia,* and sufficient of a saturated aqueous solution of *hydrogen sulphide* added to produce 100 cubic centimetres of liquid, no darkening of color should result after 5 minutes (absence of lead). One drop of *solution of ferrous sulphate,* then a few drops of *solution of hydrogen peroxide,* and finally an excess of *solution of potassium hydroxide,* added to an aqueous solution of the Acid, no purple or even light violet coloration should result (absence of tartaric acid). Or 1 gramme placed in a test-tube with 5 cubic centimetres of *solution of ammonium molybdate,* 2 or 3 drops of *solution of hydrogen peroxide* being added, should not afford a bluish coloration after the tube has been shaken and placed in boiling water for ten minutes (absence of tartaric acid; but the presence of any metallic particles gives rise to a similar coloration). On incineration with free access of air, it should not yield more than 0.05 per cent. of ash." *Br.*

Lead is often found in the metallic state in citric acid in small quantity, and this arises from small portions being rubbed off in breaking off the crystals from the crystallizing vats. The presence of lead or copper may be detected as above, or by igniting in a porcelain crucible a small quantity of the acid, dissolving the ash in a few drops of nitric acid, diluting largely, and passing hydrogen sulphide through it, a black precipitate indicating the impurity. Some interesting observations in relation to the presence of lead in citric acid and citrates are recorded by Haussmann in *A. J. P.,* 1894, 173.

Composition.—The formula of the anhydrous acid is $C_6H_5O_7H_3$. It is a tribasic acid, and may therefore yield three classes of citrates according as one, two, or three atoms of hydrogen are replaced by metal, the first two classes being acid citrates, and the third class neutral citrates. When crystallized from its solution by cooling, it contains one molecule of water. Crystals of the formula $(C_6H_8O_7)_2 + H_2O$ have also been formed. (Flückiger, *Pharm. Chem.,* 1879, p. 157.) Witter (*Ph. Centralh.,* 1892, 1003) has obtained anhydrous citric acid, in crystals melting at 153° C., by heating aqueous solutions of the hydrated acid to 130° C. If citric acid be heated until all its water of crystallization has been driven off, there will be produced *aconitic acid* ($H_3C_6H_3O_6$), which is found naturally in aconite, larkspur, black hellebore, equisetum, yarrow, and other plants. According to Hentschel, aconitic acid is best obtained by boiling for six hours 100 Gm. of citric acid with 50 Gm. of water mixed with 100 Gm. of pure sulphuric acid in a flask provided with a reverse condenser. Upon cooling the flask a solid cake of aconitic acid is formed, which may be purified by mixing with strong hydrochloric acid, and washing until free from sulphuric acid; colorless, shining crystals are obtained. (*A. Pharm.,* 1887, p. 357.)

Uses.—Citric acid acts as a poison chiefly if not solely by irritating the gastro-intestinal mucous membrane. It is, however, much less irritant than tartaric acid, and, so far as we know, no death has been caused by it. The action of therapeutic doses upon the system is not decided. In *scurvy,* citric acid is probably of no value. It is eliminated by the kidneys, and, as first stated by Bence Jones, when given in sufficient quantities renders the urine acid. In a free state it is rarely used internally, except as an imperfect substitute for lemon juice. When added in the quantity of six hundred grains to a pint of distilled water, it forms a solution of the average strength of lemon juice. Of this solution, or of lemon juice, twenty grains of potassium bicarbonate saturates three fluidrachms; twenty grains of potassium carbonate, four and a fourth fluidrachms; and twenty grains of ammonium carbonate, five and a half fluidrachms. Half a fluidounce of lemon juice, or of an equivalent solution of citric acid, when saturated, is considered a dose.

An agreeable substitute for lemonade may be made by dissolving from two or four parts of the acid, mixed with sugar and a little oil of lemon, in nine hundred parts of water; or twenty grains of the acid may be dissolved in a pint of water, and sweetened with sugar which has been rubbed on fresh lemon-peel. Citric acid is used as one of the ingredients in the effervescent salts. In the experiments of Strong, one-half to one per cent. of citric acid was found to be so poisonous to the cholera germ as to make impure water to which it was added probably a safe drink. It was further found that a large Philippine lemon, containing 40 Cc. of juice, was the equivalent of 2.74 grammes of citric acid. (*Report Government Laboratories, Philippine Islands,* Sept. 1, 1903.)

Dose, of the acid, from five to thirty grains (0.32 to 2.0 Gm.).

Off. Prep.—Bismuthi Citras, *U. S.;* Caffeina Citrata, *U. S.* (*Br.*); Caffeina Citrata Effervescens, *U. S.* (*Br.*); Ferri et Ammonii Citras, *Br.;* Ferri et Quininæ Citras, *Br.;* Liquor Ammonii Citratis, *Br.;* Liquor Magnesii Citratis, *U. S.;* Liquor Potassii Citratis, *U. S.;* Liquor Sodii Phosphatis Compositus, *U. S.;* Lithii Citras Effervescens, *U. S., Br.;* Magnesii Sulphas Effervescens, *U. S., Br.;* Potassii Citras Effervescens,

U. S.; Sodii Citro-Tartras Effervescens, *Br.;* Sodii Phosphas Effervescens, *U. S., Br.;* Sodii Sulphas Effervescens, *Br.;* Syrupus Acidi Citrici, *U. S.;* Syrupus Aurantii, *U. S.;* Syrupus Lactucarii, *U. S.*

ACIDUM GALLICUM. U. S., Br.

GALLIC ACID

(ăç'ĭ-dŭm găl'lĭ-cŭm)

$HC_7H_5O_5 + H_2O = 186.65$

"An organic acid [$C_6H_2(OH)_3.COOH + H_2O$], usually prepared from tannic acid." *U. S.* "A trihydroxybenzoic acid, $C_6H_2(OH)_3COOH,H_2O$. It may be prepared by the action of diluted sulphuric acid on tannic acid." *Br.*

Trioxybenzoic Acid, Dioxysalicylic Acid, Trihydroxybenzoic Acid; Acide gallique, *Fr. Cod.;* Gallussaure, *G.;* Acido gallico, *It.;* Acido agallico, *Sp.*

The former British Pharmacopœia process for making gallic acid is as follows: "Boil one part of coarsely powdered galls with four fluid parts of diluted sulphuric acid for half an hour, then strain through calico while hot; collect the crystals that are deposited on cooling, and purify these with animal charcoal and repeated crystallization." *Br.*

The process based on sulphuric acid's influence in favoring the change of tannic into gallic acid, requires less time than former processes.

The U. S. 1870 process was founded upon the fact that when galls in infusion, or in the state of moistened powder, are exposed to the air, their tannic acid is gradually converted into gallic acid. The gallic acid, being freely soluble in boiling, but very sparingly in cold water, is extracted from the altered galls by decoction, and is deposited as the water cools. A repetition of the solution and deposition renders the acid more pure; but it cannot be obtained wholly colorless unless by the aid of animal charcoal. There are few processes in which it is more necessary that the animal charcoal should be purified. The presence of the slightest quantity of ferric salt interferes with the bleaching of the acid; and it is even advisable to examine the filtering paper, lest it may contain sufficient of this substance to vitiate the results of the process. The first crop of crystals in the process retains a very large proportion of water; and it will be found convenient to subject them to strong expression between folds of bibulous paper.

The elder Robiquet first suggested that galls contained a principle capable of converting tannic into gallic acid, with the presence of water, and in the absence of atmospheric air. Laroque proved that this principle acts as a ferment, and that the change referred to is the result of a *gallic acid fermentation* in the galls. E. Robiquet showed that galls contain *pectose* and *pectase,* the former of which, according to the experiments of Frémy, is the principle out of which pectin is formed in plants, and the latter a peculiar ferment which effects the transformation. He believed that in galls the pectase, aided by a proper temperature and the presence of water, changed not only pectose into pectin, but also tannic into gallic acid. Strecker previously advanced the opinion that tannic acid was a combination of gallic acid and sugar, the latter of which is destroyed in the process for procuring gallic acid, which is thus simply set free from the combination. E. Robiquet admitted the occasional transformation of tannic acid into gallic acid and sugar, but did not believe that the sugar pre-existed as such in the tannin. (*J. P. C.,* 3e sér., xxiii. 241.) Wittstein, in endeavoring to obtain gallic acid from *Chinese galls* by forming them into a paste with water, found that but a very small proportion of the acid was generated at the end of six weeks. Thinking that this might have resulted from the want of the ferment in the Chinese galls, he added to these one-eighth of their weight of common galls, and at the end of three weeks obtained an amount of gallic acid nearly equal to one-half the weight of the galls employed. The same result, though more slowly, followed the addition of yeast to the Chinese galls. Wittstein obtained both carbonic acid and alcohol as products of this operation, thus favoring the views of Strecker as to the constitution of tannic acid; and the idea that tannin was a glucoside convertible through exposure of galls to the air, or more rapidly by sulphuric acid, into glucose and gallic acid, was accepted without qualification, until Schiff (*Ber. d. Chem. Ges.,* iv. 231, 967) proved that although crude tannic acid contains glucose, it is possible to separate a large quantity of the glucose without destroying the tannic acid. He proposed that *pure tannic acid* be called *digallic acid,* and that the term *tannin* be applied to natural tannin, *i.e.,* the *glucoside* of digallic or pure tannic acid, for when natural tannin is boiled with diluted mineral acids or subjected to the influence of a nitrogenous ferment, it splits into gallic acid and glucose:

$$C_{34}H_{28}O_{22} + 4H_2O = 4C_7H_6O_5 + C_6H_{12}O_6$$

Digallic acid is the first anhydride of gallic acid:

$$C_{14}H_{10}O_9 + H_2O = 2C_7H_6O_5$$

Gallic acid is a *phenol acid,* or combination of these two classes of organic compounds; its formula is $C_6H_2(OH)_3.COOH$. It may be termed, therefore, a *trioxybenzoic acid.* It is monobasic.

Properties.—Gallic acid is in "white, or pale fawn-colored, silky, interlaced needles, or triclinic prisms; odorless; having an astringent and slightly acidulous taste; permanent in the air. Soluble in 83.7 parts of water, and in 4.14 parts of alcohol at 25° C. (77° F.); in 3 parts of boiling water, and in 1 part of boiling alcohol; also soluble in 40 parts of ether, and in 12 parts of glycerin; very slightly soluble in chloroform, benzene, or petroleum benzin." *U. S.* It produces a deep bluish-black color with solutions of ferric salts, which disappears when the solution is heated, a result which Mahla

has shown to depend on the conversion of the gallic into *pyrogallic* or *metagallic acid* (pyrogallol) by the loss of carbon dioxide. (*Am. J. Sci.*, Nov., 1859.)

Gallic acid does not precipitate gelatin, or a solution of ferrous sulphate. "When heated at 100° C. (212° F.), the Acid loses its water of crystallization (nearly 9.58 percent.). At about 200° C. (392° F.) it begins to melt, and at a higher temperature it is gradually decomposed. At a low red heat it is consumed without leaving a residue. An aqueous solution of Gallic Acid has an acid reaction upon blue litmus paper." *U. S.* It should leave no residue when burned, and be entirely dissipated when thrown on red-hot iron. On exposure to the air, its solution undergoes spontaneous decomposition; but it is said that by the addition of a drop of oil of cloves it may be kept for a long time without change, the absence of tannin and microscopic fungi being proved. "Gallic Acid neither colors nor precipitates pure ferrous salts, but forms a bluish-black precipitate with ferric salts. On adding to a cold saturated aqueous solution of Gallic Acid some calcium hydroxide T.S., a bluish-white precipitate will form, where the test solution is temporarily in excess, and will disappear on shaking. When the test solution has been added in excess, the precipitate no longer dissolves, and the liquid acquires a tint which is blue by reflected and green by transmitted light, and becomes pink on the addition of a large excess of calcium hydroxide T.S. (distinction from *tannic acid*). An aqueous solution of the Acid should not precipitate alkaloids, gelatin T.S., albumin T.S., or starch T.S. (difference from and absence of *tannic acid*)." *U. S.* "It yields a bluish-black precipitate with *test-solution of ferric chloride.* The crystalline Acid loses 9.5 per cent. of its weight when dried at 212° F. (100° C.). It should yield no characteristic reaction with the tests for sulphates. Its aqueous solution is not precipitated by *solutions of isinglass, albumen,* alkaloids, or *tartarated antimony* (absence of tannic acid). It leaves no residue when burned with free access of air (freedom from mineral matter)." *Br.* By the action of arsenic it is converted almost entirely into tannic acid without the production of arsenous acid. (Schiff, *Chem. News*, xxix. 73.) Young's test, potassium cyanide, gives a reddish color with gallic acid and none with tannic acid. A mixture of ammonium chloride and ammonia produces a red coloration, but no precipitate, in gallic acid solution; while in tannic acid solution it produces a whitish precipitate rapidly turning reddish-brown. (*A. J. P.*, April, 1889.) A test proposed by Flückiger consists in adding to the solution of gallic acid a diluted (1 to 100) solution of pure ferrous sulphate. To the colorless solution a little sodium acetate is to be added, when a deep violet color will appear, due to the formation of ferrous gallate. The U. S. Pharmacopœia test is: "If 5 Cc. of a cold saturated aqueous solution of the Acid be treated, in a watch-glass, with 6 drops of sodium hydroxide T.S., the liquid will gradually acquire a deep green color, which is changed to reddish or brownish-red by acids." *U. S.* Heated to 216° C. (420° F.), gallic acid gives off carbon dioxide, and is changed into *pyrogallic acid.*

Uses.—Gallic acid is astringent, but less powerfully so than tannic acid. As it does not coagulate albumin, it is readily absorbed when ingested, and is rapidly eliminated by the kidneys. Its presence in the urine is, under these circumstances, very readily demonstrated by the addition of a soluble ferric salt. Owing to its being more readily transported by the blood, it is more effective than tannic acid in all cases of hemorrhage (*hæmoptysis, hæmaturia,* etc.) in which the bleeding vessels must be reached through the route of the circulation. But in hemorrhage from the alimentary mucous membrane, or from any other part with which tannic acid can be brought into direct contact, the latter astringent is by far the more effectual. Tannic acid is also much more efficient in anginose or other relaxations in which a decided astringent action is desired and in which a direct application can be made. Gallic acid has been employed with advantage in *pyrosis,* and in the *night-sweats* of *phthisis* or *exhaustion.* In *albuminuria,* when there is a very large amount of albumin excreted, gallic acid may be employed with service to diminish the flow, and the drug has even been used in acute *Bright's disease* following *scarlatina,* with asserted great advantage. (*N. R.*, Oct. 1875.) It is said not to constipate the bowels, and may be given in the form of pill or powder. *Ointment of gallic acid,* ten parts of the acid to ninety of benzoinated lard, was official in the U. S. Pharmacopœia of 1880.

Dose, five to fifteen grains (0.32 to 1.0 Gm.)

ACIDUM HYDRIODICUM DILUTUM. U. S.

DILUTED HYDRIODIC ACID

(ăç'ĭ-dŭm hȳ-drĭ-ŏd'ĭ-cŭm dĭ-lū'tŭm)

"A solution of Hydriodic Acid [HI = 126.9], containing not less than 10 percent., by weight, of the absolute Acid, and about 90 percent. of water. It should be kept in amber-colored, glass-stoppered bottles, protected from the light." *U. S.*

Acide hydriodique dilué, *Fr.*; Verdünnte Jodwasserstoffsaure, *G.*

* "Potassium Iodide, *one hundred and thirty-five grammes* [or 4 ounces av., 333 grains]; Potassium Hypophosphite, *ten grammes* [or 154 grains]; Tartaric Acid, *one hundred and thirty-six and five-tenths grammes* [or 4 ounces av., 356 grains]; Distilled Water, Diluted Alcohol, each, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains].

Dissolve the Potassium Salts in *two hundred and fifty cubic centimeters* [or 8 fluidounces,

217 minims] of Distilled Water with the aid of heat, and the Tartaric Acid in *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol. Having poured the solution of Tartaric Acid into a bottle of about one thousand cubic centimeters capacity, add the solution of the Potassium Salts and shake the mixture briskly. Place the bottle in a bath of ice-water for several hours and, having inserted a pledget of cotton tightly in the throat of a funnel, transfer the contents of the bottle to the funnel. When all the liquid has passed through, wash the bottle and crystalline precipitate with Diluted Alcohol in successive small portions until *one thousand grammes* [or 35 ounces av., 120 grains] of clear solution have been obtained. Evaporate the liquid at a moderate temperature, on a water-bath, until all of the Alcohol has been dissipated, and add sufficient Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]." *U. S.*

The official description is as follows: "A clear, colorless liquid, odorless, and having an acid taste. Specific gravity, about 1.106 at 25° C. (77° F.). Miscible, in all proportions, with water or alcohol. On distilling Diluted Hydriodic Acid, water with some weak acid first passes over; at the temperature of 127° C. (260.6° F.), an acid of the strength of 57.5 percent. distils over unchanged. To blue litmus paper it shows a strongly acid reaction. Silver nitrate T.S. produces a yellow, curdy precipitate, insoluble in nitric acid, almost insoluble in ammonia water, but soluble in solutions of sodium thiosulphate and potassium cyanide. If a few drops of ferric chloride T.S. or chlorine water be added to the Acid, diluted with twice its volume of water, iodine will be liberated and impart to the solution a reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color. The Acid should not become colored on keeping. Barium chloride T.S. should not produce a turbidity or precipitate (absence of *sulphuric acid*). The Acid should not be rendered turbid by the addition of potassium sulphate T.S. (absence of *barium*). Diluted Hydriodic Acid, when evaporated to dryness on a bath of boiling water, and then heated to 115° C. (239° F.), should not leave more than 1 percent. of residue. Ten Cc. of the Diluted Acid, without further acidulation, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 5 Cc. of Diluted Hydriodic Acid be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water, and then evaporated to dryness on a bath of boiling water, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). Into a flask provided with a well fitting stopper, introduce 2.54 Gm. of Diluted Hydriodic Acid, diluted with 50 Cc. of distilled water, followed by 25 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of ferric ammonium sulphate T.S., and 3 to 4 Cc. of nitric acid (free from nitrous compounds); then securely stopper the flask, and shake it well. Not more than 5 Cc. of tenth-normal potassium sulphocyanate V.S. should then be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 0.5 percent. of absolute Hydriodic Acid)." *U. S.*

Diluted hydriodic acid was introduced into the U. S. Pharmacopœia 1860; it was dismissed in the revision of 1870, and is again recognized in the present 8th Revision. The old process consisted in passing hydrogen sulphide into a bottle containing iodine and water until the iodine disappeared and the liquid was colorless, it was then filtered to separate the precipitated sulphur and the filtrate heated to drive off the excess of hydrogen sulphide. The reaction is as follows:

$$2H_2S + 2I_2 = 4HI + S_2$$

Various processes have been proposed for making hydriodic acid. Buchanan used an extemporaneous formula, which consisted in dissolving 330 grains of potassium iodide and 264 of tartaric acid, each in one and a half fluidounces of water, mixing the solutions, filtering to separate the potassium bitartrate formed, and finally adding sufficient distilled water to make the solution measure fifty fluidrachms. Each fluidrachm of this preparation represents five grains of iodine. Dunn's modification of Buchanan's process is as follows: Take of potassium iodide 209¾ grains; tartaric acid, in crystals, 190¼ grains. Dissolve the iodide in three fluidrachms of distilled water, and the acid in the same quantity, and filter if necessary; mix the solutions, set the mixture in ice-cold water, and allow it to stand for one hour; then filter, and make up the measure to two fluidounces. Each fluidrachm represents 10 grains of iodine. (*A. J. P.*, 1869, 41.) H. Kolbe (*J. Pr. Chem.*, 1879, 172, and *A. J. P.*, June, 1877) adds phosphorus to iodine in a retort filled with carbon dioxide. Heat is applied, and water added; on application of moderate heat, hydriodic acid gas free from iodine is produced. C. Winckler (*A. J. P.*, May, 1880) dissolves iodine in carbon disulphide, adds sufficient water to form a layer on top of the solution of iodine, and passes a stream of hydrogen sulphide through the mixture; when this has acquired a yellow color, the layers are separated, the aqueous hydriodic acid is boiled a few minutes to expel hydrogen sulphide, and it is then chemically pure.

The present U. S. 8th Revision process is based on Buchanan's method, but directs in addition to potassium iodide and tartaric acid, potassium hypophosphite and diluted alcohol. The hypophosphite is added in order to provide a small quantity of hypophosphorous acid which acts as a preservative, while the diluted alcohol aids in the precipitation of the potassium bitartrate because of the insolubility of the latter in alcohol. The ice-water bath is also used to assist

in the separation of the potassium bitartrate.

$$KI + 2H_2C_4H_4O_6 + KPH_2O_2 = HI + 2KHC_4H_4O_6 + HPH_2O_2$$

Uses.—Diluted hydriodic acid is used in the preparation of syrup of hydriodic acid by adding 100 Gm. of the acid to 900 Gm. of syrup and water; as now prepared the acid is reasonably permanent, but it should not be used or dispensed if discolored by the presence of free iodine; it contains ten times the amount of hydriodic acid present in the official syrup of hydriodic acid. Diluted hydriodic acid was introduced into use as a medicine by Andrew Buchanan of Glasgow. The acid official in 1860 contained ten grains of iodine in each fluidrachm, and was therefore twice as strong as Buchanan's solution. There can be little doubt that hydriodic acid is capable of producing the alterative effects of iodine, and it may be given in all cases to which that medicine is applicable. When the solution becomes discolored it may be irritant through the liberated iodine; but this effect may be partially obviated by exhibiting it in any amylaceous liquid, as barley water.

Dose, ten minims (0.6 Cc.) three times a day, well diluted.

Off. Prep.—Syrupus Acidi Hydriodici, *U. S.*

ACIDUM HYDROBROMICUM DILUTUM. U. S., Br.

DILUTED HYDROBROMIC ACID

(ăç'ĭ-dŭm hȳ-drō-brō'mĭ-cŭm dĭ-lū'tŭm)

"A liquid composed of not less than 10 per cent., by weight, of absolute Hydrobromic Acid [HBr = 80.36], and about 90 percent. of water. It should be kept in amber-colored, glass-stoppered bottles, protected from light." *U. S.* "An aqueous solution containing 10 per cent. by weight of hydrogen bromide, HBr. It may be obtained by the distillation of potassium bromide with concentrated phosphoric acid." *Br.*

Acidum Bromhydricum Dilutum, Acidum Bromohydricum; Acide Bromhydrique dissous, *Fr. Cod.*; Acide hydrobromique dilué, *Fr.*; Acidum hydrobromicum, *P. G.*; Verdünnte Hydrobromsaure, v. Bromwasserstoffsaure, *G.*

The U. S. and Br. Pharmacopœias do not give processes for this acid. Both acids are identical in strength. The following process is based upon that of E. R. Squibb: Take of Potassium Bromide and Sulphuric Acid, each, one hundred and fifty parts, Distilled Water, a sufficient quantity. Add the Sulphuric Acid to twenty-five parts of Distilled Water, and cool the mixture. Then dissolve the Potassium Bromide in one hundred and fifty parts of water by the aid of heat, supplying the loss of water by evaporation during the heating. Carefully pour the diluted Sulphuric Acid into the hot solution with constant stirring, and set the mixture aside for twenty-four hours, in order that the Potassium Sulphate may crystallize. Pour off the liquid into a retort, break up the crystalline mass, transfer it to a funnel, and having drained the crystals, drop slowly upon them fifty parts of cold Distilled Water so as to wash out the acid liquid. Add this liquid to that in the retort, and distil nearly to dryness at a moderate heat. If red fumes of bromine are given off during any stage of the distillation, change the receiver as soon as such fumes begin to appear. Finally determine in the distillate the amount of actual Hydrobromic Acid (16.1 Gm. should require 20 Cc. of the volumetric solution of sodium hydroxide), and add to the remaining weighed distillate such an amount of cold Distilled Water as shall cause the finished acid to contain 10 per cent. of actual hydrobromic acid. If the bromide used contains bromate, the distillate will probably be tinged with the red color of bromine; should such contamination be produced, the acid may be rendered fit for use by carefully adding solution of sodium sulphite until the acid is deprived of color, and then rectifying it by distillation.

This process for making solution of hydrobromic acid does not differ essentially from that of E. R. Squibb (*A. J. P.*, 1878, p. 116), except in the improvement of the rather smaller proportion of sulphuric acid used, and in the fact of the difference in strength of the two hydrobromic acids, Squibb's being 34 per cent., the above 10 per cent. The advantages possessed by both methods over those frequently used are greater purity of product and more definite strength.

The most convenient process is undoubtedly that of Dewitt C. Wade (*Peninsular Medical Journal,* Feb. 1875), modelled after Buchanan's method of making hydriodic acid, which directs that 120 grains of potassium bromide be dissolved in one fluidounce of water, and 153 grains of tartaric acid be added to the solution; acid potassium tartrate is produced, the greater part of which crystallizes out on standing 12 hours at a low temperature, and a solution of hydrobromic acid is formed, sp. gr. 1.228, containing about 80 grains pure hydrobromic acid to the fluidounce, equivalent to nearly 15 per cent. Fothergill's acid, although based upon Wade's formula, is weaker, the quantity of potassium bromide being 81¼ grains and that of tartaric acid 99 grains to the fluidounce, the manipulation being the same; each fluidounce of Fothergill's acid contains about 55 grains of pure hydrobromic acid, or about 10 per cent. Diluted hydrobromic acid made in this way is open to the objection of containing cream of tartar, and probably some undecomposed potassium bromide in solution, and thus is not strictly pure. To lessen this, Charles Rice proposed the addition of a double quantity of alcohol to facilitate the precipitation, recovering the alcohol by distillation subsequently. (*N. R.*, 1877, p. 107.) Other processes have been suggested for the preparation of hydrobromic acid. Edward Goebel (*N. R.*, Sept. 1880) proposed a method

based on Glover's process, which is to decompose 148 grains of barium bromide dissolved in half an ounce of water, with 50.6 grains of sulphuric acid, diluted with two drachms of distilled water; the precipitated barium sulphate is washed with distilled water until the filtrate weighs 810 grains to make the 10 per cent. acid solution. The processes of Balard, Millon, and Loewig are commented upon by John M. Maisch (*Proc. A. Ph. A.*, 1860), who proposed some useful modifications. Markoe (*Ibid.*, 1875, p. 686) recommends an economical process, which, however, must be followed with care, and is better adapted for making the acid on a large scale. He pours a pint of water into a gallon stoneware jar, and then adds one pound or more of phosphorus, distributing it over the bottom; ice is now added until the jar is half full, a gallon glass funnel is inserted in the throat of the jar, and a funnel tube adjusted, so that the end will be a short distance above the surface of the phosphorus; the funnel is about one-third filled with broken ice, and the jar placed in a larger vessel, and broken ice packed between. Three or four pounds of bromine, after being chilled, are *slowly* added, in order that the fumes of hydrobromic acid and bromine that may arise may be fully condensed by the ice in the funnel, and an accumulation of bromine avoided, which might produce an explosion from too sudden reaction. The excess of phosphorus is removed after all the bromine has been added, the liquid distilled, hydrobromic acid condensed, and the strength adjusted, while to the residue in the retort water may be added to make diluted phosphoric acid. A convenient method for obtaining a small amount of hydrobromic acid gas or solution, was described by L. H. Friedburg, in a communication before the New York Section of the American Chemical Society (May, 1905). Bromine is allowed to trickle into paraffin which is kept in a melted condition by placing the flask containing it in a shallow steam bath. The bromine vapors, which will pass over with the hydrobromic acid, are partly absorbed by a second flask containing paraffin, joined to the first flask and standing with it in the steam bath. (See also Gassman's process, *S. W. P.*, 1893, 107.) Marshall proposed a method which depends on the easy solubility of bromine in hydrobromic acid, the conversion of the bromine into sulphur bromide by the addition of sulphur, and the ready decomposition of sulphur bromide when shaken with water, thus:

$$3Br_2 + S + 4H_2O = 6HBr + H_2SO_4$$

(*Y. B. P.*, 1901, 483).

Properties.—Diluted hydrobromic acid is a colorless, transparent liquid, entirely vaporized by heat, inodorous, strongly acid to the taste, sp. gr. about 1.076 (U. S.) at 25° C. (77° F.) and containing 10 per cent. absolute hydrobromic acid. "Miscible, in all proportions, with water or alcohol. On distilling it, water and weak acid first pass over; when the temperature of 126° C. (258.8° F.) is reached, an acid of 48 percent. remains, which may be distilled unchanged. Diluted Hydrobromic Acid strongly reddens blue litmus paper." *U. S.* Although of a pungent and irritating odor, and fuming when in contact with the atmosphere when concentrated, in its diluted state it is odorless. On adding chlorine or nitric acid to diluted hydrobromic acid, there is liberated bromine, which is soluble in chloroform or carbon disulphide, imparting to these liquids a yellow color.

Tests.—"Silver nitrate T.S. causes a yellowish-white precipitate, which is insoluble in diluted nitric acid, but slowly soluble in an excess of stronger ammonia water, and readily soluble in solutions of sodium thiosulphate or potassium cyanide. If copper sulphate T.S. be added to the Acid, a deep red color is produced upon the addition of sulphuric acid. The Acid should not become colored on keeping. Barium chloride T.S. should not produce a turbidity or precipitate (absence of *sulphuric acid*). Ten Cc. of the Acid should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). If 10 Cc. of Diluted Hydrobromic Acid be evaporated to dryness, and heated to 110° C. (230° F.), no appreciable residue should remain (limit of *non-volatile impurities*). Ten Cc. of the Diluted Acid without further acidulation, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 10 Cc. of the Acid be shaken with 2 Cc. of chloroform, no color should be imparted to the latter (absence of *free bromine*), and upon subsequently adding chlorine water, which has been previously diluted with an equal volume of water, drop by drop, with shaking, the chloroform should be colored orange, with no trace of violet (absence of *iodine*). Five Cc. of Diluted Hydrobromic Acid should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 0.5 Cc. of Diluted Hydrobromic Acid be mixed with 10 Cc. of water, and 8 Cc. of silver nitrate T.S. with 6 Cc. of ammonium carbonate T.S. be added, and if the mixture, after digesting for ten minutes on a bath of boiling water, be cooled and filtered, the filtrate, on supersaturating with nitric acid, should not become more than slightly opalescent (limit of *hydrochloric acid* and *chlorides*). If 10 Gm. of Diluted Hydrobromic Acid be diluted with sufficient distilled water to measure 100 Cc., and if to 8.04 Cc. of this solution, after exact neutralization with diluted ammonia water (litmus T. S. being used as indicator), there be added 3 drops of potassium chromate T.S., then not less than 10 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red tint (each Cc. corresponding to 1 percent. of absolute Hydrobromic Acid)." *U. S.* "4 grammes should require for neutralization 5 (more exactly 4.98) cubic centimetres of the *volumetric solution of sodium hydroxide*, or, for complete precipitation, 50 (more exactly

49.8) cubic centimetres of the *volumetric solution of silver nitrate*. It should yield no characteristic reaction with the tests for arsenium, barium, chlorides, phosphates, sulphates, or sulphites. It should yield no residue on evaporation to dryness." *Br.* Concentrated hydrobromic acid has been furnished by manufacturing chemists containing from 20 to 50 per cent. of absolute hydrobromic acid; C. T. Tyrer states that the stronger acids are prone to show discoloration in a few days after being made, but that even the highly colored acids, when diluted to the official strength, become colorless; the concentrated acid attacks glass rapidly and the silica is not thrown out on dilution; he recommends acid of the sp. gr. 1.250 as having the most suitable limit of concentration for pharmaceutical purposes. (*Y. B. P.*, 1896, 296).

The following table by Biel will be found useful in showing from the specific gravities of solutions the percentage of absolute hydrobromic acid.

Biel's Table of Percentage and Specific Gravity of Hydrobromic Acid.

Per cent. HBr.	Specific Gravity at 15°C. (59°F.)	Per cent. HBr.	Specific Gravity at 15°C. (59°F.)
1	1.0082	26	1.219
2	1.0165	27	1.229
3	1.0230	28	1.239
4	1.0305	29	1.249
5	1.038	30	1.260
6	1.046	31	1.270
7	1.053	32	1.281
8	1.061	33	1.292
9	1.069	34	1.303
10	1.077	35	1.314
11	1.085	36	1.326
12	1.093	37	1.338
13	1.102	38	1.350
14	1.110	39	1.362
15	1.119	40	1.375
16	1.127	41	1.388
17	1.136	42	1.401
18	1.145	43	1.415
19	1.154	44	1.429
20	1.163	45	1.444
21	1.172	46	1.459
22	1.181	47	1.474
23	1.190	48	1.490
24	1.200	49	1.496
25	1.209	50	1.513

Uses.—Diluted hydrobromic acid is very nearly identical with potassium bromide in its action, but is too irritant to the stomach to be used freely in *epilepsy* and other serious affections. In an experimental study made by Reichert, of the University of Pennsylvania, it was found to act upon animals precisely as do the bromides in general. It has been especially commended in *tinnitus aurium*. Two fluidrachms contain about 12 grains of bromine, equivalent in this to 18 grains of potassium bromide, and may be given at once, well diluted with water or syrup. The addition of a trace of spirit of lemon to the mixture renders the resemblance of this dose to lemonade a very close one.

Dose, from one-half to two fluidrachms (1.8 to 7.5 Cc.).

ACIDUM HYDROCHLORICUM. U. S., Br.

HYDROCHLORIC ACID

(ăç'ĭ-dŭm hī-drŏ-ĕhlō'rĭ-cŭm)

"A liquid composed of 31.9 percent., by weight, of absolute Hydrochloric Acid [HCl = 36.18], and 68.1 percent. of water. It should be kept in glass-stoppered bottles." *U. S.* "A liquid containing 31.79 per cent. by weight of hydrogen chloride, HCl, and 68.21 per cent. of water. Obtained by dissolving in water the gas produced by the interaction of sulphuric acid and sodium chloride." *Br.*

Acidum Muriaticum. *Pharm.* 1870; Acidum Hydrochloratum. s. Chlorhydricum; Spirit of Sea Salt, Marine Acid, Muriatic Acid, Chlorhydric Acid; Acide chlorhydrique officinal. *Fr. Cod.*; Acide hydrochlorique, Acide chlorhydrique ou muriatique, *Fr.*; Acidum hydrochloricum, *P. G.*; Salzsaure, Chlorwasserstoffsaure, *G.*; Acido cloridrico concentrato, Acido muriatico, *It.*; Acido clorhidrico, Acido muriatico, *Sp.*

Preparation.—Hydrochloric acid is obtained mainly by the action of sulphuric acid on sodium chloride or common salt. In England it is produced in enormous quantities during the decomposition of common salt for the purpose of making sodium sulphate, from which soda ash and sodium carbonate are afterwards manufactured in immense quantities. The decomposition of the sea salt is performed in semi-cylindrical vessels, the curved part, next the fire, being made of iron, and the upper or flat surface, of stone. The acid gas is conveyed by a pipe to a double-necked stoneware receiver, half filled with water, and connected with a row of similar receivers, likewise containing water. As carried out on a larger scale, the decomposition of the salt takes place in hemispherical iron pans, 9 feet in diameter, covered by a brick-work dome; upon the mass of salt the requisite quantity of sulphuric acid is allowed to run from a leaden cistern placed above the decomposing pan. Torrents of hydrochloric acid gas are evolved, which collect in the space between the pan and the brick-work dome, whence they pass by a brick-work or earthenware flue into upright towers or condensers. These towers are filled with bricks or coke, down which a small stream of water is allowed to trickle. The gas, passing upward, meets the water and is dissolved by it, and as the acid liquor approaches the bottom, it becomes more and more nearly saturated with gas.

Hydrochloric acid is also made on a commercial scale by the action of steam upon magnesium chloride, which is such an abundant waste product at the rock salt mines of Stassfurt. The process used is that of Weldon as developed by Pechiney of Salindres, in France.

With the increasing development of electrolytic processes for the production of caustic alkali, it has been sought to convert the chlorine set free at the same time into hydrochloric acid. This is done by burning the chlorine direct with the hydrogen set free at the cathode. A pro-

cess of this kind is now being operated at Niagara Falls by the Roberts Chemical Company, who electrolyze potassium chloride and obtain as products potassium hydroxide and hydrochloric acid.

The acid, when required to be pure, is generally prepared by saturating distilled water with the gas in Woulfe's apparatus. A quantity of pure fused sodium chloride is introduced into a retort or flask, placed on a sand bath. The vessel is then furnished with an S-tube, and connected with a series of bottles, each two-thirds full of water. A quantity of sulphuric acid is then gradually added, equal in weight to the common salt employed, and diluted with one-third of its weight of water. The materials ought not to occupy more than half the body of the retort. When the extrication of the gas slackens, heat is applied, and gradually increased until the water in the bottles refuses to absorb any more, or until no more gas is found to come over. As soon as the process is completed, boiling water should be added to the contents of the retort or flask, in order to facilitate the removal of the residue. During the progress of the saturation, the water in the several bottles increases in temperature, which lessens its power of absorption. It is, therefore, expedient, in order to obtain a strong acid, to keep the bottles cool by means of water or ice. The connecting tubes need not plunge deeply into the acid.

In the process for hydrochloric acid, theory calls for a little less than 90 parts of liquid sulphuric acid to 100 of common salt. A moderate excess of the former may be useful to insure the complete decomposition of the salt. The reaction for its formation is:

$$NaCl + H_2SO_4 = HCl + HNaSO_4$$

If only half the amount of sulphuric acid be used, the reaction is:

$$2NaCl + H_2SO_4 = 2HCl + Na_2SO_4$$

In the first of these reactions, as only one molecule of salt is taken, it is obvious that there is not enough sodium furnished to neutralize the sulphuric acid completely and make the normal sulphate, Na_2SO_4, so the result is the acid sulphate, $HNaSO_4$. On the other hand, in the second reaction, the two molecules of salt furnish just the sodium necessary to neutralize the one molecule of sulphuric acid and make the neutral sulphate, Na_2SO_4.

As hydrochloric acid, prepared in the ordinary mode, often contains arsenic, so as to obscure its indications when employed in testing for that poison, it is of interest to the practical toxicologist to know that it may be obtained free from that impurity by distilling sodium or potassium chloride with oxalic acid in equivalent proportions.

The following method of freeing hydrochloric acid from arsenic trioxide is recommended by Engel as easy and entirely efficacious. It is founded on the fact that arsenic trioxide is reduced to arsenic by hypophosphorous acid. Into a liter (about 2 pints) of arsenical hydrochloric acid introduce 4 to 5 grammes (about 60 or 70 grains) of potassium hypophosphite, dissolved in a little water. At the end of an hour or two, the liquid becomes yellow and then brown; and a precipitate soon forms, more or less copious according to the amount of impurity. After the liquid becomes clear, which usually happens in 45 minutes, decant the hydrochloric acid and distil it. The acid thus obtained is entirely free from arsenic. This process should be conducted in a place where the direct rays of the sun may fall on the vessels; or, where this is impossible, the vessels should be subjected, by means of a water bath, from 4 to 6 hours, to a heat little short of the boiling point of the acid. (*J. P. C.*, 1873, p. 10.) Traces of arsenic may also be removed by adding solution of stannous chloride, and after the precipitate of impure arsenic has settled, the clear liquid is redistilled. (Bettendorf, *Zeit. An. Chem.* [2], 5, p. 492.)

Properties of the Pure Acid.—Hydrochloric acid, when pure, is a "colorless, fuming liquid, of a pungent odor, and an intensely acid taste; the fumes and odor disappear on diluting the Acid with two volumes of water. Specific gravity: about 1.158 at 25° C. (77° F.). Miscible, in all proportions, with water or alcohol. On distilling it, at first a stronger acid passes over, until, at 110° C. (230° F.), a liquid containing 20.13 percent. of the absolute acid remains (specific gravity, about 1.098 at 25° C.), which distils unchanged, leaving no residue." *U. S.* Exposed to the air it emits white fumes, owing to the escape of the acid gas and its union with the moisture of the atmosphere. When concentrated, it blackens organic substances, as does sulphuric acid. Its sp. gr. varies with its strength. When as highly concentrated as possible, its density is 1.21. The U. S. acid has the specific gravity of 1.158 at 25° C. (77° F.), which is practically equivalent to the figure given in the British Pharmacopœia, which is 1.160 at 15.5° C. (60° F.). When exposed to heat, it continues to give off hydrochloric acid gas, with the appearance of ebullition, until its sp. gr. falls to 1.094, when it properly boils, and may be distilled unchanged, or entirely volatilized.

Hydrochloric acid is characterized by forming, on the addition of silver nitrate, a white precipitate (silver chloride), insoluble in nitric acid, but readily soluble in ammonia. It is incompatible with alkalies, with metallic oxides and their carbonates, and with potassium sulphide, potassium tartrate, tartar emetic, iron and potassium tartrates, silver nitrate, and solution of lead subacetate.

It is very often desirable to know, in chemical and pharmaceutical operations, the quantity of absolute acid contained in samples of acid of different densities. (See table page 36.)

This acid, when pure, will evaporate without residue in a platinum spoon. On heating it with manganese dioxide an abundance of chlorine gas is given off. If sulphuric acid

Table of Percentage and Specific Gravity of Hydrochloric Acid.
U. S. P. (8th Revision).

Per cent. hydrochloric acid.	Specific gravity. 25° C./25° C.	Specific gravity. 15° C./15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent.—0.01 Cc. normal KOH.
1	1.0051	1.0051	0.00017	0.020	0.28	0.036
2	1.0101	1.0102	0.00018	0.020	0.56	0.036
3	1.0151	1.0152	0.00018	0.020	0.84	0.034
4	1.0201	1.0202	0.00019	0.020	1.13	0.036
5	1.0250	1.0253	0.00020	0.020	1.41	0.034
6	1.0299	1.0303	0.00021	0.020	1.70	0.033
7	1.0348	1.0353	0.00023	0.021	2.00	0.034
8	1.0396	1.0402	0.00024	0.021	2.29	0.033
9	1.0444	1.0452	0.00026	0.021	2.59	0.033
10	**1.0492**	**1.0502**	**0.00027**	**0.020**	**2.89**	**0.032**
11	1.0541	1.0552	0.00029	0.021	3.20	0.033
12	1.0589	1.0602	0.00031	0.020	3.50	0.032
13	1.0638	1.0652	0.00033	0.021	3.81	0.032
14	1.0686	1.0702	0.00035	0.021	4.12	0.031
15	1.0734	1.0752	0.00037	0.020	4.44	0.032
16	1.0783	1.0803	0.00039	0.020	4.75	0.031
17	1.0832	1.0853	0.00041	0.020	5.07	0.030
18	1.0881	1.0904	0.00043	0.021	5.40	0.031
19	1.0929	1.0954	0.00044	0.020	5.72	0.030
20	1.0978	1.1005	0.00046	0.020	6.05	0.030
21	1.1029	1.1058	0.00048	0.019	6.38	0.029
22	1.1081	1.1111	0.00050	0.020	6.72	0.029
23	1.1132	1.1164	0.00052	0.020	7.06	0.029
24	1.1183	1.1217	0.00054	0.020	7.40	0.029
25	1.1234	1.1270	0.00056	0.020	7.74	0.029
26	1.1284	1.1322	0.00058	0.020	8.09	0.029
27	1.1335	1.1375	0.00059	0.020	8.44	0.029
28	1.1386	1.1427	0.00061	0.020	8.79	0.029
29	1.1437	1.1480	0.00063	0.020	9.14	0.028
30	1.1487	1.1532	0.00065	0.020	9.50	0.028
31	1.1537	1.1583	0.00067	0.020	9.86	0.028
31.9	**1.1581**	**1.1629**	**0.00068**	**0.020**	**10.18**	**0.028**
32	1.1586	1.1634	0.00068	0.020	10.22	0.028
33	1.1636	1.1685	0.00070	0.020	10.58	0.027
34	1.1687	1.1737	0.00071	0.020	10.95	0.027
35	1.1736	1.1789	0.00073	0.020	11.32	0.027
36	1.1787	1.1842	0.00074	0.019	11.69	0.026
37	1.1839	1.1894	0.00076	0.019	12.07	0.026
38	1.1891	1.1947	0.00077	0.019	12.45	0.026
39	1.1943	1.2000	0.00078	0.019	12.83	0.026
40	1.1995	1.2053	0.00079	....	13.22	....

[1] Add if the temperature is above, subtract if below, 25° C.

[2] Corresponding with difference in specific gravity of 0.0001.

NOTE.—To find the per cent. of chlorine, multiply the per cent. of HCl by 0.9724.

To find the weight in grammes of HCl in 100 Cc., multiply the specific gravity by the per cent. of HCl.

To find the volume per cent. of official Hydrochloric Acid, multiply the "normality" by 9.823. For the volume per cent. of official Diluted Hydrochloric Acid, multiply the "normality" by 34.60.

be present, a solution of barium chloride will cause a precipitate of barium sulphate in the acid, previously diluted with distilled water. Iron may be detected by saturating the diluted acid with sodium carbonate, and then adding potassium ferrocyanide, which will strike a blue color if that metal be present, or by the simple addition of potassium sulphocyanate, when a blood-red coloration is produced. The absence of arsenic may be inferred if it does not tarnish bright copper foil when boiled with it. "If 10 Cc. of the Acid be evaporated from a platinum or porcelain dish, and dried at 110° C. (230° F.), no appreciable residue should remain

(limit of *non-volatile impurities*). If to 5 Cc. of Hydrochloric Acid, diluted with an equal volume of water, 1 Cc. of chloroform be added, and if chlorine water which has been diluted with an equal volume of water be then cautiously added, a drop at a time, with constant agitation, the chloroform should remain free from any yellow, orange, or violet color (absence of *bromine* or *iodine*). If 1 Cc. of the Acid be diluted with 5 Cc. of water, and if 1 Cc. of potassium iodide T.S. with 1 Cc. of chloroform be added, and the mixture agitated, the chloroform should be free from any violet coloration (absence of *free chlorine* or *bromine*). Five Cc. of diluted Hydrochloric Acid (1 in 10), should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 1 Cc. of the Acid be diluted with 5 Cc. of water, and a few drops of barium chloride T.S., be added, no precipitate or turbidity should appear within one hour (absence of *sulphuric acid* or *sulphates*), nor should the addition to this mixture of a few drops of tenth-normal iodine V.S. produce any turbidity (absence of *sulphurous acid*). Hydrochloric Acid when diluted with distilled water (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Introduce into a stoppered weighing-bottle 3 Cc. of Hydrochloric Acid and weigh accurately. Dilute the Acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 3.618, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Hydrochloric Acid in the latter." *U. S.* "Each gramme, diluted with *water,* should require for neutralization 8.7 cubic centimetres of the *volumetric solution of sodium hydroxide,* and 0.1 gramme should require, for complete precipitation, 8.7 cubic centimetres of the *volumetric solution of silver nitrate.* It leaves no residue on evaporation, and when diluted with *water* should yield no characteristic reaction with the tests for arsenium, lead, copper, iron, aluminium, bromides, iodides, sulphates, or sulphites. Diluted with much *water* and *solution of potassium iodide* added, no blue color is produced on the addition of *mucilage of starch* (absence of free chlorine)." *Br.* Ammonia in excess, if it produces no precipitate, shows the absence of iron.

If a small portion of the diluted acid be treated with test zinc, the evolved gas should not blacken paper wet with silver nitrate test solution (arsenous or sulphurous acid). Free chlorine or nitric acid may be discovered by its having the power to dissolve gold leaf. Any minute portion of the leaf which may be dissolved is detected by adding a solution of stannous chloride, which will give rise to a purplish tint. The free chlorine is derived from the reaction of nitric or nitrous acid on a small portion of the hydrochloric acid, which is thus deprived of its hydrogen. Hence it is that, when free chlorine is present, nitrous acid or some other oxide of nitrogen is also present as an impurity. The nitric and nitrous acids are derived from nitrates found as impurities in the common salt and from nitrous acid in the commercial sulphuric acid employed in the preparation of the hydrochloric acid.

Hydrochloric Acid of Commerce. Muriatic Acid.—This acid has the general properties of the pure aqueous acid. It has a yellowish color owing to the presence of ferric chloride, or of a minute proportion of organic matter, such as cork, wood, etc. It usually contains sulphuric acid, and sometimes free chlorine and nitrous acid. But the most injurious impurity, to those who consume it in the arts, is sulphurous acid. Savory analyzed three samples of commercial hydrochloric acid, each having a sp. gr. of between 1.16 and 1.17, and found them to contain from 7 to nearly 11 per cent. of sulphurous acid. To detect this acid, Girardin has proposed a very delicate test, namely, stannous chloride. The mode of using the test is to take about half an ounce of the acid to be tested, and to add to it two or three drachms of stannous chloride. The mixture having been stirred two or three times, as much of distilled water as of stannous salt is to be added. If sulphurous acid be present, the hydrochloric acid becomes turbid and yellow immediately upon the addition of stannous chloride; and upon the subsequent addition of the water a slight evolution of hydrogen sulphide takes place, perceptible to the smell, and the liquid assumes a brownish hue, depositing a powder of the same color. The manner in which the test acts is as follows: By a transfer of chlorine, stannic chloride and metallic tin are produced, the latter of which, by reacting with the sulphurous acid, gives rise to a precipitate of stannic and stannous sulphides. In case the sulphurous acid forms but one-half of one per cent. of the commercial acid, the precipitate may not be perceptible. Under these circumstances, a solution of copper sulphate must be added to the liquid previously warmed, when a brown precipitate of copper sulphide will be immediately formed (Heintz). Or, if a weak solution of iodine be decolorized by the hydrochloric acid, sulphurous or arsenous acid may be suspected. Lembert has proposed the following, which he considers as a more delicate test for sulphurous acid. Saturate the suspected hydrochloric acid with potassium carbonate, and add successively a little weak solution of starch, one or two drops of solution of potassium iodate, and sulphuric acid, drop by drop. Sulphurous acid, if present, will be set free with iodic acid, and these, by reacting on each other, will develop iodine, which will cause a blue color with the starch. Or the addition of pure zinc will liberate nascent hydrogen, which will cause the evolution of hydrogen sulphide gas, detected with lead acetate paper, and this test is preferable.

An impurity very frequently present in the commercial acid, as shown by Dupasquier, is arsenic. (See U. S. P. tests above.) The immediate source of this impurity is the sulphuric acid used to prepare the hydrochloric acid. The sulphuric acid derives the arsenic from the sulphur used in its manufacture, and this last from pyrites containing a little of the poisonous metal. The arsenic, when present, is in the form of a trichloride, and, from its volatility in this state of combination, is transferred to the hydrochloric acid, distilled from the commercial acid. This impurity is separated by diluting the acid with an equal volume of water, and passing through it hydrogen sulphide, which thus throws down the arsenic as a trisulphide. According to Wittstein, hydrochloric acid is freed from arsenic by mercury, according to Reinsch, by copper, and in either case it may be deprived of metallic impregnation by careful distillation. (*A. J. P.*, 1851, p. 408.) M. Auguste Houzeau asserts that to deprive commercial arseniferous hydrochloric acid of arsenic it is sufficient simply to boil it, in a flat bottomed vessel, to two-thirds of its original volume, all the arsenic escaping in the form of the trichloride. (*J. P. C.*, 4e sér., i. 97.) Bettendorf separates arsenous and arsenic acids from hydrochloric acid, sufficiently concentrated, by precipitating with stannous chloride, and then distilling the acid; when it is so treated, it is perfectly free from arsenic. (*A. J. P.*, 1870, p. 219.) When leaden vessels are used in preparing hydrochloric acid, it is likely to contain lead chloride, which falls as a white precipitate on neutralizing the acid. The nature of the precipitate is verified by dissolving it in nitric acid and adding potassium iodide, when the yellow lead iodide will separate (Hainault). Scheffer proved the presence of lead in a sample used for making solution of ferric chloride (*A. J. P.*, Nov. 1875). Another instance was noted by F. Reppert (*A. J. P.*, Dec. 1875). This impurity, being fixed, may be separated by distilling the acid. A small proportion of thallium has been detected in commercial hydrochloric acid by Wm. Crookes, being derived from sulphuric acid, in the manufacture of which pyrites was employed. Selenium has been found in French hydrochloric acid, causing the acid to have a bad odor.

Properties of Hydrochloric Acid Gas.—Hydrochloric acid gas is colorless and elastic, possessing a very pungent odor, and the property of irritating the organs of respiration. It destroys life and extinguishes flame. It reddens litmus powerfully, and has the other properties of a strong acid. Its sp. gr. is 1.278 (Gay-Lussac and Biot). Subjected to a pressure of 40 atmospheres, at the temperature of 10° C. (50° F.), it is condensed into a transparent liquid, to which alone the name of *liquid hydrochloric acid* properly belongs. Water absorbs this gas with the greatest avidity.

It consists of one volume of chlorine and one of hydrogen, united without condensation.

Toxicological Properties.—Hydrochloric acid, when swallowed, is highly irritating and corrosive, but less so than sulphuric or nitric acid. It produces hiccough, violent efforts to vomit, and agonizing pain in the stomach. There is much thirst, with great restlessness, a dry and burning skin, and a small concentrated pulse. If the acid has been recently swallowed, white vapors of a pungent odor will be emitted from the mouth. The best antidote is magnesia, but soap or sufficiently diluted alkaline solutions are almost equally efficient. In the course of the treatment, bland and mucilaginous drinks must be freely given. When inflammation supervenes, it must be treated on general principles.

Uses.—Hydrochloric acid is tonic, refrigerant and antiseptic. It is exhibited, largely diluted with water, in *low fevers, phthisis,* some forms of *syphilis,* and to counteract *phosphatic deposits* in the urine. It is especially valuable in *gastro-intestinal indigestion* when there is no tendency to diarrhœa, and may often be added with advantage to liquid preparations of calumba, gentian, and cinchona. It is also frequently given in *dyspepsia* along with pepsin, to aid its solvent powers. (See *Acidum Hydrochloricum Dilutum.*) In concentrated form, it is decidedly caustic, but weaker than nitric acid, and is often used to destroy small dermal growths.

Dose, five to ten minims (0.3 to 0.6 Cc.), well diluted.

Off. Prep.—Acidum Hydrochloricum Dilutum, *U.S., Br.;* Acidum Nitrohydrochloricum, *U. S.;* Acidum Nitrohydrochloricum Dilutum, *U. S., Br.;* Argenti Nitras Fusus, *U. S.;* Carbo Animalis Purificatus, *U. S.;* Extractum Cinchonæ Liquidum, *Br.;* Glycerinum Pepsini, *Br.;* Liquor Arsenici Hydrochloricus, *Br.;* Liquor Chlori Compositus, *U. S.;* Liquor Ferri Chloridi, *U. S.* (*Br.*); Liquor Zinci Chloridi, *U. S., Br.;* Resina Podophylli, *U. S.* (*Br.*); Sulphur Præcipitatum, *U. S.;* Talcum Purificatum, *U. S.*

ACIDUM HYDROCHLORICUM DILUTUM. U. S., Br.

DILUTED HYDROCHLORIC ACID

(ăç'ĭ-dŭm hȳ-drǫ-ȼhlō'rĭ-cŭm dī-lū'tŭm)

"Diluted Hydrochloric Acid should contain 10 percent., by weight, of absolute Hydrochloric Acid [HCl = 36.18], and 90 percent. of water. It should be kept in glass-stoppered bottles." *U. S.* "100 parts by weight should contain 10.58 parts of hydrogen chloride, HCl." *Br.*

Acidum Muriaticum Dilutum, *Pharm.* 1870; Diluted Muriatic Acid; Acide chlorhydrique dilué, *Fr.;* Acidum hydrochloricum dilutum, *P. G.;* Verdünnte Salzsaure, *G.;* Acido cloridrico diluito, *It.*

* "Hydrochloric Acid, *one hundred grammes* [or 3 ounces av., 231 grains]; Distilled Water, *two hundred and nineteen grammes* [or 7 ounces av., 317 grains], to make *three hundred and nineteen grammes* [or 11 ounces av., 110 grains]. Mix them." *U. S.*

"Hydrochloric Acid, 6 *fl. ounces* (more exactly, 6.035, Imperial measure) or 3063 *grains*, or 301.8 cubic centimetres or 350.1 grammes; Distilled Water, a sufficient quantity. Introduce the Hydrochloric Acid into a glass flask, the capacity of which to a mark on the neck is *one pint* (Imp. meas.) or one thousand cubic centimetres; add Distilled Water until the mixture, at 60° F. (15.5° C.), after it has been shaken, measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The official description is as follows: "Specific gravity: about 1.049 at 25° C. (77° F.). It does not fume in the air and is without odor, but otherwise it should conform to the reactions and tests given under *Acidum Hydrochloricum*. If to 3.62 Gm. of Diluted Hydrochloric Acid there be added about 20 Cc. of water, it should require 10 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Hydrochloric Acid), methyl-orange T.S. being used as indicator." *U. S.*

The British diluted acid is slightly stronger than the U. S. preparation. "Sp. gr. 1.052, containing 10.58 per cent. by weight of absolute acid. Each gramme should require for neutralization 2.9 cubic centimetres of the *volumetric solution of sodium hydroxide*. It should be free from the impurities mentioned under 'Acidum Hydrochloricum.'" *Br.*

For medicinal properties and uses, see *Acidum Hydrochloricum*.

Dose, from ten to thirty minims (0.6 to 1.8 Cc.), to be taken in water.

Off. Prep.—Acidum Hydrocyanicum Dilutum, *U. S.;* Extractum Ergotæ, *U. S., Br.;* Injectio Apomorphinæ Hypodermica, *Br.;* Liquor Acidi Arsenosi, *U. S.;* Liquor Morphinæ Hydrochloridi, *Br.*

ACIDUM HYDROCYANICUM DILUTUM. U. S., Br.

DILUTED HYDROCYANIC ACID [Diluted Prussic Acid]

(ăç'ĭ-dŭm hī-drŏ-cī-ăn'ĭ-cŭm dī-lū'tŭm)

"A liquid composed of not less than 2 per cent., by weight, of absolute Hydrocyanic Acid [HCN = 26.84], and about 98 percent. of water. It should be kept in small, dark amber-colored, cork-stoppered vials in a cool place." *U. S.* "An aqueous solution containing 2 per cent. by weight of hydrogen cyanide, HCN. It may be prepared by the interaction of diluted sulphuric acid and potassium ferrocyanide. Diluted Hydrocyanic Acid should be stored in a dark place, in small stoppered bottles of amber-colored glass; the stoppers being tied over with impervious tissue and the bottles inverted." *Br.*

Cyanhydric Acid; Acidum Hydrocyanatum, s. Borussicum; Acide cyanhydrique dissous, *Fr. Cod.;* Acide cyanhydrique, ou hydrocyanique, *Fr.;* Cyanwasserstoffsaure, Blausaure, *G.;* Acido cianhidrico, *Sp.*

The United States Pharmacopœia (8th Rev.) gives only an extemporaneous process for this acid (see below); that of the U. S. P. 1890, which may be used on a larger scale, is as follows: "Potassium Ferrocyanide, in coarse powder, *twenty grammes* [or 308 grains]; Sulphuric Acid, *eight cubic centimeters* [or 1 fluidrachm, 11 minims]; Water, *sixty-five cubic centimeters* [or 2 fluidounces, 95 minims]; Distilled Water, *a sufficient quantity*. Place the Potassium Ferrocyanide in a tubulated retort, and add to it *forty cubic centimeters* [or 1 fluidounce, 3 fluidrachms] of water. Connect the neck of the retort (which is to be directed upward), by means of a bent tube, with a well-cooled condenser, the delivery tube of which terminates in a receiver surrounded with ice-cold water, and containing *sixty-five cubic centimeters* [or 2 fluidounces, 95 minims] of Distilled Water. All the joints of the apparatus, except the neck of the receiver, having been made air-tight by means of well-fitting corks, pour into the retort, through the tubulure, the Sulphuric Acid, previously diluted with *twenty-five cubic centimeters* [or 6 fluidrachms, 45 minims] of Water. Gently mix the contents of the retort, and then heat it, in a sand-bath, so as to keep the liquid in brisk ebullition, until about one-half of its volume has passed over into the receiver. Detach the receiver, and assay a small portion of the contents by the method given below. Then add to the remainder so much Distilled Water as may be required to bring the product to the strength of *two per cent.*, by weight, of absolute Hydrocyanic Acid." *U. S.* 1890.

Diluted Hydrocyanic Acid may be prepared, extemporaneously, by the U. S. P. (8th Rev.) process: * "Silver Cyanide, *six grammes* [or 92.5 grains]; Diluted Hydrochloric Acid, *fifteen and fifty-four hundredths cubic centimeters* [or 4 fluidrachms, 12 minims]; Distilled Water, *forty-four and one-tenth cubic centimeters* [or 1 fluidounce, 3 fluidrachms, 56 minims]. Mix the Diluted Hydrochloric Acid with the Distilled Water, add the Silver Cyanide, and shake the whole together in a glass-stoppered bottle. When the precipitate has subsided, pour off the clear liquid." *U. S.*

The British Pharmacopœia does not give a detailed process for preparing this acid. It describes it as "a colorless liquid with a peculiar odor. Specific gravity 0.997. It only slightly reddens *litmus*. It yields, when neutralized, the reactions characteristic of cyanides." *Br.* It will be seen that both official acids recognize the same standard (2 per cent. of hydrogen cyanide).

When potassium ferrocyanide is decomposed by sulphuric acid, the residue in the retort is potassium sulphate, mixed with an insoluble compound of iron cyanide and potassium cyanide (*Everitt's Salt*). The reaction is expressed by the following equation:

$$2K_4FeC_6N_6 + 3H_2SO_4 = 3K_2SO_4 + 2KFeC_3N_3 + 6HCN$$

Half of the cyanogen present in the potas-

sium ferrocyanide goes to form the hydrocyanic acid, while the other half remains in the white residue. Everitt's salt, so named from its discoverer, is a yellowish-white powder. Like potassium ferrocyanide, it is a double salt (iron and potassium cyanide), but of different molecular ratio. As it appears in practice, it is apt to be greenish, owing probably to the presence of a little Prussian blue.

In the U. S. process for obtaining hydrocyanic acid extemporaneously, the reacting materials are single molecules respectively of silver cyanide and hydrochloric acid. These, by double decomposition, generate hydrocyanic acid, which dissolves in the water, and silver chloride, which subsides, and from which the acid is poured off when clear. (See *Argenti Cyanidum.*) The extemporaneous process is useful to country practitioners, because the acid will not keep indefinitely. A portion of hydrocyanic acid, if purchased by a practitioner, may spoil on his hands before he has occasion to use it; but if he supply himself with silver cyanide, he may readily at any moment prepare a small portion of the acid, by following the directions of the formula. It is doubtful, however, whether all of the silver cyanide will be decomposed, except under much more careful treatment than the process is likely to receive.

The change which was made in the process of the Pharmacopœia of 1880, in the substitution of diluted alcohol for the distilled water formerly used as the solvent for the hydrocyanic acid, was in accordance with the views of Gault and others, who asserted that greater stability was thus secured. It was not of sufficient value to be retained in the U. S. P. 1890, and the use of diluted alcohol was abandoned. (F. T. Drake, *Proc. A. Ph. A.*, 1891, p. 147.)

Another process for obtaining medicinal hydrocyanic acid, proposed by Clark, and adopted by Laming, is by the reaction of tartaric acid on potassium cyanide in solution. Laming's formula has been modified as follows: Potassium cyanide, pure, 65 parts; tartaric acid, 150 parts; alcohol, 675 parts; water, sufficient to make 1538 parts. Mix the potassium cyanide and tartaric acid with 500 parts of water in a well-stoppered bottle, or dissolve each separately in 250 parts of water, and mix the solutions; then add the alcohol and sufficient water to make 1538 parts. After the acid potassium tartrate has subsided as a heavy crystalline powder, the clear supernatant liquid is decanted.

The yield of official acid is 1350 parts, but the generated cream of tartar weighs 188 parts, thus making the 1538 parts as above directed. The solution contains mere traces of the acid tartrate. (*A. J. P.*, 1883, p. 559.)

Great care must be observed in using this process to procure pure potassium cyanide, the commercial article usually being adulterated.

Investigations have shown that potassium ferrocyanide is decomposable not only by the weakest acids but also by numerous non-acid organic substances, hydrocyanic acid being liberated; thus the diluted mineral acids (containing even less than 0.1 per cent.), formic, acetic, butyric, lactic, tartaric, benzoic acids, even carbon dioxide and hydrogen sulphide, phenols, peptones, casein, etc., will decompose potassium ferrocyanide more or less quickly at temperatures below 100° C., liberating a portion of the hydrocyanic acid. (*A. J. P.*, 1893, p. 283).

The processes thus far given are intended to furnish a *diluted* hydrocyanic acid for medicinal purposes. The methods of obtaining the *anhydrous* acid are different. Vauquelin's process for the anhydrous acid is to pass a current of hydrogen sulphide gas over mercuric cyanide contained in a glass tube, connected with a receiver kept cold by a freezing mixture of ice and salt. The first third only of the tube is filled with cyanide; the remaining two-thirds being occupied, half with lead carbonate, and half with calcium chloride; the carbonate being intended to retain the excess of hydrogen sulphide gas, while the chloride is intended to separate water.

The process of Wöhler for the anhydrous acid is the following: The potassium cyanide selected is a black cyanide, formed by fusing together, in a covered crucible, 8 parts of dry ferrocyanide, 3 of ignited cream of tartar, and 1 of charcoal in fine powder. The cyanide, while still warm, is exhausted by 6 parts of water; and the clear solution, placed in a retort, is decomposed by cold diluted sulphuric acid, gradually added. The hydrocyanic acid is condensed first in a U-tube containing calcium chloride and surrounded with ice cold water, and afterwards in a small bottle, connected with the U-tube by a narrow tube, and immersed up to the neck in a mixture of ice and salt. After the acid has been condensed and dehydrated in the U-tube, the cold water surrounding it is withdrawn by a siphon, and replaced by water at a temperature between 29.4° and 32.2° C. (85° and 90° F.), whereby the anhydrous acid is made to distil over into the small bottle. Wade and Panting prepare pure hydrocyanic acid by dropping a mixture of equal parts of sulphuric acid and water upon *pure* potassium cyanide and condensing the vapors. (*M. R.*, 1898, 339.)

Berthelot has made hydrocyanic acid synthetically. He first prepared, by a direct synthesis of its elements, *acetylene* (C_2H_2). He then mixed this gas with pure nitrogen, passed a series of electric discharges from a Ruhmkorff coil through the mixture, and, when the odor of prussic acid was perceptible, agitated with a solution of potassium hydroxide to get the fixed cyanide. It has also been made by heating chloroform with ammonia and potassium hydroxide solution. (Hofmann.)

Properties of the Diluted Acid.—Diluted hydrocyanic acid, of the proper medicinal strength, is officially described as "a colorless liquid, of a characteristic odor resembling that of bitter almonds. On account of its poisonous character *it should be tasted with great caution.*

It is completely volatilized by heat. Diluted Hydrocyanic Acid shows an acid reaction with blue litmus paper. If to 1 Cc. of the Acid, rendered alkaline by potassium hydroxide T.S., a few drops of ferrous sulphate T.S. be added and the mixture boiled and then acidulated with hydrochloric acid, a blue precipitate will be formed." *U. S.* It imparts a slight and evanescent red color to litmus. If it reddens litmus strongly and permanently, some acid impurity is present. It loses strength rapidly in open vessels. It is not reddened by potassium and mercury iodocyanide. The non-action of this test shows the absence of contaminating acids, which, if present, would react upon the iodocyanide and produce mercuric iodide. The red color produced when ammonium picrate is added to a solution of an alkaline cyanide and heated has been proposed as a test for prussic acid. (Guyot, *N. R.,* May, 1877.) It is liable to undergo decomposition if exposed to the light, but it may be kept for a longer time in a bottle covered with black paint or black paper. From experiments carefully conducted by Bussy and Buignet, it appears that, when the alteration in the acid under the influence of light has begun, it will afterwards go on very rapidly in the dark; and that after exposure for a certain time to the light, though no alteration may be apparent, an influence has nevertheless been exerted which disposes to change, and promotes decomposition even in the absence of light. Hence the necessity of immediately enclosing the acid in bottles from which the light is excluded. (*J. P. C.,* 1863, p. 475.) Experience has shown that it is best preserved in cork-stoppered bottles of amber glass; when glass and rubber stoppers were used, decomposition frequently took place rapidly.[1] Its most usual impurities are sulphuric and hydrochloric acids, the former of which may be detected by barium chloride, which will produce a precipitate of barium sulphate, and the latter by precipitating with silver nitrate, when so much of the precipitate as may be silver chloride will be insoluble in boiling nitric acid, while the silver cyanide is readily soluble.

It is now generally acknowledged that mineral acids prevent the deterioration of the diluted prussic acid. But the presence of a mineral acid is not necessary for its preservation, for Christison has known the medicinal acid from potassium ferrocyanide to keep perfectly well, although barium nitrate did not produce the slightest cloudiness. Nevertheless it has been frequently shown that much of the acid kept in the drug stores is below the official strength. Various remedies have been proposed. (*P. J.,* July, 1871; Feb. 1, 1874; Sept., 1874.) One of these is to reduce the strength to one-tenth per cent., this weak solution being said not to undergo change. In our experience a one per cent. acid retained its properties through very severe tests of exposure. John Williams has found in a series of experiments that the addition of 20 per cent. of glycerin has a very pronounced influence in preventing deterioration of the acid. (*P. J.,* Sept., 1874; Sept., 1875.)

Formerly the medicinal acid was of different strengths, as ordered by the different pharmaceutical authorities, but happily the U. S. and Br. Pharmacopœias conform in this important point. At one time its strength was indicated by its specific gravity, which is lower in proportion as it is stronger; but this inaccurate method is not now relied on, and, though the British Pharmacopœia gives the sp. gr. of its diluted acid at 0.997, both Pharmacopœias give quantitative tests as indices of the strength.

Assay.—U. S. P. 1890. "To ascertain the percentage strength, mix in a flask (of the capacity of about 100 Cc.) 0.27 Gm. of Hydrocyanic Acid (obtained by distillation as above directed) with sufficient water and magnesia to make an opaque mixture of about 10 Cc. Add to this 2 or 3 drops of potassium chromate test-solution, and then, from a burette, silver nitrate decinormal volumetric solution, until a red tint is produced which does not again disappear by shaking. Each Cc. of silver nitrate volumetric solution used indicates 1 per cent. of absolute Hydrocyanic Acid. After ascertaining the strength of the distillate, dilute it with Distilled Water so as to bring it to the strength of 2 per cent. of absolute acid. Lastly, test the finished product again, when 1.35 Gm. of it should require, for complete precipitation,

[1] Anhydrous hydrocyanic acid sometimes undergoes an apparently spontaneous molecular change by which it is converted into a black solid body, which was supposed to be *paracyanogen* or one of its compounds. This change takes place more slowly in aqueous solutions of the acid, which are converted into a black liquid, and it is only in a state of extreme dilution, when, for example, water contains not more than one per cent. of the acid, that it is altogether prevented. It sometimes takes place in the official diluted acid; and Procter exhibited a bottle, which had been most carefully closed, and kept excluded from the light, in which, nevertheless, the acid had become as black as ink. The cause of this phenomenon remained long unknown; but in 1862 M. E. Millon satisfied himself, by experiment, that the real agency was the presence of ammonia, which may sometimes operate even through the air. It has also been asserted that the cause of the decomposition is the presence of a microscopic plant. (*J. P. C.,* 1862, p. 48.) The preservative influence of a little sulphuric acid in the diluted hydrocyanic acid would be explained by its neutralization of ammonia; and it is not impossible that the greater resistance offered to the change by the preparation made by the original process, in which sulphuric acid is used, than by the others, may be owing to the influence of this acid, either passing over with its vapor, or acting on the acid vapor before it leaves the retort. An important practical inference from all this is the necessity of providing, as far as possible, that ammonia should in no manner have access to the acid, during or after its preparation. The effect of ammonia in inducing changes in diluted hydrocyanic acid is denied by Pettit. (*A. J. P.,* 1873.) Rimmington asserts that hydrocyanic acid acts upon the alkali of some varieties of glass. Siebold, who has confirmed this, declares that the addition of hydrochloric acid is useless as a preservative, except when prussic acid is kept in bottles which yield the alkali. (*P. J.,* Sept. 1874.) Lescolm and Rigaut (*C. R. A. S.,* Aug. 4, 1879) state that *pure* hydrocyanic acid can be preserved for a long time; but the presence of potassium cyanide causes decomposition even in the absence of water.

10 Cc. of silver nitrate decinormal volumetric solution." *U. S.* 1890. This method of assay is based upon Pappenheim's process for the determination of hydrocyanic acid in bitter almond water, as described by Veilhaber in *A. Pharm.*, 1878, p. 408. In the absence of free mineral acid silver nitrate precipitates the whole of the cyanogen as white silver cyanide before any of the red silver chromate is formed; the test is vitiated by the presence of hydrochloric acid or chlorides and has been replaced in the U. S. P. 8th revision by the following test, which resembles in principle that of the British Pharmacopœia: "If 5 Gm. of Diluted Hydrocyanic Acid be diluted with distilled water to measure 50 Cc., then 26.9 Cc. (26.84 Cc.) of this solution, after the addition of 5 Cc. of ammonia water and 3 drops of potassium iodide T.S., should require for the production of a slight permanent precipitate, the addition of not less than 10 Cc. of tenth-normal silver nitrate V.S." *U. S.* The Br. Pharmacopœia directs that "each gramme of Diluted Hydrocyanic Acid, rendered alkaline by the addition of *solution of sodium hydroxide*, and maintained faintly alkaline throughout the operation, should require the addition of 3.7 cubic centimetres of the *volumetric solution of silver nitrate* before a permanent precipitate begins to form." *Br.*

Tests.—The Br. Pharm. requires that "5 cubic centimetres evaporated in a platinum dish should leave no residue. It should yield only the slightest reactions with the tests for sulphates or chlorides." *Br.* To explain the volumetric test it should be noticed that silver cyanide, though itself insoluble, is rendered soluble by combining with sodium cyanide, in the proportion of one molecule of each. When, therefore, the diluted hydrocyanic acid is converted, by the addition of sodium hydroxide, into sodium cyanide, no permanent precipitate will begin to appear, upon the addition of silver nitrate, until more than sufficient silver cyanide is produced to form the soluble compound referred to, which happens when one-half of the sodium cyanide has been converted into silver cyanide. An acid of the strength indicated by either of these methods contains two per cent. of anhydrous acid. The former test of entire solubility in boiling nitric acid, applied to the precipitate obtained by silver nitrate, was intended to verify its nature; for, if the hydrocyanic acid contained hydrochloric acid, part of this precipitate would be silver chloride, not soluble in the boiling acid. *Scheele's medicinal hydrocyanic acid* contains about 5 per cent. of anhydrous acid, and therefore two minims of it are equal to five of the U. S. acid. The use of Scheele's acid should be discouraged as unnecessary and very dangerous. In view of the deterioration of hydrocyanic acid upon keeping through loss by volatilization, the following approximate practical test is recommended by E. R. Squibb: If one drop of diluted hydrocyanic acid be added to 15 Cc. of distilled water in one vessel, and one drop of silver nitrate test solution (U. S. P.) be added to 7 Cc. of distilled water in a test tube, and the first solution be dropped into the second from a pipette, and the contents be closely observed for a few seconds between the drops, a distinct opalescence should be observed before the fourth drop is added, and should become very marked as the fourth and fifth drops are added.

Fordos and Gélis have proposed, as a test of the strength of the compounds containing cyanogen, an alcoholic solution of iodine of known strength; as, for example, three grains to the fluidounce. The test solution is added, drop by drop, to the cyanogen compound, until a permanent yellowish tinge is produced. The iodine unites with the cyanogen, and with the substance in combination with the cyanogen, in the ratio of their several equivalents; and hence the cyanogen present is easily calculated from the proportion of iodine expended in uniting with it. This test is commended for its accuracy by James Roberton of Manchester, Eng. (See *A. J. P.*, 1853, p. 551.) Link and Moeckel (*Zeit. An. Chem.*, 1878, p. 455) made a series of experiments, and showed that the most delicate test for hydrocyanic acid was that of iron sulphocyanate. (*A. J. P.*, 1879, p. 86.)

Properties of the Anhydrous Acid.—Hydrocyanic acid, perfectly free from water, is a colorless, transparent, inflammable liquid, of extreme volatility, boiling at 27° C. (80° F.), and congealing at —15° C. (5° F.). Its sp. gr. as a liquid is 0.6969, at the temperature of 18° C. (64° F.); and as a vapor 0.9423. Its taste is at first cooling, then burning, with an after-taste in the throat like that of bitter almonds; but, from its extremely poisonous nature, it must be tasted with the utmost caution. Its odor is so strong as to produce immediate headache and giddiness, and its vapor so deleterious that the smallest portion of it cannot be inhaled without the greatest danger. Both water and alcohol dissolve it readily. It is much more prone to undergo decomposition than the diluted acid. In the course of a few hours it sometimes begins to assume a reddish-brown color, which becomes gradually deeper, till at length the acid is converted into a black liquid, which exhales a strong odor of ammonia. It is a very weak acid in its chemical relations, and reddens litmus but slightly. It does not form solid compounds with metallic oxides, but cyanides of metals, the elements of water being eliminated. According to Sobero, hydrocyanic acid is generated, in sensible quantities, by the action of weak nitric acid on the volatile oils and resins. Wöhler affirmed in 1828 that picric acid when treated with baryta water yields it; and Julius Post and H. Hübner have found that nitrobenzene and dinitrobenzene do also when treated, the former with fusing potassium hydroxide, the latter with boiling diluted solution of potassium hydroxide. Though a product of art, it exists in some plants, and is

generated by reaction between the constituents of many vegetable products upon contact with water. These principles are usually amygdalin and emulsin, but according to Peckholt the root of *Manihot utilissima* (Pohl) copiously generates hydrocyanic acid with water, although he was unable in 15 analyses to find amygdalin in it. (*A. J. P.*, Oct., 1872.) (See *Amygdala Amara.*)

Composition.—Hydrocyanic acid consists of one atom each of cyanogen and hydrogen; or, in volumes, of one volume of cyanogen and one of hydrogen without condensation, its formula being HCN or HCy. *Cyanogen,* $(CN)_2$, is a colorless gas, of a strong and penetrating odor, inflammable, and burning with a beautiful bluish-purple flame. Its sp. gr. is 1.8157. It was discovered in 1815 by Gay-Lussac, who viewed it as a compound radical which when combined with hydrogen becomes hydrocyanic acid. Hydrocyanic acid, in a diluted state, was discovered in 1780 by Scheele, who correctly stated its elements to be carbon, nitrogen, and hydrogen; but the peculiar way in which they are combined was first pointed out by Gay-Lussac, by whom also the anhydrous acid was first obtained.

Uses.—Diluted hydrocyanic acid has been much used in respiratory diseases and to quiet *cough,* but its action is so fugacious that it has really very little medicinal value except as a local remedy in sick stomach of nervous origin and in *gastrodynia.* Externally, it may be of great service in *pruritus.*

It should be administered with the greatest caution, on account of its minute dose, and its variable strength as usually found. The proper plan, therefore, is to begin with a small dose, two drops, for example, and gradually to increase the quantity until some obvious impression is produced. On account of the rapidity and fugaciousness of its action, it should be given at intervals of not more than two hours; indeed, it is very improbable that the largest therapeutic dose of the substance exerts any influence whatever upon the system one hour after its ingestion. If giddiness, weight at the top of the head, sense of tightness at the stomach, or faintness come on, its use should be discontinued. In all cases in which a fresh portion of medicine is used, the dose should be lowered to the minimum quantity, lest the new sample should prove stronger than that previously employed. When resorted to as a lotion, from thirty minims to a fluidrachm may be dissolved in a fluidounce of distilled water.

Dose, one to four minims (0.06 to 0.25 Cc.).

Toxicology.—Hydrocyanic acid is one of the most deadly poisons known, and frequently exceedingly rapid in its action. According to Christison, a grain and a half of the anhydrous acid is capable of producing death in the human subject. One or two drops of the pure acid are sufficient to kill a vigorous dog in a few seconds. Sometimes death occurs almost instantaneously. Usually, however, three stages of the poisoning are manifest: a first, very brief one, of difficult respiration, slow cardiac action, and disturbed nervous action; a second, violent convulsive stage, with dilated pupils, vomiting, often loud cries, unconsciousness, etc.; and a third, closing period, of asphyxia, collapse, and paralysis, sometimes interrupted by convulsions. When smaller doses are ingested, the symptoms come on more slowly, but are similar to those just described, and when paralysis is developed it affects both motility and sensation. A peculiar bloated look of the deeply suffused face and neck, with frothing at the mouth, occurring along with the symptoms previously described, is almost pathognomonic of the poisoning. The odor of hydrocyanic acid is sometimes very strong, and should always be searched for about the mouth. It is very important as an aid in the diagnosis, but is certainly not always present. Death is usually the result of asphyxia, produced by a direct paralyzing action of the poison upon the respiratory centres. The poison appears also to have a direct paralyzing action upon the heart, and sometimes to produce fatal syncope. The post mortem appearances are glistening and staring expression of the eyes, gorged state of the venous system with fluid, dark, or bluish-black blood. The lungs are sometimes natural, at other times turgid with blood. The blood may be of a uniform arterial or venous hue, according as the death has been rapid or slow. Death, if it should occur, usually takes place in from one to forty minutes. One case has, however, been reported in which it was delayed one hour and a quarter. When recovery is brought about, the symptoms in most cases abate very rapidly. T. & H. Smith of Edinburgh, recommended as an antidote for the medicinal acid a mixture of ferric salts, swallowed after the administration of magnesia as follows: From one to two drachms of magnesia, made into a smooth cream with water, are to be first swallowed, and then 16 minims of solution of perchloride of iron (*Br.*) and 12½ grains of ferrous sulphate dissolved in water. These quantities are calculated for 100 minims of medicinal hydrocyanic acid. Should more than this be supposed to have been taken, the ferruginous ingredients must be increased in proportion, but not the magnesia. (*P. J.*, 1865, 276.) Cobaltic nitrate has been found, in some cases when injected freely into the lower animals, to lessen the symptoms of cyanic poisoning, but is itself so poisonous that its use in the human subject is hardly justifiable. (*Ph. Z. R.*, 33, 518.) Attempts have been made to neutralize hydrocyanic acid in the system by converting it into a haloid compound through the subcutaneous injection of solutions of bromized sodium bromide and iodized sodium iodide (see Goldfarb, *Wirkungen d. Jodcyans, Dissert., Dorpat,* 1892), but this mixture has been condemned by Kobert, and in itself does not seem to us at all advisable. Kobert and Krohl (*Arbeiten d. Pharm. Inst. z. Dorpat,*

1891, vii.; *Ph. Centralh.*, 1891) have found that in the lower animals good results may be achieved in the poisoning by the conversion in the system of the prussic acid into oxamide by means of peroxide of hydrogen. The oxamide is itself somewhat poisonous, and after its production it is essential to give large draughts of water to wash it out of the system. It is affirmed that in various mining and extracting establishments, and in certain chemical works, where the cyanides are used in enormous quantities, Kobert's method is practically employed, and Merck furnishes what is known as an "antidote-box," containing the necessary apparatus and the supply of hydrogen peroxide. When the cyanide has been taken into the system the peroxide must be introduced by means of a stomach tube into the stomach itself, and the latter should then be washed out. Before or immediately after the administration by the mouth the salts should be given hypodermically. In cases of poisoning by inhalation the antidote should be used subcutaneously. The poison's action is, however, so rapid that there is rarely time for any antidote to be of value. Atropine, which has been suggested as physiologically antagonistic to hydrocyanic acid, has no antidotal value.

Tests.—After suspected death from poison, it is sometimes necessary to ascertain whether the event was caused by the acid. At a period long after death it would be needless to search for so volatile a poison; but it has been recognized three weeks after death, in a case reported by Brame, in which about six drachms of acid, containing between 8 and 9 per cent. of anhydrous acid, had been swallowed. If the autopsy be not too long deferred, the odor of the acid is generally perceptible when the cadaver is opened. The odor after nitrobenzene poisoning resembles very closely that of the acid, but it is affirmed that the diagnosis can be made by leaving the opened body exposed; the odor of the acid will disappear, and that of the nitrobenzene remain. One of the best tests is that proposed by Liebig in 1847, consisting in the change of the hydrocyanic acid into ammonium sulphocyanate, which salt is then tested with a ferric salt. Two drops of the acid, so diluted as not to afford the least blue tint with the salts of iron, upon being mixed with a drop of ammonium sulphydrate (yellow from dissolved sulphur), and heated upon a watch glass until the mixture is colorless, yield a solution of ammonium sulphocyanate which becomes of a deep blood-red color upon the addition of ferric sulphate, in consequence of the formation of iron sulphocyanate. (*Chem. Gaz.*, April 1, 1847; from *An. Ch. Ph.*) This test is praised by A. S. Taylor, who found it to act characteristically on two grains of diluted hydrocyanic acid, containing only 1-3930th of a grain of anhydrous acid. To render the test this delicate, Taylor deems it necessary to evaporate the liquid gently to dryness, after the addition of the ammonium sulphydrate, in order to bring the sulphocyanate to the solid state before adding the ferric salt, a fractional part of a drop of which will commonly suffice to produce the characteristic color. The red color is instantly discharged by solution of corrosive sublimate or mercuric nitrate, and is thus distinguished from that which might possibly be produced under similar circumstances by acetic acid. Should the acid be mixed with organic matters, Taylor proposes a modification of Liebig's test, as follows: Place it in a watch glass, and invert over it another, holding in the centre a drop of ammonium sulphydrate. In from half a minute to ten minutes, without heat, the ammonium sulphydrate will be converted into ammonium sulphocyanate, and upon removing the upper glass, and evaporating its contents to dryness, the ferric salt will produce the blood-red color. Even more delicate than the sulphocyanate reaction is the formation of Prussian blue as follows: A drop or two of ferrous sulphate solution is added to the suspected liquid together with one drop of solution of ferric chloride, and the mixture shaken and heated gently; on acidifying now with diluted hydrochloric acid, blue flocks of precipitated Prussian blue separate, or with very diluted solutions a blue or bluish-green color is obtained. O. Henry and E. Humbert have proposed, as a test for hydrocyanic acid, first to convert it into silver cyanide by distilling the suspected matters into a diluted solution of silver nitrate, and then to decompose the cyanide by iodine, so as to form cyanogen iodide. The dried cyanide is added to half its estimated weight of *pure* iodine, contained in a test tube. Upon the application of a gentle heat, cyanogen iodide is formed, and characteristic crystals of it are deposited on the cool surface of the tube. (*J. P. C.*, 1857, p. 173.) Wormley (*Micro-Chemistry of Poisons*, 2d ed., 186) considers the silver nitrate test as the most delicate of all when the hydrocyanic acid vapor is distilled from a mixture and received in a drop of silver nitrate solution placed in a watch glass above it.

An extremely sensitive test of hydrocyanic acid in the state of vapor has been offered by Schönbein. It consists of white filtering paper imbued with the resin of guaiacum by dipping it in a solution of 3 parts of the resin in 150 of alcohol, and then drying. At the moment of use it is to be moistened with a solution of copper sulphate containing 1 part in 500 parts of water. If now brought into contact with hydrocyanic acid, whether dissolved in water or diffused in the air in the form of vapor, it instantly becomes blue. According to Schönbein, it will change color in air containing only a forty-millionth part of hydrocyanic acid. The test cannot, however, be relied on, since a similar reaction is yielded by numerous other substances, such as nitrous, nitric, and hydrochloric acids, chlorine, bromine, iodine, ammonia, diluted sulphuric acid, chromium trioxide, potassium dichromate, etc. The

paper should be exposed to a current of air drawn through the suspected liquid, and, if indications be yielded, distillation practised to get the volatile acid in a state of sufficient purity to be submitted to the sulphocyanate test. This, as performed by Almén and Strieve, consists in adding ammonium sulphide, to form the sulphocyanate, converting this into the non-volatile potassium sulphocyanate by the addition of a few drops of solution of potassium hydroxide, then evaporating nearly or quite to dryness, adding a few drops of water acidulated with hydrochloric acid, and finally adding a drop or two of solution of ferric chloride, when the blood-red color of the sulphocyanate will be developed. (*B. M. S. J.*, July, 1873.) Another test, which was proposed by Schönbein, and which was found by Büchner to be exceedingly delicate, is dependent upon the power prussic acid has of preventing the catalytic action of the red blood corpuscles. Normally, when these are brought into contact with hydrogen peroxide, the latter is decomposed and oxygen liberated; if prussic acid be present, no oxygen is set free, but the mixture becomes of a deep brown color. In this way Büchner recognized 5 milligrammes of the anhydrous acid in 600 grammes of blood and water. This test is not applicable to old blood.

A very delicate test proposed for hydrocyanic acid is as follows: About one-half centigramme (one-twelfth grain) of ammonio-ferrous sulphate (or other pure ferrous salt) and the same quantity of uranic nitrate are dissolved in 50 Cc. of water, and 1 Cc. of this test liquid is placed in a porcelain dish. On now adding a drop of a liquid containing the smallest quantity of prussic acid, a gray purple color or a distinct purple precipitate is produced. (M. Carey Lea, *Am. J. Sci.* [3], ix. 121–123.)

Dose, of diluted hydrocyanic acid, one to four minims (0.06 to 0.25 Cc.).

Off. Prep.—Tinctura Chloroformi et Morphinæ Composita, *Br.*

ACIDUM HYPOPHOSPHOROSUM. U. S.

HYPOPHOSPHOROUS ACID

(ăç′ĭ-dŭm hȳ-pŏ-phŏs-phŏ-rō′sŭm)

"A liquid composed of 30 percent., by weight, of absolute Hypophosphorous Acid [$PO.H_2(OH) = 65.53$], and 70 percent. of water. It should be kept in glass-stoppered bottles." *U. S.*

Acide hypophosphoreux, *Fr.;* Unterphosphorigesaure, *G.*

This acid was introduced into the U. S. P. (8th Rev.) to have a permanent concentrated solution of hypophosphorous acid which could be conveniently reduced in strength by adding water, as in making the official diluted acid.

Properties.—It is officially described as "a colorless liquid, without odor, and having an acid taste. Specific gravity: about 1.130 at 25° C. (77° F.). Miscible, in all proportions, with water. Hypophosphorous Acid, even when largely diluted with water, has an acid reaction upon blue litmus paper. When heated in a porcelain dish, water evaporates, and the acid becomes more concentrated. On further heating between 130° and 140° C. (266° and 284° F.), it decomposes, forming hydrogen phosphide, which ignites, and phosphorous acid; the latter between 160° and 170° C. (320° and 338° F.) decomposes into hydrogen phosphide and phosphoric acid; the pasty residue finally reddens, ignites, and the last portions of unoxidized phosphorus burn out at a higher temperature. The addition of silver nitrate T.S. to Hypophosphorous Acid, diluted with an equal volume of water, produces a black precipitate of metallic silver; the addition of mercuric chloride T.S., a white precipitate of mercurous chloride. When the Acid is gently heated with copper sulphate T.S., a yellow precipitate forms, which rapidly assumes a reddish-brown color. If some of the Acid be neutralized with ammonia water, a clear liquid should result, and a portion of this liquid should not become turbid upon the addition of potassium sulphate T.S. (absence of *barium*); nor should more than a slight turbidity be produced in another portion by barium chloride T.S. (limit of *phosphoric, phosphorous, sulphuric, oxalic,* and *tartaric acids*). Ten Cc. of the Acid should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Neither platinic chloride T.S. nor sodium cobaltic nitrite T.S. should produce more than a slight yellow turbidity in the diluted Acid (limit of *potassium*). If 2 Cc. of Hypophosphorous Acid be measured into a beaker containing 3 Cc. of nitric acid, which has been previously diluted with about 10 Cc. of water, and the whole evaporated to dryness on a bath of boiling water, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 10 Gm. of Hypophosphorous Acid be diluted with distilled water to measure 100 Cc., then 65.5 Cc. of this solution should require 30 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Hypophosphorous Acid), methyl-orange T.S. being used as indicator." *U. S.*

Uses.—This acid is not used for medicinal purposes; in pharmacy it is employed in making the diluted acid.

Off. Prep.—Acidum Hypophosphorosum Dilutum, *U. S.*

ACIDUM HYPOPHOSPHOROSUM DILUTUM. U. S.

DILUTED HYPOPHOSPHOROUS ACID

(ăç′ĭ-dŭm hȳ-pŏ-phŏs-phŏ-rō′sŭm dī-lū′tŭm)

"A liquid composed of 10 percent., by weight, of absolute Hypophosphorous Acid [$PO.H_2(OH) = 65.53$], and 90 percent. of water." *U. S.*

Acide Hypophosphoreux dilué, *Fr.;* Verdünnte Unterphosphorigesaure, *G.*

* "Hypophosphorous Acid, *two hundred grammes* [or 7 ounces av., 24 grains]; Distilled Water, *four hundred grammes* [or 14 ounces av., 48 grains], to make *six hundred grammes* [or 21 ounces av., 72 grains]. Mix them. Keep the product in well-stoppered bottles." *U. S.*

This acid was introduced into the U. S. Pharmacopœia of 1890, and retained in the 8th Revision mainly because of its value as an addition, as a reducing agent, to pharmaceutical preparations containing iodides, which are liable to decomposition through exposure to light and air. Diluted hypophosphorous acid has proved to be the most satisfactory preservative to these easily decomposed salts. It may be added directly, or, as in the case of diluted hydriodic acid, a hypophosphite can be employed, and the salt decomposed by an acid during the manipulation. It may be made on a large scale, however, by boiling phosphorus with milk of lime and subsequently decomposing the calcium hypophosphite with a strong acid, oxalic acid being frequently used for this purpose. The following process of Procter's (*A. J. P.*, 1858, p. 121) is based on this principle. Take of calcium hypophosphite 480 grains, crystallized oxalic acid 350 grains, distilled water 9 fluidounces. Dissolve the hypophosphite in 6 fluidounces of the water, and the acid in the remainder with the aid of heat; mix the solutions, pour the mixture on a white paper filter, and when the liquid has passed add distilled water carefully till it measures 10 fluidounces; evaporate this to 8½ fluidounces. Charles T. Tyrer prefers to make this acid by decomposing barium hypophosphite carefully with diluted sulphuric acid. Hypophosphorous acid can be made to contain 30 per cent. of absolute acid; such an acid has the sp. gr. of 1.137 at 15.6° C. (60° F.), and does not deposit on long standing. (See preceding article.)

Properties.—Diluted hypophosphorous acid is a colorless, odorless liquid, having a sour taste and acid reaction: "Specific gravity: about 1.042 at 25° C. (77° F.). It should respond to the reactions and tests given under *Acidum Hypophosphorosum*. If 10 Gm. of Diluted Hypophosphorous Acid be diluted with distilled water to measure 100 Cc., then 65.5 Cc. of this solution should require 10 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Hypophosphorous Acid), methyl-orange T.S. being used as indicator." *U. S.*

Uses.—This acid is believed by many clinicians to have tonic properties, but is very rarely, if ever, used for medicinal purposes except in combinations with strychnine, quinine, or iron, which are thought by many practitioners to be especially valuable in *nervous debility*.

Dose, from five to twenty minims (0.3 to 1.3 Cc.).

Off. Prep.—Syrupus Ferri Iodidi, *U. S.*; Syrupus Hypophosphitum, *U. S.*; Syrupus Hypophosphitum Compositus, *U. S.*

ACIDUM LACTICUM. U. S., Br.

LACTIC ACID

(ăç'ĭ-dŭm lăc'tĭ-cŭm)

"A liquid organic acid, composed of not less than 75 percent., by weight, of absolute Lactic Acid [$CH_3.CHOH.COOH = 89.37$], and about 25 percent. of water." *U. S.* "A liquid containing 75 per cent. of hydrogen lactate, $C H_3.CHOH.COOH$, with 25 per cent. of water. It may be produced by the fermentation of lactose." *Br.*

Oxypropionic Acid, Ethidenelactic Acid, Isolactic Acid; Acide lactique, *Fr. Cod.*; Acidum lacticum, *P. G.*; Milchsaure, *G.*; Acido lactico, *Sp.*

Lactic acid was discovered in 1780 by Scheele. It exists in sour milk, and has been found in a number of the secretions, including the healthy gastric juice, in which its presence has been incontestably proved by Bernard and Barreswil. Lactic acid has been proved to be a product of the viscous or lactic fermentation of rice water, or of the juices of the beet, turnip, and carrot. Indeed, it is formed whenever sugar in solution, of whatever kind, is placed in contact with an alkaline or earthy carbonate in presence of a special ferment, as, for example, the casein of milk, or cheese which contains it. Pasteur demonstrated that the lactic acid fermentation, like the vinous, is caused by a peculiar microscopic plant or mycoderm. It is attended with the production not only of lactic acid, but of other substances also, and among them a peculiar gum-like substance in abundance, which, first noticed by Kirchof, has been isolated in a pure state by Brüning. Though similar to arabin and dextrin, with the formula $C_6H_{10}O_5$, it is not exactly identical with either. The lactic acid of fermentation is one of four isomeric acids possessing the formula $C_3H_6O_3$. The *first* of these is the official lactic acid, and is inactive optically. The *second* is identical chemically with this, but physically different, being dextrorotatory, and is found in the juice of flesh. It is called *paralactic acid*. The *third* or *ethylene lactic acid* is found mixed with the second in the so-called "*sarcolactic*" acid extracted from meat. The *fourth* acid has only been obtained synthetically, and is known as *hydracrylic acid*.

Preparation.—Lactic acid may be obtained by the following process, which was recommended by Louradour as the first step in preparing ferrous lactate: Ferment whey by keeping it at a temperature between 21.1° C. (70° F.) and 26.6° C. (80° F.), whereby it becomes charged with a considerable quantity of lactic acid. Evaporate the liquor to one-third of its bulk, decant and filter, and then saturate with milk of lime. This converts the lactic acid into calcium lactate, which remains in solution, and

a precipitate is thrown down, consisting principally of calcium phosphate. The liquor is filtered again, and precipitated by oxalic acid, which throws down the lime as calcium oxalate, and sets free the lactic acid. By a third filtration a solution of lactic acid is obtained, containing lactose (sugar of milk) and certain salts. From these it may be purified by concentrating it to a syrupy consistence and treating it with alcohol, which dissolves the acid, and precipitates the lactose and foreign salts. The solution is filtered, and the lactic acid is obtained pure by distilling off the alcohol. Wackenroder's method is to mix 10 parts of skimmed milk, 2.5 of milk sugar, 2 of chalk, and 20 of water, to digest at about 23.8° C. (75° F.) for a month, or till the chalk is dissolved, then to express, clarify, and evaporate so as to crystallize the calcium lactate, and, after recrystallization, to decompose it with sulphuric or oxalic acid in exact saturating proportions.

Alan A. Claflin thus describes the manufacture of lactic acid as carried out at the present time on a large scale under the patent of Charles E. Avery (*J. Soc. Chem. Ind.,* June 30, 1897). A saccharine solution varying in density from 1.05 to 1.075 is taken. This will contain from 7.5 to 11 per cent. of saccharine matter. It is advantageous to have from 10 to 15 per cent. of this, cane sugar, the rest being grape sugar. The saccharine solution, having been made up and boiled for an hour to insure sterilization, is conveyed into the fermentation tank and cooled to from 55° to 45° C., and then impregnated with nitrogenous matter (such as is extracted from bran by the action of boiling water and diluted acid) in amount equal to about 8 per cent. of the saccharine matter, and the *Bacillus acidi lactici.* In continuous manufacture the ferment solutions are impregnated from a preceding ferment liquor in which a lively fermentation is in progress; 20 per cent. of such impregnating liquor may be added. The impregnation having taken place at 45° C. or over, the temperature is allowed to decrease somewhat as the fermentation proceeds. The glucose is practically all decomposed, and the yield of lactic acid is over 98 per cent. As the fermentation progresses the solution must be neutralized with milk of lime, as the limits of acidity in which lactic acid bacteria are healthy are rigidly confined between 0.02 and 0.5 per cent. If the fermenting solution is overneutralized, the butyric ferment will immediately begin to act, and once active is difficult to control. The lactic fermentation is best completed in from three to six days, and when the fermentation is ended, the liquor must be heated sharply to kill all bacteria and spores and prevent subsequent fermentation. The solution is now filtered and evaporated, when calcium lactate may be crystallized out; or if commercial syrupy acid only is required, the solution may be at once decomposed by sulphuric acid.

Kiliani (*Ber. d. Chem. Ges.,* xv. 136 and 699) has found that lactic acid may be readily prepared by the action of potassium or sodium hydroxide upon either grape sugar or invert sugar (*i.e.,* cane sugar after treatment with diluted acids). He considers invert sugar to be the best material for use in preparing the acid, as it gives a better yield than ordinary glucose, and recommends caustic soda in preference to caustic potash.

His method for the preparation of lactic acid is as follows: 500 grammes of cane sugar are placed with 150 grammes of water and 10 Cc. of the sulphuric acid, in a stoppered flask of 2 liters' capacity and heated for 3 hours to about 50° C. (122° F.). The solution of invert sugar so obtained is colorless, or at most faintly yellow. After cooling there is to be added to it in portions of 50 Cc. at a time 400 Cc. of a caustic soda solution made by dissolving 1 part of caustic soda in 1 part of water. The strong alkali settles at first as a slimy mass on the bottom, and a new portion is only to be added when the mixture has become perfectly homogenous by shaking. The flask should also be cooled with water while the alkali is being added. The mixture nevertheless becomes colored and greatly heated. Finally the mixture is heated to 60° or 70° C. (140° to 158° F.) until a portion heated over a boiling water bath does not separate cuprous oxide from Fehling's solution, but gives it only a slight greenish tinge. Into the cooled mixture the calculated amount of sulphuric acid (made by mixing 3 parts of sulphuric acid with 4 of water) is then run. As soon as the acid liquid has cooled to the temperature of the room, a crystal of Glauber's salt is dropped in and the flask dipped in cold water until a thin crystalline crust forms on the sides, which is removed by a rapid shaking of the flask. Cooling and shaking are continued until a crust no longer forms, when the mixture is allowed to stand at rest for 12 to 24 hours. At the end of this time the contents of the flask appear to consist of a crystalline cake soaked with a reddish liquid. There is then added alcohol of 93 per cent., and the whole is shaken up until on further addition no precipitate separates out. The separated Glauber's salt is freed from the alcoholic solution by a vacuum filter, and can be washed with relatively very little alcohol. The half of the alcoholic solution is neutralized over the water bath with zinc carbonate, filtered boiling hot, and united with the other half. The crystallization begins immediately upon cooling, and is complete after standing 36 hours. The zinc lactate so obtained can be pressed free from mother liquor and crystallized once, when it is perfectly pure. The weight of this first crystallization amounts to from 30 to 40 per cent. of the sugar used. The concentrated mother liquor yields yet another portion of nearly pure, although slightly yellowish, crystals. The zinc lactate may then be treated with hydrogen sulphide to remove the zinc. For a method of making lactic acid from corn meal, see *N. R.,* 1882, p. 235.

George Jacquemin adds the pure lactic ferment, prepared by Pasteur's method, with a quantity of pure sterilized calcium carbonate, to a wort at 45° C. Fermentation is conducted at that temperature, care being taken to exclude dust, to admit filtered air at the bottom of the vessel, and to allow the carbon dioxide to escape. Fermentation is complete in five or six days, and the solution of calcium lactate is freed from nitrogenous matters by the addition of tannic acid. The calcium lactate crystallizes out on evaporation of the filtrate. This may be decomposed with an exact quantity of sulphuric or oxalic acid. (*Chem. News,* 1891, lxiv. 62.) Beckers (*Ap. Ztg.,* 1899, 400) patented a process for making lactic acid from the liquors obtained in the manufacture of "sour krout" which were formerly wasted. The liquor is neutralized with lime, filtered, evaporated and set aside to crystallize; the calcium lactate is purified, if necessary, by washing or recrystallization and then dissolved in cold water and the solution treated with sufficient sulphuric acid to set free the lactic acid.

Properties.—Lactic acid is "a colorless, syrupy liquid, odorless, of a purely acid taste, and absorbing moisture on exposure to damp air. Specific gravity: about 1.206 at 25° C. (77° F.). Freely miscible with water, alcohol, or ether; insoluble in chloroform, petroleum benzin, or carbon disulphide. Lactic Acid is not vaporized by a heat below 160° C. (320° F.); at a higher temperature it emits inflammable vapors, and is finally dissipated; 5 Gm., after combustion, should not leave more than 0.05 Gm. of fixed residue. Lactic Acid has an acid reaction upon blue litmus paper. On adding some potassium permanganate to a mixture of equal volumes of Lactic and sulphuric acids, and gently heating, the odor of aldehyde will become perceptible." *U. S.*

Exposed to a temperature of 150° C. (302° F.), it is for the most part converted into a new body, which is called concrete lactic acid or *lactide,* an anhydride having the formula $C_3H_4O_2$. It coagulates albumin and dissolves a large quantity of freshly precipitated calcium phosphate, a property which doubtless renders it important in the animal economy. "Ten Cc. of a solution of the Acid in distilled water (1 in 100) should not be rendered opalescent by 1 Cc. of silver nitrate T.S. (limit of *chloride*). Ten Cc. of an aqueous solution (1 in 10) should remain unaffected by the addition of 1 Cc. of barium chloride T.S. (absence of *sulphate*), or by 1 Cc. of copper sulphate T.S. (absence of *sarcolactic acid*), nor should it respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). On adding a few drops of Lactic Acid to 10 Cc. of hot alkaline cupric tartrate V.S., no red precipitate should be formed (absence of *sugars*). On warming Lactic Acid, the odor of rancid fat should not be noticeable (absence of *butyric* and *other fatty acids*). If a small portion of the Acid be heated on a water-bath with an excess of zinc carbonate, the mixture dried at 100° C. (212° F.), and then extracted with absolute alcohol, upon evaporation of the latter no sweet residue should remain (absence of *glycerin*). On carefully pouring Lactic Acid upon an equal volume of colorless, concentrated sulphuric acid contained in a clean test-tube, and keeping the temperature at or below 15° C. (59° F.), no dark-colored zone should develop at the line of contact upon standing for fifteen minutes (absence of more than traces of *organic impurities*). If 5 Gm. of Lactic Acid be diluted with water to measure 50 Cc., then 44.7 Cc. of this solution should require for complete neutralization not less than 37.5 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 2 percent. of absolute Lactic Acid), phenolphthalein T.S. being used as indicator." *U. S.* "Warmed with *potassium permanganate* it gives the odor of aldehyde. Each gramme should require for neutralization 8.3 cubic centimetres of the *volumetric solution of sodium hydroxide.* . . . Gently warmed, there should be no rancid odor (absence of fatty acids). No turbidity, either permanent or transient, should be produced when the Acid is added drop by drop to twice its volume of *ether* (absence of gum, sugar, mannite, calcium phosphate). It should give no precipitate with *solution of lead subacetate* (absence of malic and sulphuric acids)." *Br.* At the last revision, *diluted lactic acid* (*Acidum Lacticum Dilutum, Br.,* 1885) was dropped from the British Pharmacopœia; the old preparation was of the strength of three fluidounces to the pint (Imp. meas.) and had a specific gravity of 1.040. The U. S. P. (8th Rev.) and the British Pharmacopœia now recognize the 75 per cent. acid.

Uses.—Lactic acid has been used in *dyspepsia;* for the removal of *phosphatic deposits* in the urine; also used in *tuberculous diarrhœa,* and in the *green diarrhœa of children.* The remedy should be taken at the time of meals, in solution sweetened with sugar, prepared like lemonade. Cantani, of Naples, was induced by theoretical considerations to employ lactic acid in *diabetes,* and reported very remarkable success. (*Ed. M. J.,* 1871, p. 533.) The use of this remedy, however, has not met with the success anticipated.

Hypnotic properties have also been ascribed to lactic acid, but the claim has not been verified. In concentrated form lactic acid is an active caustic; when diluted it is stimulant and germicidal. The 50 to 80 per cent. solution has been used as a caustic antiseptic in *infected wounds, ozæna, otitis, endometritis,* etc.; the 20 per cent. solution has been used for the destruction of false membrane in *diphtheria;* the three per cent. solution has been strongly recommended by Sneguirewa for irrigation in foul *leucorrhœas.*

Dose, twenty to thirty minims (1.3 to 1.8 Cc.).

Off. Prep.—Syrupus Calcii Lactophosphatis, *U. S., Br.*

ACIDUM NITRICUM. U. S., Br.

NITRIC ACID

(ăç'ĭ-dŭm nī'trĭ-cŭm)

"A liquid composed of 68 percent., by weight, of absolute Nitric Acid [HNO_3 or $NO_2.OH$ = 62.57], and 32 percent. of water. It should be kept in glass-stoppered bottles." *U. S.* "A liquid containing 70 per cent. by weight of hydrogen nitrate, HNO_3, and 30 per cent. of water, prepared by the interaction of sulphuric acid and potassium or sodium nitrate." *Br.*

Acidum Nitri, s. Azoticum, Spiritus Nitri Acidus; Spirit of Nitre; Aqua Fortis: Acide azotique officinal, *Fr. Cod.;* Acide nitrique, *Fr.;* Acidum nitricum, *P. G.;* Salpetersaure, *G.;* Acido nitrico concentrato, *It.;* Acido nitrico, *Sp.;* Zaltpeterzuur, Sterkwater, *Dutch;* Shedwater, *Sw.*

Nitric oxide is one of the five compounds formed by nitrogen and oxygen. These are, nitrogen monoxide or hyponitrous oxide (laughing gas), N_2O; nitrogen dioxide, N_2O_2, or N O; nitrous oxide, N_2O_3; nitrogen tetroxide or peroxide, N_2O_4; and nitric oxide, N_2O_5. From this latter by the addition of water is formed nitric acid:

$$N_2O_5 + H_2O = 2HNO_3$$

Nitric acid is now official in two forms; the pure acid of the sp. gr. 1.403 at 25° C. (77° F.) and the diluted. The strong acid of the sp. gr. 1.5 has long been abandoned.

Preparation.—The usual practice adopted in the laboratory for obtaining nitric acid is to add to sodium nitrate in coarse powder contained in a retort, an equal weight of strong sulphuric acid, poured in by means of a tube or funnel, so as not to soil the neck. The materials should not occupy more than two-thirds of the capacity of the retort. A receiver being adapted, heat is applied by means of a sand bath, moderately at first, but afterwards more strongly when the materials begin to thicken, in order to bring the whole into a state of perfect fusion. Red vapors will at first arise and afterwards disappear in the course of the distillation. Towards its close they will be reproduced, and their reappearance will indicate that the process is completed.

The proportion of equal weights, as above given, corresponding nearly to one molecule of sodium nitrate and one of sulphuric acid, is the best for operations on a small scale in the laboratory.

A practical disadvantage in this method of obtaining very strong nitric acid is that, owing to the high heat and the presence of the crystals, the retort is frequently fractured. Henry Trimble recommended adding one part of commercial nitric acid to two parts of strong sulphuric acid in a retort and distilling slowly until the nitric acid is all collected.

Lunge and Rey obtained pure, colorless, concentrated nitric acid by the following method: A quantity of nitric acid, prepared and deprived of coloring impurities in the usual manner, and containing 98.7 per cent. of absolute nitric acid, was put into a retort together with twice its volume of absolute sulphuric acid (H_2SO_4), and distilled *in vacuo,* the pressure being reduced to 20 Mm. by means of a water-jet pump. This was found to be the only way to prevent the acid from becoming yellow. The connection between the neck of the retort and the receiver was effected by wrapping with asbestos paper and an external coat of moulder's clay. Great care was taken to insure the absence of organic matter. The distillation takes place at a temperature of 35° C. (95° F.), and the distillate was completely colorless. It contained 99.7 per cent. of HNO_3. (*Am. Drug.,* June 1, 1891, 170; from *Zeit. An. Chem.*)

Monohydrated Nitric Acid. Hydrogen Nitrate.—This is the strongest liquid nitric acid that can be procured, and may be obtained by distilling one molecule of pure and dry sodium nitrate with one molecule of monohydrated sulphuric acid. One molecule of monohydrated nitric acid distils over, and one molecule of sodium bisulphate remains behind:

$$NaNO_3 + H_2SO_4 = HNO_3 + HNaSO_4$$

Acid of this strength is very difficult to make, and requires for its preparation the most elaborate attention to separate the superabundant water. According to Arthur Smith of London, acid dehydrated as far as possible is perfectly colorless, boils at 84° C. (184° F.), and has the sp. gr. 1.517 at 15.4° C. (60° F.), and nearly approaches, in composition, to a monohydrate. Acid of this strength, even at the boiling temperature, has not the slightest action on tin or iron. According to Kolb (*Ann. Ch. Phys.* [4], x. 140), the true HNO_3 has a sp. gr. at 15° C. (59° F.) as high as 1.530.

The acid of a former Br. Pharmacopœia, having the sp. gr. 1.5, is of a yellowish color, and strongly corrosive. Strictly speaking, it is hydrogen nitrate diluted with half a molecule of water. An acid of this strength is inconveniently strong, is constantly undergoing decomposition under the influence of light, and was consequently replaced by a pure acid of the density 1.42 at 15.5° C. (60° F.). This substitution was made in the U. S. Pharmacopœia of 1850, and in the British Pharm. of 1867.

Nitric Acid: sp. gr. (U. S.) 1.403 at 25° C. (77° F.) and (Br.) 1.42 at 15.5° C. (60° F.). This is the acid now official in both the U. S. and Br. Pharmacopœias. Acid of the density 1.5 was not usually found in commerce, and much pains was required to get it of that strength. Besides, acid of this density was not necessary for any process of the Pharmacopœia. Considerations of this kind induced the revisers of our national standard of 1850 to lower the strength of official nitric acid to about 1.42, its purity in other respects remaining the same. In the U. S. Pharmacopœia of 1890 the strength was again very slightly reduced from 1.42 to 1.414 at 15° C. (59° F.), since it has been shown that 68 per cent. acid has this specific gravity, the acid of U. S. P. 1880, of

Table showing percentage of absolute Nitric Acid in Nitric Acid of different densities. U. S. P. (8th Rev.)

Per cent. nitric acid.	Specific Gravity. 25° C./25° C.	Specific Gravity. 15° C./15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent.= 0.01 Cc. normal KOH.
1	1.0056	1.0057	0.00018	0.018	0.16	0.063
2	1.0112	1.0114	0.00020	0.019	0.32	0.059
3	1.0166	1.0170	0.00023	0.019	0.49	0.063
4	1.0219	1.0226	0.00025	0.019	0.65	0.059
5	1.0272	1.0282	0.00028	0.019	0.82	0.059
6	1.0325	1.0338	0.00030	0.019	0.99	0.059
7	1.0378	1.0394	0.00033	0.018	1.16	0.059
8	1.0433	1.0452	0.00036	0.018	1.33	0.059
9	1.0488	1.0510	0.00040	0.018	1.50	0.056
10	**1.0544**	**1.0569**	**0.00043**	**0.018**	**1.68**	**0.056**
11	1.0601	1.0629	0.00047	0.018	1.86	0.056
12	1.0658	1.0689	0.00050	0.017	2.04	0.056
13	1.0716	1.0751	0.00054	0.017	2.22	0.056
14	1.0776	1.0814	0.00058	0.017	2.40	0.053
15	1.0835	1.0877	0.00061	0.017	2.59	0.053
16	1.0895	1.0940	0.00065	0.016	2.78	0.053
17	1.0956	1.1004	0.00068	0.017	2.97	0.053
18	1.1016	1.1068	0.00072	0.016	3.16	0.053
19	1.1077	1.1132	0.00075	0.016	3.35	0.050
20	1.1138	1.1196	0.00078	0.016	3.55	0.050
21	1.1200	1.1261	0.00080	0.016	3.75	0.050
22	1.1263	1.1326	0.00083	0.016	3.95	0.050
23	1.1326	1.1391	0.00085	0.016	4.15	0.048
24	1.1390	1.1457	0.00087	0.016	4.36	0.050
25	1.1453	1.1522	0.00089	0.016	4.56	0.048
26	1.1517	1.1588	0.00090	0.015	4.77	0.048
27	1.1582	1.1654	0.00092	0.015	4.98	0.045
28	1.1647	1.1720	0.00094	0.015	5.20	0.048
29	1.1712	1.1787	0.00096	0.015	5.41	0.045
30	1.1778	1.1854	0.00097	0.015	5.63	0.045
31	1.1844	1.1921	0.00099	0.015	5.85	0.045
32	1.1910	1.1988	0.00100	0.015	6.07	0.043
33	1.1977	1.2057	0.00101	0.015	6.30	0.045
34	1.2044	1.2125	0.00102	0.015	6.52	0.043
35	1.2112	1.2194	0.00103	0.015	6.75	0.043
36	1.2178	1.2261	0.00104	0.015	6.98	0.042
37	1.2244	1.2328	0.00105	0.015	7.22	0.043
38	1.2310	1.2394	0.00106	0.015	7.45	0.042
39	1.2375	1.2460	0.00107	0.015	7.69	0.042
40	1.2440	1.2526	0.00108	0.016	7.93	0.042
41	1.2504	1.2591	0.00109	0.016	8.17	0.042
42	1.2569	1.2657	0.00110	0.015	8.41	0.040
43	1.2634	1.2722	0.00110	0.016	8.66	0.042
44	1.2698	1.2787	0.00111	0.015	8.90	0.040
45	1.2763	1.2853	0.00112	0.015	9.15	0.040
46	1.2828	1.2918	0.00113	0.016	9.40	0.040
47	1.2891	1.2982	0.00113	0.016	9.65	0.038
48	1.2954	1.3046	0.00114	0.016	9.91	0.040
49	1.3017	1.3110	0.00115	0.016	10.16	0.040
50	1.3079	1.3172	0.00116	0.017	10.42	0.038
51	1.3139	1.3233	0.00117	0.017	10.68	0.038
52	1.3199	1.3294	0.00118	0.017	10.94	0.038
53	1.3258	1.3353	0.00119	0.017	11.20	0.038
54	1.3316	1.3412	0.00120	0.018	11.46	0.038
55	1.3373	1.3470	0.00121	0.018	11.72	0.038

Table showing percentage of absolute Nitric Acid in Nitric Acid of different densities. U. S. P. (8th Rev.) (Continued).

Per cent. nitric acid.	Specific Gravity. 25° C. / 25° C.	Specific Gravity. 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.	Normality. 1 Cc. requires normal KOH Cc.	Per cent.= 0.01 Cc. normal KOH.
56	1.3429	1.3527	0.00122	0.018	11.98	0.037
57	1.3485	1.3584	0.00123	0.018	12.25	0.038
58	1.3540	1.3640	0.00124	0.019	12.51	0.037
59	1.3594	1.3695	0.00125	0.019	12.78	0.037
60	1.3648	1.3750	0.00126	0.020	13.05	0.038
61	1.3699	1.3802	0.00127	0.020	13.31	0.037
62	1.3750	1.3854	0.00128	0.020	13.58	0.037
63	1.3800	1.3905	0.00129	0.021	13.85	0.037
64	1.3848	1.3954	0.00130	0.022	14.12	0.037
65	1.3894	1.4002	0.00132	0.022	14.39	0.037
66	1.3939	1.4049	0.00132	0.023	14.66	0.037
67	1.3983	1.4094	0.00134	0.023	14.93	0.037
68	**1.4027**	**1.4139**	**0.00136**	**0.023**	**15.20**	**0.037**
69	1.4070	1.4183	0.00137	0.024	15.47	0.037
70	1.4112	1.4226	0.00139	0.025	15.74	0.037
71	1.4152	1.4268	0.00141	0.026	16.01	0.037
72	1.4191	1.4310	0.00144	0.026	16.28	0.037
73	1.4230	1.4351	0.00146	0.026	16.55	0.037
74	1.4268	1.4391	0.00148	0.027	16.82	0.037
75	1.4305	1.4430	0.00151	0.028	17.09	0.036
76	1.4341	1.4468	0.00153	0.027	17.37	0.037
77	1.4378	1.4506	0.00154	0.027	17.64	0.037
78	1.4415	1.4544	0.00156	0.028	17.91	0.036
79	1.4451	1.4582	0.00157	0.029	18.19	0.037
80	1.4486	1.4619	0.00159	0.029	18.46	0.036
81	1.4520	1.4654	0.00160	0.030	18.74	0.037
82	1.4553	1.4688	0.00161	0.030	19.01	0.036
83	1.4586	1.4721	0.00162	0.031	19.29	0.037
84	1.4618	1.4754	0.00163	0.032	19.56	0.036
85	1.4649	1.4786	0.00163	0.033	19.84	0.037
86	1.4679	1.4817	0.00164	0.034	20.11	0.037
87	1.4707	1.4846	0.00165	0.036	20.38	0.036
88	1.4735	1.4875	0.00166	0.037	20.66	0.037
89	1.4762	1.4903	0.00167	0.040	20.93	0.037
90	1.4787	1.4929	0.00168	0.045	21.20	0.037
91	1.4809	1.4953	0.00169	0.045	21.47	0.038
92	1.4831	1.4976	0.00170	0.048	21.73	0.037
93	1.4852	1.4997	0.00172	0.056	22.00	0·037
94	1.4870	1.5017	0.00173	0.056	22.27	0.038
95	1.4888	1.5037	0.00175	0.050	22.53	0.037
96	1.4908	1.5059	0.00177	0.042	22.80	0.037
97	1.4932	1.5085	0.00179	0.037	23.07	0.036
98	1.4959	1.5115	0.00182	0.021	23.35	0.033
99	1.5007	1.5165	0.00184	0.012	23.67	0.027
100	1.5088	1.5249	0.00187	....	24.04	....

[1] Add if the temperature is above, subtract if below, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

NOTE.—To find the per cent. of N_2O_5, multiply the per cent. of HNO_3 by 0.85712. To find the per cent. of NO_3, multiply the per cent. of HNO_3 by 0.98402.

To find the weight in grammes of HNO_3 in 100 Cc., multiply the specific gravity by the per cent. of HNO_3.

To find the volume per cent. of official Nitric Acid, multiply the "normality" by 6.579. For the volume per cent. of official Diluted Nitric Acid, multiply the "normality" by 59.52.

(See reference on page 52.)

the specific gravity of 1.42, having an inconvenient fraction in its percentage (69.4 per cent.). The specific gravity 1.403 given in the U. S. Pharmacopœia (8th Revision) is practically equivalent to that given in the U. S. Pharmacopœia of 1890 (1.414), the temperature used in the U. S. Pharmacopœia (8th Revision) for specific gravity being 25° C. (77° F.) instead of the lower one of 15.6° C. (60° F.). (See official table pp. 50–51.)

"Heated with indigo T.S., it discharges the blue color of the reagent. Even when highly diluted, it shows an acid reaction upon blue litmus paper. If 10 Cc. of the Acid be evaporated to dryness and further heated at 110° C. (230° F.), no appreciable residue should remain (limit of *non-volatile impurities*). Five Cc. of diluted Nitric Acid (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). Other portions of this dilution should not yield a precipitate upon the addition of barium chloride T.S. (absence of *sulphuric acid*); or of silver nitrate T.S. (absence of *hydrochloric acid*). Nitric Acid when neutralized with ammonia water and diluted with distilled water (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If the diluted Acid (1 in 3) be shaken with a few drops of chloroform, the latter should remain colorless (absence of *iodine* or *bromine*), even after the introduction of a small piece of metallic tin (absence of *iodic* or *bromic acid*). Introduce into a stoppered weighing-bottle 3 Cc. of Nitric Acid and weigh accurately. Dilute the Acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 6.257, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Nitric Acid in the latter." *U. S.* "Each gramme diluted with *water* should require for neutralization 11.1 cubic centimetres of the *volumetric solution of sodium hydroxide*. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, chlorides, bromates, iodates, or sulphates. It should yield no residue or not more than 0.005 per cent. on evaporation to dryness." *Br.*

To correspond with the tests given in the U. S. P., it must be "a colorless, fuming liquid, very caustic and corrosive, and having a peculiar, somewhat suffocating odor. Specific gravity: about 1.403 at 25° C. (77° F.). It boils and is completely volatilized at 120.5° C. (248.9° F.). It dissolves copper, mercury, silver, and other metals with evolution of red fumes, and stains woollen fabrics and animal tissues a bright yellow." *U. S.* Acid of the density 1.42 at 15° C. is the most stable of the hydrated compounds of nitric acid, and boils at 121° C. (250° F.), the official acid boiling at 120.5° C. (248.9° F.). When either stronger or weaker than this, it distils over at a lower temperature, and, by losing more acid than water in the first case, and more water than acid in the second, constantly approaches to the sp. gr. 1.42, when its boiling point becomes stationary. Dalton first observed these facts in relation to nitric acid of this strength, which have been confirmed by Arthur Smith of London. This acid may be assumed to have the composition $HNO_3 + 1\frac{1}{2}H_2O$.

The reddish acid called *aqua fortis* or *nitrous acid* is nitric acid containing more or less nitrogen tetroxide (N_2O_4). The same acid may be formed by impregnating, to a limited extent, nitric acid with nitrogen dioxide (N_2O_2). If the saturation be complete, every two molecules of nitric oxide become three molecules of nitrogen tetroxide by the aid of one molecule of nitrogen dioxide ($2N_2O_5 + N_2O_2 = 3N_2O_4$). More commonly it is obtained by distilling a mixture of 4 parts of starch and 100 parts of potassium nitrate with 100 parts of sulphuric acid. In this way the nitrogen tetroxide produced is at once taken up in the concentrated nitric acid and an acid of sp. gr. 1.50 is obtainable.

In making nitric acid on the commercial scale, sodium nitrate is substituted for potassium nitrate, as it is much cheaper, and the salt is decomposed with sulphuric acid as before. The proportions of these two substances employed are not the same in all works. If one molecule of sulphuric acid and two of sodium nitrate be taken, the following are the reactions:

$$H_2SO_4 + NaNO_3 = NaHSO_4 + HNO_3$$

When the heat is raised, the acid sodium sulphate acts upon a second molecule of sodium nitrate, thus:

$$NaHSO_4 + NaNO_3 = Na_2SO_4 + HNO_3$$

In this case a part of the acid is decomposed, owing to the high temperature, and nitrogen peroxide is evolved in the form of red fumes, which dissolve in the concentrated acid, giving it the red appearance usually noted in the strong commercial product. When a large excess of sulphuric acid is employed, some acid sodium sulphate is formed, which lowers the melting point of the residual mass so that it can be withdrawn from the retorts in a fused state, whereas in the other case the residue can only be removed in the solid state after the cylinder has cooled.

The ordinary commercial acid has a specific gravity of from 1.30 to 1.41, and is usually prepared by means of chamber (sulphuric) acid; but if a more concentrated acid is required, a stronger sulphuric acid must be employed. The strongest nitric acid occurring in commerce has a sp. gr. of 1.43, and this is obtained by distilling well dried Chili saltpetre with sulphuric acid having a specific gravity of 1.85.

The retorts in which nitric acid is usually prepared in England consist of cast iron cylinders, built in a furnace in such a way that they may be heated as uniformly as possible. Some manufacturers cover the upper half of the cylinder with fire-bricks, in order to protect the iron from the action of the nitric acid vapors.

This is unnecessary, however, if the retorts are so thoroughly heated that no nitric acid condenses on the surface of the iron.

Mallet of Paris, has proposed to obtain nitric acid by distilling sodium nitrate with well dried boric acid, sodium biborate or borax being the residue. Another method, employed by Kuhlmann, is to expose a mixture of sodium nitrate and manganese chloride to a heat of about 232° C. (450° F.), and to pass the mixed gases which escape through water. Hyponitric acid and oxygen are disengaged, which become nitric acid when they enter the water. (*P. J.*, 1862.)

Quite recently, the Atmospheric Products Company have attempted at Niagara Falls to manufacture nitric acid by effecting the direct union of the oxygen and nitrogen of the air by means of electric arcs of high voltage. By the use of revolving frames carrying a large number of discharging points which pass the opposite poles of high voltage currents, a large number of arc discharges per minute can be obtained, and a considerable formation of nitrogen oxides, which washed with water, yield nitric acid.

In this connection it may be stated that a trace of nitric acid has been detected in the atmosphere. It is said to be always present in the air in summer (Kletsinsky).

Properties.—Nitric acid, so called from nitre, is an extremely sour and corrosive liquid. It was discovered by Raymond Lully, in the thirteenth century, and its constituents by Cavendish in 1784. When perfectly pure it is colorless; but, as usually obtained, it has a straw color, owing to the presence of hyponitric acid. The concentrated acid, when exposed to the air, emits white fumes, possessing a disagreeable odor. By the action of light it undergoes a slight decomposition, and becomes yellow. It acts powerfully on animal matter, causing its decomposition. On the living fibre it operates as a strong caustic. It stains the skin and most animal substances an indelible yellow color. On vegetable fibre it acts peculiarly, abstracting hydrogen or water, and oxidizing the remaining elements. When diluted, nitric acid converts most animal and vegetable substances into oxalic, malic, and carbonic acids. The general character of its action is to impart oxygen to other bodies, which it is enabled to do, as oxygen in the nascent state is liberated in its decomposition. If this liberation takes place while in contact with bodies capable of oxidation, the oxygen goes to effect this oxidation. Free nitric acid, however, will evolve oxygen at a red heat, according to the following reaction:

$$4HNO_3 = 2N_2O_4 + O_2 + 2H_2O$$

It oxidizes sulphur and phosphorus, giving rise to sulphuric and phosphoric acids, and all the metals, except chromium, tungsten, columbium, cerium, titanium, osmium, rhodium, gold, platinum, and iridium. It combines with salifiable bases and forms nitrates. When mixed with hydrochloric acid, mutual decomposition takes place, according to the reaction

$$HNO_3 + 3HCl = NOCl + Cl_2 + 2H_2O$$

and nitrohydrochloric acid is formed.

Great care must be used in transporting nitric acid, for if the strong acid comes in contact in quantity with vegetable substances like hay, tow, excelsior, paper, etc., fire will be apt to occur. The cause of such accidents was proved by the official inquiry of R. Hass. (*Ber. d. Chem. Ges.*, 1881, 597.)

Tests.—Nitric acid, when uncombined, is recognized by its dissolving copper with the production of red vapors. When in the form of a nitrate, it is known by its action on gold leaf, after the addition of hydrochloric acid, in consequence of the evolution of chlorine; or it may be discovered, according to O'Shaughnessy, by heating the supposed nitrate in a test tube with a drop of sulphuric acid, and then adding a crystal of morphine. If nitric acid be present, it will be set free by the sulphuric acid, and reddened by the morphine. The same effect is produced by brucine, by commercial strychnine, on account of its containing brucine, and still more strongly, according to Braun, by aniline sulphate, which affords an exceedingly delicate test. (*J. P. C.*, 1867, p. 157.) To prevent all ambiguity arising from the accidental presence of nitric acid in the sulphuric acid employed, the operator should satisfy himself, by a separate experiment, that the latter acid has no power to produce the characteristic color with morphine. Another test for nitric acid is to add *pure* sulphuric acid to the concentrated liquid suspected to contain it, together with a little concentrated solution of ferrous sulphate. The smallest trace of nitric acid affords, when the mixture is warmed, a pink red color; and if it be present in considerable amount, the liquid becomes almost black. Rosa recommends the use of ammonio-ferrous sulphate in place of ferrous sulphate, as a test for nitric acid. It is more stable than the latter, either in crystals or in solution. Equal measures of the liquid to be tested for nitric acid and of concentrated sulphuric acid are mixed, the mixture cooled, and then a layer of solution of ammonio-ferrous sulphate poured slowly on top; if even a trace of nitric acid be present, a brown zone will form at the line of contact of the liquids. (*Am. Drug.*, 1886, p. 13.)

A method particularly useful in the determination of the nitrates contained in drinking-water depends upon the fact that a thin zinc plate, which has been covered with a deposit of spongy metallic copper by dipping it in a solution of copper sulphate, on being heated with water containing nitrates, reduces them to ammonia, zinc hydroxide and free hydrogen also being formed (Gladstone and Tribe). The reaction with hydrogen is as follows:

$$KNO_3 + 4H_2 = NH_3 + KOH + 2H_2O$$

Composition.—Nitric oxide or anhydride consists of two atoms of nitrogen and five atoms of oxygen; or, in volumes, of two volumes of

nitrogen and five volumes of oxygen, supposed to be condensed into two volumes to form nitric oxide vapor. In 1849 the interesting discovery was made by Deville of Besançon, of the means of isolating nitric acid oxide or anhydride. The method pursued was to pass perfectly dry chlorine over silver nitrate. The oxide is in the form of colorless brilliant limpid crystals, which melt at 29.5° C. (85° F.) and boil at 45° C. (113° F.). In contact with water they form a colorless solution with evolution of heat, without the disengagement of gas. (*J. P. C.*, 1849, p. 207.)

Uses.—Nitric acid is tonic, antiseptic, astringent, and appears to act upon the intestinal glands in some way so as to modify their function. It is a very useful remedy in cases of *intestinal indigestion;* in this it resembles hydrochloric acid, and the choice between the two acids in any individual case should be guided by the existence or non-existence of diarrhœa, the nitric acid being given when there is looseness of the bowels. In *syphilis,* and in the *chronic hepatitis* of India, this acid was highly extolled by Scott, formerly of Bombay. It has occasionally excited ptyalism. It cannot be depended upon as a remedy in syphilis, but, in worn-out constitutions, is often an excellent adjuvant. In hepatic troubles it is markedly inferior to the nitrohydrochloric acid, unless, it may be, when there is much diarrhœa. As nitric acid dissolves both *uric acid* and the *phosphates,* it was supposed to be applicable to cases of *gravel* in which the uric acid and the phosphates are mixed, but experience has not confirmed the opinion. Nevertheless, when the sabulous deposit depends upon disordered digestion, this acid may prove serviceable by restoring the tone of the stomach. For internal use it should be well diluted and taken through a glass tube to avoid injury to the teeth.

Externally, nitric acid has been used with advantage as a lotion to *ulcers,* in the strength of about twelve minims to the pint of water. This practice originally suggested by Everard Home is practically applicable to those *ulcers* which are superficial and not disposed to cicatrize. In sloughing *phagedæna, strong* nitric acid is one of the best remedies, applied by means of a piece of lint tied around a small stick, or by the use of a glass brush. Sometimes a piece of lint is soaked with the strong acid, and pressed into the sore, being allowed to remain for several hours. In *cancrum oris,* concentrated nitric acid, freely applied, is one of the best local remedies that can be employed for arresting the phagedænic ulceration and disposing the sore to heal, but great care must be exercised to protect the teeth. The *strong* acid is also used as an escharotic in *venereal ulcers* and other affections. Nitric acid vapors were formerly used as a disinfectant. Half an ounce of powdered potassium nitrate was put into a saucer, placed in an earthen dish containing heated sand, and two drachms of sulphuric acid were then poured over it.

Toxicology.—The swallowing of concentrated nitric acid is immediately followed by burning heat in the mouth, œsophagus, and stomach, acute pain, disengagement of gas, abundant eructations, nausea, and hiccough. These effects are soon followed by repeated and excessive vomiting of matter having a peculiar odor and taste, tumefaction of the abdomen with exquisite tenderness, a feeling of coldness on the surface, horripilation, icy coldness of the extremities, small depressed pulse, great anxiety, continual tossings and contortions, and extreme thirst. The cases are almost always fatal. Sometimes the collapse has been immediate and has masked all the other symptoms. The best remedies are repeated large doses of alkaline solutions, soap, magnesia, and chalk, as antidotes, mucilaginous drinks, olive or almond oil in large doses, emollient fomentations, etc.

Dose, five to ten minims (0.3 to 0.6 Cc.), largely diluted.

Off. Prep.—Acidum Nitricum Dilutum, *U. S., Br.;* Acidum Nitrohydrochloricum, *U. S.;* Acidum Nitrohydrochloricum Dilutum, *U. S., Br.;* Hydrargyri Iodidum Flavum, *U. S.;* Liquor Bismuthi et Ammonii Citratis, *Br.;* Liquor Ferri Chloridi, *U. S. (Br.);* Liquor Ferri Pernitratis, *Br.;* Liquor Ferri Subsulphatis, *U. S.;* Liquor Ferri Tersulphatis, *U. S. (Br.);* Liquor Hydrargyri Nitratis, *U. S. (Br.);* Liquor Zinci Chloridi, *U. S.;* Pyroxylinum, *Br.;* Spiritus Ætheris Nitrosi, *Br.;* Unguentum Hydrargyri Nitratis, *U. S., Br.*

ACIDUM NITRICUM DILUTUM.

U. S., Br.

DILUTED NITRIC ACID

(ăç'ĭ-dŭm nĭ'trĭ-cŭm dĭ-lū'tŭm)

"Diluted Nitric Acid should contain 10 percent., by weight, of absolute Nitric Acid [HNO_3 or $NO_2.OH = 62.57$], and 90 percent. of water." *U. S.* "100 parts by weight should contain 17.44 parts of hydrogen nitrate, HNO_3." *Br.*

Acide azotique dilué, *Fr.;* Verdünnte Salpetersäure, *G.;* Acido nitrico diluito, *It.*

* "Nitric Acid, *one hundred grammes* [or 3 ounces av., 231 grains]; Distilled Water, *five hundred and eighty grammes* [or 20 ounces av., 201 grains], to make *six hundred and eighty grammes* [or 23 ounces av., 432 grains]. Mix them. Keep the product in dark amber-colored, glass-stoppered bottles." *U. S.*

"Nitric Acid, 3 *fl. ounces and* 7 *fl. drachms* (more exactly, 3.86 *fl. ounces,* Imperial measure) or 2400 *grains,* or 193.2 cubic centimetres or 274.3 grammes; Distilled Water, *a sufficient quantity.* Introduce the Nitric Acid into a glass flask, the capacity of which to a mark on the neck is *one pint* (Imp. meas.) or one thousand cubic centimetres; add Distilled Water until the mixture, at 60° F. (15.5° C.), measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The U. S. acid, as now directed, does not vary appreciably from that formerly official. "Specific gravity: about 1.054 at 25° C. (77° F.). It should respond to the reactions and tests given under *Acidum Nitricum.* To neutralize 6.26 Gm. (6.257 Gm.) of Diluted Nitric Acid should require 10 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 1 percent. of absolute Nitric Acid), methyl-orange T.S. being used as indicator." *U. S.*

The British diluted acid is considerably stronger than our own in the same measure. It has the sp. gr. 1.101; and "each gramme should require for neutralization 2.7 cubic centimetres of the *volumetric solution of sodium hydroxide.*" *Br.* In making the U. S. diluted acid, pharmacists should be careful to use acid of the sp. gr. 1.403; or, if the acid be weaker, to add proportionally less water; otherwise the diluted acid would be weaker than is directed in the Pharmacopœia.

The medicinal properties of the diluted acid are the same as those of the strong acid. (See *Acidum Nitricum.*)

Dose, of U. S. diluted acid, from twenty to forty minims (1.3 to 2.5 Cc.), of the British, from fifteen to thirty minims (0.9 to 1.8 Cc.), properly diluted.

ACIDUM NITROHYDROCHLORICUM. U. S.

NITROHYDROCHLORIC ACID [Nitromuriatic Acid]

(ăç'ĭ-dŭm nī-trō-hȳ-drō-ȼhlō'rĭ-cŭm)

Acidum Nitromuriaticum, U. S. P. 1870; Aqua regia, Aqua-regis; Acide chlorazotique, Eau régale, *Fr.;* Acidum Chloronitrosum; Salpetersalzsaure, Königswasser, *G.*

* "Nitric Acid, *one hundred and eighty cubic centimeters* [or 6 fluidounces, 42 minims]; Hydrochloric Acid, *eight hundred and twenty cubic centimeters* [or 27 fluidounces, 5 fluidrachms, 49 minims], to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Acids in a capacious glass vessel, and, when effervescence has ceased, pour the product into dark amber-colored, glass-stoppered bottles, which should not be more than half filled, and which should be kept in a cool place." [1] *U. S.*

Nitrohydrochloric acid is the *aqua regia* of the earlier chemists, so called from its property of dissolving gold. Nitric and hydrochloric acids, when mixed together, are mutually decomposed. According to the researches of Gay-Lussac, the reaction gives rise to two compounds, NO_2Cl (nitroxyl chloride) and NOCl (nitrosyl chloride), mixed with free chlorine. Later researches seem, however, to show that the latter of the two chlorides exclusively is produced, the reaction for the decomposition of nitrohydrochloric acid being:

$$HNO_3 + 3HCl = NOCl + Cl_2 + 2H_2O$$

[1] For an apparatus for making nitrohydrochloric acid upon a large scale, see *P. J.*, xi. 422.

The power of nitrohydrochloric acid to dissolve gold and similar metals having a weak affinity for oxygen, is owing exclusively to the free chlorine present, and is in no wise dependent on the compound above referred to, which remains entirely passive during the solution of the metal. When nitrohydrochloric acid is made from strong acids, there is always a loss of the nitrosyl chloride and of free chlorine by effervescence, in consequence of the acids not containing sufficient water to hold the gaseous products in solution.

Properties.—"A golden-yellow, fuming, and very corrosive liquid, having a strong odor of chlorine. Completely volatilized by heat. It readily dissolves gold leaf, and a drop of it, when added to potassium iodide T.S., liberates iodine." *U. S.* Nitrohydrochloric acid has an orange color, soon changing to a golden yellow, and the odor of chlorine. It should be kept in a cool dark place, on account of its liability to lose chlorine by heat, and to have its chlorine converted into hydrochloric acid by the action of light and the decomposition of water. On account of its tendency to decomposition, it should not be made in large quantities, nor be kept very long by the apothecary; and care should be taken not to transfer it to the bottle in which it is to be dispensed, until effervescence has ceased, lest the pressure within should drive out the stopper. Nitric and hydrochloric acids, as found in commerce, are sometimes so weak that when mixed they will not readily act on gold leaf. In this case their solvent power may be rendered effective by the addition of a little sulphuric acid, which, by its superior affinity for water, concentrates the other acids, and causes immediate action.

Uses.—Nitrohydrochloric acid was brought to the notice of the profession in consequence of the favorable report of its efficacy as an external remedy in *hepatitis,* made by Scott, formerly of Bombay. When thus employed, it produces a tingling sensation of the skin, thirst, a peculiar taste in the mouth, and occasional soreness of the gums and plentiful ptyalism, and at the same time stimulates the liver, as is evinced by an increased flow of bile. It is used either by sponging or in the form of a local or general bath. When applied by sponging, the acid is first diluted so as to have the sourness of strong vinegar. When used as a foot bath, three gallons of water, contained in a deep narrow wooden tub, may be acidulated with six fluidounces of the acid. In this the feet and legs are to be immersed for twenty minutes or half an hour. The bath may be employed at first daily, and afterwards twice or thrice a week; and the sponging may be used at the same time. The bath is said to be effective in promoting the passage of *biliary calculi.* The solution, prepared for a bath as above mentioned, may be used for a week, adding to it daily a pint of water acidulated with two fluidrachms of the acid, to make up for the waste by evaporation. The bath should have a temperature of about 97°

F., which may be attained by heating part of the acid solution in a non-metallic container and throwing it back into the remainder.

Nitrohydrochloric acid is much used internally and it is an excellent remedy in chronic *hepatic affections,* in *oxaluria,* and in *dyspepsia* with a tendency to constipation. It is sometimes given also in *syphilitic diseases.* The freshly prepared strong acid is preferable to the diluted, and should be given well diluted, after meals, care being exercised to prevent its injuring the teeth. It should never be prescribed in combination with strong alcoholic liquids undiluted, as gases may be generated in sufficient volume to cause explosion. (See *A. J. P.,* 1878, 67.)

Dose, three to six minims (0.2 to 0.4 Cc.).

ACIDUM NITROHYDROCHLORICUM DILUTUM. U. S., Br.

DILUTED NITROHYDROCHLORIC ACID [Diluted Nitromuriatic Acid]

(ăç'ĭ-dŭm nī-trō-hī'-drō-klō'rĭ-cŭm dī-lū'tŭm)

"An aqueous solution of free chlorine, hydrochloric, nitric, and nitrous acids." *Br.*

Acidum Nitromuriaticum Dilutum, U. S. P. 1870; Acide chlorazotique dilué, *Fr.;* Verdünnte Salpetersalzsaure, *G.*

* "Nitric Acid, *forty cubic centimeters* [or 1 fluidounce, 2 fluidrachms, 49 minims]; Hydrochloric Acid, *one hundred and eighty-two cubic centimeters* [or 6 fluidounces, 74 minims]; Distilled Water, *seven hundred and seventy-eight cubic centimeters* [or 26 fluidounces, 2 fluidrachms, 28 minims], to make about *one thousand cubic centimeters* [or 33 fluidounces 6½ fluidrachms]. Mix the Acids in a capacious glass vessel, and, when effervescence has ceased, add the Distilled Water. Diluted Nitrohydrochloric Acid should be kept in dark amber-colored, glass-stoppered bottles, in a cool place. It should not be dispensed unless recently prepared." *U. S.*

"Nitric Acid, 3 *fl. ounces* (Imperial measure) or 60 cubic centimetres; Hydrochloric Acid, 4 *fl. ounces* (Imp. meas.) or 80 cubic centimetres; Distilled Water, 25 *fl. ounces* (Imp. meas.) or 500 cubic centimetres. Mix the Acids with the Distilled Water, and keep the mixture in a glass-stoppered bottle for fourteen days before it is used. Colorless, with a pungent acid taste and odor. Specific gravity 1.07. 4 grammes should require for neutralization about 10 cubic centimetres of the *volumetric solution of sodium hydroxide." Br.* "A colorless or pale yellowish liquid, having a faint odor of chlorine, and a very acid taste. It is completely volatilized by heat. When it is added to potassium iodide T.S., iodine is liberated." *U. S.*

Between diluted nitric and hydrochloric acids no reaction occurs, and therefore the U. S. Pharmacopœia directs that the acids shall be mixed before dilution. But according to the researches of Tilden, confirmed by Redwood (*P. J.,* x. 508), water determines a decomposition of the products resulting from the reaction between nitric and hydrochloric acids, and the re-formation of hydrochloric and nitric acids, with a little nitrous acid. It would seem, therefore, that diluted nitrohydrochloric acid is not an eligible preparation, a conclusion confirmed by clinical experience.

Dose, from ten to twenty minims (0.6 to 1.3 Cc.).

ACIDUM OLEICUM. U. S., Br.

OLEIC ACID

(ăç'ĭ-dŭm ō-lē'ĭ-cŭm)

$HC_{18}H_{33}O_2 = 280.14$

"A monobasic organic acid, prepared in a sufficiently pure condition by cooling commercial Oleic Acid to about 5° C. (41° F.), then separating and preserving the liquid portion." *U. S.* "Oleic Acid, $CH_3(CH_2)_7CH : CH(CH_2)_7COOH$, or hydrogen oleate, is obtained by the saponifying action of alkalies and subsequent action of acids, or by the action of superheated steam, upon the olein of fats. Usually not quite pure." *Br.*

Acidum oleinicum, Acidum elainicum; Elaic acid; Acide oléique, *Fr.;* Oleinsaure, Elainsaure, Oelsaure, *G.*

This acid, although known for many years, was not used medicinally until 1872 (*L. L.,* 1872, 709), when John Marshall introduced the oleates to the profession as substitutes for some of the older ointments, stating that they are not only cleaner and more elegant, but also much more efficacious. (See *Oleata.*)

Preparation.—The difficulty in preparing oleates of good quality arises usually from the use of the commercial oleic acid, which, being obtained as a by-product in the manufacture of glycerin and candles, has a reddish-brown color and a disagreeable fatty odor. It is almost always contaminated with stearic and palmitic acids, with undecomposed glycerides when obtained by the autoclave process, and hydrocarbons when obtained by the distillation of the fat acids. Various processes have been suggested for the purification of oleic acid. Charles Rice (*A. J. P.,* xlv. 2) exposes the commercial acid to a temperature of 4° C. (39° F.), and expresses the liquid portion, which is oleic acid deprived of the greater part of the contaminating substances. The odorous and coloring principles are not removed by this process. A writer in *A. J. P.* (xlv. 97) prepares oleic acid for making oleates by saponifying almond oil with potassium hydroxide; decomposing by tartaric acid, separating the precipitated bitartrate, heating for several hours on a water bath with half its weight of finely powdered lead oxide; after cooling, mixing with three times its volume of ether, settling, decanting, and treating the residue with ether as before; agitating the mixed ethereal solutions with diluted hydrochloric acid; skimming off the ethereal solution of oleic acid, washing

it with water, reskimming, and recovering the ether by distillation. Wolff (*A. J. P.*, 1879) saponifies oil of sweet almond with lead oxide, agitates the lead soap in petroleum benzin, which retains lead oleate in solution, the lead palmitate being deposited. The benzin solution of lead oleate is shaken repeatedly with diluted hydrochloric acid (1 to 7), when lead chloride separates, and a benzin solution of purified oleic acid is left; finally the benzin is driven off by evaporation. The objection to this process is the difficulty of freeing the oleic acid from traces of a disagreeable benzin odor. Saunders (*N. R.*, June, 1880) makes a solution of 5 pounds of white castile soap in 20 pounds of boiling water, adds 10 ounces of sulphuric acid, and boils with stirring, until two clear layers are formed. The upper layer is decanted, shaken with 5 pounds of hot water, and the oily layer again decanted; 4 ounces of lead oxide are dissolved in it with a gentle heat, and while hot, 5 pounds of alcohol, previously heated to 65.5° C. (150° F.), are added. It is filtered after standing 24 hours, and 1 ounce of hydrochloric acid shaken with the filtrate; 10 pounds of water are added, the acid decanted, again washed with 10 pounds of water, and finally recovered; the yield is about 2½ pounds. See also process by Charles T. George (*A. J. P.*, 1881, p. 379). Low grade oleic acids, obtained by the distillation of wool-grease, etc., may contain cholesterin and other unsaponifiable materials from this source (Allen). Commercial oleic acid is often adulterated with linoleic acid. Hazura claims to be able to show the presence of one per cent. of this by saponifying the mixture and then adding potassium permanganate. (For details see *A. J. P.*, 1889, p. 356.) Grandval and Valser (*Chem. News*, 1890, p. 85) give the following tests for linoleic acid: If a thin layer of the fraudulent oleic acid be placed upon a slip of lead scraped quite clean, and some pure oleic acid be put upon a similar slip of lead for comparison, the next day the impure acid will be more or less resinified, while the pure acid will be scarcely altered. If some drops of oleic acid adulterated with linoleic acid be mixed with an equal volume of soda lye, an intense yellow color will be produced; pure oleic acid, if similarly treated, will merely take a grayish tint. Commercially, oleic acid is now obtainable by the recently described process of decomposition of fatty oils by the action of enzymes. For this purpose, the ferment of the castor oil bean has proven most efficient. Connstein has described the technical application of this process in a paper read at the *International Congress of Applied Chemistry* held at Berlin in 1903. (Vol. ii, p. 537.) For a paper on the esterification of oleic acid in the presence of a pancreatic ferment, by H. Pottevin, see *P. J.*, 1904, 492.

Properties.—"A yellowish or brownish-yellow, oily liquid, having a peculiar, lard-like odor and taste; becoming darker and absorbing oxygen on exposure to air. Specific gravity: about 0.895 at 25° C. (77° F.). Insoluble in water; soluble in alcohol, chloroform, benzene, petroleum benzin, and fixed and volatile oils. When cooled to about 4° C. (39.2° F.), Oleic Acid becomes semi-solid, and on further cooling, congeals to a whitish, solid mass. When heated to a temperature of about 95° C. (203° F.), decomposition commences, and acrid vapors are produced. At a higher temperature it is completely dissipated. An alcoholic solution of Oleic Acid has a feebly acid reaction upon blue litmus paper. Equal volumes of Oleic Acid and alcohol, mixed at the ordinary temperature, should yield a clear solution without the separation of any oily drops (absence of *fixed oils*). If 1 Gm. of Oleic Acid be heated with 20 Cc. of alcohol, and 2 drops of phenolphthalein T.S. be added, followed by a strong solution of sodium hydroxide (1 in 4), drop by drop, until the liquid has acquired a permanent red tint and the acid is saponified, and if acetic acid be added until the red color of the liquid is just discharged, and the liquid be filtered, then 10 Cc. of the filtrate mixed with 10 Cc. of ether should not be rendered more than slightly turbid by shaking with 1 Cc. of lead acetate T.S. (absence of notable quantities of *palmitic* and *stearic acids*)." *U. S.* According to Dieterich, pure oleic acid has the iodine figure 89.8 to 90.05 and commercial oleic acid 65.03 to 86.18 (see PART III, Iodine Absorption Value of Fats and Oils, Test 51; also *Ph. Post*, 1894, 436.)

"At 40° to 41° F. (4.5° to 5° C.) it becomes semi-solid, melting again at 56° to 60° F. (13.3° to 15.5° C.). . . Dissolve about 1 gramme of the Acid in 15 to 20 times its volume of *alcohol* (90 per cent.); add two drops of *solution of phenolphthalein* and, drop by drop, a 25 per cent. aqueous solution of *sodium hydroxide* until the liquid after shaking remains slightly red and the acid is completely neutralized; then drop in *diluted acetic acid* until, after shaking, the red tint just disappears; filter the liquid, and mix about 10 cubic centimetres of it with an equal volume of Purified Ether and 1 cubic centimetre of a 10 per cent. aqueous solution of *lead acetate;* only a slight turbidity should result (absence of more than traces of stearic or palmitic acid)." *Br.*

Chemical Constitution.—Oleic acid, $C_{18}H_{34}O_2$, does not belong to the "fatty acid" series, but differs from the corresponding acid of that series, stearic acid, $C_{18}H_{36}O_2$, by having two atoms less of hydrogen. It belongs to a series derived by oxidation from alcohols which, like allyl alcohol, C_3H_5OH, have two atoms of hydrogen less than the normal monatomic alcohols, like propyl alcohol, C_3H_7OH. The alcohol from which oleic acid is in theory derivable is not, however, known. Oleic acid is monobasic, as shown in the formula $HC_{18}H_{33}O_2$.

Uses.—Oleic acid is used chiefly in preparing the oleates and in ointments. It has, however, been administered in capsules taken on first

rising in the morning as a substitute for olive oil in the treatment for *gallstones* (*R. T.*, 1901).

Dose, seven to fifteen grains (0.45 to 1 Gm.).

Off. Prep.—Linimentum Ammoniæ, *U. S.;* Oleatum Atropinæ, *U. S.;* Oleatum Cocainæ, *U. S;* Oleatum Hydragyri, *U. S.* (*Br.*); Oleatum Quininæ, *U. S.;* Oleatum Veratrinæ, *U. S.;* Unguentum Aconitinæ, *Br.;* Unguentum Atropinæ, *Br.;* Unguentum Cocainæ, *Br.;* Unguentum Veratrinæ, *Br.*

ACIDUM PHOSPHORICUM. U. S. (Br.)

PHOSPHORIC ACID

(ăç'ĭ-dŭm phŏs-phŏr'ĭ-cŭm)

"A liquid composed of 85 percent., by weight, of absolute Orthophosphoric Acid [H_3PO_4 or $PO(OH)_3 = 97.29$], and 15 percent. of water. It should be kept in glass-stoppered bottles." *U. S.* "A liquid containing 66.3 per cent. of hydrogen orthophosphate, H_3PO_4, with 33.7 per cent. of water. It may be prepared by treating, with water and nitric acid, the residue left after burning phosphorus in air." *Br.*

Acidum Phosphoricum Concentratum, *Br.;* Concentrated Phosphoric Acid; Acide Phosphorique, *Fr.;* Acidum phosphoricum, *P. G.;* Phosphorsaure, *G.;* Acido fosforico, *It., Sp.*

The U. S. P. 1890 and 8th Rev. phosphoric acids are much stronger than that of the U. S. P. 1880; it is now 85 per cent., instead of 50 per cent. The United States Pharmacopœia has very properly abandoned the former official process for this acid; it is more profitably and conveniently made on a large scale, and with such precautions and safeguards as cannot be easily used by the apothecary; the process of the U. S. P. 1880, however, will be found upon page 77, U. S. D., 18th edition.

This preparation is recommended on account of its small bulk and its great convenience to the apothecary for preparing the diluted acid. The glacial phosphoric acid is no longer official, it having been shown that it is practically impossible to obtain it of sufficient purity to be reliable. (See *Proc. A. Ph. A.*, 1875, pp. 666, 672.) The present syrupy acid is a great improvement in every way, as it can be obtained of undoubted purity and strength, and by the addition of water, diluted phosphoric acid of any desired strength can easily be produced from it. The process for its preparation is the well known one of oxidizing phosphorus by the use of nitric acid, the former British method not differing materially from that of the U. S. Pharmacopœia of 1880, except in the absence of the use of hydrogen sulphide for precipitating the arsenical compounds usually found in phosphorus, and in the greater strength of the finished product. The British concentrated phosphoric acid contains 66.3 per cent. of orthophosphoric acid, while the U. S. phosphoric acid now contains 85 per cent., and that of the German Pharmacopœia is only 25 per cent. Phosphorus is oxidized at the expense of the nitric acid, any excess of nitric acid and all the lower oxides of nitrogen being driven off by heat. Strong nitric acid acts too energetically on phosphorus, producing explosion and rapid combustion, but when diluted, as in the processes above referred to, it parts with its oxygen slowly, and it is even desirable to aid the operation with a gentle heat. Along with the nitrous fumes, a portion of the undecomposed nitric acid also rises in vapor, which, in the former British process, to prevent loss, is collected by means of a distillatory apparatus and returned to the retort. In the U. S. process of 1870 the same result was effected by placing over the liquid in the capsule a glass funnel, upon the inner surface of which the acid was condensed, and returned of itself into the capsule so as considerably to simplify the operation. This modification was originally suggested by Geo. W. Andrews of Baltimore, who, however, inverted a dish over the materials, the suggestion of the funnel being due to Procter. The operation was continued till the whole of the phosphorus was converted into phosphoric acid and dissolved; the liquid having been deprived of any remaining acid, and reduced to a certain weight by concentration, the process was completed by adding a certain measure of water, so that an acid of definite strength was obtained. C. L. Diehl found, in carrying this process into effect, that the glass funnel covering the capsule almost always breaks through the violence of the reaction, thus causing loss of phosphorus, besides annoyance to the operator. He therefore prefers using a French tubulated glass retort, and this suggestion was adopted in the process for Phosphoric Acid (U. S. P. 1880). (*A. J. P.*, 1867, p. 138.)

Markoe (*Proc. A. Ph. A.*, 1875, p. 677) proposed a method for making phosphoric acid which is particularly adapted for making large quantities, yet works well in a smaller way. Into a flask (or stone jar) having double the capacity of the materials used, 12 troyounces of water, 2 troyounces of phosphorus, and 10 grains of iodine are placed, then 40 grains of bromine are cautiously dropped in; when the reaction has ceased, 12 troyounces of nitric acid are added; a glass funnel is adjusted in the neck of the flask, and a smaller inverted funnel set inside of it; the apparatus is placed in a stoneware dish, and surrounded with cold water or ice; the reaction takes place slowly and regularly. In about 24 hours, if all the phosphorus be not acted upon, heat may be applied until it disappears, and the excess of bromine, iodine, and nitric acid is driven off. The acid may then be diluted to the desired specific gravity. J. U. Lloyd (*N. R.*, July, 1880) suggests the use of pure alcohol to unite with the nitric acid to form nitrous ether, which is more volatile and more easily driven off. Markoe added a small quantity of pure oxalic acid, and heated the mixture to 300° F.; at this temperature it is asserted that all the oxalic acid splits into carbon monoxide and carbon dioxide.

Nicolas prepares a pure phosphoric acid by adding a known quantity of pure calcium phosphate gradually to a slight excess of pure diluted hydrofluoric acid contained in a lead or platinum vessel, the mixture being well stirred after each addition. An energetic action takes place. When all the calcium phosphate has been added, the temperature is still maintained for a time to complete the reaction. The calcium fluoride is then filtered off and the solution evaporated. As the solution becomes viscid, the excess of hydrofluoric acid all passes off by evaporation. A syrup containing from 60 to 70 per cent. of phosphoric anhydride can be thus obtained. Warren suggests a method for preparing phosphoric acid in a pure state, which consists in introducing sodium or other soluble phosphate into a solution of copper sulphate, washing the insoluble copper phosphate formed, and dissolving in solution of phosphoric acid, then electrolyzing the mixture. A pure and very dense copper is said to be thrown down, and a large quantity of phosphoric acid of sp. gr. 1.75 is obtained. (*Chem. News,* lxviii. 66.)

Much dissatisfaction has been caused among pharmacists by the fact that diluted phosphoric acid frequently produces a white precipitate in solutions of ferric salts. An examination proved that this occurred when the glacial acid is used, or when high heat had been employed in the concentration. Experiments conducted by Louis Dohme and Remington indicated that the precipitation resulted from the presence of pyrophosphoric acid. (*Proc. A. Ph. A.,* 1874, 431, 511; 1875, 663, 670, 667.) Considerable difficulty was experienced in driving off all the nitric acid, and in the attempt to do so the temperature became so elevated as to reconvert some of the tribasic acid to the bibasic form. This occurred slightly at 148.8° C. (300° F.), but to a much greater extent between 176.6° C. (350° F.) and 204.4° C. (400° F.). The diluted acid, made from phosphorus, can be brought to the boiling point of 232.2° C. (450° F.), and will then only produce a slight cloud with tincture of ferric chloride, but if diluted, when cool, with about half its bulk of cold water, which causes considerable elevation of temperature, it forms a clear solution. The same acid evaporated, heated to redness, allowed to congeal, and then dissolved in water, precipitated the iron solution. The addition of twenty per cent. of sodium pyrophosphate to the same diluted acid made a preparation which in all respects resembled that made from the glacial acid, thus giving evidence that the presence of this contamination was the cause of the difference in the two preparations.

It has been suggested that red phosphorus might be substituted for common phosphorus, as producing the same results, with less danger of explosion; but the official process, when carefully followed in reference to due dilution and a moderate heat, is not dangerous.

Lyons's table (pages 60 and 61), now incorporated in the U. S. P. 8th Rev., exhibits the quantity of orthophosphoric acid contained in solutions of different densities at 15° C. (59° F.) and 25° C. (77° F.).

Properties.—"A colorless liquid of a syrupy consistence, without odor, and having a strongly acid taste. Specific gravity: about 1.707 at 25° C. (77° F.). Miscible, in all proportions, with water or alcohol. When heated, the liquid loses water; at 200° C. (392° F.), it gradually begins to change to pyrophosphoric acid. At a still higher temperature it is converted into metaphosphoric acid, which volatilizes in dense fumes, or, on cooling, forms a transparent mass of glacial phosphoric acid. The Acid, even when largely diluted, has an acid reaction upon blue litmus paper. If a small portion of Phosphoric Acid be supersaturated with ammonia water, the addition of magnesium sulphate T.S. (or of magnesia mixture) produces a white, crystalline precipitate. If this precipitate be collected, washed, and dissolved in diluted acetic acid, the solution yields a yellow precipitate with silver nitrate T.S. (distinction from *metaphosphoric* or *pyrophosphoric acid*). If a crystal of ferrous sulphate be dropped into a cooled mixture of 1 Cc., each, of Phosphoric Acid, sulphuric acid, and water, no brown or brownish-black color should appear around the crystal (absence of *nitric acid*). If 1 Cc. of Phosphoric Acid be diluted with 5 Cc. of water, and the liquid gently warmed, it should not be blackened upon the addition of a few drops of silver nitrate T.S., or rendered turbid by mercuric chloride T.S. (absence of *phosphorous acid*). If Phosphoric Acid be diluted with water (1 in 10), 5 Cc. should not respond to the Modified Gutzeit's Test for *arsenic* (see Part III, Test No. 17). Upon adding to 1 Cc. of Phosphoric Acid a mixture of 3 Cc. of alcohol and 1 Cc. of ether, no turbidity should appear (absence of *phosphates*). If Phosphoric Acid be diluted with water (1 in 20), 10 Cc. should not respond to the Time-Limit Test for *heavy metals* (see Part III, Test No. 121.) After diluting a portion of the Acid with 5 volumes of water, no precipitate should be produced, in separate portions of the liquid, by barium chloride T.S. (absence of *sulphuric acid*), or by silver nitrate T.S. (absence of *hydrochloric acid*); or when dropped into albumin T.S. (absence of *metaphosphoric acid*); nor should any precipitate be formed, even after several hours, by the addition of an equal volume of official tincture of ferric chloride (absence of *pyrophosphoric* and *metaphosphoric acids*). If 10 Gm. of Phosphoric Acid be diluted to measure 100 Cc., then 9.73 Cc. of this solution, when diluted with 10 Cc. of a cold saturated solution of sodium chloride, should require 17 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 5 percent. of absolute Phosphoric Acid), phenolphthalein T.S. being used as indicator." *U. S.*

"Evaporated, it leaves a residue which melts at a low red heat, and when cold forms a glass-like mass. The Acid yields, when neu-

Table of Percentage and Specific Gravity of Phosphoric Acid. U. S. P. (8th Rev.).

Per cent. phosphoric acid.	Specific Gravity.		Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
	25° C. 25° C.	15° C. 15° C.				
1	1.0056	1.0056	0.00017	0.018	0.21	0.048
2	1.0113	1.0113	0.00017	0.018	0.42	0.048
3	1.0169	1.0170	0.00018	0.018	0.63	0.048
4	1.0225	1.0226	0.00019	0.018	0.84	0.048
5	1.0281	1.0283	0.00020	0.018	1.05	0.045
6	1.0338	1.0340	0.00020	0.018	1.27	0.045
7	1.0395	1.0398	0.00021	0.017	1.49	0.045
8	1.0453	1.0457	0.00022	0.017	1.71	0.043
9	1.0512	1.0517	0.00022	0.017	1.94	0.043
10	**1.0572**	**1.0577**	**0.00023**	**0.017**	**2.17**	**0.043**
11	1.0632	1.0637	0.00024	0.017	2.40	0.043
12	1.0692	1.0698	0.00025	0.016	2.63	0.043
13	1.0753	1.0759	0.00025	0.016	2.86	0.042
14	1.0814	1.0821	0.00026	0.016	3.10	0.042
15	1.0875	1.0883	0.00027	0.016	3.34	0.042
16	1.0937	1.0945	0.00028	0.016	3.58	0.040
17	1.0999	1.1008	0.00029	0.016	3.83	0.040
18	1.1062	1.1072	0.00030	0.016	4.08	0.040
19	1.1125	1.1136	0.00031	0.016	4.33	0.038
20	1.1189	1.1201	0.00032	0.015	4.59	0.040
21	1.1254	1.1266	0.00033	0.015	4.84	0.038
22	1.1319	1.1332	0.00034	0.015	5.10	0.037
23	1.1385	1.1399	0.00034	0.015	5.37	0.038
24	1.1452	1.1467	0.00035	0.015	5.63	0.037
25	1.1519	1.1535	0.00036	0.014	5.90	0.037
26	1.1588	1.1604	0.00037	0.014	6.17	0.036
27	1.1657	1.1674	0.00037	0.014	6.45	0.036
28	1.1727	1.1745	0.00038	0.014	6.73	0.036
29	1.1799	1.1817	0.00039	0.014	7.01	0.034
30	1.1871	1.1889	0.00040	0.014	7.30	0.034
31	1.1943	1.1962	0.00040	0.014	7.59	0.034
32	1.2015	1.2035	0.00041	0.014	7.88	0.033
33	1.2088	1.2109	0.00042	0.014	8.18	0.033
34	1.2162	1.2184	0.00042	0.013	8.48	0.033
35	1.2237	1.2260	0.00043	0.013	8.78	0.033
36	1.2313	1.2336	0.00044	0.013	9.08	0.032
37	1.2389	1.2412	0.00044	0.013	9.39	0.031
38	1.2465	1.2489	0.00045	0.013	9.71	0.032
39	1.2542	1.2567	0.00046	0.013	10.02	0.032
40	1.2620	1.2645	0.00047	0.013	10.34	0.030
41	1.2698	1.2724	0.00047	0.013	10.67	0.030
42	1.2778	1.2804	0.00048	0.013	11.00	0.030
43	1.2858	1.2885	0.00049	0.012	11.33	0.029
44	1.2940	1.2967	0.00049	0.012	11.67	0.029
45	1.3023	1.3050	0.00050	0.012	12.01	0.029
46	1.3106	1.3134	0.00051	0.012	12.35	0.029
47	1.3190	1.3219	0.00052	0.012	12.70	0.028
48	1.3276	1.3305	0.00052	0.012	13.06	0.028
49	1.3362	1.3392	0.00053	0.011	13.42	0.028
50	1.3449	1.3479	0.00054	0.011	13.78	0.027
51	1.3537	1.3568	0.00055	0.011	14.15	0.027
52	1.3626	1.3658	0.00055	0.011	14.52	0.026
53	1.3716	1.3748	0.00056	0.011	14.90	0.026
54	1.3807	1.3840	0.00057	0.011	15.28	0.026
55	1.3898	1.3932	0.00058	0.011	15.66	0.025

Table of Percentage and Specific Gravity of Phosphoric Acid. U. S. P. (8th Rev.). (Continued.)

Per cent. phosphoric acid.	Specific gravity. 25° C. / 25° C.	Specific gravity. 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.	Normality. 1 Cc. requires. normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
56	1.3991	1.4026	0.00058	0.011	16.06	0.026
57	1.4085	1.4120	0.00059	0.011	16.45	0.025
58	1.4180	1.4215	0.00060	0.010	16.85	0.024
59	1.4276	1.4312	0.00060	0.010	17.26	0.024
60	1.4373	1.4409	0.00061	0.010	17.67	0.024
61	1.4471	1.4508	0.00062	0.010	18.09	0.024
62	1.4570	1.4607	0.00063	0.010	18.51	0.023
63	1.4669	1.4706	0.00064	0.010	18.94	0.023
64	1.4768	1.4807	0.00065	0.010	19.37	0.023
65	1.4868	1.4908	0.00066	0.010	19.80	0.023
66	1.4970	1.5010	0.00067	0.010	20.24	0.022
67	1.5072	1.5113	0.00067	0.010	20.69	0.022
68	1.5175	1.5217	0.00068	0.010	21.14	0.022
69	1.5280	1.5322	0.00069	0.009	21.60	0.021
70	1.5386	1.5429	0.00070	0.009	22.07	0.021
71	1.5493	1.5536	0.00071	0.009	22.54	0.021
72	1.5600	1.5644	0.00072	0.009	23.01	0.021
73	1.5708	1.5753	0.00072	0.009	23.49	0.020
74	1.5817	1.5862	0.00073	0.009	23.98	0.020
75	1.5927	1.5972	0.00074	0.009	24.47	0.020
76	1.6038	1.6083	0.00073	0.009	24.97	0.020
77	1.6149	1.6193	0.00072	0.009	25.48	0.020
78	1.6261	1.6304	0.00072	0.009	25.99	0.020
79	1.6374	1.6416	0.00071	0.009	26.50	0.019
80	1.6488	1.6529	0.00070	0.009	27.02	0.019
81	1.6602	1.6642	0.00070	0.009	27.55	0.019
82	1.6717	1.6756	0.00069	0.009	28.09	0.019
83	1.6832	1.6871	0.00069	0.009	28.63	0.019
84	1.6948	1.6986	0.00068	0.009	29.17	0.018
85	**1.7065**	**1.7102**	**0.00068**	....	**29.72**	....

[1] Add if the temperature is above, subtract if below, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

NOTE.—To find the per cent. of P_2O_5, multiply the per cent. of H_3PO_4 by 0.7243. To find the per cent. of PO_4, multiply the per cent. of H_3PO_4 by 0.96916.

To find the weight in grammes of H_3PO_4 in 100 Cc., multiply the specific gravity by the per cent. of H_3PO_4.

To find the volume per cent. of official Phosphoric Acid, multiply the "normality" by 3.365. For the volume per cent. of official Diluted Phosphoric Acid, multiply the "normality" by 46.08.

tralized, the reactions characteristic of phosphates. Specific gravity 1.5. Each gramme of it mixed with 2.5 grammes of Lead Oxide in fine powder should leave on evaporation a residue which, after it has been heated to dull redness, weighs 2.98 grammes. It should yield, when diluted with *water*, no characteristic reaction with the tests for lead, copper, arsenium, calcium, potassium, sodium, ammonium, chlorides, or nitrates, and only slight traces of iron or sulphates. Diluted, with five or six times its bulk of *water*, it is not precipitated by *solution of albumen* (absence of metaphosphoric acid), nor on adding Tincture of Ferric Chloride and setting the mixture aside for several hours (absence of metaphosphoric and pyrophosphoric acids). Diluted with *water* and the mixture set aside, no precipitate occurs (absence of silica). Diluted and mixed with an equal volume of *test-solution of mercuric chloride* and heated, no precipitate is formed (absence of phosphorous acid)." *Br.*

Uses.—This acid is used in making phosphates and lactophosphates. It has the same medicinal properties and uses as the diluted Phosphoric Acid (see p. 62).

Dose, two to five minims (0.12 to 0.3 Cc.).

Off. Prep.—Acidum Phosphoricum Dilutum, *U. S., Br.;* Elixir Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Glyceritum Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Syrupus Calcii Lactophosphatis, *U. S., Br.;* Syrupus Ferri Phosphatis, *Br.;* Syrupus Ferri Phosphatis cum Quinina et Strychnina, *Br.*

ACIDUM PHOSPHORICUM GLACIALE.—(*Glacial Phosphoric Acid; Metaphosphoric Acid; Monobasic Phosphoric Acid; Monohydrated Phosphoric Acid; Acide phosphorique glacial,* Fr.; *Glasige Phosphorsaure,* G.) Formula HPO_3; mol. wt. 79.41.—Phosphoric oxide consists of two atoms of phosphorus and five atoms of oxygen, P_2O_5, and can be obtained only by the direct union of its constituents, which takes place when phosphorus is burned in perfectly dry oxygen gas. Thus procured, it is in the form of a white amorphous powder, extremely deliquescent, volatilizable at a red heat, and assuming, when it cools after fusion, a vitreous appearance. The classic researches of Graham first established clearly the character of the several varieties of phosphoric acid, which may be considered as derived from this oxide.

When amorphous phosphorus is boiled with nitric acid, or when phosphoric oxide is boiled with water, the oxide takes up three molecules of water, and yields tribasic or *ordinary phosphoric* acid according to the reaction:

$$P_2O_5 + 3H_2O = H_6P_2O_8 \text{ or } (H_3PO_4)_2$$

If this acid be heated for a considerable time to 215° C. (419° F.), the two molecules lose one mol. of water and yield *pyrophosphoric* acid, a tetrabasic variety, according to the reaction:

$$H_6P_2O_8 - H_2O = H_4P_2O_7$$

Lastly, at a red heat the ordinary phosphoric acid is converted into *metaphosphoric* acid, a monobasic variety, according to the reaction:

$$H_3PO_4 - H_2O = HPO_3$$

This last variety may also be obtained direct from the oxide by dissolving it in cold water, when it takes up one molecule of water:

$$P_2O_5 + H_2O = H_2P_2O_6 \text{ or } (HPO_3)_2$$

An aqueous solution of either of the three acids, heated so long as water escapes, yields the monobasic or metaphosphoric acid; and as, upon cooling, it becomes a transparent ice-like solid, it has received in this state the name of glacial phosphoric acid. Conversely, this monobasic acid is slowly transformed, in aqueous solution, and more rapidly if the solution is heated, into the tribasic form. John M. Maisch ascertained that nitric acid, added to the solution of the monobasic acid, with the aid of heat, caused the change from the monobasic to the tribasic form, *i.e.,* to the common phosphoric acid, without the intermediate production of the tetrabasic variety. *Pyrophosphorous Acid,* $H_4P_2O_5$, has been obtained by V. Auger in the form of colorless needles, melting at 38° C. (100.4° F.). (*C. R. A. S.,* 136, 814.)

Tests.—The three forms of phosphoric acid are distinguishable by peculiar reactions. Thus, the *monobasic* is characterized by coagulating albumin, and giving white, gelatinous, uncrystallizable precipitates with the soluble salts of barium, lime, and silver; the *tetrabasic* does not coagulate albumin, and, though it causes a *white* precipitate with silver nitrate, must first be neutralized; the *tribasic* does not coagulate albumin, and, until neutralized, does not precipitate silver nitrate, but after neutralization throws down a *yellow* precipitate of silver phosphate.

Glacial phosphoric acid is most advantageously obtained from calcined bones, by first treating them with sulphuric acid, which produces an insoluble calcium sulphate and soluble acid phosphate; then dissolving out the latter salt, and saturating it with ammonium carbonate, which generates ammonium phosphate in solution; and, finally, obtaining the ammonium phosphate by evaporation to dryness, and then igniting it in a platinum crucible. The ammonia and all the water except the one molecule needed for the formation of metaphosphoric acid are driven off, and the glacial acid remains.

Properties.—Glacial phosphoric acid is in the form of a white, uncrystallizable, fusible solid; inodorous, very sour to the taste, slowly deliquescent, slowly soluble in water, and soluble also in alcohol. Its formula is HPO_3, and it is made up of 11.2 per cent. of water in combination with 88.8 per cent. of phosphoric oxide. It is characterized by producing white gelatinous precipitates with albumin, and with the soluble salts of lime, barium, and silver; and the precipitate produced with the barium chloride is readily redissolved by an excess of the acid. This form of acid results when the oxide, produced by burning phosphorus in dry oxygen gas, is introduced into cold water.

Impurities.—Glacial phosphoric acid is seldom prepared in this country. That found in commerce is almost all imported, and chiefly from Germany. It is often more or less impure, containing (as shown by the experiments of Maisch), silica and calcium and magnesium phosphates, which are precipitated from a neutralized solution of the acid by ammonia. In one instance 8 per cent. of these impurities was found, but in some others little or none. Maisch never found nitric or hydrochloric acid, and sulphuric acid rarely; and, though the presence of ammonia might be suspected from the source whence the acid is obtained, he did not detect it. (*A. J. P.,* 1860, p. 194.) The chief impurity, however, is soda, as has been pointed out by Brescius, Remington, Dohme, Prescott, and others (see *Proc. A. Ph. A.,* 1875, 666, 672); the acid has been found to contain occasionally as much as 60 per cent. of sodium metaphosphate, and rarely less than 55 per cent. (*N. R.,* Feb. 1879). Hodgkin (*P. J.,* 1891, p. 217) examined eight samples of German and English glacial phosphoric acid, and found in them, respectively, the following proportions of absolute orthophosphoric acid: 92.8, 91.5, 90.8, 85.4, 84.4, 83.8, 80.1, and 78.1 per cent. In consequence of its deliquescence upon exposure to the air, a portion of the monobasic acid passes into the tribasic state. This may be detected, if in considerable quantity, by its giving a yellowish colored precipitate with silver nitrate. The U. S. P. 1870 directed that the acid, in aqueous solution, should yield no precipitate with hydro-

gen sulphide, showing the absence of metals; should cause a white precipitate with barium chloride soluble in an excess of acid; with an excess of ammonia should cause only a slight turbidity, proving the almost total absence of earthy salts; and should yield no ammonia when treated with potassium hydroxide in excess. Should the presence of arsenic be ascertained by the tests for that metal, it may be separated by boiling with hydrochloric acid, so as to convert the arsenic into its very volatile chloride, which would escape with vapors of hydrochloric acid.

Glacial phosphoric acid was introduced into the U. S. P. 1860 as affording a convenient method of preparing the medicinal acid, but, owing to its unreliability, was very properly dismissed; 38½ grains, dissolved in a fluidounce of water, form a solution about equal in strength to the diluted acid of U. S. P. 1860.

ACIDUM PHOSPHORICUM DILUTUM. U. S., Br.

DILUTED PHOSPHORIC ACID

(ăç'ĭ-dŭm phŏs-phŏr'ĭ-cŭm dī-lū'tŭm)

"Diluted Phosphoric Acid should contain 10 percent., by weight, of absolute Orthophosphoric Acid [H_3PO_4 or $PO(OH)_3 = 97.29$], and 90 percent. of water." *U. S.* "A liquid containing, by weight, 13.8 parts of hydrogen orthophosphate, H_3PO_4, and 86.2 parts of water." *Br.*

Acide phosphorique médicinal, *Fr.;* Verdünnte Phosphorsaure, *G.*

* "Phosphoric Acid, *one hundred grammes* [or 3 ounces av., 231 grains]; Distilled Water, *seven hundred and fifty grammes* [or 26 ounces av., 199 grains], to make *eight hundred and fifty grammes* [or 29 ounces av., 430 grains]. Mix them. Keep the product in glass-stoppered bottles." *U. S.*

"Concentrated Phosphoric Acid, 3 *fl. ounces* (Imperial measure) or 4.5 *ounces,* or 150 cubic centimetres or 225 grammes; Distilled Water, a sufficient quantity. Dilute the Concentrated Phosphoric Acid with sufficient Distilled Water to form, at 60° F. (15.5° C.), *one pint* (Imp. meas.) or one thousand cubic centimetres of Diluted Phosphoric Acid." *Br.*

It will be observed that in both Pharmacopœias diluted phosphoric acid is made by simple dilution of the stronger acid, and that the older method of dissolving the glacial acid has been very properly abandoned. (See *Acidum Phosphoricum Glaciale,* p. 62.) The official diluted acid is weaker than the British, the U. S. P. acid containing 10 per cent. of orthophosphoric acid, while the British contains 10 per cent. of phosphoric anhydride, P_2O_5, which corresponds to about 14 (13.8) per cent. of orthophosphoric acid. The specific gravity of the British acid is 1.08, and "each gramme of it mixed with 0.5 gramme of Lead Oxide in fine powder should leave on evaporation a residue which after it has been heated to dull redness weighs 0.6 gramme." *Br.*

Properties.—Diluted phosphoric acid is a colorless, inodorous, sour liquid, acting strongly on litmus, and possessing powerful acid properties, although when evaporated so as to become dense, it is not corrosive like the other mineral acids. Neubauer found that the strong acid, when pure and warm, was capable of dissolving calcium oxalate. Diluted Phosphoric Acid is officially described as follows: "Specific gravity: about 1.057 at 25° C. (77° F.). It corresponds in chemical properties and should conform to the reactions and tests given under *Acidum Phosphoricum.* If 4.87 Gm. of Diluted Phosphoric Acid be diluted with 5 Cc. of a cold saturated solution of potassium chloride, it should require 10 Cc. of normal potassium hydroxide V.S. for neutralization (each Cc. corresponding to 1 percent. of absolute Phosphoric Acid), phenolphthalein T.S. being used as indicator." *U. S.* It has been supposed that one-tenth of phosphorous acid would render the diluted acid dangerous to life; but experiments go far to show that this was an erroneous opinion, as half a drachm of that acid given to a dog produced no obvious poisonous effect. (See *A. J. P.,* 1858, p. 359.) Phosphorous acid may be detected by testing the medicinal acid with a solution of corrosive sublimate, which will be converted into calomel if this impurity be present.

Old diluted phosphoric acid is very apt to contain microscopic plants. The presence of traces of hydrochloric acid is said to prevent their formation. (Rother, *D. C.,* 1886, p. 99; L. E. Sayre, *Proc. A. Ph. A.,* 1885; Samuel G. Ade, *Proc. A. Ph. A.,* 1884.)

Uses.—Diluted phosphoric acid is deemed tonic and refrigerant. It is free from astringency, and is certainly a valuable remedy in many cases of *dyspepsia.* Various properties have been ascribed to it, such as allaying pain and spasm, strengthening the sexual organs, preventing the morbid secretion of bony matter, and correcting phosphatic deposits in the urine. The last two properties are supposed to depend upon its power of dissolving calcium phosphate. Diluted phosphoric acid has been recommended for use in the treatment of *hysteria, diabetes,* and *leucorrhœa* when the secreted fluid is thin and acrid; it has also been used with asserted good results in the treatment of *low fevers,* but probably has no action upon the system other than that upon the digestive organs, although A. Judson (*Ann. Thér.,* 1871 and 1872, p. 152) asserts that in doses of one to three drachms it acts as a stimulant, increasing the force and frequency of the pulse, and causing headache and cerebral confusion,—effects which may be the result of gastric irritation.

Dose, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.), largely diluted.

ACIDUM SALICYLICUM. U. S., Br.

SALICYLIC ACID

(ăç'ĭ-dŭm săl-ĭ-cŷl'ĭ-cŭm)

$HC_7H_5O_3 = 137.01$

"A monobasic organic acid [$C_6H_4(OH)COOH$ 1 : 2], existing naturally in combination in various plants, but generally prepared synthetically from phenol." *U. S.* "A crystalline acid, $C_6H_4.OH.COOH$, obtained from natural salicylates such as the oils of wintergreen (Gaultheria procumbens, *Linn.*) and sweet-birch (Betula lenta, *Linn.*), or by the interaction of sodium carbolate and carbonic anhydride." *Br.*

Ortho-oxybenzoic Acid; Acidum Spiricum; Acide salicylique, *Fr. Cod.*; Acidum salicylicum, *P. G.*; Salicylsaure, Spirsaure, Salicoylsaure, Spiroylsaure, *G.*; Acido salicilico, *It., Sp.*

In 1834 salicyl aldehyde (*salicylous acid*) was discovered by Pagenstecker in the flowers of *Spiræa Ulmaria*, L. In 1837, Piria and Ettling found that by oxidizing agents salicyl aldehyde was converted into a new body, salicylic acid, and in 1839, Löwig and Weidmann derived the latter principle directly from the flowers of the *Spiræa Ulmaria*, L. Shortly afterwards Procter (*A. J. P.*, 1843; Aug. 1875) discovered that the acid could be procured from the oil of wintergreen (*Gaultheria procumbens*), which is now known to contain fully 90 per cent. of methyl salicylate. Methyl salicylate is indeed obtainable by distillation from very many plants, but the probabilities are that it never exists already formed in the plant, but is produced during the process of distillation. (See *Betula lenta*, PART II.) When potassium hydroxide is added to methyl salicylate, a new salt is formed, from which the acid is readily obtained by means of hydrochloric acid. Notwithstanding the discovery of this fact, and also the invention of still another process of manufacture by Ettling in 1845, salicylic acid remained so expensive as to be of no value in the arts until Kolbe and Lautemann discovered that it could be prepared by uniting phenol with carbon dioxide through the instrumentality of sodium. The article now began to attract some attention, but remained beyond the reach of general use until Kolbe, by continuing his researches, succeeded, in 1874, in producing it at a moderate cost (*J. Pr. Chem.*, July, 1874). Traphagen and Burke found salicylic acid to be a natural constituent of many fruits, as follows: strawberries, raspberries, blackberries, currants, plums, black cherries, apricots, peaches, grapes, crab apples, apples, and oranges. (*J. Am. C. S.*, 1903, 242.)

Preparation.—While salicylic acid may be prepared from salicin by fusion with potassium hydroxide, or from oil of wintergreen by saponification with potassium hydroxide solution, practically it is now obtained, according to Kolbe's patent, by treating sodium phenol (or carbolate) with carbon dioxide gas. For this purpose, the most concentrated caustic soda solution is evaporated with the corresponding amount of phenol to a dry powder, which is then heated to 100° C. (212° F.), while a stream of dry carbon dioxide gas is passed over it. The temperature is gradually raised to 180° C. (356° F.), increased to 220° C. (428° F.) as soon as phenol distils over, and finally raised to 250° C. (482° F.), until no more phenol distils. In the retort, the half of the phenol used remains as basic sodium salicylate, while the other half has distilled over unchanged. The reaction is as follows:

$$2C_6H_5ONa + CO_2 = C_6H_5OH + C_6H_4(ONa)COONa$$

The sodium salt thus obtained is dissolved in water, decomposed by hydrochloric acid, the salicylic acid filtered off, washed, and crystallized out of hot water, or purified by sublimation in a current of superheated steam. P. W. Hofmann subsequently patented a process whereby distillation with superheated steam, with its attendant loss, is obviated; to the crude solution is added stannous chloride, which precipitates a dark mass containing the impurities, the clear supernatant liquid is then decomposed with hydrochloric acid and the crystals of salicylic acid purified by washing and the use of centrifugals. (*Ph. Centralh.*, 1892, 412.) An important improvement was subsequently made in Kolbe's process whereby all, instead of only half, of the phenol-sodium is converted into salicylate. R. Schmitt has found (Wagner's *Jahresbericht für Chem. Tech.*, 1885, p. 490) that if dry sodium phenolate and dry carbon dioxide are allowed to act on each other at ordinary temperatures, as long as absorption takes place a phenyl-sodium carbonate, $CO\begin{cases} OC_6H_5 \\ ONa \end{cases}$, is formed. If this is now heated for several hours in a closed vessel to 140° C., a molecular rearrangement takes place, and simple sodium salicylate, $C_6H_4(OH)COONa$, is formed without any separation whatever of phenol. Schmitt's process was purchased by the owners of Kolbe's patent. Lloyd's process for preparing salicylic acid from oil of wintergreen is as follows: Pure wintergreen oil, 3 parts; white potassium hydroxide, 3 parts; hydrochloric acid, 8 parts; water, q. s. Dissolve the potassium hydroxide in two parts of water in a glass or porcelain vessel, and heat to the temperature of 180° F. Stir into this gradually the oil, using a glass or porcelain spatula. Into another vessel place 64 parts of cold distilled water, and add the hydrochloric acid. Then with constant stirring add the solution of the potassium salicylate. The magma of minute crystals of salicylic acid must be separated with a thin muslin strainer (previously moistened) and pressed, then dried by exposure to a temperature of 150° F. The yield of this crude acid will be slightly over two parts. Dissolve this in six parts of cold alcohol, and filter through a funnel stopped with cotton. Then with constant stirring pour the filtrate into 32 parts of cold water. The magma of minute crystals must be separated with a thin

muslin strainer, and dried by exposure to a heat of 150° F. The yield is a trifle less than 2 parts. For Walter's process, see *Bull. Pharm.*, 1899, 54. Salicylic acid has also been obtained synthetically from copper benzoate and water, which, when heated together in sealed tubes, yield cuprous oxide, free benzoic acid, and salicylic acid. (E. F. Smith, *Am. Chem. J.*, 2, p. 338.) A. Rautert has found that the acid volatilizes with steam of 170° C. (338° F.), and has devised a process of purification based upon this, which yields at very little cost a beautiful product. Biel (*Ph. Z. R.*, 1876) reports that the sublimed acid is liable to decompose spontaneously. Dialyzed salicylic acid of beautiful appearance has been in the market since 1876. All traces of tarry matter can be removed by dialysis, and this acid is unexceptionable. Kolbe also obtained salicylic acid from barium and calcium carbolates, but the yield was less than when sodium salt was employed. Potassium phenol yielded only a trace of salicylic acid, but an abundance of *paraoxybenzoic* acid.

Properties.—Salicylic acid, when pure, occurs as a snow-white crystalline powder, free from odor, and also from taste, but leaving a sense of astringency on the tongue and of irritation in the fauces, with an increased flow of saliva. "Light, fine, white, prismatic needles, or a bulky, white, crystalline powder; odorless, or having a slight gaultheria-like odor, with a sweetish, afterwards acrid taste, and permanent in the air." *U. S.* To the mucous membrane of the nose it is irritating, and it will sometimes produce sneezing. It crystallizes out of its hot aqueous solution on cooling in slender, often very long needles, and on the spontaneous evaporation of its alcoholic solution, in large four-sided prisms. It is strongly acid, acting decisively on blue litmus, and forming salts not only with alkalies, but also with metallic oxides. Salicylic acid is "soluble in 308 parts of water and in 2 parts of alcohol at 25° C. (77° F.); in 14 parts of boiling water, and very soluble in boiling alcohol; also soluble in ether, absolute alcohol, and chloroform. When heated to 156° C. (312.8° F.), the Acid begins to melt, and is completely melted at 157° C. (314.6° F.); at a higher temperature it is gradually dissipated without leaving more than 0.6 percent. of fixed residue. The saturated aqueous solution has an acid reaction upon blue litmus paper, and is colored intensely bluish-violet (in high dilution violet-red) by ferric chloride T.S." *U. S.* "Soluble in 3 parts of *alcohol* (90 per cent.), in 2 of *ether*, or in 200 of *glycerin*. Dissolves in *solutions of ammonium citrate, ammonium acetate, sodium phosphate,* and in solution of *borax;* also in solutions of alkaline hydroxides and carbonates, salicylates being produced; such solutions of salicylates, if not weaker than 1 per cent., afford a yellowish-brown precipitate with *solution of uranium nitrate* (distinction from carbolates and sulphocarbolates). The crystals melt at 312.8° to 314.6° F. (156° to 157° C.), and below 392° F. (200° C.) volatilize without decomposition. *Test-solution of ferric chloride* gives with the aqueous solution a violet color, or, if the solution be largely diluted, a reddish-violet color." *Br.* When heated rapidly it is converted into phenol and carbon dioxide. It is stated that, by careful heating, glycerin can be made to dissolve 1 part in 50, and that the solution not only remains clear on cooling, but also may be diluted with water without separating. (*A. J. P.*, 1875, p. 212.) Goldsborough affirms that a mixture of the acid with alcohol, 1 to 10, may be diluted with 150 parts of water without crystallizing. By the presence of various neutral salts its solubility is increased without its antiseptic value being interfered with. It dissolves when mixed with 1 part of potassium nitrate, in 50 parts water; 1½ parts of ammonium citrate, in 60 parts water; 2 parts sodium sulphite, in 50 parts water; 2 parts sodium phosphate, in 50 parts water; 2½ parts sodium phosphate, in 12½ parts water. (Allen, *Com. Org. Anal.*, 1879, p. 344; also see Rother, *A. J. P.*, 1886, p. 420.)

On distilling salicylic acid or one of its salts with methyl alcohol and sulphuric acid, acid methyl salicylate is formed, having an agreeable aromatic odor. The reaction with ferric salts is much more delicate (1 in 100,000) than that of phenol with the same reagent (1 in 3000). Commercial salicylic acid is often very impure. Sodium chloride, phenol, cresotic acid, and oxybenzoic and paraoxybenzoic acids are the usual impurities. The first of these substances remains on igniting the acid. Phenol may be detected by nearly neutralizing the sample with sodium hydroxide and agitating the liquid with ether. On evaporating, the ethereal liquid leaves the phenol, recognizable by its odor and taste. (Allen, *Com. Org. Anal.*, p. 347.)

The most sensitive test for it is a ferric salt, with which it develops a beautiful violet color. Goldsborough states that to insure the delicacy of this reaction it is necessary that the iron salt be perfectly neutral; also that with this precaution he has clearly detected 1 part of the acid in 400,000 parts of water. On the addition of ammonia the violet color is changed to a reddish-brown, then to an orange, then to a permanent greenish-yellow. Sulphuric and nitric acids change the violet to a light brown (Goldsborough). It must be remembered that salicylous acid reacts similarly with ferric salts. Salicylous acid, however, precipitates the silver potassio- or ammonio-nitrate white, the salicylic acid yellow. A. Fagans (*A. J. P.*, 1893, p. 133) points out that salicylic acid cannot be colorimetrically estimated in aqueous solutions in presence of phenols, but that in alcoholic solution only the former reacts with ferric chloride. Kolbe recommends a simple test to detect impurities. A little of the acid is dissolved in 10 times its weight of strong alcohol, and the solution allowed to evaporate spontaneously from a watch crystal. If the

salicylic acid which remains in the dish be perfectly colorless, the acid is strictly pure; it should not be of a brown color, although a slight yellowish color would not indicate sufficient impurity to affect its medicinal value. Hager states that pure salicylic acid equal in volume to the size of a bean produced, after agitation with about 5 Cc. of pure sulphuric acid, a colorless solution, while other samples which yielded a white residue from the alcoholic solution produced yellowish to brown-yellow solutions. (*A. J. P.*, June, 1877.)

By distilling with alcohol and strong sulphuric acid, salicylic acid forms methyl- and ethyl-salicylic acids.

Tests.—"On adding to a small portion of Salicylic Acid, in a test-tube, about 1 Cc. of concentrated sulphuric acid, then, cautiously, about 1 Cc. of methyl alcohol in drops, and heating the mixture to boiling, methyl salicylate will be produced, which may be recognized by its odor. On allowing a saturated alcoholic solution of the Acid to evaporate spontaneously in a glass or porcelain evaporating dish, in a place protected from dust, a perfectly white, crystalline residue should remain (absence of *iron, phenol,* or *coloring matter*). If 1 Gm. of the Acid be dissolved in an excess of cold sodium carbonate T.S., the liquid agitated with an equal volume of ether, and the ethereal solution allowed to evaporate spontaneously, the residue, if any, should be free from the odor of *phenol.* On treating about 0.5 Gm. of Salicylic Acid, in a clean test-tube, with 10 Cc. of concentrated sulphuric acid, no color should be imparted to the latter within fifteen minutes (absence of *readily carbonizable, organic impurities*). A solution of 0.5 Gm. of the Acid in 10 Cc. of alcohol, mixed with a few drops of nitric acid, should remain unaffected upon the addition of a few drops of silved nitrate T.S. (absence of *hydrochloric acid*)." *U. S.* "Shaken up with a small proportion of *water,* the mixture filtered, and the solution evaporated, there remains a white residue, having no buff-tinted fringe (absence of iron, organic impurities, and coloring matter). Salicylic Acid dissolves in cold *sulphuric acid,* imparting to the liquid no color in 15 minutes (absence of organic impurities). When 1 gramme of the Acid is dissolved in an excess of cold *solution of sodium carbonate,* the liquid agitated with an equal volume of *ether,* and the ethereal solution allowed to evaporate spontaneously, the residue, if any, should be free from the odor of phenol (absence of phenol)." *Br.* Traces of salol are found in salicylic acid. (Hoffmann, *Proc. A. Ph. A.*, 1896, 232.)

Uses.—Salicylic acid was originally brought to the notice of the profession on account of its inhibitory influence on putrefaction. Kolbe found that 0.04 per cent. had great influence in preventing souring of milk. Bucholz found that 0.15 per cent. of the acid is sufficient to prevent the development of bacteria in ordinary organic mixtures, and that the influence of 0.005 per cent. is plainly visible; 0.3 to 0.4 per cent. of the acid killed bacteria in vigorous growth. (*A. E. P. P.*, Bd. iv.) Sodium salicylate was about equal to the pure acid, 0.4 per cent. destroying the bacteria. In the preservation of urine, Meyer and Kolbe found that one part of salicylic acid to two thousand of urine was sufficient to prevent putrefaction. (*J. Pr. Chem.*, Bd. xii.) According to Kolbe and others, salicylic acid arrests or prevents the action of the non-organized organic ferments. Thus, it will prevent the development of the hydrocyanic acid by the action of emulsin upon amygdalin in the presence of water, and will also inhibit the formation of the volatile oil of mustard. Miller found that one per cent. of salicylic acid was sufficient to check the action of ptyalin upon starch, thus equalling in power ten per cent. of phenol. He also found that 0.2 per cent. of salicylic acid distinctly affected outside of the body the digestive action of pepsin. The test of clinical experience has shown that salicylic acid is capable of accomplishing much in antiseptic surgery; but, in spite of certain advantages which the remedy has, it has failed to maintain itself against phenol and other antiseptics, so that it is at present but little used by the surgeon. Nevertheless, as it is still employed to some extent, we give the following methods of use.

Thiersch's *salicylic acid wadding* for hermetically sealing wounds is made by dissolving two ounces of the acid in two pints of alcohol (sp. gr. 0.83), diluting with twenty pints of water at from 158° to 178° F., saturating with this six pounds and eight ounces of cotton batting deprived of oily matter, and afterwards drying. This wadding contains 3 per cent. of the acid; for some purposes a stronger batting, containing 10 per cent., is prepared. When the wound or abscess is discharging profusely, jute is substituted for the cotton batting, because it is much more permeable to pus. An efficient ointment may be prepared by dissolving one and a half parts of the acid in two parts of alcohol and adding lard, or advantage may be taken of the solubility of the drug in glycerin. The following solutions are used in St. Bartholomew's Hospital. Sodium phosphate, three parts; salicylic acid one part; water fifty parts. —Salicylic acid one part; olive oil forty-nine parts.—Salicylic acid one part; sodium bicarbonate half part; water one hundred parts. —Salicylic acid ten parts; borax eighteen parts; water one hundred parts. A 25 per cent. solution, which will bear dilution with water or alcohol, may be prepared according to the following formula: Salicylic acid, 120 grains; sodium borate, 60 grains; glycerin, sufficient to make 1 fluidounce; heat gently until dissolved.

When salicylic acid is given to man in doses just sufficient to manifest its presence, symptoms closely resembling those of cinchonism result. These are fulness of the head, with roaring and buzzing in the ears. After larger doses,

to these symptoms are added distress in the head, or positive headache, disturbances of hearing and vision (deafness, amblyopia, partial blindness), and excessive sweating. In some cases there is a decided fall of temperature without alteration of the pulse; but probably more commonly the bodily temperature remains unaltered. The action upon the system of the acid and of its sodium, ammonium, potassium, and methyl (oil of gaultheria) salts appears to be identical, and, as several cases of poisoning with one or other of these agents have occurred, we are able to trace the toxic manifestations. Along with an intensification of the symptoms already mentioned, there are ptosis, deafness, strabismus, mydriasis, disturbance of respiration, excessive restlessness passing into delirium, slow laboring pulse, olive-green urine, and involuntary evacuations. In some cases the temperature has remained about normal, but in others has approached that of collapse. The respiration seems to be characteristic, it being both quickened and deepened, often sighing. Sweating usually is very free, and the urine early becomes albuminous. Various local evidences of vasomotor weakness may supervene, such as rapidly appearing bed sores at points subjected to pressure, and transitory dark-colored maculæ on various parts of the body. In several cases death was probably produced by the acid, although there is scarcely one instance which is beyond doubt. In certain cases the mental disturbance has been strangely prolonged, lasting for eight days. In some instances it is cheerful, in others melancholic in type. It is stated that upon drunkards the acid acts very unfavorably, violent delirium being an early symptom.

Upon the lower mammals salicylic acid acts very much as it does upon man, causing mydriasis, marked disturbance of respiration, great nervous prostration, delirium, dyspnœa, and, if the dose has been large enough, death by respiratory paralysis. Moderate therapeutic doses appear to have no powerful influence upon the circulation, such physiological evidence as we have indicating that they increase arterial pressure somewhat by exciting the vasomotor centre and directly increasing the cardiac force. In overdoses salicylic acid causes fall of the arterial pressure, partly by a direct action upon the heart. Our knowledge of the action of the acid upon the nervous system is very imperfect, but it seems to be a depressant of the motor centres. Moderate doses increase the frequency of the respiration, probably in part by an action upon the peripheral pneumogastrics, but chiefly by a direct influence upon the respiratory centres. Toxic doses paralyze the respiratory centres. The action of salicylic acid upon the temperature of normal man is slight and inconstant, unless toxic doses be given; in fever its antipyretic influence is pronounced, but we have no exact knowledge as to the method of its action. It is absorbed and circulates in the blood probably as sodium salicylate, and is eliminated partly unchanged as a salicylate, and partly as salicyluric acid, the green discoloration of the urine being due to indican, or perhaps to pyrocatechin, which may be an educt from the acid. The elimination both of urea and uric acid is increased by the salicylates, which appear in some way to profoundly affect the general protoplasmic chemical activities. Given in very large doses the salicylates irritate the kidneys.

The first effect of a single antipyretic dose in *fever* is usually a profuse sweat, which may appear fifteen minutes after the ingestion of the remedy. Very shortly after this the temperature begins to fall, the depression reaching its maximum in from five to six hours. The sweating is profuse and exhausting, amounting, according to Ewald, not rarely to seven hundred and fifty grammes. As a practical antipyretic, however, salicylic acid has been superseded by more convenient remedies. The possession of very marked antiperiodic powers has been claimed for salicylic acid, but experience has not substantiated this claim. In *rheumatism* the remedy is the most valuable one known. Although some cases do not seem to yield to the drug, in the great majority of instances improvement sets in within twenty-four hours, and is rapidly followed by disappearance of the pain and fever. The dangers of cardiac and cerebral complications are certainly lessened, but not altogether done away with. In excessive *rheumatic hyperpyrexia* it cannot be depended upon to the exclusion of the cold bath. In chronic *rheumatism* and in *gout*, indeed in all the various forms of the uric acid diathesis, salicylic acid is an extremely valuable remedy, in many cases bringing relief when all other known remedies fail. To gouty patients it is often administered with great advantage in combination with preparations of colchicum. In all of these cases, however, salicylic acid must be considered as essentially palliative rather than curative. Most of the symptoms of gouty or rheumatic affections are due to an excess of uric acid, locally deposited or circulating in the blood or other fluids of the system. The salicylates bring relief by causing the elimination of this accumulated uric acid, but, so far as we know, they do not in any way affect the fundamental lesions or conditions which cause the excessive production of uric acid. The salts of salicylic acid are so much less irritant than the acid, that the latter is rarely used in practical medicine, but it may be given up to a drachm (3.88 Gm.) in the twenty-four hours, although it is employed by some practitioners in much larger doses. If ringing in the ears or other evidences of intoxication appear, the remedy should at once be partially or entirely withdrawn.

Although Kolbe took fifteen grains of salicylic acid daily for nine months without sensible effect, and Lehmann (*Archiv f. Hygiene*, v.) carried similar experiments even to a greater length with similar results, yet the prac-

tice of using salicylic acid for a preservative of beer and of articles of food is to be condemned. A commission appointed by the French government reported that the prolonged use even of very small amounts of salicylic acid is dangerous, especially to very aged persons. The question of the comparative medicinal value of the artificial and the natural salicylic acid is one of importance. It is seemingly established that the commercial artificial acid is distinctly more poisonous than the natural acid. According to the researches of Dunstan, the poisonous properties of the artificial acid are due to the presence of three impurities,—namely, meta-, ortho-, and para-cresotic acid, of which acids the ortho- and para- are centric poisons. (See PART II.) Salicylic acid produced from synthetic phenol does not contain these poisons. According to the researches of M. Charteris, any artificial salicylic acid which does not closely resemble in crystalline forms the natural acid, and also have a melting point of almost 157° C., should be rejected as probably poisonous.

Dose, five to thirty grains (0.32 to 2.0 Gm.).

Off. Prep.—Injectio Cocainæ Hypodermica, *Br.;* Liquor Atropinæ Sulphatis, *Br.;* Unguentum Acidi Salicylici, *Br.*

ACIDUM STEARICUM. U. S.

STEARIC ACID

(ăç′ĭ-dŭm stē-ăr′ĭ-cŭm)

$HC_{18}H_{35}O_2 = 282.14$

"A monobasic organic acid [$C_{17}H_{35}.COOH$], in its commercial, more or less impure form, usually obtained from the more solid fats, chiefly tallow." *U. S.*

Acidum Stearinicum; Acide Stéarique, *Fr.;* Talgsaure, Stearinsaure, *G.*

Preparation.—Stearic acid is obtained from tallow soap by treating it with sulphuric or hydrochloric acid, whereby sodium sulphate or chloride is produced and stearic acid liberated; it is also made on a large scale by purifying the residue left after making glycerin by acting on stearin with superheated steam. (See *Glycerinum.*)

Properties.—It is officially described as "a hard, white, somewhat glossy solid; odorless and tasteless, and permanent in the air. Insoluble in water; soluble in about 16.6 parts of alcohol at 25° C. (77° F.); readily soluble in boiling alcohol, and in ether. Stearic Acid, when pure, melts at 69.2° C. (156.6° F.). The commercial Acid should have a melting point not lower than 56° C. (132.8° F.), and the melted Acid should become opaque and begin to congeal at a temperature not lower than 54° C. (129.2° F.). If 1 Gm. of Stearic Acid and 0.5 Gm. of monohydrated sodium carbonate be boiled with 30 Cc. of water, in a capacious flask, the resulting solution, while hot, should not be more than opalescent (limit of *undecomposed fat.*)" *U. S.*

Uses.—This acid was introduced into the U. S. P. of 1890 and 8th Rev. solely because of its use in making glycerin suppositories.

Off. Prep.—Suppositoria Glycerini, *U. S.*

ACIDUM SULPHURICUM. U. S., Br.

SULPHURIC ACID

(ăç′ĭ-dŭm sŭl-phū′rĭ-cŭm)

$H_2SO_4 = 97.35$

"A liquid composed of not less than 92.5 percent., by weight, of absolute Sulphuric Acid [H_2SO_4 or $SO_2(OH)_2 = 97.35$], and about 7.5 percent. of water. It should be kept in glass-stoppered bottles." *U. S.* "An acid produced by the combustion of sulphur or pyrites and the oxidation and hydration of the resulting sulphurous anhydride by means of nitrous and aqueous vapors. It should contain about 98 per cent. by weight of hydrogen sulphate, H_2SO_4." *Br.*

Oil of Vitriol, Vitriolic Acid; Hydrogen Sulphate; Acide sulfurique, Huile de Vitriol, *Fr.;* Acidum Sulfuricum, *P. G.;* Vitriolöl, Schwefelsaure, *G.;* Acido solforico, *It.;* Acido sulfurico, *Sp.*

Preparation.—Sulphuric acid is obtained by burning sulphur or iron pyrites, FeS_2, and allowing the product of combustion, SO_2, to mix with nitrous fumes obtained from the decomposition of sodium nitrate, which change SO_2 into SO_3, and this uniting with steam yields H_2SO_4. If the sulphur were burned by itself, the product would be sulphurous oxide, which contains only two-thirds as much oxygen as sulphuric oxide. The object of the sodium nitrate is to furnish, by its decomposition, the requisite additional quantity of oxygen. To understand the process, it is necessary to remember that several oxides of nitrogen have oxidizing power. Thus, the main reactions of the sulphuric acid process are

$$2SO_2 + N_2O_4 = 2SO_3 + N_2O_2$$
$$SO_3 + H_2O = H_2SO_4$$
$$N_2O_2 + O_2 = N_2O_4$$

in which the sulphurous oxide from the burning pyrites or sulphur is oxidized to sulphuric oxide by the nitrogen tetroxide, which readily parts with two atoms of oxygen to such bodies as sulphurous oxide, and then takes two atoms of oxygen again from the atmosphere, regenerating the original tetroxide. The nitrogen tetroxide thus acts simply as a carrier of atmospheric oxygen, whereby the SO_2 is changed into SO_3. This latter compound then unites with steam to form H_2SO_4, the final product. If the supply of steam be insufficient, white crystals (*lead chamber crystals*) will also form, which have the composition $HSO_3(NO_2)$, according to the following reactions:

$$2SO_2 + H_2O + N_2O_3 + O_2 = 2HSO_3(NO_2)$$

when steam enters in larger amount they disappear, with formation of sulphuric acid, while red fumes are given off, thus:

$$2HSO_3(NO_2) + H_2O = 2H_2SO_4 + N_2O_3$$

Thus, here, nitrous oxide, N_2O_3, aids oxidation.

Preparation on the Large Scale.—The manufacture of this most important chemical has grown to enormous proportions. In England, where it is very largely manufactured, the production in 1900 amounted to 992,400 tons from pyrites and 100,000 tons from sulphur and gas purifying mixture; in the United States the amount from pyrites and sulphur was 863,282 tons, and from the roasting of zinc blende 75,000 tons; in Germany there were manufactured 878,000 tons; France 492,000 tons; Italy and Austria each 200,000 tons; Belgium 164,000 tons; Russia 125,000 tons; Japan 50,000 tons; and additional amounts not definitely ascertained in Spain and in Scandinavian countries. As made from pyrites, the process is as follows: Beginning with the pyrites-kilns, or burners, the broken mineral is placed in moderate-sized lumps on the bars of the burners, which have previously been heated to redness, and when the burning is once started, the fire is kept up by placing a new charge on the top of that nearly burned out. The ordinary charge for each burner of pyrites, containing about 48 per cent. of sulphur, is from 5 to 6 cwt., which is burnt out in twenty-four hours. The hot sulphur dioxide and air are drawn from the pyrites-burners through the whole system of tubes, towers, and chambers by help of the powerful draught from a large chimney which is placed in connection with the apparatus. These gases then pass either into a tall tower (called the Glover or denitrating tower), where they meet a descending stream of strong sulphuric acid charged with nitrous fumes, which at this moment of descent is mixed with a weaker sulphuric acid, thereby liberating the nitrous fumes which then mix with the sulphur dioxide and air, or they are charged with nitrous fumes direct from the nitre-pots, where a mixture of Chili saltpetre and sulphuric acid liberates them. The mixed gases are then delivered at a temperature of about 75° C. (167° F.) into the first of the leaden chambers. These chambers, of which there are three, are now made of much larger size than was formerly the case, having often a capacity of 38,000 cubic feet. Here the gases meet jets of steam and deposit liquid sulphuric acid, as also in the second chamber. In the third or exhaust chamber all the sulphur dioxide should have been converted into sulphuric acid, and red nitrous fumes must always be visible. These must not be lost, but are drawn into a so-called Gay-Lussac tower filled with coke, over which a finely divided shower of strong acid is allowed to fall. The nitrous fumes are absorbed by this, and give the so-called nitrated acid used as before mentioned in the Glover tower. The acid obtained in the leaden chambers has a sp. gr. of 1.55, or contains 64 per cent. of H_2SO_4. The acid which comes from the Glover tower (or, in case this is not used, is obtained by further concentration of chamber acid in leaden pans) has a sp. gr. of 1.71, and contains 78 per cent. H_2SO_4. The strongest acid must be procured by still further concentration in glass or platinum vessels, and will contain 98 per cent. H_2SO_4. (Roscoe and Schorlemmer, *Chem.*, vol. i. pp. 321-338.) Within recent years it has been found that to continue the concentration to the limit of 98 per cent. acid in platinum vessels is very destructive to these. Therefore it has been proposed, after a strength of 65° B. or about 90 per cent. acid has been reached, to finish in vessels of cast iron. It is found that the concentrated acid does not attack this, and therefore it can be substituted for platinum to advantage.

According to theory, 100 parts of sulphur burnt should yield 305.9 parts of pure sulphuric acid. In practice the yield is 290 to 294. The amount of sodium nitrate used varies very much. Manufacturers who employ Glover and Gay-Lussac towers require from 3.5 to 6.5 parts of nitrate for every 100 of sulphur burnt, while works unprovided with these appliances may take from 12 to 13 parts. (Roscoe and Schorlemmer, *Chem.*, vol. i. p. 337.)

In 1901, the "Badische Anilin and Sodafabrik" began on a large scale the manufacture of sulphuric acid by what is known as the "contact process," and since then this process has developed very successfully, and is now in use in this country in a number of the newer chemical works. It is rather a process for the manufacture, on a commercial scale, of sulphur trioxide, which then can be allowed to take up the necessary amount of water to form acid of any strength. A mixture of sulphur dioxide and purified air is passed over heated platinized asbestos, which is the so-called "contact material." To make the process successful, the sulphur dioxide gas must be washed to free it from dust, and all traces of volatile arsenic compounds (arising from arsenical pyrites) must be absent; in addition, the temperature must be regulated with great care to avoid the dissociation of the sulphur trioxide formed. The sulphur trioxide can be marketed as anhydride or as concentrated sulphuric acid of any desired strength.

The only way to obtain pure sulphuric acid from chamber acid is by distillation. Owing to the high boiling point of this acid, the operation is rather precarious, in consequence of the danger of the fracture of the retort from the sudden concussions to which the boiling acid gives rise. Ure recommended that a retort of the capacity of from two to four quarts be used in distilling a pint of acid. This is connected, by means of a wide glass tube three or four feet long with a receiver surrounded with cold water. All the vessels must be perfectly clean, and no luting employed. The retort is then gradually heated by a small furnace of charcoal, or, what is better, by means of a sand bath, the retort being buried in the sand up to the neck. It is useful to put into the retort a few sharp-pointed pieces of glass, slips of platinum foil, or clay tobacco pipe tubes, with the view of diminishing the shocks

produced by the acid vapor. The distilled product ought not to be collected until a dense grayish-white vapor is generated, the appearance of which is a sign that the pure concentrated acid is coming over. If this vapor should not immediately appear, it shows that the acid subjected to distillation is not of full strength; and the distilled product, until this point is attained, will be an acid water. In the distillation of sulphuric acid, Lembert uses, instead of pieces of glass or platinum foil, fragments of the mineral called quartzite; these after a time get worn and must be changed.

What is said above relates to the mode of preparing common sulphuric acid; but there is another kind, known on the continent of Europe by the name of the *fuming sulphuric acid of Nordhausen*, so called from its properties, and a place in Saxony where it was first manufactured. This acid is obtained by distilling dried ferrous sulphate in large stoneware retorts, heated to redness, and connected with receivers of glass or stoneware. The fuming acid distils over, and ferric oxide is left in the form of *colcothar* or *polishing rouge*, a material used for polishing metals, particularly gold and silver. The formula usually given for fuming sulphuric acid is $H_2S_2O_7$ or $H_2SO_4 + SO_3$. This would demand about 45 per cent. of sulphuric oxide or SO_3. In fact, the so-called Nordhausen acid seldom contains more than 10 per cent. of SO_3, and to obtain that demanded by the formula a re-distillation is necessary. This product is semi-solid, and is now obtainable in commerce put up in sealed glass flasks. Its sale has been largely curtailed lately, owing to the introduction into commerce of the *anhydride* under the name of *Solid Sulphuric Acid*. When moisture is rigidly excluded, the acid has little action on metals, and it is put up in soldered boxes of tinned sheet-iron; it is used largely in the arts in the manufacture of artificial alizarin and indigo. *Persulphuric acid* and the *persulphates* are among recent products of electrolysis. The ammonium persulphate, $(NH_4)_2S_2O_8$, and potassium persulphate, $K_2S_2O_8$, both form white crystalline salts. The former has already found a considerable technical application as an energetic oxidizing agent in the manufacture of organic dyestuffs and the cyanide extraction of gold.

Properties.—Sulphuric acid (*hydrogen sulphate*), commonly called *oil of vitriol*, is a dense, colorless, inodorous liquid, of an oily appearance, and strongly corrosive. On living tissues it acts as a powerful caustic. It unites with water in all proportions, and much heat is evolved on the mixture of the two fluids. When pure and as highly concentrated as possible, as manufactured in leaden chambers, its sp. gr. is 1.840 (1.8485, Ure), a fluidounce weighing a small fraction over 14 drachms. If its density exceed this, the presence of lead sulphate or other impurity may be inferred. Kohlrausch (*Pogg. Ann. Erganzungs*, Bd. viii. p. 675, Lunge) found the sp. gr. of *pure sulphuric acid, real hydrate*, to be 1.8342, and believes that a higher sp. gr. than this is due to impurities (probably lead sulphate). The commercial acid is seldom of this strength. According to Phillips, it has generally the sp. gr. 1.8433, and this is about the strength of the Br. acid, of which the sp. gr. is stated to be 1.843 at 15.6° C. (60° F.). The specific gravity of the U. S. P. (8th Rev.) acid is 1.826 at 25° C. (77° F.); the British acid contains about 98 per cent. of absolute sulphuric acid and the U. S. P. (8th Rev.) acid 92.5 per cent. Mendelejeff, after a careful determination, found that pure monohydrated sulphuric acid had the specific gravity 1.8371 at 15° C. (59° F.) compared with water at its maximum density, 4° C. (*Am. Drug.*, 1885, p. 16.) The strong acid boils at 338° C. (640.4° F.), and freezes at —26° C. (—15° F.). When diluted, its boiling point is lowered. When of the sp. gr. 1.78, it deposits crystals of the formula $H_2SO_4 + H_2O$ at about 0° C. (32° F.), and hence it is hazardous for manufacturers to keep an acid of that strength in glass vessels in cold weather, as they are liable to burst. With salifiable bases it forms a numerous class of salts, called sulphates. It acts powerfully on organic bodies, whether vegetable or animal, depriving them of the elements of water, developing charcoal, and turning them black. A small piece of cork or wood dropped into the acid will for this reason render it of a dark color. It absorbs water with avidity, and is used as a desiccating agent. It has been ascertained by W. B. and R. E. Rogers to be capable of absorbing 94 per cent. of carbon dioxide, a fact having an important bearing on analytical operations. When diluted with distilled water, it ought to remain limpid; and, when heated sufficiently in a platinum spoon, the fixed residue should not exceed one part in 400 of the acid employed. When present in small quantity in solution, it is detected unerringly by barium chloride, which causes a precipitate of barium sulphate. The most usual impurities in it are arsenic compounds and lead sulphate; the former derived from the presence of arsenides in the pyrites, where that has been used in the production of the sulphurous oxide, the latter from the leaden boilers in which the acid is concentrated. Sodium or magnesium sulphate is said to have been added to increase its specific gravity. "Miscible, in all proportions, with water or alcohol, with evolution of much heat; the Acid should be added with great caution to the diluent. It boils at 338° C. (640.4° F.). When heated on platinum foil, it is vaporized, with the evolution of dense fumes, without leaving a residue. Sulphuric Acid, even when highly diluted, shows an acid reaction upon blue litmus paper. If Sulphuric Acid be dropped upon cane-sugar or wood, it chars them. Diluted with 20 volumes of water, it yields with barium chloride T.S. a copious white precipitate, insoluble in hydrochloric acid." *U. S.*

Occasionally potassium nitrate is added to render dark samples of acid colorless. This addition gives rise to the impurity of potassium sulphate. These impurities often amount to 3 or 4 per cent. The commercial acid cannot be expected to be absolutely pure; but when properly manufactured it should not contain more than one-fourth of 1 per cent. of impurity. The fixed impurities are discoverable by evaporating a portion of the acid, when they will remain. If lead sulphate be present, the acid will become turbid on dilution with an equal bulk of water. This impurity is not detected by hydrogen sulphide unless the sulphuric acid be saturated with an alkali. If only a scanty white turbidity arise, the acid is of good commercial quality.

Other impurities occur in the commercial sulphuric acid. The several oxides of nitrogen are always present in greater or less amount in lead chamber acid. They may be detected by gently pouring a solution of ferrous sulphate over the commercial acid in a tube, when the solution, at the line of contact, will acquire a deep red color, due to the liberation of nitrogen tetroxide. Another method is to pass into tincture of guaiac the gases proceeding from the suspected acid heated with iron filings. If nitrogen tetroxide be present, the tincture becomes blue. The commercial acid, however, is not to be rejected unless the test shows the presence of nitrogen tetroxide in unusual quantity. Nitrogen tetroxide is an injurious impurity when the sulphuric acid is employed in the manufacture of hydrochloric acid, which is decomposed by the nitrogen tetroxide with evolution of chlorine. To remove this impurity it was recommended by Wackenroder, before distilling it, to heat the acid with a little sugar. This and the N_2O_4 mutually decompose each other, and the products are dissipated by heat. For the removal of the nitrogen acids generally, J. Löwe recommends the addition to the heated sulphuric acid of small portions of dry oxalic acid, so long as it exhibits a yellow tinge. The oxalic acid is decomposed into carbon dioxide and oxide, the latter of which, in becoming carbon dioxide, deoxidizes and destroys the nitrogen acids. A slight excess of oxalic acid produces no harm, as it is immediately decomposed. Perhaps a better method of getting rid of these acids is to distil with a little ammonium sulphate. Potassium sulphate, fraudulently introduced into the acid to increase its density, may be detected by saturating the acid with ammonia and heating to redness in a crucible, when ammonium sulphate will be expelled, and the potassium sulphate left.

Arsenic is sometimes present in sulphuric acid. In consequence of the high price of Sicilian sulphur, most English manufacturers have employed iron pyrites for the purpose of furnishing the necessary sulphurous acid in the manufacture of oil of vitriol. As the pyrites usually contains arsenic, it happens that the sulphurous acid fumes are accompanied by arsenous oxide, and thus the sulphuric acid becomes contaminated. From 22 to 35 grains of arsenic trioxide have been found in 20 fluid-ounces of oil of vitriol, of English manufacture, by G. O. Rees and Watson, and a still larger proportion by J. Cameron of South Wales. To detect this impurity, the acid, previously diluted with five or six measures of distilled water, must be examined by Marsh's test. (See *Arseni Trioxidum.*) But an easier method, said to be nearly as delicate, is that of Bettendorf. A little stannous chloride is treated, in a shallow dish, with pure hydrochloric acid (sp. gr. 1.12) until dissolved. The suspected sulphuric acid is then added, drop by drop, to the solution, the vessel being shaken on each addition. Considerable heat will be produced, and the liquid, if no arsenic be present, will remain clear; but if the acid be in the slightest degree contaminated with the poison, first a yellow, then a brown, and finally a dark grayish brown color will appear, and the liquid become turbid. (*N. R.*, April, 1873, p. 367.) To separate the arsenic trioxide, J. Löwe recommends that the concentrated sulphuric acid should be gently heated in a flat dish, in a place where the fumes may be carried off, and then treated with small quantities of finely powdered sodium chloride, constantly stirred in with a glass rod. By the reaction between the arsenic trioxide and disengaged hydrochloric acid arsenic trichloride is formed, which, being volatile, is separated by the heat. The heat is afterwards continued, to expel the excess of hydrochloric acid. This mode of purification introduced into the oil of vitriol a little sodium sulphate. Buchner proposes a similar process; instead of sodium chloride, employing hydrochloric acid, or a stream of the acid gas. This plan does not introduce sodium sulphate into the acid, but is less convenient than that of Löwe, and, when the aqueous hydrochloric acid is used, tends to weaken the oil of vitriol by introducing water. Experience, however, has shown that neither plan can be entirely relied on. An excess of sulphuric acid is said to prevent the formation of the arsenic chloride. (See *A. J. P.*, 1860, p. 88.) For other methods of detecting arsenic in sulphuric acid, see *N. R.*, 1876, p. 297; 1880, p. 101. Denigés proposes to detect arsenic in sulphuric acid by the use of a liquid containing equal volumes of a solution of ammonium molybdate (1 to 10) and sulphuric acid. (*D. C.*, 1894, 12.) Until within recent years all the sulphuric acid produced in the United States was made from sulphur. At the present time many of the sulphuric acid works are using pyrites. Most of the American pyrites ore is entirely free from arsenic. Dupasquier states that tin is sometimes present in commercial sulphuric acid, derived from the solderings of the leaden chambers; but this could scarcely happen now, as care is taken to avoid soldering, and to effect the union of the metal by fusion by means of the blow-pipe. It may

Table of Percentage and Specific Gravity of Sulphuric Acid. U. S. P. (8th Rev.)

Per cent. sulphuric acid. by weight	Specific gravity. 25° C./25° C.	Specific gravity. 15° C./15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent. = 0.01 Cc. normal KOH.
1	1.0067	1.0070	0.00021	0.015	0.21	0.048
2	1.0132	1.0137	0.00023	0.015	0.42	0.048
3	1.0197	1.0204	0.00025	0.015	0.63	0.048
4	1.0263	1.0272	0.00027	0.015	0.84	0.045
5	1.0329	1.0340	0.00029	0.015	1.06	0.045
6	1.0395	1.0408	0.00031	0.015	1.28	0.045
7	1.0462	1.0477	0.00034	0.015	1.50	0.043
8	1.0529	1.0547	0.00036	0.014	1.73	0.045
9	1.0598	1.0617	0.00038	0.014	1.95	0.042
10	**1.0667**	**1.0688**	**0.00040**	**0.014**	**2.19**	**0.043**
11	1.0737	1.0760	0.00042	0.014	2.42	0.042
12	1.0808	1.0832	0.00044	0.014	2.66	0.042
13	1.0879	1.0905	0.00046	0.014	2.90	0.042
14	1.0950	1.0978	0.00047	0.014	3.14	0.040
15	1.1023	1.1052	0.00049	0.014	3.39	0.040
16	1.1096	1.1127	0.00050	0.014	3.64	0.040
17	1.1170	1.1202	0.00052	0.014	3.89	0.038
18	1.1244	1.1277	0.00053	0.013	4.15	0.038
19	1.1319	1.1354	0.00054	0.013	4.41	0.038
20	1.1394	1.1430	0.00056	0.013	4.67	0.038
21	1.1471	1.1508	0.00057	0.013	4.93	0.037
22	1.1547	1.1586	0.00058	0.013	5.20	0.036
23	1.1625	1.1664	0.00060	0.013	5.48	0.037
24	1.1703	1.1743	0.00061	0.013	5.75	0.036
25	1.1781	1.1823	0.00062	0.013	6.03	0.034
26	1.1860	1.1903	0.00063	0.013	6.32	0.036
27	1.1939	1.1983	0.00065	0.013	6.60	0.033
28	1.2019	1.2064	0.00066	0.012	6.90	0.034
29	1.2100	1.2145	0.00066	0.012	7.19	0.034
30	1.2181	1.2226	0.00067	0.012	7.48	0.032
31	1.2262	1.2308	0.00068	0.012	7.79	0.033
32	1.2344	1.2391	0.00068	0.012	8.09	0.032
33	1.2427	1.2474	0.00069	0.012	8.40	0.032
34	1.2511	1.2558	0.00069	0.012	8.71	0.031
35	1.2594	1.2642	0.00070	0.012	9.03	0.031
36	1.2679	1.2727	0.00070	0.012	9.35	0.031
37	1.2764	1.2812	0.00071	0.012	9.67	0.030
38	1.2849	1.2898	0.00071	0.011	10.00	0.030
39	1.2936	1.2985	0.00071	0.011	10.33	0.029
40	1.3023	1.3072	0.00072	0.011	10.67	0.029
41	1.3111	1.3160	0.00072	0.011	11.01	0.029
42	1.3200	1.3249	0.00072	0.011	11.35	0.029
43	1.3289	1.3339	0.00072	0.011	11.70	0.028
44	1.3380	1.3429	0.00072	0.011	12.06	0.028
45	1.3471	1.3521	0.00073	0.011	12.42	0.028
46	1.3563	1.3613	0.00073	0.011	12.78	0.027
47	1.3657	1.3707	0.00074	0.011	13.15	0.027
48	1.3751	1.3802	0.00074	0.010	13.52	0.026
49	1.3847	1.3897	0.00075	0.010	13.90	0.026
50	1.3943	1.3994	0.00075	0.010	14.28	0.026
51	1.4041	1.4092	0.00076	0.010	14.67	0.026
52	1.4140	1.4191	0.00076	0.010	15.06	0.025
53	1.4239	1.4292	0.00077	0.010	15.46	0.025
54	1.4340	1.4393	0.00077	0.010	15.86	0.024
55	1.4442	1.4495	0.00078	0.010	16.27	0.024

Table of Percentage and Specific Gravity of Sulphuric Acid. U. S. P. (8th Rev.) (Continued.)

Per cent. sulphuric acid.	Specific Gravity. 25° C./25° C.	Specific Gravity. 15° C./15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal KOH Cc.	Per cent.= 0.01 Cc. normal KOH.
56	1.4546	1.4599	0.00079	0.010	16.68	0.024
57	1.4650	1.4703	0.00079	0.010	17.10	0.023
58	1.4755	1.4809	0.00079	0.009	17.53	0.023
59	1.4862	1.4916	0.00080	0.009	17.96	0.023
60	1.4969	1.5025	0.00081	0.009	18.39	0.022
61	1.5078	1.5134	0.00082	0.009	18.84	0.023
62	1.5188	1.5244	0.00083	0.009	19.28	0.022
63	1.5299	1.5355	0.00083	0.009	19.74	0.022
64	1.5411	1.5467	0.00083	0.009	20.20	0.022
65	1.5523	1.5580	0.00084	0.009	20.66	0.021
66	1.5637	1.5694	0.00085	0.009	21.13	0.021
67	1.5751	1.5809	0.00085	0.009	21.61	0.021
68	1.5866	1.5924	0.00086	0.009	22.09	0.020
69	1.5981	1.6040	0.00087	0.009	22.58	0.020
70	1.6097	1.6156	0.00087	0.009	23.07	0.020
71	1.6214	1.6273	0.00088	0.009	23.57	0.020
72	1.6331	1.6391	0.00089	0.009	24.08	0.020
73	1.6448	1.6509	0.00090	0.009	24.59	0.020
74	1.6565	1.6627	0.00091	0.009	25.10	0.019
75	1.6682	1.6746	0.00092	0.008	25.62	0.019
76	1.6800	1.6864	0.00093	0.009	26.14	0.019
77	1.6916	1.6981	0.00094	0.009	26.67	0.019
78	1.7032	1.7097	0.00095	0.009	27.20	0.019
79	1.7146	1.7213	0.00096	0.009	27.73	0.019
80	1.7260	1.7328	0.00098	0.009	28.27	0.019
81	1.7370	1.7440	0.00100	0.009	28.81	0.019
82	1.7477	1.7548	0.00102	0.010	29.34	0.019
83	1.7579	1.7652	0.00103	0.010	29.88	0.019
84	1.7678	1.7752	0.00104	0.011	30.41	0.019
85	1.7771	1.7845	0.00105	0.011	30.93	0.019
86	1.7858	1.7934	0.00106	0.013	31.45	0.020
87	1.7938	1.8013	0.00105	0.014	31.96	0.020
88	1.8012	1.8086	0.00105	0.015	32.46	0.020
89	1.8080	1.8153	0.00103	0.016	32.95	0.021
90	1.8141	1.8212	0.00102	0.019	33.43	0.021
91	1.8195	1.8265	0.00101	0.020	33.90	0.022
92	1.8243	1.8311	0.00099	0.024	34.36	0.022
92.5	**1.8263**	**1.8331**	**0.00099**	**0.026**	**34.59**	**0.022**
93	1.8284	1.8351	0.00098	0.029	34.82	0.023
94	1.8319	1.8384	0.00097	0.037	35.26	0.023
95	1.8346	1.8411	0.00097	0.050	35.69	0.024
96	1.8366	1.8430	0.00096	0.091	36.10	0.025
97	1.8377	1.8441	0.00096	....	36.50	0.027
97.5	[3]1.8379	1.8442	0.00095	....	36.69	0.028
98	1.8377	1.8441	0.00096	0.067	36.87	0.029
99	1.8364	1.8427	0.00095	0.029	37.22	0.032
100	1.8330	1.8394	0.00096	....	37.53	....

[1] Add if the temperature is above, subtract if below, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

[3] Note that the specific gravity diminishes in acids of more than 97.5 per cent. strength as the percentage increases.

NOTE—To find the per cent. of SO_3, multiply the per cent. of H_2SO_4 by 0.81633; to find the per cent. of SO_4, multiply the per cent. of H_2SO_4 by 0.97946.

To find the weight in grammes of H_2SO_4 in 100 Cc., multiply the specific gravity by the per cent. of H_2SO_4.

To find the volume per cent. of official Sulphuric Acid, multiply the "normality" by 2.891. For the volume per cent. of official Diluted Sulphuric Acid, multiply the "normality" by 45.76.

be discovered by hydrogen sulphide, which precipitates sulphide of tin, convertible by nitric acid into the white insoluble stannic oxide. Should the precipitate be the mixed sulphides of arsenic and tin, the former would be converted by nitric acid into arsenic acid and dissolved, and the latter into insoluble stannic oxide and left. Another impurity occasionally existing in French sulphuric acid is selenium, supposed to be derived from copper pyrites sometimes substituted for sulphur in the manufacture of the acid.

Tests.—"On mixing the Acid carefully with 4 or 5 volumes of alcohol, no precipitate should be formed within one hour (absence of *lead*). If there be carefully poured upon it, in a test-tube, a layer of ferrous sulphate T.S., and the liquid cooled, the zone of contact should not assume a brown or reddish color (limit of *nitric* or *nitrous acid*). Sulphuric Acid, diluted with 20 volumes of water, should yield no precipitate upon the addition of silver nitrate T.S. (absence of *hydrochloric acid*); nor should the solution respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121); nor, upon supersaturating with ammonia water, should the solution leave any appreciable fixed residue on evaporation and ignition (absence of *non-volatile impurities*). One Cc. of Sulphuric Acid, diluted with 5 Cc. of water and cooled, should not at once discharge the color of 0.1 Cc. of tenth-normal potassium permanganate V.S. (limit of *sulphurous* or *nitrous acid*). If Sulphuric Acid be diluted with water (1 in 10), 5 Cc. should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17).

If 2 Cc. of hydrochloric acid in which a fragment of sodium sulphite has been dissolved be carefully poured upon 2 Cc. of Sulphuric Acid contained in a test-tube, the zone of contact should not assume a pink or red color upon standing, nor should a precipitate form after heating (limit of *selenium*). Introduce into a stoppered weighing-bottle 3 Cc. of Sulphuric Acid and weigh accurately. Dilute the acid with 50 Cc. of distilled water and titrate with normal potassium hydroxide V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal potassium hydroxide V.S. consumed, by 4.8675, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Sulphuric Acid in the latter." *U. S.* "Each gramme diluted with 20 or 30 cubic centimetres of *water* should require for neutralization 20.1 cubic centimetres of the *volumetric solution of sodium hydroxide*. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, ammonium, chlorides, nitrates, nitrites, or sulphites. It should yield no appreciable residue on evaporation. *Hydrochloric acid* containing *sodium sulphite*, when poured carefully upon an equal volume of Sulphuric Acid contained in a test-tube, should not cause a red coloration at the junction of the two liquids, and no red precipitate should form on warming the tube (absence of selenium)." *Br.*

The table (pages 72 and 73) from the U. S. P. (8th Rev.) shows the percentage and specific gravity of sulphuric acid of various strengths.

Composition.—The normal acid of the sp. gr. 1.842 consists of one molecule of oxide and one molecule of water. As the hydrogen acts the part of a metal in the compound, the systematic name would be hydrogen sulphate. The oxide consists of one atom of sulphur and three atoms of oxygen. The ordinary commercial acid consists, according to Phillips, of one molecule of oxide and one and a quarter molecules of water. The hydrated acid of Nordhausen has a density as high as 1.89 or 1.9, and consists of two molecules of oxide and one molecule of water ($2SO_3 + H_2O$). This acid is particularly adapted to the purpose of dissolving indigo for dyeing the Saxon blue. When heated gently in a retort, connected with a dry and refrigerated receiver, sulphuric oxide or anhydride distils over, and the common monohydrated acid remains behind. In performing this operation, much difficulty from concussion is avoided, and the product of oxide increased, by introducing a coil of platinum wire into the retort. The oxide may also be obtained by the action of phosphoric oxide on concentrated sulphuric acid, according to the method of Barreswil. The mixture must be made in a refrigerated retort, and afterwards distilled by a gentle heat into a refrigerated receiver. *Sulphuric oxide* (*solid sulphuric acid*) under 18° C. (64° F.) is in small colorless crystals, resembling asbestos. It is tenacious, difficult to cut, and may be moulded in the fingers like wax, without acting on them. Exposed to the air, it emits a thick opaque vapor of an acid odor. Above 18° C. (64° F.) it is a liquid, very nearly of the density 2.

Uses.—For the therapeutic powers and uses of sulphuric acid when administered internally, see *Acidum Sulphuricum Dilutum*. Externally it is sometimes employed as a caustic; but, from its liquid form, it is very inconvenient for that purpose, and should be applied with caution. A plan, however, has been proposed by Simpson by which it becomes very manageable. This consists in mixing it with dried and powdered zinc sulphate sufficient to give it a pasty consistence. *Michel's Paste* consists of strong sulphuric acid three parts, and finely powdered asbestos one part, thoroughly rubbed together. Mixed with saffron to the consistence of a ductile paste, Velpeau found it a convenient caustic not liable to spread or be absorbed, and producing an eschar which is promptly detached.

Toxicological Properties.—The symptoms of poisoning by this acid are the following: Burning heat in the throat and stomach, extreme fetidness of the breath, nausea and excessive vomitings of black or reddish matter, excruciating pains in the bowels, difficulty of breathing, extreme anguish, a feeling of cold

on the skin, great prostration, constant tossing, convulsions, and death. Sometimes there is no pain whatever in the stomach, sensibility being apparently destroyed by the violence of the caustic action. The intellectual faculties remain unimpaired. Frequently the uvula, palate, tonsils, and other parts of the fauces are covered with black or white sloughs. The treatment consists in the administration of large quantities of magnesia, or, if this be not at hand, of solution of soap. The safety of the patient depends upon the greatest promptitude in the application of the antidotes. After the poison has been neutralized mucilaginous and other bland drinks must be taken freely.

Upon the skin sulphuric acid acts as a very rapid and powerful corrosive. When it has been spilled or thrown upon the person the part should be immediately washed with a weak solution of sodium carbonate or bicarbonate, or soap may be well rubbed into the surface. After the removal and neutralization of the acid, Carron oil or similar protective may be applied. Further treatment is that of a burn.

The holes burnt in linen by sulphuric acid, so long as the texture is undisturbed, are distinguished from those produced by red-hot coals, by the paste-like characters of their edges.

Uses in the Arts.—Sulphuric acid is more used in the arts than any other acid. It is employed to obtain many of the other acids; to extract soda from common salt; to make alum and ferric sulphate; to refine petroleum and paraffin; to decompose the neutral fats; to dissolve indigo; to prepare phosphorus, chlorinated lime, magnesium sulphate, etc. Petroleum refining and manufacture of fertilizers from phosphatic materials consume the largest amounts of sulphuric acid in the United States.

Off. Prep.—Acidum Sulphuricum Aromaticum, *U. S., Br.;* Acidum Sulphuricum Dilutum, *U. S., Br.;* Acidum Sulphurosum, *U. S.;* Benzinum Purificatum, *U. S.;* Glycyrrhizinum Ammoniatum, *U. S.;* Liquor Ferri Subsulphatis, *U. S.;* Liquor Ferri Tersulphatis, *U. S. (Br.);* Oleum Æthereum, *U. S.;* Pyroxylinum, *Br.;* Spiritus Ætheris Compositus, *Br.;* Spiritus Ætheris Nitrosi, *U. S., Br.*

ACIDUM SULPHURICUM AROMATICUM. U. S., Br.

AROMATIC SULPHURIC ACID

(ăç'ĭ-dŭm sŭl-phū'rĭ-cŭm ăr-ǫ-măt'ĭ-cŭm)

"Aromatic Sulphuric Acid should contain not less than 20 percent., by weight, of absolute Sulphuric Acid [H_2SO_4 or $SO_2(OH)_2 = 97.35$], partly in the form of ethyl-sulphuric acid." *U. S.*

Tinctura Aromatica Acida; Elixir of Vitriol; Elixir vitriolique, Teinture (alcoolé) aromatique sulphurique, *Fr.;* Saure Aromatische Tinctur, Elixir Vitrioli Mynsichti, Mynsicht's Elixir, *G.*

* "Sulphuric Acid, *one hundred and eleven cubic centimeters* [or 3 fluidounces, 6 fluidrachms, 1 minim]; Tincture of Ginger, *fifty cubic centimeters* [or 1 fluidounce, 5½ fluidrachms]; Oil of Cinnamon, *one cubic centimeter* [or 16 minims]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Add the Sulphuric Acid gradually, and with great caution, to *seven hundred cubic centimeters* [or 24 fluidounces] of Alcohol, and allow the mixture to cool. Then add to it the Tincture of Ginger and the Oil of Cinnamon, and afterwards enough Alcohol to make the whole measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Keep the product in glass-stoppered bottles." *U. S.*

"Tincture of Ginger, 10 *fl. ounces* (Imperial measure) or 250 cubic centimetres; Spirit of Cinnamon, ½ *fl. ounce* (Imp. meas.) or 12.5 cubic centimetres; Alcohol (90 per cent.), 29½ *fl. ounces* (Imp. meas.) or 737.5 cubic centimetres; Sulphuric Acid, 3 *fl. ounces* (Imp. meas.) or 2419 *grains,* or 75 cubic centimetres or 138.2 grammes. Mix the Sulphuric Acid gradually with the Alcohol; add the Spirit of Cinnamon and Tincture of Ginger." *Br.*

The formula adopted at the 1880 revision of the U. S. Pharmacopœia and continued in the 1890 and 8th Revision is that recommended by Thomas N. Jamieson, *A. J. P.,* 1867, p. 201. The change in the appearance and properties from the preparation of the U. S. P. 1870 was so marked that the wisdom of making so radical a change was doubted. Experience has proved, however, that the new preparation has not the same tendency to precipitate, and the lightness in color has been offset by more substantial advantages. The British formula has been remodelled to accord with the U. S. P. The proportion of sulphuric acid was increased in the U. S. P. (8th Rev.) about 10 per cent. over that of the previous Pharmacopœia.

Properties.—Aromatic sulphuric acid of the older Pharmacopœias was of a deep reddish brown, but it is a straw-colored liquid when freshly prepared according to the directions of the U. S. Pharmacopœia (8th Rev.), of a peculiar aromatic odor, and, when sufficiently diluted, of a grateful acid taste. It has been supposed by some to contain ethylic ether or sulphovinic acid, its main ingredients justifying such a suspicion; but Duncan of Edinburgh, who originally held this opinion, satisfied himself that the alcohol and sulphuric acid, in the proportions here employed, do not generate a single particle of ethylic ether; and Attfield has shown that there is no ethyl-sulphuric acid in the official preparation. (*P. J.,* 1869, p. 471.) It cannot, however, be viewed merely as a sulphuric acid diluted with alcohol and containing essential oils, for the difference between fresh and old preparations is quite marked, and a peculiar and agreeable ethereal odor is developed by age. The U. S. official definition recognizes the presence of ethyl sulphuric acid.

"Specific gravity: about 0.933 at 25° C. (77° F.). If 10 Gm. of Aromatic Sulphuric Acid be

mixed in a small flask with 30 Cc. of water and be boiled for several minutes, cooled and diluted with water to measure 100 Cc., then 48.68 Cc. of this solution, to which exactly 25 Cc. of normal potassium hydroxide V.S. have been added, should require not more than 5 Cc. of normal sulphuric acid V.S. for complete neutralization (each Cc. of the normal potassium hydroxide V.S. consumed corresponding to 1 percent. of absolute Sulphuric Acid), methyl-orange T.S. being used as indicator." *U. S.*

The sp. gr. of the British preparation is "0.922 to 0.926. The neutralizing power of 100 grammes should be equivalent to that of 13.8 grammes of hydrogen sulphate, H_2SO_4." *Br.*

Samples of fresh aromatic sulphuric acid as well as older specimens have been assayed by E. W. Clark, and all were found to be more or less deficient in sulphuric acid; the inference is quite clear that there is some decomposition of sulphuric acid in the preparation upon keeping. (*Ph. Era*, 1887, p. 69.)

Uses.—This valuable preparation is tonic and astringent. It acts precisely as does the *Acidum Sulphuricum Dilutum.*

Dose, from five to fifteen minims (0.3 to 0.9 Cc.), in a wineglassful of water, repeated two or three times a day. Care must be taken that the teeth are not injured.

Off. Prep.—Infusum Cinchonæ Acidum, *Br.*

ACIDUM SULPHURICUM DILUTUM. U. S., Br.

DILUTED SULPHURIC ACID

(ăç'ĭ-dŭm sŭl-phū'rĭ-cŭm dī-lū'tŭm)

"Diluted Sulphuric Acid should contain not less than 10 percent., by weight, of absolute Sulphuric Acid [H_2SO_4 or $SO_2(OH)_2 = 97.35$], and about 90 percent. of water." *U. S.* "100 parts by weight should contain 13.65 parts of hydrogen sulphate, H_2SO_4." *Br.*

Acide sulphurique dilué, *Fr.*; Acidum sulphuricum dilutum, *P. G.*; Verdünnte Schwefelsaure, *G.*

* "Sulphuric Acid, *one hundred grammes* [or 3 ounces av., 231 grains]; Distilled Water, *eight hundred and twenty-five grammes* [or 29 ounces av., 44 grains], to make *nine hundred and twenty-five grammes* [or 32 ounces av., 274 grains]. Pour the Acid gradually, with constant stirring, into the Distilled Water. Keep the product in glass-stoppered bottles. Specific gravity: about 1.067 at 25° C. (77° F.). It should respond to the reactions and tests given under *Acidum Sulphuricum.* To neutralize 4.868 Gm. of Diluted Sulphuric Acid not less than 10 Cc. of normal potassium hydroxide V.S. should be required (each Cc. corresponding to 1 percent. of absolute Sulphuric Acid), methyl-orange T.S. being used as indicator." *U. S.*

"Sulphuric Acid, 1 *fl. ounce* and 5¼ *fl. drachms* (more exactly, 1.65 *fl. ounces*, Imperial measure) or 1333 *grains*, or 82.7 cubic centimetres or 152.4 grammes; Distilled Water, a sufficient quantity. Half fill with Distilled Water a glass flask the capacity of which to a mark on the neck is *one pint* (Imp. meas.) or one thousand cubic centimetres. Then introduce the Sulphuric Acid, and add very gradually Distilled Water until the mixture, after it has been shaken and cooled to 60° F. (15.5° C.), measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This preparation is sulphuric acid diluted to such an extent as to make it convenient for prescription. It is not exactly coincident in strength as directed in the two Pharmacopœias, the U. S. acid (sp. gr. 1.067) being weaker than the British (sp. gr. 1.094), but slightly stronger than that formerly official; but the difference is not so great as to be of practical importance. The British Pharmacopœia requires that "each gramme should require for neutralization 2.8 cubic centimetres of the *volumetric solution of sodium hydroxide.*" *Br.* The strong acid is added gradually to the water, to guard against the too sudden production of heat, which might cause the fracture of the vessel. During the dilution, when commercial sulphuric acid is used, the liquid becomes slightly turbid, and in the course of a few days deposits a grayish-white powder, which is lead sulphate, and from which the diluted acid should be poured off. This noxious salt is thus disposed of; but potassium sulphate, another impurity in the strong acid, still remains. The presence of a little potassium sulphate will do no harm; but, if it should be fraudulently introduced into the strong acid to increase its specific gravity, its amount may be ascertained by saturating the acid, after dilution, with ammonia, and expelling by a red heat the ammonium sulphate formed. Whatever potassium sulphate is present will remain behind. If the directions of the Pharmacopœias are strictly carried out, and the kind of sulphuric acid is used which is known in commerce as chemically pure, responding to the tests given under the head of *Acidum Sulphuricum*, the official manipulations will be all-sufficient.

Uses.—Diluted sulphuric acid is tonic, refrigerant, and astringent. It is given in *typhoid fever*, and often with advantage. In the convalescence from protracted fevers it acts beneficially as a tonic, exciting the appetite and promoting digestion. As an astringent, it is employed in *colliquative sweats, passive hemmorrhages*, and diarrhœas dependent on a relaxed state of the mucous membrane of the intestines, *i.e.*, in *serous diarrhœas.* In 1851, Buxton of London, called attention to its great value in *choleraic diarrhœas;* his assertions have received abundant confirmation both in this country and in England. (See *M. T. G.*, Oct. 1853; *M. S. Rep.*, ix. 199; *P. M. T.*, iii. 649.) In incipient *cholera* it is an efficient remedy; diluted with water, it may be given every twenty minutes in ordinary cases, every quarter of an hour in severe cases. For *bilious diarrhœa* the acid is not a suitable remedy. In *calculous af-*

fections attended with *phosphatic sediments* it is the proper remedy, being preferable to hydrochloric acid, as less liable to disorder the stomach by continued use. It is added with advantage to infusions of cinchona, the alkaloids of which it tends to hold in solution. As it is injurious to the teeth, it is best taken by sucking it through a glass tube or quill. It is much less used in the United States than is the elixir of vitriol. An elegant form for its administration is the Compound Infusion of Rose, *U. S.* 1870.

Dose, ten to thirty minims (0.6 to 1.8 Cc.).

Off. Prep.—Antimonium Sulphuratum, *Br.;* Ferri et Quininæ Citras, *Br;* Ferri Sulphas Granulatus, *U. S.;* Infusum Rosæ Acidum, *Br.;* Syrupus Rosæ, *U. S.*

ACIDUM SULPHUROSUM. U. S., Br.

SULPHUROUS ACID

(ăç'ĭ-dŭm sŭl-phū-rō'sŭm)

"An aqueous solution containing not less than 6 percent., by weight, of sulphur dioxide [$SO_2 = 63.59$], and about 94 percent. of water." *U. S.* "An aqueous solution containing 6.4 per cent. of hydrogen sulphite, H_2SO_3, corresponding to 5 per cent. by weight of sulphurous anhydride, SO_2. The sulphurous anhydride may be prepared by burning sulphur in air or oxygen, or by boiling sulphuric acid with carbon, mercury, or copper." *Br.*

Acide sulfureux, *Fr.;* Schwefligsaure, Schwefligsaurewasser, *G.*

* "Sulphuric Acid, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Charcoal, in coarse powder, *twenty grammes* [or 309 grains]; Distilled Water, *five hundred cubic centimeters* [or 16½ fluidounces]. Introduce the Charcoal into a glass flask having a capacity of about five hundred cubic centimeters, add the Acid, and mix them well. Connect the flask by means of bent glass tubing, about fifty centimeters in length, with a wash-bottle having a capacity of about two hundred cubic centimeters, containing about *fifty cubic centimeters* [or 1 fluidounce, 5 fluidrachms] of water, so that the end of the inlet tube shall be below the surface of the water. Through the triply perforated rubber stopper of the wash-bottle pass a safety tube, which should reach nearly to the bottom of the bottle, and connect the latter, by means of glass tubing, with a bottle provided with a doubly perforated rubber stopper, having a capacity of about one thousand cubic centimeters, and containing *five hundred cubic centimeters* [or 16½ fluidounces] of well-cooled Distilled Water. The inlet tube should dip about twenty-five millimeters below the surface of the Distilled Water. By means of a second tube connect this bottle with another containing water, the end of the tube extending five centimeters below the surface. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask containing the Sulphuric Acid and Charcoal, until the evolution of gas has nearly ceased, and, during the passage of the gas, keep the bottle containing the Distilled Water at or below 10° C. (50° F.), by surrounding it with cold water or ice. Assay a small portion of the Sulphurous Acid by the method given below. Then add to the remainder sufficient Distilled Water to bring the product to the strength of 6.4 percent., by weight, of sulphur dioxide. Finally pour the Sulphurous Acid into dark amber-colored, glass-stoppered bottles, which should be completely filled, and kept in a cool place, protected from light. Owing to its rapid deterioration, Sulphurous Acid should be frequently assayed, and none should be dispensed, if it fails to conform to the assay given below." *U. S.*

The British Pharmacopœia no longer gives a detailed process. The process of the U. S. Pharmacopœia is essentially that of Wittstein. The sp. gr. of the U. S. preparation is about 1.028, of the British, 1.025, the former being slightly stronger.

The rationale of the process is simple. When the sulphuric acid (H_2SO_4) and charcoal are heated together, two molecules of the former give up each an atom of oxygen to the latter, and there are thus produced sulphur dioxide and carbon dioxide, which, having been first passed through a wash bottle containing a little water to absorb impurities, are received into the distilled water, where the sulphur dioxide is absorbed, while the greater part of the carbon dioxide escapes:

$$4H_2SO_4 + C_2 = 2CO_2 + 4H_2O + 4SO_2$$

The excess of sulphur dioxide or sulphurous acid gas which escapes absorption may be received into a solution of sodium carbonate, to prevent the escape of gas into the room. The point of saturation may be roughly indicated by the bubbles formed by the escape of the gas from the distilled water being equal in size to those formed in the wash bottle. If there is any difficulty in getting the solution up to the official strength, the proportionate amount of sulphuric acid and of charcoal should be increased, and care exercised that the gas pass through the water in an abundant stream. The direction to keep the acid in well stoppered bottles, in a cool place, is necessary in consequence of the strong tendency of the gas to escape and to undergo oxidation. Old sulphurous acid often contains sulphuric acid, which may be nearly all removed by the cautious addition of barium sulphite and the removal by filtration of the precipitated sulphate.

According to W. L. Scott (*P. J.*, Oct. 1869, p. 217), the best results are obtained when sulphuric acid containing 75 per cent. of anhydrous acid is employed; when a too concentrated acid is used, a part of it is entirely reduced and sulphur deposited, while a too diluted acid causes the evolution of hydrogen sulphide. He also affirms that a purer gas is obtained by placing a little lead sulphite and a few pieces of charcoal in the wash bottles.

F. C. Calvert gives a process for preparing this acid on a large scale by which he avoids all the inconveniences usually attendant on its manufacture, and has prepared thousands of gallons daily of a saturated solution. It consists in burning sulphur in a small furnace, and conducting the acid gas through earthenware tubes surrounded with water so as to cool them. The gas is then made to ascend through a wooden tube 40 feet high and about 4 feet wide, sometimes called a coke scrubber, filled with pumice stone previously washed first with hydrochloric acid and then with water. A certain amount of water is introduced into the tube from above, which, in its descent, meets and dissolves the gas, and runs out saturated from the bottom of the tube into an air tight reservoir. (*P. J.*, xvii. 512.) Where sulphurous acid is to be used as a disinfectant, carbon disulphide, either pure or mixed with petroleum, or sulphur moistened with wood alcohol, may be burned in the room to be disinfected. Keates (*Chem. News,* Dec. 8, 1876) suggests the use of a suitable lamp. Stevenson uses an open copper dish or porcelain capsule, and simply ignites the liquid; care should be used, however, as the disulphide is very inflammable and volatile. A purer sulphurous acid than the official may be made by John Kennedy's process, that of reducing sulphuric acid with metallic copper and passing the gas through a cylinder containing lumps of moist charcoal and then through a wash bottle. The by-product is available as copper sulphate. (*A. J. P.*, 1886, p. 226.)

Properties.—The official sulphurous acid is a strong solution of sulphurous oxide gas. The oxide is an irrespirable gas, of a suffocating odor familiar to every one as that of burning sulphur, which is converted into it by combustion. If inhaled in the concentrated state, it proves fatal. Cold reduces it to a colorless liquid, which boils at —10.5° C. (13.1° F.). It has the sp. gr. 2.21, liquefies at —10° C. (14° F.), has a strong acid reaction, extinguishes burning bodies, has the power of bleaching many colored substances, and has a strong affinity for oxygen, with which it combines in the presence of water, forming sulphuric acid. Water at 18° C. (65° F.) takes up about 50 volumes of gas, and the solution has the sp. gr. 1.04. (Brande and Taylor.) Liquefied sulphurous acid gas (oxide) is now manufactured by Pictet in Geneva, and is sent into commerce in copper cylinders. It also forms the basis of the Pictet ice making process. The Pictet machines are constructed to use either the pure SO_2 or the "Pictet fluid," a mixture of compressed carbon dioxide and sulphur dioxide.

Sulphurous acid sometimes exists as an impurity in hydrochloric, acetic, and other acids; according to P. Schweitzer, the minutest quantity may be detected by dissolving zinc in the suspected acid, when, if sulphurous acid be present, hydrogen sulphide will be evolved, recognizable by its odor. (*Chem. News,* xxviii. 293.)

When sulphurous acid is exposed to the air it slowly absorbs oxygen, with the formation of sulphuric acid, and acquires a sour taste, and the property of changing vegetable blues to red. When kept in closed vessels exposed to the sunlight, a portion of it is decomposed, sulphur being deposited and sulphuric acid formed by the union of the liberated oxygen with other portions of the acid. (*A. J. P.*, xlii. 352.) It should be entirely volatilized by heat. It decolorizes iodine by producing hydriodic acid, and on this fact is based the Br. test given below. It decomposes bone calcium phosphate.

"A colorless liquid, having the characteristic odor of burning sulphur, and an acid, sulphurous taste. Specific gravity: not less than 1.028 at 25° C. (77° F.). By heat it is completely volatilized. Blue litmus paper moistened with the Acid is first reddened and afterwards bleached. On gently heating a few Cc. of the Acid in a test-tube, the gas evolved will blacken a strip of paper moistened with mercurous nitrate T.S., but will not affect one moistened with lead acetate T.S. On mixing, in a test-tube, 1 Cc. of Sulphurous Acid with 5 Cc. of diluted hydrochloric acid, and adding a small piece of pure zinc, hydrogen sulphide gas will be evolved, which will blacken a strip of paper moistened with lead acetate T.S. If to 10 Cc. of Sulphurous Acid there be added 1 Cc. of diluted hydrochloric acid, and afterwards 1 Cc. of barium chloride T.S., not more than a slight turbidity should be at once produced (limit of *sulphuric acid*)." *U. S.*

Assay of Sulphurous Acid.—"Introduce into a stoppered weighing-bottle 2 Cc. of Sulphurous Acid and weigh accurately. To this add 50 Cc. of tenth-normal iodine V.S., and allow it to stand for five minutes, then slowly add tenth-normal sodium thiosulphate V.S. until the mixture is just decolorized. Subtract the number of cubic centimeters of the tenth-normal sodium thiosulphate V.S. used, from 50, and multiply the difference by 0.318, and divide this product by the weight of the Acid taken; the quotient represents the percentage of absolute Sulphurous Acid in the latter. Dilute the Sulphurous Acid with distilled water, as directed in the process above, so that it shall have the strength of 6.4 per cent. of sulphur dioxide." *U. S.* "It gives but a slight precipitate with *solution of barium chloride* (absence of excess of sulphates), but a copious precipitate if *solution of chlorine* also be added. When evaporated it leaves no residue. Specific gravity 1.025. Mixed with 100 times its volume of recently boiled and cooled *water,* and a little *mucilage of starch,* it should not acquire a permanent blue color with the *volumetric solution of iodine* until, for each gramme of the acid, 15.7 cubic centimetres of the *volumetric solution of iodine* have been added." *Br.*

Uses.—Sulphurous acid is a powerful antiseptic and germicide, arresting putrefaction and other fermentations by killing the organisms which produce them. It is supposed to be thus

destructive by its anti-oxygenizing or reducing influence, suffocating organic beings by denying them the oxygen necessary to their existence; but it probably acts also by a physiological property independently of its mere chemical effect. Sulphurous acid and sulphites are widely used for preserving food, especially dried fruits. So-called "sulphite powders" containing either sodium sulphite or calcium or magnesium bisulphites have figured largely in pure food prosecutions, as being used to brighten the color of chopped meat in "Hamburg steaks." According to the experiments of L. Pfeiffer (*A. E. P. P.*, xxvii.), the sulphites are capable of causing death by paralyzing the heart and also the respiratory and other motor nerve centres, but are so rapidly and completely changed into the sulphates that unless given in enormous amount they exert very little influence upon the system; 96.5 per cent. of the sulphite was regained from the urine as a sulphate, and 86 per cent. passed out in five hours after ingestion. Although Robert Bird affirms that sulphurous acid and its salts are powerful antipyretics (*Am. J. M. S.*, lviii. 236), and the acid in the form of the fumes of burning sulphur has been used by inhalation in *low fevers, diphtheria,* and *whooping cough* with alleged advantage, yet the sulphites are at present employed in medicine almost solely as germicides and parasiticides. In *pyrosis* and in cases of *sarcinæ ventriculi* sulphurous acid may be taken internally; but one of the sulphites, as sodium sulphite, is perhaps preferable for the purpose, as it yields the acid always by decomposition in the stomach. As an external application, it is used in *psora,* the different forms of *porrigo, trichosis of the scalp, pityriasis versicolor,* and the *thrush* of children, all *parasitic affections,* either animalcular or cryptogamous, generally yielding to it, if proper care be taken, by previous removal of scabs or scales, to bring it into contact with the morbific cause. When locally used it should be diluted with two or three measures of water or of glycerin, and applied as a lotion, or by cloths wet with it. Sulphurous acid constitutes the active principle of burning sulphur fumes, used for disinfecting purposes.

Dose, for internal use, half to one fluidrachm (1.8 to 3.75 Cc.), well diluted.

ACIDUM TANNICUM. U. S., Br.

TANNIC ACID [Gallotannic Acid]

(ăç'ĭ-dŭm tăn'nĭ-cŭm)

$HC_{14}H_9O_9 = 319.66$

"A monobasic organic acid [$C_{13}H_9O_7.COOH$], obtained from nutgall." *U. S.* "Tannic acid, $C_{14}H_{10}O_9,2H_2O$, may be extracted by water-saturated ether from Galls which have been subjected to a special fermentation." *Br.*

Tannin, Digallic Acid, Acidum Gallo-tannicum, Tanninum; Acide tannique, Tannin officinal, *Fr. Cod.;* Acidum tannicum, *P. G.;* Gerbsaure, Gallusgerbsaure, Tannin, *G.;* Acido tannico, *It.;* Acido tanico, *Sp.*

The present British Pharmacopœia does not give a detailed process for preparing tannic acid; the former British Pharmacopœia adopted a process which was almost identical with that of the U. S. P. 1870, both being essentially the process of Leconnet, modified by Dominé, which had been substituted for that of Pelouze previously employed in both Pharmacopœias. The process of the British Pharmacopœia (1885) was as follows: "Galls in powder, Ether, of each a sufficient quantity. Expose the powdered galls to a damp atmosphere for two or three days, and afterwards add sufficient ether to form a soft paste. Let this stand in a well-closed vessel for twenty-four hours, then, having quickly enveloped it in a linen cloth, submit it to strong pressure in a suitable press, so as to separate the liquid portion. Reduce the pressed cake to powder, mix it with sufficient ether, to which one-sixteenth of its bulk of water has been added, to form again a soft paste, and press this as before. Mix the expressed liquids, and expose the mixture to spontaneous evaporation until, by the aid subsequently of a little heat, it has acquired the consistence of a soft extract; then place it on earthen plates or dishes, and dry it in a hot-air chamber at a temperature not exceeding 212° F. (100° C.)." *Br.* (1885).

While the Pelouze process yields the tannic acid probably in a somewhat purer state than Leconnet's, it is less easy of performance, and much less productive, and the product of the above formula is sufficiently pure for all practical purposes. The addition of a little alcohol —8 per cent., for example—to the ethereal menstruum still further increases the product. The exposure of the powdered galls to a damp atmosphere for two or three days is for the purpose of inducing a special fermentation, whereby the yield of tannin is materially increased. There appear to be two coloring principles in galls, one soluble in ether and not in alcohol, the other in alcohol and not in ether. Hence, while the tannic acid, in whichever way procured, is yellowish, that obtained by ether has a greenish tint, while that obtained by the addition of alcohol is slightly brownish. In consequence of the mode in which the acid is dried, in thin layers, on tinned or glass plates, and equally exposed to the heat above and below, it froths up on the escape of the ether, and concretes in a soft, cellular, friable form, which is strikingly characteristic of the preparation made in strict accordance with the formula.

From a superficial examination of this process, it might appear that the result can be nothing more than an ethereal extract; but it is necessary that the ether employed should contain water, as it is directed to be washed; and yet the quantity of water is so small that it can hardly operate by its mere solvent power. The circumstances attendant upon the process of Pelouze afford the means of a satisfactory explanation, which was first suggested by Beral. In this, the powdered galls are submitted to

percolation by watered ether, and the liquid which passes separates into two layers, a heavier which sinks to the bottom and a lighter which floats upon the surface. It is the heavier which contains the tannic acid, and from which the acid is obtained by evaporation. The most probable explanation is that ether, water, and tannic acid unite to form a definite compound, in which the affinities are too feeble to resist the tendency of the ether to rise in vapor, and which is, therefore, decomposed by its evaporation. The proportion of the menstruum to the galls is very small, much smaller than would be employed to obtain an extract; and the whole or nearly the whole of both liquids is probably occupied in the formation of the definite compound referred to, thus leaving little or none to act merely as solvents. Hence the exclusion from the resulting acid, in great measure, of the other soluble constituents of the galls; and the slight amount of impurity really present in the acid is probably owing to the action of that small quantity of the menstruum not occupied in forming the liquid compound. Opinion is not altogether united in this explanation, but it is that which appears to us the best to account for the phenomena of the case. It has been stated that the tannic acid obtained by either process has a more or less yellowish tint. From this, according to F. Kummel, it may be freed by the percolation, through recently ignited animal charcoal, of its solution in a mixture of ether and alcohol. It has, too, a slight odor, which, according to Procter, is derived from a volatile odorous principle existing in galls, which he succeeded in separating from the acid by the action of benzene. From 30 to 35 per cent. of tannic acid is obtained from galls by Pelouze's method; 60 per cent. by that of Leconnet. Alcohol tannin and water tannin are terms used to indicate the method of extraction; in the former the powdered nutgall is percolated with alcohol (50 per cent.) and the solution of tannin evaporated in a vacuum apparatus; in the water tannin, water is used as in the ether process as above described and the aqueous solution evaporated *in vacuo*. Gartenmeister used acetic ether for a solvent and a patent was secured for this process in Germany.

Crystallized tannic acid is said to be made by forcing a thick syrupy solution of tannin through finely perforated sieves and dropping the threads from a height upon rapidly revolving wooden cylinders and scraping off the product. The term crystallized is of course a misnomer, as tannin is amorphous. For the preparation of tannin from Chinese galls, Oscar Rothe proposes the following as a superior process. Macerate eight parts of the powdered galls with twelve of ether and three of strong alcohol for two days, decant, renew the menstruum, and finally express. Mix the liquids, and after standing decant from the sediment, add twelve parts of water, recover the alcohol and ether by distillation, rapidly filter the aqueous solution, and quickly evaporate by means of a steam bath; dry, and pulverize the residue. (*A. J. P.*, xlii. 403.)

Henry Trimble and J. C. Peacock recommend acetone as a valuable solvent for extracting tannin from oak bark (*Proc. A. Ph. A.*, 1893, p. 110), and acetone is now largely used by manufacturers as a solvent in extracting tannin from galls. B. L. DeGraffe (*A. J. P.*, 1896, 313) recorded investigations upon the plants of the Ericaceæ to determine the character of their tannins; acetone and acetic ether were used as solvents. For Sisley's method of preparing *pure* tannin, see *Proc. A. Ph. A.*, 1894, 1087.

The term *tannin* is applied to a class of vegetable principles the aqueous solutions of which give blue or green colors or precipitates with ferric salts, and precipitate solutions of gelatin and albumin. They are mainly glucosides. Chemists have recognized two kinds, one distinguished by producing a bluish-black precipitate with ferric salts, and the other characterized by producing a greenish-black or dark olive precipitate with the same salts. The former is the one which has received most attention, and from an examination of which the characters of tannin have generally been given. It is the substance described in this article. It is called, for the sake of distinction, *gallotannic acid*. According to Pettenkofer, it is found only in perennial plants, indicating some relation to the production of woody fibre. (*Buchner's Neues Repert.*, iii. 74-76.) Henry Trimble (*The Tannins*, vol. ii. p. 132, Phila., 1894) classifies the tannins into two main groups: Group *a*. Gallotannic acid, chestnut wood tannin, chestnut bark tannin, pomegranate bark tannin, and sumac tannin. Group *b*. Oak bark tannin, mangrove tannin, canaigre tannin, rhatany tannin, kino tannin, catechu tannin, and tormentil tannin. R. Wagner (*Bull. Soc. Chim.*, 1866, ii. 461) divides tannin into two great classes: pathological, found only in diseased vegetable tissue, as gallotannic acid, etc.; and physiological, occurring in leaves, bark, wood, etc. in a natural state, as quercitannic acid, etc.

For another scheme of classification of the tannins, based on the products they yield when heated alone, when heated with diluted acid, and when fused with caustic alkali, see Allen, *Com. Org. Anal.*, 2d ed., vol. iii., part i., p. 77.

Properties.—Pure tannic acid is solid, uncrystallizable, white, or slightly yellowish, inodorous; taste strongly astringent without bitterness, very soluble in water, much less soluble in alcohol and ether, especially when anhydrous, insoluble in the fixed and volatile oils.

The U. S. Pharmacopœia thus describes this acid: "A light yellowish, amorphous powder, gradually turning darker when exposed to air and light, usually cohering in the form of glistening scales or spongy masses, odorless, or having a faint, characteristic odor, and a strongly astringent taste. Soluble in about 0.34

part of water and in about 0.23 part of alcohol at 25° C. (77° F.); very soluble in boiling water, and in boiling alcohol; also in about 1 part of glycerin, with the application of a moderate heat; freely soluble in diluted alcohol, sparingly in absolute alcohol; almost insoluble in absolute ether, chloroform, benzene, or petroleum benzin. When heated on platinum foil, the Acid is gradually consumed, leaving not more than 0.2 percent. of ash. An aqueous solution of Tannic Acid reddens blue litmus paper. The addition of a small quantity of ferric chloride T.S. to an aqueous solution of the Acid produces a bluish-black color or precipitate. On adding to an aqueous solution (1 in 100) of Tannic Acid a small quantity of calcium hydroxide T.S., a pale bluish-white, flocculent precipitate is produced which is not dissolved on shaking (difference from *gallic acid*), and which becomes more copious and of a deeper blue by the addition of a moderate excess of calcium hydroxide T.S., while a large excess of the latter imparts a pale pinkish tint to the solution. The aqueous solution of the Acid produces precipitates with most alkaloids and glucosides, and with test solutions of gelatin, albumin, and starch (distinction from *gallic acid*). If 2 Gm. of Tannic Acid be dissolved in 10 Cc. of boiling water, and the liquid allowed to cool, no turbidity should be produced on diluting 5 Cc. of the solution with 10 Cc. of alcohol (absence of *gum* or *dextrin*), or with 10 Cc. of water (absence of *resinous substances*)." *U. S.* "It is precipitated from its aqueous solution and loses its astringency in the presence of many mineral salts and acids. The aqueous solution precipitates *solutions of isinglass, albumen,* alkaloids, and *tartarated antimony,* and gives with *test-solution of ferric chloride* a bluish-black color. It should leave no appreciable residue when incinerated with free access of air." *Br.*

Commercial tannic acid often has a decided odor, which Procter, after a practical investigation, believed to be owing chiefly to the presence of the odorous principle of the galls, though sometimes to matter derived from the ether with which it is prepared. (*A. J. P.,* 1865, p. 53.) According to Heinz, the odor is due to a greenish resinous principle, which may be separated by dissolving the acid in twice its weight of hot water, adding one-fourth part of ether, agitating slowly, allowing the coagulated coloring matter to precipitate, filtering, and evaporating. (*J. P. C.,* xv. 308.)

Exposed to heat, tannic acid partly melts, swells up, blackens, takes fire, and burns with a brilliant flame. Thrown on red hot iron, it is entirely dissipated. Its solution reddens litmus, and it combines with most of the salifiable bases. It forms with potassium hydroxide a compound but slightly soluble, and is, therefore, precipitated by this alkali or its carbonates from a solution which is not too dilute, though a certain excess of alkali will cause the precipitate to be redissolved. Its combination with soda is much more soluble, and this alkali affords no precipitate, unless with a very concentrated solution of tannic acid. With ammonia its relations are similar to those with potassium hydroxide. Lime and magnesia added in the state of hydroxides, form with it compounds of little solubility. The same is the case with most of the metallic oxides, when presented in the state of salts to a solution of potassium tannate. Tannic acid even when in the uncombined state precipitates many of the metallic salts, especially those of lead, copper, silver, uranium, chromium, mercury, antimony trioxide, and stannous oxide. With ferric salts it forms a black precipitate, which is a compound of tannic acid and the iron, and is the basis of ink. It does not disturb the solutions of the pure ferrous salts. Several of the alkaline salts precipitate it from its aqueous solution, either by the formation of insoluble compounds or by simply abstracting the solvent. Potassium chlorate when rubbed up with it explodes with great violence, and several serious accidents are recorded as having occurred during the attempt to dispense such a mixture.

Tannic acid unites with most of the vegetable alkaloids, forming compounds which are for the most part of a whitish color, and but very slightly soluble in water, though they are soluble in the vegetable acids, especially acetic, and in alcohol. In this latter respect they differ from most of the compounds which tannic acid forms with other vegetable principles. On account of this property of tannic acid, it has been employed as a test for some of these alkaloids.

Tannic acid when in solution affords precipitates with sulphuric, nitric, hydrochloric, phosphoric, and arsenic acids, but not with oxalic, tartaric, lactic, acetic, or citric. The precipitates are considered as compounds of tannic acid with the respective acids, and are soluble in pure water, but insoluble in water with an excess of acid. Hence, in order to insure precipitation, it is necessary to add the acid in excess to the solution of tannic acid. Strecker, however, denies that the precipitates are compounds of the tannin with the acid, and maintains that they are tannin imbued with free acid.

When tannic acid, iodine, and water are mixed, a reaction takes place, by which the water is decomposed, its hydrogen forming with the iodine hydriodic acid, which combines with a portion of the tannic acid and remains in solution, while the oxygen of the water combines with another portion of the tannic acid, to form a compound, which, being insoluble, is precipitated. The iodized solution thus obtained is capable of dissolving more iodine, and holding it in permanent solution, however much diluted. (Socquet and Guilliermond, *J. P. C.,* xxvi. 280.) Iodine in a liquid containing tannic acid cannot be detected by starch, but if the liquid is placed in a watch-glass, ferrous sulphate

added, and the glass covered with a starched paper, ferric tannate being precipitated, the blue color soon appears. (*A. J. P.*, xlvii. 398.)

Griessmayer (*Zeit. An. Chem.*, 1873) proposes a test for tannin and free alkalies. On mixing a drop of a solution of tannin with 1 Cc. of $\frac{1}{100}$ normal solution of iodine, the reddish color of the iodine solution instantly disappears; if one drop of solution of ammonia be now added (previously diluted with ten times its bulk of water), a brilliant red color is produced which is quite permanent. Tannic acid precipitates solutions of starch, albumin, and gluten, and forms with gelatin an insoluble compound, which is the basis of leather. J. Napier Spence (*J. Soc. Chem. Ind.*, 1891, p. 1114) has reviewed all the current tests for distinguishing between tannic acid and gallic acid. (See *Proc. A. Ph. A.*, 1892, p. 1032.)

Mulder gave for tannic acid the formula $C_{14}H_{10}O_9$; and both Julius Löwe and Hugo Schiff confirmed these figures. (*A. J. P.*, xxv. 223; xlvii. 208.) Schiff asserts that it is not a glucoside; that glucose exists in commercial tannic acid as an impurity, and is not a necessary part of it, and that it is a "first anhydride," formed from two molecules of gallic acid by the abstraction of water, thus:

$$2C_7H_6O_5 - H_2O = C_{14}H_{10}O_9$$

It is consequently digallic acid; this is the present view. (See *Acidum Gallicum.*) (*Chem. News*, xxix. 73; also *A. J. P.*, xlvi. 234.)[1]

Uses.—Tannic acid is the chief principle of vegetable astringents, and has an advantage over the astringent extracts in the comparative smallness of its dose, which renders it less apt to offend an irritable stomach. In most of the vegetable astringents it is associated with more or less bitter extractive, or other principle which modifies its operation and renders the medicine less applicable than it otherwise would be to certain cases in which there is an indication for pure astringency without any tonic power. Such is particularly the case in the active *hemorrhages;* and tannic acid, in its separate state, is here preferable to the native combinations in which it ordinarily exists. In *diarrhœa* it is probably more beneficial than ordinary astringents, as less liable to irritate the stomach and bowels. Owing to its very powerful coagulant action upon albumin, it is, however, absorbed only after conversion into gallic acid, and consequently has been superseded by the latter agent in all cases in which it must reach the diseased surface through the blood, or in which a general astringent action is desired. Internally various combinations with albumin are now largely employed (see *Tannalbin*, PART II). Locally applied, it is much more powerful than gallic acid, and is very largely employed in *hemorrhages* from external surfaces or from mucous membrane which can be reached from without, as in *relaxation of the uvula, coryza, chronic inflammation of the fauces, diphtheria, toothache, aphthæ, excessive salivation, leucorrhœa, chapped nipples, gleet, gonorrhœa, flabby* and *phagedænic ulcers, piles, chilblains*, etc. (See *Collodium Stypticum*). It may also be applied in solution of varying concentration according to the necessities of the case. When a very powerful influence is desired, the solution in glycerin may be used. (See *Glyceritum Acidi Tannici.*) In *affections of the rectum* it may be used in the form of a suppository. In *diseases of the uterus* it has been recommended in the form of a cylindrical pencil about an inch long and two lines thick, made with 4 parts of the acid to 1 part of tragacanth, with a little crumb of bread to give the mixture due flexibility.

As already stated, tannic acid is probably converted into gallic acid before absorption; it is eliminated through the kidneys in the form of gallic and pyrogallic acids. In the largest amounts it produces only a mild gastro-intestinal irritation.

Dose, from three to ten grains (0.20 to 0.65 Gm.).

Off. Prep.—Collodium Stypticum, *U. S.;* Glyceritum Acidi Tannici, *U. S.* (*Br.*); Suppositoria Acidi Tannici, *Br.;* Trochisci Acidi Tannici, *U. S.* (*Br.*); Unguentum Acidi Tannici, *U. S.*

ACIDUM TARTARICUM. U. S., Br.

TARTARIC ACID

(ăç'ĭ-dŭm tär-tăr'ĭ-cŭm)

$H_2C_4H_4O_6 = 148.92$

"A dibasic organic acid [$C_2H_2(OH)_2(COOH)_2$], usually prepared from argol. It should contain not less than 99.5 percent. of pure Tartaric Acid." *U. S.* "Tartaric Acid, or dextro-rotatory hydrogen tartrate, $C_4H_6O_6$, prepared from acid potassium tartrate. In constitution it may be regarded as dioxysuccinic acid, or dihydroxysuccinic acid,

$$\begin{array}{l} CH.OH.COOH \\ | \\ CH.OH.COOH. \end{array}$$

" *Br.*

Dextrotartaric Acid; Sal Essentiale Tartari; Acide Tartrique, *Fr. Cod.;* Acide du Tartre, Acide dextro-racémique, *Fr.;* Acidum tartaricum, *P. G.;* Weinsteinsaure, Weinsaure, *G.;* Acido tartarico, *It.;* Acido tartrico, *Sp.*

No formula for the preparation of tartaric acid is given in either Pharmacopœia. It is

[1] Various plans have been proposed for estimating the quantity of tannic acid, which is an object of importance to tanners, as enabling them to judge of their tanning materials; but on this point we must content ourselves, from want of space, with referring to *A. J. P.* (1859, p. 427; 1861, p. 164; 1863, p. 519; 1864, p. 314); also a paper by John Watts in the *P. J.* (1867; p. 515); and by the following: H. R. Procter, *Chem. News* (1874, p. 51); A. Muntz and Ramspacher; *J. P. C.* (xx. 287); *J. P. C.*, 1874, pp. 445–447; *A. J. P.*, March, 1874, and Aug. 1877; *N. R.*, Aug. 1878; *N. R.*, 1882, pp. 150, 185; *P. J.*, 1885, pp. 121, 850. See also paper by S. J. Hinsdale (*West. Drug.*, 1891, p. 445), and a monograph on "*The Tannins,*" by Henry Trimble (J. B. Lippincott Co., 1894). John H. Yocum, after reviewing various methods of estimating tannin, believes the "hide-powder" method most practical and useful. (*Am. Chem. Soc.*, Jan. 9, 1897.)

extracted from *tartar,* or *argol,* a peculiar substance which is deposited on the inside of wine casks during the fermentation. Tartar, when purified and reduced to powder, is the cream of tartar of commerce, and consists of acid potassium tartrate. (See *Potassii Bitartras.*) The following is the former British process:

"Take of Acid Tartrate of Potassium *forty-five ounces* [av.]; Distilled Water *a sufficiency;* Prepared Chalk *twelve ounces and a half* [av.]; Chloride of Calcium *thirteen ounces and a half* [av.]; Sulphuric Acid *thirteen fluidounces.* Boil the Acid Tartrate of Potassium with two gallons [Imp. measure] of the Water, and add gradually the Chalk, constantly stirring. When the effervescence has ceased, add the Chloride of Calcium dissolved in two pints [Imp. meas.] of the Water. When the tartrate of calcium has subsided, pour off the liquid, and wash the tartrate with Distilled Water until it is rendered tasteless. Pour the Sulphuric Acid, first diluted with three pints [Imp. meas.] of the Water, on the tartrate of calcium, mix thoroughly, boil for half an hour with repeated stirring, and filter through calico. Evaporate the filtrate at a low temperature until it acquires the sp. gr. of 1.21, allow it to cool, and then separate and reject the crystals of sulphate of calcium which have formed. Again evaporate the clear liquor till a film forms on its surface, and allow it to cool and crystallize. Lastly, purify the crystals by solution, filtration (if necessary), and recrystallization." *Br.* (1885).

Tartaric acid was first obtained in a separate state by Scheele in 1770. The process consists in saturating the excess of acid in potassium bitartrate or cream of tartar with calcium carbonate, and decomposing the resulting insoluble calcium tartrate by sulphuric acid, which precipitates in combination with the lime, and liberates the tartaric acid. The equivalent quantities are two molecules of the acid tartrate and one molecule of calcium carbonate. The process, when thus conducted, furnishes one half of the tartaric acid. The other half may be procured, as in the British process, by decomposing the neutral potassium tartrate remaining in the solution after the precipitation of the calcium tartrate, by calcium chloride in excess. By double decomposition, potassium chloride will be formed in solution, and a second portion of calcium tartrate will precipitate, which may be decomposed by sulphuric acid together with the first portion. The process, when thus conducted, will furnish twice as much tartaric acid as when the acid salt only is decomposed. The reactions are:

$$2KHC_4H_4O_6 + CaCO_3 =$$
$$K_2C_4H_4O_6 + CaC_4H_4O_6 + H_2O + CO_2$$
$$CaC_4H_4O_6 + H_2SO_4 = CaSO_4 + H_2C_4H_4O_6$$
$$K_2C_4H_4O_6 + CaCl_2 = 2KCl + CaC_4H_4O_6$$
$$CaC_4H_4O_6 + H_2SO_4 = CaSO_4 + H_2C_4H_4O_6$$

Scarlata (*Chem. News,* 1899, 296) has devised a method of making tartaric acid based on the decomposition of potassium and calcium tartrates by *fluosilicic acid;* tartaric acid is liberated and corresponding fluosilicates are formed; the latter may then be decomposed by sulphuric acid and fluosilicic acid reproduced for use in a subsequent operation. By this method tartaric acid of 99 per cent. purity may be obtained. Zinno has prepared tartaric acid synthetically by passing carbon dioxide under pressure over potassium glycerate. (*Proc. A. Ph. A.,* 1902, 263.)

Formerly all the tartaric acid used in America was imported from England and France, the amount in some years being as much as 500,000 lbs. annually; but it is now made in the United States not only of better quality, but actually cheaper than the imported acid costs in bond. The importations of argol, or crude tartar, are, however, considerable. In 1902, they amounted to 29,286,980 lbs., valued at $2,263,538; in 1903, to 29,481,046 lbs., valued at $2,732,706; and in 1904, to 24,406,705 lbs., valued at $2,549,108. According to the census of 1900 there were produced in the United States, in that year, 2,677,004 lbs. of tartaric acid, the value of which was fixed at $781,600.

Preparation on the Large Scale.—To obtain tartaric acid from the crude materials (argol and wine lees), the method still largely used is the precipitation of the acid potassium tartrate as calcium tartrate and subsequent preparation of the tartaric acid from the latter. The methods of obtaining the calcium tartrate vary according to the nature of the crude material. A suitable method of producing it from argol is to mix the argol, preferably in the form of a powder, with water, and boil, after the addition of some hydrochloric acid. Milk of lime is then added to the boiling mass until this is nearly neutral, when calcium tartrate is precipitated and neutral potassium tartrate and calcium chloride left in solution. The neutral potassium tartrate is decomposed either by boiling with a sufficient amount of calcium sulphate or by adding calcium chloride solution, an excess of the precipitant being avoided in either case. The small amount of acid potassium tartrate purposely left in the liquid, when treating the latter with milk of lime, is decomposed with pure precipitated calcium carbonate. The object of not adding the milk of lime to the neutral point or in excess is to avoid the precipitation of iron or aluminum oxides. The solution must still remain perceptibly acid after the addition of the calcium carbonate. When cooled to about 40° C., the liquid is filtered with the aid of a suction pump, and the residue washed with water.

In the oldest methods of obtaining calcium tartrate from wine lees the latter were boiled with water and hydrochloric acid, the clear solution removed, and the residue treated with more water. As the extraction was very incomplete, these methods have not been employed of late years. When filtration of the lees was first attempted it was found that the pores of

the filter became clogged, and that even under a pressure of four or five atmospheres no liquid would pass through. This difficulty was overcome by the process of Dietrich and Schnitzer, in which the albuminoid substances are coagulated by heating for about six hours under a pressure of four or five atmospheres. Wet lees, when thus treated, can be readily filtered. Dried lees are crushed, stirred in a tank with water, and heated by steam for some time, until air is completely expelled, before being heated in the pressure boiler.

During the process of heating the lees, the steam passing from the apparatus carries with it volatile empyreumatic products derived from the decomposed albuminoids. These have a very offensive odor, and should be conveyed into a factory chimney of sufficient height, so that the evil-smelling vapors are drawn up and decomposed by the furnace gases.

When the heating is finished, the steam outlet pipe is opened and the pressure allowed to fall to from one to one-half atmosphere, this pressure being required to force the lees from the boiler into a tank, which may be suitably constructed of wood. Here they are mixed with water, which has previously been put into the tank, and the requisite quantity of crude hydrochloric acid (21° to 22° B.). Experience has shown that for every 100 parts by weight of argol in the lees 100 parts of acid are required. Too little acid causes deposition of argol in the cloths of the filter-press, while too much destroys the cloths, and more lime is needed to neutralize the filtrate. If the conditions are right, the filtered liquid should have a specific gravity of about 6° B.

The acidified lees are pressed and washed, the washings being used instead of clear water for mixing with the next charge of lees from the pressure boiler. The tartaric acid in the filtrate is precipitated with lime and calcium carbonate, and the remainder of the process is the same as in the case of the argol, with the exception that there is no necessity to add calcium chloride or calcium sulphate.

Calcium tartrate obtained from wine lees is of a clear gray color, considerably purer than the dark gray or dark brown product from argol.

Oscar Ficinus of Bensheim, proposes the following process to procure a pure tartaric acid. Saturate the crude tartar with calcium carbonate, and decompose the resulting calcium tartrate with solution of zinc chloride, whereby calcium chloride and zinc tartrate are produced. The latter is almost insoluble, and is completely decomposed by hydrogen sulphide. The residuary zinc sulphide may again be converted by means of hydrochloric acid into zinc chloride and hydrogen sulphide, so that the expense of the process is very small. The liquid filtered from the precipitated zinc sulphide, containing tartaric and sulphydric acids in solution, is heated for some time to 60° to 80° C. (140° to 176° F.), in order to dissipate the latter acid, filtered from the precipitated sulphur, and concentrated to the point of crystallization. (*A. Pharm.*, April, 1879, p. 310.) It is asserted that in Hungary and Southern Italy tartaric acid of extreme purity is prepared, that occurring in flat, crystalline crusts being chemically pure, that in pointed crystals containing a little sulphuric acid.

Properties.—"Colorless, translucent, monoclinic prisms, or crystalline crusts, or a white powder, odorless, having a purely acid taste, and permanent in the air. Soluble in 0.71 part of water, and in 1.67 parts of alcohol at 25° C. (77° F.); in about 0.5 part of boiling water, and in about 0.2 part of boiling alcohol; also in 250 parts of ether; nearly insoluble in chloroform, benzene, or petroleum benzin. When heated for some time at 100° C. (212° F.), the powdered crystals do not suffer a sensible loss of weight. At 135° C. (275° F.) the Acid melts. At a higher temperature it is gradually decomposed, emitting an odor resembling burning sugar, and is finally consumed, leaving not more than 0.05 percent. of ash." *U. S.* "Readily soluble in less than its own weight of *water* and in less than three times its weight of *alcohol* (90 per cent.). An aqueous solution rotates the plane of a ray of polarized light to the right." *Br.* The powder is sometimes directed to be kept in well-stoppered vials; but Otto has shown that this method tends to spoil it. A better plan is to keep the powder in ordinary boxes.

As found in commerce, it is in the form of a fine white powder, prepared by pulverizing the crystals. A weak solution undergoes spontaneous decomposition when kept, becoming covered with a mouldy pellicle; but, if boiled and filtered, it is said to lose this tendency. It is asserted that the addition of 1-1000th of salicylic acid will effectually preserve solutions of tartaric acid. In uniting with bases it has a remarkable tendency to form double salts, several of which constitute important medicines. It combines with several of the vegetable alkaloids, so as to form salts. It is distinguished from all other acids by forming a crystalline precipitate, consisting of potassium bitartrate, when added to a neutral salt of that alkali. When associated with an excess of boric acid, it is detected with difficulty, potassium hydroxide not precipitating it, even with the addition of acetic or hydrochloric acid. Its separation, however, may be effected, according to Barfoed, by means of potassium fluoride, which detaches the boric acid, to form potassium fluoborate, and renders free the tartaric acid, which then responds to the ordinary test. (*J. P. C.*, 4e sér., ii. 70.) Its most usual impurity is sulphuric acid, which may be detected by the solution affording with lead acetate a precipitate only partially soluble in nitric acid. When incinerated with mercuric oxide, it leaves no residue, or a mere trace. The British Pharmacopœia directs that "each gramme of tartaric acid dissolved in *water* should require for neutralization 13.3 cubic centimetres of the

volumetric solution of sodium hydroxide. It should yield no characteristic reaction with the tests for copper, arsenium, iron, potassium, sodium, or oxalates, only the slightest reactions with the tests for calcium or sulphates, and no reaction for lead by the test described under 'Acidum Citricum.' On incineration with free access of air, it should not yield more than 0.05 per cent. of ash." *Br.* "An aqueous solution of Tartaric Acid reddens blue litmus paper. An aqueous solution (1 in 2) of the Acid mixed with a strong solution (1 in 3) of potassium acetate yields a white crystalline precipitate, which is soluble in solutions of alkalies and in mineral acids, but insoluble in acetic acid. The aqueous solution (1 in 10) of the Acid, acidulated with a few drops of hydrochloric acid, should remain unaffected by barium chloride T.S. (absence of *sulphuric acid*). An aqueous solution (1 in 10) in which the free Acid has been nearly but not entirely neutralized by ammonia water, should not be affected by calcium sulphate T.S. (absence of, and difference from, *oxalic acid*). On supersaturating 10 Cc. of the aqueous solution (1 in 10) with ammonia water, no more than a faint turbidity should be produced in the liquid by ammonium oxalate T.S. (absence of more than a trace of *calcium*), nor should the aqueous solution (1 in 10) mixed with a few drops of hydrochloric acid show any color in the acid solution when submitted to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121), omitting the subsequent addition of ammonia water. To neutralize 3.73 Gm. (3.723) of Tartaric Acid should require not less than 49.8 Cc. of normal potassium hydroxide V.S. (each Cc. corresponding to 2 percent. of pure Tartaric Acid), phenolphthalein T.S. being used as indicator." *U. S.* Denigés gives the following modification of Mohler's test for tartaric acid. A solution of 2 Gm. of resorcinol in sufficient diluted sulphuric acid (1 per cent.) is added to 20 times its volume of strong sulphuric acid. In the presence of tartaric acid this liquid gives with a few drops of the fluid to be tested a characteristic violet-red color when the mixture is heated to 115° to 140° C. (*Am. Drug.*, 1896, 182.)

Tartaric acid is incompatible with salifiable bases and their carbonates; with salts of potassium, with which it produces a crystalline precipitate of bitartrate; and with the salts of calcium and lead, with which it also forms precipitates. It consists of four atoms of carbon, six of hydrogen, and six of oxygen. Of the six hydrogen atoms, however, only two are replaceable by metal, so that it is dibasic, and can form both acid and neutral salts with monad elements like potassium and sodium. Thus, cream of tartar is the acid potassium tartrate (potassium bitartrate), and the so-called "soluble tartar" is the neutral potassium tartrate.

MODIFICATIONS OF TARTARIC ACID.—Five distinct modifications of tartaric acid exist. Their chief physical and chemical differences are:—

a. Dextro-tartaric acid, or ordinary tartaric acid, forms anhydrous, hemihedral, rhombic crystals, the aqueous solution of which turns the plane of polarization of a luminous ray to the *right*. The crystals fuse at 135° C. (275° F.), have a sp. gr. of 1.74 to 1.75, and are readily soluble in absolute and aqueous alcohol.

b. Lævo-tartaric acid forms anhydrous, hemihedral, rhombic crystals, the aqueous solution of which turns the plane of polarization of a luminous ray to the *left*.

c. Racemic or *para-tartaric* acid forms hydrated, holohedral, triclinic crystals of $H_2C_4H_4O_6 + H_2O$, which are optically *inactive*. The crystals have a sp. gr. of 1.69, and are soluble in five parts of cold water and with difficulty in cold alcohol. The calcium racemate is less soluble in water than calcium dextro-tartrate, and is also distinguished by its insolubility in acetic acid and in ammonium chloride solution. Racemic acid can be prepared by mixing *a*- and *b*- tartaric acids, and can be resolved into them by appropriate methods. Racemic acid exists naturally in small proportion in the juice of grapes growing in particular localities, and was first obtained artificially in 1853 by Pasteur.

d. Inactive or *meso-tartaric* acid, optically inactive, but not resolvable into *a* and *b* acids.

e. Meta-tartaric acid, produced by fusing the ordinary variety. It is deliquescent and uncrystallizable. Its solution and the solutions of its salts are converted by boiling into those of the ordinary modification.

Uses.—Tartaric acid, being cheaper than citric acid, forms, when dissolved in water and sweetened, an available substitute for lemonade. It may be improved by adding a drop of fresh volatile oil or a few drops of spirit of lemon. Dried by a gentle heat, and then mixed with sodium bicarbonate, in the proportion of thirty-five grains of the acid to forty of the bicarbonate, it forms a good effervescing powder, the dose of which is a teaspoonful (3.9 Gm.) stirred in a tumbler of water. Tartaric acid resembles citric acid in its medicinal properties, but is more irritant, and taken in large amount and concentrated form has caused fatal gastro-intestinal inflammation. It is chiefly used in medicine in the preparation of effervescing draughts and the official effervescent salts. For the preparation of *solution of magnesium tartrate* see U. S. D., 18th edition, p. 106.

Dose, from five to thirty grains (0.32 to 2.0 Gm.).

Off. Prep.—Acidum Hydriodicum Dilutum, *U. S.;* Caffeina Citrata Effervescens, *U. S.* (*Br.*); Lithii Citras Effervescens, *U. S., Br.;* Magnesii Sulphas Effervescens, *U. S., Br.;* Pilula Quininæ Sulphatis, *Br.;* Potassii Citras Effervescens, *U. S.;* Pulvis Effervescens Compositus, *U. S.* (*Br.*); Sodii Citro-Tartras Effervescens, *Br.;* Sodii Phosphas Effervescens, *U. S., Br.;* Sodii Sulphas Effervescens, *Br.*

ACIDUM TRICHLORACETICUM. U. S.

TRICHLORACETIC ACID

(ăç'ĭ-dŭm trī-ċhlōr-ą-cēt'ĭ-cŭm)

$HC_2Cl_3O_2 = 162.12$

"A monobasic organic acid [$CCl_3.COOH$], usually obtained by the oxidation of hydrated chloral with nitric acid. It should be kept in dark amber-colored, well-stoppered bottles in a cool place." *U. S.*

Acide trichloracétique, *Fr.;* Acidum trichloraceticum, *P. G.;* Trichloressigsaure, *G.*

Three forms of chloracetic acid are known, mono-, di-, and tri-chloracetic acids, having the following formulas respectively, $C_2H_3ClO_2$, $C_2H_2Cl_2O_2$, and $C_2HCl_3O_2$. *Monochloracetic acid* may be prepared by acting upon glacial acetic acid containing 10 per cent. of iodine with dry chlorine, reserving the portion distilling over between 180° C. and 188° C. *Dichloracetic acid* distils over between 189° and 191° C. *Trichloracetic acid,* discovered by Dumas in 1838, may be most conveniently prepared by treating hydrated chloral with three times its volume of fuming nitric acid, and placing the whole mixture in the sunlight until the red fumes have disappeared; the liquid is then distilled, and the portion coming over at 195° C. is pure trichloracetic acid. All the chloracetic acids are powerful caustics, destroying the epidermis. They form various salts, most of which are easily soluble in water. The mono- and tri-acids are solid, crystalline, deliquescent bodies; dichloracetic acid is a colorless liquid having a suffocating odor, and crystallizing at 0° C.

While trichloracetic acid is usually formed by the oxidation of hydrated chloral with nitric acid, it may also be obtained by the action of potassium permanganate in concentrated solution upon hydrated chloral, the potassium trichloracetate crystallizing out in white silky crystals. The reduction of trichloracetic acid to acetic acid can be accomplished by the use of nascent hydrogen.

It is officially described as in "white, deliquescent, rhombohedral crystals, having a slight characteristic odor. Very soluble in water, alcohol, and ether. The aqueous solution, on boiling, is decomposed with the formation of chloroform and carbon dioxide. Heated to 52° C. (125.6° F.) it melts, and at 195° C. (383° F.) it boils and vaporizes without leaving a residue. An aqueous solution of Trichloracetic Acid has an acid reaction upon blue litmus paper. On heating with potassium hydroxide T.S., it is decomposed with the formation of chloroform and potassium carbonate. If to its aqueous solution (1 in 10) ferric chloride T.S. be added, a faint reddish color is developed. One Gm. when diluted with 50 Cc. of water should not require less than 6.1 Cc. of normal sodium hydroxide V.S. for neutralization, phenolphthalein T.S. being used as indicator." *U. S.*

Uses.—Trichloracetic acid is an active caustic which has been largely employed for the destruction of *papillomata, vascular nævi, chancroids,* various small growths in the mouth, and similar minor structures. It is also actively antiseptic and is used in diluted solution, 1 in 1000 to 1 in 2000, in *ozæna* and other forms of chronic *inflammation of the nose, pharynx* and *tonsils.* It has also been used for *gleet* in solutions of from 1 to 5 per cent. As its action is purely local it is not employed in internal medicine.

ACONITINA. U. S., Br.

ACONITINE

(ą-cŏn-ĭ-tī'na)

$C_{34}H_{47}NO_{11} = 640.55$

"An alkaloid obtained from Aconite. It should be kept in amber-colored, well-stoppered vials." *U. S.* "An alkaloid obtained from Aconite Root, and having the formula $C_{33}H_{45}NO_{12}$." *Br.*

Aconitia, Aconitinum, Aconitin; Aconitine, *Fr. Cod.;* Aconitin, *G.;* Aconitina, *It., Sp.*

Formerly a process for the manufacture of aconitine was given in the U. S. and Br. Pharmacopœias, but in the 1880 revision the so-called alkaloid was dropped from the U. S. P., while in the late revision of the Br. Ph. the process of manufacture was omitted. Aconitine was again made official in the U. S. Pharmacopœia 8th Revision.

Crystallized aconitine was first made known by the researches of Groves (*P. J.,* 2d ser., viii. 121), but it was elaborately studied by Duquesnel. The methods of obtaining it differ, but, according to Patrouillard (*J. P. C.,* 4e sér., xix. 151), that of Duquesnel gives much the larger yield. It is as follows: 100 parts of the powdered roots having been mixed with one part of tartaric acid, and the whole exhausted by repeated percolation with cold alcohol, the liquid is evaporated at a low temperature on a water bath to the consistence of a fluidextract. To this, distilled water is added, and the precipitated resinous and oily matters removed by filtration. The solution of aconitine tartrate is then precipitated with a slight excess of potassium bicarbonate, agitated with washed ether, and the two fluids separated with a siphon. The ethereal solution is shaken four or five times with a 10 per cent. solution of hydrochloric acid, which takes up the alkaloids from the ethereal solution. The acid liquids are treated with calcium carbonate to saturation in order to prevent the prolonged and injurious action of the acid upon the crystallizable aconitine, the mixture is evaporated at a very gentle heat, filtered, and while still warm mixed with a solution of sodium nitrate (2 of salt to 3 of water) having the same temperature. The whole is allowed to cool slowly during several

hours, and set away for several days' rest, when the crystals separate out as a crust on the bottom.

Pure aconitine may exist in an amorphous or in a crystalline form. The official product is always crystalline, but of amorphous aconitine there are two varieties, the hydrated and the anhydrous. When the alkaloid is dried at ordinary temperature, it retains 20 (Hager) or 25 (Hottot) per cent. of water; but when dried at the temperature of the water bath, it is anhydrous, and is then *not* soluble in 50 parts of boiling water. (Hager, *A. J. P.*, xlvii. 210.) For Hottot's process of preparing aconitine, see 15th ed. U. S. D.

The amorphous aconitine of commerce is of very uncertain composition and value, and should never be substituted for official aconitine.

Properties.—The U. S. P. (8th Rev.) describes aconitine as occurring in "colorless or white rhombic tables or prisms, possessing no odor, permanent in the air, and producing, in extremely diluted solutions, a characteristic tingling sensation when brought in contact with the mucous surfaces of the tongue or lips. *The alkaloid itself should never be tasted, and its solutions only when largely diluted, and then with the utmost caution.* Soluble in 3200 parts of water, 22 parts of alcohol, 44 parts of ether, 5.6 parts of benzene, and 3580 parts of petroleum benzin, at 25° C. (77° F.); also very soluble in chloroform. When heated rapidly, Aconitine melts at 195° C. (383° F.); when heated slowly, decomposition takes place, and it melts at 182° C. (359.6° F.). Upon ignition, it is consumed without leaving a residue. Aconitine solutions have an alkaline reaction upon litmus, and are lævogyrate. Aconitine, when dropped upon sulphuric or nitric acids, should produce no color, but if rubbed with sulphuric acid containing a crystal of ammonium vanadate, an orange color is produced. Dilute solutions of Aconitine yield precipitates with mercuric potassium iodide T.S., tannic acid T.S., and gold chloride T.S., but only concentrated solutions yield precipitates with platinic chloride T.S., mercuric chloride T.S., and picric acid T.S. On evaporating 0.01 Gm. of Aconitine with 5 drops of fuming nitric acid, the resulting yellow residue, when cooled, should not yield a violet color when treated with alcoholic potassium hydroxide T.S. (difference from *pseudaconitine* and *atropine*). Any soluble salt of Aconitine in dilutions of 1 in 1000 produces, with a drop of potassium permanganate T.S., a blood-red precipitate of aconitine permanganate. Aconitine containing decomposition products (amorphous Aconitine) forms this precipitate only in solutions containing not less than 1 in 200. (Cocaine, hydrastine, and papaverine also yield similar precipitates, but only when in more concentrated solutions)." *U. S.*

Aconitine as defined by the Br. Pharmacopœia is in "colorless hexagonal prisms of the rhombic system. Melting point 372.2° to 374° F. (189° to 190° C.). Slightly above this temperature it yields acetic acid. Readily soluble in *alcohol* (90 per cent.) or *chloroform*, less readily in *ether*. Nearly insoluble in *water* and in *petroleum spirit*. An alcoholic solution of the alkaloid turns the plane of a ray of polarized light to the right. A drop of even an extremely dilute solution (not more than one-tenth per cent.) when placed on the tongue produces a persistent tingling sensation. The salts of Aconitine are crystalline. The hydrochloride melts at 300.2° F. (149° C.) and the hydrobromide at 327.2° F. (164° C.). A dilute solution of the alkaloid, even 1 part in 4000 parts of *water*, faintly acidulated with *acetic acid*, deposits a red crystalline precipitate on the addition of a few drops of *solution of potassium permanganate*." *Br.* It restores the blue color of litmus reddened by acids, and neutralizes the acids, forming crystallizable salts. The solution of these salts produces a white precipitate with platinic chloride, a yellowish with auric chloride, and a yellowish brown with free iodine. Aconitine is precipitated from the solution by caustic alkalies, but not by ammonium carbonate or potassium and sodium bicarbonates. A spurious substance has sometimes been sold under the same name, which is nearly or quite inert; and at best the alkaloid is apt to be of uncertain strength as found in commerce.

For E. R. Squibb's physiological tests for aconitine and aconite preparations, see page 91. Its only peculiar color reaction is obtained with difficulty by dissolving in diluted phosphoric acid and evaporating, when at a certain degree of concentration a violet coloration appears.

The investigations of C. R. A. Wright upon *Aconitum Napellus*, which were fully stated in a previous edition (16th ed., p. 125), have been corrected in part by later studies by Wyndham Dunstan (*J. Chem. S.*, May, 1891, April and May, 1892.) He has shown that the roots of true *Aconitum Napellus* contain four alkaloids, of which one is crystallized and three are amorphous: *aconitine*, to which he gives the formula $C_{33}H_{45}NO_{12}$ instead of the formula $C_{33}H_{43}NO_{12}$ proposed by Wright; *aconine*, $C_{26}H_{41}NO_{11}$ instead of the formula $C_{26}H_{39}NO_{11}$ proposed by Wright; *napelline*, or *isoaconitine*, which was shown by Dunstan (*P. J.*, 1893, 625) to have the composition $C_{33}H_{45}NO_{12}$, and is thus isomeric with aconitine. *Aconitine* melts at 188.6° C. (371.5° F.), "189°-190° C. (372.2°-374° F.)" *Br.;* and aconine when purified melts at 132° C. (269.6° F.). Dunstan was able by heating aconine together with ethyl benzoate in a sealed tube to effect the synthesis of the anhydride of aconitine. The *picraconitine* of Wright is considered by Dunstan to have been a mixture. In a later communication (*P. J.*, 1893, p. 1045) Dunstan shows that the roots of *Aconitum Napellus* contain, besides the highly poisonous aconitine, an almost non-poisonous isomeride, *isoaconitine*. Both furnish the same

hydrolytic products,—viz., aconine and benzoic acid. Aconitine hydrobromide (melting point 163° C.), when heated in aqueous solution, is very gradually changed into the isomeric isoaconitine hydrobromide (melting point 282° C.). The change is facilitated by the presence of a small quantity (1 to 2 per cent.) of free hydrobromic acid, but is not assisted if sufficient is present to induce hydrolysis of a large proportion of the aconitine. The hydrolysis of napelline, or aconitine, into aconine and benzoic acid is represented by the following equation:

$$C_{33}H_{45}NO_{12} + H_2O = C_{26}H_{41}NO_{11} + C_7H_6O_2$$

Aconitum ferox was examined by Wright. In it he found chiefly the alkaloid *pseudaconitine,* $C_{36}H_{49}NO_{12}$.[1] It crystallizes in transparent needles and sandy crystals, but is apt to separate as a varnish if not evaporated extremely slowly. It forms crystallized salts with difficulty. It can be dehydrated, forming *apo-pseudaconitine,* $C_{36}H_{47}NO_{11}$, and when saponified yields dimethyl-protocatechuic acid instead of benzoic, and a new base, *pseudaconine,*

$$C_{36}H_{49}NO_{12} + H_2O = C_9H_{10}O_4 + C_{27}H_{41}NO_9$$

Pseudaconitine crystallizes with H_2O and melts at 104° to 105° C. (219.2° to 221° F.). Dunstan and Carr (*J. Chem. S.,* 1897, 350) give a process for making the very poisonous alkaloid pseudaconitine, which they obtained in crystals; it dissolves in hot water, very slightly in cold water, readily in alcohol, chloroform, and acetone, less readily in ether. The products of hydrolysis, which occurs in two stages, result in the separation of *veratryl pseudaconine,* $C_{34}H_{47}NO_{11}$, and *pseudaconine,* $C_{25}H_{39}O_8$; *veratric acid* is eliminated. *Pyropseudaconitine,* $C_{34}H_{45}NO_{10}$, an anhydride of veratryl pseudaconine, did not appear to be poisonous. In Japanese aconite roots (species not certainly known) Wright found a larger percentage of active alkaloids than in either of the other varieties. He also considers that he has obtained here a new base, *japaconitine,* $C_{66}H_{88}N_2O_{21}$. This base on saponification splits up into benzoic acid and a base, *japaconine,* $C_{26}H_{41}NO_{10}$.[2]

Aconitine exists in the root in combination with *aconitic acid,* $C_6H_6O_6$. Dragendorff and Spohn (*J. P. C.* (5), 10, 361–368) find in *Aconitum Lycoctonum* two alkaloids; *lycaconitine,* $C_{27}H_{34}N_2O_6 + 2H_2O$, which is not crystalline, nor does it yield a crystalline aurochloride or platinochloride, and *myoctonine,* $C_{27}H_{30}N_2O_8 + 5H_2O$, which is amorphous. The former alkaloid, heated with water under pressure, gives rise to two acids, a volatile one and a crystalline one, *lycoctonic acid,* $C_{17}H_{18}N_2O_7$, while two alkaloids remain dissolved, one, *lycaconine,* soluble in ether, the other soluble in chloroform, and apparently Hübschmann's acolytine.

Hübschmann is said to have extracted two alkaloids from *A. Lycoctonum;* one in the form of a white powder, insoluble in ether, but soluble in water and alcohol, which he names *acolytine;* the other crystallizable, very soluble in alcohol, and but slightly so in ether or water, and named by him *lycoctonine.* (*A. J. P.,* 1866, p. 376.) According to Flückiger, *lycoctonine* is in white acicular crystals, melting like aconitine in boiling water, though at a somewhat higher heat. On cooling it crystallizes only when moistened with water, when the amorphous mass is converted into tufted crystals. It loses no water upon melting, and combines with none on crystallizing. It readily dissolves in chloroform, and upon evaporation is left as an amorphous varnish, which on the addition of a little water becomes strikingly crystalline. It is largely dissolved by carbon disulphide, ether, alcohol, the fixed and volatile oils, amyl alcohol, and petroleum benzin; but requires 600 parts of boiling water for solution. The solution is bitter and has an alkaline reaction, and with bromine water produces fine yellow crystals; and this effect results though the solution contain only one part of the alkaloid in 30,000. Lycoctonine is an alkaloid quite distinct from aconitine and pseudaconitine, and is much less poisonous than either. (Flückiger, *P. J.,* 1870, p. 122.) Wright and Luff concluded that lycoctonine and acolytine are identical with *aconine* and *pseudaconine,* decomposition products respectively of aconitine and pseudaconitine, but according to Dragendorff and Spohn they are really decomposition products of two previously unnoticed alkaloids of *A. Lycoctonum,* namely, *lycaconitine* and *myoctonine.* (See p. 87; also *P. J.,* viii. 169, and xv. 104.) Jacobowsky found lycaconitine to resemble curare in its physiological action, but to be of no value in practical medicine.

[1] *Pscudaconitine* has been physiologically studied by Boehm and Ewens (*A. E. P. P.,* 1873, 1) and by Cash and Dunstan (*P. Tr. R. S. L.,* Series B., 1902), who are in accord in finding that its physiological action is that of aconitine save only in regard to strength. 0.4 gr. of it is said to be equivalent in toxic power to 0.45 of true aconitine. *Japaconitine,* the alkaloid of Japanese aconite, *Kuza-uza, A. japonicum* or *A. Fischeri,* according to Cash and Dunstan, acts physiologically as true aconitine, except that 0.85 gr. is equivalent to 0.9 in toxicity. For local application these three alkaloids may be substituted for aconitine.

[2] *Aconitine Derivatives.*—Certain alkaloids have been prepared by Cash and Dunstan by the withdrawal of the acetyl group from aconitine (*Philosophical Trans.,* 1898, vol. 190; and 1902, vol. 195.); of these *benzaconine,* in which an acetyl group of aconitine is replaced by an atom of hydrogen, has been found to differ physiologically entirely from aconitine: being, in fact, so far as its action on the heart is concerned, antagonistic to the parent alkaloid. *Pyraconitine* differs from aconitine by the loss of one molecule of acetic acid. It differs physiologically from aconitine chiefly in being devoid of local action; it slows the heart by stimulating the vagus, at the same time depressing the heart muscles or its ganglia, and is a powerful respiratory and centric motor depressant. *Methylbenzaconine* differs from aconitine in that an acetyl group has been replaced by a methyl group. It is much less active locally and less poisonous than aconitine; it is a somewhat feeble cardiac depressant, but this is especially characterized physiologically by a curare-like action upon the motor nerves. It seems, also, to have influence upon the muscles, producing in the frog marked persistent fibrillary contractions even at a time when the reflexes are abolished.

Even different specimens of apparently pure crystallized aconitine made by the same chemist in the same manner vary greatly in toxic property. (See K. F. Mandelin, *A. Pharm.*, 1885, xxiii.; abstracted, *P. J.* xvi.; Bunzen and Madsen, *Trans. Internat. Congress,* Copenhagen, 1884.) Lepine states that the crystallized alkaloid made from plants gathered in Switzerland is much more active than that from plants of the Vosges or of the Pyrenees. (*S. M.,* March 30, 1892.)

Uses.—The various products obtained from aconite sold in the market as aconitine vary so enormously in their purity, nature, and toxic properties, that the alkaloid should scarcely be used internally. According to Cash and Dunstan (*B. M. J.,* 1901, ii.) there are four commercial brands of aconitine. *Amorphous aconitine,* a mixture of various alkaloids, but principally consisting of aconitine and picroaconitine, and being from fifteen to twenty times less poisonous than pure crystallized aconitine; *crystallized aconitine,* the official alkaloid; *pseudaconitine,* obtained from *Aconitum ferox,* which is nearly twice as toxic as crystallized aconitine; *japaconitine,* from *Aconitum japonicum,* which is twenty per cent. more powerful than crystallized aconitine. Two and a half grains of commercial aconitine have been taken almost with impunity, and 1-50th of a grain has nearly proved fatal; indeed, a fatal case of poisoning by half a milligramme (1-128th gr.) of pure aconitine is reported (*J. P. A.,* Feb. 1890). One-tenth of a milligramme (1-640th gr.) should be considered the maximum dose of the alkaloid. Tison (*Atti Dell' xi. Cong. Med. Intern.,* iii., 1894) considers this the ordinary dose of the crystallized aconitine nitrate, and repeats it at such intervals that one milligramme is taken in twenty-four hours.

Even as an external remedy, aconitine is of very limited value. It produces in the skin a sensation of heat and prickling, followed by numbness, lasting, according to the quantity applied, from two to twelve hours or more. Applied much diluted and in a minute quantity to the eye, or even to the upper eyelid, it causes contraction of the pupil, with an almost intolerable sense of heat and tingling. Turnbull employed it with benefit in *neuralgia, gout,* and *rheumatism.* If the alkaloid be pure, the ointment should not exceed ten grains to the ounce, and even then must be used with great caution by friction over the part affected, to be continued till the peculiar sensation above described is produced, and to be repeated three or four times, or more frequently, during the day. No good can be expected unless the sensation alluded to be experienced in a greater or less degree. Care should be taken not to apply the medicine to an abraded surface, or to a mucous membrane, for fear of poisoning.

Dose, one eight-hundredth to one four-hundredth of a grain (0.00008 to 0.00015 Gm.).

Off. Prep.—Unguentum Aconitinæ, *Br.*

ACONITUM. U. S. (Br.)

ACONITE

(ăc-o-nī′tŭm)

"The dried tuberous root of *Aconitum Napellus* Linné (Fam. *Ranunculaceæ*), collected in autumn; yielding, when assayed by the process given below, not less than 0.5 percent. of aconitine." *U. S.* "The root of Aconitum Napellus, *Linn.,* collected in the autumn from plants cultivated in Britain, and dried." *Br.*

Aconiti Radix, *Br.;* Aconite Root, Monkshood, Wolfsbane, Wolfroot, Friar's cap, Cuckoo's cap, Blue rocket; Racine d'Aconite, Aconit, Coqueluchon, Aconit Napel, *Fr.;* Tubera Aconiti, *P. G.;* Eisenhut, Eisenhutknollen, Sturmhut, Mönchskappe, Akonitknollen, *G.;* Aconito, *It., Sp.*

The U. S. Pharmacopœia formerly recognized aconite leaves under the name of *Aconiti Folia.*

The plants belonging to this genus are herbaceous, with divided leaves, and violet, yellow, or white flowers, in spikes, racemes, or panicles. In the Paris Codex three species were recognized as official, *A. Anthora, A. cammarum,* and *A. Napellus;* but the French authorities unite at present with our own and the British in acknowledging only *A. Napellus.* There has been much difference of opinion as to the plant originally employed by Störck. Formerly thought to be *A. Napellus,* it was afterwards generally believed to be *A. neomontanum* of Willdenow, and by De Candolle was determined to be a variety of his *A. paniculatum,* designated as *Störckianum.* It is probable that this species, which is not infrequent in the Alps, yields much of the aconite of commerce, as probably does also *A. Lycoctonum.* But, according to Geiger, *A. neomontanum* is possessed of little acrimony; and Christison states that *A. paniculatum,* raised at Edinburgh from seeds sent by De Candolle himself, was quite destitute of that property. Neither of these, therefore, could have been Störck's plant, which is represented as extraordinarily acrid. *A. septentrionale,*[1] Koelle, which is

[1] Rosendahl found in *A. septentrionale* three alkaloids, to which he gave the names of lappaconitine, septentrionaline, and cynoctonine.

Lappaconitine, $C_{34}H_{48}N_2O_8$, occurs in crystals belonging to the hexagonal system, bitter in taste, melting point, 205° C.; soluble in 126 parts of alcohol, 330 of ether, 1472 of water. Its alcoholic or ethereal solution shows a reddish-violet fluorescence. It is colored yellowish red by sulphovanadic acid, afterwards becoming green. It is a convulsant, which finally paralyzes the respiratory muscles; at the same time it lowers blood pressure by a direct action upon the heart, and also by an influence on the vasomotors. During the convulsion the pupils are contracted; during the paralysis they are dilated. Upon muscles, blood, lower organisms, and general protoplasm the alkaloid has no influence. It is rapidly eliminated by the urine.

Septentrionaline, $C_{31}H_{48}N_2O_9$, occurs in a white or yellowish powder of a bitter taste, with a pronounced local anæsthetic influence; melting point, 128.9° C. It is very soluble in alcohol and ether, and in 58 parts of water; its solutions are without fluorescence. It is colored cherry-red by fresh furfurol sulphuric acid. When given by the mouth, septentrionaline, according to Rosendahl, produces no poisonous effects; its subcutaneous or intravenous injection is followed

generally considered by botanists to be a variety of *A. Lycoctonum,* although it differs somewhat in the shape of its leaves and is a native of Finland, Sweden, and other northern portions of Europe, has been elaborately studied by H. V. Rosendahl (*Arbeiten des Pharmakol. Institutes zu Dorpat,* 1895), who believes it to be a distinct species. There are five American species of the genus, each of which is probably active, although none of them are commercial sources of the drug. Under the name of *Bish,* or *Bikh,* or *Nepaul aconite,* an active aconite is largely sold in the bazaars of India. It has been usually attributed to *A. ferox,* Wall., a Himalayan plant with large dull blue flowers, which reaches the height of three to six feet; but according to the latest researches the roots are much longer and of smaller diameter than are those of the *A. ferox,* Wall., so that the botanical source of Nepaul aconite remains at present uncertain. In an elaborate study of the aconites of India (*P. J.,* 1903, 68) George Watt says that the botany of the poisonous Indian aconites is at present very uncertain. Of the number of varieties of *A. ferox* which have been made by authors, one or more are thought by Watt to be distinct species, and the examination of the plants in the Kew Herbarium by Stapf led him to the opinion that *A. Napellus* does not exist in India at all, *A. multifida* and *A. rotundifolia,* which have been believed to be varieties of *A. Napellus,* being really distinct non-poisonous species. A monograph on the Indian aconites has been promised by Stapf but so far as we know has not yet appeared. The non-poisonous aconites of India are affirmed to include *A. heterophyllum,* Wall., and *A. palmatum,* Don, and the species, *A. multifida,* and *A. rotundifolia,* hitherto referred to *A. Napellus.* They are said to be eaten by shepherds on the Alpine ranges, and do not appear to be collected for commercial purposes. For a structural study of the Indian aconite roots see *P. J.,* lxvii. p. 576. Under the name of *Utees, Atees,* or *Atis,* the root of *A. heterophyllum,* Wall., of India, is said to be largely employed in doses of 20 grains as an antiperiodic. It yielded to Wasowicz six one-hundredths of 1 per cent. of *atisine,* an amorphous, very slightly poisonous alkaloid (the same alkaloid was pointed out by Broughton), besides aconitic acid. See *P. J.,* xvi. *Wakhma* is the root of *A. palmatum,* Don, in which Jowett found aconitic acid and the alkaloid atisine, $C_{22}H_{33}NO_3$, which according to Cash is physiologically very feeble. (*J. Chem.* S., 1896.)

Aconitum Napellus, Linn., *Flor. Suec.,* ed. 1755, p. 168. *A. neubergense,* De Candolle, *Prodom.,* i. 62. *A. variabile neubergense,* Hayne, *Darstel. und Beschreib.,* xii. 14.—This is a perennial herbaceous plant, with a conical-shaped, tapering root, seldom exceeding the thickness of the finger at top, three or four inches or more in length, brownish externally, whitish and fleshy within, and sending forth numerous long, thick, fleshy fibres. When the plant is in full growth, there are usually two roots joined together, of which the older is dark brown and supports the stem, while the younger is of a light yellowish brown, and is destined to furnish the stem of the following year, the old root decaying. The stem is erect, round, smooth, leafy, usually simple, and from two to six or even eight feet high. The leaves are alternate, petiolate, divided almost to the base, from two to four inches in diameter, deep green upon their upper surface, light green beneath, somewhat rigid, and more or less smooth and shining on both sides. Those on the lower part of the stem have long footstalks and five or seven divisions; the upper, short footstalks and three or five divisions. The divisions are wedge-form, with two or three lobes, which extend nearly or quite to the middle. The lobes are cleft or toothed, and the laciniæ or teeth are linear or linear-lanceolate and pointed. The flowers are of a dark violet-blue color, large and beautiful, and are borne at the summit of the stem upon a thick, simple, straight, erect, spike-like raceme, beneath which, in the cultivated plant, several smaller racemes arise from the axils of the upper leaves. Though without calyx, they have two small calycinal stipules, situated on the peduncle within a few lines of the flower. The petals are five, the upper helmet-shaped and beaked, nearly hemispherical, open or closed, the two lateral roundish and internally hairy, the two lower oblong-oval. They enclose two pediceled nectaries, of which the spur is capitate, and the lip bifid and revolute. The fruit consists of three, four, or five follicles.

The plant is abundant in the mountain forests of France, Switzerland, and Germany. It is also cultivated in the gardens of Europe, and has been introduced into this country as an ornamental flower. All parts of the plant

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by increased salivation, nausea, and wide-spread anæsthesia, due to an action upon the peripheral sensory nerves. If the dose has been sufficient, after the paralysis of sensibility a motor peripheral paralysis comes on, which finally invades the muscles of respiration so that the function ceases, although the heart is still working, and if artificial respiration be employed recovery occurs. The heart is said to be almost completely unaffected, excepting that the force of its contractions is augmented. Intestinal peristalsis is arrested; the pupils are not affected. Elimination is very rapid. Rosendahl asserts that the alkaloid is of great value as a substitute for curare in the physiological laboratory.

Dose, for curarization, per kilogramme of bodily weight; frogs, 0.000174 to 0.0005; dogs, 0.0070; cats, 0.0100; rabbits, 0.003000 to 0.0050; fowls, 0.0090 grammes.

Cynoctonine, $C_{36}H_{55}N_2O_{13}$, is an amorphous hygroscopic grayish powder, having a feebly bitter taste, melting at 137° C.; easily soluble in alcohol and water, soluble in 1373 parts of ether without fluorescence. If evaporated to dryness with fuming nitric acid, the residue becomes blood-red on the addition of an alcoholic solution of potassium hydroxide, afterwards changing to reddish brown. It is a very violent convulsant, producing also vomiting, temporary loss of superficial sensibility, followed by heightened reflexes, violent convulsions, and respiratory death. Upon the heart and blood pressure it has very little influence. The pupils are in the advanced poisoning dilated. Cynoctonine, however, does not act as a poison on the lower organisms.

are acrid and poisonous. The leaves and root are used. The leaves should be collected when the flowers begin to appear, or shortly before. After the fruit has formed, they are less efficacious. The root is much more active than the leaves, and an extract from the latter is said to have only one-twentieth of the strength of one made from the former. It should be gathered in autumn or winter after the leaves have fallen, and is not perfect until the second year. It has been mistakenly substituted for horseradish root, as a condiment, with fatal effect. The wild plant is said to be more active than the cultivated. (Schroff.) Procter found the roots of the plant cultivated in this country richer in active alkaloidal principles than the imported roots, having obtained as much as 0.85 per cent. from the former. (*Proc. A. Ph. A.*, 1860.) The studies of P. W. Squire seem to show that in the autumn the root is the most active. So far, however, as concerns the whole plant, the practical difficulty is that the root of *A. paniculatum*, Lam., cannot be distinguished from that of *A. Napellus*, except by taste; so that the custom which seems to prevail of gathering the root about the flowering period is probably well founded. The plant is being cultivated to some extent for medicinal purposes in England, but much of the stock is of doubtful nature, owing to the extraordinary tendency of *A. Napellus* to hybridize with other species and to alter under cultivation. (See *P. J.*, 1889, 645.) For Keller's tests for aconite root and leaves, see *Proc. A. Ph. A.*, 1895, 539.

Aconite root is generally brought into market in packages or bales, either from the continent of Europe or from India. It is of variable quality, some parcels being unobjectionable, while others contain a considerable proportion of inert or defective roots. Among these roots that of *Imperatoria ostruthium* has been especially observed. (*P. J.*, vii. 749.) The best test is the taste; roots should be rejected which have not in a fair degree the characteristic properties in this respect described below, especially the production of the sensation of numbness and tingling on the tongue, lips, and fauces.

Nepaul aconite is composed of elongated, conical, tuberous, or nearly cylindrical roots, 3 to 4 inches long, ½ to 1¾ inches in diameter at the base; unbranched; often abruptly broken off below; more or less flattened; shrivelled chiefly in a longitudinal direction, and sparsely marked with the scars of rootlets. *Japanese aconite* has also been largely sold in London. It consists of plump, oblong, or ovoid, dark grayish or blackish tubers, from half an inch to an inch in length, and ⅛ to ⅜ of an inch in diameter. Seven varieties of aconite tubers are reported by Langaard to be found in the Japanese drug stores, usually preserved in vinegar or child's urine, or by drying. The botanical source of these aconite roots is not accurately determined, but they are probably, at least in part, yielded by *A. japonicum*, Thunb., and *A. Fischeri*, Reich., believed by many botanists to be respectively identical with *A. Lycoctonum*, Linn., and *A. chinense*, Sieb. Several alkaloids have been separated; of these, *japaconitine* is said to be the most poisonous of the known aconite alkaloids. (See *P. J.*, 1880, 149, 1021.) O. Lezius (*In. Dis.*, Dorpat, 1890) asserts that the active principle of Japanese aconite is true crystallizable aconitine, and in an elaborate study Alfred E. Bradley found the physiological activity of *A. Fischeri* very similar to that of *A. Napellus*. (*Weekly Med. Rev.*, April, 1888.)

Properties.—The *fresh leaves* have a faint narcotic odor, most sensible when they are rubbed. Their taste is at first bitterish and herbaceous, afterwards burning and acrid, with a feeling of numbness and tingling on the inside of the lips, tongue, and fauces, which is very durable, lasting sometimes many hours. When long chewed, they inflame the tongue. The *dried leaves* have a similar taste, but the acrid impression commences later. Their sensible properties and medicinal activity are impaired by long keeping. They should be of a green color, and free from mustiness. The *root* has a feeble earthy odor. Though sweetish at first, it has afterwards the same effect as the leaves upon the mouth and fauces. It shrinks much in drying, and becomes darker, but does not lose its acrimony. Those parcels, whether of leaves or roots, should always be rejected which are destitute of this property. Aconite root is officially described as being "slenderly conical, 4 to 10 Cm. long, 10 to 20 Mm. thick at the crown; occasionally split; longitudinally wrinkled; dark brown and marked with coarse whitish root-scars; fracture short, horny or mealy; internally whitish or light brown; the cambium zone irregular and 5- to 7-angled; odor very slight; taste sweetish, soon becoming acrid and developing a tingling sensation, followed by numbness." *U. S.* "The transverse section exhibits a thick parenchymatous cortex and a large stellate pith with about seven projecting angles; the groups of vessels are small and few in number." *Br.* The seeds also are acrid. The British Pharmacopœia formerly recognized the flowering tops of the Aconite (*Aconiti Folia*). To be effective they should be collected just as the flowers are beginning to expand, at which time they are richest in alkaloid. The dried leaves are stated to contain about 0.3 per cent. and the flower-buds about 0.4 per cent. of aconitine. For an account of the chemistry of aconite, see *Aconitina*, page 86. In the absence of any reliable chemical tests for aconitine E. R. Squibb suggested that a fluidrachm of a highly diluted solution of the various preparations be taken into the anterior part of the mouth (after the latter has been thoroughly rinsed) and held there for one minute by the watch, and then discharged. The peculiar numbing sensation should be experienced within

fifteen minutes, and it should continue for fifteen or thirty minutes. Tested in this way, he found the commercial aconitines, in solution of the strength of $\frac{1}{800}$ grain in 1 fluidrachm of water, to have the following relative strengths: 1 grain of good powdered aconite root is equal to 1 grain of ordinary commercial aconitine, $\frac{1}{8}$ grain of Merck's ordinary aconitine, $\frac{1}{38}$ grain of Merck's pseudaconitine, $\frac{1}{111}$ grain of Duquesnel's crystallized aconitine (really aconitine nitrate). He also found by this approximate method that 1 grain of powdered aconite root was equivalent to 1 minim of fluidextract, $\frac{1}{6}$ grain of alcoholic extract of aconite root, 2.66 minims of U. S. (1890) or 9.31 minims of U. S. (8th Rev.) tincture of aconite root, 8.43 minims of British tincture of the root, 11.8 minims of German tincture of the root, 1.5 minims of Fleming's tincture, 9 grains of powdered aconite leaf, 1.5 grains of alcoholic extract of dried aconite leaf, 1 grain of Allen's English extract of fresh plant, and 72 minims of tincture of aconite leaf. For methods of assaying aconite, see A. R. L. Dohme's paper (*Proc. A. Ph. A.*, 1895, 206); also *P. J.*, 1895, 860; *D. C.*, 1900, 69, 132.

The quality of aconite root is officially determined by the following assay, which was introduced into the U. S. P. (8th Rev.)

Assay of Aconite.—"Aconite, in No. 40 powder, *ten grammes* (10 Gm.), Alcohol, Distilled Water, Ether, Ammonia Water, Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., each, *a sufficient quantity*. Introduce the Aconite into a 200 Cc. Erlenmeyer flask, add 75 Cc. of a mixture of alcohol, 7 parts, and distilled water, 3 parts (by volume), stopper the flask securely, and agitate it at intervals during four hours. After placing a pledget of cotton in the bottom of a small cylindrical glass percolator (25 Mm. in diameter), carefully transfer the contents of the flask to the percolator. When the liquid has all passed through, continue the percolation with more of the same mixture until 150 Cc. of percolate have been obtained. Pour the percolate into a shallow porcelain evaporating dish, and evaporate it to dryness at a temperature not exceeding 60° C. (140° F.). Add 5 Cc. of tenth-normal sulphuric acid V.S., and 10 Cc. of distilled water. When the extract is dissolved, filter the liquid into a separator, washing the dish and filter with about 40 Cc. of distilled water, and add the washings to the separator. Add 25 Cc. of ether and 2 Cc. of ammonia water to the separator, and agitate it for one minute. Draw off the lower layer into a flask, and filter the ether-solution into a beaker. Return the contents of the flask to the separator, add 15 Cc. of ether, and again agitate it for one minute. Draw off the lower layer into the flask, and filter the ether-solution into the beaker. Repeat the shaking out with two other portions of 10 Cc. each of ether. Evaporate the combined ether-solutions to dryness, and dissolve the residue in 3 Cc. of tenth-normal sulphuric acid V.S. Add to the solution 5 drops of hematoxylin T.S., and then carefully run in fiftieth-normal potassium hydroxide V.S. until a violet color is produced, the transition stages being as follows: first yellow, then green, finally passing into violet. Divide the number of Cc. of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 3 (the 3 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.064, and this product by 10, which will give the percentage of aconitine in the Aconite." *U. S.*

Uses.—Aconite was well known to the ancients as a powerful poison, but was first employed as a medicine by Baron Störck of Vienna, whose experiments with it were published in the year 1762. In moderate doses, it produces warmth in the stomach and sometimes nausea, general warmth of the body, numbness and tingling in the lips and fingers, muscular weakness, diminished force and frequency of the pulse, and diminished frequency of respiration. From larger doses all these effects are experienced in an increased degree. The numbness and tingling extend over the body; vertigo and dimness of vision occur; the pulse, respiration, and muscular strength are greatly reduced; and a state of general prostration ensues. The effects of remedial doses are felt in twenty or thirty minutes, are at their height in an hour or two, and continue with little abatement from three to five hours. In poisonous doses, besides the characteristic tingling in the mouth and elsewhere, aconite occasions burning heat of the œsophagus and stomach, thirst, violent nausea, vomiting and purging, severe gastric and intestinal spasms, headache, dimness of vision, with contracted or expanded pupils, numbness or paralysis of the limbs, diminished sensibility in general, stiffness or spasm of the muscles, great prostration, pallid countenance, cold extremities, an extremely feeble pulse, and death in a few hours, sometimes preceded by delirium, stupor, or convulsions. All these effects are not experienced in every case; but there is no one of them which has not been recorded as having occurred in one or more instances. The proper treatment of aconite poisoning consists in the maintenance of absolute rest in a position horizontal, or with the head lower than the feet; the evacuation of the stomach by the siphon tube or stomach pump, if free vomiting does not occur, the administration of stimulants, and the use of external heat to keep up the bodily temperature. Whisky or brandy should be given freely in a concentrated form by the mouth and rectum; when the symptoms are very urgent, it may be injected under the skin. The chief reliance in any case, however, must be on the tincture of digitalis aided by strychnine, the two remedies being given hypodermically, but separately, in large doses. Ammonia may be employed carefully. We have known life to

be apparently saved by a fluidrachm of laudanum. Fall of the bodily temperature must be met by external heat.

The symptoms produced by aconite are chiefly due to its action upon the circulation and the nervous system. It is a direct and powerful depressant of the heart, if in sufficient amount completely paralyzing the cardiac muscle. The lowering of the force of the circulation is certainly in large part due to this action; it is probable that it has comparatively little effect upon the vasomotor system. Upon the cerebrum the drug exerts very little if any direct influence. Upon the peripheral sensory nerves it acts as a powerful depressant, thereby causing the characteristic tingling and numbness of aconite poisoning. The influence upon the spinal marrow seems to be less pronounced than that upon the sensory nerves; but, if in sufficient amount, the poison depresses the motor centres of the cord. To this, and not to any effect upon the motor trunks or the muscles, is due the loss of reflex activity and of voluntary power caused by toxic doses.

As an internal remedy, aconite is valuable in *sthenic fever* from any cause; when the condition is *asthenic* it should never be administered. It is also useful in some cases for the purpose of benumbing sensitive nerves: thus, it will sometimes arrest the *vomiting of pregnancy*, and has often been used with excellent results in *rheumatic neuralgia*. To obtain such effects it must be given boldly. Applied locally to a sensitive or painful part, it is very efficient, owing to its being brought in a concentrated state into contact with the irritated nerves. It is a favorite application in *neuralgias*, and will probably achieve good more often than any other narcotic local remedy. Applied to the skin, aconite occasions heat and prickling or tingling, followed by numbness, and, if in contact with a wound, produces its peculiar constitutional effect. Applied to the eye, it causes decided contraction of the pupil. The dose of the extract of the leaves is from half a grain to a grain (0.03 to 0.065 Gm.). The preparation now almost exclusively employed is the tincture of the root, *Tinctura Aconiti*, U. S., the strength of which was decreased from 35 per cent. to 10 per cent. in the U. S. P. (8th Revision). Of this from three to ten minims (0.2 to 0.6 Cc.) may be given every two to four hours until its effects become obvious. It is important to distinguish between the tincture of the leaves formerly official and the much stronger tincture of the root just referred to. Few patients will bear at first more than four minims of the latter. Very properly, we think, the tincture of the leaves was abandoned at the revision of the U. S. P. 1860. Aconite may be used externally in the form of the fluidextract of the root, of an extract mixed with lard, of a plaster or liniment, or of aconitine ointment or oleate. The fluidextract may be applied by means of a little absorbent cotton tied on the end of a stick.

Dose, of aconite root, one half to one grain (0.032 to 0.065 Gm.).

Off. Prep.—Fluidextractum Aconiti, *U. S.;* Linimentum Aconiti, *Br.;* Tinctura Aconiti, *U. S., Br.*

ADEPS. U. S., Br.

LARD

(ăd'ĕps)

"The prepared internal fat of the abdomen of the hog (*Sus scrofa*, var. *domesticus* Gray), purified by washing, melting, and straining. It should be kept in well-closed vessels impervious to fat, in a cool place." *U. S.* "The purified fat of the hog, Sus Scrofa, *Linn.*" *Br.*

Axungia Porci, s. Porcina, Axungia; Prepared Lard, Hog's Lard; Axonge, *Fr. Cod.;* Graisse, Graisse de Porc, Saindoux, *Fr.;* Adeps Suillus, *P. G.;* Schweineschmalz, *G.;* Grasso suino, Sugna, Grasso di Porco, Lardo, *It.;* Grasa de cerdo, Manteca de puerco, Lardo, *Sp.*

Preparation.—Lard is the prepared fat of the hog. The Br. Pharmacopœia gives a process for its preparation; but in this country it is generally purchased by the druggists already prepared. The adipose matter of the omentum and mesentery, and that around the kidneys, are usually employed, though the subcutaneous fat is said to afford lard of a firmer consistence. In the crude state it contains membranes and vessels, and is more or less contaminated with blood, from all which it must be freed before it is fit for use. For purification, the fat, having been deprived of membranous matter as far as possible by the hand, is cut into pieces, washed with water till the liquor ceases to be colored, and then, after carefully separating the water, it is melted in a copper or iron vessel, over a slow fire, or on the large scale by steam heat. The heat is continued until all the moisture is evaporated, which may be known by the transparency of the melted fat, and the absence of crepitation when a small portion of it is thrown into the fire. Care should be taken that the heat be not too great, as otherwise the lard might be partially decomposed, acquire a yellow color, and become acrid. This may be guarded against by using a water bath in melting the lard. The process is completed by straining the liquid through linen, and pouring it into suitable vessels, in which it concretes upon cooling. To render it, however, perfectly free from particles of membrane and tissue, which are often the cause of rancidity and unfit lard for its finer and more permanent uses, Ed. Smith of Torquay, insists on the necessity of filtering the lard through paper, after freeing it from its coarser impurities by straining through linen. By this author it is recommended that the process of purification should be completed by remelting the lard, by means of a water bath, and then carefully filtering it through paper in a warm closet. Lard may be rendered quite inodorous by melting it, when fresh, by means

of a salt water bath, adding a little alum or common salt, continuing the heat till a scum rises, which is to be skimmed off, and, after the lard has concreted, separating the saline matter by washing it thoroughly with water. For a particular account of the process, see *A. J. P.*, xxviii. 176.

The following is the process of the British Pharmacopœia for preparing lard. "From the perfectly fresh fat of the abdomen of the hog remove as much of the external membranes as possible; suspend the fat so that it shall be freely exposed to the air for some hours; cut it into small pieces; reduce these to a uniform mass in which the membranous vesicles are completely broken, by beating in a mortar or by some similar process; put the mass thus produced into a vessel surrounded by warm water; heat to a temperature not exceeding 135° F. (57.2° C.) until the fat has melted and separated from the membranous matter; strain." *Br.* The process of the British Pharm. differs from that formerly used, and is modelled upon the suggestions of Redwood, that the use of water be especially avoided, and that the selected fat be exposed freely to air and light before rendering. (*P. J.*, 1883, p. 364; also *Ephem.*, 1884, p. 504.)

Lard, as offered for sale, often contains common salt, which renders it unfit for pharmaceutical purposes. This may be detected, when the quantity is insufficient to be sensible to the taste, by means of silver nitrate, which will produce a precipitate of silver chloride with water in which the salted lard has been boiled, after cooling and filtration. To free it from this impurity, it may be melted with twice its weight of boiling water, the mixture well agitated and set aside to cool, and the fat then separated. Lard is sometimes adulterated with water, starch, and a small portion of alum and quicklime, which render it whiter, but unfit for medicinal use. But by far the most common adulteration of lard in recent years is through the use of cotton seed oil. Indeed, some specimens of lard consist almost wholly of mixtures of stearin and cotton seed oil. Lard of this kind can easily be detected by the disagreeable and characteristic odor of cotton seed oil which is evolved when it is heated. For Taylor's method of differentiation, see *Nat. Drug.*, 1892, p. 103. Crookes (*Analyst*, 1893, p. 221) gives the following very delicate modification of Milliau's test. Pure white filtering paper is first moistened with 12 per cent. solution of silver nitrate and held over a small sample of the lard, which is gradually heated in an oil bath to 115.5° C. (240° F.), when, if even less than 1 per cent. of cotton seed oil is present, the paper will turn light brown to nearly black. Pure fresh lard does not affect the paper. Although it is possible at this time (1905) to obtain lard of excellent quality in the American market, if due care is observed (Gordon, *Proc. Pa. Pharm. Assoc.*, 1901, 126), there are many grades of lard to be found in commerce, designated by the dealers as follows: 1. Neutral (or Kettle) lard. 2. Leaf lard; made by melting the whole flare with steam, followed by pressure. 3. Choice kettle-rendered lard, chiefly from fat from the back of the hog. 4. Prime steam lard, from all the fatty parts of the hog. 5. Butcher's lard, melted on an open fire. 6. Off grade lard, from salt fat. 7. Dead hog grease, from diseased hogs. 8. Brown grease, from the intestines. 9. White grease, from the other parts. 10. Yellow grease, from the waste of packing warehouses. 11. Pig's foot grease, from glue factories. (*Ph. Ztg.* 96, 402.)

Lard from hogs which have been fed with cotton seed meal will not only show the tests for cotton seed oil (Becchi and Halphen tests), but even the presence of physosterin or vegetable cholesterin can be shown (Emmett & Grindley, *J. Am. C. S.*, 1905, 270).

Properties.—Lard is "a soft, white, unctuous solid, having a faint odor free from rancidity, and a bland taste. Insoluble in water; very slightly soluble in alcohol; readily soluble in ether, chloroform, carbon disulphide, or petroleum benzin. Specific gravity: about 0.917 at 25° C. (77° F.), and about 0.904 at 40° C. (104° F.), water at 25° C. (77° F.) taken as the standard. It melts at 38° to 40° C. (100.4° to 104° F.) to a perfectly clear liquid, which is colorless in thin layers and from which an aqueous layer should not separate. Distilled water boiled with Lard should not acquire an alkaline reaction (absence of *alkalies*). A portion of the water, when filtered, acidulated with nitric acid and treated with silver nitrate T.S., should not yield a white precipitate soluble in ammonia water (absence of *chlorides*). If 10 Gm. of Lard be dissolved in chloroform, and the solution mixed with 10 Cc. of alcohol and 1 drop of phenolphthalein T.S., it should not require more than 0.2 Cc. of normal potassium hydroxide V.S. to produce a pink tint after strongly shaking (limit of *free fatty acids*). If 5 Cc. of melted and filtered Lard be, while warm, intimately mixed by agitation in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol, and adding 2 drops of nitric acid), and the mixture then heated for five minutes in a water-bath, the liquid fat should not acquire a reddish or brown color, nor should any dark color be produced at the line of contact of the hot liquids (absence of more than about 5 percent. of *cotton seed fats*). If 2 Cc. of the melted and filtered Lard be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, no reddish color should develop in from ten to fifteen minutes (absence of *cotton seed oil* or of *certain other fats*)." *U. S.* It "is neutral to *litmus;* dissolves entirely in *ether.* It should yield no reaction

with the tests for sodium, chlorides, or starch. If a solution of 0.05 gramme of *silver nitrate* in 5 cubic centimetres of *alcohol* (90 per cent.), to which a drop of *nitric acid* has been added, be heated with 5 cubic centimetres of melted Lard on a water-bath for 5 minutes and then vigorously shaken, the fatty layer which separates on standing should not darken in color (absence of cotton-seed oil.) 10 grammes of Lard dissolved in a mixture of equal volumes of *chloroform* and *alcohol* (90 per cent.), two drops of *solution of phenol-phthalein* being added, should not require more than 0.2 cubic centimetre of the *volumetric solution of sodium hydroxide* to produce a permanent red color (limit of acidity)." *Br.* When melted, it readily unites with wax and resins. Like most animal fats and oils, it consists of stearin, palmitin, and olein, its consistence, when pure, depending largely upon the relative proportions of these principles; olein, being the liquid principle, can readily be separated from the other two by subjecting lard in cold weather to strong pressure, when the *olein* (*lard oil*) is pressed out, the solid residue (*stearin*) being used for various purposes, more particularly the manufacture of candles. Olein may also be separated by means of boiling alcohol, which, on cooling, deposits the concrete principles of the lard. Lard oil (see *Oleum Adipis*) is extensively employed for burning in lamps, as a lubricant, and for greasing wool. Vast quantities of it are prepared in Cincinnati, Chicago, and other centres of the pork slaughtering industry. The exports of lard for 1903 amounted to 535,375,757 lbs., and for 1904, to 563,520,159 lbs.

Exposed to the air, lard absorbs oxygen and becomes rancid. It should, therefore, be kept in well closed vessels, or procured fresh when wanted for use. In the rancid state, it irritates the skin, and sometimes exercises an injurious reaction on substances mixed with it. Rancidity in lard and other fats is prevented by digesting them with benzoin or poplar buds, and rancid lard may often be greatly improved by washing it with lime water. (See *Unguenta.*) Lard even when fresh is slightly acid, as was proved by Dieterich. (*A. Pharm.*, 1887.)

Uses.—Lard is emollient, and is occasionally employed by itself in frictions, or in connection with poultices to preserve their soft consistence; but its chief use is, in pharmacy, as an ingredient in the preparation of ointments and cerates.

Off. Prep.—Adeps Benzoinatus, *U. S.* (*Br.*).

ADEPS BENZOINATUS. U. S. (Br.)

BENZOINATED LARD

(ăd'ĕps bĕn-zō-ĭ-nā'tŭs)

Adeps Benzoatus, *Br.*, *P. G.*, Benzoated Lard; Ointment of Benzoin; Unguentum Benzoini, *U. S.* 1870; Axungia Balsamica, s. Benzoinata, s. Benzoata; Axonge (Graisse) benzoinée (balsamique), *Fr.*; Benzoinirtes Schmalz, Benzoeschmalz, *G.*; Grasso con benzoino, *It.*; Manteca benzoada, Manteca con benjui, *Sp.*

* "Lard, *one thousand grammes* [or 35 ounces av., 120 grains]; Benzoin, in coarse powder, *twenty grammes* [or 309 grains]. Add the Benzoin to the Lard and mix thoroughly; then melt the Lard by means of a water-bath, and, stirring frequently, continue the heat for two hours, covering the vessel and not allowing the temperature to rise above 60° C. (140° F.). Lastly, strain the liquid through muslin and stir occasionally while it cools. When Benzoinated Lard is to be kept or used during warm weather, 5 percent. (or more, if necessary) of the Lard should be replaced by White Wax." *U. S.*

"Lard, 1 *pound* (Imperial) or 500 grammes; Benzoin, in powder, 210 *grains* (Imperial) or 15 grammes. Melt the Lard on a water-bath; add the Benzoin; continue the application of heat for two hours, frequently stirring; remove the residue of the Benzoin by straining; stir the Benzoated Lard until cold." *Br.* That the balsamic or resinous principles, in certain substances like benzoin, exercise a valuable function in preserving fats has been proved by abundant experience. It has been shown that when made, as originally suggested by Doliber and directed in the U. S. Pharmacopœia of 1870, by incorporating the tincture with lard, ointment of benzoin was irritating to the skin in certain diseases; hence the return to the old process of digesting the benzoin in lard, kept at a temperature of 60° C. (140° F.). The present U. S. formula does not differ materially from the British. The name "benzoinated lard" is preferred by the U. S. Pharmacopœia to that used by the British Pharmacopœia "benzoated lard" because benzoin is used as a preservative; the word benzoated might imply that a benzoate or benzoic acid is employed. A much pleasanter and more agreeable product is insured by heeding the U. S. directions as to limiting the temperature, a high heat volatilizing the odorous principles and communicating an empyreumatic odor. Benzoinated lard is largely manufactured by several firms in the United States and is usually of excellent quality.

ADEPS LANÆ. U. S., Br.

WOOL-FAT

(ăd'ĕps lā'næ)

"The purified fat of the wool of sheep (*Ovis aries* Linné), freed from water." *U. S.* "The purified cholesterin-fat of sheep's wool." *Br.*

Anhydrous wool-fat, *E.*; Suint de laine, *Fr.*; Adeps Lanæ anhydricus, *P. G.*; Wollfett, *G.*

Both the United States and the British Pharmacopœias now recognize wool-fat (anhydrous) and hydrous wool-fat.

Preparation.—The wool of sheep contains on the average about 45 per cent. of its weight of fat, which must be removed before the wool can be used in the manufacture of woollen tissues. The crude fat has been termed *œsipus*

and *œsipum*. This fat, to which the name of lanolin has been given, is a mixture of esters of *cholesterin*, $C_{26}H_{43}(OH)$, with the several fatty acids contained in ordinary fats. Darmstaedter and Lifscheitz obtained from the alkaline washings of partially saponified wool-fat two unsaturated alcohols, $C_{10}H_{20}O$ and $C_{11}H_{22}O$, both being colorless, odorless, and tasteless powders; *lanolin alcohol*, $C_{12}H_{24}O$, also a colorless, odorless powder, was isolated by G. Marchetti (*Ber. d. Chem. Ges.*, 1895, No. 19); by the action of chromium trioxide the latter is converted into lanolinic acid, $C_{12}H_{22}O_3$, a white, crystalline powder (*P. J.*, 1895, p. 75.). Wool-fat under the name of lanolin was originally recommended by Oscar Liebreich, and may be readily procured from the washings of the wool by a process which has been patented by him, or it may be obtained by treating the wool with petroleum benzin and distilling off the benzin. The objection to the latter process is the difficulty of getting rid of the benzin odor. Liebreich's patented process is as follows. The fresh undecomposed waste liquor or lye is passed through a centrifugal machine, in which the dirt and fat are separated from each other, while the cleansed soap liquor is continually drawn off by means of a pipe and led directly into the vat which serves for the acidulation. The raw lanolin thus obtained is thoroughly kneaded by suitable machinery in cold flowing water until the water which flows off is as clear as the water which flows in. The raw lanolin is then heated with water, whereby it is split up into water and fat. The latter is skimmed off from the surface and cooled, and for further purification it can be treated in the centrifugal machine in a melted condition, or it can be dissolved in ether, ethylated or methylated spirits, or other solvents, and the solution can be separated from the residue by filtration or other means. The solvents can be recovered by treatment in suitable stills. After the fat has been cleaned as above stated, it is thoroughly kneaded with water for a long time, and a perfectly white neutral colorless ointment is obtained. From the deposit in the lowest part of the centrifugal machine a further portion of lanolin can be obtained by stirring the same up with clean or salt water and again treating it in the centrifugal machine, or extracting it, either in a wet or a dry condition, by means of a solvent, after which it is treated as above.

Instead of producing lanolin from wool-washing water it may be obtained from commercial wool-fat by stirring this wool-fat together with water containing sodium carbonate, caustic soda, or an alkali, or a mixture of these to form a thin milky solution, which is treated in the manner above described.

Properties.—Wool-fat is "a light-yellowish, tenacious, unctuous mass, having a slight, peculiar odor. Insoluble in, but miscible with, large quantities of water, sparingly soluble in cold alcohol, more soluble in hot alcohol, readily soluble in ether and chloroform. Wool-Fat melts at about 40° C. (104° F.), and at a higher temperature vaporizes, the vapor igniting and burning with a luminous, sooty flame. The solution of Wool-Fat in chloroform (1 in 50), when poured upon the surface of concentrated sulphuric acid, gradually develops a deep brownish-red color at the line of contact of the layers. When Wool-Fat is incinerated it should leave not more than 0.3 percent. of ash, which should not show an alkaline reaction to litmus paper (freedom from *alkalies*). If 2 Gm. of Wool-Fat be dissolved in 10 Cc. of ether, and 2 drops of phenolphthalein T.S. added, a colorless liquid should be obtained (absence of *free alkalies*), which, on the addition of 1 drop of normal potassium hydroxide V.S., should develop a deep red color (absence of *free fatty acids*). If 1 Gm. of Wool-Fat be boiled with 20 Cc. of alcohol, and the solution filtered after cooling, the filtrate should not be rendered turbid by the addition of an alcoholic solution of silver nitrate (1 in 20) (absence of *chlorides*). If 10 Gm. of Wool-Fat be heated with 50 Cc. of water on a bath of boiling water until completely fused, the lower aqueous layer, when filtered through a well-wetted filter, should not yield *glycerin* on evaporation, and when boiled with potassium hydroxide T.S. it should not give off vapors of ammonia (absence of *organic nitrogenous matter*)." *U. S.* "A yellowish, tenacious unctuous substance; almost inodorous; melting point varies from 104° to 112° F. (40° to 44.4° C.); readily soluble in *ether* or in *chloroform*, sparingly soluble in *alcohol* (90 per cent.). 1 gramme should dissolve almost completely in 75 cubic centimetres of boiling *alcohol* (90 per cent.), the greater part separating in flocks on cooling. When incinerated with free access of air, it leaves not more than 0.3 per cent. of ash, which should not be alkaline to *litmus*. 10 grammes dissolved in 25 cubic centimetres of *ether*, two drops of *solution of phenol-phthalein* being added, should not require more than 0.1 cubic centimetre of *volumetric solution of sodium hydroxide* to produce a permanent red coloration (limit of acidity). The solution in *chloroform* poured gently over the surface of *sulphuric acid* acquires a purple-red color. Heated with *solution of sodium hydroxide*, no ammoniacal odor should be evolved (absence of nitrogenous animal matter)." *Br.*

Off. Prep.—Adeps Lanæ Hydrosus, *Br.*

ADEPS LANÆ HYDROSUS. U. S., Br.

HYDROUS WOOL-FAT

(ăd'ĕps lā'næ hȳ-drō'sŭs)

"The purified fat of the wool of sheep (*Ovis aries* Linné), mixed with not more than 30 percent. of water." *U. S.*

Lanoline; Lanolin, Adeps lanæ cum aqua, *P. G.*; Wasserhaltiges Wollfett, *G.*; Lanolina, *It., Sp.*

"Wool Fat, 7 *ounces* (Imperial) or 140 grammes; Distilled Water, 3 *fl. ounces* (Imp. meas.) or 60 cubic centimetres. Place the Wool Fat in a warm mortar; add the Distilled Water gradually and with constant trituration." *Br.*

Properties.—Hydrous wool-fat is officially described as "a yellowish-white, or nearly white, ointment-like mass, having a slight, peculiar odor. Insoluble in water, but miscible with twice its weight of the latter, without losing its ointment-like character. With ether or chloroform it yields turbid solutions which are neutral to moistened litmus paper. Hydrous Wool-Fat melts at about 40° C. (104° F.), and separates into an upper oily and a lower aqueous layer. When heated on a water-bath, with stirring until it ceases to lose weight, there should remain not less than 70 percent. of a residue, which is transparent when melted, and when cold remains as a yellowish, tenacious, unctuous mass, completely soluble in ether or chloroform, and only sparingly soluble in alcohol. If Hydrous Wool-Fat be thus deprived of water, it should respond to the tests given under *Adeps Lanæ*." *U. S.* "10 grammes heated on a water-bath, with stirring, until the weight is constant, should yield not less than 7 grammes of residue, which should answer to the tests for Wool Fat." *Br.*

Uses.—It has been claimed for hydrous wool-fat that it passes through the skin much more readily than do ordinary fatty substances. According to Patschkowski, half an hour after inunction of a mixture of lanolin and potassium iodide, iodine can be recovered from the urine, while the official ointment yields a negative result. This has been confirmed by Kaspar; but Ritter and Pfeiffer in a long series of experiments were unable to perceive that hydrous wool-fat had any superiority over other fats in promoting absorption. Further, when it is remembered that it is a sebaceous secretion, largely composed of cholesterin and allied substances, and not intended by nature to be absorbed, but to grease and soften the fibres of the wool, the possession by it of the property of aiding absorption through the skin becomes very doubtful. On the other hand, it is undoubtedly soothing to the skin, and often makes an excellent vehicle for ointments intended to act especially upon the skin. It has been used in suppositories, bougies, and plasters as a vehicle and is an ingredient in six official ointments and a plaster.

ÆTHER. U. S. (Br.)

ETHER [Stronger Ether]

(æ'ther)

"A liquid composed of about 96 percent., by weight, of absolute Ether or Ethyl Oxide [$(C_2H_5)_2O = 73.52$], and about 4 percent. of alcohol containing a little water. Ether should be kept in partially filled, well-stoppered containers, preferably tin cans, in a cool place, remote from lights or fire." *U. S.* "A volatile liquid prepared from ethylic alcohol by interaction with sulphuric acid. It contains not less than 92 per cent. by volume of ethyl oxide $(C_2H_5)_2O$." *Br. Purified Ether* is defined as "Ether from which most of the ethylic alcohol has been removed by washing with distilled water, and most of the water by subsequent distillation in the presence of calcium chloride and recently prepared lime." *Br.*

Æther Purificatus, *Br,* Purified Ether; Æther sulphuricus, *Ed., Dub.;* Ether, Hydric Ether, Sulphuric Ether, Naphtha Vitrioli, Hydrate of Ethylen, Oxide of Ethyl; Ether officinal, Ether pur, *Fr. Cod.;* Ether, Ether hydrique, ou vinique, ou sulfurique, *Fr.;* Aether, *P. G.;* Reiner Aether, Schwefeläther, *G.;* Etere, *It.;* Eter, Eter sulfurico, *Sp.*

The U. S. Pharmacopœia of 1880 recognized Æther containing about 74 per cent. of ethyl oxide and Æther Fortior containing about 94 per cent. of ethyl oxide. The present Æther of the U. S. Pharmacopœia replaces the Æther Fortior of the U. S. P. 1880, the Æther of the U. S. P. 1880 being dropped, as its deficient strength rendered it of little use. The Æther Purificatus of the British Pharmacopœia and the Æther of the U. S. Pharmacopœia (8th Rev.) are practically identical in strength. The British purified ether, on account of its having the alcohol removed by washing with water, is sometimes termed *Æther Lotum*, or washed ether. It still contains a trace of water.

Preparation.—A process for preparing ether upon the small scale was given in the U. S. P. 1870, and a former British Pharmacopœia, see U. S. D., 18th ed. p. 118, but it was properly abandoned by both Pharmacopœias, as the production of this inflammable and very volatile liquid should be undertaken only in buildings properly safeguarded, and it is now made of excellent quality on a large scale with special apparatus. Ether was made officially by the action of sulphuric acid upon alcohol, in a glass flask, at a temperature ranging between 130° C. (266° F.) and 137.7° C. (280° F.), the distillate being afterwards rectified to remove impurities.

In the apparatus employed by E. R. Squibb the ether is made in one operation; the vapors of ether and unchanged alcohol are first washed by a solution of caustic potash maintained at a temperature above the boiling point of alcohol, the alcoholic vapor is then condensed in a worm kept at a suitable temperature and runs back into the still, while the ether vapor, retaining about 4 per cent. of alcohol, is condensed in a well cooled apparatus. 360 lbs. of concentrated sulphuric acid are sufficient to etherify 120 barrels of clean spirit; the acid has then to be changed, chiefly because the impurities of the spirit render the mixture dark and tarry and liable to froth in the still. (*Ephem.*, ii. p. 590.) Kraft proposes to manufacture ether by heating alcohol in contact with the alkyl esters of sulphonic acid. He states that benzene-sul-

phonic acid under favorable conditions is capable of converting several thousand times its weight of alcohol into ether. The advantage claimed for this method is greater purity of the resulting ether. (*Chem. Ztg.*, 1893, 1876.) Ekenberg purifies ether by mixing it with 5 or 10 per cent. of liquid paraffin, which has a boiling point of about 300° C., and distilling at a temperature of from 40° to 50° C. The liquid paraffin holds the impurities and permits the pure ether to distil over. (*Chem. Ztg.*, 1894, 1240.)

Properties of Ether.—In considering the properties of ether it is necessary to draw a sharp distinction between the official ethers of the two Pharmacopœias. The term Ether (*Æther*) is used now (1905) for the second grade ether (sp. gr. 0.735) of the British Pharmacopœia as well as for the only ether now recognized by the U. S. Pharmacopœia [sp. gr. 0.716 to 0.717 at 25° C. (77° F.)]; this latter corresponds with the Purified Ether (*Æther Purificatus*) of the British Pharmacopœia, which has the sp. gr. 0.720 at 15.6° C. (60° F.) Ether of the U. S. Pharmacopœia (8th Rev.) is described as follows. "A transparent, colorless, mobile liquid, having a characteristic odor, and a burning and sweetish taste. Specific gravity: 0.716 to 0.717 at 25° C. (77° F.). Soluble in about 10 times its volume of water at 25° C. (77° F.), with slight contraction of volume. Miscible, in all proportions, with alcohol, chloroform, petroleum benzin, benzene, fixed and volatile oils. Ether boils at about 35.5° C. (96° F.), and it should, therefore, boil when a test-tube, containing some broken glass and half filled with it, is held for some time closely grasped in the hand. Ether is highly volatile and inflammable. Its vapor, when mixed with air and ignited, explodes violently. The color of light blue litmus paper moistened with water should not be changed to red when the paper is immersed in Ether for ten minutes. Upon evaporation, Ether should leave *no residue*. If 10 Cc. of it be poured, in portions, upon clean, odorless blotting paper, and allowed to evaporate spontaneously, *no foreign odor* should become perceptible when the last traces of Ether leave the paper. When 20 Cc. of Ether are shaken, in a graduated tube, with 20 Cc. of water, just previously saturated with Ether, the ether-layer, upon separation, should measure not less than 19.2 Cc. (absence of an *undue amount of alcohol or water*). If 10 Cc. of Ether be shaken occasionally, during one hour, with 1 Cc. of potassium hydroxide T.S., no color should be developed in either liquid (absence of *aldehyde*)." *U. S.* The British Pharmacopœia gives the following tests for purified ether. "Specific gravity not exceeding 0.722 and not below 0.720. 5 cubic centimetres on spontaneous evaporation should not afford any abnormal odor and should not leave any residue. Its vapor is heavy and highly inflammable. It should dissolve in an equal volume of *carbon bisulphide* (absence of excess of water). Heated, it begins to distil at a temperature not under 94.1° F. (34.5° C.) (absence of methylic ether). No effect should be produced by the addition of *potassium hydroxide* (absence of aldehyde). No alteration in color is produced on moistened *blue litmus paper* after twenty-four hours' contact (absence of acid). On shaking with half its bulk of a diluted solution of *potassium bichromate* acidulated with *sulphuric acid*, and setting aside, the supernatant Ether should have no blue color (absence of hydrogen peroxide). Filter-paper moistened with Purified Ether should remain odorless when the liquid has evaporated." *Br.*

Commercial ether, which is sometimes used as a solvent, varies in sp. gr. from 0.733 to 0.765. The impurities found in it are excess of alcohol, water, sulphurous and other acids, heavy oil of wine, and various fixed substances.

The ether of U. S. P. 1880 should have the sp. gr. 0.750; if heavier than this, it must contain too much alcohol or water. The statement that water takes up only one-tenth of ether, when equal volumes of ether (sp. gr. 0.750) and water are shaken together in a graduated tube, has been shown by Squibb to be erroneous. If it take up more than one-fourth, the ether must contain an excess of alcohol or water, or of both. If the alcohol be in excess, it may be removed by agitating the liquid with twice its bulk of water, which unites with the alcohol, forming a heavier stratum, from which the ether may be poured off. The ether, however, takes up about one-tenth of water, which may be removed by agitation with freshly burned lime, and subsequent distillation. An easy method for detecting and measuring any alcohol present in ether was given by the Edinburgh College; namely, to agitate it, in a graduated cylinder, with half its volume of a concentrated solution of calcium chloride. This will remove the alcohol and the reduction of the volume of the ether, when it rises to the surface, will indicate the amount. The official test is based upon this old method; the use of water saturated with ether is, however, an improvement over the use of a solution of calcium chloride. Heavy oil of wine may be discovered by the ether becoming milky upon being mixed with water. If the ether be pure, it wholly evaporates in the air, leaving no solid residue. All non-volatile impurities are thus detected. The point of ebullition is also an indication of the strength of the ether. When evaporating from bibulous paper, it should offer only a slight degree of foreign odor, aromatic and free from pungency, and should leave the paper, when dry, nearly or quite odorless. This test proves the absence of volatile impurities, except a slight and not inadmissible proportion of light oil of wine.

The tests for the British ether are as follows: "100 volumes agitated with an equal volume of *water* should not be reduced to less than 90 (absence of excess of ethylic alcohol). It should boil below 105° F. (40.5° C.). Spe-

cific gravity 0.735. It evaporates without residue. It should have no action on *solution of litmus*. It should dissolve without coloration when introduced drop by drop into *sulphuric acid* kept cool during the test (absence of organic impurities)." *Br.* This commercial ether may answer for external application, and may even be given by the mouth, but for purposes of inhalation it is entirely unfitted without further purification.

The extreme volatility of ether causes it to evaporate speedily in the open air, with the production of considerable cold. Its inflammability is very great, and the products of its combustion are water and carbon dioxide. In consequence of this property the greatest care should be used not to bring it in the vicinity of flame, as, for example, a lighted candle. One of the great advantages of using steam as the source of heat is that it obviates, in a great measure, the danger of its accidental inflammation. When too long kept it undergoes decomposition, and is converted in part into acetic acid. It dissolves iodine and bromine freely, and sulphur and phosphorus sparingly. Its power to dissolve corrosive sublimate makes it a useful agent in the manipulations for detecting that poison. It is also a solvent of volatile and fixed oils, many resins and balsams, tannic acid, caoutchouc, and most of the organic vegetable alkaloids. It does not dissolve potassium or sodium hydroxide, in which respect it differs from alcohol. Ether unites in all proportions with alcohol. According to R. Boettger, water may be detected in ether by agitating the suspected liquid with carbon disulphide; if water be present the mixture becomes milky and turbid, otherwise it remains clear. Stefanelli (*Ber. d. Chem. Ges.*, 8, 439) proposed to shake ether with a small fragment of aniline-violet, which does not impart color to ether free from alcohol. One per cent. of alcohol may be thus detected. Ether is usually made anhydrous by allowing it to remain in contact with dry calcium chloride or by distilling it with a small quantity of metallic sodium in a flask or retort.

The most delicate test for the presence of alcohol in ether is that of Lieben, founded on the formation of iodoform by alcohol but not by ether. (See p. 105.) The mere keeping of ether in the presence of moisture is said to generate sufficient alcohol to produce the reaction. (Allen, *Com. Org. Anal.*, 2d. ed., i. p. 125.)

On filtering an ethereal liquid with free access of air, a frost-like congelation is observed on the upper part of the filter, its appearance and quantity depending upon the temperature and the hygrometric state of the atmosphere. Tanret has collected some of this *ether hydroxide*, and found that after it had been completely freed from ether by strongly blowing upon it, it had the temperature —3.5° C. (25.7° F.), and on fusion yielded 17 to 18 parts of water for 37 of ether; the formula $(C_2H_5)_2O$, $2H_2O$ requires 18 parts. (*A. J. P.*, 1878.)

Composition and Theory of its Production.—The empirical formula of ether is $C_4H_{10}O$, and this is the result both of analysis and of a determination of its vapor density, whereby the molecular weight is established. This formula, however, is better understood when we examine the conditions of its formation. Ether is then found to be the oxide of ethyl (C_2H_5). This is the group which gives character to common alcohol and all its salts, whether with organic or inorganic acids. The group C_2H_5 acts as a monad radical, and common alcohol is its hydroxide, C_2H_5,OH. Its oxide then should be $(C_2H_5)_2O$, and all the reactions by which ether is produced show it to be this oxide. It is commonly formed from common alcohol (ethyl hydroxide) by the action of sulphuric acid, according to the following reactions:

$$C_2H_5OH + SO_2OH.OH = SO_2OH.OC_2H_5 + HOH$$

that is, alcohol reacting with sulphuric acid yields ethyl-sulphuric acid (sulphovinic acid) and water. In the presence of an excess of alcohol and at the proper temperature the ethyl-sulphuric acid then reacts with another molecule of alcohol, as follows:

$$C_2H_5OH + SO_2OH.OC_2OH_5 = C_2H_5OC_2H_5 + SO_2OH.OH$$

whereby ethyl oxide (ether) is formed, and sulphuric acid is regenerated. These reactions take place best at a temperature of about 140° C. (284° F.), and if the mixture in the still is kept at this temperature a steady stream of alcohol can be converted into ether, whence the process has been called "the continuous etherification process."

Uses.—As early as 1805, inhalations of ether were recommended by Warren of Boston, to relieve pulmonary distress in advanced *phthisis*, and in 1812 ether intoxication by inhalation was said to have been frequently practiced in Philadelphia, but it was not until October, 1846, that Warren, at the instance of W. T. G. Morton of Boston, used ether as a surgical anæsthetic at the Massachusetts General Hospital. A few days subsequently, C. T. Jackson of Boston, claimed to have first made known to Morton the use of ether for the prevention of pain in dental operations.

Locally, ether is a violent irritant. It is absorbed through the lungs with very great rapidity, and less quickly but with equal certainty through the mucous membrane of the gastro-intestinal tract, and is eliminated by the lungs and kidneys. Its first action upon the circulation is to raise the arterial pressure by increasing the output of work from the heart, and probably also by stimulating the vasomotor centres and bringing about contraction of the blood vessels. The large dose finally depresses both the heart and the vasomotor system. In full dose it acts as a depressant to the ganglionic cells or to the nerve centres, paralyzing the cerebral cortex so as to produce loss of consciousness; lessening the activity of the spinal cord, so as to cause loss of sensi-

bility, muscular relaxation, and paralysis of the reflexes. Rarely the loss of sensibility precedes the loss of consciousness, showing that the loss of sensibility is not simply due to the suspension of consciousness. In the great majority of cases when ether produces death either in man or in the lower animals, the fatal result is caused by a central paralysis of respiration; in very rare instances, however, sudden cardiac arrest has occurred during etherization both in man and in animals.

As a practical anæsthetic, ether is inferior to chloroform in being distinctly slower in action, more disagreeable to the patient by producing greater excitement and in being more apt to cause prolonged nausea and vomiting after use. Statistics show, however, that the proportion of deaths due to chloroformization is four to five times greater than after etherization; and only in rare circumstances is the surgeon justified for the sake of convenience in selecting the more dangerous anæsthetic.

It being impossible in the space which can be allotted to the subject in the present work to discuss to any advantage the subject of etherization, either in its general, theoretical, or practical aspects, the reader is referred to works on practical anæsthesia and to text books on therapeutics.

Given by the mouth, ether may be used in *nausea* dependent upon gastric depression, in excessive *flatulence* especially when attended by colic, and in *gastrodynia*. It has also been administered in the treatment for *gall stones* with the belief, probably not well founded, that it would aid in the solution of the stones. As a constituent of Hoffmann's anodyne it is much used as a stimulant antispasmodic. For administration by the mouth it is best given floating on ice-cold water, though it is sometimes administered in capsules under the name of *pearls*, and a syrup of ether is recognized by the French Codex. According to Regnault and Adrian, the best syrup of ether is to be made by shaking together in a bottle 440 parts of sugar, 490 parts of distilled water, 50 parts of alcohol (sp. gr. 0.833), 20 parts of ether. If the parts taken are represented by grains the formula would give one full dose of the narcotic.

Dose, half to one fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Collodium, *U. S.*, *Br.*; Collodium Stypticum, *U. S.*; Oleum Æthereum, *U. S.*; Extractum Filicis Liquidum, *Br.*; Extractum Strophanthi, *Br.*; Spiritus Ætheris, *U. S.*, *Br.*; Spiritus Ætheris Compositus, *U. S.*, *Br.*

ÆTHER ACETICUS. U. S., Br.

ACETIC ETHER [Ethyl Acetate]

(æ'thẹr ą-cĕt'į-cŭs)

$C_2H_5.C_2H_3O_2 = 87.4$

Naphtha Aceti; Ethyl Acetate: Ether acétique, Acétate d'éthyl, *Fr. Cod.*; Naphte acétique, *Fr.* Aether aceticus, *P. G.*; Essigäther, Essignaphtha, *G.*; Etere acetico, *It.*; Eter acetico, *Sp.*

"A liquid composed of about 90 percent., by weight, of Ethyl Acetate [$CH_3CO.OC_2H_5 = 87.40$], and about 10 percent. of alcohol containing a little water. It should be kept in well-stoppered bottles, in a cool and dark place, remote from lights or fire." *U. S.* "An ethereal liquid consisting of ethyl acetate, $CH_3.COO(C_2H_5)$, together with unimportant amounts of ethylic alcohol or other substances, obtained by distillation from a mixture of ethylic alcohol, sulphuric acid, and dried sodium acetate, digestion of the distillate with dried potassium carbonate, and subsequent separation, by distillation, of the portion boiling between 165° and 172° F. (73.9° and 77.8° C.)." *Br.*

Preparation.—A process for preparing this ether will be found in a former British Pharmacopœia (1885). It is a modification of the process recommended by W. I. Clark (*P. J.*, 1883, p. 777), and is as follows: "Take of Rectified Spirit, 32¼ fluidounces [Imp. meas.]; Sulphuric Acid, 32½ fluidounces [Imp. meas.]; Acetate of Sodium, 40 ounces [av.]; Carbonate of Potassium, freshly dried, 6 ounces [av.]. To the spirit slowly add the acid, keeping the fluid cool, and, the product being cold, add the acetate, mixing thoroughly. Distil forty-five fluidounces [Imp. meas.]. Digest the distillate with the carbonate of potassium for three days in a stoppered bottle. Separate the ethereal fluid, and again distil until all but about four fluidounces have passed over. Preserve the resulting acetic ether in a well-closed bottle and in a cool place." *Br.* 1885. In addition to this method, acetic ether may be made by several processes, the chief of which are the following: 1. Mix 100 parts of alcohol (sp. gr. 0.83) with 63 parts of concentrated acetic acid, and 17 parts of strong sulphuric acid, and distil 125 parts into a well cooled receiver. 2. Distil to dryness a mixture of three parts of sodium acetate, three of alcohol, and two of sulphuric acid, mix the distilled product with one-fifth of sulphuric acid, and distil a second time an amount of ether equal to the alcohol employed. 3. Distil two parts of efflorescent lead acetate with one part of alcohol and a little more than one part of sulphuric acid. In the last two processes, the acetic acid is set free by the action of the sulphuric acid on the acetate employed. J. A. Pabst has devised a process for acetic ether in imitation of that for the preparation of common ether. 50 Cc. of sulphuric acid and the same quantity of alcohol are heated together in a retort to 140° C. (284° F.), and then a mixture of one liter of 96 per cent. alcohol and one liter of acetic acid (93 per cent.) is allowed to flow in slowly. At first some ethyl ether goes over, and then a liquid which contains, with considerable uniformity, 85 per cent. acetic ether. The reaction takes place between 130° C. (266° F.) and 135° C. (275° F.); at 145° C. (293° F.) some sulphurous acid is produced. The yield is about 1350 grammes, or 78 per cent., which is 90 per cent. of the theoretical amount. With

reference to the solubility of acetic ether in saturated calcium chloride solution, it is to be remarked that pure acetic ether is not dissolved, except when it is mixed with 90 per cent. alcohol. One volume acetic ether, one volume alcohol, and two volumes calcium chloride solution give a homogeneous liquid. The methyl acetic ether can be prepared exactly as the ethyl compound, but in the attempt to prepare the amyl acetic ether, in an analogous manner, side reactions were found to interfere. In order to study the proportional power of combination possessed by the two alcohols, Pabst allowed a mixture of 100 Cc. methyl alcohol and 100 Cc. acetic acid to flow into a mixture of 50 Cc. sulphuric acid and 50 Cc. ethyl alcohol. The first distillates contained essentially methyl acetate and the latter pure ethyl acetate. In the flask were found remaining nearly equal amounts of sulphuric and ethyl-sulphuric acids, and in addition alcohol, acetic acid, and some residual ethyl acetate. (*Bull. Soc. Chim.*, vol. xxxiii. pp. 350, 351; *A. J. P.*, 1880.)

Properties.—The U. S. Pharmacopœia describes it as "a transparent, colorless liquid, of a fragrant and refreshing, slightly acetous odor, and a peculiar acetous and burning taste. Specific gravity: 0.883 to 0.885 at 25° C. (77° F.). Soluble in about 7 parts of water at 25° C. (77° F.); miscible, in all proportions, with alcohol, ether, fixed and volatile oils. Boiling point: about 72° C. (161.6° F.). Acetic Ether is readily volatilized, even at a low temperature. It is inflammable, burning with a yellowish flame and an acetous odor. It should not immediately redden blue litmus paper. Upon evaporation, Acetic Ether should leave no residue. If a portion be allowed to evaporate spontaneously from clean, odorless blotting paper, the final odor should not resemble that of pineapple (absence of *butylic* and *amylic derivatives*). When 25 Cc. of Acetic Ether are shaken, in a graduated tube, with 25 Cc. of water just previously saturated with Acetic Ether, upon separation the ethereal layer should not measure less than 22.5 Cc. (absence of an *undue proportion of alcohol* or *water*). When a small portion of Acetic Ether is carefully poured upon concentrated sulphuric acid, no dark ring should be developed at the point of contact of the two layers (absence of *readily carbonizable, organic impurities*)." *U. S.* "1 part by weight dissolves in not less than 10 parts of cold *water*. Specific gravity 0.900 to 0.905. It should have no action on *solution of litmus*. It is not colored when mixed with an equal volume of *sulphuric acid* (absence of organic impurities). Filter-paper moistened with Acetic Ether should remain odorless when the liquid has evaporated." *Br.*

Uses.—Acetic ether is occasionally used in medicine as a stimulant and antispasmodic. Its action upon the system is probably very similar to that of ether; but as it is less volatile it is less rapidly absorbed and eliminated, and consequently is much less prompt and fugacious in its influence than is ether. It is locally irritating. H. C. Wood found it to be capable of being used as an anæsthetic, but to be too slow in its action for practical purposes. It is sometimes employed externally, by friction, as a resolvent, and for *rheumatic pains*.

Dose, fifteen to fifty minims (0.9 to 3.1 Cc.).

Off. Prep.—Liquor Epispasticus, *Br.*

ÆTHYLIS CARBAMAS. U. S.

ETHYL CARBAMATE

(æ′thyl-ĭs cär′bą-măs)

$C_3H_7NO_2 = 88.42$

"An ester of carbamic acid [$CO(OC_2H_5)NH_2$] obtained by the reaction of ethyl alcohol upon urea (carbamide) or one of its salts. It should be kept in well-stoppered bottles." *U. S.*

Ethyl urethane, Urethane; Uréthane, *Fr.*; Carbaminsaureaethylester, Aethyl-urethan, Urethan, *G.*; Uretano, Eter Carbamico, *Sp.*

Ethyl carbamate was introduced into the U. S. Pharmacopœia (8th Rev.) and is made by allowing ammonia to act upon ethyl carbonate, when urethane and ethyl alcohol are produced, or by heating urea nitrate with alcohol to from 120° to 130° C., resulting in the formation of ethyl carbamate and ammonium nitrate.

Properties.—It is officially described as in "colorless, columnar crystals or scales, odorless, and having a cooling, saline taste. Soluble in less than 1 part of water, 0.6 part of alcohol, 1 part of ether, 1.3 parts of chloroform, and 3 parts of glycerin, at 25° C. (77° F.). When heated between 47.5° and 50° C. (117.5° and 122° F.) it melts, and at a higher temperature is decomposed, burning without leaving a weighable residue. If 1 Gm. of Ethyl Carbamate be added to 5 Gm. of sulphuric acid and gently heated, it is decomposed with the evolution of carbon dioxide, while alcohol and acid ammonium sulphate remain in solution. If 1 Gm. of Ethyl Carbamate be heated with 5 Cc. of concentrated potassium hydroxide solution, ammonia gas is given off, recognizable by the usual tests. If 0.5 Gm. of Ethyl Carbamate be dissolved in 5 Cc. of water with 1 Gm. of dry sodium carbonate and 0.01 Gm. of iodine, and the solution warmed, yellow crystals of iodoform should separate on cooling. If 6 Gm. of Ethyl Carbamate be dissolved in 6 Cc. of water, and the solution be divided into 3 equal parts, the addition severally of 5 Cc. of nitric acid, of mercuric nitrate T.S., or of oxalic acid T.S. should not produce a white precipitate (distinction from, and absence of, *urea* or *carbamide*)." *U. S.* When it is heated with ammonia to 180° C., urea is formed.

Uses.—Urethane produces in the lower animals a brief period of excitement, which is followed by deep sleep, with slowing of the respiration. If a fatal dose has been taken, the respiration becomes slower, the unconsciousness absolute, the reflexes are abolished, and a

pronounced fall of bodily temperature occurs, with marked weakness of the cardiac action, and finally death from asphyxia. In therapeutic doses it is depressant to the brain and spinal cord but has practically no effect on the circulation. The psychomotor centres in the cerebral cortex, according to von Anrep, suffer decrease of faradic excitability under the influence of decided doses. Urethane has been largely used as a hypnotic and in the milder forms of *insomnia* is often a useful remedy on account of its safety. In severe cases it is, however, uncertain in its effect. It has been used by Jackman and others (*L. L.*, June, 1886) in *traumatic tetanus* and other convulsions, as *puerperal eclampsia*, with success.

Dose, as somnifacient, fifteen to forty-five grains (1 to 3 Gm.); in tetanus seventy-five grains (5 Gm.) may be given as a dose.

ÆTHYLIS CHLORIDUM. U. S.

ETHYL CHLORIDE

(æ'thyl-ĭs ȼhlō'rĭ-dŭm)

"A haloid derivative [Monochlor-Ethane, $C_2H_5Cl = 64.00$], prepared by the action of hydrochloric acid gas upon absolute ethyl alcohol. On account of its extreme volatility, it should be preserved in hermetically sealed glass tubes, and kept in a cool place, remote from lights or fire." *U. S.*

Hydrochloric ether; Chlorethyl, Monochlorethane; Ethylum chloratum, Æther chloratus; Chlorure d' éthyle, Ether hydrochlorique, *Fr.*; Aethylchlorid, Chlorwasserstoffäther, Chloraethyl, *G.*

Preparation.—This ether was discovered by Rouelle, but first obtained in sufficient quantities to permit the examination of its properties by Basse. It may be procured by several processes, but the following is the best. Distil a mixture of equal measures of concentrated hydrochloric acid and alcohol, and receive the product, by means of a curved glass tube, in a tubulated bottle, half filled with water at a temperature between 21.1° C. (70° F.) and 26.6° C. (80° F.), and connected by means of a second tube with another bottle, loosely corked, and surrounded by a mixture of common salt with snow or pounded ice. The ether, as it enters the first bottle, is mixed with alcohol and acid, which are retained by the water; while the pure ether passes forward, and is condensed in the refrigerated bottle. It must be kept in strong bottles, well secured with ground stoppers covered with leather. Before being opened, the bottle should be cooled to the freezing point.

Properties.—Ethyl chloride is a colorless liquid, having a strong, slightly saccharine, alliaceous taste, and a penetrating, ethereal, alliaceous odor. Its sp. gr. at the temperature of 0° C. (32° F.) is 0.9214. It is extremely volatile, entering into ebullition at 10° C. (50° F.), so that in summer it may be collected in the gaseous state, in bell glasses over water. Its sp. gr. in the state of vapor is 2.22. When kindled as issuing from a fine orifice, it burns with an emerald-green flame, without smoke, diffusing a strong odor of hydrochloric acid; but, when set on fire in quantities, it burns with a greenish-yellow, smoky flame. Water dissolves one-fiftieth of its weight of this ether, and acquires a sweetish, ethereal taste; and alcohol unites with it in all proportions. These solutions are not precipitated by silver nitrate, showing that the chlorine present is in a peculiar state of combination. Like common ether and ethyl nitrite, it dissolves sulphur, phosphorus, the fixed and volatile oils, and many other substances. It consists of one atom of chlorine combined with the monatomic radical or group C_2H_5, *ethyl*, and its composition is sufficiently shown by the reaction for its production:

$$C_2H_5OH + HCl = C_2H_5Cl + H_2O$$

It is officially described as "a colorless, mobile, very volatile liquid, having a characteristic, rather agreeable odor, and a burning taste. Specific gravity: 0.918 at 8° C. (46.4° F.). Ethyl Chloride is slightly soluble in water, readily soluble in alcohol. It boils at a temperature of 12.5° to 13° C. (54.5° to 55.4° F.), and at its ignition temperature burns with a smoky, green-edged flame, with the production of gaseous hydrochloric acid. When liberated, at ordinary room-temperatures, from its sealed glass tube, Ethyl Chloride vaporizes at once; the gas is very inflammable, and consequently it should not be used in proximity to a gas-flame or fire. If 10 Cc. of Ethyl Chloride, while cold, be dissolved in alcohol, and a few drops of silver nitrate T.S. be added, no turbidity should be produced (absence of *hydrochloric acid*). If 10 Cc. of Ethyl Chloride be agitated with 10 Cc. of cold water, and the supernatant stratum of Ethyl Chloride be evaporated spontaneously, and if a few drops of potassium dichromate T.S. be added to the remaining aqueous liquid, followed by some diluted sulphuric acid, and the mixture be boiled, no odor of aldehyde should be developed, and a greenish or purplish color should not be produced in the liquid (absence of *alcohol*). On allowing Ethyl Chloride to evaporate from clean, odorless blotting paper which has been saturated with it, no unpleasant odor should remain upon the paper (absence of *sulphur compounds*, etc.)." *U. S.*

Owing to its extreme volatility, it cannot be kept readily. It may, however, be preserved in a cool cellar, the temperature of which does not rise above 7.2° C. (45° F.) or 10° C. (50° F.), being well secured in bottles, which should be stored in a reversed position.

Uses.—Ethyl chloride has been used in practical medicine as a method of producing local anæsthesia by freezing, and internally as a general anæsthetic. As an anæsthetic its action is extremely rapid and fugacious. Its action upon the circulation is similar to but less imperious than that of chloroform, the arterial pressure being lessened by depression of the

heart. It appears to be safer than chloroform, Ware having recorded over 11,000 cases of its use with but one death. Advantage has been taken of the great volatility of ethyl chloride for practical use as a local anæsthetic by freezing. It is now furnished for dental and other use, in hermetically sealed tubes, so made that when the end is broken off, and the tube held in the hand, the liquid comes out in a fine stream which may be directed upon the part to be frozen. H. C. Wood and David Cerna (*Dental Cosmos*, 1892) find that ethyl chloride taken into the blood acts very much like chloroform. On account of its great inflammability it should not be used near a light or flame. *Alcoholic muriatic ether*, or a solution of ethyl chloride in an equal bulk of alcohol, has been used as an internal stimulant, in the *dose* of ten to thirty minims (0.6 to 1.8 Cc.).

ALCOHOL. U. S. (Br.)

ALCOHOL

(ăl'cǫ-hŏl)

"A liquid composed of about 92.3 percent., by weight, or about 94.9 percent., by volume, of absolute Ethyl Alcohol [$C_2H_5.OH = 45.70$], and about 7.7 percent., by weight, of water. It should be kept in well-closed vessels, in a cool place, remote from lights or fire." *U. S.* "A liquid containing 90 parts by volume of ethyl hydroxide, C_2H_5OH, and 10 parts by volume of water; obtained by the distillation of fermented saccharine liquids." *Br.*

Spiritus Rectificatus, *Br.;* Ethyl alcohol, Ethyl hydroxide, Rectified Spirit; Spiritus Vini Rectificatissimus, Alcohol ethylicum, Alcohol Vini; Spirit of Wine; Alcool, *Fr. Cod.;* Esprit de Vin, *Fr.;* Spiritus, *P. G.;* Rectificirter Weingeist, Aethyl alkohol, Alkohol, *G.;* Alcool, Acquavite rectificata, *It.;* Alcohol, Espiritu rectificado de vino, *Sp.*

ALCOHOL ABSOLUTUM. U. S., Br.

ABSOLUTE ALCOHOL

(ăl'cǫ-hŏl ăb-sǫ-lū'tŭm)

$C_2H_5OH = 45.7$

"Ethyl Alcohol [$C_2H_5.OH = 45.70$], containing not more than 1 percent., by weight, of water. It should be kept in well-stoppered bottles or tin cans, in a cool place, remote from lights or fire." *U. S.* "Ethyl hydroxide, C_2H_5OH, with not more than 1 per cent., by weight, of water; obtained by the removal of water from less strong ethylic alcohol, and subsequent distillation." *Br.*

Alcohol absolutus, *P. G.;* Absoluter Alkohol, *G.;* Alcool absolu, *Fr.;* Alcool assoluto, *It.;* Alcohol anhidro, *Sp.*

ALCOHOL DILUTUM. U. S. (Br.)

DILUTED ALCOHOL

(ăl'cǫ-hŏl dī-lū'tŭm)

"A liquid composed of about 41.5 percent., by weight, or about 48.9 percent., by volume, of absolute Ethyl Alcohol [$C_2H_5.OH = 45.7$], and about 58.5 percent., by weight, of water. It should be kept in well-closed vessels, in a cool place, remote from lights or fire." *U. S.* "The four official liquids obtained by diluting 'Alcohol (90 per cent.)' with Distilled Water, contain, respectively, 70, 60, 45, and 20 per cent. of ethyl hydroxide by volume." *Br.*

Spiritus Tenuior, *Br.* 1885, Proof Spirit; Alcool dilué, *Fr.;* Spiritus Dilutus *P. G.;* Verdünnter Spiritus, Verdünnter Weingeist, *G.*

From the titles and definitions above given, which include all the forms of alcohol recognized by the U. S. and Br. Pharmacopœias, it will be perceived that there are three U. S. official Alcohols, and four strengths of diluted alcohol recognized by the British Pharmacopœia, those being considered the same which have nearly the same specific gravities and are employed for similar purposes.

The extensive use of alcohol in pharmacy renders it desirable not only to group the official kinds together here, but to consider each in detail in the subsequent pages. In the U. S. P. (1890) two new kinds of alcohol were made official, "Alcohol Absolutum" and "Alcohol Deodoratum." The former, which had been made official in the Br. Pharm. (1885) under the title "Alcohol Ethylicum," is in the Br. Pharm. (1898) termed "Alcohol Absolutum," so that the two Pharmacopœias are now in accord in this. The U. S. Pharmacopœia (8th Rev.) dismissed Alcohol Deodoratum (U. S. P. 1890), but raised the standards for Alcohol to correspond with those formerly required for the dismissed deodorized alcohol.

Alcohol, in the chemical sense, is a peculiar liquid generated for the most part in vegetable juices and infusions by a *fermentation*, called the *vinous* or *alcoholic*. The liquids which have undergone it are called vinous liquors, and are of various kinds. Thus, the fermented juice of the grape is called wine; of the apple, cider; and the fermented infusion of malt, beer.

With regard to the nature of the liquids susceptible of the vinous fermentation, however various they may be in other respects, one general character prevails; that, namely, of containing sugar in some form or other. It is found, further, that after they have undergone the vinous fermentation the sugar they contain has either wholly or in part disappeared; and it was long believed that the only new products are alcohol which remains in the liquid, and carbonic acid which escapes during the process, and that these, when taken together, are equal in weight to the sugar lost. It was hence inferred that sugar is the subject matter of the changes occurring during the vinous fermentation, and that it is resolved into alcohol and carbon dioxide. More recently, however, it has been shown by Pasteur that, along with alcohol and carbon dioxide, glycerin and succinic acid are generated in small amount, and that the process is not so simple as at first supposed.

Sugar will not undergo the vinous fermentation by itself, but requires to be dissolved in water, subjected to the influence of a ferment, and kept at a certain temperature. Accordingly, sugar, water, the presence of a ferment, and the maintenance of an adequate temperature may be deemed the prerequisites of the vinous fermentation. The water acts by giving fluidity, and the ferment and temperature by commencing and maintaining the chemical changes. The precise manner in which the ferment operates has not been positively determined; but the fermentative change seems to be intimately connected with the multiplication of a microscopic plant, *Torula cerevisiæ*. Pasteur has shown that the yeast plant lives and grows at the expense of the sugar, which is converted partly into the plant's tissue, partly into alcohol and other products. The proper temperature for conducting vinous fermentation ranges from 15.5° C. to 32.2° C. (60° to 90° F.).

Certain vegetable infusions, as those of potatoes and rice, readily undergo vinous fermentation, on account of the ease with which their starch is changed into sugar under the influence of certain ferments. Taking the formula of starch as $(C_6H_{10}O_5)_3$ for illustration, it is first changed under the influence of dilute acids or ferments according to the two reactions:

$$(C_6H_{10}O_5)_3 + H_2O = \underset{\text{Dextrin.}}{(C_6H_{10}O_5)_2} + \underset{\text{Dextrose.}}{C_6H_{12}O_6}$$

$$(C_6H_{10}O_5)_3 + 2H_2O = \underset{\text{Maltose.}}{C_{12}H_{22}O_{11}} + \underset{\text{Dextrose.}}{C_6H_{12}O_6}$$

The two compounds, *dextrin* and *maltose*, then pass gradually into dextrose, according to the reactions:

$$(C_6H_{10}O_5)_2 + 2H_2O = 2C_6H_{12}O_6$$

$$C_{12}H_{22}O_{11} + H_2O = 2C_6H_{12}O_6$$

Neither dextrin nor maltose is directly fermentable. Arnoult has succeeded in obtaining alcohol by fermenting sugar (glucose), formed by the action of sulphuric acid on poplar wood sawdust, which yielded from 70 to 80 per cent. of this kind of sugar. Simmson (*Ap. Ztg.*, 1898, 776) obtained 6.5 liters of absolute alcohol from 100 kilogrammes of air dried sawdust. The action of sulphurous acid upon wood fibre has been found by Clássen to be even more satisfactory as a saccharifying agent, and the process has been successfully used in practice.

Alcohol, being the product of the vinous fermentation, necessarily exists in all vinous liquors, and may be obtained from them by distillation. Formerly it was supposed that these liquors did not contain alcohol, but were merely capable of furnishing it, in consequence of a new arrangement of their ultimate constituents, and the result of the heat applied. Brande, however, disproved this idea, by showing that alcohol may be obtained from all vinous liquors without the application of heat, and therefore must pre-exist in them. His method of separating it consists in precipitating the acid and coloring matter from each vinous liquor by lead subacetate, and removing the water by potassium carbonate. According to Gay-Lussac, litharge, in fine powder, is the best agent for precipitating the coloring matter.

In vinous liquors, the alcohol is largely diluted with water, and associated with coloring matter, volatile oil, extractive, ethereal substances, and various acids and salts. In purifying it, advantage is taken of its volatility, which enables it to be separated by distillation, combined with some of the principles of the vinous liquor employed, and more or less water. The distilled product of vinous liquors forms the different *ardent spirits of commerce*. When obtained from wine, it is called brandy; from fermented molasses, rum; from cider, malted barley, or rye, whisky; from malted barley and rye meal with hops, and rectified from juniper berries, Holland gin; from malted barley, rye, or potatoes, and rectified from turpentine, common gin; and from fermented rice, arrack. These spirits are of different strengths, that is, contain different proportions of alcohol, and have various peculiarities by which they are distinguished by the taste. Their strength is accurately judged by the specific gravity, which is always less in proportion as their concentration is greater. When they have the sp. gr. 0.920 (0.91984, Drinkwater), they are designated in commerce by the term *proof spirit*. The United States Custom House and Internal Revenue Service defines the term proof spirit to be alcohol containing 50 per cent. by volume of absolute alcohol at 15.6° C. (60° F.).

Proof spirit is still very far from being pure, being a diluted alcohol, containing about half its weight of water, together with a peculiar oil and other foreign matters. It may be further purified and strengthened by redistillation, or *rectification* as it is called. Whisky is the spirit usually employed for this purpose; and from every hundred gallons, between fifty-seven and fifty-eight may be obtained, of the average strength of rectified spirit (sp. gr. 0.835), corresponding very nearly with the *Spiritus Rectificatus* of the Br. Pharm. When this is once more cautiously distilled, it may be further purified from water, and the specific gravity attained will be about 0.820, which is the lightest spirit that can be obtained by ordinary distillation, and is practically the pure spirit of the British system of excise. It still, however, contains 11 per cent. of water. In the meanwhile, the spirit, by these repeated distillations, becomes more and more freed from the contaminating oil, called *grain oil* or *fusel oil*. (See *Alcohol Amylicum*.) The synthesis of alcohol from ethylene through the intervention of ethyl-sulphuric acid has long been known to be a scientific possibility; with the production of acetylene industrially from calcium carbide, this synthesis has been asserted to be a commercial possibility. Acetylene, made as stated from calcium carbide and water, is generated in the same flask in which nascent hydrogen is being formed, the result being the pro-

duction of ethylene gas. This is brought in contact with concentrated sulphuric acid at 80° C., when the two unite to form ethyl-sulphuric acid, which is then condensed and redistilled, when it breaks up into alcohol and sulphuric acid, which later can be used over again. The reactions for this synthesis are:

C_2H_2 (acetylene) + H_2 (hydrogen) = C_2H_4 (ethylene),

C_2H_4 (ethylene) + H_2SO_4 = $(C_2H_5)HSO_4$ (ethyl-sulphuric acid),

$C_2H_5HSO_4 + HOH = C_2H_5.OH$ (alcohol) + H_2SO_4

Wood (*Chem. News,* 1898, 308), after repeated experiments, doubts the probability of making alcohol synthetically by this process. Berthelot announced the formation of alcohol synthetically, by the union of olefiant gas with water, but in this discovery he was anticipated by Hennel, who published it in 1828.

We shall first consider the general properties of alcohol, and afterwards the different official forms.

Properties.—Alcohol, using this term in a generic sense, is a colorless, transparent, volatile liquid, of a penetrating, agreeable odor, and burning taste. It should be free from foreign odor, which, when present, is owing to fusel oil. When free from water, it is called *anhydrous* or *absolute alcohol.* It is inflammable, and burns without smoke or residue, forming water and carbon dioxide. Its flame is bluish when strong, but yellowish when weak. It combines in all proportions with water and ether, and, when diluted with distilled water, preserves its transparency. Its density varies with the proportion of water it contains. (See alcohol tables, PART III.) Its value depends upon the quantity of absolute alcohol contained in it; and, as this is greater in proportion as the specific gravity is less, it is convenient to take the density of a sample as a means of estimating its strength.

This is done by instruments called hydrometers or alcoholmeters, which, when allowed to float in the spirit, sink deeper into it in proportion as it is lighter. Each hydrometer degree has a corresponding specific gravity, and, by referring to tables constructed for the purpose, the percentage of absolute alcohol is at once shown. Hydrometer manufacturers graduate instruments showing specific gravity and Baumé's degrees upon the same scale in parallel columns, with a thermometer taking the place of the bulb; these are exceedingly convenient. Alcoholmeters are also constructed to show the alcohol percentage by weight directly, as well as percentage of proof spirit.

Alcohol is used enormously in the arts as a solvent and for other purposes, and the U. S. government has established suitable regulations permitting the proper use of alcohol in manufacturing and controlling its use as a beverage. The liquid treated so that it is rendered unfit for use in beverages is termed *denatured* or *denaturized alcohol.* The introduction of *methylated spirit* (alcohol with 10 per cent. of methyl alcohol) has not proved effective. (See *Methylic Alcohol,* PART II.) The French excise directs that alcohol should be denatured or deprived of its natural properties by the addition of 500 Cc. of petroleum benzin and 1 Gm. of malachite green to each hectoliter; it has been found, however, that the color can be destroyed by calcium hypochlorite.

The dangerous properties of methyl alcohol when taken internally caused the Committee of Revision of the U. S. P. (8th Rev.) to introduce a test which is very reliable for determining the presence or absence of methyl alcohol, which is sometimes used as an adulterant for alcohol. It is as follows: *Methyl Alcohol Test,* U. S. P. (8th Rev.). "Into a test-tube of the capacity of about 40 cubic centimeters, 1 Cc. of the Alcohol or spirit to be tested should be poured, and, if it be undiluted, enough distilled water added to make the liquid measure 10 Cc. If the alcohol be already diluted, a correspondingly larger volume of it should be taken and diluted to 10 Cc., so that the proportion of alcohol in the liquid shall not be more than about 10 per cent., by volume. A copper wire spiral (made by winding 1 meter of No. 18 clean copper wire closely around a glass rod 7 millimeters thick, making a coil about 3 centimeters long, the end of the wire being formed into a handle) should be heated to redness in a flame free from soot, and plunged steadily quite to the bottom of the liquid in the test-tube and held there for a second or two, then withdrawn and dipped into water to cool. This treatment with red-hot copper should be repeated five or six times, immersing the test-tube in cold water to keep down the temperature of the liquid. The contents of the test-tube should now be filtered into a wide test-tube and boiled very gently. If the odor of acetaldehyde be perceptible, the boiling is to be continued until the odor ceases to be distinguished clearly. The liquid is now cooled, and to it should be added 1 drop of a solution containing 1 part of resorcinol in 200 parts of water. A portion of this liquid is then poured cautiously into a second tube containing pure sulphuric acid, in such a way that the two liquids shall not mix, the tube being held in an inclined position; this tube is allowed to stand for three minutes, and then slowly rotated. No rose-red ring should show at the line of contact of the two layers (absence of more than 2 percent. of *methyl alcohol*)." *U. S.*

Alcohol is capable of dissolving a great number of substances; as, for example, sulphur and phosphorus in small quantity, iodine and ammonia freely, and the hydroxides of potassium, sodium, and lithium, but not the carbonates of these metals. Among organic substances, it is a solvent of most of the vegetable alkaloids, urea, tannic, citric, and tartaric acids, sugar, mannite, camphor, resins, balsams, volatile oils, and soap. It dissolves the fixed oils sparingly, except castor oil, which is abundantly soluble in it. It reacts chemically with some acids, forming the ethyl esters, but with others acts

only as a solvent. All deliquescent salts are soluble in alcohol, except potassium carbonate; while the efflorescent salts, and those either insoluble or sparingly soluble in water, are mostly insoluble in it. It dissolves ammonium chloride, and most of the chlorides readily soluble in water; also some nitrates, but none of the metallic sulphates.

A method of detecting alcohol in small proportions has been proposed by Carstanjin. The liquid supposed to contain it, having been mixed with platinum black in a small flask, is heated to 51.1° C. (124° F.), well shaken, and filtered. To the filtrate a few drops of solution of potassium hydroxide are added, and the liquor evaporated to dryness on a water bath. The residue is then heated with a little arsenic trioxide, when, if alcohol be present, a garlicky odor will be perceived, owing to the production of cacodyl. According to Nickles, however, propylic alcohol will produce the same result. (*A. J. P.*, 1865, p. 334.) A very delicate test for small quantities of alcohol is that of Lieben as modified by Hager. (*Zeit. An. Chem.*, ix. 492.) It depends on the fact that alcohol under the influence of iodine and an alkali yields iodoform, CHI_3, the properties of which are very characteristic. To 10 Cc. of the clear suspected liquid five or six drops of a 10 per cent. solution of potassium or sodium hydroxide are added, and the liquid is warmed to about 50° C. (122° F.). A solution of potassium iodide fully saturated with free iodine is next added drop by drop, with agitation, until the liquid becomes permanently yellowish brown, when it is carefully decolorized by a further cautious addition of the caustic alkali solution. If alcohol be present, iodoform is gradually deposited at the bottom of the tube in yellow crystals, which, after standing, may be examined with a lens. Spirit diluted with 2000 parts of water, when treated as above and allowed to stand twelve hours, gives a distinct dust-like deposit of iodoform. Unfortunately, the above delicate reaction is not peculiar to alcohol, being produced by acetone, aldehyde, propylic and butylic alcohols, various ethers, etc. On the other hand, it is not given by pure methyl or amyl alcohol, chloroform, chloral, glycerin, or ether, nor by acetic, formic, or oxalic acids. (Allen, *Com. Org. Anal.*, 2d ed., i. p. 59; see also *A. J. P.*, Feb. 1877, Feb. 1879, Nov. 1879; *N. R.*, Aug. 1876.) Barfoed of Copenhagen, recommends for an approximate simple test, to moisten small slips of filtering paper thoroughly with the alcohol, and set fire to them. If, when the alcohol has burned out, the paper slip catches fire readily, the alcohol must be stronger than 80 per cent.; if the paper barely catches fire, the strength may be presumed to be between 75 and 80 per cent.; if it does not catch fire at all, the alcohol cannot be stronger than 73 or 75 per cent. (*A. J. P.*, Jan. 1875.)

Alcohol tables will be found in PART III, which will give the specific gravities of the various strengths of alcoholic liquids. The temperature at which the specific gravities of these liquids is taken was not changed to 25° C. (77° F.) in the U. S. P. (8th Rev.), as it was for most liquids, because the temperature 15.6° C. (60° F.) was the one adopted by the U. S. government and still retained by it, for all of the national legal requirements.

ALCOHOL ABSOLUTUM. *Absolute Alcohol, Anhydrous Alcohol, Ethylic Alcohol.*—No process is given in the U. S. Pharmacopœia for the preparation of absolute alcohol; the definition given, however, is "Ethyl Alcohol [$C_2H_5.OH = 45.70$], containing not more than 1 percent., by weight, of water." *U. S.* The following is the process of the Br. Pharmacopœia (1885): "Rectified Spirit, 1 pint [Imp. meas.]; Carbonate of Potassium, anhydrous, 2 ounces [av.]; Chloride of Calcium, fused, a sufficiency. Add the carbonate of potassium to the spirit in a stoppered bottle, and macerate for twenty-four hours with frequent agitation. Put the chloride of calcium into a covered crucible, and subject it to a red heat for half an hour; then pour the fused salt on to a clean stone slab, cover it quickly with an inverted porcelain dish, and when it has congealed, break it up into small fragments and enclose in a dry stoppered bottle. Put one pound [av.] of this fused chloride of calcium into a flask, pour over it the spirit decanted from the carbonate of potassium, and, closing the mouth of the flask with a cork, shake them together and allow them to stand for twenty-four hours with repeated agitation. Then attaching a dry condenser closely connected with a receiver from which free access of air is excluded, and applying the flame of a lamp to the flask, distil about two fluidounces [Imp. meas.], which should be returned to the flask, after which the distillation is to be continued until fifteen fluidounces [Imp. meas.] have been recovered." *Br.* 1885. By the term absolute alcohol is meant pure alcohol, entirely free from water. In this state it cannot be obtained by ordinary distillation alone, the purest alcohol thus procured still containing 5 per cent. of water. To separate this it is customary to have recourse to substances having a very strong affinity for water, sufficient not only to abstract it from the alcohol, but to retain it at a temperature at which alcohol will distil over. Soubeiran recommends the following method for obtaining it, and the British process is largely based upon this plan. 1st. Rectify alcohol marking 86° of the centesimal alcoholmeter of Gay-Lussac (rectified spirit), by distilling it from potassium carbonate. This operation should raise its strength to 94° or 95°. 2nd. Raise this alcohol to 97° by distilling it with fused calcium chloride, or by digesting it with quicklime (from which it must be afterwards poured off), in the proportion of a pint of the alcohol to 1½ ounces of the chloride, or 2¼ ounces of the lime. 3rd. Distil the product of this operation slowly with quicklime, in the proportion of 3¾ ounces to the pint. The product will be absolute alcohol. The operation

may be shortened to two steps by distilling the alcohol of 94° or 95° with an excess of quicklime (7¼ ounces to the pint). In all cases, before decanting or distilling, the alcohol must be digested for two or three days with the lime, at a temperature between 95° and 100° F. Lime will not answer as a substance to be distilled from, unless it be in sufficient excess; for otherwise, towards the end of the distillation, the calcium hydroxide formed will yield up its water to the alcohol, and weaken the distilled product. J. Lawrence Smith (*Amer. Chemist,* Oct. 1874) procures an alcohol of 98 to 100 per cent. by macerating 3 pints of alcohol, 94 per cent., in a four-pint bottle with about six troyounces of well burned lime; well corked and agitated at intervals for ten days, the strengthened alcohol, at the end of this time, is drawn off by a siphon, and may be freed, if desired, of the small trace of lime by redistillation. Yvon prepares absolute alcohol by treating strong alcohol with powdered calcium carbide (*Chem. News,* 1898, 52).

Properties.—Absolute alcohol is a colorless, volatile liquid, of an agreeable odor and burning taste. It boils at 78.4° C. (173.1° F.), and is congealed at —130.5° C. Its sp. gr. is 0.7978 at 68°, according to Regnault; 0.79381 at 60°, according to Drinkwater; 0.794 (equivalent to 99.95 per cent. of ethyl hydroxide by volume and by weight) to 0.7969 (equivalent to 99.4 per cent. of ethyl hydroxide by volume or 99 per cent. by weight), by the British Pharmacopœia; while E. R. Squibb has shown that pure alcohol is obtainable of as low a density as 0.7935, and possibly lower. (*Ephem.,* ii. p. 522.) The sp. gr. of its vapor is 1.59. Absolute alcohol is officially described as "a transparent, colorless, mobile, and volatile liquid, of a characteristic, rather agreeable odor, and a burning taste. Very hygroscopic. Specific gravity: not higher than 0.797 at 15.6° C. (60° F.); or 0.790 at 25° C. (77° F.). In other respects Absolute Alcohol has the properties, and should respond to the reactions and tests, of Alcohol (see *Alcohol*)." *U. S.* "Mixed with 1 to 2 per cent. of anhydrous *copper sulphate* in a well-closed bottle, and the mixture set aside for two or three hours and occasionally well shaken, the salt does not become of a decidedly blue color (absence of excess of water). Absolute Alcohol should be free from the impurities mentioned under 'Alcohol (90 per cent.),' and in other general characters should resemble it." *Br.* The tests usually given to prove the absence of water by dropping into the absolute alcohol anhydrous barium oxide or anhydrous copper sulphate are not reliable, as Squibb has demonstrated that when half of one per cent. of water was added to absolute alcohol no change in either the barium oxide or the anhydrous copper sulphate took place. Görgeu's test of forming a clear solution when mixed with an equal bulk of pure benzene is more delicate, but a test for determining the presence of as little as one per cent. of water is needed. Absolute alcohol should be free from fusel oil. Absolute alcohol burns with a pale flame without residue, the products being carbon dioxide and water. Its vapor, passed through a porcelain tube filled with pumice stone and heated to redness, yields carbon, gaseous hydrocarbons, aldehyde, naphthalene, benzene, phenol, and various other substances. (Berthelot.) It unites in all proportions with ether and water. Its union with water is attended by condensation and a rise of temperature. When 52.6 volumes of alcohol are mixed with 47.4 of water, corresponding with one molecule of the former to three of the latter, the decrease of volume is at the maximum, amounting to 3.4 per cent.

Composition.—Absolute alcohol consists of two atoms of carbon, six of hydrogen, and one of oxygen. Its empirical formula is, therefore, C_2H_6O. It is, however, recognized as the hydroxide of the radical ethyl (C_2H_5), so that its rational formula would be $C_2H_5.OH$.

During the vinous fermentation sugar disappears, and the sole products were formerly supposed to be alcohol and carbon dioxide, which, taken together, were believed to equal in weight the lost sugar; the comparative composition of the substances concerned supports the opinion that these are the sole derivatives of a portion of the sugar lost. Preparatory to the fermentation, the cane sugar is changed into *grape sugar,* or into a mixture of equal molecules of *dextrose* and *levulose,* called *invert* sugar, according to the reaction given on page 104. These two sugars, dried at 100° C. (212° F.), consist of $C_6H_{12}O_6$. Supposing one molecule of this fermentable sugar to be the subject of the change, it will be found to have a composition which admits of its being broken up into two molecules of alcohol and two of carbon dioxide:

$$C_6H_{12}O_6 = 2C_2H_6O + 2CO_2$$

But it does not follow that all the sugar has been converted into alcohol and carbon dioxide; and Pasteur, as before stated, has shown that a portion lost has not been thus converted, but has been partly appropriated to the growth of the yeast plant of the ferment, and partly changed into glycerin and succinic acid.

Alcohol. *U. S. Alcohol,* sp. gr. 0.816 at 15.6° C. (60° F.).—This is the so-called "95 per cent. alcohol" of commerce (or 94.9 per cent. by volume); it was an official preparation of the Dublin College, which gave a formula for its preparation, and stated its sp. gr. at 0.818. The Stronger Alcohol introduced into the U. S. P. (1860), though of the sp. gr. 0.817, and therefore a little stronger than the old Dublin preparation, was for all practical purposes identical with it. The British Pharmacopœia (1898), under the title "Spiritus Rectificatus," recognizes alcohol of 90 per cent. by volume. This is slightly stronger (1.35 per cent.) than the alcohol of the same name in the Br. Pharm. (1885). To prepare it on a small scale, potassium carbonate,

previously ignited in a heated mortar, may be mixed with ordinary alcohol in a bottle, and shaken occasionally for about four hours, the mixture being, in the meantime, maintained at the temperature of about 100° F. Upon standing, the liquid divides into two layers, the lower consisting of an aqueous solution of potassium carbonate, the upper of the stronger alcohol, which is to be separated, and distilled so as to obtain the measure of about nine-tenths of the original alcohol employed.

It is described as "a transparent, colorless, mobile and volatile liquid, of a slight, agreeable odor, and a burning taste. Specific gravity: about 0.816 at 15.6° C. (60° F.), the standard temperature for Alcohol, or 0.809 at 25° C. (77° F.). Miscible with water in all proportions, and without any trace of cloudiness; also miscible with ether or chloroform. It is readily volatilized, even at low temperatures, and boils at 78° C. (172.4° F.). It is inflammable, and burns with a pale blue, smokeless flame. It should not affect the color of blue or red litmus paper previously moistened with water. If 50 Cc. of Alcohol be evaporated in a clean glass vessel, no *color* or *weighable residue* should remain. If 10 Cc. of Alcohol be mixed with 5 Cc. of water and 1 Cc. of glycerin, and the mixture allowed to evaporate spontaneously from a piece of clean, odorless blotting paper, *no foreign odor* should become perceptible when the last traces of the Alcohol leave the paper (absence of *fusel oil constituents*). If 25 Cc. be allowed to evaporate spontaneously in a porcelain evaporating dish, carefully protected from dust, until the surface of the dish is barely moist, no red or brown color should be produced upon the addition of a few drops of colorless, concentrated sulphuric acid (absence of *amyl alcohol*, or *non-volatile, carbonizable, organic impurities*, etc.). If 10 Cc. of Alcohol be mixed in a test-tube with 5 Cc. of potassium hydroxide T.S., the liquid should not at once assume a yellow color (absence of *aldehyde* or *oak tannin*). If 20 Cc. of Alcohol be shaken in a clean, glass-stoppered vial with 1 Cc. of silver nitrate T.S., the mixture should not become more than faintly opalescent, or acquire more than a faint brownish tint when exposed for six hours to diffused daylight (limit of *organic impurities, amyl alcohol, aldehyde*, etc.)." *U. S.* "Specific gravity 0.8340. It contains 85.65 per cent. by weight of ethyl hydroxide, C_2H_5OH, and 14.35 per cent. by weight of water. It burns with a blue smokeless flame. It leaves no residue when evaporated (absence of fixed matter). It remains clear when mixed with *water* (absence of oily or resinous substances). A little exposed on clean white filter paper leaves no unpleasant smell after the alcohol has evaporated (absence of fusel oil and allied impurities). 100 cubic centimetres, with 2 cubic centimetres of the *volumetric solution of silver nitrate*, exposed for 24 hours to bright light and then decanted from the black powder which has formed, undergo no further change when again exposed to light with more of the *volumetric solution* (absence of more than traces of amylic alcohol and of other organic impurities). When mixed with half its volume of *solution of potassium hydroxide*, the liquid should not immediately darken in color (absence of more than traces of aldehyde). The addition of *solution of ammonia* should not cause an immediate darkening in color (absence of tannic acid, excess of aldehyde, and other organic impurities)." *Br.*

On a large scale, alcohol of this strength is now prepared in the United States, very abundantly, by simple distillation by means of a modified distillatory apparatus known as a "still and column." The modification consists in substituting for a single refrigerated receiver a series of receivers, kept at such temperatures that, in the first of them, the aqueous vapor shall condense with comparatively little of the alcoholic, which, as it passes through the successive recipients, is more and more deprived of water, until, when condensed in the last, it yields a spirit at least as strong as the official Alcohol of the sp. gr. 0.816. At the same time that the spirit is thus strengthened, it becomes, on the same principle, more and more freed from fusel oil, until almost wholly deprived of it.

The British preparation contains 14.35, the U. S. only 7.7 per cent. of water. Official alcohol, though of standard strength, may still be impregnated with a volatile principle, called *fusel oil*. This is usually separated by digesting the alcohol with charcoal. It, as well as other impurities, may also be removed by passing the impure spirit through a filtering bed, composed of sand, wood charcoal, boiled wheat, and broken oyster shells, arranged in layers. If 5 Cc. of alcohol be mixed with 6 times its volume of water and then agitated with about 20 drops of chloroform, the latter will, if separated and allowed to evaporate spontaneously, leave the fusel oil, which will be perceptible by its odor; and by treating with a little sulphuric acid and potassium acetate, its peculiar ether may be recognized by its odor. (*Ber. d. Chem. Ges.*, viii.; *A. J. P.*, 1875, p. 304.) If a little of the solution of silver nitrate be added to alcohol and the mixture exposed to a bright light, a black powder will be precipitated, if fusel oil be present. Official alcohol will not withstand this test, as the best contains a little of the foreign oil. According to E. N. Kent of New York, silver nitrate will not detect fusel oil, but affords its indications by reacting with other organic substances. For detecting fusel oil, Kent finds pure sulphuric acid the best test. To apply it he half fills a test tube with the spirit to be tested, and then fills it up very slowly with pure concentrated sulphuric acid. If the spirit be pure, it will remain colorless, otherwise it will become colored, the tint being deeper in proportion to the amount of the impurity. The presence of a small proportion of fusel oil is readily detected by the use of this test.

Deodorized alcohol is, as its name implies, alcohol deprived of foreign odor; there are certain uses in pharmacy for which any other alcohol would be unsuited, such as the solution of volatile oils and essences having delicate odors, the manufacture of compound spirits, etc. This was official in the U. S. P. 1890, under the title *Alcohol Deodoratum,* but, inasmuch as it is easily obtained in the United States, at a slight advance in price over commercial alcohol, its standards of purity, odor and strength were retained for the *Alcohol* of the U. S. P. (8th Rev.), see page 103, hence the alcohol used in pharmacopœial preparations is now deodorized alcohol.

The best deodorized alcohol is that manufactured under Atwood's patent process, in which manganic acid or potassium or sodium permanganate is used to destroy fusel oil and other foreign substances. This alcohol withstands the tests of silver nitrate and sulphuric acid remarkably well. Pure fused sodium acetate has been proposed as a substance particularly adapted to retain fusel oil, and has been used by adding it to the alcohol to be rectified in the proportion of about 10 pounds to the barrel of forty-five gallons, and redistilling. The purification of alcohol is best accomplished, according to Schmitt, by taking crude alcohol containing 30 per cent. by volume, adding potassium carbonate (not enough to cause two layers to form), and agitating with pure petroleum benzin; this solvent removes completely the fusel oil from the alcohol. After separating the light layer, potassium carbonate is added to the alcohol in sufficient quantity to form two layers, the lower one consisting of a saturated solution of potassium carbonate, the upper one of 94 per cent. alcohol containing a small quantity of potassium carbonate. The alcohol layer is siphoned off and mixed with just sufficient strong sulphuric acid to precipitate the potassium salt as sulphate, which is insoluble in alcohol of 94 per cent., and which can then be removed. Alcohol purified in this manner, without distillation, it is stated, cannot be distinguished from that purified by the usual method. (See *Ph. Centralh.,* 1889, p. 722.) F. G. Earl recommends the following method, which has the advantage of requiring no special apparatus. "Rub four drachms of powdered unslaked lime with two drachms of powdered alum intimately; add one gallon (95 per cent.) alcohol, and shake well, then add one fluidrachm of spirit of nitrous ether, set aside for seven days, and filter through animal charcoal." (*C. D.,* 1895, 35.) *Perfumers' alcohol* can now be had, which is very much cleaner than *cologne spirit,* as the purest alcohol attainable was formerly called. It is termed perfumers' alcohol because it was found necessary to prepare a very high grade of alcohol for those who need a solvent for fine odors, on the score of economy and to insure greater excellence of product.

ALCOHOL DILUTUM. *U. S.*—"A liquid composed of about 41.5 percent., by weight, or about 48.9 percent., by volume, of absolute Ethyl Alcohol [$C_2H_5.OH = 45.7$], and about 58.5 percent., by weight, of Water." *U. S.* Specific gravity about 0.936 at 15.6° C. (60° F.) and about 0.930 at 25° C. (77° F.). The strength of diluted alcohol has been somewhat altered by the U. S. P. (8th Rev.) Since the present official alcohol is somewhat stronger than that of the U. S. P. 1890, the strength of diluted alcohol is correspondingly slightly increased.

Diluted alcohol is officially made by mixing equal measures of alcohol and water together.[1] "Alcohol, *five hundred cubic centimeters* [or 16 fluidounces, 7 fluidrachms, 15 minims]; Distilled Water, *five hundred cubic centimeters* [or 16 fluidounces, 7 fluidrachms, 15 minims]. Mix them. If the two liquids be measured at the temperature of 25° C. (77° F.), the mixture, when cooled to the same temperature, will measure about 970 Cc. [or 32 fluidounces, 384 minims]. *Diluted Alcohol* may also be prepared as follows: Alcohol, *four hundred and eight grammes* [or 14 ounces av., 171 grains]; Distilled Water, *five hundred grammes* [or 17 ounces av., 279 grains]. Mix them." *U. S.*

The British Pharmacopœia (1898) no longer uses the titles "Spiritus Tenuior" or "Proof Spirit" for diluted alcohol, but admits four official liquids under the name of diluted alcohol, as follows:

"1. **Alcohol (70 per cent.).**—With *one hundred fluid ounces* of Alcohol (90 per cent.) mix *thirty-one* (more accurately 31.05) *fluid ounces* of Distilled Water. Or, with *one thousand cubic centimetres* of Alcohol (90 per cent.) mix *three hundred and ten and a half* (310.5) *cubic centimetres* of Distilled Water. Specific gravity 0.8900.

2. **Alcohol (60 per cent.).**—With *one hundred fluid ounces* of Alcohol (90 per cent.) mix *fifty-three and two-thirds* (more accurately 53.65) *fluid ounces* of Distilled Water. Or, with *one thousand cubic centimetres* of Alcohol (90 per cent.) mix *five hundred and thirty-six and a half* (536.5) *cubic centimetres* of Distilled Water. Specific gravity 0.9135.

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[1] "RULES FOR MAKING AN ALCOHOL OF ANY REQUIRED LOWER PERCENTAGE FROM AN ALCOHOL OF ANY GIVEN HIGHER PERCENTAGE:

I. *By Volume.*—Designate the volume-percentage of the stronger alcohol by *V*, and that of the weaker alcohol by *v*.

Rule.—Mix *v* volumes of the stronger alcohol with distilled water to make *V* volumes of product. Allow the mixture to stand until full contraction has taken place, and until it has cooled, then make up the deficiency in the *V* volumes by adding more distilled water.

Example.—An alcohol of 30 percent. by volume is to be made from an alcohol of 94.9 percent. by volume.—Take 30 volumes of the 94.9 percent. alcohol, and add enough distilled water to produce 94.9 volumes.

II. *By Weight.*—Designate the weight-percentage of the stronger alcohol by *W*, and that of the weaker alcohol by *w*.

Rule.—Mix *w* parts by weight of the stronger alcohol with distilled water to make *W* parts by weight of product.

Example.—An alcohol of 50 percent. by weight is to be made from an alcohol of 92.3 percent. by weight.—Take 50 parts by weight of the 92.3 percent. alcohol, and add enough distilled water to produce 92.3 parts by weight." *U. S.*

3. **Alcohol (45 per cent.).**—With *one hundred fluid ounces* of Alcohol (90 per cent.) mix *one hundred and five and one third* (more accurately 105.34) *fluid ounces* of Distilled Water. Or, with *one thousand cubic centimetres of Alcohol* (90 per cent.) mix *one thousand and fifty-three and a half* (more accurately 1053.4) *cubic centimetres* of Distilled Water. Specific gravity 0.9436.

4. **Alcohol (20 per cent.).**—With *one hundred fluid ounces* of Alcohol (90 per cent.) mix *three hundred and fifty-five and three-quarters* (more accurately 355.8) *fluid ounces* of Distilled Water. Or, with *one thousand cubic centimetres* of Alcohol (90 per cent.) mix *three thousand five hundred and fifty-eight* (3558.0) *cubic centimetres* of Distilled Water. Specific gravity 0.9760." *Br.*

This is a convenient pharmaceutical method of providing suitable menstrua for making tinctures, fluidextracts, and other galenical preparations, which have been adopted by the British Pharmacopœia.

"Diluted Alcohol has a specific gravity of about 0.936 at 15.6° C. (60° F.), the standard temperature for Alcohol, and about 0.930 at 25° C. (77° F.). It should respond to the reactions and tests given under *Alcohol*." *U. S.*

Uses.—The local action of alcohol is that of an active irritant and germicide; in the absence of better antiseptic remedies it may afford a very useful application to wounds and even to infected sores, upon which it should be used freely and of strengths varying from 50 to 80 per cent. When it is taken habitually in excess, its local irritant influence often leads to the production of gastritis, to that form of hepatitis which is known in its advanced stage as cirrhosis of the liver, and to inflammatory disease of the kidney. Very frequently, especially when the alcohol is taken well diluted and with an abundance of food, the organic changes produced by its continued use are rather those of fatty degeneration of the liver and kidneys, and it may be of the heart, than of inflammation. It is absorbed with rapidity, is either completely oxidized in the system or in part eliminated unchanged, according to the amount which has been ingested, the animal organism having apparently the power of burning up only so much alcohol. The excess of alcohol escapes chiefly through the kidneys but probably to a greater or less extent through the lungs and skin. The single large dose of alcohol will produce the condition known as drunkenness, ending, if sufficient of the poison has been taken, in absolute muscular relaxation, profound stupor, fall of bodily temperature, collapse, and it may be, death.

The treatment of alcoholic narcotism consists in immediate washing out of the stomach, in the maintenance of the bodily temperature by external warmth if the fall has been great, and in the hypodermic injection of strychnine, cocaine and atropine to maintain respiration, and of digitalis for its action upon the heart.

Alcohol in small doses acts as a stimulant to the ganglionic cells of the cerebrum, and perhaps also to the motor tract of the spinal cord. In large amount it certainly is a depressant to the cerebral and spinal ganglionic cells, as well as the nerve trunks. The action of small doses upon the respiratory centres is not thoroughly established, but large doses depress the respiratory centres, and finally may cause death by centric paralytic asphyxia. Alcohol does not usually increase the arterial pressure, but when in moderate doses it increases to a remarkable degree the rapidity of the flow of blood through the arteries. It does this by stimulating the heart and by depressing the vasomotor centres, widening out the blood vessel system so that there is increase of the driving force and lessening of the resistance. The toxic dose of alcohol depresses both the heart and the blood vessel system, decreasing the rate of flow through the blood vessels and the arterial pressure. The peripheral temperature is often increased by small amounts of alcohol, and there may be even a slight increase in the central temperature, probably caused by quickening of the circulation; the large dose of alcohol depresses the animal temperature, probably by causing vasomotor paralysis, and thereby increasing heat dissipation.

In regard to the effect of alcohol upon the nutrition there is much contradictory evidence, but the present probabilities are that the drug has no specific influence upon the production of heat or of carbon dioxide, or upon nitrogenous elimination, and that therefore it has little or no direct effect upon the nutrition, unless it be in poisonous doses, when it certainly disturbs all nutritive processes. In its oxidation in the system alcohol undoubtedly yields force, and it would appear to be demonstrated that the animal organism has the power of using this force for the purposes of life. In one sense, therefore, alcohol is a food, and our present knowledge indicates that it is, in a measure but not altogether, capable of replacing in the system such hydrocarbons as starch and fats. On the other hand, alcohol is incapable of yielding material to the system which shall be built up into tissue, and it is therefore incapable of supplying the place of any food except in the degree to which it may be used as a source of force.

In acute diseases associated with *debility*, alcohol is often an invaluable remedy. Of all medicines it is the one most frequently employed as a stimulant. Taken along with food in small quantity, it favors digestion by its local effect upon the stomach, and possibly also by stimulating the nerve and arterial centres. It does not directly elevate temperature, and hence is not contra-indicated by fever; in *typhoid* and other *low fevers* it is of great value. In all conditions of depression the system tolerates much more of it than in health; hence in *snake bite, typhoid* and *typhus fever, diphtheria*, etc., enormous quantities are often exhibited with

great benefit. So long as it is not perceptible in the breath, and does not cause nervous or circulatory excitement, alcohol in these cases is probably not in excess. In chronic diseases great care is necessary in the exhibition of the remedy, for fear of begetting intemperate habits. This is especially the case in *neuralgia* and other painful affections in which the narcotic influence may be very soothing; under these circumstances there is a constant tendency to an increase of the frequency and size of the dose. Taken habitually in excess, alcohol produces the most deplorable results, and is a very common cause of fatal maladies. Locally, alcohol is sometimes used for the purpose of hardening the skin and as an antiseptic dressing for *wounds*, the wound being washed out with it until all bleeding has ceased, the edges then united, and the whole surrounded by an alcoholic dressing. Pure alcohol is rarely used internally, but only as spirit, wine, or fermented liquor, described elsewhere.

The purer forms of alcohol, whether strong or diluted, are employed almost exclusively in pharmacy; as in the preparation of medicines, such as ether, into the composition of which they enter; for the preservation of organic substances; in the extraction of the active principles of drugs, as in the tinctures; for dissolving bodies soluble in alcohol much more readily than in water, or insoluble in the latter fluid; and for other pharmaceutical purposes. Diluted alcohol is employed as an addition to some infusions and decoctions, and to some of the distilled waters, in order to preserve them from decomposition; as a menstruum for extracting the virtues of plants, preparatory to the formation of extracts and syrups; and in preparing many of the spirits, and a few of the medicated wines. But it is in forming the tinctures that diluted alcohol is chiefly used. Some of these are made with official alcohol (rectified spirit), but the majority with mixtures of alcohol and water of different percentages. As diluted alcohol contains more than half its weight of water, it is well fitted for acting on organic substances the virtues of which are partly soluble in water and partly in alcohol. The apothecary, however, should never substitute the commercial proof spirit for diluted alcohol, on account of the impurities in the former, even though it may be of the same strength, and when it is recollected how variable the so-called proof spirits are in strength, the objection to their use in pharmacy becomes still stronger.

ALOE. U. S.

ALOES [Aloe Barbadensis, Aloe Socotrina, Pharm. 1890]

(ăl'o-ē)

"The inspissated juice of the leaves of *Aloe vera* (Linné) Webb, *Aloe Chinensis* Baker, *Aloe Perryi* Baker, or other species of *Aloe* (Fam. *Liliaceæ*)." *U. S.*

Acibar, *Sp.*

ALOE BARBADENSIS. Br.

BARBADOS ALOES [Curaçao Aloes]

(ăl'o-ē bär-bā-dĕn'sis)

"The juice that flows from the transversely cut leaves of Aloe vera, *Linn.*, Aloe chinensis *Bak.*, and probably other species, evaporated to dryness. Imported from the West Indian Islands, and known in commerce as Barbados and Curaçao aloes." *Br.*

Aloès hépatique des Barbades, *Fr.*; Barbados Aloe, *G.*

ALOE PURIFICATA. U. S.

PURIFIED ALOES

(ăl'o-ē pū-rĭ-fĭ-cā'tă)

Aloès dépuré, *Fr.*; Gereinigte Aloe, *G.*

* "Aloes, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]. Heat the Aloes, by means of a water-bath, until it is completely melted. Then add the Alcohol, and, having stirred the mixture thoroughly, strain it through a No. 60 sieve, which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the mass becomes brittle on cooling. Lastly, break the product, when cold, into pieces of a convenient size, and keep it in well-stoppered bottles." *U. S.*

"Purified Aloes is in irregular, brittle pieces of a dull-brown or reddish-brown color, and having the peculiar odor of Aloes. It is almost entirely soluble in alcohol." *U. S.*

Aloes, as found in the market, even of good quality, is so often mixed with various accidental impurities, such as fragments of wood, vegetable remains, pieces of leather, and earthy matter, that it has been thought advisable to have an official process by which it may be freed from these, should its purification be found necessary in any particular instance. The use of alcohol in the formula is simply to render the melted aloes more liquid, and thus facilitate the straining; it is subsequently eliminated by evaporation; but care should be taken not to use too great a heat, or to continue it too long, for fear of impairing the virtues of the drug.

Off. Prep.—(See page 117.)

ALOE SOCOTRINA. Br.

SOCOTRINE ALOES

(ăl'o-ē sŏc-o-trī'nă)

"The juice that flows from the transversely cut leaves of Aloe Perryi, *Baker*, and probably other species of Aloe, evaporated to dryness.

Imported principally by way of Bombay, and known in commerce as Socotrine and Zanzibar aloes." *Br.*

Aloés socotrin, ou sucotrin, *Fr.;* Socotora oder Socotrinische Aloe, *G.;* Musebber, *Ar.;* Acíbar Sucotrino, *Sp.*

The 1890 edition of the U. S. Pharmacopœia agreed with the British in recognizing as distinct varieties Barbados and Socotrine aloes; very wisely, however, in the eighth revision the general title of Aloe was adopted as representing any varieties of the drug which would conform with the official description and tests.

Most plants belonging to the genus Aloe are capable of yielding a bitter juice from which may be prepared an aloes, and there is little doubt that in many cases a commercial aloes exported from one country is the product of several species.

In former editions of the U. S. Dispensatory, Cape aloes was attributed to the *Aloe spicata,* L., but as was originally pointed out by J. Medley Wood (*P. J.,* Dec., 1890), Cape aloes is in fact chiefly yielded by the much larger plant, *A. ferox,* Miller.

The two plants are quite different in appearance. *A. spicata,* L., Willd., *Sp. Plant.* ii. 185, has a simple stem, three or four feet high, about four inches in diameter, with twelve to twenty leaves laxly disposed in the form of a rosette at the top; the leaves themselves are one to one and a half feet long, one and one-half to two inches in breadth near the base; glaucous green, without prickles except on the margin, which is armed with strong, spreading, deltoid, cuspidate prickles one-eighth to one-sixth of an inch long.

A. ferox, Miller (*Gard. Dict.,* ed. viii., No. 22) has a simple stem ten to fifteen feet long, four to six inches in diameter; furnished at the top with a dense rosette containing thirty to fifty leaves, which are lanceolate, one and one-half to two feet long, very rigid, with copious prickles on back and face, the margin armed with brown-tipped deltoid or cuspidate prickles one-eighth to one-sixth of an inch long.

According to L. Pappe, Cape aloes of poor quality is obtained from *A. africana* and *A. plicatilis,* of Miller; while in Lindley's *Flora Medica, A. purpurascens,* Haworth, *A. arborescens,* Mill., *A. Commelyni,* Willd., and *A. multiformis* are all said to contribute to commercial Cape aloes. *Curaçao Aloes* is apparently produced by the following species: *A. vera* (L.), Webb, *A. vulgaris,* Lam., *A. spicata,* L., and *A. socotrina,* Lam., all of which have been introduced into the island (see *P. J.,* Jan., Sept., 1890), although E. R. Holmes believes it to be at least in part the product of *A. chinensis,* Baker.

A. socotrina, Lamarck, *Encycl.* i. 85; De Cand., *Plantes Grasses,* fig. 85. *A. vera,* Miller, *Dict.,* ed. viii., No. 55—The stem of this species is erect, eighteen inches or more in height, woody, and leafless below. At top it is embraced by green, sword-shaped, ascending leaves, somewhat concave on their upper surface, convex beneath, curved inward at the point, with numerous small white serratures at their edges.

This plant was supposed to be a native of Socotra and the source of the Socotrine aloes, but was shown by Bolus to be indigenous to the Cape of Good Hope.

A. vera, L. *A. vulgaris,* Lamarck, *Encycl.,* i. 86. *A. barbadensis,* Miller. *A. indica,* Royle. *A. littoralis,* Koenig.—This species has a very short, woody stem, and lanceolate embracing leaves, which are first spreading, then ascending, of a glaucous green color, somewhat mottled with darker spots, flat on the upper surface, convex beneath, and armed with hard reddish spines, distant from each other, and perpendicular to the margin. *A. vera* is a native of Southeastern Europe, Northern Africa, and Madagascar. It is cultivated in Italy, Sicily, Malta, and especially in the West Indies, where it contributes largely to furnish the Barbados aloes.

A. Perryi, J. G. Baker, *Tr. Linn. Soc.,* xxviii. The true Socotrine aloe plant was first described from specimens sent to Kew Gardens by Wykeham Perry, and was subsequently found by Balfour of Edinburgh, growing abundantly upon the island of Socotra, especially in the limestone tracts, from the sea level to an altitude of 3000 feet; along with it, but much less abundant, was a dwarf species with spotted leaves. It resembles in its general habit the Barbados aloe, but differs in its shorter leaves, and especially in its flowers, which are arranged in looser racemes on longer pedicels and have the tube much longer than the segments.

The proper aloetic juice was formerly thought to exist in longitudinal vessels beneath the epidermis of the leaves, and readily flows out when these are cut transversely; but, according to E. Robiquet, who made elaborate researches in relation to this drug, these vessels are air ducts, and the juice flows in the intercellular passages between them. The liquid obtained by expression from the parenchyma is mucilaginous, and possessed of little medicinal virtue. After condensation by artificial or natural heat the aloe juice is poured into gourds, more commonly boxes, or into monkey skins [Socotrine aloes], allowed to harden and sent into commerce.

Commercial History and Varieties.—Three chief varieties of aloes have been known in comparatively recent commerce: Barbados or Curaçao, Socotrine, and Cape.

Barbados Aloes.—This aloes appears to have been brought to London as early as 1693, and to have reached its greatest commercial abundance in the year 1843, when 4227 gourds of it are said to have been exported from Barbados, a gourd containing from twenty to sixty pounds. At present no appreciable quantity is produced in Barbados, the last sale that we know of having taken place in London in 1902. Nevertheless, Barbados aloes is still sold in the

drug stores, being simply selected specimens that look like the old Barbados aloes, taken from aloes produced in various parts of the world. Most of the Barbados aloes was produced from *A. vera,* although *A. socotrina, A. purpurascens,* and *A. arborescens* are said to have been cultivated.

The method of obtaining Barbados aloes seems to have varied at different periods of time, and possibly in different portions of the island. According to various authors the lower ends of the freshly cut leaves were put into wooden V-shaped troughs, and the exuding juice collected and dried in the sun or boiled in copper pans; again, a decoction of the chopped-up leaves was boiled to the proper consistency; in either case, when the liquor had become so thick that it hardened on cooling, it was poured into calabashes or gourds.

Barbados aloes, as formerly supplied, varied in color from very dark blackish-brown through reddish-brown and liver-colored to orange-brown. It yielded a dull olive-yellow powder, of a disagreeable, even nauseous odor, and it is described in the British Pharmacopœia as follows: "Fracture either dull and waxy, in which case small splinters are opaque; or smooth and glassy, in which case the splinters are transparent; the opaque variety examined under the microscope exhibits numerous minute crystals embedded in a transparent mass." *Br.* "Mixed with nitric acid, it acquires a red color. Barbadoes Aloes is not colored, or acquires only a light bluish-green tint, on being mixed with sulphuric acid and blowing the vapor of nitric acid over the mixture (difference from *Natal aloes*)." *U. S.* 1890.

According to Marais, Barbados aloes could be distinguished by the fact that its solution in distilled water, 1 to 100,000 parts, yielded on the addition of gold chloride or of tincture of iodine a fine rose color, all other varieties of aloes producing with the reagents named either a feeble color of slow development, or no change of color whatever.

Curaçao or Bonaire Aloes.—This aloes, which is produced in the Dutch West Indian Islands, chiefly in the Island of Aruba, appears not to have entered commerce extensively before the early part of the 19th century, but at present constitutes a very large proportion of commercial aloes. It occurs chiefly in three forms; first, an opaque, brittle aloes, showing abundant crystals under the microscope, and sold in gourds usually as Barbados aloes; second, aloes having an appearance like the first variety but sold in cases; third, glossy Curaçao or Capey Curaçao aloes, which occurs in cases and is glossy and transparent.

It is affirmed that the difference in these varieties of Curaçao aloes depends upon the extent of the evaporation by artificial heat, the aloes being dark colored and opaque when poured into the gourds while still soft; glossy and transparent when allowed to evaporate to dryness over the fire. It is said that the juice is obtained by allowing the leaves to drain into V-shaped troughs, and that it is never evaporated spontaneously.

According to P. van der Wielden, shining Curaçao aloes dissolves completely in nitric acid with the production of a red color, while the dull Curaçao aloes, giving the same color reaction, fails to entirely dissolve. Kremel gives a method to distinguish Curaçao aloes from other kinds by adding to it a little cupric sulphate solution, then some saturated solution of common salt, which makes the color an intense carmine. The reaction is due to *cupro-aloin.* (*C. D.,* 1895, 759.) Curaçao aloes is sometimes found in the markets which has been deprived of its aloin; this fraudulent product is then sold as Cape aloes; the odor of the Curaçao variety still remains.

Socotrine Aloes.—This variety appears to have been the original aloes, having been produced in the island of Socotra at least as early as the time of Alexander the Great, 333 B.C., who is said to have sent a commission to investigate its manufacture. Very little, however, of the true Socotrine aloes at the present time comes into the Western markets, the aloes which reaches European commerce from Bombay, Muscat, Aden, and Zanzibar having various botanical and geographical origins.

It is stated that the production of aloes in Arabia was formerly a government monopoly, but that at present it is entirely free to the inhabitants. The leaves, which are cut at any time of year, are allowed to drain into a goat's or sheep's skin, and the gathered juice permitted to evaporate spontaneously. In the course of about one month, when it has become thick and viscid, it is known by the Arabic name of *Jâyef Gesheeshah;* several weeks subsequently, when it has become hard, it is called *Jâyef Kasahul.* Due to its exposure throughout the long process of desiccation, all the varieties of Socotrine aloes contain much foreign matter, which, according to E. R. Squibb, amounts to from 7 to 22 per cent. of the bulk.

The best Socotrine aloes occurs in pieces varying from a dark ruby-red to a yellowish or reddish-brown, more or less semi-transparent, with a glossy surface and a smooth or ragged but not conchoidal fracture, and yielding a bright golden-yellow powder. Its odor is peculiar, almost fragrant, especially developed by breathing upon the aloes, and its bitter, disagreeable taste has a somewhat aromatic tang. The poorest variety of Socotrine aloes, *Mocha aloes* of the East, is soft, dark, and malodorous. Even the finest Socotrine aloes may consist of an orange or yellow colored distinctly fragrant, semi-liquid mass, while the variety known as *Zanzibar aloes* usually occurs in liver-brown masses, with a dull, waxy fracture, a characteristic odor and a nauseous, bitter taste. The variability of Socotrine aloes probably depends upon not only different methods of preparation but a different origin. "Almost entirely soluble in alcohol and in 4 parts of boiling water.

The aqueous solution becomes turbid on cooling and yields a deposit. . . The powder, on being thoroughly dried on a water-bath and then heated to 100° C., should not cake. Mixed with nitric acid, it acquires a reddish-brown color. Socotrine Aloes is not colored blue on being mixed with sulphuric acid and blowing the vapor of nitric acid over the mixture (difference from *Natal aloes*)." *U. S.* 1890. Both Zanzibar and true Socotrine Aloes "are opaque even in small splinters, exhibit when examined under the microscope numerous minute crystals embedded in a transparent mass, and impart to *nitric acid* a reddish or yellowish-brown color." *Br.*

The general method of collecting Cape aloes is to allow the excised leaves to drain into a sheep's skin, which has been so placed in a hole in the ground as to force the juice to collect in the centre. Later this juice is evaporated by artificial heat, and when sufficiently concentrated, poured into boxes or skins. Cape aloes differs from Socotrine aloes especially in its brilliant conchoidal fracture and peculiar odor, which is strong, but neither nauseous nor aromatic. When freshly broken it has a very dark olive or greenish color approaching to black, presents a smooth, bright, almost glassy surface, and if held up to the light appears translucent at its edges. The small fragments also are semi-transparent, and have a tinge of yellow or red mixed with the deep olive of the opaque mass. The same tinge is sometimes observable in the larger pieces. The powder is of a fine greenish-yellow color, and, being generally more or less sprinkled over the surface of the pieces as they are kept in the shops, gives them a somewhat yellowish appearance. Cape aloes, when quite hard, is very brittle and readily powdered; but in very hot weather it is apt to become somewhat soft and tenacious, and the interior of the pieces is occasionally more or less so even in winter.

Uganda or *crown aloes* is a brand of Cape aloes produced by manufacturers who buy the aloe juice from the collectors, allow it to undergo a slight fermentation, and dry it in the sun in wooden troughs. It is sent into commerce in bags containing coarse or fine powder, or chips, and in bricks wrapped in red paper; it has a very bitter, aromatic taste and a strongly aromatic odor. The bricks are of a hepatic brown color, with a resinous fracture, which has a bronzy-gold lustre by reflected light. Splinters are translucent, but not garnet-red. With nitric acid it forms a brown solution, gradually changing through dull brownish-yellow to a deep green color.

Natal aloes is a variety coming from Natal, on the southeast coast of Africa, which occurs in irregular pieces, with a fracture much less shining than that of Cape aloes and a totally different color, having a greenish slate hue. It yields a greenish-brown powder, which has the odor of Cape aloes. It is less soluble than Cape aloes, and has a peculiar composition, which will be adverted to under the chemistry of the drug.

Besides the chief varieties of aloes, others are or have been known in the market. *Hepatic aloes,* as well as *fetid, caballine* or *horse aloes,* have no proper claim to be considered distinct varieties, being simply inferior aloes of various origins, the first liver-colored, the second blackish and fetid and full of impurities. *Jafferabad aloes,* supposed to be the same as *Mocha aloes* (*A. J. P.,* 1881, 175), has been shown to be the product of *A. abyssinica,* Lam., and is said by Shenstone to contain ĩ-barbaloin (*A. J. P.,* 1883, 92). Aloes made in India from the *A. vera* is known as *Musambra aloes.* It appears to be a very inferior variety, and rarely, if ever, reaches Europe (*P. J.,* Aug., 1889).

It is evident that the labels under which aloes are largely sold often have little or no connection with the place of production, or with the variety of aloes in the package. This fact has probably come about through the indifference of retail druggists to the variety of the aloes which they are using, an indifference largely due to their common habit of buying aloes in powder. Wilbert (*A. J. P.,* 1903), proposed that aloes should be classified as follows:

Aloes A.—Containing barbaloin; responds to Bornträger's test for emodin, but does not give a distinct red color with nitric acid, or with Klunge's test.

Aloes B.—Containing isobarbaloin with barbaloin; responds to Bornträger's test for emodin, and also gives a deep red color with strong nitric acid, or with Klunge's test.

The revisers of the U. S. Pharmacopœia have acted wisely in refusing to recognize all varieties of aloes, requiring only that any specimens shall conform to the following description and tests: "In yellowish-brown or orange-brown to blackish-brown opaque masses; translucent in thin fragments; fracture uneven, dull and waxy, somewhat resinous, or smooth and glassy, somewhat conchoidal; occasionally exhibiting microscopic crystals of aloin; odor characteristic; taste nauseous, bitter. Aloes gives a reddish color with nitric acid or with solutions of the alkalies. If Aloes be dried at 100° C. (212° F.) until it ceases to lose weight, the loss of moisture should not exceed 10 percent. A solution of Aloes in hot water yields, with a concentrated solution of sodium borate, a mixture having a greenish fluorescence. If to 5 Gm. of Aloes 60 Cc. of boiling water be added, a nearly clear solution should be obtained, from which not more than 2 Gm. should separate on cooling. If to 1 Gm. of Aloes 5 Cc. of Alcohol be added, and the mixture gently heated, a nearly clear solution should be obtained after cooling the liquid (absence of *gum, dextrin,* and *inorganic impurities*)." *U. S.*

Chemical Properties.—Several distinguished chemists have investigated the nature and com-

position of aloes. Braconnot found a bitter principle, which he named *resino-amer* (*resinous bitter*), and another substance in smaller proportion, which he designated by the name of *flea-colored principle.* These results were essentially confirmed by Trommsdorff, Bouillon-Lagrange, and Vogel. Robiquet obtained a product from aloes which he called *aloëtin.* (For details, reader is referred to 14th ed. U. S. Dispensatory.)

ALOINS.—The bitter substances noticed above, viz., the *resino-amer* of Braconnot, and the *aloëtin* of Robiquet, probably contain the active principle of aloes, but combined with impurities which render it insusceptible of crystallization. It has been assumed that there exists not one compound, but a set of three closely related compounds, to which the general name of *aloins* is now given. The first of these, found exclusively in Barbados aloes, and discovered by T. and H. Smith, is called *barbaloin;* the second, discovered by Flückiger in Natal aloes, is called *nataloin;* the third, found by Histed and Flückiger in Socotrine aloes, is called *socaloin.*

Hugo Bornträger asserts that one part of aloes in 5000 can be detected in the following manner. A little of the suspected liquid is shaken with about twice its bulk of benzin, which is allowed to separate, decanted, and shaken with a few drops of stronger water of ammonia. On separation the ammonia will be of a clear red color. With solids a tincture should first be made. According to R. H. Groves (*P. J.,* 3d ser., xi. 1045), this test will never succeed with a less concentration than 1 part in 250, and with some aloes 1 in 100, and is due to the tannin-like substance of aloes; he also states that extreme care is necessary to have the benzin solution perfectly clear. (*P. J.,* 1885, p. 633. For Hager's quantitative method for determining the percentage of aloin in aloes, see *A. J. P.,* 1885, p. 237.)

R. A. Cripps and T. S. Dymond have given the testing of aloes a lengthy investigation, and they recommend the following method. Place 1 grain of the substance in a glass mortar standing on white paper, now add 16 drops of strong sulphuric acid and triturate until dissolved, then add 4 drops of nitric acid, sp. gr. 1.42, and then 1 ounce of distilled water. If aloes be present, a color varying from deep orange to crimson will be produced, according to the kind of aloes that has been used; the color is deepened by the addition of ammonia. The table below is taken from the paper of Bainbridge & Morrow (*P. J.,* Jan. 1890). Under the heading of Kew Specimens are given the results obtained with juice of aloe plants grown in Kew Gardens.

The three aloins, *barbaloin, nataloin,* and *socaloin,* are easily distinguished by the following reaction, first noticed by Histed. A drop of nitric acid on a porcelain slab gives, with a few particles of barbaloin or nataloin, a vivid crimson (rapidly fading in the case of barbaloin, but permanent with nataloin unless heat be applied), but produces little effect with socaloin. To distinguish barbaloin from nataloin, test each by adding a minute quantity to a drop or two of sulphuric acid, then allowing the *vapor* from a rod touched with nitric acid to pass over the surface. Barbaloin (and socaloin) will undergo no change, but nataloin will assume a fine blue. (*Pharmacographia,* 2d ed., p. 688.) E. von Sommaruga and Egger consider that the three aloins form a homologous series possessing the formulas: barbaloin, $C_{17}H_{20}O_7$; nataloin, $C_{16}H_{18}O_7$; socaloin, $C_{15}H_{16}O_7$, and that they are all derived from *anthra-*

Commercial Specimens.	HNO_3.	H_2SO_4 and vapor of HNO_3.	Cripps and Dymond test.	C. and D. test with NH_4HO.	Bromine Test.	$FeCl_3$.
Hepatic aloes . .	Reddish-brown.	Nil.	Orange-red.	Intense brownish-red.	Nil.	All varieties of aloes give an olive-green coloration with the above reagent.
True Socotrine .	Reddish-brown.	Nil.	Orange-red.	Intense brownish-red.	Nil.	
Commercial Socotrine . . .	Faint crimson.	Nil.	Crimson.	Deep claret.	Nil.	
Cape	Permanent green after standing a few minutes.	Nil.	Orange-red.	Pale claret.	Nil.	
Curaçao	Evanescent crimson.	Nil.	Crimson.	Intense claret.	Nil.	
Natal	Permanent crimson.	Deep blue.	Deep crimson.	Intense brownish-red.	Nil.	
Barbados . . .	Crimson soon fading.	Slight bluish-green occasionally.	Crimson.	Deep claret.	Nil.	
KEW SPECIMENS.						
Aloe ferox	Evanescent crimson.	Green.	Pale yellow.	Red.	Violet.	
—*socotrina* . . .	Permanent crimson.	Deep blue.	Crimson.	Intense brownish red.	Deep purplish-red.	
—*vera*	Nil.	Slight green.			Nil.	
—*Perryi*	Nil.	Nil.			Nil.	
—*purpurascens* . .	Crimson fading to light red.	Nil.			Violet.	
—*platylepis* . . .	Nil.	Nil.			Nil.	
—*arborescens*, var. *frutescens* .	Nil.	Nil.			Nil.	
—*africana* . . .	Evanescent red, changing after a few minutes to green.	Nil.	Orange-red.	Pale claret.	Nil.	
—*chinensis* . . .	Nil.	Nil.			Nil.	

cene, $C_{14}H_{10}$. Tilden subsequently assigned a different composition to the aloins: barbaloin and socaloin, each $C_{16}H_{18}O_7$; for nataloin, the formula $C_{25}H_{28}O_{11}$. He further states that barbaloin and socaloin differ in physical and chemical properties on account of the variation in the molecules of water which are associated with them. Léger assigns to nataloin the formula $C_{23}H_{26}O_{10}$. The British Pharmacopœia (1898) assigns to barbaloin the formula $C_{16}H_{16}O_7,3H_2O$. Two bases only are recognized now, *barbaloin* (or simply aloin) and *isobarbaloin.* According to Léger (*P. J.,* 1902, 21) *Cape aloes* contains from 5 to 6 per cent. of aloin (barbaloin) without any admixture of the isomeric isobarbaloin. The Barbados aloes of English commerce never gave more than 5 per cent. of barbaloin with but minute traces of isobarbaloin, which, however, is always met with in the so-called Barbados aloes of French commerce. *Curaçao aloes* is rich in aloin, containing 10 per cent., of which half is barbaloin and the other half isobarbaloin. *Jafferabad aloes* is very rich in aloin, yielding 20 per cent., chiefly in the form of isobarbaloin. *Socotrine aloes* does not contain more than 4 per cent. of aloin, almost wholly barbaloin with a very little isobarbaloin. Since barbaloin is found in almost all varieties, the significance of the prefix "barb" is misleading. The only aloes in which it does not occur is that of Natal.

Tschirch of Berne, Switzerland, published in the *Journal of the German Pharmaceutical Society* (viii., 1898, Heft 6) an important communication, in which he showed that *emodin,* $C_{15}H_{10}O_5$, or *trioxymethylanthraquinone,* is the purgative principle of the aloins. He succeeded in obtaining emodin in orange-red crystals which melt at 216° C. Emodin was found in the aloins obtained from Cape, Barbados, and Socotrine Aloes; it is extracted by treating barbaloin with ether, which dissolves out the emodin. Tschirch found that if a liquid extract of aloes be deprived of its resin and aloin, an additional quantity of emodin could be obtained by boiling the liquid extract with diluted sulphuric acid, thus pointing to the fact that emodin may be produced through hydrolysis. He also showed that emodin could be obtained from purgative drugs of the same class as aloes: rhubarb, rumex, frangula, cascara, senna, rhamnus catharticus, morinda bark, and parmelia. (See *Emodin,* PART II.)

Aloes yields its active matter to cold water, and when good is almost wholly dissolved by boiling water; but the inert portion, or apotheme of Berzelius, is deposited as the solution cools. It is also soluble in alcohol, rectified or diluted. Long boiling impairs its purgative properties by oxidizing the aloin and rendering it insoluble. The alkalies, their carbonates, and soap alter in some measure its chemical nature, and render it of easier solution. It is inflammable, swelling up and decrepitating when it burns, and giving out a thick smoke which has the odor of the drug.

Those substances only are incompatible with aloes which alter or precipitate the soluble matter, as the insoluble portion is without action upon the system. Among these is the infusion of galls, which we have found, probably through its tannic acid, to afford a copious precipitate with an aqueous solution of aloes. It is said that such a mixture will keep a long time, even for a period of several months, without mouldiness or putrescence, though it becomes ropy.

Uses.—Aloes was known to the ancients. It is mentioned in the works of Dioscorides and Celsus, the former of whom speaks of two kinds. The varieties are similar in their mode of action. They are all cathartic, operating very slowly but certainly, and having a peculiar affinity for the large intestine, and especially its pelvic portion. Their action, moreover, appears to be directed rather to the muscular coat than to the exhalant vessels, and the discharges which they produce are, therefore, seldom very thin or aqueous. In a full dose they quicken the circulation, and produce general warmth. When frequently repeated, they are apt to irritate the rectum. Aloes has a decided tendency to the uterine system. Its emmenagogue effect, which is often very considerable, is generally attributed to a sympathetic extension of irritation from the rectum to the uterus, but we can see no reason why the medicine should not act specifically upon this organ, and its influence in promoting menstruation is by no means confined to cases in which its action upon the neighboring intestines is most conspicuous. A peculiarity in the action of this cathartic is, that an increase of the quantity administered, beyond the medium dose, is not attended by a corresponding increase of effect. Its tendency to irritate the rectum may be obviated, in some measure, by combining with it soap or an alkaline carbonate; but it does not follow, as supposed by some, that this modification of its operation is the result of increased solubility, for aloes given in a liquid state produces the same effect as when taken in pill or powder, except that it acts somewhat more speedily. Besides, when externally applied to a blistered surface, it operates exactly in the same manner as when internally administered, thus proving that its peculiarities are not dependent upon the particular form in which it may be given, but on specific tendencies to particular parts. (Gerhard, *N. Am. Med. and Surg. Journ.,* x. 155.) With its other powers, aloes combines the property of slightly stimulating the stomach. It is, therefore, in minute doses, an excellent remedy in habitual *costiveness* attended with torpor of the digestive organs. It has been supposed to stimulate the hepatic secretion, and certainly acts sometimes very happily in *jaundice,* producing bilious stools even after calomel has failed. From its special direction to the rectum, it has been found peculiarly useful in the treatment of *ascarides,* and is prescribed for *hemorrhoids* without inflammation. In *amenorrhœa* it is perhaps more frequently employed

than any other remedy, entering into almost all the numerous empirical preparations habitually resorted to by women in that complaint. It is much used in regular practice, and is frequently combined with more irritating cathartics, in order to regulate their liability to excessive action. In *amenorrhœa* it is said to be peculiarly efficacious when given, in the form of enema, about the period when the menses should appear. Aloes is unsuitable, unless modified by combination, to the treatment of inflammatory diseases.

Dose (medium), ten grains (0.65 Gm.), but as a laxative it will often operate in the quantity of two to three grains (0.13 to 0.20 Gm.), and when a decided impression is required, the dose may be augmented to twenty grains (1.3 Gm.). In consequence of its excessively bitter and somewhat nauseous taste, it is most conveniently administered in pills.

Off. Prep.—Aloe Purificata, *U. S.;* Extractum Aloe, *U. S.* (*Br.*); Extractum Colocynthidis Compositum, *U. S.* (from purified aloes), *Br.;* Pilulæ Aloes, *U. S.* (from purified aloes); Pilula Aloes Barbadensis, *Br.;* Pilula Aloes et Asafœtidæ, *Br.;* Pilulæ Aloes et Ferri, *U. S.* (from purified aloes) (*Br.*); Pilulæ Aloes et Matisches, *U. S.* (from purified aloes); Pilulæ Aloes et Myrrhæ, *U. S.* (from purified aloes) (*Br.*); Pilula Aloes Socotrinæ, *Br.;* Pilula Cambogiæ Composita, *Br.;* Pilula Colocynthidis Composita, *Br.;* Pilulæ Rhei Compositæ, *U. S.* (from purified aloes) (*Br.*); Tinctura Aloes, *U. S.* (from purified aloes), *Br.;* Tinctura Aloes et Myrrhæ, *U. S.* (from purified aloes); Tinctura Benzoini Composita, *U. S.* (from purified aloes), *Br.*

ALOINUM. U. S., Br.

ALOIN

(ăl-o-ī'nŭm)

"A neutral principle obtained from Aloes, varying more or less in chemical composition and physical properties according to the source from which it is obtained. Chiefly prepared from Curaçao Aloes." *U. S.* "Aloin is extracted from Barbados or Socotrine Aloes by solvents and purified by recrystallization. The products from the different varieties of Aloes possess similar properties. The Aloin extracted from Barbados Aloes has the formula $C_{16}H_{18}O_7,3H_2O$." *Br.*

Although aloin has been used for many years, it was not recognized by the U. S. Pharm. until the revision of 1890.

Preparation.—Aloin may be prepared by W. A. Tilden's process as follows: 1 part of aloes is dissolved in 10 parts of boiling water acidulated with hydrochloric acid, and allowed to cool. The liquid is then decanted from resinous matter, evaporated to about 2 parts, and set aside two weeks for crystals to form; the liquid portion is poured off, the crystals pressed, and the adherent resinous matter separated by shaking with acetic ether, which dissolves the resin. This process answers fairly well for obtaining aloin from Barbados or Curaçao aloes. Aloin from Socotrine aloes is best obtained by digesting the aloes in 3 parts of alcohol for 24 hours, then transferring to a water bath, and boiling for 2 hours. After cooling, the liquid is filtered and set aside to crystallize. The crystals are washed with a little alcohol and dried. The yield is about 10 per cent. (H. C. Plenge, *A. J. P.*, 1884, p. 507.) Schäfer obtains from 15 to 30 per cent. of crystallized aloin from commercial aloes by the following process: 50 Gm. of aloes dissolved in 300 Cc. of hot water are slightly acidulated with hydrochloric acid. The solution, after standing (for the resins to separate), is decanted, mixed with 50 Cc. of 20 per cent. ammonia water, followed by a solution of 15 Gm. of calcium chloride in 30 Cc. of water. The liquid is agitated and the aloin-calcium compound which separates is collected, drained, and mixed in a mortar with a slight excess of hydrochloric acid; the mixture of aloin and calcium chloride is dissolved in the smallest possible quantity of boiling water, filtered, and the filtrate cooled by means of ice; the aloin crystallizes. (*P. J.*, 1897, p. 287.) The yield of aloin from Curaçao aloes varies from 5 to 30 per cent.

Aloin is officially described as in "a microcrystalline powder or minute acicular crystals, lemon-yellow to dark yellow in color, possessing a slight odor of aloes and an intensely bitter taste. It is slightly hygroscopic, the air-dried powder yielding 1 molecule of water of crystallization at 100° C. (212° F.). Aloin from Curaçao Aloes is soluble in about 65 parts of water, 10.75 parts of alcohol, 664 parts of ether, 4260 parts of chloroform, 3120 parts of benzene, 1475 parts of petroleum benzin, and 21 parts of acetone, at 25° C. (77° F.). The melting point of Aloin from Curaçao Aloes which has been dried over sulphuric acid, is about 147° C. (296.6° F.). When ignited, it is consumed without leaving a residue. Aloin dissolves in water, forming a yellow solution, which is neutral to litmus paper, turns brown on standing, and has an intensely bitter taste. Ammonia water and alkali-solutions dissolve Aloin, forming a yellow solution, soon turning red and exhibiting a greenish-red fluorescence. Nitric Acid dissolves Aloin from Curaçao Aloes, forming a cherry-red solution (distinction from *Nataloin, Socaloin,* and *Capaloin*). Aloin when added to alkaline solutions is rapidly decomposed, but if mixed with acid solutions decomposition is slower. Aloin added in minute quantity to concentrated sulphurie acid forms a yellowish-red solution which, upon the addition of a small crystal of potassium dichromate, changes to an olive-green, then to a dark green, and finally, on standing, to a blue. If a large amount of potassium dichromate be used, the yellowish-red solution first turns purple, then brown, and finally green. Bromine water added to the aqueous solution of Aloin produces a pink color. Gold chloride T.S., when added to an aqueous solution of Aloin, turns it carmine-

red, changing later to violet. A drop of ferric chloride T. S. added to an alcoholic solution of Aloin produces a brownish-green color. If to a dilute aqueous solution of Aloin obtained from Curaçao Aloes, 1 drop of copper sulphate T.S. be added, a bright yellow color will be produced; upon adding a few drops of a concentrated solution of sodium chloride, the liquid will acquire a red color, and upon the further addition of a little alcohol the color will be changed to violet (distinction from *Nataloin* and *Capaloin*). On shaking 1 Gm. of Aloin with 10 Cc. of benzene for one minute and filtering, the filtrate should not impart more than a faint pink color to an equal volume of ammonia water (5 percent.), when shaken with it (limit of *emodin*)." *U. S.* Aloin of commerce is frequently contaminated with resin from aloes, indicating want of care in manufacturing. According to Serre (*D. C.*, 1895, 8), this may be detected by finely powdering 1 grain of the sample, shaking it in a test tube with 20 Cc. of water, and allowing it to stand one minute. The solution should be perfectly clear. See also paper by C. H. LaWall (*Proc. Penn. Pharm. Assoc.*, 1895, 92).

Uses.—Socaloin and barbaloin are active purgatives in doses of 2 to 4 grains. Barbaloin is affirmed to be the more powerful, and, according to the researches of Hans Moyer (*A. E. P. P.*, xxviii.), when given hypodermically in the dose of four-fifths of a grain (0.05 Gm.), it produces repeated moderate purging in from seven to twenty-two hours. Moyer found that Natal aloin, though acting energetically upon dogs, usually fails to affect the alvine discharges in man, except when the person has for some days been fed exclusively upon animal food. In combination with belladonna and strychnine, as in the official compound laxative pill, aloin is one of the most serviceable and pleasantly acting laxatives that we have. Frommüller (*L. M. R.*, 1879, p. 70) affirms that aloin dissolved in 25 times its weight of water acts as an efficient though slow purgative, when given hypodermically, without causing any local irritation; Moyer found that formamide is an apt vehicle for the hypodermic use of barbaloin; in making it, the solution may be warmed, but not heated, for fear of producing ammonia.

Dose, as a laxative, one-fourth grain (0.016 Gm.); as a purgative, one grain (0.065 Gm.).

Off. Prep.—Pilulæ Laxativæ Compositæ, *U. S.*

ALTHÆA. U. S.

ALTHÆA [Marshmallow]

(ăl-thæ'a)

"The dried root of *Althæa officinalis* Linné (Fam. *Malvaceæ*), collected from plants of the second year's growth, and deprived of the periderm." *U. S.*

Radix Hibisci, Radix Bismalvæ; Wymote, White Mallow, Mortification root; Racine de Guimauve, Guimauve, *Fr.*; Radix Althææ, *P. G.*; Altheewurzel, Althee, Eibischwurzel; Eibisch, *G.*; Altea, Malvavischio, *It.*; Altea, Raiz de Malvavisco, *Sp.*

Althæa officinalis, Willd., *Sp. Plant.* iii. 770; Woodv., *Med. Bot.* p. 552, t. 198.—Althæa is an herbaceous perennial, with a perpendicular branching root and erect woolly stems, from two to four feet or more in height, branched and leafy towards the summit. The leaves are alternate, petiolate, nearly cordate on the lower part of the stem, oblong-ovate and obscurely three-lobed above, somewhat angular, irregularly serrate, pointed, and covered on both sides with a soft down. The flowers are terminal and axillary, with short peduncles, each bearing one, two, or three flowers. The corolla has five spreading, obcordate petals, of a pale purplish color. The fruit consists of numerous capsules united in a compact circular form, each containing a single seed. The plant grows throughout Europe, inhabiting salt marshes, the banks of rivers, and other moist places. It is found also in this country on the borders of salt marshes. In some parts of the continent of Europe it is largely cultivated for medicinal use, particularly in Germany, where, in the neighborhood of Nuremberg and Schweinfurt, about 15 tons are harvested annually. The whole plant abounds in mucilage. The flowers, leaves, and root are mucilaginous, and were formerly official; but only the last is employed to any considerable extent in this country.

The roots should be collected in autumn from plants at least two years old. They are usually prepared for the market by removing the epidermis; commerce is supplied from Europe.

Properties.—Althæa occurs "slenderly tapering, 15 to 30 Cm. long, rarely exceeding 20 Mm. in diameter; externally whitish, traversed longitudinally by several broad, shallow furrows, and covered with loosened bast fibres; fracture of bark fibrous, of wood short and granular; internally yellowish-white; odor faint; taste sweetish, mucilaginous. The powder contains rosette-shaped crystals of calcium oxalate, about 0.025 Mm. in diameter, and ellipsoidal starch grains from 0.010 to 0.020 Mm. in diameter." *U. S.* Sections of the root assume a bright yellow tint when an alkali is added to them. The plump and but slightly fibrous pieces of the root are to be preferred. The woody part, on examination with the microscope, is seen to consist of scalariform or pitted vessels, and a few ligneous cells embedded in a loose parenchymatous tissue. The bark is composed of numerous branched liber cells, in bundles of 3 to 30 fibres separated by parenchymatous tissue. The abundant mucilage is situated chiefly in the parenchymatous cells, and can be seen to be in layers when alcohol is added. It, with starch and saccharine matter, is taken out by boiling water. The mucilage, without the starch, is extracted by cold water, which thus becomes ropy. Marshmallow is said to become somewhat acid by decoction. Pieces should be rejected which are woody, discolored, mouldy, of a sour or musty smell, or of a sourish taste. A principle was discovered in the root by Bacon, which has been ascertained to be identical with

asparagin, $C_4H_8N_2O_3 + H_2O$. Boutron-Charland and Pelouze found it to belong to that class of organic principles which are convertible by strong acids, and other agencies, into ammonia and organic acids, and which are designated by the termination *amide,* being compounds of acid radicals with the group NH_2 derived from ammonia by the withdrawal of an atom of hydrogen. When such an amide is acted upon by acids, it is decomposed, the acid radical taking OH to form the free acid and the amide group taking H to form ammonia. Thus asparagin, which in this view should be called *asparamide,* is converted into ammonia and *aspartic acid,* $C_4H_7NO_4$, and one molecule of the resulting ammonium aspartate corresponds with one molecule of asparamide and one of water. (*J. P. C.,* xix. 208.) Asparagin, being now recognized as a derivative of succinic acid, is called *amido-succinamide,* and the aspartic acid is called *amido-succinic* acid. It is found in various other plants besides the marshmallow, as in the shoots of asparagus, in vetches grown in the dark, in all the varieties of the potato, and in the roots of the comfrey and licorice plant. According to Pira, asparagin has acid properties. It has no therapeutic value. *Betaine* (trimethyl-glycocoll) has been obtained from althæa by Orlow. (*Ph. Z. R.,* 1898.)

The roots of other Malvaceæ are sometimes substituted for that of marshmallow, without disadvantage, as they possess similar properties. Among these are *Althæa rosea,* Cav., or *hollyhock,* and *Malva Alcea,* L. The dark purple flowers of a variety of *A. rosea* have been proposed as a test for acids and alkalies. A strong infusion of these flowers imparts to slips of white filtering paper a permanent purplish-blue color, which is reddened by acids, and rendered bluish green by alkalies.

Uses.—The virtues of marshmallow are exclusively those of a demulcent. The decoction of the root is much used in Europe in irritation and inflammation of the mucous membranes. A syrup of althæa is official in the German Pharmacopœia, and was introduced into the U. S. Pharmacopœias of 1880 and 1890, see U. S. D. 18th edition, p. 1327. Owing to its tendency to ferment rapidly it was not retained in the U. S. P. (8th Rev.). The roots themselves, as well as the leaves and flowers, boiled and bruised, are sometimes employed as a poultice. In France the powdered root is much used in the preparation of pills and electuaries. It enters, as an ingredient, into one mass and two pills of the U. S. P.

Off. Prep.—Massa Hydrargyri, *U. S.;* Pilulæ Ferri Carbonatis, *U. S.;* Pilulæ Phosphori, *U. S.*

ALUMEN. U. S., Br.

ALUM [Potassium Alum, Aluminum and Potassium Sulphate]

(ą-lū′mẹn)

$AlK(SO_4)_2 + 12H_2O = 471.02$

"It should contain not less than 99.5 percent. of pure Aluminum and Potassium Sulphate." *U. S.* "Aluminium and potassium sulphate (Potassium Alum), $Al_2(SO_4)_3,K_2SO_4,24H_2O$, or aluminium and ammonium sulphate (Ammonium Alum), $Al_2(SO_4)_3,(NH_4)_2SO_4,24H_2O$, produced by the combination of aluminium sulphate with potassium sulphate or with ammonium sulphate." *Br.*

Aluminii et Potassii Sulphas, *U. S.* 1870, Potassa Alum; Sulphas Aluminico-potassicus; Alun de potasse, *Fr. Cod.;* Alun, Sulfate d'Alumine et de Potasse, *Fr.;* Alumen, *P. G.;* Alaun, Kalialaun, *G.;* Solfato di allumino e di potassio, Allume, *It.;* Sulfato aluminico-potasico, Alumbre, *Sp.*

Aluminii et Ammonii Sulphas, Sulphas Aluminico-Ammonicus; Alun ammoniacal, *Fr.;* Ammoniak-Alaun, *G.*

The name alum has been applied indifferently to two salts, one consisting of aluminum trisulphate combined with ammonium sulphate, the other of the same salt of aluminum combined with potassium sulphate, and distinguished as *ammonium alum* and *potassium alum.* The former was official in the U. S. P. 1870, but has been replaced by *potassium alum. Ammonium alum* is still retained with potassium alum under the title *Alumen* in the British Pharmacopœia.

Alum (*Aluminum and Potassium Sulphate. U. S.* 8th Rev).—Potassium alum is manufactured occasionally from earths which contain it ready formed, but most generally from minerals which, from the fact of their containing most or all of its constituents, are called *alum ores.* The principal alum ores are the *alum stone,* which is a native mixture of aluminum sulphate and potassium sulphate, found in large quantities at Tolfa and Piombino in Italy; certain natural mixtures of iron disulphide with alumina, silica, and bituminous matter, called *aluminous schist* or *alum slate; bauxite,* a native aluminum hydroxide, and *cryolite.* (See *Sodii Carbonas.*)

At the Solfatara, and other places in Southern Italy, alum was formerly extracted from earths containing it ready formed. The ground being of volcanic origin, and having a temperature of about 104° F. an efflorescence of pure alum formed upon its surface. This was collected and lixiviated, and the solution crystallized by slow evaporation in leaden vessels sunk in the ground. The alum stone is manufactured into alum by calcination, and subsequent exposure to the air for three months, the mineral being frequently sprinkled with water, in order that it may be brought to a soft mass. This is lixiviated, and the solution obtained crystallized by evaporation. The alum stone may be considered as consisting of alum united with a certain quantity of aluminum hydroxide. The latter, by the calcination, loses its water, and becomes incapable of remaining united with the alum of the mineral, which is consequently set free. Alum of the greatest purity is obtained from this kind of ore.

Alum slate, when compact, is first exposed to the air for a month. It is then stratified with wood, which is set on fire. The combus-

tion which ensues is slow and protracted. The sulphur is in part converted into sulphuric acid, which unites with the alumina; and the aluminum sulphate thus formed generates a portion of alum with the potassium hydroxide derived from the ashes of the wood. The iron, in the mean time, is almost wholly converted into sesquioxide, and thus becomes insoluble. The matter is lixiviated, and the solution crystallized into alum by evaporation. The mother waters, containing aluminum sulphate, are then drawn off, and made to yield a further portion of alum by the addition of potassium sulphate or potassium chloride, the latter being obtained from the soap boilers, or from native potassium chloride of the Stassfurt deposits. When alum slate is easily disintegrated, it is not calcined, but merely placed in heaps and occasionally sprinkled with water. The iron disulphide gradually absorbs oxygen, and passes into ferrous sulphate, which effloresces on the surface of the heap. Part of the sulphuric acid formed unites with the alumina, so that, after the chemical changes are completed, the heap contains both ferrous sulphate and aluminum sulphate. At the end of about a year, the matter is lixiviated, and the solution of the two sulphates produced is concentrated to the proper degree in leaden boilers. The ferrous sulphate crystallizes, while the aluminum sulphate, being of a more soluble nature, remains in the mother waters.

These are drawn off, and treated with potassium sulphate in powder, heat being at the same time applied. The whole is then allowed to cool, that the alum may crystallize. The crystals are then separated from the solution, and purified by a second solution and crystallization. They are next treated with water just sufficient to dissolve them at the boiling temperature, and the saturated solution is run into casks or tubs so constructed as to be easily taken to pieces and set up again. In the course of ten or fifteen days the alum concretes into a crystalline mass, from which the mother liquor is let off. The vessel is then taken to pieces, and the salt, having been broken up, is packed in barrels for sale. This process for forming the alum in large masses is called *rocking*.

Alum is largely manufactured by the direct combination of its constituents. With this view, clays are selected as free from iron and calcium carbonate as possible, and calcined to sesquioxidize the iron and render them more easily pulverizable; after which they are dissolved, by the assistance of heat, in weak sulphuric acid. Advantage has been found in mixing the clay, previous to calcination, with powdered charcoal, coke, or other carbonaceous matter, in the proportion of about one to six of the clay, and then applying heat by a reverberatory furnace until all the carbon is consumed. It is asserted that the alumina is thus rendered more soluble in the acid. (*P. J.*, Dec. 1857, p. 328.) The aluminum sulphate, thus generated, is next crystallized into alum by the addition of potassium sulphate in the usual manner. Alum is made in this way from the ashes of the Boghead cannel coal, which occurs near Edinburgh. These ashes, which form the residue of the combustion of the coke derived from the coal used for making gas, contain a considerable quantity of alumina in a state readily soluble in acids. For an account of the manufacture of alum in India, see *C. D.*, 1892, 636. *Bauxite*, a hydrated oxide of aluminum, containing from 56 to 60 per cent. of aluminum oxide, has within recent years become one of the most important raw materials for the alum manufacture. It is found in very rich deposits in Georgia and Alabama. *Cryolite*, a double fluoride of sodium and aluminum, also serves as a source of supply, the aluminum hydroxide being produced as an intermediate product.

The elements *rubidium* and *cæsium* are found in *lepidolite*, and, as much of the alum in continental Europe is made from this mineral, Salzer found samples of commercial potassium alum which contained a considerable quantity of rubidium alum; this contaminated potassium alum is less soluble in water than ordinary alum. (*A. Pharm.*, 1887, p. 217.)

The production of crystallized alum in the United States has decreased in recent years, while that of aluminum sulphate (so-called concentrated alum), containing half the usual quantity of water of crystallization, has steadily increased. In 1902 the production of alum was 8,539 tons, valued at $299,500, and in 1903, 7,574 tons, valued at $210,910.

ALUMEN, *Br.* ALUMINII ET AMMONII SULPHAS. *Aluminium and Ammonium Sulphate, Ammonia alum.*—Besides the potassium alum, which is now the only U. S. official variety of this salt, there are several others, in which the potassium is replaced by some other base, as, for example, ammonium or sodium. Of these, *ammonium alum*, or aluminum and ammonium sulphate, was introduced in the U. S. Pharmacopœia at the revision of 1860; and in the Pharmacopœia of 1870 and Br. Pharmacopœia it was adopted under the name of alumen. It is made by adding ammonium sulphate to the solution of aluminum sulphate. This kind of alum came into very general use, owing to the comparative cheapness of ammonia, obtained in the process for potassium ferrocyanide, or derived from the liquor of gas works. Ammonium alum was extensively manufactured by Powers & Weightman of Philadelphia. *Scotch* alum, made near Paisley, generally contains both potassium and ammonium. Ammonium alum resembles potassium alum so exactly that it cannot be distinguished by simple inspection; and in composition it is perfectly analogous to the potassium salt. It may be distinguished by subjecting it to a strong calcining heat, after which alumina will be the sole residue; or by rubbing it with potassium hydroxide or lime and a little water, when the odor of ammonia will be perceived.

Properties.—Alum, as usually seen, is officially described as in "large, colorless, octahedral crystals, sometimes modified by cubes, or in crystalline fragments; without odor, but having a sweetish and strongly astringent taste. Soluble in 9 parts of water at 25° C. (77° F.), and in 0.3 part of boiling water; it is also freely soluble in warm glycerin, but insoluble in alcohol. When gradually heated, it loses water; at 92° C. (197.6° F.) it fuses, and if the heat be gradually increased to 200° C. (392° F.), it loses all of its water of crystallization (45.55 percent. of its weight), leaving a voluminous, white residue (see *Alumen Exsiccatum*). An aqueous solution of Alum has an acid reaction upon blue litmus paper. An aqueous solution of the salt affords, with ammonia water, a white, gelatinous precipitate, which is almost insoluble in an excess of ammonia; with barium chloride T.S., a white precipitate, insoluble in hydrochloric acid. When a saturated solution of Alum is shaken with sodium bitartrate T.S., it produces, within half an hour, a white, crystalline precipitate. The aqueous solution of Alum affords, with potassium hydroxide T.S., a white, gelatinous precipitate, which is completely soluble in an excess of the alkali, and this alkaline solution should not evolve the odor of ammonia, even when heated (distinction from, and absence of, *ammonium alum*). The aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). (The subsequent addition of ammonia water, as directed in this test, should be omitted.) The addition of 5 drops of potassium ferrocyanide T.S. to 20 Cc. of an aqueous solution of alum (1 in 20) should not at once produce a blue coloration (limit of *iron*)." *U. S.* "It is soluble in ten times its weight of cold and in one third of its weight of boiling *water*, the solution having an acid reaction. It is freely soluble in *glycerin*, insoluble in *alcohol* (90 per cent.). It affords the reactions characteristic of aluminium, of potassium or ammonium, and of sulphates. It should yield no characteristic reaction with the tests for copper, lead, zinc, calcium, or sodium, and only the slightest reactions with the tests for iron." *Br.* Its sp. gr. is 1.71. It reddens litmus, but changes the blue tinctures of the petals of plants to green. When heated a little above 100° C. (212° F.), it undergoes the aqueous fusion; and, if the heat be continued, it loses its water, swells up, becomes a white, opaque, porous mass, and is converted into the official *exsiccated alum*. (See *Alumen Exsiccatum*.) Exposed to a red heat, it gives off oxygen, together with sulphurous and sulphuric oxides, and the residue consists of aluminum oxide and potassium sulphate. When calcined with finely divided charcoal, it forms a spontaneously inflammable substance, called *Homberg's pyrophorus*, which consists of a mixture of potassium sulphide, alumina, and charcoal.

Several varieties of alum are known in commerce. *Roche alum*, so called from its having come originally from Rocca, in Syria, is a sort which occurs in fragments about the size of an almond, and of a pale rose color, which is given to it, according to Pereira, by bole or rose-pink. *Roman alum*, which is the purest variety found in commerce, also occurs in small fragments, covered with a reddish-brown powder, resembling ochre, which is put on by the manufacturers. It has been supposed that the powder contains iron, but this is probably a mistake. Roman alum crystallizes in cubes, from the fact that the crystals are deposited from a solution always containing an excess of alumina, which decomposes any iron salt that may be present. This crystalline form of alum is, therefore, an index of its freedom from much contamination with iron.

All the alums of commerce contain more or less ferrous sulphate, varying from five to seven parts in the thousand. The iron is readily detected by adding to a solution of the suspected alum a few drops of potassium ferrocyanide, which will cause a greenish-blue tint, if iron be present. It may be detected also by precipitating the alumina as a subsulphate with a solution of potassium hydroxide, and afterwards adding the alkali in excess. This will redissolve the precipitate, with the exception of any iron, which will be left in the state of sesquioxide. The proportion of iron usually present, though small, is injurious when the salt is used in dyeing. Alum may, however, be purified, either by dissolving it in the smallest quantity of boiling water, and stirring the solution as it cools, or by repeated solutions and crystallizations.

Incompatibles.—Alum is incompatible with the alkalies and their carbonates, lime and lime water, magnesium oxide and carbonate, potassium tartrate, and lead acetate.

Composition.—Alum was regarded as an aluminum sulphate, until it was proved by Descroizilles, Vauquelin, and Chaptal to contain also potassium sulphate, ammonium sulphate, or both these salts. When its second base is potassium, it consists of one molecule of aluminum sulphate 339.85, one of potassium sulphate 173.07, and twenty-four of water 429.12 = 942.04, but one half of this molecule of alum is now more often written, making its molecular weight 471.02 for the formula $AlK(SO_4)_2 + 12H_2O$. In the ammonium alum, the molecule of potassium sulphate is replaced by one of ammonium sulphate. *Alumina* is classed as an earth, and may be obtained by subjecting ammonium alum to a strong calcining heat. It consists of two atoms of the metal *aluminum* 53.8, and three of oxygen 47.64 = 101.44. It is, therefore, a sesquioxide. The existence of this metal was rendered probable by Sir H. Davy in 1808; but it was not fairly obtained until 1828, when Wöhler procured it in an impure state, in globules of the size of a pin's head, by the action of potassium on aluminum chloride. In 1854, Deville succeeded in obtaining the pure metal in ingots by decomposing the same chloride with

sodium. The process of Deville remained the only practical process for its manufacture until 1886, when the Messrs. Cowles of Cleveland, Ohio, succeeded in effecting the reduction of corundum, the native oxide, by charcoal with the aid of a powerful electric current from a Brush dynamo-electric machine, using large carbon electrodes. They manufactured the pure aluminum and the alloys of copper known as aluminum bronzes. This process in turn has been practically displaced by the Hall process, as operated by the Pittsburg Reduction Company at Niagara Falls and elsewhere. This is to electrolyze pure alumina dissolved in a bath of melted cryolite. The cryolite (a double fluoride of sodium and aluminum) is continuously regenerated, so that by feeding in the pure alumina the process can be made continuous. A German process, that of Graetzel, for electrolyzing the fused chloride, is also in successful use.

Aluminum is silver-white, sonorous, unalterable in the air, and lighter than glass, having only the sp. gr. 2.56. Its fusing point is somewhat lower than that of silver. It is not attacked by sulphuric or nitric acid, nor tarnished by hydrogen sulphide. Its proper solvent is hydrochloric acid. After silver, gold, and platinum, it is the least alterable of the metals.

The world's production of aluminum in 1903 was 8,252 metric tons, of which the United States produced 3,402 tons, which was valued at $2,325,000.

Uses.—Alum is a powerful astringent, with very decided irritant qualities, owing to which, when taken internally in sufficient quantity, it is emetic and purgative, and may even cause fatal gastro-intestinal inflammation. It may be employed in passive relaxations of the mucous membrane or skin, *hemorrhages, serous diarrhœa, colliquative sweats,* etc., but is not much used internally, except in *colica pictonum.* The latter employment of it was introduced by Grashuis, a Dutch physician, in 1752, was imitated by Percival with great success, and has been revived in recent times with the happiest results. It allays nausea and vomiting, relieves flatulence, mitigates the pain, and opens the bowels with more certainty than any other medicine. Sometimes it is advantageously conjoined with opium and camphor. It is also efficacious in *nervous colic.* Sir James Murray found it a useful remedy in *gastrorrhœa.* He gave it in doses of ten or twelve grains (0.65 to 0.78 Gm.) three or four times a day, mixed with an equal quantity of cream of tartar to prevent constipation, and a little ginger to obviate flatulence. By C. D. Meigs alum has been strongly recommended, in doses of a teaspoonful (3.9 Gm.), in *pseudo-membranous croup* as a mechanical emetic, but its action is not as certain or powerful as is that of zinc sulphate.

Alum is a powerful astringent when topically applied, and has been largely used as such. In various *anginas* it has been a favorite remedy, but on account of its destructive influence upon the teeth it should never be used alone in gargles, but be applied in powder or concentrated solution with the brush. Bretonneau, Vulpian, etc., strongly recommended it in *pseudo-membranous angina,* applied by insufflation in the case of children. When used in the latter way, a drachm of finely powdered alum may be placed in one end of a tube, and then blown by means of the breath into the throat of the child. Alum coagulates blood very rapidly and firmly, and is frequently used as a local styptic in external *hemorrhages* and in *epistaxis* and other bleedings from the mucous membrane to which it can be applied directly. In *hæmoptysis* its saturated solution may be used by atomization. It is sometimes applied locally in the form of *cataplasm,* made by coagulating the whites of two eggs with a drachm of alum. In *colica pictonum* from 20 to 30 grains of alum in molasses (or thick syrup) may be given three or four times a day. The emetic dose is one to two teaspoonfuls, repeated, if necessary, in fifteen minutes. An elegant mode of giving alum in solution is in the form of *alum whey,* made by boiling two drachms of alum with a pint of milk, and then straining to separate the curd; the dose is a wineglassful (60 Cc.). As a collyrium, a solution is made of various strengths, as 4, 6, or 8 grains to the fluidounce of water. A solution containing from half an ounce to an ounce in a pint of water, and sweetened with honey, is a convenient gargle. In the treatment of *gleet, leucorrhœa, ulcers,* etc., solutions of alum must vary in strength according to the state of the parts to which they are applied.

In a case recorded by Ricquet of Liège, death resulted from about an ounce of alum taken in solution by mistake for Epsom salt. A sensation of burning in the mouth, throat, and stomach occurred immediately upon the swallowing of the poison, followed by bloody vomiting, and death in the midst of inexpressible suffering. Upon post mortem examination there was found a grayish-yellow coating covering the mucous membrane of the mouth, pharynx, and œsophagus; the tongue and uvula were swollen, and the stomach, bowels, and kidneys were injected. (*J. P. C.,* Oct. 1873, p. 333.).

Alum is sometimes used to adulterate bread, with the view to increase its whiteness and to conceal the defects of the flour. If the quantity used be sufficient, the alum acts as an irritant to the gastro-intestinal tract, and, according to the results of experiments made by Bigelow and Hamilton, it actively checks peptic digestion.

Dose, as an astringent, five to twenty grains (0.32 to 1.3 Gm.); as an emetic, one drachm (3.9 Gm.).

Off. Prep.—Alumen Exsiccatum, *U. S., Br.;* Alumini Hydroxidum, *U. S.;* Glycerinum Aluminis, *Br.*

ALUMEN EXSICCATUM. U. S., Br.

EXSICCATED ALUM [Alumen Ustum, Dried Alum, Burnt (Burned) Alum]

(ą-lū'mĕn ĕx-sĭc-cā'tŭm)

$AlK(SO_4)_2 = 256.46$

"Exsiccated Alum should contain not less than 99 percent. of pure anhydrous Aluminum and Potassium Sulphate." *U. S.*

Alun calciné, desséché, brûlé, *Fr.;* Alumen ustum, *P. G.;* Gebrannter Alaun, Gebrannter Kalialaun, *G.;* Solfato di allumino e di potassio usto, Allume usto, *It.;* Solfato aluminico-potasico anhidro, Alumbre calcinado, *Sp.*

* "Alum, in small pieces, *one hundred grammes* [or 3 ounces av., 231 grains], to make *fifty-five grammes* [or 1 ounce av., 411 grains]. Place the Alum in a tared shallow porcelain dish so as to form a thin layer, and heat it on a sand-bath until it liquefies. Then continue the application of a moderate heat, with constant stirring, until aqueous vapor ceases to be disengaged, and a dry, white, porous mass weighing *fifty-five grammes* [or 1 ounce av., 411 grains] is obtained. When cold, reduce the product to a fine powder, and preserve it in well-stoppered bottles." *U. S.*

"Potassium Alum, 4 *ounces* (Imperial) or 100 grammes. Heat the Potassium Alum in a porcelain dish or other suitable vessel till it liquefies, then increase and continue the application of heat until aqueous vapor ceases to be disengaged, and the salt has lost between 45 and 46 per cent. of its weight." *Br.*

The object of these processes is to obtain the alum free from its water of crystallization, without otherwise in the least decomposing it. For this purpose a certain degree of heat is necessary; and yet if the heat be too great the salt itself is decomposed, and the desired end is not attained. If the alum employed be the potassium alum, the old indefinite directions will generally be sufficient to secure the requisite result, as this salt will resist a heat short of redness; but this is not the case with the ammonium salt, which is official in the Br. P. To guard against failure from this cause, the Pharmacopœias formerly directed 205° C. (400° F.) as the highest heat to be used, and the checking of the operation when nearly all the water has been driven off, as indicated by the weight of the residue. John M. Maisch satisfactorily determined by experiment that, whichever alum may be used, this temperature is quite high enough, and the direction of the Pharmacopœias, as to the weight of the residue, insures that a sufficient heat will be employed. By the official process there is left behind about one and one-fourth per cent. of the water of crystallization, when potassium alum is used.

Properties.—Exsiccated alum is officially described as "a white, granular powder, without odor, possessing a sweetish, astringent taste, and attracting moisture on exposure to the air. It is very slowly but completely soluble in about 17 parts of water at 25° C. (77° F.), and quickly soluble in 1.4 parts of boiling water. Its aqueous solution should respond to the reactions and tests given under *Alumen.*" *U. S.* Before pulverization, it is a light, white, opaque, porous mass. During the exsiccation, alum loses 45 per cent. of its weight in dissipated water. Exsiccated alum resists the action of cold water for a long time, showing its altered aggregation. In composition it differs from crystallized alum merely in the absence of water.

Uses.—Exsiccated alum has the same medicinal properties as ordinary alum, except that it is much more powerful and irritant. It is used as a mild escharotic to destroy *exuberant granulations,* on which it should be freely dusted.

ALUMINI HYDROXIDUM. U. S.

ALUMINUM HYDROXIDE [Alumini Hydras, Pharm. 1890]

(ą-lū'mĭ-nī hȳ-drŏx'ĭ-dŭm)

$Al(HO_3) = 77.54$

Aluminum Hydrate, Hydrated Alumina; Argilla Pura, s. Hydrata; Hydrate de l'Alumine, *Fr.;* Thonerdehydrat, *G.*

* "Alum, *one hundred grammes* [or 3 ounces av., 231 grains]; Monohydrated Sodium Carbonate, *forty-three grammes* [or 1 ounce av., 226 grains]; Water, *a sufficient quantity.*

Dissolve each salt separately in *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water, filter the solutions and heat them to boiling. Then having poured the hot solution of Monohydrated Sodium Carbonate into a capacious vessel, gradually pour in the hot solution of Alum with constant stirring, and add *two thousand cubic centimeters* [or 67 fluidounces, 5 fluidrachms] of boiling Water. Allow the precipitate to subside, decant the clear liquid, and pour upon the precipitate *two thousand cubic centimeters* [or 67 fluidounces, 5 fluidrachms] of hot Water. Again decant, transfer the precipitate to a strainer, and wash it with hot Water, until the washings produce not more than a faint cloudiness with barium chloride T.S. Then allow it to drain, dry it at a temperature not exceeding 40° C. (104° F.), and reduce it to a uniformly fine powder." *U. S.*

Properties.—It is "a white, light, amorphous powder, odorless and tasteless, and permanent in dry air. Insoluble in water or alcohol, but completely soluble in hydrochloric or sulphuric acid, and also in potassium hydroxide T.S. When heated to redness, it loses about 34 percent. of its weight." *U. S.*

Tests.—"A solution of 1 Gm. of Aluminum Hydroxide in 20 Cc. of diluted hydrochloric acid should not at once assume a blue color on the addition of 1 drop of potassium ferrocyanide T.S. (limit of *iron*), and should not give more than a faint cloudiness with barium

chloride T.S. (limit of *sulphate*). If 1 Gm. of the salt be boiled with 20 Cc. of distilled water, and the liquid filtered, the filtrate should not have an alkaline reaction, and on evaporation should leave a residue weighing not more than 0.005 Gm. (limit of *alkali salts*). A solution of the salt (1 in 20) in diluted hydrochloric acid should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). (The subsequent addition of ammonia water, as directed in this test, should be omitted)." *U. S.*

Uses.—A very feebly astringent and desiccant powder, sometimes used externally as an application in inflammatory affections of the skin. So far as our experience goes, it is very rarely employed in this country.

ALUMINI SULPHAS. U. S.

ALUMINUM SULPHATE

(ą-lū'mį-nī sūl'phăs)

$Al_2(SO_4)_3 + 16H_2O = 625.93$

"It should contain not less than 99.5 percent. of pure Aluminum Sulphate." *U. S.*

Sulfate d'Alumine, *Fr.*; Aluminium sulfuricum, *P. G.*; Aluminium sulfat, Schwefelsaure Thonerde, *G.*

A process was given in the U. S. P. 1870 for the preparation of this salt, but the 1880 Committee of Revision very properly omitted the process, merely giving a description and tests for the salt. The process of 1870 is as follows: "Take of Alum, Carbonate of Sodium, each, *four troyounces;* Sulphuric Acid *a troyounce and one hundred and fifty grains;* Water *a sufficient quantity.* Dissolve the salts separately, each in six fluidounces of boiling water, and pour the solution of the Alum gradually into that of the Carbonate of Sodium, then digest with a gentle heat until the evolution of carbonic acid ceases. Collect upon a filter the precipitate formed, and wash it with water, until the washings are no longer affected by chloride of barium. Next, with the aid of heat, dissolve the precipitate in the Sulphuric Acid, previously diluted with half a pint of Water, and, having filtered the solution, evaporate it until a pellicle begins to form. Then remove it to a water-bath, and continue the evaporation, with constant stirring, until a dry salt remains. Lastly, preserve this in a well-stoppered bottle." *U. S.* 1870.

The sodium of the carbonate unites with the sulphuric acid of the aluminum sulphate, with the escape of the carbon dioxide, and the precipitation of the aluminum in the form of an hydroxide, while the undecomposed ammonium sulphate of the alum, and the newly formed sodium sulphate, remain in solution. The aluminum hydroxide is then washed in order to separate any portion of the sulphates adhering to it, the absence of which is shown by the non-action of barium chloride on the washings. It now remains to unite the aluminum hydroxide and sulphuric acid, which is affected by heating them with water; the salt, which is formed in solution, is obtained by evaporating the solution to dryness. It may also be obtained from the solution by the addition of alcohol, which precipitates it. In the process the several substances are used in very nearly saturating proportions. (See paper on Aluminum Sulphate by J. U. Lloyd, *N. R.*, Aug. 1879, p. 237.)

Aluminum sulphate may be prepared also by the process of Huria and Brunel, which consists in exposing, in an iron cylinder, aluminum and ammonium sulphate (ammonium alum), first dried to separate its water of crystallization, to a cherry-red heat. Aluminum sulphate remains in the cylinder, and the volatilized products are collected in water. The chief of these is ammonium sulphite, which serves for the preparation of a fresh portion of alum, after having been changed into the sulphate by oxidation in the air. It is now also obtained in enormous quantities, for use in the place of alum as a mordant in dyeing, as one of the by-products in the manufacture of soda from cryolite. Aluminum sulphate is also obtained from bauxite.

The American production, chiefly from bauxite, in 1901 amounted to 74,721 short tons; in 1902 to 80,075 tons; and in 1903 to 80,726 tons.

Sometimes free sulphuric acid exists in aluminum sulphate. It may be recognized by the salt imparting a strongly acid reaction to alcohol, also by the fact that the dark violet color imparted to decoction of logwood by aluminum sulphate changes to brown in the presence of free acid. (*A. J. P.*, Nov. 1873.) Wittstein treats the finely powdered salt with absolute alcohol; if the latter does not become acid, no free acid is present. (See also *Proc. A. Ph. A.*, 1887, p. 216.) Egger recommends Pettenkofer's bile reaction for the detection of free sulphuric acid in aluminum sulphate and alum. (*Chem. News,* 1889, p. 169.)

Properties.—As procured by the process of 1870, aluminum sulphate is in the form of a white powder. It may, however, be obtained in lamellar crystals. It is described in the U. S. P. (8th Rev.) as "a white, crystalline powder, or shining plates, or crystalline fragments; without odor, having a sweetish and afterwards an astringent taste, and permanent in the air." *U. S.* As seen in commerce, it is usually in flattened crystalline cakes, which appear as though formed by the cooling of soft masses of minute crystals. It has a sour as well as sweet and very astringent taste, is soluble in its weight of water, and has an acid reaction.

The salt is "soluble in 1 part of water at 25° C. (77° F.), more soluble in boiling water, but insoluble in alcohol. When gradually heated to about 200° C. (392° F.), it loses its water of crystallization (45.7 percent. of its weight). The aqueous solution of the salt has an acid reaction upon blue litmus paper. The

aqueous solution of the salt yields, with barium chloride T.S., a white precipitate insoluble in hydrochloric acid; and with potassium hydroxide T.S., a white, gelatinous precipitate which is soluble in an excess of the alkali, but which is again separated on the addition of a sufficient amount of ammonium chloride T.S." *U. S.*

It is formed by the union of one molecule of alumina, which is an aluminum sesquioxide, and three molecules of sulphuric acid, $Al_2(SO_4)_3$, and, when crystallized, contains sixteen molecules of water. The salt is, therefore, an aluminum trisulphate.

Tests.—"If 1 Gm. of Aluminum Sulphate be gently heated with 5 Cc. of potassium hydroxide T.S., the liquid should not evolve the odor of *ammonia*. A filtered, aqueous solution of the salt (1 in 10) should not become more than faintly opalescent within five minutes after the addition of an equal volume of tenth-normal sodium thiosulphate V.S. (limit of *free acid*). The aqueous solution of the salt (1 in 10) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). (The subsequent addition of ammonia water, as directed in this test, should be omitted). The addition of 5 drops of potassium ferrocyanide T.S. to 20 Cc. of the aqueous solution of the salt (1 in 20) should not produce at once a blue coloration (limit of *iron*)." *U. S.*

Uses.—The soluble simple salts of aluminum have the property of opposing animal putrefaction, but the sulphate is probably the most powerful and certainly is the most used. It has been employed in aqueous solution (20 grains in a fluidounce up to saturation *pro re nata*) as an antiseptic, detergent application to *foul ulcers*, and as an injection in *fetid discharges from the vagina*. Solution of aluminum sulphate is capable of dissolving a considerable quantity of recently precipitated gelatinous alumina. Such a solution, impregnated with benzoin, has been proposed by Mentel as a hæmostatic, under the name of *benzoinated solution of alumina*. It resembles the *styptic liquid of Pagliari*. It is prepared by saturating with gelatinous alumina a solution made of eight ounces of aluminum sulphate dissolved in a pint of water. To the saturated solution six drachms of bruised amygdaloid benzoin are added, and the whole is kept at a temperature of about 150° F. for six hours, with occasional agitation, so that the liquid, after filtration, may have about the density 1.26. This liquid, put in a cool place for several days, so as to deposit some crystals of alum, forms the benzoinated solution, remarkable for its very sweet odor and astringent balsamic taste. Benzoinated solution of alumina, diluted in the proportion of from two to five fluidrachms to the pint of water, has been found useful as an injection in *leucorrhœa*. Aluminum sulphate in saturated solution has been used for the preservation of cadavers for dissection, but is much inferior to zinc chloride.

AMMONIA.

AMMONIA

(ạm-mō′nĭ-ạ)

$NH_3 = 16.93$

All the ammoniacal compounds owe their distinctive properties to their combination with a peculiar gaseous substance, composed of nitrogen and hydrogen, called *ammonia*. This is most easily obtained by the action of lime on ammonium chloride, or sal ammoniac,—when the lime unites with the hydrochloric acid, so as to form calcium chloride and water, and expels the ammonia. It is transparent and colorless, like common air, but possesses an acrid taste and an exceedingly pungent odor. It has a powerful alkaline reaction, and, from this property and its gaseous nature, was called the *volatile alkali* by the earlier chemists. Its sp. gr. is 0.59. It is irrespirable, the glottis closing spasmodically when the attempt is made to breathe it. Each molecule consists of one atom of nitrogen and three of hydrogen, or, in volumes, of one volume of nitrogen and three volumes of hydrogen, condensed into two. Its formula is NH_3. The sources of ammonia will be mentioned elsewhere (see *Ammonii Chloridum*, p. 131), but a synthesis of ammonia from simple elements may be noted here. Hydrogen, nitrogen, and aqueous vapor in the presence of porous contact substances like pumice, charcoal, etc., unite to form ammonia, and this, in the presence of CO and CO_2, gives rise to ammonium formate or carbonate.

As the gas ammonia exists in the free state, the molecule NH_3 is a definite saturated compound under ordinary conditions. When, however, ammonia gas is mixed with hydrochloric acid gas or its aqueous solution with hydrochloric acid in solution, the two unite to form a new compound, NH_4Cl, which proves to be a definite compound, analogous to potassium or sodium chlorides. Berzelius, therefore, proposed to call this ammonium chloride, assuming that the monad group (NH_4) acted like the monad metal K in forming compounds, and in fact it is found that when sulphuric, nitric, carbonic, and other acids are neutralized by *ammonia* gas or solution, crystallizable salts like $(NH_4)_2SO_4$, NH_4NO_3, and $(NH_4)_2CO_3$ are formed, which are termed ammonium sulphate, nitrate, and carbonate respectively. *Ammonium* is believed to exist although it has not been isolated in a pure state. *Ammonium amalgam* is a compound of ammonium with mercury.

The atmosphere contains a minute proportion of ammonia, probably in the state of carbonate. (A. Vogel, *N. R. Pharm.*, 1872.)

Ozonized oxygen oxidizes the elements of ammonia, producing water and nitric acid; the latter, uniting with undecomposed ammonia, generates ammonium nitrate. Ordinary oxygen, under the influence of platinum-black, or finely-divided copper, likewise oxidizes the ele-

ments of ammonia, the nitrogen to the extent only of forming nitrous acid, with the result of producing ammonium nitrite.

AMMONIACUM. Br.

AMMONIAC

(ăm-mo-nī'ă-cŭm)

"A gum-resin exuded from the flowering and fruiting stem of Dorema Ammoniacum, *D. Don;* and probably other species." *Br.*

Gummi-resina Ammoniacum or Doremæ, Ammoniacum; Ammoniaque, Gomme-résine ammoniaque, Gomme ammoniaque, *Fr.;* Ammoniacum, *P. G.;* Ammoniak, Ammoniak-gummi, *G.;* Gomma ammoniaco, *It.;* Gomo-resina amoniaco, Goma amoniaco, *Sp.;* Ushek, *Ar.;* Semugh belsheren, *Pers.*

This gum-resin was dropped in the Eighth Revision of the U. S. Pharmacopœia on account of its having fallen, at least in America, almost into desuetude.

Formerly ammoniac was believed to be yielded by *Heracleum gummiferum,* Willd.; this plant was, however, ascertained by Sprengel to be a native of the Pyrenees, and not to yield gum at all. A substance resembling true gum ammoniac has long been produced in Morocco, and has been shown by Jackson and by Falconer to be the product of the *Ferula tingitana,* L. This gum is probably the ammoniac of the ancients, which was obtained from Africa; the present official drug comes exclusively from Persia, and is the product of the plant first found by Fontanier in the province of Fars, subsequently described by Mérat and De Lens under the name of *Ferula ammonifera.* David Don (see *Linn. Trans.,* vol. 16), determined that this plant belonged to a new genus, Dorema, so that the official authorities now recognize the drug as the product of the *Dorema Ammoniacum,* Don, syn. *Diserneston gummiferum,* Jaubert and Spack (see *Illustrations of Oriental Plants,* Paris 1842). *Dorema Aucheri,* Boiss., and *D. robustum,* Loftus, of Western Persia, are believed to contribute to the official drug.

The ammoniac plant grows spontaneously in Farsistan, Irak, Khorassan, and other Persian provinces. Grant found it abundantly in Syghan near Bamian, on the northwest slope of the Hindu-Kush Mountains. It attains the height of six or seven feet, and in the spring and early part of summer abounds in a milky juice, which flows out upon the slightest puncture. From the accounts of travellers, it appears that in the month of May the plant is pierced in innumerable places by an insect of the beetle kind. The juice, exuding through the punctures, concretes upon the stem, and when quite dry is collected by the natives. Fontanier states that the juice exudes spontaneously, and that the harvest is about the middle of June. According to Grant, the drug is collected in Syghan, like asafetida, from the root of the plant. The gum-resin is sent to Bushire, whence it is transmitted to India, chiefly to Bombay. A small portion is said to be taken to the ports of the Levant, and thence distributed. The name of the drug is thought to have been derived from the temple of Jupiter Ammon in the Libyan desert, where the ammoniac of the ancients is said to have been collected; but Don considers it a corruption of *Armeniacum,* originating in the circumstance that the gum-resin was formerly imported into Europe through Armenia. The *African Ammoniac,* which is said to have appeared in the London market only in the years 1857 and 1871, has been described by Daniel Hanbury as follows. It is "in large, compact, dark, heavy masses, formed of agglutinated tears of a gum-resin of hard, waxy consistence. The tears are opaque, white or of a pale greenish yellow, mixed with others of a blackish brown, which, with vegetable and earthy impurities, constitute a large portion of the mass." The odor of the drug is feeble, and quite different from that of the Persian gum-resin; its taste slightly acrid and very persistent. (*P. J.,* March, 1873, p. 741.) Examined by John Moss, it was found to consist of 67.76 per cent. of resin, 9.1 of gum, 4.29 of water and volatile oil, and 18.85 of bassorin and insoluble matters. (*Ibid.,* p. 742.) It is used chiefly for incense in Mohammedan countries, and is sent eastward by the caravans, or in vessels from the ports of Morocco to Alexandria.

Properties.—Ammoniac comes either in the state of tears, or in aggregated masses, and in both forms is frequently mixed with impurities. That of the tears, however, is preferable, as the purest may be conveniently picked out and kept for use. These are of an irregular shape, usually more or less globular, from two to eight lines in diameter, opaque, yellowish on the outside, whitish within, compact, homogeneous, brittle when cold, and breaking with a conchoidal, shining, waxy fracture. The masses are often of a darker color and less uniform structure, appearing, when broken, as if composed of numerous white or whitish tears, embedded in a dirty-gray or brownish substance, and frequently mingled with foreign matters, such as seeds, fragments of vegetables, and sand or earth. According to the 1890 U. S. Pharmacopœia, only such masses should be considered up to the standard as are composed entirely of tears "without any intervening dark-colored substance."

The odor of ammoniac is peculiar, and stronger in the mass than in the tears. The taste is slightly sweetish, bitter, and somewhat acrid. The sp. gr. is 1.207. When heated, the gum-resin softens and becomes adhesive, but does not melt. It burns with a white flame, swelling up, and emitting a smoke of a strong, resinous, slightly alliaceous odor. It is partly soluble in water, alcohol, ether, vinegar and alkaline solutions. Triturated with water it forms an opaque milky emulsion, which becomes clear upon standing. The alcoholic solution is transparent, but is rendered milky by

the addition of water. "The freshly fractured surface is colored yellow by *solution of potassium hydroxide,* and dark red or orange by *solution of chlorinated soda.* If a small fragment be strongly heated in a dry test-tube, the contents of the tube, after cooling, yield with boiling *water* a solution which when largely diluted with *water,* and made alkaline with *solution of ammonia,* does not exhibit a blue fluorescence (distinction from asafetida and galbanum)." *Br.* Martius found 0.4 per cent. of ethereal oil, Flückiger 0.33 per cent. (*Pflanzenstoffe,* 2d ed., p. 962.) Plugge's analysis gives 1.27 per cent. of volatile oil, 5.10 per cent. of water, 2 per cent. of ash, 65.53 per cent. of resin, and 26.10 per cent of gum. Hager succeeded in procuring the volatile oil in a separate state by repeated distillation with water. It has a penetrating disagreeable odor, and a taste at first mild, but afterwards bitter and nauseous. Flückiger says that the oil contains no sulphur. The resin in ammoniacum usually amounts to about 70 per cent. Unlike the gum-resin of allied plants ammoniacum yields no umbelliferone. When melted with potassium hydroxide it affords protocatechuic acid and resorcinol. The resin of ammoniac is dissolved by alcohol, and by the fixed and volatile oils; but it is divided by ether into two resins, of which one is soluble and the other insoluble in ether. Plugge states that sodium hypobromite, made by dissolving 30 grammes of pure sodium hydroxide in water, adding 20 grammes of bromine, cooling the mixture, and adding distilled water until the whole measures 1 liter, is a sensitive reagent for ammoniac resin. (*A. Pharm.,* 1883.)

Tschirch and Luz have made an elaborate research of the chemistry of ammoniac, and state the following conclusions. Ammoniac contains resin, gum, and volatile oil, together with about 3.5 per cent. of a residue insoluble in water and alcohol. The portion soluble in alcohol and ether is a mixture of a so-called acid resin and a neutral resin, and amounts to 69 per cent. Both resins are free from sulphur, despite the statement of Preiszewski, who considered the latter of them to contain sulphur. The saponification of the so-called acid resin yielded salicylic acid of the formulas $C_6H_4OHCOOH$ and $C_6H_4OHCOOH + \frac{1}{2}H_2O$. Along with this were volatile acids, consisting of valeric and butyric acids, and an alcohol which belongs to the class of *resinotannols,* and has the same formula as galbaresinotannol, $C_{18}H_{30}O_3$. The resin is, therefore, a salicylic ester of resinotannol. From this resinotannol both the acetyl and the benzoyl derivatives were made, and the formula $C_{18}H_{30}O_3$ thus established. On oxidizing the resinotannol with nitric acid, *styphnic acid* was obtained, and on fusing it with potassium hydroxide, resorcinol. Volatile oil was found in small amount only. It contains no umbelliferone, and is free from sulphur. The crude ammoniac showed traces of a free acid which was recognized as salicylic both by its fusing point and the ferric chloride reaction. The gum contained 3.5 per cent. of ash, of which 1.2 per cent. was calcium oxide, so that the gum is probably related to gum arabic, and is an acid calcium arabinate. (*A. Pharm.,* 1895, p. 571.) Dieterich proposes the following tests: 1. Loss at 100° C. (212° F.). 2. Per cent. of ash. 3. Determination and weighing of alcohol-soluble constituents. 4. Determination and weighing of alcohol-insoluble constituents. 5. Saponification number. 6. Acid number. 7. Ester number. (*Ph. Ztg.,* 96, 401, and *P. J.,* 1900, 647.)

Uses.—This gum-resin is stimulant and expectorant, in large doses cathartic, and, like many other stimulants, may be so given as occasionally to prove diaphoretic, diuretic, or emmenagogue. It has been employed in medicine from the highest antiquity, being mentioned in the writings of Hippocrates, but is now seldom administered. The complaints in which it was most frequently used were *chronic catarrh, asthma,* and other *pectoral affections* attended with deficient expectoration without acute inflammation, or with a too copious secretion from the bronchial mucous membrane, dependent upon debility of the vessels. It is usually administered in combination with other expectorants, with tonics, or with emmenagogues. Externally applied, in the shape of a plaster, it is thought to be useful as a discutient or resolvent in white swellings of the joints, and other indolent tumors. (See *Emplastrum Ammoniaci cum Hydrargyro.*) It is given in substance, in pill or emulsion. The latter form, however, is preferable. (See *Emulsum Ammoniaci,* U. S. 1890.)

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Emplastrum Ammoniaci cum Hydrargyro, *Br.;* Mistura Ammoniaci, *Br.;* Pilula Ipecacuanhæ cum Scilla, *Br.;* Pilula Scillæ Composita, *Br.*

AMMONII BENZOAS. U. S., Br.

AMMONIUM BENZOATE

(ąm-mō′nĭ-ī bĕn′zo-ăs)

$NH_4C_7H_5O_2 = 138.06$

"It should contain not less than 98 percent. of pure Ammonium Benzoate [$C_6H_5.COONH_4$], and should be kept in well-stoppered bottles." *U. S.* "This salt, $C_6H_5.COONH_4$, is produced by neutralizing benzoic acid with solution of ammonia." *Br.*

Ammoniæ Benzoas, Ammonium Benzoicum, Benzoas Ammonicus; Benzoate of Ammonia; Benzoate d'Ammoniaque, *Fr. Cod.;* Benzöesaures Ammonium, Ammonium benzoat, *G.;* Benzoato amonico, *Sp.*

The process for the preparation of this salt was omitted in the 1880 U. S. revision. The process of U. S. 1870 is appended. "Take of Benzoic Acid *two troyounces;* Water of Ammonia *three fluidounces and a half,* or *a sufficient quantity;* Distilled Water *four fluidounces.*

Dissolve the Acid in three fluidounces and a half of the Water of Ammonia, previously mixed with Distilled Water; evaporate with a gentle heat, occasionally adding Water of Ammonia, if necessary, to maintain a slight excess of the alkali; then set aside to crystallize, and dry the crystals without heat." *U. S.* 1870.

Although the quantity of ammonia ordered in the formula is in excess, yet, from the feeble affinity between the constituents, and the consequent escape of ammonia during the evaporation, a portion of the acid benzoate would be formed, if it were not that a little solution of ammonia is from time to time added during or near the close of the evaporation, so as to maintain the alkali in slight excess. The crystals, for the same reason, should be dried without heat. If slightly evaporated, and then allowed to cool, the solution becomes a mass of crystals, retaining so much water as to render it necessary to dry them by means of bibulous paper.

Properties.—"Thin, white, laminar crystals or a crystalline powder; odorless, or having a slight odor of benzoic acid, a saline, bitter, afterwards slightly acrid taste, and gradually losing ammonia on exposure to the air. Soluble in about 10.5 parts of water and 25 parts of alcohol at 25° C. (77° F.), in 1.2 parts of boiling water, and in 7.6 parts of boiling alcohol. The salt fuses at 193° to 194° C. (379.4° to 381.2° F.), with decomposition, and when strongly heated emits vapors having the odor of ammonia and benzoic acid, and is finally completely volatilized. The aqueous solution of the salt is neutral, or very slightly reddens blue litmus paper. A saturated aqueous solution of Ammonium Benzoate affords with ferric chloride T.S. a flesh-colored precipitate, and when such a solution is gently heated with potassium hydroxide T.S. ammonia is evolved. If diluted nitric acid be added in slight excess to the aqueous solution of the salt (1 in 10), the precipitated benzoic acid, after collecting and washing, should respond to the tests of purity and identity given under *Acidum Benzoicum,* and the filtrate from this precipitate should not be affected by barium chloride T.S. (absence of *sulphate*), or by silver nitrate T.S. (absence of *chloride*). If the aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121)." *U. S.* "Soluble in 6 parts of cold *water,* in 30 of *alcohol* (90 per cent.), and in 8 of *glycerin.* It affords the reactions characteristic of ammonium salts. An aqueous solution yields a yellowish or flesh-colored precipitate when mixed with *test-solution of ferric chloride.* A strong aqueous solution to which a little *sulphuric acid* is added affords a crystalline precipitate of benzoic acid. It should yield no residue on heating to redness, and no characteristic reaction with the tests for chlorides or sulphates. Its cold aqueous solution does not at once redden *solution of litmus* (absence of acid); on boiling the solution it slowly dissociates into benzoic acid and ammonia, and affords an acid reaction." *Br.* Gmelin states that by boiling its solution the salt is converted into the acid benzoate, which crystallizes in feathery tufts of needles. (*Handbook,* xii. 38.) According to Lichtenstein, it deliquesces in the air. It gives a copious yellow precipitate with ferric salts, and is known to contain benzoic acid and ammonia, by depositing the former when the solution is acidulated with hydrochloric acid, and giving off the latter when it is heated with potassium hydroxide. According to Squire, the acid salt, which is that commonly met with in commerce, is less soluble than the official salt, requiring 60 parts of water and 12 of alcohol for solution. This is a decided objection to it.

Uses.—Ammonium benzoate is a slightly stimulant diuretic, which acts chiefly through its benzoic acid, it being decomposed by the gastric acids, which combine with the ammonia, while the benzoic acid is absorbed, and passes out through the kidneys in the form of hippuric acid. (See *Benzoic Acid.*) The salt has been found useful as an alterative diuretic, in chronic inflammation of the genito-urinary tract, and as a solvent of the *phosphatic deposits,* through the hippuric acid into which it is converted. It has been employed in *gouty affections* with a view to the removal of the deposits of sodium urate about the joints; but it has been shown to have no effect on the elimination of *uric acid.*

Dose, from ten to thirty grains (0.65 to 2.0 Gm.), which may be taken dissolved in water.

AMMONII BROMIDUM. U. S., Br.

AMMONIUM BROMIDE

(ąm-mō'nĭ-ī brō'mĭ-dŭm)

$NH_4Br = 97.29$

"It should contain not less than 97 percent. of pure Ammonium Bromide, and should be kept in well-stoppered bottles." *U. S.* "This salt, NH_4Br, is formed by neutralizing hydrobromic acid with a solution of ammonia." *Br.*

Ammonium Bromatum; Bromhydrate d'Ammoniaque, *Fr. Cod.;* Bromure d'Ammonium, *Fr.;* Ammonium bromatum, *P. G.;* Ammonium bromid, Brom-Ammonium, *G.;* Bromuro di ammonio, *It.;* Bromuro amonico, *Sp.*

Ammonium bromide may be made by dissolving bromine in ammonia water; but the U. S. Pharm. 1870 preferred the method of first forming solution of ferrous bromide, precipitating with ammonia water, separating by filtration the ferric oxide, and obtaining by evaporation the ammonium bromide from the solution. This process is similar to that by which potassium bromide is prepared. According to Procter, a still better method consists in adding to bromine and water sufficient solution of ammonium sul-

phide to discharge the color, filtering to separate the sulphur, and then evaporating to dryness. Charles Rice (*A. J. P.*, 1873, p. 249) recommends making ammonium bromide by double decomposition between hot solutions of potassium bromide and ammonium sulphate, assisting the precipitation of potassium sulphate by alcohol. W. H. Pile (*Proc. A. Ph. A.*, 1874, p. 434) published a simple process for this salt. Pour the bromine (one pound) carefully into four times its weight of distilled water in a stone jar, add *very gradually* about one quart of solution of ammonia, cover the top of the jar with a glass plate when vapors arise, and when all the ammonia has been added, and the solution is free from the odor of bromine, it is evaporated and the salt granulated; the yield is about twenty ounces.

Properties.—Ammonium bromide may be obtained in colorless crystals, but the official salt is also a white, crystalline powder. Whether in crystals or in powder, on exposure to the air it gradually becomes yellowish, in consequence of a partial decomposition, by which hydrobromic acid appears to be liberated, as it now changes litmus red. The salt has a saline, pungent taste. Exposed to heat, it sublimes unchanged. It is officially described as in "colorless, transparent, prismatic crystals, or a white, crystalline powder; odorless, of a pungent, saline taste, and permanent in dry air. Soluble in 1.2 parts of water, and in 12.5 parts of alcohol at 25° C. (77° F.), in 0.7 part of boiling water, and in 9 parts of boiling alcohol. When heated, Ammonium Bromide volatilizes completely, without fusing. An aqueous solution of the salt slightly reddens blue litmus paper." *U. S.* It is sparingly soluble in ether, and is incompatible with acids, acid salts, and spirit of nitrous ether.

"When the aqueous solution is gently heated with potassium hydroxide T.S., ammonia is evolved. Silver nitrate T.S. produces a yellowish-white precipitate, insoluble in nitric acid or in a moderate excess of ammonia water. If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and if chlorine water, which has been diluted with an equal volume of water, be cautiously introduced drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of *iodide*). If a few drops of diluted sulphuric acid be brought in contact with a little of the powdered salt on a porcelain plate, the salt should not at once assume a yellowish color (absence of *bromate*). An aqueous solution of the salt (1 in 100) should not at once assume a blue color with potassium ferrocyanide T.S. (limit of *iron*). Ten Cc. of an aqueous solution of Ammonium Bromide (1 in 20), when acidulated with acetic acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 3 Gm. of the salt be dissolved in sufficient water to measure 100 Cc., then 10 Cc. of this solution, after the addition of a few drops of potassium chromate T.S., should require not more than 31.6 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red coloration." *U. S.* "0.5 gramme of the dry salt dissolved in *water* should require not more than 51.8 and not less than 51.1 cubic centimetres of the *volumetric solution of silver nitrate* for complete precipitation (limit of impurities). It should yield no residue on being heated to redness, no characteristic reaction with the tests for lead, iron, bromates, iodides, or nitrates, and not more than the slightest reactions with the tests for sulphates or chlorides." *Br.*

Uses.—This bromide resembles potassium bromide in its physiological powers, but has a less depressing effect upon the arterial and muscular systems. It is certainly superior to potassium bromide in most cases of *epilepsy* and even of minor *neuroses*.

Dose, 15 grains (1 Gm.), or one to two drachms a day (3.9 to 7.7 Gm.), in dilute solution.

AMMONII CARBONAS. U. S., Br.

AMMONIUM CARBONATE

(ąm-mō'nī-ī cär'bọ-năs)

$C_2H_{11}N_3O_5 = 156.01$

"It should contain not less than 97 percent. of a mixture of Acid Ammonium Carbonate [$CO(OH)ONH_4$] and Ammonium Carbamate [$CO(NH_2)ONH_4$] and should yield not less than 31.58 percent. of ammonia gas. It should be kept in well-stoppered bottles, in a cool place. For dispensing purposes, only the translucent portions should be used." *U. S.* "A variable mixture of ammonium hydrogen carbonate, NH_4HCO_3, with ammonium carbamate, $NH_4NH_2CO_2$, produced on heating ammonium sulphate or chloride with calcium carbonate." *Br.*

Ammoniæ Carbonas, *Br.* 1867; Ammoniæ Sesquicarbonas, *Lond., Dub.*; Carbonas Ammonicus, Sal Volatile Siccum; Volatile Salt, Sal Volatile; Carbonate d'Ammoniaque, *Fr. Cod.*; Alcali volatil concret, Sel volatil d'Angleterre, *Fr.*; Ammonium carbonicum, *P. G.*; Ammonium-carbonat, Kohlensaures Ammonium, Flüchtiges Laugensalz, Reines Hirschhornsalz, *G.*; Carbonato di ammonio, *It.*; Carbonato amonico, *Sp.*

There have been many methods of obtaining ammonium carbonate, in all of which the ammonia originated in organic decomposition. It was probably originally prepared from putrid urine, and it is sometimes made in Scotland now from this source. A patent was taken out in England for manufacturing it from guano, and another for making it by the direct combination of its constituents, the carbon dioxide and ammoniacal gases being introduced simultaneously into leaden chambers. (*Chem. News*, Dec. 29, 1865.) At present the salt is manufactured by

subliming a mixture of either the chloride or the sulphate with chalk. Ammonium chloride and chalk (calcium carbonate) are heated together in iron pots or retorts, and sublimed into large earthen or leaden receivers. By the reciprocal action of the salts employed, the carbon dioxide of the chalk unites with the ammonia of the chloride, generating ammonium carbonate, and the hydrochloric acid with the lime, forming water and calcium chloride. The carbonate and water sublime together as hydrated ammonium carbonate, and the residue is calcium chloride. The relative quantities of chalk and ammonium chloride, for mutual decomposition, are 50 of the former and 53.5 of the latter, or one molecule of each. But a great excess of chalk is usually taken, in order to insure the perfect decomposition of the ammonium chloride, any redundancy of which would sublime with the carbonate and render it impure.

Ammonium sulphate may be substituted for the chloride with much economy, as was shown by Payen. This double decomposition between ammonium sulphate and calcium carbonate takes place in the dry way only,—that is, by sublimation. In the wet way, the double decomposition is reversed, ammonium carbonate and calcium sulphate reacting so as to form ammonium sulphate and calcium carbonate. Large quantities of this carbonate are manufactured indirectly from *coal gas liquor* and *bone spirit*, the ammoniacal products in these liquors being converted successively into ammonium sulphate, chloride, and carbonate. (See *Ammonii Chloridum.*) The salt as first obtained has a slight odor of tar, and leaves a blackish carbonaceous matter when dissolved in acids. Hence it requires to be purified, which is effected in iron pots surmounted with leaden heads. The American carbonate has almost supplanted the English article, which was formerly used exclusively.

Properties.—The official salt is described as in "white, hard, translucent, striated masses, having a strong odor of ammonia without empyreuma, and a sharp, saline taste. On exposure to the air, the salt loses both ammonia and carbon dioxide, becoming opaque, and is finally converted into friable, porous lumps, or a white powder." *U. S.* (Acid ammonium carbonate). Commercial ammonium carbonate, recently prepared, is in white, translucent masses, consisting of Ammonium Bicarbonate (Acid Carbonate) and Carbamate.

"Slowly but completely soluble in about 4 parts of water at 25° C. (77° F.); it is decomposed by hot water, with the elimination of carbon dioxide and ammonia. By prolonged boiling with water, the salt is completely volatilized. Alcohol dissolves the carbamate, and leaves the acid carbonate. When heated, Ammonium Carbonate is completely volatilized, without charring. The aqueous solution effervesces with acids, and shows an alkaline reaction with red litmus paper. The aqueous solution of the salt (1 in 20), when slightly supersaturated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Another portion of this solution should not be affected by barium chloride T.S. (absence of *sulphate*). The aqueous solution of the salt (1 in 20), on the addition of a slight excess of silver nitrate T.S., and subsequent supersaturation with nitric acid, should neither assume a brown color (absence of *thiosulphate*), nor become more than slightly opalescent within two minutes (limit of *chloride*). If an aqueous solution containing 1 Gm. of the salt be slightly supersaturated with nitric acid, and then evaporated to dryness on a water-bath, it should afford a colorless and odorless residue, which, upon gentle ignition, should be completely volatilized (absence of *empyreumatic* or *non-volatile matters*). If 2 Gm. of unaltered, translucent Ammonium Carbonate be dissolved in a mixture of 50 Cc. each of distilled water and normal sulphuric acid V.S., boiled for a few minutes to expel the liberated carbon dioxide, and then cooled, not more than 12.7 Cc. of normal potassium hydroxide V.S. should be required for exact neutralization, litmus T.S. being used as indicator." *U. S.* "Exposed to the air it becomes covered with a white efflorescence which should be only superficial; this should be scraped off before the salt is used for dispensing purposes. It affords the reactions characteristic of ammonium salts and of carbonates. Each gramme dissolved in 40 cubic centimetres of *water* should require for neutralization at least 18.7 cubic centimetres of the *volumetric solution of sulphuric acid.* It should yield no residue on being heated to redness, and not more than the slightest reactions with the tests for chlorides or sulphates. When its aqueous solution is neutralized with an acid and evaporated to dryness, the residue should be colorless and odorless (absence of tarry matters)." *Br.* If commercial ammonium carbonate be treated with 90 or 91 per cent. alcohol, it is decomposed into the two salts of which it is composed, ammonium carbamate going into solution while the acid ammonium carbonate remains undissolved. This latter compound also remains undissolved when the commercial carbonate is treated with an amount of water insufficient for complete solution. The result of the complete solution of the commercial salt in water is a mixture of acid and neutral carbonates, the carbamate having been decomposed according to the reaction:

$$(NH_4)HCO_3 + CO\left\{\begin{matrix} ONH_4 \\ NH_2 \end{matrix}\right. + H_2O = (NH_4)HCO_3 + (NH_4)_2CO_3$$

When long or insecurely kept, it gradually passes into a bicarbonate, becoming opaque and friable, and falling into powder. When heated on a piece of glass, the commercial carbonate should evaporate without residue, and, if turmeric paper held over it undergoes no change, it has passed into bicarbonate. As prepared from

coal gas liquor, it sometimes contains traces of tarry matter, which give a dark color to its solution in acids, but a refined carbonate, made by resubliming the commercial article, is now in the market, and this alone should be dispensed in preparations for internal use. When it is saturated with nitric acid, neither barium chloride nor silver nitrate causes a precipitate. The non-action of these tests shows the absence of ammonium sulphate and chloride. The presence of lead in small quantities was detected by Bennett in commercial ammonium carbonate (*C. D.*, 1904, 203). It is decomposed by acids, the fixed alkalies and their carbonates, lime water and magnesia, solution of calcium chloride, alum, acid salts such as potassium bitartrate and bisulphate, solutions of iron (except the iron and potassium tartrate and analogous preparations), corrosive sublimate, lead acetate and subacetate, and ferrous and zinc sulphates. Traces of chlorine have been noticed in some samples of commercial carbonate, and a sublimed salt which had been sold as carbonate, was *devoid of odor,* hard, crystalline, yet having the external appearance of carbonate, and was proved by Bridges to be anhydrous ammonium bicarbonate. (*A. J. P.,* Nov. 1874). Although much inferior to the official compound, this salt is often found in the market. For papers on testing commercial ammonium carbonate see *A. J. P.,* 1890, p. 500, by G. M. Beringer; also *Ph. Era,* 1889, p. 417, by Charles C. Abbey.

Uses.—Locally applied ammonium carbonate is an irritant and an irritant poison in overdoses. When administered in therapeutic doses it is a powerful cardiac stimulant, acting not so rapidly and fugaciously as the solutions of ammonia, but still in a very prompt and temporary manner. It is employed in low conditions of the system as a stimulant, but it should always be remembered that its influence lasts for only a short time, and that there is reason for believing that when continously given it is apt to impair the crasis of the blood. It is probably eliminated in part by the lungs, and certainly is a stimulant to the respiratory centres. It seems also to exert some influence upon the pulmonary mucous membrane, and is largely employed in *adynamic pneumonias* and *bronchitis,* in the last stages of *phthisis,* etc. In some of these cases it does good by increasing muscular power and aiding in the expulsion of the sputa.

Coarsely bruised with the addition of half its bulk of stronger ammonia water, and scented with oil of lavender, it constitutes the common *smelling-salts,* so much used as a nasal stimulant in *syncope* and *hysteria.*[1] It should never be given in powder or in pill, on account of its volatile nature and its irritant action on the mucous membrane.

Ammonium carbonate is sometimes employed in making effervescing draughts, 20 grains of the salt requiring for this purpose 6 fluidrachms of lemon juice, 24 grains of citric acid, or 25½ grains of tartaric acid.

Dose, five to ten grains (0.32 to 0.65 Gm.) every two hours.

Off. Prep.—Ferri Carbonas Saccharatus, *Br.;* Liquor Ammonii Acetatis, *U. S., Br.;* Liquor Ammonii Citratis, *Br.;* Spiritus Ammoniæ Aromaticus, *U. S., Br.*

AMMONII CHLORIDUM. U. S., Br.

AMMONIUM CHLORIDE [Ammonium Muriate, Muriate of Ammonia]

(ạm-mō′nī-ī ȼhlō′rị-dŭm)

$NH_4Cl = 53.11$

"It should contain not less than 99.5 percent. of pure Ammonium Chloride." *U. S.* "This salt, NH_4Cl, may be formed by neutralizing crude solution of ammonia or ammonium carbonate with hydrochloric acid, and purifying the product." *Br.*

Ammonium Muriaticum, s. Hydrochloratum, Chloruretum Ammonicum, Sal Ammoniacum, Ammoniæ Hydrochloras, s. Murias; Sal Ammoniac, Hydrochlorate of Ammonia; Chlorhydrate d'Ammoniaque, *Fr. Cod.;* Hydrochlorate d'Ammoniaque, Muriate d'Ammoniaque, Sel Ammoniac, Chlorure d'Ammonium, Chlorure d'Ammonium pur, *Fr.;* Ammonium Chloratum, *P. G.;* Ammoniumchlorid, Salmiak Chlorammonium, Reiner (gereinigter) Salmiak, *G.;* Cloruro di ammonio, Sale ammoniaco, *It.;* Cloruro amonico, Sal amoniaco, *Sp.*

In the U. S. Pharmacopœia of 1870 both the crude and the purified ammonium chloride were official, under the names *Ammonii Chloridum* and *Ammonii Chloridum Purificatum.* The U. S. P. (8th Rev.) recognizes but one, *Ammonii Chloridum,* but it transfers this title, which formerly was given to the crude sal ammoniac, to the purified salt, without giving a process for preparing it. The U. S. P. 1870 process is as follows: "Take of Chloride of Ammonium, in small pieces, *twenty troyounces;* Water of Ammonia *five fluidrachms;* Water *two pints.* Dissolve the Chloride of Ammonium in the water, in a porcelain dish, with the aid of heat; add the Water of Ammonia, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring at a moderate heat, until it granulates." *U. S.* 1870.

This process is used to free the salt from ferric chloride, a frequent impurity of the crude product, derived from the subliming vessels.

Ammonium chloride originally came from Egypt, where it was obtained by sublimation from the soot resulting from the burning of camels' dung, which is used in that country for fuel, and it is still to be found in the Indian

[1] In Mounsey's recipe for the English *Preston salts* the essence to be added to the carbonate is made as follows: Take oil of cloves, 30 min.; oil of lavender 1 fl. dr.; oil of bergamot 2½ fl. dr; stronger ammonia water (sp. gr. 0.880) 10 fl. dr. Mix. The bottles are to be filled with ammonium carbonate, half with the salt coarsely bruised, and the remainder with it in fine powder; and then as much of the above essence as the salt will readily absorb is to be added. (*P. J.,* xiii. 628.)

bazaars in an impure state as it has been obtained from the unburnt residue in the interior of brick-kilns in which camel's manure is used for fuel. It has long been known in China, where it is obtained from the water of certain volcanic springs, and exists in commerce in various states of purity. It is found in the fumeroles of Vesuvius, Etna, Hecla, and other volcanoes, as well as in the cracks and fissures in recent lava streams.

Preparation.—At present ammonium chloride is derived from two principal sources, the ammoniacal liquor, called *gas liquor,* found in the condensing vessels of coal gas works, and the brown, fetid ammoniacal liquor, known under the name of *bone-spirit,* which is a secondary product, obtained from the destructive distillation of bones, in the manufacture of bone black. These two liquors are the chief sources of ammoniacal compounds, for they are both used to procure ammonium sulphate, and this salt is employed directly or indirectly for obtaining all the other salts of ammonium. A third source of increasing importance is its production as a by-product in ovens for coking coal. Other sources are stale urine, coal soot, guano, peat, and bituminous schist.

Gas liquor contains ammonium carbonate, cyanide, sulphide, and sulphate, but principally the carbonate. It is saturated with sulphuric acid, and the solution obtained, after due evaporation, furnishes brown crystals of ammonium sulphate. These are then sublimed with sodium chloride in iron pots lined with clay and furnished with a leaden dome or head. By the mutual action of the sulphate and chloride, there are formed ammonium chloride which sublimes, and sodium sulphate which remains behind. Thus:

$$(NH_4)_2SO_4 + 2NaCl = 2NH_4Cl + Na_2SO_4$$

Gas liquor is usually distilled with lime with the aid of column stills, whereby a relatively pure and strong solution of ammonia is obtained.

This may be further purified, however, from empyreumatic matter by treatment with potassium permanganate and then driven over by heat and absorbed in hydrochloric acid. In this way, as the solution becomes concentrated, the sal ammoniac crystallizes out in the bottom of the leaden tanks in which the absorption takes place. Impure sal ammoniac may be purified either by crystallization or by sublimation. In the latter case the sal ammoniac is placed in an iron subliming pot coated with a composition of clay, sand, and charcoal and covered with a dome of lead. These pots are sometimes sufficiently large to hold 500 pounds. A gentle fire is kept up under the subliming pot for seven or eight days, when, the dome having cooled down, and the sal ammoniac somewhat contracted, so as to loosen from the sides, the dome is thrown off from the iron pot, and about two or three hundred-weight of white, semitransparent sal ammoniac is knocked off in cakes.

In the destructive distillation of bones for making bone black, the distilled products are the bone spirit already mentioned, being chiefly an aqueous solution of ammonium carbonate, and an empyreumatic oil, called *animal oil.* Ammonium chloride may be obtained from the bone spirit in the manner just described for procuring it from gas liquor. Sometimes, however, the ammonium sulphate is not made by direct combination, but by digesting the bone spirit with ground plaster of Paris. By double decomposition, ammonium sulphate and calcium carbonate are formed. The ammonium sulphate is then converted into the chloride by sublimation with common salt. The chloride "may be formed by neutralizing hydrochloric acid with ammonia or carbonate of ammonium, and evaporating to dryness." *Br.,* 1885.

Other processes have been proposed or practised for obtaining ammonium chloride. For an account of the manufacture of ammoniacal salts, and for a list of the patents issued in Great Britain, since 1827, for their preparation, the reader is referred to *P. J.,* xi^{3}. 20, 63, 113.

Properties.—Commercial ammonium chloride is a white, transparent, tough, fibrous salt, occurring in large cakes about two inches thick, convex on one side and concave on the other, due to the shape of the dome of the subliming apparatus; the pieces are frequently tinged on the surface with iron stains, owing to the contact with the iron dome. It has a pungent, saline taste, but no odor. Its sp. gr. is 1.45. This salt is very difficult to powder in the ordinary way. Its pulverization, however, may be readily effected by making a boiling saturated solution of the salt and stirring it as it cools. The salt is thus made to granulate, and in this state, after draining from the remaining solution and drying, may be easily powdered. At a red heat it sublimes without decomposition or residue. Exposed to a damp atmosphere it becomes slightly moist. It has the property of increasing the solubility of corrosive sublimate in water. It is decomposed by the strong mineral acids, and by the alkalies and alkaline earths,—the former disengaging hydrochloric acid, the latter ammonia, both sensible to the smell. Ammonium chloride is usually employed for obtaining gaseous ammonia, which is conveniently disengaged by lime. It is incompatible with lead acetate and silver nitrate, producing precipitates respectively of lead and silver chlorides.

Ammonium chloride is little subject to adulteration. If not entirely volatilized by heat, and if incompletely soluble in water, it contains impurity. As ordinarily prepared, it contains ferrous chloride, and this may be detected by boiling a small portion of a saturated solution of the salt with a drop or two of nitric acid, and then adding potassium ferrocyanide, when the characteristic blue color occasioned by iron will be produced. If the salt is entirely volatilized by heat, and yet produces a precipitate with barium chloride, the presence of ammonium sulphate is indicated. The description and tests of the official salt are as follows:

"A white, crystalline powder, without odor, having a cooling, saline taste, and permanent in the air. Soluble in 2 parts of water, in 50 parts of alcohol, and in 5 parts of glycerin, at 25° C. (77° F.), and in one part of boiling water. On ignition, Ammonium Chloride is completely volatilized, without charring. The aqueous solution of the salt (1 in 20) in ice-cold water, should not redden blue litmus paper at once; it affords, with silver nitrate T.S., a white, curdy precipitate, which is soluble in ammonia water. The aqueous solution, when gently heated with potassium hydroxide T.S., evolves ammonia. The aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121), nor should it be affected by barium chloride T.S. (*sulphate*), nor diluted sulphuric acid (*barium*), nor ammonium oxalate T.S. (*calcium*). When acidulated with hydrochloric acid, the solution should not assume a red color on the addition of a few drops of ferric chloride T.S. (absence of *sulphocyanate*). Twenty Cc. of the aqueous solution of the salt (1 in 20) should not at once assume a blue color on the addition of 5 drops of potassium ferrocyanide T.S. (limit of *iron*). If to 1 Gm. of the salt a little nitric acid be added, and the mixture evaporated to dryness in a porcelain dish on a water-bath, a white residue should be obtained, which, when more strongly heated, should be volatilized (absence of *empyreumatic* or *non-volatile substances*). If 1 Gm. of Ammonium Chloride be dissolved in sufficient distilled water to measure 100 Cc., then 10 Cc. of this solution should, after the addition of five drops of potassium chromate T.S., require not less than 18.7 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color." *U. S.* "It should yield no residue on being heated to redness, and no characteristic reaction with the tests for lead, copper, arsenium, calcium, carbonates, or nitrates, and only the slightest reactions with the tests for iron, or for sulphates. Its aqueous solution should not give a blood-red coloration with *test-solution of ferric chloride* (absence of thiocyanates)." *Br.*

Uses.—Ammonium chloride has the stimulant properties of ammonia, and probably differs little in its physiological powers from the carbonate, but it is believed by many to be less fugacious in its action and to be less stimulant to the circulation than is the latter salt. Clinical experience has also led to a somewhat particular use of it in diseases. It is one of the most employed of the stimulant expectorants in the advanced stages of *acute bronchitis* and in *chronic bronchitis,* also in *catarrhal pneumonia.* It has been very highly recommended of late years in *chronic hepatic torpor and engorgement,* and even in *acute hepatitis,* by W. Stewart, who gives twenty grains of it three times a day and continues its use for weeks. We have seen *catarrhal jaundice* apparently very much benefited by it. Many years ago it was a favorite remedy as a resolvent in *chronic glandular enlargements,* but at present it is rarely so employed. There is much testimony as to the value of ammonium chloride in certain obscure nervous affections, especially *hemicrania, ovaralgia, dysmenorrhœa, sciatica,* and various other neuralgic disorders. The usual expectorant dose of the chloride is five to ten grains (0.32 to 0.65 Gm.) every two hours, administered in sweetened mucilage; but formerly in *prostatic* and other *glandular enlargements* it was recommended to increase the dose until half an ounce a day was ingested. When such amounts are given, the remedy is prone to produce disordered digestion, a miliary eruption, profuse sweats, and scorbutic symptoms.

The vapor of ammonium chloride has been administered by inhalation, employed several times a day, in *chronic catarrh,* with marked advantage by Gieseler of Germany. Hermann Beigel of London, strongly recommends its inhalation in the nascent state, resulting from a mixture of the two gases composing it. Three bottles are used, one containing ammonia water, the second an equivalent quantity of liquid hydrochloric acid, and the third half filled with water, connected with the first two by tubes, and supplied itself with a tube for inhalation. By inhalation the patient draws the two gases from their respective bottles into the third, where they combine to form ammonium chloride, which is freed from any excess of either gas by the water. Another mode of inhaling ammonium chloride is in *spray,* by means of the atomizer; ten to twenty grains are dissolved for the purpose in a fluidounce of water.

Dose, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Trochisci Ammonii Chloridi, *U. S.*

AMMONII IODIDUM. U. S.

AMMONIUM IODIDE

(ąm-mō′nī-ī ī-ōd′ī-dŭm)

$NH_4I = 143.83$

"It should contain not less than 97 percent. of pure Ammonium Iodide, and should be kept in small amber-colored, well-stoppered vials, protected from light. When deeply colored, the salt should not be dispensed, but it may be deprived of free iodine by adding to its concentrated aqueous solution sufficient ammonium sulphide T.S. to render it colorless, then filtering, and evaporating in a water-bath to dryness." *U. S.*

Iodhydrate d'ammoniaque, *Fr. Cod.;* Iodure d'Ammonium, *Fr.;* Ammonium jodatum, Jodammonium, *G.;* Yoduro amonico, *Sp.*

No process is given in the U. S. P. (8th Rev.) for this salt; it was formerly prepared according to the method of John A. Spencer of London, the formula for which is as follows: Add to a portion of iodine, placed in a flask with a little water, a solution of ammonium sulphy-

drate, until the mixture loses its red color, and is turbid from the separation of sulphur only. Shake the flask, which causes the sulphur, for the most part, to agglomerate, and having poured off the liquid, boil it until all odor of hydrogen sulphide and of ammonia is lost. Then filter the liquid, and, constantly stirring, evaporate it, first with a naked flame until it becomes pasty, and then in a water bath until it forms a dry salt. In 1864 (*A. J. P.*, May, 1864), Jacobson proposed a process in which double decomposition between solutions of ammonium sulphate and potassium iodide was employed. James F. Babcock (*Proc. A. Ph. A.*, 1866) stated that on trial of the first of the above processes, and of all others in which hydrogen sulphide or an alkaline sulphide was employed, the resulting ammonium iodide retained a portion of sulphur, which caused its color to change with time to yellow and ultimately to brown, and rendered it unfit for the accurate solutions required in photography. Having tried also other formulas, which he found objectionable, he at length satisfied himself that Jacobson's process, above described, was the best in use, and with slight modifications would yield an absolutely pure product.

In a former edition of the Dispensatory may be found the exact process finally adopted by Babcock. It is substantially that which was official in U. S. P. 1870 [1] and is in close accord with that of Jacobson. The object of the first step of the process is sufficiently evident. After the double decomposition has occurred, the alcohol is added to complete the precipitation of the potassium sulphate; the pouring of alcohol upon the cotton filter is to remove completely from the sulphate all of the iodide. As made by this process, ammonium iodide always contains a minute proportion of potassium sulphate. Charles Rice (*A. J. P.*, 1873, p. 249) calls attention to the fact that the process official in U. S. P. 1870 is deficient in the amount of ammonium sulphate required, and therefore wasteful of the more expensive iodide; instead of one ounce of ammonium sulphate the quantity should be 867 grains. The view taken by Charles Rice, however, is that the reaction takes place between single molecules of the respective salts, which is no doubt correct, whereas the view of the Pharmacopœia committee was that two molecules of the iodide reacted with one of ammonium sulphate,

$$2KI + (NH_4)_2SO_4 = K_2SO_4 + 2NH_4I$$

[1] "Take of Iodide of Potassium, in coarse powder, *four troyounces;* Sulphate of Ammonium, in coarse powder, a *troyounce* [this should be 867 grains]; Boiling Distilled Water, *two fluidounces;* Alcohol, Water, each, *a sufficient quantity.* Mix the salts, add them to the Boiling Water, stir well, and allow the mixture to cool; then add a fluidounce of Alcohol, mix well, and reduce the temperature, by a bath of iced water, to about 40°; throw the mixture into a cool glass funnel, stopped with moistened cotton, and, when the clear solution has passed, pour upon the salt a fluidounce of a mixture containing two parts of Water and one part of Alcohol. Lastly, evaporate the solution rapidly to dryness, stirring constantly; and preserve the residue in a well-stoppered bottle." *U. S.* 1870.

Properties.—Ammonium iodide occurs in "minute, colorless, cubical crystals, or a white, granular powder, without odor when colorless, but emitting a slight odor of iodine when colored, and having a sharp, saline taste. The salt is very hygroscopic, and soon becomes yellow or yellowish-brown on exposure to the air and light, owing to the loss of ammonia and the liberation of iodine. Soluble in 0.6 part of water, and in 9 parts of alcohol at 25° C. (77° F.); in 0.43 part of boiling water, and in 3.7 parts of boiling alcohol. When heated on platinum foil, Ammonium Iodide evolves vapor of iodine, and volatilizes completely without fusing. The aqueous solution of the salt shows a neutral reaction to litmus paper, and when gently heated with potassium hydroxide T.S., evolves ammonia. If to 5 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated and impart to the solution a light reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color. Ten Cc. of the aqueous solution of Ammonium Iodide (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). An aqueous solution of the salt (1 in 100) should not at once assume a blue color with potassium ferrocyanide T.S. (limit of *iron*), nor, after being agitated with 1 Cc. of chloroform, should the latter assume a violet color (limit of *free iodine*). The aqueous solution of Ammonium Iodide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 0.25 Gm. of the salt, dried at 100° C. (212° F.), be dissolved in 5 Cc. of ammonia water (10 percent.), the solution shaken with 16.9 Cc. of tenth-normal silver nitrate V.S., and the filtrate supersaturated with 5 Cc. of nitric acid, no cloudiness should make its appearance within ten minutes (absence of more than about 3 percent. of *chlorides* or *bromides*)." *U. S.*

Uses.—Ammonium iodide is employed, both externally and internally, as a resolvent, and resembles closely, in its action, iodine and potassium iodide. B. W. Richardson of London, has prescribed it, in the dose of from one to three grains, with considerable success, in *secondary syphilis, chronic rheumatism, incipient phthisis,* and in a variety of forms of *scrofulous disorder,* attended with glandular enlargements. Richardson found a liniment, made by dissolving half a drachm of the iodide in an ounce of glycerin, very efficacious in *enlarged tonsils,* applied every night with a large camel's-hair brush, and his practice has been followed to some extent by other members of the profession. Externally, this salt has been used as a substitute for potassium iodide. By Pennock it is considered a good remedy in certain cases of *lepra* and *psoriasis,* in the form of ointment, applied by friction in the quantity

of half an ounce, morning and evening. The proportions employed are from twenty grains to a drachm of the salt to an ounce of lard, the weaker preparation being used when the disease is recent, the stronger when it is chronic. As the iodide is decomposed by the air, the ointment should be kept in well-stoppered bottles.

Dose, three to five grains (0.20 to 0.32 Gm.).

AMMONII PHOSPHAS. Br.

AMMONIUM PHOSPHATE

(ąm-mō'nī-ī phŏs'phăs)

$(NH_4)_2HPO_4 = 131.15$

"A salt, $(NH_4)_2HPO_4$, which may be obtained by neutralizing phosphoric acid with solution of ammonia." *Br.*

Ammoniæ Phosphas; Phosphate of Ammonia; Phosphas Ammonicus; Phosphate d'Ammoniaque, *Fr.*; Ammonium Phosphoricum; Phosphorsaures Ammoniak, *G.*

This salt was introduced into the 1880 U. S. P., but was dropped at the 1890 revision.

Preparation.—The salt commonly found in commerce is either this acid phosphate, or a mixture of the two acid salts. The official salt may be made by saturating the excess of acid in acid calcium phosphate by means of ammonium carbonate. Calcium phosphate is precipitated and ammonium phosphate obtained in solution, which, being duly concentrated by a gentle heat, affords the salt in crystals upon cooling. The method of obtaining the acid calcium phosphate is given under the head of sodium phosphate. (See *Sodii Phosphas.*) Ammonium phosphate prepared in this way is a white salt, crystallizing in six-sided tables, derived from oblique quadrangular prisms, efflorescent, insoluble in alcohol, and soluble in four parts of cold water. The solution has an alkaline somewhat saline taste, and an alkaline reaction, and gives off ammonia when heated.

The other acid phosphate, $NH_4H_2PO_4$, is obtained by boiling a solution of either of the other salts so long as ammonia escapes, and then crystallizing. Its crystals are four-sided prisms, permanent in the air, of an acid taste and reaction, and soluble in 5 parts of cold water. (Bridges.) In a specimen of the common ammonium phosphate of commerce which came under our notice, we recognized both the tabular crystals of the phosphate with two molecules of ammonium, having a saline slightly acrid taste, and neutral in reaction, and the prisms of the acid salt, with a sour and saline taste and a decidedly acid reaction.

The variety of phosphoric acid employed in this formula is the tribasic, which forms three salts with ammonia, one containing three atoms of ammonium without basic hydrogen, which is called the neutral phosphate, the second, two molecules of ammonium and one of basic hydrogen, forming an acid phosphate, and the third, one molecule of ammonium and two of basic hydrogen, forming also an acid phosphate. The second of these is the one intended by the U. S. (1880) and British Pharmacopœias, and is represented by the formula $(NH_4)_2HPO_4$. To prepare it, a constant excess of ammonia must be maintained, and this is done by strict compliance with the process, if the materials are of due strength. Without such a precaution, more or less of the more acid phosphate would be generated, in consequence of the escape of the alkali.

Properties.—Hydrogen di-ammonium phosphate, which is the official salt, occurs in "colorless, translucent, monoclinic prisms, losing ammonia on exposure to dry air, without odor, having a cooling, saline taste and a neutral or faintly alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.), in 0.5 part of boiling water, but insoluble in alcohol. When strongly heated, the salt fuses, afterwards evolves ammonia, and at a bright red heat is wholly dissipated." *U. S.* 1880.

Tests.—"The aqueous solution of the salt, when heated with caustic potassa, evolves vapor of ammonia. Addition of test-solution of nitrate of silver to the aqueous solution produces a canary-yellow precipitate, soluble in nitric acid and in ammonia. The aqueous solution should remain unaffected by sulphide of ammonium, or, after being acidulated with hydrochloric acid, by hydrosulphuric acid (abs. of metals), or by test-solution of chloride of barium (sulphate). When acidulated with nitric acid, it should not be rendered turbid by test-solution of nitrate of silver (chloride). 2 Gm. of the salt dissolved in water and precipitated with test-mixture of magnesium, yields a crystalline precipitate, which, when washed with diluted water of ammonia, dried, and ignited, should weigh 1.68 Gm." *U. S.* 1880. This quantitative test was intended as a means of identifying the hydrogen di-ammonium salt. The British Pharmacopœia gives the following quantitative test. "When 2 grammes are dissolved in *water,* and *solution of magnesium ammonio-sulphate* is added in excess, a crystalline precipitate should be formed, which, after being well washed upon a filter with *solution of ammonia* diluted with an equal volume of *water,* and then dried and heated to redness, weighs 1.68 grammes. Its aqueous solution should yield no characteristic reaction with the tests for lead, copper, or arsenium, and only the slightest reactions with the tests for iron, chlorides, or sulphates." *Br.* The amount of the residue, which is magnesium pyrophosphate, indicates the quantity of phosphoric acid contained in the salt.

Uses.—This salt was first brought to the notice of the profession, as a remedy for *gout* and *rheumatism,* by T. H. Buckler (*A. J. M. S.,* 1846), and has since been so employed with apparently useful results.

Dose, from ten to forty grains (0.65 to 2.6 Gm.), three or four times a day, dissolved in a tablespoonful of water.

AMMONII SALICYLAS. U. S.

AMMONIUM SALICYLATE

(ąm-mō′nĭ-ī săl-ĭ-cȳ′ląs)

$NH_4C_7H_5O_3 = 153.94$

"It should contain not less than 98 percent. of pure Ammonium Salicylate [$C_6H_4(OH)CO ONH_4$], and should be kept in well-stoppered bottles, protected from heat and light." *U. S.*

Ammonium Salicylicum; Salicylate d'Ammoniaque, *Fr.;* Ammoniumsalicylat, Salicylsaures Ammonium, *G.*

This salt was introduced into the U. S. Pharmacopœia (8th Rev.) and may be made by adding salicylic acid to ammonia water until the latter is nearly neutralized, then evaporating the solution (which should be slightly acid to litmus paper) and crystallizing. Care should be used to prevent contamination with iron, which would give the product a pinkish or reddish tinge, and overheating, which would cause decomposition, evidenced by a phenol-like odor.

Properties.—Ammonium salicylate is officially described as in "colorless, lustrous, monoclinic prisms, or plates, or a white, crystalline powder; odorless, and having at first a slightly saline, bitter taste, and a sweetish after-taste. Permanent in dry air. Soluble in 0.9 part of water, and 2.3 parts of alcohol at 25° C. (77° F.); freely soluble in boiling water and in 1 part of boiling alcohol. When heated, the salt fuses with decomposition, giving off inflammable vapors and an odor of phenol, and is finally completely volatilized. The concentrated aqueous solution should be colorless, it should redden blue litmus paper, and when gently heated with potassium hydroxide T.S evolves ammonia. Ferric chloride T.S., added to an excess of a concentrated solution of Ammonium Salicylate, produces a dark red precipitate, but imparts to a very dilute solution (1 in 100) a deep violet-blue color. If copper sulphate T.S. be added to the aqueous solution of the salt (1 in 20), a green color will be produced. If to 0.2 Gm. of the salt, contained in a test-tube, about 1 Cc. of concentrated sulphuric acid be added, and then cautiously about 1 Cc. of methyl alcohol, drop by drop, on heating the mixture to boiling, methyl salicylate will be formed, which can be recognized by its odor. If an aqueous solution of Ammonium Salicylate (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If diluted nitric acid be added in slight excess to the aqueous solution of the salt (1 in 10), the precipitated salicylic acid, after collecting and washing, should respond to the tests of purity and identity given under *Acidum Salicylicum*." *U. S.*

Uses.—Ammonium Salicylate is the best of the salicylates for ordinary use in *rheumatism*, being less depressing and nauseating than the official sodium salt.

Dose, ten to twenty grains (0.65 to 1.3 Gm.).

AMMONII VALERAS. U. S.

AMMONIUM VALERATE [Ammonii Valerianas, Pharm. 1890; Ammonium Valerianate]

(ąm-mō′nĭ-ī văl′ę-răs)

$NH_4C_5H_9O_2 = 118.24$

"It should contain not less than 98 percent. of pure Ammonium Valerate [$C_4H_9.COONH_4$], and should be kept in well-stoppered bottles." *U. S.*

Valérianate d'Ammoniaque, *Fr. Cod.;* Baldriansaures (Valeriansaures) Ammonium, Ammoniumvalerianat, *G.;* Valerianato amonico, *Sp.*

A process for preparing this salt is no longer official; that of the U. S. P. 1870 will be found in the U. S. D., 18th edition, p. 163.

Ammonium valerate was introduced into the U. S. Pharmacopœia of 1860; much difficulty was experienced by manufacturing chemists in procuring a crystallized ammonium valerate, until, after a series of experiments, B. J. Crew of Philadelphia, ascertained that it was necessary to employ the *monohydrated* valeric acid, as the ordinary acid with three molecules of water could not be successfully used for the purpose. The official formula of 1870 was based upon that of Crew, published in the *A. J. P.* (1860, p. 109). In this formula the monohydrated valeric acid, procured by a special process (see *Valeric Acid*), is saturated with gaseous ammonia obtained in the usual manner from a mixture of ammonium chloride and lime. The saturation is known to have been effected when litmus paper is no longer acted on. During the operation heat is developed sufficient to prevent premature crystallization, and, when the saturation is completed, nothing more is necessary than to allow the solution to cool. Crystallization soon begins, and in a few hours the contents of the vessel become a nearly solid mass of crystals; these should be thoroughly drained, and, without unnecessary exposure, at once transferred to well-stoppered bottles.

Properties.—Thus prepared, ammonium valerate is in snow white, pearly, four-sided, tabular crystals, perfectly dry, of an offensive odor like that of valeric acid, and a sharp sweetish taste. Instead of liquefying whenever exposed to the air, as happened to the salt formerly procured, it undergoes this change only in a moist atmosphere, and effloresces when the air is dry. It is very soluble in water, ether, and alcohol. Exposed to heat it is in great measure volatilized unchanged; but a small portion, by giving off a part of its ammonia, is converted into the acid valerate. Hager (*Ph. Centralh.*, 1879, p. 465) states that commercial ammonium valerate is always the acid salt, as is proved by the acid reaction and the strong rotation of the crystals when placed upon cold water; the neutral salt is obtained only with difficulty, is in prismatic crystals, and is easily liquefied by moderate temperatures. It is officially de-

scribed as in "colorless, or white, quadrangular plates, emitting the odor of valeric acid, of a sharp and sweetish taste, and deliquescent in moist air. Very soluble in water and in alcohol; also soluble in ether. When heated, the salt fuses, gives off vapor of ammonia and of valeric acid, and is finally completely volatilized. The aqueous solution shows an acid reaction to blue litmus paper, and, when gently heated with potassium hydroxide T.S., evolves ammonia. If a concentrated, aqueous solution of Ammonium Valerate be slightly supersaturated with sulphuric acid, an oily layer of valeric acid will rise to the surface. If a neutral solution of the salt be completely precipitated by ferric chloride T.S., the filtrate should not possess a deep red color (absence of *acetate*). The aqueous solution of the salt (1 in 20), when slightly acidulated with hydrochloric acid and filtered through a small, wetted filter, should not respond to the Time-Limit Test for *heavy metals* (See PART III, Test No. 121)." *U. S.*

Uses.—Ammonium valerate is not poisonous. Given to dogs in the dose of 150 grains, it produced no inconvenience. As a therapeutic agent it was first brought to the notice of the profession, in 1856, by Déclat of Paris in the form of a solution by Pierlot, an apothecary of Paris. Since then it has been used in various diseases, principally of the nervous system, such as *hysteria, epilepsy, chorea, neuralgia,* and is certainly useful in various mild functional nervous affections, but in such grave maladies as epilepsy it is powerless. The drug may be conveniently administered in coated pills, or in capsules. *Pierlot's solution,* mentioned above, should be made by dissolving a drachm of valeric acid in thirty-two drachms of distilled water, saturating the solution with ammonium carbonate, and adding to the salt formed forty grains of the alcoholic extract of valerian. According to Pierlot, the latter addition is necessary to preserve the preparation from change, for a simple solution of the ammoniacal salt is rapidly decomposed. It will keep still better if the extract, when added to the solution, be mixed with a fluidounce of diluted alcohol, with only 24 drachms of distilled water to preserve the measure. The solution of Pierlot is neutral, color brown, odor of valerian strong. It contains 1-25th of its weight of the pure salt. The dose is six to thirty minims (0.36 to 1.9 Cc.), given in water or on a lump of sugar.

Dose, of ammonium valerate, two to ten grains (0.13 to 0.6 Gm.).

AMYGDALA AMARA. U. S., Br.

BITTER ALMOND

(ą-mŭg'dą-lą ą-mā'rą)

"The ripe seed of *Prunus Amygdalus* Stokes, var. *amara* De Candolle (Fam. *Rosaceæ*)." *U. S.* "The ripe seed of Prunus Amygdalus, *Stokes, var.* amara, *Baillon.*" *Br.*

Semen Amydali Amarum; Amandes amères, *Fr. Cod.*; Amygdalæ Amaræ, *P. G.*; Bittere Mandeln, *G.*; Mandorle amare, *It.*; Almendra amarga, *It.*

Amygdalus communis, Willd., *Sp. Plant.* ii. 982; Woodv., *Med. Bot.* p. 507, t. 183.—The almond tree rises usually from fifteen to twenty feet in height, and divides into numerous spreading branches. The leaves stand upon short stalks, are about three inches long and three-quarters of an inch broad, elliptical, pointed at both ends, veined, minutely serrated, with the lower serratures and petioles glandular, and are of a bright green color. The flowers are large, of a pale red color varying to white, with very short peduncles, and petals longer than the calyx, and usually stand in pairs upon the branches. The fruit is of the peach kind, with the outer covering thin, tough, dry, and marked with a longitudinal furrow, where it opens when fully ripe. Within this covering is a rough shell, containing the kernel or almond.

There are several varieties of this species of Amygdalus, differing chiefly in the size and shape of the fruit, the thickness of the shell, and the taste of the kernel. The two most important are *Amygdalus* (*communis*) *dulcis* and *Amygdalus* (*communis*) *amara,* the former bearing sweet, the latter bitter almonds. Another variety is the *A. fragilis* of De Candolle, which yields the *paper-shelled almonds.* The almond tree is a native of Persia, Syria, and Barbary, and is extensively cultivated in the south of Europe. It has been introduced into the United States; but in the northern and middle sections the fruit does not come to perfection.

Bitter Almonds.—These are smaller than the sweet almonds, and are thus described in the U. S. Pharmacopœia. "Ovate or oblong-lanceolate, 20 to 30 Mm. long; seed-coat thin, brown, finely downy; embryo straight, white, and with two plano-convex cotyledons; taste bitter and oily; when triturated with water Bitter Almond yields a milk-white emulsion which emits an odor of hydrocyanic acid." *U. S.* They have the bitter taste of the peach kernel, and, though when dry, inodorous or nearly so, have, when triturated with water, the fragrance of the peach blossom. They contain nearly the same ingredients as sweet almonds, and like them form a milky emulsion with water. It was formerly supposed that they also contained hydrocyanic acid and volatile oil, to which their peculiar taste and odor and their peculiar operation upon the system were ascribed. It was, however, ascertained by Robiquet and Boutron that these principles do not pre-exist in the almond, but result from the reaction of water; and Wöhler and Liebig proved, what was suspected by Robiquet, that they are formed out of a peculiar substance denominated *amygdalin,* which is the characteristic constituent of bitter almonds. This substance, which was discovered by Robiquet and Boutron in 1830, is white, crystallizable, inodorous, of a sweetish bitter taste, unalterable in the air, freely soluble in water and hot alcohol, very slightly soluble in cold alcohol, and insoluble in ether. It is decomposed by the action of diluted acids or in the

presence of water by the nitrogenous ferments, like *emulsin,* which accompany it in the bitter almond. The reaction is as follows:

$$\underset{\text{Crystallized amygdalin.}}{C_{20}H_{27}NO_{11}} + 3H_2O =$$

$$2(\underset{\text{Dextro-glucose.}}{C_6H_{12}O_6}) + \underset{\text{Hydrocyanic acid.}}{HCN} + \underset{\text{Oil of bitter almond.}}{C_7H_6O} + H_2O$$

It is recognized as belonging to the glucoside class, compounds which, when decomposed by diluted acids, alkalies, or ferments, yield glucose and some other characteristic decomposition product. They may be considered as esters of glucose analogous to the esters of glycerin which exist in the fats under the name of *glycerides.* Liebig and Wöhler give the following process for obtaining amygdalin, in which the object of the fermentation is to destroy the sugar with which it is associated. Bitter almonds, previously deprived of their fixed oil by pressure, are to be boiled in successive portions of alcohol till exhausted. From the liquors thus obtained all the alcohol is to be drawn off by distillation, care being taken, near the end of the process, not to expose the syrupy residue to too great a heat. This residue is then to be diluted with water, mixed with good yeast, and placed in a warm situation. After the fermentation which ensues has ceased, the liquor is to be filtered, evaporated to the consistence of syrup, and mixed with alcohol. The amygdalin is thus precipitated in connection with a portion of gum, from which it may be separated by solution in boiling alcohol, which will deposit it upon cooling. If pure, it will form a perfectly transparent solution with water. Any oil which it may contain may be separated by washing with ether. One pound of almonds yields at least 120 grains of amygdalin. (*Ann. Pharm.,* xxii. 329.) Amygdalin appears to be extensively diffused in plants, having been noticed not only in the different genera of the Rosaceæ, as *Amygdalus, Cerasus,* and *Prunus,* but also by Wicke in various Pomaceæ, as *Pyrus Malus, Sorbus Aucuparia, Sorbus hybrida, Sorbus torminalis, Amelanchier vulgaris, Cotoneaster vulgaris,* and *Cratægus Oxyacantha.* (*Ann. Ch. Ph.,* lxxix. 79.) It may be advantageously procured from peach kernels, which have been found to yield 80 grains for each avoirdupois pound, or more than 1 per cent. (*A. J. P.,* xxvii. 227.) According to the researches of Johannen, the emulsin is contained in the radicle and plumule, and in the vascular bundles of the cotyledons, while the parenchyma of the cotyledons contains the amygdalin. (*P. J.,* March, 1888.)

Amygdalin, mixed with emulsion of sweet almonds, gives rise, among other products, to the volatile oil of bitter almond and hydrocyanic acid,—the emulsin in the sweet almonds acting the part of a ferment, by causing a reaction between the amygdalin and water; and the same result is obtained when pure *emulsin* is added to a solution of amygdalin. It appears, then, that the volatile oil and hydrocyanic acid developed in bitter almonds when moistened result from the mutual reaction of amygdalin, water, and emulsin. Certain substances have the effect of preventing this reaction, as, for example, alcohol and acetic acid. It is asserted that emulsin procured from other seeds, as those of the poppy, hemp, and mustard, is capable of producing the same reaction between water and amygdalin, though in a less degree. (*Ann. Pharm.,* xxviii. 290.) Amygdalin appears not to be poisonous when taken pure in the stomach, unless there be emulsin in the food in the stomach.

Bitter almonds yield their fixed oil by pressure, and at the present time this oil is an article of commerce, and is frequently sold as oil of sweet almond, being produced from North African bitter almonds; the volatile oil, impregnated with hydrocyanic acid, may be obtained from the residue by distillation with water. (See *Oleum Amygdalæ Amaræ.*)

Uses.—Confectioners employ bitter almonds for communicating flavor to orgeat syrup. (See *Syrupus Amygdalæ.*) The kernel of the peach possesses similar properties, and is frequently used as a substitute. It has been ascertained that bitter almond paste, and other substances which yield the same volatile oil, such as bruised cherry-laurel leaves, peach leaves, etc., have the property of destroying the odor of musk, camphor, most of the volatile oils, creosote, cod liver oil, the balsams, etc.; and Mahier, a French pharmacist, has employed them successfully to free mortars and bottles from the odor of asafetida and other substances of disagreeable odor. All that is necessary is first to remove any oily substance by means of an alkali, and then to apply the paste or bruised leaves. (See *Amygdala Dulcis.*)

AMYGDALA DULCIS. U. S., Br.

SWEET ALMOND

(ă-mŷg'dą-lą dŭl'cĭs)

"The ripe seed of *Prunus Amygdalus* Stokes, var. *dulcis* De Candolle (Fam. *Rosaceæ*)." *U. S.* "The ripe seed of Prunus Amygdalus, *Stokes, var.* dulcis, *Baillon.* It is known in commerce as the Jordan almond." *Br.*

Semen Amygdali Dulce; Amandes douces, *Fr. Cod.;* Amygdalæ Dulces, *P. G.;* Süsse Mandeln, *G.;* Mandorle dolci, *It.;* Almendra dulce, *Sp.*

We are supplied with sweet almonds chiefly from Spain, the south of France, and Southern California. They are separated into the soft-shelled and hard-shelled, the former of which come from Marseilles and Bordeaux, the latter from Malaga. From the latter port they are sometimes brought to us without the shell. In British commerce, the two chief varieties are the *Jordan* and *Valencia* almonds, the former imported from Malaga, the latter from Valencia. The former are longer, narrower, more pointed, and more highly esteemed than the latter. The bitter almonds are obtained chiefly from Morocco, and are exported from Mogador.

Properties.—The shape and appearance of almonds are too well known to require description. Each kernel consists of two white cotyledons, enclosed in a thin, yellowish-brown, bitter skin, which is easily separable after immersion in boiling water. Deprived of this covering, they are called *blanched almonds.* On exposure to the air they are apt to become rancid; but, if thoroughly dried and kept in well-closed glass vessels, they may be preserved unaltered for many years. The two varieties require separate notice.

Sweet almonds, when blanched, are without odor, and have a sweet, very pleasant taste, which has rendered them a favorite article of diet in all countries where they are readily attainable. They are, however, generally considered difficult of digestion. The U. S. Pharmacopœia thus describes them. "Closely resembling the Bitter Almond (see *Amygdala Amara*), but usually broader, with lighter seed-coat, having a bland, sweetish taste and giving no odor of hydrocyanic acid when triturated with water." *U. S.* By the analysis of Boullay, it appears that they contain, in 100 parts, 5 parts of pellicle, 54 of fixed oil, 24 of albumen, 6 of uncrystallizable sugar, 3 of gum, 4 of fibrous matter, 3.5 of water, and 0.5 of acetic acid, comprising loss. The albumen is somewhat peculiar, and is called *emulsin.* It may be obtained separate by treating the emulsion of almonds with ether, allowing the mixture, after frequent agitation, to stand until a clear fluid separates at the bottom of the vessel, drawing this off by a siphon, adding alcohol to it so as to precipitate the emulsin, then washing the precipitate with fresh alcohol, and drying it under the receiver of an air pump. In this state it is a white powder, inodorous and tasteless, soluble in water, and insoluble in ether and alcohol. Its solution has an acid reaction, and, if heated to 100° C. (212° F.), becomes opaque and milky, and gradually deposits a snow-white precipitate, amounting to about 10 per cent. of the emulsin employed. (*A. J. P.*, xxi. 354.) Its distinguishing characteristic is that of producing certain changes noticed previously in amygdalin, which property it loses when its solution is boiled, though not by exposure in the solid state to a heat of 100° C. (212° F.). (*Ibid.*, 357.) It consists of nitrogen, carbon, hydrogen, and oxygen, with a minute proportion of sulphur, and is probably identical with the *synaptase* of Robiquet. L. Portes announced the discovery of *asparagin* in sweet almonds. (*N. R.*, January, 1877.) The fixed oil is described under the head of *Oleum Amygdalæ,* to which the reader is referred. Sweet almonds, when rubbed with water, form a milky emulsion, free from the odor of hydrocyanic acid, the insoluble matters being suspended by the agency of the albuminous, mucilaginous, and saccharine principles.

Uses.—*Sweet almonds* have no other influence on the system than that of a nutrient and demulcent. The emulsion formed by triturating them with water is a pleasant vehicle. From their nutritive properties, and the absence of starch in their composition, they are much used in the diet of *diabetics*, as originally recommended by Pavy. (*Guy's Hosp. Rep.*, 1862, p. 213.) *Bitter almonds* are more active, on account of the hydrocyanic acid developed in them. Largely taken, they have sometimes proved poisonous. Landerer mentions the case of a lady who was alarmingly affected by a bath made from the residue of bitter almonds after expression of the fixed oil (*A. J. P.*, xxviii.) Wöhler and Liebig propose as a substitute for cherry-laurel water, which owes its effects to the hydrocyanic acid it contains, but is objectionable from its unequal strength, an extemporaneous mixture of seventeen grains of amygdalin and one fluidounce of an emulsion made with two drachms of sweet almonds and a sufficient quantity of water. This mixture contains, according to the above-named chemists, one grain of anhydrous hydrocyanic acid, and is equivalent to two fluidounces of fresh cherry-laurel water. If found to answer in practice, it will have the advantage of certainty in relation to the dose, as amygdalin may be kept any length of time unaltered. If the calculation of Wöhler and Liebig be correct as to the quantity of acid it contains, not more than half a fluidrachm (1.8 Cc.) should be given as a commencing dose.

Off. Prep.—Emulsum Amygdalæ, *U. S.;* Pulvis Amygdalæ Compositus, *Br.*

AMYLIS NITRIS. U. S. (Br.)

AMYL NITRITE [Amyl Nitris, Pharm. 1890]

(ăm'y-lĭs nī'trĭs)

$C_5H_{11}NO_2 = 116.24$

"A liquid containing about 80 percent. of Amyl (chiefly Iso-amyl) Nitrite [$C_5H_{11}NO_2 = 116.24$], when assayed by the process given below. It should be kept in hermetically sealed glass bulbs, or in dark amber-colored, glass-stoppered vials, in a cool and dark place." *U. S.* "A liquid produced by the interaction of amylic alcohol which has been distilled between 262° and 270° F. (127.7° to 132.2° C.) and nitrous acid. It consists chiefly of iso-amyl nitrite, $C_5H_{11}NO_2$, but contains also other nitrites of the homologous series." *Br.*

Amyl Nitris, *Br.*, Amylo-nitrous Ether, Amyl-æther Nitrosus; Ether amylnitreux, *Fr. Cod.;* Ether amylazoteux, Azotite d'Amyl, *Fr.;* Amylium Nitrosum, *P. G.;* Amylinitrit, *G.;* Etere Isoamilnitroso, *It.;* Nitrito de amilo, *Sp.*

This substance, which was discovered by Balard in 1844, should not be confounded with *amyl nitrate,* $C_5H_{11}NO_3$, which is not used as a medicine.

Preparation.—Amyl nitrite may be prepared by passing a stream of nitrous acid (hyponitric acid) gas through purified amyl alcohol at a temperature of 132° C. (269.6° F.), or by acting upon amyl alcohol with nitric acid, as

originally suggested by Balard. The alcohol should always first be purified according to the method of Hirsch (*A. J. P.*, 1862, pp. 139, 328), by agitating with an equal bulk of strong solution of common salt, then distilling in a retort with a thermometer, collecting what comes over between 125° C. (257° F.) and 140° C. (284° F.), and redistilling this until it has a boiling point near 132° C. (269.6° F.). The purified alcohol should be mixed with about an equal bulk of nitric acid in a capacious glass retort, being gradually heated until it approaches boiling, when the fire is to be removed. As soon as a thermometer inserted into the tubulures rises above 100° C. (212° F.) the receiver is changed, because both ethyl-amylic ether and amyl nitrate at such temperatures come over freely and would contaminate the product. The distillate obtained below 100° C. (212° F.) is agitated with a solution of potassium carbonate, and the oily liquid which separates is very slowly heated in a clean retort to 96° C. (204.8° F.), then the receiver is changed and the distillate collected as before, until the thermometer reaches 100° C. (212° F.). That which comes over between the two temperatures is pure amyl nitrite. It is essential to this process that in every case the heating be very gradual. (*A. J. P.*, 1871, p. 148.) Allen states (*Com. Org. Anal.*, 2d ed., i. 159) that the use of nitric acid is certain to result in the formation of much valeric aldehyde and more or less amyl nitrate, and the boiling point of the former of these bodies precludes the possibility of subsequently separating it by fractioning the crude product. He therefore prefers the passing of nitrous acid gas into purified amyl alcohol. John M. Maisch attempted to produce amyl nitrite by Redwood's process (*A. J. P.*, 1867, p. 330) for the production of nitrous ether, substituting amyl for ethyl alcohol. He found that the reactions occurred with such excessive violence as to render the preparation of the nitrite in this way impracticable. Subsequently, however, Alfred Tanner pointed out (*P. J.*, Nov. 1871, also *A. J. P.*, 1872, p. 21) that Maisch used a nearly anhydrous amyl alcohol, and that the reactions are equally violent with ethyl alcohol of similar strength. He finds no difficulty when the fusel oil is diluted with water, and prefers the process, especially for the production of the drug upon a small scale. Having introduced the purified amyl alcohol into a tubulated retort containing copper wire, he adds one-tenth of its bulk of strong sulphuric acid, and then the same quantity of nitric acid, previously diluted with an equal bulk of water, and heats gently to 63° C. (145.4° F.). At this temperature the reaction commences, and goes on very manageably, until a bulk about equal to double the quantity of nitric acid collects in the receiver. The chemical movement now ceases, and the temperature, which has risen to near 100° C. (212° F.), begins to fall. More diluted nitric acid is added, and the process carried out as before. These additions are repeated until the amyl alcohol is exhausted, which is known by the appearance of red fumes in the retort. The whole product is washed with caustic soda, to remove hydrocyanic and other acids, and rectified over potassium carbonate, to get rid of moisture. The portion which distils over between 95° C. (203° F.) and 100° C. (212° F.) is medicinally pure amyl nitrite. John Williams (*Year-Book of Pharmacy*, 1885) recommends the method of passing nitrous acid, obtained by acting upon lump arsenic trioxide with nitric acid, sp. gr. 1.350, into purified amyl alcohol until the latter has assumed a brownish-green color; the product is then washed and distilled fractionally; the distillate under 100° C. and 105° C. amounted to nearly 95 per cent. D. B. Dott (*P. J.*, Aug. 31, 1878) called attention to the difficulties in the way of fixing a standard boiling point for amyl nitrite, and W. H. Greene (*A. J. P.*, 1879, p. 65) shows that nitropentane (an isomer of amyl nitrite) is almost invariably a constituent of amyl nitrite, and he believes that commercial amyl nitrite is frequently put upon the market unrectified, specimens examined having boiling points varying from 70° C. (158° F.) to 180° C. (356° F.).

Dunstan and W. Lloyd Williams (*P. J.*, 1888, p. 487) have shown that the supposed pure amyl nitrite is a mixture of α-amyl nitrite and β-amyl nitrite, arising from the fact that the amyl alcohol used is always a mixture of α-amyl alcohol and β-amyl alcohol in varying proportions. They find the α-amyl nitrite to be optically inactive and to boil at 97° C., while the β-amyl nitrite has dextro-rotatory power and boils at about 94° C. Much of the commercial amyl nitrite also contains iso-butyl nitrite, boiling at 67° C. It is a question whether the physiological action of commercial amyl nitrite is really due to the amyl nitrite or to impurities, especially to the iso-butyl nitrite, but the experiments of Brunton and Bokenham (*P. J.*, xix. 490) indicated that the commercial, impure nitrite is stronger than either pure α- or β-amyl nitrite. According to Bals and Broglio, the *tertiary amyl nitrite* differs from amyl nitrite in not giving rise to toxic symptoms, and in being slightly hypnotic.

Properties.—"A clear, yellowish liquid, of a peculiar, ethereal, fruity odor, and a pungent, aromatic taste. Specific gravity: 0.865 to 0.875 at 25° C. (77° F.). Almost insoluble in water; miscible, in all proportions, with alcohol or ether. It is very volatile, even at a low temperature, and is inflammable, burning with a yellow, luminous and sooty flame. It boils at about 96° to 99° C. (204.8° to 210.2° F.). If 1 Cc. of normal potassium hydroxide V.S. and 10 Cc. of water be mixed in a test-tube with a drop of phenolphthalein T.S., then 5 Cc. of Amyl Nitrite added, and the tube inverted a few times, the red tint of the aqueous layer should still be perceptible (limit of *free acid*). A mixture of 1.5 Cc. of silver nitrate T.S. and

1.5 Cc. of alcohol with a few drops of ammonia water should not become brown or black if 1 Cc. of Amyl Nitrite be added and the mixture gently heated (absence of *aldehyde*). Amyl Nitrite should remain transparent, or nearly so, when exposed to the temperature of melting ice (absence of *water*)." *U. S.*

"Almost insoluble in *water;* soluble in *alcohol* (90 per cent.) in all proportions. If it be added drop by drop to fused *potassium hydroxide,* potassium iso-valerianate will be formed. Specific gravity 0.870 to 0.880. Submitted to distillation, about 70 per cent. passes over between 194° and 212° F. (90° and 100° C.), the bulb of the thermometer not dipping below the surface of the residual fluid. A mixture of 5 volumes with sufficient *alcohol* (90 per cent.) to form 100 volumes affords a liquid of which a portion tested in a nitrometer as described under 'Spiritus Ætheris Nitrosi' should yield not less than 6 times its bulk of nitric oxide gas. On shaking with an equal volume of *solution of potassium hydroxide* the aqueous portion should have only a pale yellow color (limit of aldehyde). A small quantity in a test-tube placed in melting ice remains transparent (absence of water). It deteriorates unless kept in well-stoppered bottles." *Br.* According to Carl E. Smith (*A. J. P.,* 1898, p. 273), the U. S. 1890 method of assay (Allen's) is not accurate, owing to the nitric oxide instantly changing to nitrogen tetroxide on contact with air, and this continuing to set free iodine in the solution of hydriodic acid, thus registering too high a result. He proposes using a solution of potassium chlorate, nitric acid, silver nitrate, ferric ammonium sulphate, and potassium sulphocyanate.

Assay.—"Transfer about 3 Cc. of Amyl Nitrite, which has been previously shaken with 0.5 Gm. of potassium bicarbonate and carefully decanted, to a tared 100 Cc. measuring flask, and weigh it accurately. Add sufficient alcohol to bring the volume to exactly 100 Cc. and mix thoroughly. Introduce into a nitrometer (see PART III, Gasometric Estimations) exactly 10 Cc. of the alcoholic solution, followed by 10 Cc. of potassium iodide T.S., and afterwards by 10 Cc. of normal sulphuric acid V.S. When the volume of gas has become constant (within 30 to 60 minutes), note the volume of gas collected. Multiply this volume in Cc., by 4.8, and divide the product by the original weight of the Amyl Nitrite. At the standard temperature and pressure, the quotient will represent the percentage of Amyl Nitrite in the liquid. The temperature correction is one-third of one percent. of the total percentage just found for each degree,—additive if the temperature is below 25° C. (77° F.), and subtractive if it is above 25° C. (77° F.). The barometric correction is four-thirtieths of one percent. for each millimeter; additive if it is above, and subtractive if it is below 760. When assayed according to the above method, it should yield not less than 80 percent. of Amyl Nitrite." *U. S.*

Uses.—When inhaled in doses of from five to ten drops, amyl nitrite produces in man violent flushing of the face, accompanied with a feeling as though the head would burst, and a very excessive action of the heart. Along with these symptoms, after a larger quantity, there is a sense of suffocation, and more or less marked muscular weakness. As no case of serious poisoning from amyl nitrite has occurred in man, for a further knowledge of its action we are dependent upon studies made on the lower animals. In dogs, rabbits, cats, etc., it induces effects similar to those occurring in man, followed, after toxic doses, by violently hurried, panting respiration, progressive loss of muscular power and of reflex activity, and finally death from failure of respiration, sensation and consciousness being preserved to the last. Although the frequency of the pulse may be increased, the force of the circulation is always diminished. This decrease of the arterial pressure is in a great measure due to a dilatation of the capillaries. The vasomotor palsy appears to be chiefly produced by a direct action upon the coats of the capillaries, but may in part be caused by an influence exerted upon the vasomotor centres. The cause of the acceleration of the pulse is a depressing action upon the inhibitory cardiac centres, and it is also probable that small quantities of the drug act as a primary stimulant to the cardiac muscle.

The diminution of voluntary movements and of reflex action is chiefly owing to a powerful depressing influence exerted upon the spinal centres, although the drug does act to some extent upon both motor nerve and muscle, lowering their functional activity. Upon the perceptive and conscious portions of the nervous system amyl nitrite has almost no influence, so that, as already stated, both consciousness and sensation are preserved in poisoning by it almost to the close. After toxic doses the animal temperature falls in a remarkable degree. Very small doses produce in man a slight (½° F.) temporary increase of the bodily heat, probably caused by the vascular dilatation. The vapors of amyl nitrite outside of the body have a very extraordinary power of checking oxidation, and the results of numerous experiments seem to show that, in the body, the drug lessens decidedly the chemical interchanges. This is largely due to the formation of a new compound methæmoglobin, which being a comparatively stable body is not an efficient carrier of oxygen, the alteration in the composition of the blood may be recognized by the chocolate-brown color of the latter, but more accurately by the use of a spectroscope. With the possible exception of the decrease of temperature, the general symptoms produced by the poison do not seem to be due to this lowered oxidation, but to a direct influence exerted upon the various tissues. Locally applied, amyl nitrite causes a progressive loss of power in every highly organized

tissue; this may end in a total cessation of function, but, even after this, recovery is possible, provided the poison be withdrawn sufficiently early.

The chief indication for the employment of amyl nitrite is to relax *spasm*, either of the vasomotor muscular fibres or of the voluntary or involuntary muscles. A disease, probably associated with vasomotor spasm, but whose pathology is not established, in which experience has demonstrated the extreme value of amyl nitrite, is *angina pectoris*. Immediate and great relief is nearly always afforded, whether the heart-pain is or is not connected with *organic cardiac disease*. So far as experience goes, the cautious use of the remedy is safe, even when there is severe organic cardiac disease. In these cases it should always be administered by inhalation. Experience has also justified the use of the drug in many spasmodic diseases. In *asthma* the relief is often immediate; in *convulsions* occurring after labor the nitrite affords quiet, but its employment is dangerous on account of its tendency to produce uterine relaxation and consequent flooding. In *spasmodic dysmenorrhœa* good may be expected from its use; in *tetanus* it will frequently temporarily arrest the spasm and aid other remedies in securing recovery; in *strychnine poisoning*, in *hysterical convulsions*, indeed, in almost any convulsive disorder, much is to be expected from its employment. The convulsive stage of the ordinary *epileptic paroxysm* is so short that the nitrite is usually not available; when however, there is a marked *epileptic* condition and the patient passes from one convulsion to another, the drug may be used with benefit. In those cases in which there is an aura of sufficient length, the epileptic attacks may be arrested if the patient carry in the pocket pearls of the nitrite or a tightly-corked homœopathic vial containing five to ten drops of the remedy, and, as soon as the aura commences, inhale the vapor.

Amyl nitrite is generally administered by inhalation, usually in doses of from three to five drops, although much larger quantities have been given without bad results. The rule is to commence with three drops on a handkerchief held close to the nose, and then gradually to increase *pro re nata*. The handkerchief should always be withdrawn so soon as the face flushes or the heart begins to become excited, as the effects always increase for some time, even if no more be inhaled. The best method, however, of administering the very volatile liquid is by the use of glass pearls,—small flask-shaped vessels containing two, five, or ten minims of the nitrite; these are crushed in a handkerchief or towel when wanted for inhalation, the thin and fragile glass causing no inconvenience. The drug may also be given by the mouth.

Dose, from three to five minims (0.2 to 0.3 Cc.), given on sugar or dissolved in alcohol.

AMYLUM. U. S., Br.

STARCH [Corn Starch]

(ăm′y-lŭm)

"The starch grains obtained from the fruit of *Zea Mays* Linné (Fam. *Gramineæ*)." *U. S.* "The starch procured from the grains of common wheat, Triticum sativum, *Lam.;* maize, Zea Mays, *Linn.;* and rice, Oryza sativa, *Linn.*" *Br.*

Amylum Tritici, *P. G.;* Amylum Zeæ, Wheat Starch; Amidon, *Fr. Cod.;* Fécule de Froment de Blé, de Maïs, *Fr.;* Stärkmehl, Stärkes, Kraftmehl, Maisstärke, Weizenstärke, *G.;* Amido, *It.;* Almidon, *Sp.*

Starch is a proximate vegetable principle contained in most plants, and especially abundant in the various grains, such as wheat, rye, barley, oats, maize, etc.; in other seeds, as peas, beans, chestnuts, acorns, etc.; and in numerous rhizomes and tuberous roots, as those of the potato, the sweet potato, the arrow-root, etc. The starch is always in the form of grains, which are contained within the parenchymatous cells, and is procured by reducing the substances in which it exists to a state of minute division, agitating or washing them with cold water, straining or pouring off the liquid, and allowing it to stand till the fine fecula which it holds in suspension has subsided. This, when dried, is starch, more or less pure, according to the care taken in conducting the process. Electricity has been used to bleach starch and thus raise its commercial value. (*D. C.*, 1893, 203.) In the U. S. P. of 1880 the official starch was that derived from wheat, but in the revision of 1890 corn starch was substituted. The starch of European commerce is largely obtained from the potato, while in the United States corn starch is almost exclusively in use, wheat and rice starch coming next in importance. For a description of the differences, see page 144.

Starch is white, inodorous and tasteless, pulverulent, opaque, and, as found in commerce, is usually in columnar or irregular angular masses which are easily reduced to powder, which produces a peculiar sound when pressed between the fingers. Its specific gravity is 1.505 at 67° F. (Payen.) It is composed of minute microscopic granules, in starch from the same plant nearly uniform in size, more or less plainly striate, and having a distinct hilum. In the different species of plants the starch granules differ in their characteristic forms. When exposed to a moist air, it absorbs a considerable quantity of water, which may be driven off by a gentle heat. It is insoluble in alcohol, ether, and cold water, but unites with boiling water, which, on cooling, forms with it a soft semi-transparent paste or a gelatinous opaline solution according to the proportion of starch employed. The paste placed on folds of blotting-paper, renewed as they become wet, loses water, contracts, and assumes the appearance of horn. If the proportion of starch be very

small, the solution, after slowly depositing a very minute quantity of insoluble matter, continues permanent, and upon being evaporated yields a semi-transparent mass, which is partially soluble in cold water. The starch has, therefore, been modified by the combined agency of water and heat; nor can it be restored to its original condition. Heating with glacial acetic acid to 100° C., or with glycerin to 190° C., will also make starch soluble. Corn starch is officially characterized as "in fine powder or irregular, angular white masses, consisting of somewhat spherical, but usually polygonal grains, about 0.010 to 0.025 Mm. in diameter, with a lenticular, circular, or triangular central fissure; inodorous and tasteless; insoluble in cold water or alcohol; forming a whitish jelly when boiled with water, which when cool gives a deep blue color with iodine T.S.; triturated with cold water, showing neither acid nor alkaline reaction with litmus paper; when completely incinerated, leaving not more than 1 percent. of ash. When freed from water by careful drying in a current of warm air, Starch should show not less than 95 percent. of hydrolyzable carbohydrate." *U. S.* At a temperature of 160° C. (320° F.) for air-dried starch, and 200° C. (392° F.) for starch previously dried at 100° C., it is changed into *dextrin* (*British gum*), and at 200° C. (392° F.) to 215° C. (419° F.) forms a transparent fused mass, which consists exclusively of dextrin (Payen); at 220° C. (428° F.) to 230° C. (446° F.) it undergoes further change and yields chiefly *pyrodextrin*, a brown, tasteless, and odorless compound, readily soluble in water, insoluble in alcohol and ether. (Gelis, *Ann. Ch. Phys.*, (3) lii. 388.)

Composition and Nature.—The formula of starch is generally taken as $C_6H_{10}O_5$, or a multiple of this. Musculus, in 1861, showed that by the action of diluted acids or of *diastase*, starch is resolved into *dextrin*, $C_{12}H_{20}O_{10}$, and *dextrose*, $C_6H_{12}O_6$, so that its formula, in simplest terms, would be $(C_6H_{10}O_5)_3$. Recent determinations of its molecular weight by Brown and Morris make it as high as $5(C_{12}H_{20}O_{10})_{20}$. Iodine forms with starch, whether in its original state or in solution, a blue compound; and the tincture of iodine is the most delicate test for its presence. The color varies somewhat according to the proportions employed. When the two substances are about equal, the compound is of a beautiful indigo blue; if the iodine be in excess, it is blackish blue; if the starch, violet blue. A singular property of starch iodide is that its solution becomes colorless if heated to about 93.5° C. (200° F.), and afterwards recovers its blue color upon cooling. By boiling, the color is permanently lost, while Puchot states that certain nitrogenized organic bodies, as albumin, prevent the reaction of iodine on starch or destroy it. (*N. R.*, Nov. 1876.) Alkalies unite with starch, forming soluble compounds, which are decomposed by acids, the starch being precipitated. It is thrown down from its solution by lime water and baryta water, forming insoluble compounds with these earths. The solution of lead subacetate precipitates it in combination with the oxide of the metal. Starch may be made to unite with tannin by boiling their solutions together; and a compound results, which, though retained by the water while hot, is deposited when it cools. By long boiling with diluted sulphuric, hydrochloric, or oxalic acid, it is converted into *dextrin*[1] and glucose or grape sugar. A similar conversion into dextrin and glucose is effected by means of *diastase*, which change can be represented as taking place in several stages:

$$3C_6H_{10}O_5 + H_2O = \underset{\text{Dextrin.}}{C_{12}H_{20}O_{10}} + \underset{\text{Dextrose.}}{C_6H_{12}O_6}$$

$$C_{12}H_{20}O_{10} + H_2O = \underset{\text{Maltose.}}{C_{12}H_{22}O_{11}}$$

$$C_{12}H_{22}O_{11} + H_2O = 2\underset{\text{Dextrose.}}{C_6H_{12}O_6}$$

Many observers claim to recognize the production of other intermediate substances, as *amylodextrin* (soluble starch), *erythrodextrin*, *achroodextrin*, *maltodextrin*, none of which reduce Fehling's solution, followed by *maltose*, which does reduce Fehling's solution. Strong hydrochloric and nitric acids dissolve starch; and the latter acid, by the aid of heat, converts it into oxalic and malic acids. By the action of strong nitric, sulphuric, or crystallizable acetic acid, used with certain precautions, the starch is rendered soluble, and may be obtained in this state by separating the acid by means of alcohol. By the continued action of concentrated sulphuric acid it is decomposed. When it is dissolved in strong nitric acid, and precipitated by water, a white powder is thrown down, called *xyloidin*, $C_6H_9(NO_2)O_5$ (Braconnot), in which one atom of the hydrogen of the starch is replaced by one group, NO_2, furnished by the nitric acid. Mixed with hot water and exposed to a temperature of 27° C. (80° F.), it undergoes chemical changes, which result in the formation of several distinct principles,

[1] *Dextrin* is a substance resembling gum in appearance and properties, but differing from it in not affording mucic acid by the action of nitric acid. It is largely dissolved by water, hot or cold, and forms a mucilaginous solution, from which it is precipitated by alcohol. Large quantities of dextrin are now made both here and abroad and employed for various purposes in the arts, under the name of *artificial gum*. It is found in the market usually in the form of a yellowish or brilliant white powder, and in small masses or fragments resembling natural gum. It is made by the action either of acids or of diastase on starch, or by heating starch slightly moistened with nitric acid to a temperature of from 100° to 140° C. For particulars as to the manufacture, see paper by Thomas, republished in *A. J. P.* (vol. xix. p. 284). Researches of Naegeli and Musculus seem to show that the change of starch into dextrin takes place in several phases, and they name the products *amylodextrin*, *erythrodextrin*, *achroodextrin α and β*. For a fuller account see Husemann, *Pflanzenstoffe*, 2d ed., 1882. Dextrin, according to Payen, is converted into glucose through the action of diastase; but the glucose impedes the action unless removed; as, however, during alcoholic fermentation the glucose is consumed, the influence of diastase is not retarded. Hence dextrin by conversion into sugar may contribute to the alcoholic product.

among which are sugar, a gummy substance (perhaps *dextrin*), and a soluble modification of starch. With yeast, starch undergoes the vinous fermentation, being, however, first converted into sugar. Mixed with cheese and chalk it is said to yield alcohol without the previous saccharine conversion. (Berthelot, *J. P. C.*, 3e sér., xxxii. 260.) All plants which contain chlorophyll have the power of using the chemical rays of sunlight in producing from inorganic compounds and elements a substance which is organic. There is first formed in the centre of the chlorophyll granule a minute speck, which is believed to be starch; this new starch granule is incapable of solution, but by conversion into sugar or dextrin is rendered soluble, and in this form is carried in the juices of the plant. One of two destinies there awaits it. It may be converted into the permanent compound cellulose which constitutes the woody tissue, or it may be reconverted to its original form and be deposited in some part of the plant. These stores of starch are usually accumulated for future growth, and are especially seen in plants which flower in the spring before the leaves are put forth, or which reproduce the species without seeding.

When the potato is planted, the starch is converted into a soluble form, passes into the growing "eye" or bud, and, as cellulose, forms the new shoot. The structure and nature of the starch granule has been the subject of much investigation and discussion. Its microscopic appearance supports, but of course does not prove, the original theory advanced by Schleiden, that it is composed of concentric layers of similar chemical composition, in which the outer layer has been the first formed while the inner layers have been successively deposited in its interior. The microscopic characters, however, are just as readily explained on the theory that the central layer was the first formed and that the peripheral layers have been deposited around the point of the hilum. This view, originally advanced by Fritsche in 1834, has been widely supported by various observers. Other authorities have come to the conclusion that the starch grain grows as do ordinary vegetable cells, but the theory brought forward in 1880 by Schimper, that all starch grains develop within plastids *i.e.*, in protoplasmic masses or cells, and that in starch which is stored, the leucoplastids finally disappear, is the theory which has been of recent times most widely believed and is probably correct. In stating his views, Schimper further came to the conclusion that the outer portion of the grain is the part most recently produced. That there is a marked difference in the layers of the starch grains is shown by the varying effects of staining reagents, certain parts of the grains being much more affected by safranin and gentian-violet than others. It would further appear that though the starch layers each contain colloidal substances besides crystalloidal cellulose, the proportion of their constituents varies so much that the alternate layers are different, one set being colloidal and others crystalloidal, in their general nature. For details see Kraemer, *Botan. Gaz.*, vol. 24, Nov. 1902; also *Proc. Am. Philosoph. Soc.*, vol. xli.

Varieties.—Starch, as obtained from different substances, is somewhat different in its characters. *Wheat starch*, when examined with a microscope, is found to consist of granules varying from about $\frac{1}{1000}$ of an inch in diameter to a mere point, the smaller being spheroidal, the larger rounded and flattened, with the hilum in the centre of the flattened surface, and surrounded by concentric rings, which often extend to the edge. The granules are mixed with loose integuments, resulting from the process of grinding. This variety of starch has a certain degree of hardness and adhesiveness, owing, according to Guibourt, to the escape of a portion of the interior substance of the broken granules, which attracts some moisture from the air, and, thus becoming glutinous, acts as a bond between those which remain unbroken. Another opinion attributes this peculiar consistence to the retention of a portion of the gluten of the wheat flour, which causes the granules to cohere. Under the name of *corn starch*, a variety of fecula obtained from the meal of maize or Indian corn is much used for nutritive purposes in the United States. It is now the official starch. The granules of maize starch are very small, with a diameter not exceeding, according to Payen, one-sixth of that of the potato, and little more than one-half of that of the wheat granules. They have a very distinct hilum but no evident concentric striæ. *Rice starch* has extremely minute granules, nearly uniform in size, polygonal, without evident hilum or striæ. *Potato starch* is employed in various forms, being prepared so as to imitate more costly amylaceous substances, such as arrow-root and sago. In its ordinary state it is more pulverulent than is wheat starch, has a somewhat glistening appearance, and may be distinguished, with the aid of the microscope, by the size of its granules, which are larger than those of any other known fecula except canna, or *tous les mois*. They are exceedingly diversified in size and shape, though their regular form is thought to be ovate. The characters of other kinds of fecula will be given under the heads of the several official substances of which they constitute the whole or a part. According to Chevallier, starch is sometimes adulterated with calcium carbonate and calcium sulphate; and the fraud is also practised of saturating it with moisture, of which it will absorb 12 per cent. without any obvious change.

Uses.—Starch is nutritive and demulcent, but in its ordinary form is seldom administered internally. Powdered and dusted upon the skin, it is sometimes used to absorb irritating secretions and prevent excoriation. Dissolved in hot water and allowed to cool, it is often employed in enemata, either as a vehicle, or as a

demulcent application in irritated states of the rectum; this liquid may also be used as an antidote in iodine poisoning, and given freely in other cases where amylaceous or mucilaginous drinks are indicated.

Off. Prep.—Glyceritum Amyli, *U. S.* (*Br.*); Pulvis Tragacanthæ Compositus, *Br.*

ANETHI FRUCTUS. Br.

DILL FRUIT

(ą-nē'thī frŭc'tŭs)

"The dried fruit of Peucedanum graveolens, *Benth.* and *Hook.*" *Br.*

Garden Dill, Dilly, Anet; Aneth, *Fr. Cod.*; Fenouil puant, *Fr.*; Dill, *G.*; Eneldo, *Sp.*

Anethum graveolens, Willd., *Sp. Plant.* i. 1469; Woodv., *Med. Bot.* p. 125, t. 48.—Dill is an annual plant, three or four feet high, with a long spindle-shaped root; an erect, striated, jointed branching stem; and bipinnate or tripinnate, glaucous leaves, which stand on sheathing footstalks and have linear and pointed leaflets. The flowers are yellow, and in large, flat, terminal umbels, destitute of involucre. The plant is a native of Spain, Portugal, and the south of France, and is found growing wild in various parts of Africa and Asia. It is cultivated in all the countries of Europe, and has been introduced into our gardens. For a paper by J. C. Umney describing the commercial varieties, see *Year Book of Pharmacy,* 1898, 374. The seeds, as the fruit is commonly called, are the only part used. They are usually rather more than a line in length, and less than a line in breadth, of an oval shape, thin, concave on one side, convex and striated on the other, of a brown color, and surrounded by a yellowish membranous expansion. The dorsally compressed mericarps are usually separate and freed from the pedicel; each of them is broadly oval, about one-sixth of an inch long, flat, and furnished with three sharply keeled dorsal ridges, besides two marginal thin membranous projections or wings. The vittæ, or oil-tubes, are six in number, two upon the face and one in each furrow between the ridges. The odor is strong and aromatic, but less agreeable than that of fennel seed; the taste, moderately warm and pungent. These properties depend on a volatile oil. (See *Oleum Anethi.*) The bruised seeds impart their virtues to alcohol and to boiling water.

Uses.—Dill seeds have the properties common to the aromatics, but are very seldom used in this country. They may be given in powder or infusion.

Dose, of the fruit, from fifteen grains to a drachm (1 to 3.9 Gm.); of the oil, two or three minims (0.12 to 0.2 Cc.).

Off. Prep.—Aqua Anethi, *Br.*

ANISUM. U. S. (Br.)

ANISE

(ą-nī'sŭm)

"The ripe fruit of *Pimpinella Anisum* Linné (Fam. *Umbelliferæ*), obtained from cultivated plants." *U. S.* "The dried ripe fruit of Pimpinella Anisum, *Linn.*" *Br.*

Anisi Fructus, *Br.*; Fructus (Semen) Anisi, s. Anisi vulgaris; Aniseed, Anny, Aneys, Annyle; Anis, Anis vert, Graines d'Anis, *Fr.*; Fructus Anisi, *P. G.*; Anissame, Anis, *G.*; Anice, Anace, Semi d'Aniso, *It.*; Anis (Fruto de), Simiente de Anis, *Sp.*; Anison, *Ar.*

Pimpinella Anisum, Willd., *Sp. Plant.* i. 1473; *B. & T.* 122. *Anisum vulgare,* Moench. This is an annual plant, about a foot in height, with an erect, smooth and branching stem. The leaves are petiolate, the lower roundish-cordate, lobed, incised-serrate, the middle pinnate-lobed with cuneate or lanceolate lobes, the upper trifid, or undivided, linear. The flowers are white, and in terminal compound umbels, destitute of involucres.

The anise plant is a native of Egypt and the Levant, but has been introduced into Southern Europe and is cultivated in various parts of that continent. It is also cultivated occasionally in the gardens of this country. The fruit is abundantly produced in Malta and Spain; in Romagna, in Italy, whence it is largely exported through Leghorn; and in Central and Southern Russia. The Spanish is smaller than the German or French, and is usually preferred; the Russian fruit is very short. It is said also to be extensively cultivated in India and South America, although we are not aware that the product ever comes into American commerce.

It is one of the oldest aromatics, having been spoken of by Theophrastus and cultivated in the imperial German farms of Charlemagne. In 1305 Edward I. granted a patent giving the right to levy tolls upon it at the Bridge of London for the purpose of repairing the bridge.

Anise seeds (botanically, fruit) are about a line in length, oval, striated, somewhat downy, attached to their footstalks, and of a light greenish-brown color, with a shade of yellow. "Ovoid, laterally compressed, 4 to 5 Mm. long; carpels usually cohering and attached to a slender pedicel; grayish or greenish-gray to grayish-brown; each with a flat face and five light brown filiform ridges and about 16 oil-tubes; odor and taste agreeable and aromatic. No mouse-like odor should be developed when solution of potassium hydroxide is poured upon Anise (absence of *conium*). The powder contains one-celled, straight or curved, non-secreting hairs, which vary from 0.025 to 0.100 Mm. in length." *U. S.* Their odor and taste, which depend upon a peculiar volatile oil existing in the seed envelopes, are imparted sparingly to boiling water, but freely to alcohol. (See *Oleum Anisi.*) The internal substance of the seed contains a bland fixed oil. By expression, a greenish oil is obtained, which is a mixture of the

two. The seeds are sometimes adulterated with small fragments of an argillaceous earth which resembles them in color; and their aromatic qualities are occasionally impaired by a slight fermentation, which they are apt to undergo in the mass, when collected before maturity. When examined by the microscope, anise is seen to contain a very great but variable number of small oil-tubes,—from fifteen to thirty to each mericarp. The epidermis is supplied with short, simple hairs, easily detached in making a section.

A case of poisoning is on record from the accidental admixture of the fruits of *Conium maculatum,* which bear some resemblance to those of anise, but may be distinguished by their crenate or notched ridges and the absence of oil tubes; by their mericarps being smooth, grooved upon the face, and having crenate or notched ridges with wrinkles between them. The conium fruits are, moreover, broader in proportion to their length, and are generally separated into half fruits (or single mericarps), while those of anise are whole (double mericarps).

Star aniseed, the *Cardamomum Siberiense* or *Annis de Sibérie* of the seventeenth century and the *badiane* of the French writers, is the product of *Illicium verum,* Hook. f., Gaertn., and is fully described under the heading *Illicium,* PART II. They contain about 4 per cent. of a volatile oil very closely resembling that of anise. There are no known chemical differences between these oils, although dealers distinguish them by their odor and taste.

Ruschenberger, U. S. N., has shown that oil of anise has a remarkable power of deodorizing potassium sulphide; a drop of the oil having entirely deprived of offensive odor a drachm of lard with which five grains of the sulphide had been incorporated. (*Am. J. M. S.,* N. S., xlviii. 419.)

Uses.—Anise, a grateful aromatic carminative, may be used in flatulent *colic,* and as a corrigent of griping or unpleasant medicines.

Dose, twenty to thirty grains (1.3 to 2.0 Gm.); of the oil, which should always be preferred, five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Aqua Anisi, *U. S.* (from Oil of Anise), *Br.*

ANTHEMIS. U. S. (Br.)

ANTHEMIS [Chamomile, English Chamomile, Roman Chamomile]

(ăn'thẹ-mĭs)

"The dried flower-heads of *Anthemis nobilis* Linné (Fam. *Compositæ*), collected from cultivated plants." *U. S.* "The dried expanded flower-heads of Anthemis nobilis, *Linn.,* collected from cultivated plants." *Br.*

Anthemidis Flores, *Br.;* Flores Chamomillæ Romanæ, *P. G.;* Roman, Low, Garden, White or English Chamomile, Chamomile Flowers, Camil, Camovyne, Whig-plant; Camomille Romaine, *Fr.;* Römische Kamille, *G.;* Camomilla Romana, Camomilla Ingleses, *It.;* Manzanilla (Flor de), Manzanilla Romana, *Sp.*

Several species of Anthemis have been employed in medicine. *A. nobilis,* which is the subject of the present article, is by far the most important. *A. Cotula,* L., or *mayweed,* was formerly recognized by the U. S. Pharmacopœia. *A. Pyrethrum,* which affords the pellitory root, is among the official plants. (See *Pyrethrum.*) *A. arvensis,* L. (*corn chamomile*), a native of Europe, naturalized in this country, bears flowers which have an acrid bitter taste and possess medicinal properties analogous though much inferior to those of common chamomile. They may be distinguished by their want of odor. *A. tinctoria,* L., is occasionally employed as a tonic and vermifuge in Europe. *Matricaria suaveolens* is said to yield the chamomile of the Indian bazaars.

Anthemis nobilis, Willd., *Sp. Plant.* iii. 2180; *B. & T.* 154. *Chamomilla nobilis,* Godr. This is an herbaceous plant with a perennial root. The stems are from six inches to a foot long, round, slender, downy, trailing, and divided into branches, which turn upward at their extremities. The leaves are bipinnate, the leaflets small, thread-like, somewhat pubescent, acute, and generally divided into three segments. The flowers are solitary, with a yellow convex disk, and white rays. The involucre is of a hemispherical form, and composed of several small imbricated hairy scales. The receptacle is convex, prominent, and furnished with rigid bristle-like paleæ. The ray florets are numerous, narrow and terminated with three small teeth. The whole herb has a peculiar fragrant odor, and a bitter aromatic taste.

This plant is a native of Europe, and grows wild in all the temperate parts of that continent. It is also largely cultivated for medicinal purposes. In France, Germany, and Italy, it is generally known by the name of *Roman chamomile.* By cultivation the yellow disk florets are often converted into the white ray florets. Thus altered, the flowers are said to be *double,* while those which remain unchanged are called *single;* but, as the conversion may be more or less complete, it generally happens that with each of the varieties there are intermingled some flowers of the other kind, or in different stages of the change. The double flowers are generally preferred; though, as the sensible properties are found in the greatest degree in the disk, the single are the more powerful. It is rather, however, in aromatic flavor than in bitterness that the radial florets are surpassed by those of the disk. If not well and quickly dried, the flowers lose their beautiful white color, and are less efficient. The flowers which are largest, most double, and whitest should be preferred. They are thus described officially. "Subglobular, 1.5 to 2 Cm. broad, consisting of an imbricated involucre and numerous white, strap-shaped, obscurely three-toothed ray florets, and usually a few tubular disk florets, inserted upon a chaffy, conical, solid receptacle; odor agreeable; taste strongly aromatic and bitter." *U. S.*

The seeds yield by expression a fixed oil, which is said to be applied in Europe to various economical uses.

Though not a native of America, chamomile grows wild in some parts of this country, and is occasionally cultivated in our gardens for family use, the whole herb being employed. The medicine, as found in commerce, consists chiefly of the double flowers, and is imported from Germany and England. From the former country the flowers of *Matricaria Chamomilla* are also occasionally imported, under the name of chamomile. (See *Matricaria.*) In Europe the flowers of *A. arvensis,* L., corn chamomile, are sometimes substituted for the official drug. In France corn chamomile flowers are sold in commerce indiscriminately with those of *Anthemis nobilis,* of *Chrysanthemum parthenium,* (L.), Pers. (*Pyrethrum parthenium,* Smith), or of *Anthemis parthenoides,* De Cand., (*Matricaria parthenoides, Desf.*). (*J. P. C.,* Mai, 1859, p. 347.) For the peculiar character by which these two flowers may be distinguished from the chamomile, see *Pyrethrum parthenium* in PART II.

Properties.—Chamomile flowers, as usually found in commerce, are large, almost spherical, of a dull white color, a fragrant odor, and a warmish, bitter, aromatic taste. When fresh, their odor is much stronger, and was fancied by the ancients to resemble that of the apple. Hence the name *chamæmelum* (*χαμαί*, on the ground, and *μῆλον*, an apple); and it is somewhat singular that the Spanish name *manzanilla* (a little apple) has a similar derivation. The flowers impart their odor and taste to water and alcohol, the former of which, at the boiling temperature, extracts only one-fourth of their weight. The investigations of several chemists made in 1878–1879, in Fittig's laboratory at Strassburg, have shown the oil of chamomile to contain the following constituents:—a fraction distilling at 147° to 148° C. (296° to 298° F.) consisting of *isobutylic esters* and hydrocarbons; *isobutyl angelicate* at 177° C. (350.5° F.); *isoamyl angelicate* at 200° to 201° C. (392° to 394° F.); *isoamyl tiglinate* at 204° to 205° C. (399° to 401° F.) (both of these esters answering to the formula $C_5H_{11},C_5H_7O_2$). In the residual portion, hexylic alcohol, C_6H_{13},OH, and an alcohol of the formula $C_{10}H_{16}O$ isomeric with camphor, to which the name of *anethol* has been given (See *Chem. Cb.,* 1903 (1) 1226), are met with, both probably occuring in the form of esters. By decomposing the angelicates and the tiglinate with potassium hydroxide, *angelic acid,* $C_5H_8O_2$, and *tiglinic acid* (or *methyl-crotonic*) isomeric with the former are obtained to the extent of about 30 or more per cent. of the crude oil. In the oil examined by Fittig, angelic acid prevailed; from another specimen E. Schmitt (1879) obtained but very little of it, tiglinic acid prevailing. Naudin (*Bull. Soc. Chim.,* 1884, 41, 483) extracted also a solid paraffin, $C_{18}H_{36}$, to which the name of *anthemene* was given; Klopp obtained another body, *anthesterin* from chamomile. (*P. J.,* 1903, 458.) Umney states that pure oil of chamomile has the sp. gr. 0.905 to 0.912 at 15° C. (*P. J.,* 1895, p. 949). The oil from *Anthemis Cotula* closely resembles that from *A. nobilis,* see *A. J. P.,* 1885, pp. 376, 381. E. Amerman (*A. J. P.,* 1889, p. 69) obtained a wax which was nearly white, bitter, and crystalline, melting at about 130° C., and a crystalline substance distinctly acid and of a glucosidal nature. There was no evidence of the presence of an alkaloid.

Uses.—Chamomile is a mild tonic, in small doses acceptable and corroborant to the stomach, in large doses capable of acting as an emetic. In cold infusion it is often advantageously used in cases of *enfeebled digestion* in convalescence, of *general debility,* with languid appetite, which often attends convalescence from idiopathic fevers. The flowers are sometimes applied externally in the form of fomentation, in cases of irritation or inflammation of the abdominal viscera, and as a gentle incitant in flabby, ill-conditioned *ulcers.* The infusion is usually preferred. The decoction and extract cannot exert the full influence of the medicine, as the volatile oil is driven off.

Dose, of the powder as a tonic, from half a drachm to a drachm (2.0 to 3.9 Gm.) three or four times a day, or more frequently.

Off. Prep.—Extractum Anthemidis, *Br.*

ANTIMONII ET POTASSII TARTRAS.
U. S. (Br.)

ANTIMONY AND POTASSIUM TARTRATE
[Tartar Emetic; Tartarated Antimony]

(ăn'tĭ-mō'nĭ-ī ĕt pŏ-tăs'sĭ-ī tär'trăs)

$2K(SbO)C_4H_4O_6 + H_2O = 659.80$

"It should contain not less than 99.5 percent. of pure Antimony and Potassium Tartrate $[2C_2H_2(OH)_2(COOK)COOSbO + H_2O]$." *U. S.* "Tartarated Antimony, $[K(SbO)C_4H_4O_6]_2 H_2O$, is prepared by setting aside a mixture of antimonious oxide and acid potassium tartrate, made into a paste with a little water, until combination has taken place, and then purifying by crystallization from water." *Br.*

Antimonium Tartaratum, *Br.;* Potassium antimonyl tartrate, Antimonium Tartarizatum, Tartarized Antimony, Tartrated Antimony; Potassio-Tartrate of Antimony, Antimonii Potassio-Tartras, Tartarus Emeticus, Stibio-Kali Tartaricum; Tartrate d'Antimoine et de Potasse, *Fr. Cod.;* Emétique, Tartre stibié, *Fr.;* Tartarus Stibiatus, *P. G.;* Brechweinstein, *G.;* Tartrato di antimonio e di potassio, *It.;* Tartrato antimonico potasico, *Sp.*

A process for Tartar Emetic not now being given in the U. S. Pharmacopœia, that of 1870 follows: "Take of Oxide of Antimony, in very fine powder, *two troyounces;* Bitartrate of Potassium, in very fine powder, *two troyounces and a half;* Distilled Water *eighteen fluidounces.* To the Water, heated to the boiling point in a glass vessel, add the powders,

previously mixed, and boil for an hour; then filter the liquid while hot, and set it aside that crystals may form. Lastly, dry the crystals, and keep them in a well-stoppered bottle. By further evaporation the mother-water may be made to yield more crystals, which should be purified by a second crystallization." *U.S.*1870. This compound is a normal tartrate. Tartaric acid is dibasic. In acid potassium tartrate (cream of tartar) one of the two hydrogen atoms is replaced by potassium, while the other is unreplaced; in neutral potassium tartrate (soluble tartar) both are replaced by potassium; in tartar emetic one is replaced by potassium, while the other is replaced by the group (SbO) antimonyl, which is an univalent group, exactly replacing one hydrogen atom.

In the preparation of tartar emetic the cream of tartar should not be in excess, as in that case it is apt to crystallize, upon cooling, with the tartar emetic. To avoid such a result it is better to have a slight excess of antimonial oxide. The hot filtration, directed in the U. S. Pharmacopœia of 1870, may be conveniently performed by a jacketed funnel filled with hot water. In all cases the salt should be obtained in well-defined crystals, unmixed with those of cream of tartar, as the best index of its purity. The practice of some manufacturing chemists of boiling the filtered liquor to dryness, whereby an impure mass is obtained, consisting in part only of the antimonial salt, is very reprehensible.[1]

It is not easy to decide as to the relative eligibility of the different forms of antimonial oxide used for preparing tartar emetic. The preference, however, was given to the oxychloride (*powder of Algaroth*) by Berzelius; and M. Henry, an eminent pharmaceutist of Paris, after a careful comparison of the different processes, declared also in its favor; his process will be found in detail in the U. S. D., 17th ed., p. 175.

Tartar emetic is not usually prepared by the apothecary, but made on a large scale by the manufacturing chemist. Different processes are pursued in different manufactories; it is not material what plan is adopted, provided the crystals of the antimonial salt be carefully purified. Mohr prefers the use of a moist oxide, prepared by adding gradually an intimate mixture of one part, each, of antimony trisulphide and potassium nitrate to a boiling mixture of one part of sulphuric acid and two of water. The liquid is boiled down nearly to dryness and allowed to cool. The grayish-white mass thus formed is then washed thoroughly with water. The details of this process are given by Soubeiran, by whom it is praised, in the *J. P. C.*, 3e sér., iii. 327. Yuntz (*A. Pharm.*, 1887, p. 641) communicates the following process for *Antimony Tartrate* $(SbO)O_6C_4H_5$. An excess of antimony oxide is boiled with solution of tartaric acid, the clear solution evaporated to a syrupy consistence, allowed to cool, and the crystalline precipitate which forms washed with alcohol to free it from any excess of tartaric acid.

Properties.—It is in the form of "colorless, transparent crystals of the rhombic system, becoming opaque and white on exposure to air, or a white, granular powder; without odor, and having a sweet, afterwards disagreeable, metallic taste. Soluble in 15.5 parts of water at 25° C. (77° F.), and in 3 parts of boiling water, but insoluble in alcohol, which precipitates it from its aqueous solution in the form of a crystalline powder. When heated to 110° C. (230° F.), the salt loses its water of crystallization (2.71 percent.). When heated to redness, it chars, emits an odor resembling that of burning sugar, and leaves a blackened residue having an alkaline reaction. The aqueous solution of the salt possesses a slightly acid reaction, and yields with hydrochloric acid a white precipitate, soluble in an excess of the acid; but no precipitate occurs if tartaric acid has previously been added." *U. S.* Antimony and potassium tartrate was discovered in 1631 by Adrian de Mynsicht. When prepared from the oxychloride it crystallizes in tetrahedrons. As it occurs in commerce, it is often in the form of a white powder, resulting from the pulverization of the crystals. It is insoluble in alcohol, but dissolves in proof spirit or wine. (See *Vinum Antimonii.*) Its aqueous solution slightly reddens litmus, and undergoes decomposition by keeping. If one-fifth of its bulk of alcohol be added to the water, this decomposition is prevented. It is incompatible with acids, alkalies and their carbonates, some of the earths and metals, calcium chloride, and lead acetate and subacetate. It is incompatible also with astringent infusions and decoctions, as of rhubarb, cinchona, catechu, galls, etc.; but these substances, unless galls be an exception, do not render it inert, though they lessen its activity to a greater or less extent.

Characteristics and Tests of Purity.—"In a solution of Antimony and Potassium Tartrate, acidulated with hydrochloric acid, hydrogen sulphide T.S. produces an orange-red precipitate, which is soluble in ammonium sulphide T.S. and potassium hydroxide T.S. Antimony and Potassium Tartrate is precipitated from its aqueous solution by tannic acid T.S., and yields a white precipitate with solutions of the alkaline carbonates and hydroxides, soluble in excess of the latter. An aqueous solution of the salt (1 in 100), acidulated with acetic acid, should not be affected by the addition of a few drops of barium chloride T.S. (absence of *sulphate*), silver nitrate T.S. (*chloride*), ammonium oxalate T.S. (*calcium*), or potassium ferrocyanide T.S. (*iron*). If to the aqueous solution of the salt (1 in 20) just sufficient sodium hydroxide T.S. be added to redissolve the precipitate formed, and if to this solution an equal volume of freshly prepared hydrogen

[1] For still another method of preparing tartar emetic, which we omit from want of space, see *J. P. C.*, 4e sér., xl. 404.

sulphide T.S. be added, no coloration should be noticeable after standing in a warm place for half an hour when viewed by reflected light while held against a white surface (absence of *heavy metals*). On adding sodium carbonate T.S. to crushed crystals of the salt, effervescence should not occur (absence of *potassium bitartrate*). Two Gm. of Antimony and Potassium Tartrate, when dissolved in 5 Cc. of hydrochloric acid, should not respond to Bettendorf's Test for *arsenic* (see PART III, Test No. 16). If 1 Gm. of Antimony and Potassium Tartrate be dissolved in sufficient water to measure 100 Cc., then 33 Cc. (32.99 Cc.) of this solution should, after the addition of 20 Cc. of a cold saturated aqueous solution of sodium bicarbonate and a little starch T.S., require not less than 19.9 Cc. of tenth-normal iodine V.S. to produce a permanent blue color (each Cc. corresponding to 5 percent. of the pure salt). Titration should begin immediately after the addition of the sodium bicarbonate solution." *U. S.* "Each gramme dissolved in *water* with 2 or 3 grammes of *sodium bicarbonate* should discharge the color of not less than 60.2 nor more than 60.7 cubic centimetres of the *volumetric solution of iodine* quickly introduced from a burette. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, calcium, sodium, ammonium, chlorides, or sulphates. It should not effervesce with *solution of sodium bicarbonate* (absence of acid potassium tartrate). 1.66 grammes should dissolve slowly but without residue in 25 cubic centimetres of *water* at 60° F. (15.5° C.)." *Br.* Tartar emetic, when pure, exhibits its appropriate crystalline form. A crystal or two, dropped into a solution of hydrogen sulphide, will be covered with an orange-colored deposit of antimony trisulphide. Entire solubilty in water is not a character belonging exclusively to the pure salt, for, according to Hennell, tartar emetic may contain 10 per cent. of uncombined cream of tartar and yet be wholly soluble in the proper proportion of water. Hennell's method of detecting uncombined bitartrate is to add a few drops of a solution of sodium carbonate to a boiling solution of the antimonial salt. If the precipitate formed be not redissolved, no bitartrate is present.

The impurities found in tartar emetic are uncombined cream of tartar from faulty preparation or fraudulent admixture, calcium tartrate, iron, sulphates, and chlorides. The mode of detecting cream of tartar has been indicated above. Calcium tartrate is derived from the cream of tartar, which often contains this impurity. It is apt to form on the surface of the crystals of tartar emetic in crystalline tufts, which are easily brushed off. Iron is sometimes present, especially when the antimonial salt has been prepared from glass of antimony. It is detected by a blue color being *immediately* produced by potassium ferrocyanide, added after a little acetic acid. If the blue color be *slowly* produced, it may arise from reactions on the iron of the ferrocyanide itself. If much iron be present the solution of the tartar emetic will be yellow instead of colorless. According to Sérullas, tartar emetic, except when well crystallized, and all the other antimonial preparations usually contain a minute proportion of arsenic, derived from the native antimony trisulphide, which almost always contains this dangerous metal. Subsequently, however, Thos. Williams (*P. J.*, July, 1874, p. 63) examined a number of samples of various antimonial preparations and found them remarkably free from arsenic. Tartar emetic should always be bought by the apothecary in good crystals, in which state the salt is pure, or very nearly so, and entirely free from arsenic. Its powder is perfectly white; but when it is yellowish white, iron is probably present. A. H. Jackson found some samples of commercial tartar emetic to contain from 40 to 70 per cent. of potassium sulphate. (*Year-Book of Pharmacy*, 1885, p. 459.) Tartar emetic loses water of crystallization on exposure to dry air and is sometimes two per cent. stronger than the official product on this account.

It has been already stated in general terms that tartar emetic in solution is incompatible with acids and alkalies, and with some of the earths; but this salt is so important that some details in regard to the effects of particular reagents, included under these titles, seem to be necessary. Hydrochloric and sulphuric acids, added to a solution of the antimonial salt, not too dilute, throw down a white precipitate of antimony trichloride or subsulphate, mixed with cream of tartar, which is redissolved by an excess of the precipitant. Nitric acid throws down a subnitrate, which is taken up by an excess of acid. When solution of potassium hydroxide is added to a concentrated solution, it produces at first no effect, and then a precipitate of trioxide, which is redissolved on the continued addition of the alkali. Lime water acts in a weaker solution, and throws down a white precipitate, consisting of the mixed calcium and antimony tartrates. Potassium carbonate affects still weaker solutions, throwing down a white precipitate of trioxide; but this test does not act in solutions containing less than a quarter of a grain to the fluidounce. Ammonia, both pure and carbonated, precipitates a solution of tartar emetic, throwing down the pure trioxide. To these reagents may be added infusion of galls, which, when fresh and strong, causes a dirty-yellowish-white precipitate of antimony tannate.

Uses.—When tartar emetic is given in minute doses (gr. $\frac{1}{12}$, or 0.005 Gm.) to a healthy man it produces only a slight lessening of the force of the pulse and a tendency to increased secretion from the skin. After somewhat larger amounts these symptoms are more pronounced, and have nausea added to them. If a grain be ingested, the nausea and vomiting will be severe and persistent, and accompanied by marked prostration, both of the circulation and of the

muscular strength. In the lower animals antimony causes symptoms similar to those which it produces in man. It has been experimentally proved that the fall of the arterial pressure is produced, at least in part, by a direct action upon the heart. The loss of muscular power, of reflex activity, and of sensibility is believed to be due to depression of the spinal centres, and the disturbance of respiration to a direct influence upon the nerve-centres which preside over that function. The purging and vomiting are connected with an effort at elimination, the poison escaping through the gastro-intestinal mucous membrane, as well as through the kidneys. After death from antimony, fatty degeneration of the liver, kidneys, and other organs has been found, indicating that the poison has a powerful influence upon nutrition. It is evident that in small doses tartar emetic is powerfully depressant to the circulation and stimulant to the secretion of the skin. At one time tartar emetic was very largely used in medicine; at present it is employed almost solely as a diaphoretic and expectorant, having been supplanted by other less dangerous remedies as a circulatory depressant. In the first stage of a *bronchitis* in a sthenic subject, it is often of great service. Its emetic action is very certain, powerful, prolonged, and accompanied with much depression. It is very badly borne by children. Tartar emetic is occasionally used as a counter-irritant in the form of an ointment or plaster, whose application produces sooner or later a burning sensation accompanied by a very painful pustular eruption with ulcerations.

Poisoning.—Symptoms of acute poisoning by the drug are an austere metallic taste, excessive nausea, copious vomiting, frequent hiccough, burning pain in the stomach, colic, frequent stools and tenesmus, fainting, small, contracted, and accelerated pulse, coldness of the skin, and even of the internal organs, difficult and irregular respiration, cutaneous anæsthesia, convulsive movements, very painful cramps in the legs, prostration, and death. Ten grains (0.65 Gm.) is the smallest dose reported to have proved fatal. In rare cases vomiting and purging do not take place, and when they are absent, the other symptoms are aggravated. Sometimes a pustular eruption is produced, like that caused by the external application of the antimonial.

When given in repeated small doses, tartar emetic produces both in man and in the lower animals a chronic poisoning, in which the chief symptoms are nausea, vomiting, watery purging, often followed by constipation, failing circulation, and a general asthenia, deepening into death from exhaustion. After death from antimonial preparations, decided evidences of gastro-intestinal irritation are apt to be present, but they have been in some cases wanting. The blood is often markedly fluid. Intense venous congestion, especially of the lungs, is usually present, and in some cases pulmonary apoplexy, atelectasis, or other structural lesion of the lungs has been found. A wide-spread fatty degeneration has been noted as constant in chronic poisoning in animals, and probably occurs also in man.

The treatment of tartar emetic poisoning consists, first, in washing out the stomach with a solution of tannic acid; second, in meeting the symptoms as they arise, especially by the use of opiates, which should be administered hypodermically and by rectal suppositories; external warmth, stimulants, etc., should be used *pro re nata*. In all cases of suspected poisoning, the vomit, the passages from the bowels, and especially the urine, should be saved. The metal has been found in all the tissues of the body, but in the experiments of B. W. Richardson it was most abundant in the liver.

In examining the contents of the stomach or intestines for tartar emetic, they should be digested in water acidulated with hydrochloric and tartaric acids. The former acid will serve to coagulate organic matter, the latter to give complete solubility to the antimony. The solution obtained, after having been filtered, should be subjected to a stream of hydrogen sulphide, which, if tartar emetic be present, will throw down the orange-red antimony tersulphide, distinguished from arsenic tersulphide and all other precipitates by forming with hot hydrochloric acid a solution, from which (after boiling to expel traces of hydrogen sulphide) a white curdy precipitate of antimony oxychloride (powder of Algaroth) is thrown down upon the addition of water. Hydrogen sulphide is by far the most delicate test for tartar emetic.

The mode of extracting the antimony from the solid tissues, recommended by Orfila, is to carbonize the dried viscera with pure concentrated nitric acid in a porcelain capsule, to boil the charred mass obtained for half an hour with hydrochloric acid, assisted with a little nitric acid, to filter the liquor, and introduce it into Marsh's apparatus. Hydrogen antimonide will be formed, which, being inflamed, will deposit the antimony on a cold surface of porcelain as a black stain, distinguishable from the similar stain produced by arsenic by its slighter volatility, by its forming with hot hydrochloric acid a solution which affords a white precipitate of antimony oxychloride when added to water, by its insolubility in solution of bleaching powder or chlorinated soda, and by its solubility in solution of stannous chloride. (See *Arseni Trioxidum.*)

Reinsch's process is a good one for separating antimony from the tissues, and was first used for that purpose by Alfred Taylor of London. The tissues are boiled in hydrochloric acid, and a bright slip of copper is immersed in the hot solution. The metallic film deposited on the copper must be proved to be antimony. This is done by Odling by first boiling the coated copper in a solution of potassium permanganate, with a little excess of potassium hydroxide, for a few minutes, whereby the anti-

mony becomes oxidized and dissolved, and then passing hydrogen sulphide through the filtered and acidulated solution. The characteristic orange-red precipitate of antimony trisulphide is produced, which may be tested for antimony as above mentioned. H. H. Watson has simplified Odling's process by dispensing with the use of the potassium permanganate. He subjects the coated copper slip, in a tube, to a boiling very dilute solution of caustic potassium hydroxide, the metal being alternately drawn out of and immersed in the solution, by the aid of a copper wire, until the whole of the coating is oxidized and dissolved. The solution is then treated as directed by Odling. (*M. T. G.*, July, 1857, p. 613.) Hydrogen antimonide (evolved either by galvanic processes or from zinc and sulphuric acid), when passed over sulphur, is decomposed, slowly in diffused daylight, very rapidly in sunlight, antimony sulphide forming, with liberation of hydrogen sulphide. The orange-red sulphide can be freed from excess of sulphur by exhaustion with carbon disulphide. (Jones, *J. C. S.*, i. 1876.)

Dose, as a diaphoretic or expectorant, one-twelfth to one-sixth of a grain (0.005 to 0.01 Gm.); as an emetic, half a grain (0.032 Gm.).

Off. Prep.—Syrupus Scillæ Compositus, *U. S.*; Vinum Antimonii, *U. S.* (*Br.*).

ANTIMONII OXIDUM. Br.

ANTIMONIOUS OXIDE [Antimony Trioxide]

(ăn-tĭ-mō'nĭ-ī ŏx'ĭ-dŭm)

$Sb_2O_3 = 286.24$

"Antimonious Oxide, Sb_4O_6, may be prepared by pouring solution of antimonious chloride into water, and decomposing the precipitated antimony oxychloride with sodium carbonate." *Br.*

Antimonious Oxide, Oxide of Antimony; Stibium Oxydatum, Oxydum Antimonicum s. Stibicum; Oxyde d'Antimoine, *Fr.*; Antimonoxyd, *G.*; Oxido de antimonio, *Sp.*

This compound is no longer official in the U. S. Pharmacopœia. The process of the U. S. P. 1870 was as follows: "Take of Sulphuret of Antimony, in very fine powder, *four troyounces;* Muriatic Acid *eighteen troyounces;* Nitric Acid *a troyounce and one hundred and twenty grains;* Water of Ammonia *a fluidounce and a half;* Water, Distilled Water, each, *a sufficient quantity.* Introduce the Sulphuret into a flask, of the capacity of two pints, and, having added the Muriatic Acid, digest, by means of a sand-bath, until effervescence ceases. Then, having removed the flask from the sand-bath, add the Nitric Acid gradually; and, when nitrous acid vapors cease to be given off, and the liquid has grown cold, add to it half a pint of Water, and filter. Pour the filtered liquid gradually into twelve pints of Water, constantly stirring, and allow the precipitate to subside. Decant the supernatant liquid, and wash the precipitate twice by decantation, using, each time, eight pints of Water. Then transfer it to a muslin filter to drain, and, after the draining is completed, wash it with Water until the washings cease to have an acid reaction. Next introduce it into a suitable vessel, and subject it to the action of the Water of Ammonia for two hours; at the end of which time transfer it to a moistened muslin filter, and wash it with Distilled Water as long as the washings produce a precipitate with nitrate of silver. Lastly, dry the precipitate upon bibulous paper with the aid of a gentle heat." *U. S.* 1870.

When antimony trisulphide is digested with hydrochloric acid, a chemical reaction takes place as follows:

$$Sb_2S_3 + 6HCl = 2SbCl_3 + 3H_2S$$

the hydrogen of the acid uniting with the sulphur of the antimonial, and escaping as hydrogen sulphide, while the chlorine and antimony combine to form antimony trichloride, which is held in solution. The effect of the nitric acid is supposed to be to render the oxide whiter, by decomposing any remaining hydrogen sulphide, and thus preventing it from contaminating the product. Though the result thus far is an aqueous solution of the trichloride, this cannot be diluted beyond a certain degree without decomposition. Hence, if largely diluted, as when poured into an excess of water, decomposition takes place, and a white powder is precipitated, formerly called *powder of Algaroth*, which is mainly an oxychloride. The decomposition of the powder, however, is not uniform, as it contains more trioxide the greater the proportion of water used in the decomposition. The pure oxychloride, SbOCl, is formed when the proportion of 4 molecules of water to 1 molecule of antimony chloride exists, but with a relatively larger proportion of water the average composition of the powder is $Sb_4O_5Cl_2$, which may be considered as made up of $(SbOCl)_2 + Sb_2O_3$. The oxychloride is first washed with abundance of water to separate adhering hydrochloric acid, and then acted upon by an alkaline solution (ammonia or sodium carbonate) to decompose the oxychloride, with the effect of adding to the amount of teroxide; after which the teroxide requires only to be washed with water in order to render it pure. The last washing separates the ammonium or sodium chloride resulting from the decomposition of the oxychloride; and the water of this washing is tested by silver nitrate, until the presence of chlorine ceases to be indicated.

Properties.—Antimony trioxide is a heavy, grayish-white powder, permanent in the air, almost insoluble in water, insoluble in alcohol and nitric acid, readily soluble in hydrochloric or tartaric acid, or in boiling solution of potassium bitartrate. Heated in close vessels it becomes yellow, fuses at a full red heat, and finally sublimes in crystalline needles. When cooled from a state of fusion, it forms a fibrous

crystalline mass, of pearl color. Heated in open vessels it suddenly becomes red hot, and, by the absorption of oxygen, changes into Sb_2O_4 (antimony antimonate), which differs from the trioxide in being insoluble in hydrochloric acid, less fusible, and not volatile. "On dropping its solution in hydrochloric acid into water, a white precipitate is produced, which is at once changed to orange by hydrogen sulphide test-solution. If 1 Gm. of the Oxide be dissolved with the aid of 5 Gm. of tartaric acid in a little water, and the solution diluted with water to the measure of 100 Cc., portions of this solution should not be affected by test-solutions of silver nitrate (absence of *chloride*), barium chloride (*sulphate*), or potassium ferrocyanide (*iron* and *other metals*). If a solution of the Oxide in hydrochloric acid be diluted with water, until it just begins to become permanently turbid, and then precipitated with hydrogen sulphide, this precipitate, when collected and thoroughly washed, should be completely soluble in ammonium sulphide test-solution (absence of *copper* and *lead*). If 1 Gm. of the Oxide be dissolved in hydrochloric acid, and to this solution 1 Cc. of stannous chloride test-solution (see List of Reagents, Bettendorf's Test for Arsenic, PART III) be added, no turbidity or coloration should ensue within one hour (limit of *arsenic*)." *U. S.* 1890. "If 0.5 gramme be dissolved in a hot solution of 1 gramme of Acid Potassium Tartrate and the solution then made alkaline with 3 grammes of *sodium bicarbonate*, the cooled liquid should discharge the color of 70 cubic centimetres of the *volumetric solution of iodine*. Antimonious Oxide should yield no characteristic reaction with the tests for lead, copper, arsenium, calcium, sodium, or potassium, only slight reactions with the tests for iron, and only the slightest reactions with the tests for chlorides or sulphates. It should dissolve entirely when boiled with an excess of Acid Potassium Tartrate." *Br.* It is frequently impure from the presence of the before-mentioned antimony antimonate, in which case it is not *entirely* soluble in hydrochloric acid. If it contain oxychloride, which it is apt to do from the imperfect action of the alkaline solutions employed in its purification, its solution in tartaric acid will be precipitated by silver nitrate. When antimony antimonate is substituted for it, the fraud may be detected by the spurious preparation being entirely insoluble in hydrochloric acid.

Uses.—This oxide, which must not be confounded with the powder of Algaroth, has the general therapeutic properties of the antimonials. Like antimonial powder, it is not uniform in its effects, and ought not to be used in practical medicine. The inequality of action is plausibly explained by the state of the stomach as to acidity, the presence of acids giving the medicine activity, and this explanation is confirmed by the experiments of Osburn of Dublin. As to the French Codex oxide, prepared by boiling the oxychloride with a solution of potassium bicarbonate, the inequality is attributed by Durand of Caen, to the presence of more or less trichloride, which is separated with difficulty. Objecting to the Codex oxide, Durand proposes to prepare the trioxide by precipitating tartar emetic with ammonia in excess. Thus obtained it contains no trichloride, and does not cause vomiting. (*J. P. C.*, 3e sér., ii. 364.) It was introduced into the British Pharmacopœia as an ingredient in *Pulvis Antimonialis*.

Dose, of antimony trioxide, three grains (0.20 Gm.) every two or three hours, but the drug should not be employed as a medicine.

Off. Prep.—Pulvis Antimonialis, *Br.*

ANTIMONIUM.

ANTIMONY

(ăn-tĭ-mō′nĭ-ŭm)

Sb = 119.3

Stibium, *Lat.*; Antimoine, *Fr.*; Antimon, Spiessglanz Metall, *G.*; Antimonia, *It.*; Antimonio, *Sp.*

Metallic antimony, sometimes called *regulus of antimony*, is not official in the British or United States Pharmacopœias; but, as it enters into the composition of a number of important pharmaceutical preparations, we have thought it proper to notice it under a distinct head.

Antimony exists in nature— 1, uncombined, 2, as an oxide; 3, as antimonous sulphide (tersulphide), and 4, as an oxysulphide. It is found principally in France and Germany, but has been discovered also in the provinces of New Brunswick and Ontario, Canada, the latter locality yielding a large portion of that consumed in the United States.

Extraction.—All the antimony of commerce is extracted from the native sulphide. The ore is first separated from its gangue by fusion. It is then reduced to powder, and placed on the floor of a reverberatory furnace, where it is subjected to a gentle heat, being constantly stirred with an iron rake. This process of roasting is known to be completed when the matter is brought to the state of a dull grayish-white powder called *antimony ash*. By this treatment the antimony is partly trioxidized, and partly converted into antimonous acid, while nearly all the sulphur is dissipated in the form of sulphurous acid gas; a portion of trisulphide, however, remains undecomposed. The matter is then mixed with charcoal impregnated with a concentrated solution of sodium carbonate, and the mixture heated in crucibles, in a melting-furnace. The charcoal reduces the antimony trioxide, while the alkali unites with the undecomposed trisulphide, and forms melted scoriæ, which cover the reduced metal and diminish its loss from volatilization. Antimony is more generally obtained by the reduction by iron of the native sulphide. The reduction of the antimony sulphide by iron takes

place at a red heat, but as iron sulphide needs a higher temperature for its fusion, and its specific gravity is not much less than that of the metallic antimony, the mass must be heated to a white heat to effect a perfect separation, and this occasions a loss of antimony. In order to avoid this, sodium sulphide is added in practice, which unites with the iron sulphide to form a more fusible and lighter slag of double sodium and iron sulphide. For 100 parts of antimony sulphide are taken 42 parts of iron, 10 parts of anhydrous sodium sulphate, and 2½ to 3½ parts of carbon.

The purest commercial antimony is not entirely free from foreign metals, chiefly iron, lead, and arsenic. Lefort purifies it for the purposes of pharmacy by gradually adding twenty-five parts of the metal, in fine powder, to fifty parts of nitric acid, by the action of which the antimony is precipitated as antimonous acid, while the foreign metals remain in solution. The precipitate is then thoroughly washed with water containing a hundredth part of nitric acid, drained completely, mixed with three or four parts of powdered sugar, and reduced to the metallic state by being heated to redness in a Hessian crucible. Antimony is imported into the United States in the form of antimony sulphide, as antimony regulus or metal, and most largely as "hard lead", or antimonial lead, obtained as a by-product in smelting lead or silver ores which contain a small percentage of antimony. Both native antimony and stibnite, or antimonous sulphide, are also brought from South Ham, Canada. The production of metallic antimony in the United States in 1902 was 3561 short tons, valued at $634,506, and in 1903, 3128 tons, valued at $548,433. The importations of ore and regulus (or metal) during the year 1903 were 2,714,617 lbs. and 4,694,309 lbs. respectively.

Properties.—The time of the discovery of antimony is not known, but Basil Valentine was the first to describe the method of obtaining it, in his work entitled "*Currus Triumphalis Antimonii,*" published towards the end of the fifteenth century. It is a brittle, brilliant metal, ordinarily of a lamellated texture, of a silver-white color when pure, but bluish white as it occurs in commerce. Its atomic weight is 119.3 (or according to some authorities, 122), symbol Sb, sp. gr. 6.7 and fusing point 425° C. (797° F.), or about a red heat. On cooling, after fusion, antimony assumes an appearance on the surface bearing some resemblance to a fern leaf. When strongly heated, it burns with the emission of white vapors, consisting of teroxide, formerly called *argentine flowers of antimony.* A small portion being fused and then thrown upon a flat surface divides into numerous globules, which burn rapidly as they move along. It forms three combinations with oxygen, *antimony trioxide* (antimonous oxide), Sb_2O_3, *antimony tetroxide,* Sb_2O_4 (by some considered to be an antimonate of the radical *antimonyl,* SbO.SbO_3), and *antimony pentoxide* (antimonic oxide), Sb_2O_5. The first of these unites with water to form antimonous acid, the salts of which are called *antimonites,* the third unites with water to form antimonic acid, the salts of which are called *antimonates.* The trioxide was noticed under the head of *Antimonii Oxidum.* The tetroxide is a white powder, yellowish when hot, and difficultly soluble in acids. It forms when either of the other two oxides is strongly heated in air. *Antimony ash,* described above, is also an impure tetroxide. *Antimonic acid* is a lemon-colored powder, which may be prepared by oxidizing the metal by digestion in nitric acid, and then driving off the excess of the acid by a heat not exceeding 315.5° C. (600° F.). When exposed to a red heat, it parts with oxygen, and is converted into the *antimony tetroxide* just described. This, though medicinally inert, frequently forms a large proportion of the preparation called antimonial powder. (See *Pulvis Antimonialis.*)

The antimonial preparations are active in proportion to their solubility in the gastric juice. According to Mialhe, those antimonials which contain the hydrated tetroxide, or are easily converted into it, are most active. Hence metallic antimony in fine powder, and tartar emetic, act with energy. The teroxide is much more active when prepared in the moist than in the dry way. According to Sérullas, all the antimonial preparations except tartar emetic and butter of antimony (or trichloride) contain a minute proportion of arsenic. Tartar emetic is an exception, because it separates entirely, in the act of crystallizing, from any minute portion of arsenic in the materials from which it is prepared, the poisonous metal being left behind in the mother water of the process.

ANTIMONIUM NIGRUM PURIFICATUM. Br.

ANTIMONIOUS SULPHIDE

(ăn-tĭ-mō′nĭ-ŭm nī′grŭm pū-rĭ-fĭ-cā′tŭm)

$Sb_2S_3 = 334.09$

"Native antimonious sulphide, Sb_2S_3, from which siliceous matter has been removed by fusion, reduced to fine powder, and, if any salt of arsenium be present, purified by digesting with half its weight of solution of ammonia for several days, washing and drying." *Br.*

Antimonii Sulphidum Purificatum, *U. S.* 1890; Purified Antimony Sulphide; Purified Black Antimony; Sulfure d'Antimoine pur, *Fr. Cod.;* Gereinigtes Schwefelantimon, *G.;* Trisolfuro di antimonio depurato, *It.*

Purified antimony sulphide was dropped at the eighth revision of the U. S. Pharmacopœia. The process of the U. S. P. 1890 is as follows:

"Antimony Sulphide, *one hundred grammes* [or 3 ounces av., 231 grains]; Ammonia Water, *fifty cubic centimeters* [or 1 fluidounce, 5½ fluidrachms]; Water, *a sufficient quantity.*

Reduce the Antimony Sulphide to a very fine powder. Separate the coarser particles by elutriation, and, when the finely-divided sulphide has been deposited, pour off the water, add the Ammonia Water, and macerate for five days in a well-closed vessel, agitating the mixture frequently. Then let the powder settle, pour off the Ammonia Water, and wash the residue by repeated affusion and decantation of Water. Finally dry the product by the aid of a gentle heat." *U. S.* 1890.

The test for arsenic is as follows. "If one grain be dissolved in hydrochloric acid, and the solution, slightly diluted, be gently warmed with a piece of bright copper foil, the copper being washed, dried, and heated in a dry, narrow test-tube, no crystalline sublimate (of arsenous anhydride) should form on the upper cool part of the tube." *Br.* (1885).

These processes are intended to furnish a black antimony sulphide better fitted for the manufacture of the official preparations of antimony and for internal administration. Copper, a common impurity in the crude sulphide, is rendered soluble by the ammonia water, while the subsequent washing and decantation effectually remove all soluble impurities. (See *Antimonii Sulphidum*, PART II.)

Properties.—"A heavy, grayish-black, lustreless powder, without odor or taste, and permanent in the air. Insoluble in water or alcohol, but soluble in hydrochloric acid with the evolution of hydrogen sulphide. At a temperature below a red heat it fuses to a dark brown liquid." *U. S.* 1890.

Tests.—"If 1 Gm. of the Sulphide be digested, and finally boiled, with 10 Cc. of hydrochloric acid, it should dissolve without leaving more than 1 per cent. of residue. This acid solution, completely deprived of hydrogen sulphide by boiling, yields, when added to water, a white precipitate, which is soluble in a solution of tartaric acid. After the separation of the precipitate by filtration, the filtrate yields an orange-red precipitate with hydrogen sulphide test-solution. If 2 Gm. of the Sulphide be mixed and cautiously ignited, in a porcelain crucible, with 8 Gm. of pure sodium nitrate, and, after cooling, the fused mass be boiled with 25 Cc. of water, there will remain a residue which should be white or nearly so, and not yellowish nor brownish (absence of *other metallic sulphides*). On boiling the filtrate separated from the last-mentioned residue with a slight excess of nitric acid, until no more nitrous vapors are evolved, then dissolving in it 0.1 Gm. of silver nitrate, filtering again if necessary, and cautiously pouring a few drops of ammonia water on top, not more than a white cloud, but no red or reddish precipitate, should appear at the line of contact of the two liquids (absence of more than about 0.1 per cent. of *arsenic*)." *U. S.* 1890. "A grayish-black crystalline powder decomposed on boiling with *hydrochloric acid*, an almost clear solution being formed and hydrogen sulphide escaping. The solution affords the reactions characteristic of antimony. It should not yield more than slight characteristic reactions with the tests for arsenium." *Br.*

Uses.—This preparation is not used in medical practice.

Off. Prep.—Antimonium Sulphuratum, *Br.*

ANTIMONIUM SULPHURATUM. Br.

SULPHURATED ANTIMONY [Kermes Mineral]

(ăn-tĭ-mō'nĭ-ŭm sŭl-phū-rā'tŭm)

"A mixture containing antimony sulphides and oxides, Sb_2S_5, Sb_2O_5, Sb_2S_3, Sb_4O_6, and sulphur." *Br.*

Antimonii Oxysulphuretum, *Lond.;* Antimonii Sulphuretum Aureum, *Ed.;* Precipitated Sulphide of Antimony; Sulphur Stibiatum Aurantiacum, Sulphur Auratum Antimonii; Golden Sulphuret of Antimony, Golden Sulphur; Soufre doré d'Antimoine, *Fr. Cod.;* Stibium Sulfuratum Aurantiacum, *P. G.;* Goldschwefel, Gefälltes Schwefeltantimon, *G.;* Kermes minerale, *It.;* Quermes mineral, Oxisulfuro de antimonio hidratado, *Sp.*

Sulphurated antimony was not introduced into the U. S. P. 8th Rev.; the U. S. Pharmacopœia of 1890 added the synonym "Kermes mineral" to this preparation, intending that it should be used when "Kermes" was ordered in prescriptions. The process was as follows:

"Purified Antimony Sulphide, *one hundred grammes* [or 3 ounces av., 231 grains]; Solution of Soda, *twelve hundred cubic centimeters* [or 40 fluidounces, 4 fluidrachms, 37 minims]; Distilled Water, Diluted Sulphuric Acid, each, *a sufficient quantity.* Mix the Purified Antimony Sulphide with the Solution of Soda and *three thousand cubic centimeters* [or about 6¼ pints] of Distilled Water, and boil the mixture over a gentle fire for two hours, with frequent stirring, and occasionally adding Distilled Water so as to preserve the same volume. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, Diluted Sulphuric Acid so long as it produces a precipitate. Wash the precipitate with hot Distilled Water until the washings are at most but very slightly clouded by barium chloride test-solution; then dry the precipitate at a temperature not exceeding 25° C. (77° F.), and rub it to a fine powder. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

"Antimonious Sulphide, 10 *ounces* (Imperial) or 200 grammes; Sublimed Sulphur, 10 *ounces* (Imp.) or 200 grammes; Caustic Soda, of commerce, 5 *ounces* (Imp.) or 100 grammes; Diluted Sulphuric Acid, Distilled Water, of each a sufficient quantity. Dissolve the caustic soda in *five pints* (Imp. meas.) or two thousand cubic centimetres of the Distilled Water; with this solution mix the Antimonious Sulphide and the Sublimed Sulphur; boil for two hours with frequent stirring, adding Distilled Water occasionally to maintain the same

volume; then, while the whole is still hot, add *nine pints* (Imp. meas.) or three thousand six hundred cubic centimetres of boiling Distilled Water; strain the product through calico; before the strained liquid cools add to it by degrees the Diluted Sulphuric Acid till the latter is in slight excess; collect the precipitate on a calico filter; wash with Distilled Water till the washings are free from sulphates; dry at a temperature not exceeding 212° F. (100° C.)." *Br.*

There are three preparations containing antimony and sulphur,—viz., the *amorphous precipitated antimony sulphide,* Sb_2S_3, which while orange-red in color corresponds to the black native sulphide; a reddish-brown mixture known as "*Kermes mineral,*" which contains both antimony sulphide and oxide, and has an average composition $2Sb_2S_3 + Sb_2O_3$;[1] and the *golden sulphide,* which is antimonic sulphide, Sb_2S_5, and is obtained by decomposing sulphantimonates like *Schlippe's salt,* $SbS_4Na_3 + 9H_2O$, by the addition of a strong mineral acid.

The first of these may be obtained by dissolving the powdered native sulphide in potassium hydroxide solution with the aid of heat, and then adding to this solution, which contains the antimony combined as potassium antimonite and sulphantimonite, sulphuric acid, when a reddish precipitate is formed which dries to a reddish-brown powder.

The second may be obtained by boiling the native sulphide or the red amorphous sulphide just described with sodium carbonate, and then allowing the compound to settle out from the hot filtered liquid as it cools.

The third may be obtained by first forming a sulphantimonate by boiling finely-powdered antimony sulphide and sodium hydroxide with sulphur (or sodium carbonate and chalk instead of the sodium hydroxide), and then adding the solution of this to diluted hydrochloric or sulphuric acid, when yellow Sb_2S_5 separates, according to the reaction:

$$2(SbS_4Na_3 + 9H_2O) + 3H_2SO_4 = 3Na_2SO_4 + Sb_2S_5 + 3H_2S + 18H_2O$$

Ten parts of Schlippe's salt yield in theory 4.17 parts of antimony pentasulphide. The U. S. 1890 sulphurated antimony belonged to the first kind above mentioned, the British (1898) to the third variety. E. G. Eberhardt recommends the more direct preparation of sulphurated antimony by treating the native sulphide with hydrochloric acid and precipitating the solution with hydrogen sulphide. The objection that arsenic might be found in the product was met by an examination which showed that traces of arsenic present were not more than when the then official process had been employed. (*A. J. P.,* 1886, p. 229.) The color of sulphurated antimony or Kermes mineral is influenced by porphyrization, with the admixture of a little sugar or gum; if hastily porphyrized, the mixture has a violet tint; if carefully and slowly, it has a russet color.

Properties of the Precipitated Antimony Sulphide. (*Sulphurated Antimony, Br.*)—"An amorphous, reddish-brown powder, becoming lighter in color on exposure to light, and having neither odor nor taste. Insoluble in water or alcohol, but soluble in hydrochloric acid with the evolution of hydrogen sulphide. When heated in a dry test-tube, it emits moisture and leaves a black residue. If 1 Gm. of Sulphurated Antimony be gently heated with 10 Cc. of hydrochrloric acid, it should dissolve, with the exception of a slight residue, which, when washed and dried, should burn on the application of a flame with the characteristic odor of sulphur, leaving not more than a scanty ash. The acid solution, completely deprived of hydrogen sulphide by boiling, yields, when added to water, a white precipitate, which, after being washed and dried, should weigh not less than 85 per cent. of the original weight of the sulphide. The liquid filtered from this precipitate yields an orange-red precipitate with hydrogen sulphide test-solution. If 1 Gm. of Sulphurated Antimony be shaken with 20 Cc. of hot water, the filtrate should be neutral to test-paper, should not be rendered more than slightly opalescent by barium chloride test-solution (limit of *sulphate*), or silver nitrate test-solution (limit of *chloride*), and should not be affected by ammonium oxalate test-solution (absence of *calcium*). When tested for arsenic, as described under Purified Antimony Sulphide, it should afford no reaction beyond the limit prescribed for the latter." *U. S.* 1890. "A dull-red powder, readily dissolved by *solution of sodium hydroxide,* also by hot *hydrochloric acid* with the evolution of hydrogen sulphide and the separation of sulphur. 3 grammes moistened and warmed with successive portions of *nitric acid* until red fumes cease to be evolved, and then dried and heated to redness, should leave a white residue weighing about 2 grammes. Sulphurated Antimony should not yield more than the slightest characteristic reactions with the tests for arsenium." *Br.* Water in which this preparation has been boiled should not yield a white precipitate with ammonium oxalate. The non-action of this test shows the absence of lime. When pure, precipitated antimony sulphide is completely soluble in a hot solution of potassium hydroxide; but, as it is found in commerce, a white substance is usually left undissolved. When boiled with a solution of cream of tartar, about 12 per cent. of trioxide is dissolved; but, according to H. Rose, this method of determining the proportion of the trioxide cannot be relied on. Exposed to heat it takes fire, and

[1] Kermes mineral of the U. S. P. 1870 differed somewhat from that of the U. S. P. 1890. The former process produced a powder of a purplish-brown color, the product of the latter was reddish-brown; both powders became lighter in color on exposure to air and light (see U. S. D., 18th ed., p. 186).

burns with a greenish-blue flame, giving off sulphurous acid, while the metal remains behind in the state of a grayish oxide.

John Moss asserted before the London Pharmaceutical Society that the British process always yields a dark reddish or reddish-brown powder, but that the Kermes mineral in English commerce is golden yellow or yellowish red, and must be prepared by some other method. He was confirmed by Redwood and Attfield, the latter explaining that the official Kermes contains antimony trisulphide, the commercial antimony pentasulphide.

Uses.—Precipitated antimony sulphide (*sulphurated antimony*) is alterative, diaphoretic, and emetic. It is, however, an uncertain medicine, and is very little used. In combination with calomel and guaiac (*Plummer's pill*), it was formerly employed in *secondary syphilis* and *cutaneous eruptions*. (See *Pilulæ Antimonii Compositæ*, U. S. P. 1890.) During its use the patient should abstain from acidulous drinks.

Golden sulphide acts like Kermes mineral, but is much weaker, and must be given in a larger dose.

Dose, as an alterative, from one to two grains (0.065 to 0.13 Gm.), given twice a day, in the form of pill; as an emetic, from five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Pilula Hydrargyri Subchloridi Composita, *Br.*

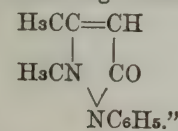
ANTIPYRINA. U. S. (Br.)

ANTIPYRINE

(ăn-tĭ-py-rī'nạ)

$C_{11}H_{12}N_2O = 186.75$

"Phenyldimethylpyrazolon [$C_3HN_2O(CH_3)_2.C_6H_5$], obtained by the condensation of phenyl-hydrazine with aceto-acetic ether, and methylation of the product." *U. S.* "Phenazone, or phenyl-dimethyl-iso-pyrazolone, is obtainable from phenyl-hydrazine by interaction with aceto-acetic ether, and the subsequent interaction of the resulting phenyl-methyl-iso-pyrazolone with methyl iodide. Its constitution is indicated by the following formula:



"*Br.*

Phenazonum, *Br.*; Phenazone; Phenyldimethylisopyrazolone, Methozine, Dehydrodimethylphenylpyrazine; Analgésine, *Fr. Cod.*; Antipyrine, Parodyne, Anodyne, *Fr.*; Pyrazolonum phenyldimethylicum, *P. G.*; Phenyldimethylpyrazolon, Antipyrin, *G.*; Antipirina, *It., Sp.*

Antipyrine was made official for the first time in the U. S. P. 8th Rev., the patent having expired; the British Pharm. (Additions 1885) introduced it under the specially coined word "Phenazone."

Preparation.—Antipyrine has been prepared by other synthetic methods, such as acting with methylphenylhydrazine upon aceto-acetic ether, thus avoiding the separate methylating step, but the original process of Knorr, mentioned in the definition, has proved to be the best.

This compound is one of the first important synthetical remedies introduced into medicine; it is now generally conceded to be a derivative of pyrrol, C_4H_5N, a base found in coal tar and in bone oil. From this base, $\begin{matrix}HC{=}CH\\|\\HC{=}CH\end{matrix}\!>\!NH$, pyrazole, $\begin{matrix}HC{=}N\\|\\HC{=}CH\end{matrix}\!>\!NH$, is derived (see PART II); from this pyrazolon, $\begin{matrix}HC{=}N\\|\\H_2C{-}CO\end{matrix}\!>\!NH$, which by molecular rearrangement yields isopyrazolon, $\begin{matrix}CH{-}NH\\\|\\CH{-}CO\end{matrix}\!>\!NH$. Phenyldimethylisopyrazolon, $\begin{matrix}(CH_3)C{-}N(CH_3)\\\|\\HC{-}CO\end{matrix}\!>\!N(C_6H_5)$, is a substitution product from this. Practically it is made by Knorr's patented process of acting upon phenyl-hydrazine, $C_6H_5{-}HN{-}NH_2$, with ethyl aceto-acetate, $(CH_3.CO)CH_2.CO.C_2H_5$, when phenyl-methyl-pyrazolon, $\begin{matrix}(CH_3)C{=}N\\|\\H_2C{-}CO\end{matrix}\!>\!N(C_6H_5)$, is formed. This is then methylated by treatment with methyl iodide, when the hydriodide of the finished base results. Another reaction's product—viz., that of a halogen butyrate upon phenyl-hydrazine and subsequent oxidation and methylation of the compound so obtained, which is also a phenyldimethylpyrazolon—is only an isomer of true antipyrine; not identical with it.

Properties.—It is officially described as "a colorless, almost odorless, crystalline powder or tabular crystals, with a slightly bitter taste. Soluble in less than 1 part of water, in 1 part of alcohol, 1 part of chloroform, and in 30 parts of ether at 25° C. (77° F.). When heated to 113° C. (235.4° F.) it melts. Upon ignition it is consumed without leaving a weighable residue. The aqueous solution has a neutral reaction upon litmus paper, but Antipyrine unites directly with acids to form salts. If to an aqueous solution of Antipyrine, tannic acid T.S. be added, an abundant white precipitate (tannate) is formed. If 0.1 Gm. of sodium nitrite and 12 Cc. of an aqueous solution of Antipyrine (1 in 100) be mixed, a nearly colorless liquid is obtained, which, upon the addition of 1 Cc. of diluted sulphuric acid, develops a deep green color (formation of *isonitroso-antipyrine*). If to 2 Cc. of a dilute aqueous solution of Antipyrine (1 in 1000) 1 drop of ferric chloride T.S. be added, a deep red color is produced, which upon the addition of 10 drops of sulphuric acid is changed to light yellow. Two

Cc. of an aqueous solution of Antipyrine (1 in 100) mixed with an equal volume of nitric acid assumes a yellowish color, passing to crimson on warming (distinction from *acetanilide* and *acetphenetidin*). On warming 0.1 Gm. of Antipyrine with sodium hydroxide T.S. and again warming after the addition of chloroform, the disagreeable odor of phenyl-isocyanide should not be developed (absence of *acetanilide*)." *U. S.* It is described in the British Pharmacopœia as "in colorless and inodorous scaly crystals with a bitter taste. Melting point about 235.4° F. (113° C.). Soluble in its own weight of *water*, in 1½ parts of *alcohol* (90 per cent.) or of *chloroform*, and in 40 parts of *ether*. 0.1 gramme of *sodium nitrite* and 12 cubic centimetres of a 1 per cent. aqueous solution of Phenazone yield a nearly colorless liquid which turns deep green on the addition of 1 cubic centimetre of *diluted sulphuric acid*. An aqueous solution of the same strength mixed with an equal volume of *nitric acid* assumes a yellow color, passing to crimson on warming. *Test solution of ferric chloride* produces in a very dilute aqueous solution a deep red color, which is nearly discharged by excess of *diluted sulphuric acid*. A 5 per cent. aqueous solution of Phenazone gives with *test-solution of mercuric chloride* a white precipitate which disappears on boiling, but reappears as the liquid cools. The aqueous solution should not affect *solution of litmus*, and should not be affected by *hydrogen sulphide*. 2 cubic centimetres of a 1 per cent. aqueous solution should be colored green by 2 drops of *fuming nitric acid*, and the color should be changed to red by boiling with an additional 3 or 4 drops of the acid." *Br.*

Uses.—Antipyrine, when given in such doses as simply to produce physiological effects, causes languor, malaise, a peculiar livid complexion, and in many cases an eruption upon the skin very closely resembling measles. In some instances an erythema or a violent urticaria or even wide-spread œdematous dermatitis is produced. When these skin symptoms are severe, the mucous membranes may share in the irritation, and a general rise of temperature, dyspnœa, hysterical unrest, and even more severe constitutional symptoms come on. The ordinary symptoms of poisoning by antipyrine are cephalic distress, giddiness, tremblings, excessive sweating, increased frequency of the pulse, often accompanied by precordial anguish, fall of temperature, arrested respiration, exaggeration of the reflexes, followed, if the dose has been large enough, by somnolence deepening into coma, and passing into profound stertorous unconsciousness, with dilatation of the pupil and epileptiform convulsions. In some cases of poisoning the chief symptoms have been those of profound progressive collapse. Various irregular symptoms have been noted, such as amaurosis, pseudo-membranous stomatitis, swelling of the lips and tongue, laryngeal interference with the respiration. When antipyrine is given in fever it acts as a very powerful and certain antipyretic, the fall of temperature usually appearing in half an hour after the dose, and being very marked and continuing for some hours. It is usually, but not always, accompanied by a profuse sweat, which is not, however, the cause of the fall of temperature, as the latter may occur without the sweat, and is not prevented by hypodermic injections of atropine which check the perspiration. With the fall of temperature there is usually a decrease in the rate but not in the force of the pulse. Physiological doses of antipyrine have very little influence upon the circulation, and a reduction of temperature in fevered animals of four or five degress with complete steadiness of the arterial pressure may be often observed. That the fall of temperature is not due to an action upon the circulation is further shown by the calorimetrical experiments of Wood, Reichert, and Hare, which clearly demonstrate that there is an absolute decrease in the production of animal heat caused by the action of the drug upon the nervous system.

The work of physiologists has proved that antipyrine has a peculiar influence upon the cerebral cortex: that when in toxic dose it probably acts as a primary stimulant and a secondary depressant to the spinal cord; that it paralyzes both the motor and the sensory nerve-trunks, and has some distinct but feeble influence upon the muscles themselves; that in very large doses it increases the arterial pressure, although toxic doses decrease the pressure, probably in part by an action upon the vessels and in part by an action upon the heart; that upon the respiration antipyrine has no distinct influence, unless in toxic dose, when it seems to act as a primary stimulant and secondary depressant to the respiratory centres.

The absorption and elimination of antipyrine are rapid; it has been detected in the urine in less than half an hour after its ingestion. The chief channel of escape is the kidneys, but it has been detected in the milk of nursing women. It appears in health and in fever to diminish the elimination of urinary solids, and the whole output from the body of the nitrogenous products of tissue-waste. A peculiar livid discoloration of the surface of the body is one of the most characteristic symptoms of antipyrine poisoning, and is probably due to the formation in the blood of methæmoglobin or of some similar compound.

Antipyrine has been used in practical medicine to meet various indications. First, for the relief of pain. As an analgesic it is of no value when the pain is dependent upon a local inflammation, but it is often remarkably efficient in *migraine*, in the fulgurant pains or the pain-crises of *locomotor ataxia*, and in other paroxysms of suffering dependent upon disease of the nerve-centres or having the character of nerve-storms; it is also useful in the pains of *rheumatism* and of *neuritis*. Second, for the quieting of nervous irritation, as in nervous *urticaria*, *nocturnal emissions*, and

hysterical unrest. Third, for the purpose of combating excitability of the motor nerve-centres, as in *laryngismus stridulus, chorea, whooping cough, tetanus, epilepsy.* In the latter disease it usually fails, but sometimes acts with extraordinary power. The combination of it with ammonium bromide is much more efficacious in epilepsy than are the bromides by themselves. Fourth, to affect secretion, as in infantile *diarrhœa,* in *diabetes,* true and insipid, and as an antigalactagogue when it is desired to arrest secretion of milk. Clément (*Lyon Méd.,* 1891) affirms that it is remarkably effectual in bringing about the absorption of pleuritic effusions. Fifth, as an antipyretic. For this purpose it has been employed in all diseases with high temperature, and, as it has little influence upon the circulation, may be used in asthenic fevers. Usually the fall of temperature which it produces is accompanied by marked increase in the comfort of the patient, but occasionally severe collapse occurs.

Locally, antipyrine is sometimes used for benumbing sensitiveness of the mucous membrane of the throat and nose, but its anæsthetic powers are not comparable with those of cocaine. It has also been employed as a hæmostatic, especially in *nasal hemorrhage.* For either of the above purposes a 15 to 50 per cent. solution may be employed.

Antipyrine has in a number of cases produced serious poisoning, and sometimes acts out of all proportion to the amount of the drug which has been exhibited. The hypodermic injections at times produce local irritation, but usually they are well borne. The full antipyretic dose for the adult should not exceed twenty grains (1.29 Gm.), repeated in half the quantity every half hour until forty grains have been taken or a fall of temperature or sweating occurs. The analgesic dose is from ten to fifteen grains (0.65 to 1.0 Gm.); in epilepsy ten grains (0.65 Gm.) a day may be continuously exhibited. Owing to the readiness with which antipyrine is decomposed, when prescribed with many other remedies in liquid form, it is preferably administered in the form of powder, pill or capsule.

Dose, five to twenty grains (0.32 to 1.3 Gm.).

APOCYNUM. U. S.

APOCYNUM [Canadian Hemp]

(ą-pŏç′y-nŭm)

"The dried rhizome of *Apocynum cannabinum* Linné, or of closely allied species of Apocynum (Fam. *Apocynaceæ*)." *U. S.*

Black Indian Hemp; Dogsbane; Chanvre du Canada, *Fr.;* Canadische Hanfwurzel, *G.*

There are two indigenous species of this genus, *A. cannabinum,* L., and *A. androsæmifolium,* L., of very similar general aspect. Both plants abound in a milky juice, and have a tough fibrous bark, which, by maceration, affords a substitute for hemp; hence the common name.

In the official species the stems and branches are upright or ascending, terminated by erect and close, many-flowered cymes, which are usually shorter than the leaves, and the corolla has nearly erect lobes, with the tube not longer than the lanceolate divisions of the calyx. In *A. androsæmifolium* the branches are divergently forked, the cymes loose and spreading, the open bell-shaped corolla with revolute lobes and a tube much longer than the ovate-pointed divisions of the calyx. The two plants grow together, although *A. cannabinum* seems to be proportionately more common in the West. *A. androsæmifolium* was formerly included in the U. S. secondary list, but is asserted to be inert. It is sometimes sold as true Apocynum, but its herbal parts are easily distinguished by their botanical characters; further, according to E. A. Manheimer, its root can be distinguished by the thick-walled bast-cells, which are arranged somewhat in a circle near the middle of the bark. (*A. J. P.,* Nov. 1881. See also *A. J. P.,* 1888.)

The root of *A. cannabinum* is five or six feet in length, about one-third of an inch thick, dividing near the end into branches which terminate abruptly, of a yellowish-brown color when young, but dark chestnut when old, of a strong odor, and a nauseous, somewhat acrid, permanently bitter taste. The internal ligneous portion is yellowish white and less bitter than the exterior or cortical part. "Of varying lengths, 3 to 8 Mm. thick, cylindrical or with a few angles produced by drying, lightly wrinkled longitudinally, and usually more or less fissured transversely; orange-brown, becoming gray-brown on keeping; brittle; fracture sharply transverse, exhibiting a thin brown layer of cork, the remainder of the bark nearly as thick as the radius of the wood, white or sometimes pinkish, starchy, containing lacticiferous ducts; the wood yellowish, having several rings, finely radiate and very coarsely porous; almost inodorous, the taste starchy, afterwards becoming bitter and somewhat acrid." *U. S.* The fresh root, when wounded, emits a milky juice, which concretes into a substance resembling caoutchouc. In the dried state, it is brittle and readily pulverized, affording a powder like that of ipecacuanha.

Schmiedeberg (*Pflanzenstoffe,* 2d ed., p. 1332) found two principles both of which acted like digitalin: one, an amorphous resinous substance, not a glucoside, easily soluble in alcohol and ether, almost insoluble in water, which he called *apocynin,* and the other, a glucoside, easily soluble in water, which he named *apocyneïn.* Neither of the principles gives any color reaction with sulphuric acid and bromine. Merck & Co. offer for sale a crystalline principle, *apocynin,* which H. C. Wood, Jr., has shown to be almost inert, and not the active principle of apocynum. The fluid-

extract of apocynum yielded to H. C. Wood, Jr., a crystalline substance which he believes to be identical with Merck's apocynin, and an amorphous extremely active substance which he believed to be an impure glucoside. (*J. A. M. A.*, Dec. 24, 1904.) The root yields its virtues to water and alcohol, but, according to Griscom, more readily to the former. J. U. Lloyd noticed a white, tasteless, crystalline, waxy precipitate formed in a fluidextract of *A. cannabinum.* Von Oefele (*Journ. Pharm. Elsass-Lothr.*, 1891, 325) describes *apocynteine,* an alkaloid obtained from *A. venetum;* it is said to be a cardiac sedative.

Uses.—There is much clinical testimony to show that apocynum is a valuable cardiac stimulant and diuretic, useful especially in cases of *cardiac dropsy,* and also, it is stated, in *chronic Bright's Disease.* (See *T. G.*, 1898, 1899.) In very large doses it causes violent vomiting and sometimes purging, though we know of no serious cases of poisoning by it on record.

The physiological testimony in regard to its action is insufficient and discordant. According to D. A. Sokoloff, the administration of apocynum has the effect of producing a primary rise of the arterial pressure which is due to a stimulation of the heart, and the vasomotor centres, followed, if the dose has been sufficient, by fall of pressure caused by depression of the same parts. In the experiments of J. Rose Bradford, apocynum was found to lessen the frequency and increase the force of the cardiac beat, arresting in the frog the heart in systole and in mammals sometimes in diastole and sometimes in systole; but not producing increase in the blood pressure or acting upon the vasomotor centres. Petteruti and Somma state that the decoction of apocynum acts chiefly as an emeto-cathartic, increasing the rate of the heart beat. In their experiments the tincture was found to be free from gastro-intestinal irritant effects. The difference in the action of the two preparations is explained by the supposition that apocyneïn, being soluble in boiling water and insoluble in diluted alcohol, is present in the decoction but not in the tincture.

Commercial apocynin is an impure substance obtained by the precipitation of a strong tincture with water, and is said to be highly effective in doses ranging from one-sixth to one-third of a grain. It is stated that from fifteen to thirty grains (1 to 2 Gm.) of powdered apocynum root produce copious vomiting and purging. The decoction (half an ounce in one and a half pints boiled to a pint) may be given in doses of one to two fluidounces (30 to 60 Cc.) at short intervals. The dose of the aqueous extract is set down at three to four grains (0.2 to 0.26 Gm.) three times a day. The fluidextract is perhaps the best form of preparation.

Dose, of apocynum, five to fifteen grains (0.32 to 1.0 Gm.).

Off. Prep.—Fluidextractum Apocyni, *U. S.*

APOMORPHINÆ HYDROCHLORIDUM. U. S., Br.

APOMORPHINE HYDROCHLORIDE

[Apomorphinæ Hydrochloras, Pharm. 1890, Apomorphine Hydrochlorate]

(ăp-ǫ-mör-phī′næ hȳ-drǫ-ȼhlō′rị-dŭm)

$C_{17}H_{17}NO_2.HCl = 301.34$

"The hydrochloride [$HCl.C_{17}H_{17}NO_2$] of an alkaloid prepared from morphine by the abstraction of one molecule of water. It should be kept in small, dark amber-colored vials, which have been previously rinsed with diluted hydrochloric acid and dried." *U. S.* "The hydrochloride, $C_{17}H_{17}NO_2,HCl$, of an alkaloid obtained by heating morphine hydrochloride or codeine hydrochloride in sealed tubes with hydrochloric acid." *Br.*

Hydrochlorate of Apomorphine; Chlorhydrate d'Apomorphine, *Fr. Cod.;* Apomorphinum Hydrochloricum, *P. G.;* Apomorphinhydrochlorid, *G.;* Cloridrato di apomorfina, *It.;* Cloruro de apomorfina, *Sp.*

Apomorphine was discovered by Matthiessen and C. A. Wright. It is prepared by heating morphine in a closed tube with a great excess of hydrochloric acid for two or three hours to the temperature of 140° to 150° C. The contents of the tube are then dissolved in water, an excess of sodium bicarbonate added, and the precipitate exhausted with ether or chloroform. On the addition to the solution of a very small quantity of hydrochloric acid, crystals of apomorphine hydrochloride form. The process is one of dehydration; the morphine parting with one molecule of water, the formula of apomorphine being $C_{17}H_{17}NO_2$. Apomorphine may also be made by the action of hydrochloric acid upon codeine, and it is affirmed that the best method in practice is that of E. Mayer, in which morphine is treated with a solution of zinc chloride, at 120° C. (*Ber. d. Chem. Ges.*, Berlin, 1871, iv. 121.) Codeine, $C_{18}H_{21}NO_3$, when treated with hydrochloric acid, yields first $C_{18}H_{20}ClNO_2$, and then splits off methyl chloride, CH_3Cl, and leaves apomorphine, $C_{17}H_{17}NO_2$. Pschorr (*Ber. d. Chem. Ges.*, 1902, 4377) believes that apomorphine is a derivative of phenanthrene-quinoline.

Properties.—Apomorphine Hydrochloride is officially described as in "minute grayish-white monoclinic prisms, glistening, odorless, having a slightly bitter taste, and acquiring a greenish tint upon exposure to light and air. Soluble in 39.5 parts of water, 38.2 parts of alcohol, 1864 parts of ether, and in 3800 parts of chloroform at 25° C. (77° F.); soluble in 16 parts of water at 80° C. (176° F.) and in 30 parts of alcohol at 60° C. (140° F.). The salt decomposes between 200° and 210° C. (392° and 410° F.), and melts at 263° C. (507° F.). The aqueous solution shows a neutral reaction with litmus paper. If the salt imparts at once an emerald-green color to 100 parts of water on

being shaken with it a few times in a test-tube, it should be rejected. Apomorphine Hydrochloride is not colored when treated with sulphuric acid; with nitric acid a deep purple color fading to orange is produced; with sulphuric acid containing a trace of selenous acid, a dark blue color, fading to violet, and then turning black; with sulphuric acid containing a trace of nitric acid, a blood-red color, fading to orange; with sulphuric acid containing a trace of ferric chloride, a pale blue color; with sulphuric acid containing a trace of ammonium vanadate, a violet-blue color, changing to deep greenish-blue; with sulphuric acid containing a little paraldehyde, a green color, fading to reddish-brown; with sulphuric acid containing potassium iodate, a black color, changing to brown, and finally to pale brown. If sulphuric acid be added to a crystal of Apomorphine Hydrochloride and a crystal of potassium nitrate, the latter is colored red, and on stirring with a glass rod the solution becomes green, then blue, then purple, and finally cherry-red. Acetic acid dissolves the salt without color, but on adding a trace of potassium iodate, the solution turns blood-red, changes to purple, and on adding a little ether and shaking, the latter assumes a blue color. Gold chloride T.S. produces a reddish-purple precipitate in a solution of the salt. Diluted ferric chloride T.S. colors Apomorphine Hydrochloride solution red (distinction from *morphine,* which, by the same test, is colored blue). Silver nitrate T.S. added to the aqueous solution of the salt throws down a white precipitate, insoluble in nitric acid, soon turning black by reduction to metallic silver, and instantly reduced by the addition of ammonia water. If 0.05 Gm. of the salt be shaken with a solution made by dissolving 0.05 Gm. of ferrous sulphate in 10 Cc. of water, the solution will gradually turn blue and then black; upon the addition of some alcohol the solution resumes its blue color (difference from *codeine, morphine, narceine,* and *narcotine*)." *U. S.*

"Small grayish-white, shining, acicular crystals, turning green on exposure to light and air, inodorous. Soluble in 50 parts of *water* and more soluble in *alcohol* (90 per cent.), the solutions being decomposed with production of a green color when they are boiled. Neutral or very feebly acid to *solution of litmus.* From solutions, *solution of sodium bicarbonate* throws down a precipitate which becomes green on standing and then forms a solution which is purple with *ether,* violet with *chloroform,* and bluish green with *alcohol* (90 per cent.). With dilute *test-solution of ferric chloride* it gives a deep red, and with *nitric acid,* a blood-red coloration. If the salt impart an emerald-green color to 100 parts of *water,* after shaking the mixture, it should be rejected." *Br.* The alkaloid is colored dark red by nitric acid and rose red by ferric chloride, changing to violet, and finally black, on exposure. The aqueous and alcoholic solutions are at first colorless, if heated becoming pinkish, but change rapidly to greenish, finally becoming deep emerald green in color. This change in color has been attributed to oxidation, and it has been noticed that the solution on standing loses its power; for this reason it is best not to keep the solution, but to make it as wanted. C. Bernbeck affirms that the change in the solution to a green color may be prevented by the addition of a small quantity of hydrochloric acid, the green coloration being due to ammonia. (*Ph. Ztg.,* 1885.)

According to Max Quehl and H. Koehler apomorphine is precipitated from its solutions greenish by tannic acid, lemon yellow by picric acid, bluish white, and turning to sap-green by copper sulphate on boiling, purplish by gold chloride, white, turning to blackish violet by potassium ferricyanide on boiling, blood-red by iodine in solution of potassium iodide, the precipitate disappearing on boiling, white and curdy by potassium sulphocyanate. (*A. J. P.,* 1873, p. 166.) With potassium dichromate and concentrated sulphuric acid it turns a dark red; with the potassium salt alone, a deep yellow-orange; with neutral iron chloride, an amethyst color.

Uses.—Apomorphine hydrochloride was first brought forward as a prompt and safe emetic by Gee. It has the great advantages of smallness of dose and freedom from irritating properties, so that it can be used hypodermically. When from one-fifteenth to one-tenth of a grain (0.004 to 0.006 Gm.) of it is injected under the skin of a man, free emesis usually occurs in from 5 to 20 minutes; the dose may be repeated at intervals if necessary. The effects upon the general system are usually not marked; but in some cases very alarming syncopal symptoms have been produced, and death is said to have resulted from one-sixteenth of a grain (0.004 Gm.) in a feeble adult worn out with chronic bronchitis and emphysema. (*Med. Rec.,* 1877, p. 664.) According to Harnack, young children bear the remedy very badly. Apomorphine hydrochloride is a valuable sedative expectorant, useful whenever it is desired to produce relaxation and increase of secretion. As an emetic, it has been employed in *narcotic poisoning,* to dislodge *foreign bodies from the œsophagus,* in *suffocative catarrh,* etc. In acute debauch, it is asserted that apomorphine hydrochloride is especially valuable as an emetic on account of producing a marked tendency to sleep after vomiting. Very alarming symptoms have followed the use of a solution which has undergone change, and fresh solutions only should be administered. Under no circumstances should more than one-fourth of a grain (0.016 Gm.) be given at a dose.

Dose, as an expectorant, one-twentieth to one-twelfth of a grain (0.003 to 0.005 Gm.); as an emetic, one-tenth to one-fourth of a grain (0.006 to 0.016 Gm.).

Off. Prep.—Injectio Apomorphinæ Hypodermica, *Br.*

AQUA. U. S.

WATER

(ă'quạ)

$H_2O = 17.88$

"Potable Water in its purest obtainable state." *U. S.*

Ὕδωρ, *Gr.;* Eau, *Fr.;* Wasser, *G.;* Acqua, *It.;* Agua, *Sp.*

Water has always been included in the U. S. Pharmacopœia, on account of its great importance as a medicinal and pharmaceutical agent. It was not admitted into the official lists of the British Pharmacopœias until 1839, when it was first recognized by the Edinburgh College, but it was dropped at the last revision of the British Pharmacopœia. It is more or less concerned in almost all the changes which take place in inorganic matter, and is essential to the growth and existence of living beings, whether animal or vegetable. In treating of a substance of such diversified agency, our limits will allow of a sketch only of its properties and modifications. We shall speak of it under the several heads of *pure water, common water,* and *mineral waters.*

Pure Water.—Water, in a pure state, is a transparent liquid, without color, taste, or odor. Its sp. gr. is assumed to be unity, and forms the term of comparison for that of solids and liquids. A cubic inch of it, at the temperature of 15.5° C. (60° F.), weighs very nearly 252.5 grains; when weighed in air with brass weights at 25° C. (77° F.) it weighs 251.91 grains. In the metric system the weight of 1 Cc. of distilled water taken at 4° C. (39.2° F.) is made equal to 1 gramme, the unit of weight in this system. It is compressible to a small extent, as was proved first by Canton, and afterwards, in an incontestable manner, by Perkins. Reduced in temperature to 0° C. (32° F.), it becomes a solid or ice, with the sp. gr. 0.9175 (Dufour, *C. R. A. S.,* Juin, 1860); and raised to 100° C. (212° F.), an elastic fluid called steam. In the latter state its bulk is increased nearly 1700-fold, and its sp. gr. so far lessened as to be not much more than half that of atmospheric air. At the temperature of 4° C., or 39.2° F., its density is at the maximum; and consequently, setting out from that point, it is increased in bulk by being either heated or cooled. It has the power of dissolving more or less of all gases, including the constituents of common air, which are always present in natural water in variable proportions. It uniformly exists in the atmosphere, in the form of invisible vapor.

Water consists of two atoms of hydrogen and one of oxygen; or, in volumes, of two volumes of hydrogen and one volume of oxygen condensed into two volumes of aqueous vapor or steam. On these data, it is easy to calculate the sp. gr. of steam; which will be 0.0693 (sp. gr. of hydrogen) + 0.5528 (half the sp. gr. of oxygen) = 0.6221.

Common Water.—By reason of its extensive solvent powers, water, in its natural state, must be more or less contaminated with foreign matter. Thus, it becomes variously impregnated, according to the nature of the strata through which it percolates. When the foreign substances present are in so small an amount as not materially to alter its taste and other sensible qualities, it constitutes the different varieties of *common water.*

There are almost innumerable shades of difference in common water, as obtained from different localities and sources; but all its varieties may be conveniently arranged under the two heads of soft and hard. A *soft water* is one which contains but inconsiderable impurities, and which, when used in washing, forms a lather with soap. By a *hard water* is understood a variety of water which contains calcium or magnesium salts, through which it curdles soap, and is often unfit for domestic purposes. Solution of soap is a good test liquid for ascertaining the hardness of water. In distilled water it produces no effect; in soft water, only a slight opalescence; but in hard water, a milky appearance. The milkiness is due to the formation of an insoluble compound between the fatty acids of the soap and the lime or magnesia of the foreign salt. The hardness may be classed as temporary or permanent, as in waters which contain much free carbon dioxide, the hardness is removed or diminished by boiling, which causes a loss of the gas and a deposition of the calcium and magnesium salts which produce the hardness. The hardness may be estimated by means of a volumetric soap solution which is added in small quantities to a measured quantity of the water, shaking after each addition and noting the volume of the soap solution which is required to produce a lather which will remain on the surface for five minutes.

The most usual foreign substances in common water, besides oxygen and nitrogen, and matters held in a state of mechanical suspension, are carbon dioxide, calcium sulphate, magnesium carbonate, and sodium chloride. Carbon dioxide is detected by lime water, which produces a precipitate before the water is boiled, but not afterwards, as ebullition drives off the dioxide. The presence of calcium sulphate is shown by precipitates being produced by barium nitrate, and, after ebullition, by ammonium oxalate. The former test shows the presence of sulphuric acid, and the latter, after boiling the water, indicates lime not held in solution by carbon dioxide. Calcium carbonate, when held in solution by an excess of carbon dioxide, may be detected by boiling the water, which causes it to precipitate; but even after ebullition and filtration the water will retain enough calcium carbonate to give a precipitate with lead acetate, calcium carbonate being itself to a minute extent soluble in water. Silver nitrate will produce a precipitate if any soluble chloride be present; and, ordinarily, the one present may be assumed to be common salt.

Arsenic in minute quantity has been found in water used as drink. At Whitbeck, in Cumberland, England, the inhabitants employ, both as drink and for culinary purposes, a water holding enough arsenic in solution to be quite sensible to tests, without any known injurious consequences. (*Chem. News,* 1860, p. 128.) Small amounts of iron and aluminum salts are frequently, and silica almost always, found in potable waters.

Clark has proposed to purify hard water, when the hardness arises from calcium bicarbonate, by a process which he calls *liming.* This consists in adding to the water sufficient lime water to convert the bicarbonate into the very sparingly soluble carbonate. This procedure renders the water soft, and gets rid of all the lime, except that in the minute portion of carbonate dissolved. The merit of this process consists chiefly, not in the removal of lime, but in preventing the formation of organic growths, principally confervæ, the decomposition of which renders the water offensive and unwholesome. River water containing the usual amount of calcareous matter, if allowed to stagnate in open reservoirs, in the summer, will become contaminated with myriads of microscopic plants and animals. This change is prevented, according to Clark, by his peculiar treatment, which deprives the living organisms of the nutriment derived from loosely combined carbon dioxide.

The oxygen and nitrogen present in neutral waters are not usually in the same proportion as in atmospheric air; the oxygen in atmospheric air amounts to about 20 per cent. in volume, while the usual gaseous mixture expelled from fresh water by boiling contains 32 per cent. (See table on page 163.) The important discovery has been made by Moore and Kellerman of the U. S. Department of Agriculture, that copper sulphate, if present in amounts such as 1 in 4,000,000 will be toxic to algæ, destroying them and preventing their reappearance; this statement has been confirmed by Gildersleeve (*Am. J. M. S.,* 1905, 129, p. 757), Stewart (*Am. J. M. S.,* 1905, p. 761), Kraemer (*A. J. P.,* 1906, 140), and others. They state that one part of copper sulphate in 100,000 of water will destroy typhoid and cholera germs in from three to four hours, and it appears to be established that waters not containing too large amounts of organic matter, exposed to the action of copper foil, kept in copper vessels, or treated with small amounts of copper sulphate (1 to 500,000) will destroy all typhoid bacilli and many other organisms in from 3 to 6 hours. On the other hand as shown by Doty (*N. Y. M. R.,* cxvii. p. 90), and Fowler (*Jour. Roy. Army Med. Corps,* 1905, v. 391), in the presence of even moderate quantities of organic matter the bactericidal power of copper is much reduced, while in foul waters it is almost nil. See "The Use of Copper in Destroying Typhoid Organisms and the Effects of Copper on Man," Henry Kraemer. (*A. J. P.,* 1905, p. 265.)

Common water is also divided into varieties according to its source. Thus, we have rain, snow, spring, river, well, lake, and marsh water.

Rain and *snow water* are the purest kinds of natural water. Rain water, to be obtained as pure as possible, must be collected in large vessels in the open fields, at a distance from houses, and some time after the rain has commenced falling; otherwise it will be contaminated with the dust which floats in the atmosphere, and with other impurities derived from roofs. The rain water of large cities contains nitrogenized organic matter, as shown by the odor produced by burning the residue left after the water has been evaporated. In districts near the sea coast rain water usually contains appreciable quantities of chlorides.

Rain water ordinarily contains atmospheric air, and, according to Liebig, a little nitric acid, the amount of which is increased when the rain descends during a thunder storm. Chabrier states as the result of his observations that rain water contains either nitrous or nitric acid, the one or the other predominating according to the condition of the weather, the nitrous acid being relatively in excess in mild weather, but the nitric when the rain is attended with tempestuous winds. (*J. P. C.,* Janv. 1872, p. 42.) According to an analysis, made by Martin, of rain water which fell at Marseilles during a violent storm, 1000 parts by weight contained 0.004 of chlorine and 0.003 of ammonia. Not a trace of iodine or of nitric acid was discovered. Boussingault has ascertained that the rain which falls in towns contains considerably more ammonia than that which falls in the country. Thus the rain of Paris was found by him to contain three or four parts of ammonia per million, while that collected in a mountainous region contained about four-fifths of one part only in a million. The average results of J. B. Lawes and J. H. Gilbert give one part of ammonia to the million of rain water. Snow water has a peculiar taste, which was supposed to depend on the presence of air more oxygenated than that of the atmosphere; but in point of fact it contains no air, and this accounts for its vapid taste. Rain and snow water are sufficiently pure for most chemical operations.

Spring water (*aqua fontana*) depends entirely for its quality on the strata through which it flows, being purest when it passes through silicious sand or gravel, or where the prevailing rock formation is granitic. On the contrary, where the formation is limestone, the water will, because of the carbon dioxide dissolved in it, take up calcium carbonate and become what is called a *hard water.* It almost always contains a trace of common salt, and generally other impurities, which vary according to the locality of the spring.

River water (*aqua fluvialis*) is, generally speaking, less impregnated with saline matter than spring water, because made up in considerable part of rains, while its volume bears a larger proportion to the surface of its bed.

It is, however, much more apt to have mechanically suspended in it insoluble matters, of an earthy nature, like clay and silt, which impair its transparency. It is frequently rendered more sightly by being run through porous stone, carbon, or sand filters. The coarse particles are by this filtration removed; but sewage or injurious products resulting from decomposition which are dissolved in the water are not removed, so that such clean filtered water may be a very deadly poison. Water may be purified for manufacturing purposes by what is termed the alum process,—*i.e.*, by adding 2 grains of alum to a gallon of water, and permitting the impurities to subside for 48 hours. (*Chem. News*, July 23, 1886.) River water is purified now (1906) at Philadelphia on the large scale by filtration in conjunction with sedimentation, at the lower Roxborough filter plant; the walls surrounding the preliminary filters are of concrete; ten of the filters are in operation, controlled separately so that one can be cleaned without interfering with another. The filtering material consists of several sizes of broken slag, arranged in layers according to size, the finer at the top because the unfiltered water enters from the bottom; on the surface of the slag is placed a layer of sponge clippings one foot in thickness, but compressed to about six inches and held down by lattice work; the cleaning of the sponge layer is accomplished by suitable machinery. "Raw water" is filtered at the rate of 45,000,000 gallons per acre per day of such quality that it enables the hygienic filters to deliver clean and wholesome water at the rate of 6,000,000 gallons per acre per day. The hygienic filters are constructed of beds 4 inches in depth of sharp silicious sand laid upon gravel and broken stone graded in fineness; the coarser particles are at the bottom; the water is made to enter from below so as to avoid disarranging the particles of sand, for this, through the escape of air, would occur if the water was let in from the top. (Toplis, *A. J. P.*, 1902, p. 67, 1904, p. 116).

Well water, like that from springs, is liable to contain various impurities. As a rule, the purity of the water of a well will be in proportion to its depth and the constancy with which it is used. Well water in large cities always contains a large amount of impurity, both organic and inorganic, the result of sewage contamination. R. D. Thomson found 147.6 gr., per Imperial gallon, of impurity in a well in London. (*P. J.*, 1856, p. 27.) The presence of nitrates in water is destructive to many forms of organic life. *Artesian Wells*, from their great depth, generally afford a pure water, although on analysis they frequently show a larger proportion of solid constituents on evaporation than do waters from rivers.

Lake water cannot be characterized as having any invariable qualities. The water of most of the lakes in the United States is pure and wholesome.

Marsh water is generally stagnant, and contains vegetable remains undergoing decomposition. It is unwholesome, and ought never to be used internally.

All water which is exposed to the air dissolves a quantity of oxygen, nitrogen, and carbon dioxide, in obedience to the laws of gaseous absorption. It is indeed upon this dissolved oxygen that the life of water-breathing animals depends. In every pure water the proportion between the dissolved nitrogen and oxygen is found to be constant, and it is represented by the following numbers:—oxygen 34.91, and nitrogen 65.09 per cent.; 1000 Cc. of pure water, such as rain water, when saturated dissolves 17.95 Cc. of air. If the water be rendered impure by the introduction of organic matter undergoing oxidation, the proportion between the dissolved oxygen and nitrogen becomes different, owing to the oxygen having been partly or wholly used for the oxidation of this material. This is clearly shown in the above analysis made by Miller of the dissolved gases contained in Thames water collected at various points above and below London.

	Thames water taken at					
	Kingston.	Hammersmith.	Somerset House.	Greenwich.	Woolwich.	Erith.
Total volume of gas per liter	Cc. 52.7	Cc. . . .	Cc. 62.9	Cc. 71.25	Cc. 63.05	Cc. 74.3
Carbon dioxide	30.3	. . .	45.2	55.6	48.3	57.0
Oxygen	7.4	4.1	1.5	0.25	0.25	1.8
Nitrogen	15.0	15.1	16.2	15.4	14.5	15.5
Ratio of oxygen to nitrogen	1 : 2	1 : 3.7	1 : 10.5	1 : 60	1 : 52	1 : 8.1

The above table shows that whereas pure water at Kingston contains the normal quantity of dissolved oxygen, the ratio of nitrogen to oxygen increases at a very rapid rate as the river water becomes contaminated with London sewage, but that this ratio again shows signs of a return to the normal at Erith. Moreover, carbon dioxide should not constitute more than from 8 to 10 per cent. of the dissolved gases in a pure water, but in these cases it has become 60 per cent. or over of the gases as obtained from the water for analysis.

Hence it is clear that an analysis of the gases dissolved in water may prove of much help in ascertaining whether the water is pure or

whether it has been contaminated with putrescent organic matter. Indeed, Miller concludes that whenever the proportion between dissolved oxygen and nitrogen falls to less than 1 to 2 the water is unfit for drinking purposes. (Roscoe and Schorlemmer, *Treatise on Chem.*, i. 245.)

The second class of dissolved impurities consists of inorganic salts, even rain water washing some of these out of the atmosphere. It invariably contains ammoniacal salts, sodium chloride, and particles of organic matter, living and dead. In towns the rain water also contains a larger proportion of nitrates than that falling in the country. It is, however the spring waters especially which contain the largest amount of mineral matter in solution. The salts which most commonly occur in solution in spring water are: (1) Calcium, magnesium, iron, and manganese carbonates, dissolved in an excess of carbon dioxide. (2) Calcium and magnesium sulphates. (3) Alkaline carbonates, chlorides, sulphates, nitrates, or silicates.

Spring waters which issue from considerable depths, or which originate in volcanic districts, are always hotter than the mean annual temperature of the locality where they come to the surface.

The term *Aqua,* in the United States Pharmacopœia, may be considered as designating any natural water of good quality which answers well for cooking and does not curdle soap. "A colorless, limpid liquid, without odor or taste at ordinary temperatures, and odorless when heated. Water should be perfectly neutral to litmus paper. 1000 Cc., when concentrated by evaporation to 20 Cc., should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). On evaporating 1000 Cc. of Water on a water-bath, it should not leave a residue weighing more than 0.5 Gm. (limit of *soluble salts*), and this residue, when ignited, should not carbonize, nor evolve *ammoniacal* or *acid* vapors. If 200 Cc. of Water be acidulated with hydrochloric acid, heated to boiling, and 0.5 Cc. of barium chloride T.S. be added, the liquid, when cooled and filtered, should give no further precipitate on the addition of a few drops of barium chloride T.S., even on standing (limit of *sulphates*). If 200 Cc. of water be acidulated with nitric acid, heated to boiling, and 0.5 Cc. of tenth-normal silver nitrate V.S. be added, the liquid, when cooled and filtered, should not be affected by the subsequent addition of a few drops of silver nitrate T.S. (limit of *chlorides*). If 10 Cc. of Water mixed with a few drops of diphenylamine T.S. be carefully poured upon about 3 Cc. of sulphuric acid, free from nitrous compounds, contained in a test-tube, so as to form a separate layer, no blue color should be formed at the line of contact of the two liquids (limit of *nitrates*). If to 50 Cc. of Water contained in a glass cylinder 2 Cc. each of sulphanilic acid T.S. and naphthylamine acetate T.S. are added, and the solution well mixed, no distinct pink coloration should appear within five minutes, if the cylinder be placed upon a white surface and viewed from above (limit of *nitrites*). If to 50 Cc. of Water contained in a glass cylinder 2 Cc. of alkaline mercuric potassium iodide T.S. (Nessler's Reagent) be added and thoroughly mixed, no yellow or brownish tint should be produced immediately; the cylinder should be placed upon a white surface and viewed from above (limit of *ammonia*). On heating to boiling 100 Cc. of Water, acidulated with 10 Cc. of diluted sulphuric acid, and subsequently adding 0.4 Cc. of tenth-normal potassium permanganate V.S., the pink color of the liquid should not be completely destroyed after it has been boiled for ten minutes (limit of *organic* or *other oxidizable substances*)." *U. S.*

The British Pharmacopœia no longer includes *"Aqua;"* it recognizes *"Aqua Destillata,"* and gives appropriate tests. (See page 178.)

Water should never be kept in leaden cisterns, on account of the risk of its dissolving a small portion of lead. This risk is greater in proportion to the softness and purity of the water; for it is found that the presence of a minute proportion of saline matter, as for example of calcium sulphate, protects the water from the slightest metallic impregnation. The chlorides are not protective, as they give rise to lead chloride, which is slightly soluble. The protection has been ascribed to an insoluble film on the surface of the lead, formed by the decomposition of the saline matter. Upon this principle is based a plan of protection by Schwartz of Breslau, who proposes to fill leaden pipes through which water is conducted, with a strong solution of an alkaline sulphide, which forms a perfectly insoluble coating of lead sulphide (*sulphuret*), said to be quite impermeable by the water afterwards introduced. (*Chem. News,* 1863, p. 157.) Galvanized iron (zinc coated) does not rust as readily as iron which is unprotected, because as the zinc has the greater solution tension it protects the iron, which remains unacted upon. On the other hand, tinned iron (tin plate) rusts more readily than iron alone if the iron is exposed at any point; the iron being the anode end is at once attacked. A. Wynter Blyth proposed a simple test for lead in drinking-water. A solution of cochineal is made by boiling cochineal in water, filtering, and adding a little alcohol to preserve it. A few drops of this solution are added to the water, which, if acid, must be rendered neutral by a trace of alkali; if lead be present, even in the proportion of one-tenth of a grain in a gallon of water, a mauve-blue color will develop, its depth depending upon the quantity of lead in the water. (*Am. Drug.,* 1884, p. 93, from *The Analyst.*)

A very important class of dissolved impurities is made up of organic compounds. This organic matter may be derived from a vegetable source, such as leaf-mould and the decomposition products of wood, in which case it is

practically harmless, or it may be derived from animal sources, in which case it almost always proves a serious impurity.

The careful observations of students of public health leave no doubt that a number of epidemic diseases, especially cholera and typhoid fever, are often contracted and spread by means of drinking water contaminated with germs of disease from excreta and general sewage. This impure water may be clear and may have filtered through considerable distances of soil, and yet may contain these poisonous germs. Now, nitrogen is one of the characteristic constituents of animal matter as contrasted with vegetable matter, relatively few forms of which contain it, and those are of a character not likely to be found in natural waters. Hence, if water should be impregnated with animal matter, this would be indicated by the presence of nitrogen in solution, either in the form of albumin or albuminous matter, if the animal matter in the water is still unchanged, or, if the animal matter has undergone oxidation, in the form of ammonia or nitrous or nitric acid.

There are, therefore, to be determined in the examination of a water with reference to this presence of organic nitrogenous matter, (1) the ammonia, (2) the unchanged albuminous matter, which, as it is changed into and determined as ammonia, is called "albuminoid ammonia," and (3) the nitrates and nitrites present.

The ammonia is first determined by distilling the water made alkaline with sodium carbonate as long as the distillate carries enough ammonia to be recognized by *Nessler's solution.* (See PART III.) For this purpose the distillate is collected successively in volumes of 50 Cc. and the amount of ammonia in each of these separate distillates determined. The smallest quantity of ammonia will produce a yellow color, the tint of which is to be compared with that obtained from the Nessler solution treated with a standard ammonium chloride solution.

After the free ammonia has been distilled off, a solution of sodium hydroxide and potassium permanganate is added and the distillation is continued. Another portion of ammonia now comes off, owing to the action of the permanganate on the nitrogenous organic matter. The amount of ammonia thus obtained is determined, and is tabulated as "albuminoid ammonia," because albumin is one of the bodies which is decomposed in this way. L. de Konnick found that the Nessler test in ammoniacal liquids does not produce the usual yellowish-brown precipitate, nor even a coloration, in the presence of alcohol. (*Am. Drug.*, 1893, p. 386.)

Instead of this method proposed by Wanklyn and Chapman, another process, described by Frankland and Armstrong, is often used. In this case, the water having been evaporated, the dry residue is submitted to an organic combustion analysis, which gives the "organic nitrogen" and the "organic carbon," and the ratio of these gives an indication as to the presence of albuminous matter rich in nitrogen. If the amount of albuminoid nitrogen indicated by either of these processes exceed 0.15 part for one million of water, the latter should be rejected as a drinking water. In some large towns, however, the surface well waters have shown albuminoid nitrogen to the amount of 0.3 to 0.8 part per million. Such waters are little better than sewage. The free ammonia, moreover, should not exceed 0.08 part per million, or the water must be considered as containing sewage contamination.

Nitrates may be estimated by the following process: A measured volume (15 to 25 Cc.) of the water is evaporated just to dryness in a flat-bottomed porcelain dish, 1 Cc. of phenoldisulphonic acid (made by heating 37 grammes of strong sulphuric acid with 3 grammes of pure phenol for 6 hours in a water bath) is added and thoroughly mixed with the residue by means of a glass rod. It is then diluted with about 25 Cc. of water, solution of ammonium hydroxide added in excess and the volume of the solution made up to 50 Cc. The nitrates present in the residue convert the phenoldisulphonic acid into picric acid, which, by the action of ammonium hydroxide forms ammonium picrate; this imparts to the

Examples of City Supplies.

Milligrammes per Liter.

(Parts per Million.)

City.	New York.	Brooklyn.	Boston.		Cincinnati.	Chicago.	Little Rock, Ark.	Philadelphia.	Washington, D. C.
Class of water.	Surface.	Subsoil.	Surface.		Surface.	Surface.	Surface.	Surface.	Surface.
Total solids	75.0	64.0	47.6	156.0	140.00	136.0	283.0	120.00	126.00
Chlorine	2.8	13.5	5.1	34.8	14.00	2.3	8.2	4.00	2.8
Nitrogen as nitrates	0.28	16.0	0.07	0.5	0.26	Trace.	1.1	1.00	1.0
Nitrogen as nitrites	None.	None.	0.001	0.01	. . .	None.	. . .	None.	0.001
Nitrogen as ammonium	0.009	0.001	0.008	0.38	0.003	0.005	0.012	0.01	0.00
Nitrogen by permanganate	0.26	0.07	0.16	0.23	0.09	0.075	0.13	0.10	0.12

These figures are taken from official reports and do not represent averages of large numbers of analyses, but individual analyses of samples representative of the supplies. The figures for Boston water represent the Cochituate and Mystic Rivers respectively. The Little Rock supply is in the unfiltered condition; much of the solid matter is in suspension.

solution a yellow color which is proportional in its intensity to the amount of nitrates present in the water, and by carrying out a similar test with a standard solution of potassium nitrate similarly evaporated, the amount may be accurately estimated. Nitrites may be estimated by the sulphanilic acid and naphthylamine acetate test given for the qualitative detection of nitrites by the U. S. Pharmacopœia (see page 164), by carrying out a similar test with a standard solution of sodium nitrite and making a comparison of the relative intensity of the color which is produced in each.

The determination of chlorides is also frequently of great importance, for although mineral waters may be rich in chlorides, ordinary well waters or river waters, which are the chief sources of supply, will not contain much chlorine unless they have been contaminated. Both urine and sewage may contribute this chlorine, as they are highly charged with sodium chloride. As a rule, it may be said that water containing more than two grains of chlorine per gallon must be looked upon with suspicion, unless some good reason for the presence of sodium chloride can be assigned.

The analyses (see table page 165) of the water supplied to several American cities are taken from Henry Leffman's *Manual of Water Analysis,* 4th ed. 1900.

Mineral Waters.—When natural spring waters are so far impregnated with foreign substances as to have a decided taste, and to operate in a peculiar manner upon the human economy, they are called *mineral waters.* These are conveniently arranged under the heads of *carbonated, alkaline, sulphureted, saline* (including *magnesian, chalybeate,* and *chlorinated*), and *silicious.* For a more comprehensive and detailed classification of this class of waters see *Mineral Waters of the United States,* U. S. Department of Agriculture, Bulletin No. 91.

1.—*Carbonated waters* are cold, and are characterized by containing an excess of carbon dioxide, which gives them a sparkling appearance, and the power of reddening litmus paper. These waters frequently contain calcium, magnesium, and iron carbonates, which are held in solution by the excess of carbon dioxide. The waters of Selters, Spa, Apollinaris, and Pyrmont in Europe, and of the sweet springs in Virginia, belong to this class. For Artificial Carbonic Acid Water, the reader is referred to page 168.

2.—*Alkaline waters* contain a large quantity of sodium bicarbonate, as well as common salt and Glauber's salt. These are sometimes warm, such as the springs at Ems and Vichy, but generally cold. Gettysburg spring water is of this class.

3.—*Sulphureted waters* are such as contain hydrogen sulphide, and are distinguished by the peculiar fetid odor of that gas, and by yielding a brown precipitate with the salts of lead or silver. Examples of this kind are the waters of Aix-la-Chapelle and Harrogate in Europe, and those of the White, Red, and Salt sulphur springs in Virginia.

4.—*Saline waters* are those the predominant properties of which depend upon saline impregnation. The salts most usually present are sodium, calcium, and magnesium sulphates and carbonates, in which latter case the name *magnesian* is given to them, the presence of the chlorides of these alkalies making the class *chlorinated* waters, which reach their maximum concentration in sea waters; while the presence of ferrous salts makes another class, the *chalybeate.* Among magnesium waters may be mentioned those of Friedrichshall, Hunyádi Janos, and Epsom; among chalybeate waters, those of Tunbridge and Brighton in England, of Pyrmont, Wiesbaden, and Spa on the Continent, and of Bedford, Pittsburg, and Brandywine in the United States. Potassium sulphate is occasionally present, and lithium has been detected by Berzelius in Carlsbad and other salt springs of Germany, and is also found in some American spring waters. Boric acid, usually in the form of an alkaline borate, is of frequent occurrence in mineral waters of certain portions of the United States. Cæsium and rubidium have also been detected in certain mineral waters, such as the Dürkheim and Baden-Baden waters, in the former of which these elements were first discovered by Bunsen. Bromine is found in the saline at Theodorshalle, in Germany, as also in the salt wells of Western Pennsylvania, Ohio, Michigan, and West Virginia. The mineral springs at Saratoga contain a small proportion of iodine and bromine. The principle saline waters are those of Seidlitz in Bohemia, Cheltenham and Bath in England, and Harrodsburg and Saratoga in the United States.

5.—*Silicious waters* are those in which the contents consist chiefly of alkaline silicates, such as the hot spring waters of Iceland and the geysers of Fire-hole Basin and Gardiner's River, Yellowstone National Park, U. S.

6.—*Sea water* (*English Channel*).—In a thousand grains: water 964.744 gr.; sodium chloride 27.059; potassium chloride 0.765; magnesium chloride 3.667; magnesium bromide 0.029; magnesium sulphate 2.296; calcium sulphate 1.407; calcium carbonate 0.033. Total 1000 gr. (Schweitzer.) The proportion of sodium chloride is from 36 to 37 parts in 1000 in the ocean, at a distance from land. Its amount is small in the interior of the Baltic. It is perceived that bromine is present in very minute amount, 100 pounds of sea water yielding only $3\frac{1}{3}$ gr. of this element. Iodine exists in the water of the Mediterranean, and it has been found in ocean water. Besides these ingredients, others are alleged to exist in minute proportion in sea water, as fluorine by G. Wilson; lead, copper, and silver by Malaguti, Durocher, and Sarzeau; and iron and manganese by Uziglio. Gold in very minute quantity has been found in sea water. Prior to Wilson's researches, Middleton and Silliman, Jr., had

inferred the existence of fluorine in sea water, from its presence in marine animals. The lead and copper above mentioned were found in certain fuci only, the silver in the sea water itself. The presence of silver in sea water has been demonstrated by F. Field, by a comparative analysis of the same copper sheathing, when new, and after having been on a vessel for many years. The old sheathing was always found to contain more silver than the new; and the observations of Field have been subsequently confirmed by others. Schweitzer's analysis gives a small proportion of calcium carbonate, but Bibra could not detect any. John Davy's examinations of sea water show that calcium carbonate does not exist at a great distance from land, except in very minute proportion, but becomes quite evident at a distance of from fifty to a hundred miles from coasts. Boric acid has been found by Veatch in the sea water on the coast of California. (See *A. J. P.*, 1860, p. 330.)[1]

Sea water, filtered, and charged with five times its volume of carbon dioxide, forms, according to Pasquier, a gentle purgative, which keeps very well, and is not disagreeable to take. The dose is from half a pint to a pint.

By freezing, sea water is almost entirely freed from saline matter, the ice being nearly pure water. It is obvious that the unfrozen water contains much more than its ordinary proportion of salts; and this is one of the methods of concentrating this and other saline solutions.

Medicinal Properties of Water.—Water is a remedy of great importance. When taken into the stomach, it acts by its temperature, by its bulk and by being absorbed. When of the temperature of about 15.5° C. (60° F.), it gives no positive sensation either of heat or cold; between 15.5° C. (60° F.) and 7.2° C. (45° F.), it creates a cool sensation; and below 7.2° C. (45° F.), a decidedly cold one. Between 15.5° C. (60° F.) and 37.7° C. (100° F.), it relaxes the fibres of the stomach, and is apt to produce nausea, particularly if the effect of bulk be added to that of temperature. By its bulk and solvent powers, it allays irritation of the stomach and bowels, by diluting the acrid contents and favoring their final expulsion, and by its absorption it promotes perspiration and the secretion of urine.

Water externally applied as a bath is also an important remedy. It may act by its own specific effect as a liquid, or as a means of modifying the heat of the body. It acts in the latter way differently, according to the temperature at which it may be applied. When this is above 36.1° C. (97° F.), it constitutes the vapor or hot bath; when between 36.1° C. (97° F.) and 29.4° C. (85° F.), the warm bath; between 29.4° C. (85° F.) and 18.3° C. (65° F.), the tepid bath; and between 18.3° C. (65° F.) and 0° C. (32° F.), the cold bath.

The general action of the *vapor* bath is to accelerate the circulation, and produce profuse sweating. It acts locally on the skin, by softening and relaxing its texture. In stiffness of the joints, and in various diseases of the skin, it has often proved beneficial.

The *hot bath,* like the vapor bath, is decidedly stimulant. By its use the pulse becomes full and frequent, the veins turgid, the face flushed, the skin red, and the respiration quickened. If the temperature be high, and the constitution peculiar, its use is not without danger, as it is apt to produce a feeling of suffocation, violent throbbing in the temples, and vertigo with tendency to apoplexy. When it acts favorably, it produces profuse perspiration.

The *warm bath,* though below the animal heat, nevertheless produces a sensation of warmth, as its temperature is above that of the surface. It diminishes the frequency of the pulse, renders the respiration slower, lessens the heat of the body, and relaxes the skin. It cannot therefore, be deemed a stimulant. By relieving certain diseased actions and states, accompanied by morbid irritability, it often acts as a soothing remedy, producing a disposition to sleep.

The *tepid bath* is not calculated to have much modifying influence on the heat of the body. Its peculiar effects are to soften and cleanse the skin, and to promote insensible perspiration.

The *cold bath* acts differently according to its temperature and manner of application, and the condition of the system to which it is applied. When of low temperature and suddenly applied, it acts primarily as a stimulant, by the sudden and rapid manner in which the heat is abstracted; next as a tonic, by condens-

[1] The following analysis of sea water, taken at two leagues from Fécamp, on the coast of France, merits special notice from the care with which it was made, and the large quantity operated on. The sp. gr. was 1.026, at 57° F.

Gaseous Contents.	*In one kilo. liters.*	*In one liter. liters.*
Atmospheric air	0.0120	0.0123
Free carbonic acid	traces	traces
" hydrogen sulphide	traces	traces
Solid Contents.	*gm.*	*gm.*
Potassium chloride	0.09763	0.10019
Sodium "	26.09300	26.78913
Lithium "	0.00042	0.00043
Ammonium "	0.00178	0.00183
Magnesium "	3.19300	3.27700
Sodium iodide	0.00920	0.00944
" bromide	0.10605	0.10882
Magnesium bromide	0.03084	0.03163
Calcium sulphate	0.90170	0.92540
Potassium "	0.00919	0.00943

Solid Contents.	*In one kilo. gm.*	*In one liter. gm.*
Sodium sulphate	2.57250	2.64012
Magnesium sulphate	0.32736	0.33597
" phosphate	0.00046	0.00047
(Ammonio-magnesian) phosphate	signs	signs
Calcium carbonate	0.13600	0.13959
Magnesium "	traces	traces
Iron "	0.00021	0.00021
Manganese "	signs	signs
Silicic acid	0.01420	0.01457
Organic matter	signs	signs
Pure water	966.50646	991.91577
Total	1000.00000	1026.30000

(*J. P. C.*, 4e sér., i, 381, 1865.)

ing the living fibres; and finally as a sedative. It is often useful in diseases of relaxation and debility, when practiced by affusion or plunging. But it is essential to its efficacy and safety that the stock of vitality should be sufficient to create, immediately after its use, those feelings of warmth and invigoration included under the term reaction. In *febrile diseases* with high bodily temperature the use of the cold bath is a very important therapeutic measure. For details as to method of use, see 13th edition of H. C. Wood's *Therapeutics*.

Cold water is frequently applied as a sedative in local *inflammations*, and as a means of restraining *hemorrhage*. Its use, however, is scarcely admissible in *inflammations of the chest*.

Aqua Acidi Carbonici, *Carbonic Acid Water*, or *Soda Water* (so called), (*Aqua acidula simplicior*, F. P.; *Eau gazeuse simple*, Fr.; *Kohlensaurewasser*, G.), which was formerly official in the U. S. Pharmacopœia, consists of water highly charged with carbonic acid.

Preparation.—Water is found to take up its volume of this gas under the pressure of the atmosphere; and Henry ascertained that precisely the same *volume* of the compressed gas is absorbed under a higher pressure. From this law, the bulk taken up is constant, the quantity being different in proportion as there is more or less driven into a given space. As the space occupied by a gas is inversely as the compressing force, it follows that the quantity of the acid forced into the water will be directly as the pressure. From the principles above laid down it follows that, to saturate water with five times its volume of carbon dioxide, it must be subjected to a pressure of five atmospheres. Carbonic acid gas compressed into the liquid state is now manufactured on an immense scale and supplied in 20 pound and 50 pound steel cylinders. This allows of convenient transportation, and the purity of the gas is usually excellent.

Carbonic acid water is familiarly called in this country "*mineral water*" and "*soda water*;" the latter name, originally applied to the preparation when it contained sodium carbonate, being from habit continued since the alkali has been omitted.

Carbonic acid water is dispensed in most of the pharmacies in this country. The fountain is usually placed in the cellar, and the tube proceeding from the fountain is made to pass through the floor and counter of the store, and to terminate in a draught tube, by means of which the carbonic acid water may be drawn off at pleasure. In order to have the liquid cool, the tube from the cellar generally terminates in a strong metallic vessel of convenient shape, or a series of block tin pipes called coolers, placed inside the counter apparatus, and surrounded with ice.

Properties.—Carbonic acid water is a sparkling liquid, possessing an agreeable pungent, acidulous taste. It reddens litmus deeply from its state of concentration, and is precipitated by lime water in excess. Being impregnated with a large quantity of the acid gas under the influence of pressure, it effervesces strongly when freed from restraint. Hence, to preserve its briskness, it should be kept in strong vessels or in strong well-corked bottles placed inverted in a cool place. Several natural waters are of a similar nature, such as those of Selters, Spa, Pyrmont, Apollinaris, etc., but the artificial water has the advantage of a stronger impregnation with the acid gas. Carbonic acid water should be made with every precaution to avoid metallic impurity. Hence the necessity of having the fountain well protected on the inner surface. Even with this precaution, a slight metallic impregnation is not always avoided, especially in the winter season, when the water is less consumed as a drink, and, therefore, allowed to remain longer in the tubes and stop-cocks. Iron fountains lined with a hard enamel are preferred to those of copper, but the best fountains are made of cast steel, lined with block tin. When leaden tubes are employed to convey the water, it is liable to be contaminated with this metal, which renders it deleterious. Tubes of pure tin are free from objection, and should be exclusively used.

Copper fountains, well tinned, are liable to the objections that the tin lining wears away by use, and that there is no convenient means of inspecting the interior, owing to the solder joint which permanently unites the two sections of the fountain. Sometimes drops of solder and chips of copper are carelessly left in the fountain, and form an additional source of danger. There can be no doubt that carbonic acid water is not unfrequently rendered poisonous by metallic impregnation. R. O. Doremus has proved by a chemical examination that lead and copper are sometimes present. (*A. J. P.*, 1854, p. 422; from the *Am. Med. Monthly.*) John T. Plummer of Richmond, Ind., has found lead. The latter metal is detected by hydrogen sulphide, which gives with it a black precipitate, and copper by potassium ferrocyanide, which causes a brown precipitate. In testing for copper, a few drops of the reagent should be added to a glass of the suspected water, placed on a sheet of white paper, when, if even a minute proportion of copper be present, a brownish discoloration will be seen, upon looking down through the liquid. Fortunately copper fountains have largely gone out of use, having been supplanted by those made of steel.

Uses.—Carbonic acid water is a grateful drink to *febrile patients*, allaying thirst, lessening *nausea* and *gastric distress*, and promoting the secretion of urine. The quantity taken need only be regulated by the reasonable wishes of the patient. It also forms a very convenient vehicle for the administration of magnesia, the carbonated alkalies, magnesium sulphate, and the saline cathartics generally, rendering these medicines less unpleasant to the palate, and, in irritable states of the stomach, increasing the

chances of their being retained. When used for this purpose, six or eight fluidounces (178 to 236 Cc.) will be sufficient.

AQUA AMMONIÆ. U. S. (Br.)

AMMONIA WATER

(ă'quą ąm-mō'nĭ-æ)

"An aqueous solution of Ammonia [NH_3 = 16.93] containing 10 percent., by weight, of gaseous ammonia. This solution deteriorates on keeping, and should be tested frequently. It must not be dispensed for medicinal purposes if it contains less than 10 percent., by weight, of the gas. Ammonia water should be kept in glass-stoppered bottles, in a cool place." *U. S.* "An aqueous solution containing 10 per cent. by weight of ammonia, NH_3." *Br.*

Liquor Ammoniæ, *Br.;* Solution of Ammonia; Water of Ammonia; Spiritus Salis Ammoniaci Causticus, Ammoniaque liquide officinale, *Fr. Cod.;* Eau (Solution, Liqueur) d'Ammoniaque, *Fr.;* Liquor Ammonii Caustici, *P. G.;* Salmiakgeist, Aetzammoniak, Ammoniak-Flüssigkeit, *G;* Ammoniaca, *It.;* Amoniaco, Amoniaco liquido, *Sp.*

The U. S. Pharmacopœia (8th Rev.) omits a process for preparing Ammonia Water. The U. S. P. 1870 contains an excellent process, which is as follows: "Take of Chloride of Ammonium, in small pieces, Lime, each, *twelve troyounces;* Water *six pints;* Distilled Water *a sufficient quantity.* Pour a pint of the Water upon the Lime, in a convenient vessel; and, after it has slaked, stir the mixture so as to bring it to the consistence of a smooth paste. Then add the remainder of the Water, and mix the whole thoroughly together. Decant the milky liquid from the gritty sediment into a glass retort, of the capacity of sixteen pints, and add the Chloride of Ammonium. Place the retort on a sand-bath, and adapt to it a receiver purposely connected with a two-pint bottle, by means of a glass tube, reaching nearly to the bottom of the bottle, and containing a pint of Distilled Water. Surround the bottle with ice-cold water; and apply heat, gradually increased, until ammonia ceases to come over. Remove the liquid from the bottle, and add to it sufficient Distilled Water to raise its specific gravity to 0.960. Lastly, keep the liquid in small bottles, well stopped." *U. S.* 1870.

"Strong Solution of Ammonia, 1 *pint* (Imperial measure) or 500 cubic centimetres; Distilled Water, 2 *pints* (Imp. meas.) or 1000 cubic centimetres. Mix." *Br.*

The title of this preparation was changed, at the revision of the U. S. Pharmacopœia in 1860, from Liquor Ammoniæ to Aqua Ammoniæ, that it might conform in name as well as character with the Waters, among which the official preparations consisting of aqueous solutions of gaseous bodies are included. In the revision of 1890 the English name was changed from Water of Ammonia to Ammonia Water.

In the U. S. P. 1870 process, the ammonium chloride is decomposed by the superior affinity of the lime for its acid, ammonia is disengaged, and the lime, combining with the acid, forms calcium chloride and water,

$$2NH_4Cl + Ca(OH)_2 = CaCl_2 + 2H_2O + 2NH_3$$

This differs from the 1850 process in introducing the materials into the retort with a large quantity of water, instead of in the dry state. In both cases the gas is driven over by heat, but in the moist plan it is accompanied with more aqueous vapor than in the dry. If the object were to obtain ammonia water in the highest concentrated state, there might be some advantage in the dry method; but, as a weak solution is contemplated, the wet method is equally efficient, while in all respects it is more convenient, and productive of better results, for, according to E. R. Squibb, the ammonia water made by the older official process has invariably an empyreumatic odor, from which that made by the present process is free. (*Proc. A. Ph. A.,* 1858, p. 407.) The receiver is intended to retain any water holding in solution undecomposed chloride, or the oily matter sometimes contained in the salt, as well as other impurities, which may be driven over by the heat while the pure gas passes forward into the bottle containing the distilled water, which should not fill it, on account of the increase in the bulk of the water during the absorption of the gas. The tube should extend to near the bottom of the bottle, and pass through a cork loosely fitting its mouth. To prevent the regurgitation of the water from the bottle into the intermediate vessel, the latter should be furnished with a Welter's safety tube.

In preparing solution of ammonia, equal weights of ammonium chloride and lime are used for generating the gaseous ammonia. This proportion gives a great excess of lime, compared with the quantity required if determined by the molecular weights; but in practice it is found advantageous to have an excess, in order to insure the full decomposition of the ammonium chloride, as well as to make up for accidental impurities in the lime.

The British Pharmacopœia gives directions for diluting *Liquor Ammoniæ Fortior* so as to reduce it to the strength of *Liquor Ammoniæ.* This is effected by mixing one measure of their stronger preparation with two measures of distilled water. The ammonia water of commerce is known as "Aqua Ammoniæ F. F. F.," or "20° ammonia;" it may be diluted by adding 2 volumes of water to 4 volumes of 20° ammonia water to make official ammonia water. Ammonia water of other strengths may be diluted by consulting the table given on page 171, and applying the rules given in Remington's *Practice of Pharmacy,* 4th ed., p. 98.

Properties.—Ammonia water is "a colorless, transparent liquid, having a very pungent, characteristic odor, a caustic alkaline taste, and a strongly alkaline reaction upon red litmus paper. Specific gravity: 0.958 at 25° C. (77° F.). It is completely volatilized at 100° C. (212° F.). On bringing a glass rod dipped

into hydrochloric acid near cold Ammonia Water, dense white fumes are produced. On slightly supersaturating 10 Cc. of Ammonia Water with diluted sulphuric acid, no *empyreumatic odor* or *red color* should be developed, and if to this liquid 0.1 Cc. of tenth-normal potassium permanganate V.S. be added, the pink color should not be completely destroyed within ten minutes (absence of *readily oxidizable substances*). If Ammonia Water be mixed with 4 times its volume of calcium hydroxide T.S., it should not afford an immediate turbidity (absence of more than minute traces of *carbonic acid*). When neutralized and made slightly acid with hydrochloric acid, Ammonia Water should not respond to the Time-Limit Test for *heavy metals* (see Part III, Test No. 121). If Ammonia Water be slightly supersaturated with nitric acid, it should not be affected by barium chloride T.S. (absence of *sulphates*), nor by silver nitrate T.S. (*chlorides*); and if a third portion of the acidulated liquid be evaporated on a water-bath to dryness, it should afford a colorless residue which on ignition should be completely volatilized (absence of *coal-tar bases* and of *fixed impurities*). Introduce into a stoppered weighing-bottle 3 Cc. of Ammonia Water and weigh accurately. Dilute with 50 Cc. of distilled water and titrate with normal sulphuric acid V.S., using litmus or methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal sulphuric acid V.S. consumed, by 1.693, and divide this product by the weight of the Ammonia Water taken; the quotient represents the percentage of ammonia gas." *U. S.* Of the British preparation, "each gramme should require for neutralization 5.9 cubic centimetres of the *volumetric solution of sulphuric acid.* It should respond, qualitatively, to the characters and tests described under 'Liquor Ammoniæ Fortis.' Specific gravity 0.959." *Br.*

Ammonia Water is incompatible with acids, and with acidulous and many earthy and metallic salts; but it does not decompose the salts of lime, barium, or strontium, and only partially decomposes those of magnesium. Commercial solution of ammonia sometimes contains *pyrrol, naphthalene, aniline,* and *pyridine.* These may be detected by the solution being reddened by nitric acid, and, after having been supersaturated with hydrochloric acid, by its tingeing a slip of fir wood of a rich purple color, characteristic of pyrrol. (Maclagan.) The source of these impurities is coal gas liquor, from which the ammonia compounds are largely obtained. Donath (*Dingler's Polytechnisches Journal,* vol. iv. p. 229) tested some ammonia prepared from gas liquor, by neutralizing with diluted sulphuric acid, when the liquid assumed a rose color, and a solution of the sulphate emitted the characteristic odor of naphthalene.

Composition.—Water is capable of absorbing 670 times its volume of ammonia gas at 10° C. (50° F.), and increases in bulk about two-thirds. But the official solution of ammonia is by no means a saturated one. Thus, the ammonia contained in the U. S. preparation is about 10 per cent. The official table on page 171 gives the percentage of ammonia gas in aqueous solutions of different densities at the temperature of 25° C. (77° F.) and 15°C. (59° F.).

Uses.—When brought into contact with living tissue, ammonia acts as a stimulant, irritant, or caustic, according to the strength of its solution. When applied to the skin, it may excite simply burning pain and redness, but in the form even of the present preparation, if the contact be sufficiently maintained, it is capable of destroying the whole dermal tissue; taken internally in a concentrated form, it acts as a violent corrosive poison, and may cause rapidly fatal gastro-enteritis, with the destruction of the visceral coats. In some cases it has produced death in a few minutes by entering the larynx and causing œdema, with consequent suffocation. When taken internally in therapeutic doses its action is immediate, and continues but for a few moments. In the stomach it acts as a stimulant antacid, and is often useful in *heartburn, sick headache,* etc. After absorption it stimulates most powerfully the circulation and respiration, affecting especially the heart and respiratory centres. By full doses the respiratory rate and the arterial pressure are for a few moments enormously increased. Toxic doses are directly paralyzing to the heart muscle, and may cause, if injected into a vein, immediate diastolic arrest of the heart. According to Bence Jones, ammonia is oxidized in the system, with the formation of nitric acid, which is eliminated by the kidneys.

Ammonia water is a valuable remedy in all forms of sudden *syncope.* The injection of ammonia into a vein was brought forward by G. B. Halford of Melbourne, as a specific against the *poison of serpents,* and some evidence has been adduced as to its value. As long ago, however, as 1782, Fontana published at Florence a series of experiments showing the uselessness of such injections as a remedy for *snake-bite,* and the subject has been investigated in India by Sir Joseph Fayrer (*Ind. Ann. Med. Sci.,* 1872), and by a Royal Commission (*L. L.,* Sept. 1874), with the result of completely establishing the truth of the experiments and conclusions of Fontana. In *collapse* following severe accident, or in sudden *cardiac failure* from other acute cause, the intravenous injection of ammonia water has been of the greatest service in arousing the action of the heart. Half a drachm to a drachm diluted with half an ounce to an ounce of water may be slowly thrown directly into a vein. In some cases the drug has been simply used hypodermically, but is almost certain to cause severe local symptoms. On account of its cheapness, ammonia water is much used as an ingredient in stimulating liniments, especially combined with olive or other oil.

Dose, ten to thirty minims (0.6 to 1.8 Cc.), largely diluted.

Table of Percentage and Specific Gravity of Ammonia. U. S. P. (8th Rev.).

Per cent. of Ammonia NH_3.	Specific Gravity. 25° C. / 25° C.	Specific Gravity. 15° C. / 15° C.	Correction of specific gravity for 1° C.[1]	Fractional per cent.[2]	Normality. 1 Cc. requires normal H_2SO_4 Cc.	Per cent. = 0.01 Cc. normal H_2SO_4.
1	0.9955	0.9956	0.00019	0.023	0.58	0.017
2	0.9911	0.9913	0.00020	0.024	1.16	0.017
3	0.9869	0.9872	0.00021	0.024	1.74	0.018
4	0.9827	0.9832	0.00022	0.024	2.31	0.018
5	0.9786	0.9792	0.00023	0.024	2.88	0.018
6	0.9745	0.9752	0.00024	0.024	3.44	0.018
7	0.9704	0.9712	0.00025	0.024	4.00	0.018
8	0.9663	0.9673	0.00027	0.025	4.55	0.018
9	0.9623	0.9634	0.00028	0.026	5.10	0.018
10	**0.9585**	**0.9597**	**0.00029**	**0.026**	**5.65**	**0.019**
11	0.9547	0.9561	0.00031	0.027	6.19	0.019
12	0.9510	0.9526	0.00033	0.027	6.72	0.019
13	0.9473	0.9491	0.00034	0.027	7.25	0.019
14	0.9436	0.9456	0.00036	0.028	7.78	0.019
15	0.9400	0.9422	0.00038	0.028	8.31	0.019
16	0.9364	0.9387	0.00039	0.029	8.83	0.020
17	0.9329	0.9354	0.00040	0.029	9.34	0.019
18	0.9295	0.9321	0.00042	0.029	9.86	0.020
19	0.9261	0.9288	0.00043	0.030	10.37	0.020
20	0.9228	0.9256	0.00044	0.029	10.87	0.020
21	0.9194	0.9224	0.00046	0.030	11.37	0.020
22	0.9161	0.9192	0.00047	0.030	11.87	0.020
23	0.9128	0.9161	0.00049	0.031	12.37	0.020
24	0.9096	0.9131	0.00050	0.031	12.86	0.020
25	0.9064	0.9100	0.00052	0.031	13.35	0.020
26	0.9032	0.9070	0.00053	0.031	13.83	0.021
27	0.9000	0.9039	0.00055	0.032	14.31	0.021
28	**0.8969**	**0.9010**	**0.00056**	**0.032**	**14.79**	**0.021**
29	0.8938	0.8980	0.00058	0.032	15.27	0.021
30	0.8907	0.8951	0.00060	0.032	15.74	0.021
31	0.8876	0.8921	0.00061	0.034	16.21	0.021
32	0.8847	0.8893	0.00062	0.036	16.68	0.021
33	0.8819	0.8867	0.00063	0.038	17.15	0.022
34	0.8793	0.8842	0.00064	0.042	17.61	0.021
35	0.8769	0.8819	0.00065	.....	18.08	....

[1] Add if the temperature is below, subtract if above, 25° C.

[2] Corresponding with a difference in specific gravity of 0.0001.

NOTE.—To find the per cent. of NH_4, multiply the per cent. of NH_3 by 1.0591.

To find the weight in grammes of NH_3 in 100 Cc., multiply the specific gravity by the per cent. of NH_3.

To find the volume per cent. of official Ammonia Water, multiply the "normality" by 17.699. For the volume per cent. of official Stronger Ammonia Water, multiply the "normality" by 6.761.

Off. Prep.—Bismuthi et Ammonii Citras, *U. S.;* Extractum Glycyrrhizæ Purum, *U. S.;* Ferri et Ammonii Citras, *Br.;* Ferri et Quininæ Citras, *Br.;* Ferri Hydroxidum, *U. S.;* Ferrum Tartaratum, *Br.;* Fluidextractum Glycyrrhizæ, *U. S.;* Glycyrrhizinum Ammoniatum, *U. S.;* Hydrargyrum Ammoniatum, *U. S., Br.;* Linimentum Ammoniæ, *U. S., Br.;* Liquor Bismuthi et Ammonii Citratis, *Br.;* Liquor Ferri Acetatis, *Br.;* Mangani Dioxidum Præcipitatum, *U. S.;* Spiritus Ammonii Aromaticus, *U. S.;* Tinctura Ergotæ Ammoniata, *Br.;* Tinctura Opii Ammoniata, *Br.;* Tinctura Quininæ Ammoniata, *Br.;* Tinctura Valerianæ Ammoniata, *U. S., Br.;* Sulphur Lotum, *U. S.*

AQUA AMMONIÆ FORTIOR.
U. S. (Br.)

STRONGER AMMONIA WATER

(ă'quạ ạm-mō'nĭ-æ för'tĭ-ọr)

"An aqueous solution of Ammonia [NH_3 = 16.93] containing 28 percent., by weight, of gaseous ammonia. This solution deteriorates on keeping, and should be tested frequently. Stronger Ammonia Water should be kept in partially filled, strong, glass-stoppered bottles, in a cool place. Great caution should be used in handling this liquid." *U. S.* "An aqueous

solution containing 32.5 per cent. by weight of ammonia, NH_3. It may be obtained by heating a mixture of ammonium chloride and slaked lime, and passing the resulting ammonia into distilled water." *Br.*

Liquor Ammoniæ Fortis, *Br.;* Strong Solution of Ammonia; Eau d'Ammoniaque forte, *Fr.;* Stärker Salmiakgeist, *G.*

This preparation is too strong for internal exhibition, but forms a convenient ammoniacal solution for reduction, by dilution with two measures of distilled water, to the strength of ordinary Ammonia Water, or for preparing strong rubefacient liniments.

The U. S. Pharmacopœia does not give a process. The process of the British Pharmacopœia (1885) will be found in detail in the U. S. D., 17th ed., p. 202.

Stronger Ammonia Water is seldom made by this process, but is prepared on a large scale, from one of the products of the coal gas manufacture, by the more economical process of distilling *gas liquor;* the distillate, which is principally ammonium sulphide, is then converted into ammonium sulphate by sulphuric acid. The sulphate is gently distilled with milk of lime, the still being connected with a series of glass carboys, arranged like Woulf's bottles, and three-fourths filled with distilled water. In this way solution of ammonia may be obtained of maximum strength. It is also made by diluting the concentrated liquid ammonia.

Properties of Aqueous Ammonia of Maximum Strength.—This is a colorless liquid, of an acrid taste and very pungent odor. It is strongly alkaline, and immediately changes the color of turmeric, when held over its fumes, to reddish brown. Cooled to 40° F. below zero, it concretes into a gelatinous mass, and at 54° C. (130° F.) boils, owing to the rapid disengagement of the gas. Its sp. gr. is 0.875 at 10° C. (50° F.) Anhydrous ammonia is said to dissolve metallic sodium, and the solution is intensely blue. (*Chem. News,* Nov. 4, 1870, p. 217.)

Anhydrous liquefied ammonia is now an article of commerce, being used on a large scale in the manufacture of artificial ice and in refrigerating plants, where the cold produced by its rapid evaporation under a partial vacuum is utilized to furnish the necessary lowering of temperature. The apparatus used for its production is almost identical with that employed in the manufacture of liquid carbon dioxide, and consists of a combination of vacuum and condensing pumps. The gas is obtained from the strongest ammonia water by heating, with application of a partial vacuum, and must be well dried before the compression. To obtain a pure product, it has been found best to allow the liquefied ammonia to expand several times in a gasometer, in which case, the larger part of the impurities are left behind in liquid form. These consist of water, alcohol, acetone, traces of the lubricating oil from the compressing pumps, and a little ammonium carbonate. In ammonias made from the distillation of bones, pyridine is also found to occur as an impurity. Liquefied ammonia comes into commerce in steel cylinders which have been tested to stand 100 atmospheres internal pressure, and are provided with well fitting screw valves.

Properties of the Official Stronger Ammonia Water.—This has similar properties to those above mentioned. Its sp. gr. is 0.897 at 25° C. (77° F.), *U. S.,* 0.891, *Br.* When of the former density, it contains 28 per cent. of the gas; when of the latter, 32.5 per cent. It is "a colorless, transparent liquid, having an excessively pungent odor, a very caustic and alkaline taste, and a strongly alkaline reaction upon red litmus paper. Specific gravity: 0.897 at 25° C. (77° F.) If Stronger Ammonia Water be diluted with twice its volume of distilled water, it should respond to the reactions and tests described under *Aqua Ammoniæ.* The percentage of ammonia gas in Stronger Ammonia Water should be determined by the same test as that given under *Aqua Ammoniæ." U. S.* The stronger ammonia water of commerce usually ranges in density from 0.900 to 0.920. Even when of proper official strength at first, it gradually becomes weaker by the escape of ammonia. To prevent its deterioration, it should be kept in closely-stoppered bottles in a cool place. If precipitated by lime water it contains carbon dioxide. After having been saturated with nitric acid, a precipitate by ammonium carbonate indicates earthy impurity, by silver nitrate, a chloride, and by barium chloride, a sulphate. "When mixed with an equal volume of *water,* with the addition of a slight excess of *hydrochloric acid,* no color or odor should be developed (absence of tarry matters). It should not yield any characteristic reaction with the tests for arsenium, lead, iron, aluminium, zinc, calcium, magnesium, potassium, sodium, carbonates, sulphates, or sulphides, and only the slightest reactions with the tests for chlorides. Specific gravity 0.891. Each gramme should require for neutralization 19.1 cubic centimetres of the *volumetric solution of sulphuric acid." Br.*

When purchasing the Stronger Solution of Ammonia, the apothecary should not trust to its being of the official strength, but should ascertain the point by taking its density, either by the specific gravity bottle or the hydrometer. Another method of ascertaining its density is by the *ammonia-meter* of J. J. Griffin of London, described and figured in *P. J.* (x. 413.) Although the U. S. Pharmacopœia states that "if stronger ammonia water be diluted with twice its volume of distilled water it should respond to the reactions and tests described under *Aqua Ammoniæ,"* it will be usually found in practice that two volumes of water will be too much; in any event it would be safer to use a smaller quantity of water (one and a half volumes), and, if the mixture should not have the sp. gr. 0.958, it should be brought to that density by the addition either of the stronger solution or

of distilled water, as the case may require. *Great care should be exercised in opening bottles containing stronger ammonia water.* It is safer, if the ammonia water has been kept in a warm room, to cool it with ice before attempting to withdraw the stopper, as the liberated gas, when warm, frequently is forced out with extreme violence, and accidents which have resulted in injury to the sight of the operator are recorded.

Uses.—This solution is too strong for medicinal use in its unmixed state. Sufficiently diluted with spirit of camphor and rosemary, it has been much employed as a prompt and powerful rubefacient, vesicatory, or escharotic, in various *neuralgic, gouty, rheumatic, spasmodic,* and *inflammatory affections* in which strong and speedy counter-irritation is indicated. When mere rubefaction is desired, a mixture may be used composed of five fluidounces of the ammoniacal liquid and eight of the diluent liquid; and this will answer even for blistering or cauterizing, unless a very prompt effect be necessary. In the latter case a lotion may be resorted to consisting of five measures of the ammoniacal to three of the diluent liquid. These mixtures are applied by means of linen folded several times, or a thick piece of flannel saturated with the liniment. A convenient mode is to fill the wooden cover of a large pill or ointment box, an inch or two in diameter, with purified cotton, saturate this with the liquid, and press it upon the part. The ammonia is thus prevented from escaping, and a definite boundary given to the inflammation. The application will generally produce rubefaction in from one to eight minutes, vesication in from three to ten minutes, and a caustic effect in a somewhat longer time.

When a solution of ammonia of 25° (sp. gr. 0.905) is mixed with fatty matter, the mixture forms the *vesicating ammoniacal ointment* of Gondret. The revised formula of this ointment is as follows: Take of lard 32 parts, oil of sweet almond 2 parts. Melt them together by the *gentle* heat of a candle or lamp, and pour the melted mixture into a bottle with a wide mouth. Then add 17 parts of solution of ammonia of 25°, and mix with continued agitation until the whole is cold. The ointment must be preserved in a bottle with a ground stopper, and kept in a cool place. When well prepared, it vesicates in ten minutes. There may be danger of excessive irritation and inflammation of the nostrils, mouth, and air passages, from the inadvertent inhalation of the gas escaping from a bottle of the stronger ammonia water, when freshly opened; and serious consequences have occurred from this cause, or from the accidental breaking of the bottle. The best antidote, under these circumstances, is the inhalation of the vapors of vinegar or acetic acid.

Dose, three to six minims (0.2 to 0.4 Cc.), largely diluted.

Off. Prep.—Linimentum Camphoræ Ammoniatum, *Br.;* Linimentum Hydrargyri, *Br.;* Liquor Ammoniæ, *Br.;* Spiritus Ammoniæ, *U. S.;* Spiritus Ammoniæ Aromaticus, *Br.;* Spiritus Ammoniæ Fetidus, *Br.;* Tinctura Guaiaci Ammoniata, *Br.*

AQUA AMYGDALÆ AMARÆ. U. S.

BITTER ALMOND WATER

(ă'quạ ạ-mŷg'dạ-læ ạ-mā'ræ)

Eau d'Amandes amères, *Fr.;* Aqua Amygdalarum Amararum, *P. G.;* Bittermandelwasser, *G.;* Acqua distillata di mandorle amare, *It.;* Agua de almendras amargas, *Sp.*

* "Oil of Bitter Almond, *one cubic centimeter* [or 16 minims]; Distilled Water, *nine hundred and ninety-nine cubic centimeters* [or 33 fluidounces, 6 fluidrachms, 14 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Oil in the Distilled Water by agitation, and filter through a well-wetted filter." *U. S.*

Owing to the almost universal employment at this time (1906) of artificial oil of bitter almond (or benzaldehyde), which is free from hydrocyanic acid (such oil being much cheaper than that made from bitter almond), the bitter almond water of pharmacy cannot be relied upon as a medicinal agent, but is used mainly as a pleasant vehicle, but the requirements of the U. S. P. (8th Rev.) are that the oil of bitter almond shall contain not less than 85 per cent. of benzaldehyde, and not less than 2 per cent. nor more than 4 per cent. of hydrocyanic acid, hence the use of benzaldehyde (see *Benzaldehydum*) is no longer permissible and care must be exercised not to prescribe a larger dose of the water to begin with than two teaspoonfuls (7.5 Cc.). Its principal use in this country is as a vehicle, many physicians prescribing it not for its medicinal virtues, but on account of its agreeable taste and powers of masking the taste of saline substances. The process for *Aqua amygdalarum amararum* of the German Pharmacopœia directs that 12 parts of bruised bitter almonds shall be expressed without heat, so as to remove as much fixed oil as possible; the press-cake is powdered, mixed thoroughly with 20 parts of water, and 9 parts distilled off into a receiver containing 3 parts of alcohol; the distillate is assayed to determine the percentage of hydrocyanic acid, and then diluted with a mixture of 1 part of alcohol and 3 parts of water, so that 1000 parts of the final product shall contain 1 part of hydrocyanic acid.

Under the name of *chloral hydrocyanate* a substance has been introduced for making cherry-laurel or bitter almond water extemporaneously. It occurs in white, translucent, rhombic prisms, soluble in water, alcohol, and ether. It has the odor of hydrocyanic acid and chloral, and is said to be a very stable compound. A solution of 6.5 grains of the salt in 1000 grains of distilled water corresponds with the official bitter almond water of the German Pharmacopœia, which is 1 to 1000. (*Merck's Bulletin.*)

For a method of determining the amount of hydrocyanic acid in bitter almond water, see *A. Pharm.*, Nov. 1878, 408; *A. J. P.*, Feb. 1879; *Zeit. Oest. Apoth. Ver.*, 1893, 45, 344, 387, 391.

Dose, one fluidrachm (3.75 Cc.).

AQUA ANETHI. Br.

DILL WATER

(ă'quạ ạ-nē'thī)

Eau d'Aneth, *Fr.*; Dillwasser, *G.*

"Dill Fruit, 1 *pound* (Imperial) or 500 grammes; Water, 2 *gallons* (Imp. meas.) or 10 litres. Distil one-half." *Br.*

This water, which is frequently prescribed in Great Britain, is occasionally used here; it closely resembles caraway water, over which it has no advantages. It is used only as a vehicle.

AQUA ANISI. U. S., Br.

ANISE WATER

(ă'quạ ạ-nī'sī)

Eau d'Anis, *Fr.*; Aniswasser, *G.*; Acqua distillata di anice, *It.*; Agua de anis, *Sp.*

* "Oil of Anise, *two cubic centimeters* [or 32 minims]; Purified Talc, *fifteen grammes* [or 231 grains]; Distilled Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Oil of Anise with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Anise Water is perfectly clear." *U. S.*

"Anise Fruit, 1 *pound* (Imperial) or 500 grammes; Water, 2 *gallons* (Imp. meas.) or 10 litres. Distil one-half." *Br.*

Anise water is rarely made by distillation, although the product thus secured has a more delicate flavor than the U. S. preparation. It is used solely as a vehicle.

AQUA AURANTII FLORUM. U. S. (Br.)

ORANGE FLOWER WATER

(ă'quạ âu-răn'tī-ī flō'rŭm)

"The orange-flower water of commerce, prepared by distillation from the flowers of the Bitter Orange tree, Citrus Aurantium, var. Bigaradia, *Hook. f.*, diluted, immediately before use, with twice its volume of Distilled Water." *Br.*

Aqua Aurantii Floris, *Br.*, Aqua Florum Naphæ; Eau distillée (Hydrolat) de Fleurs d'Oranger, *Fr. Cod.*; Eau de Naphe, *Fr.*; Orangenblüthenwasser, *G.*; Acqua distillata di arancio, *It.*; Aqua destilada de azahar, *Sp.*

"Stronger Orange Flower Water, Distilled Water, each, *one volume*. Mix them immediately before use." *U. S.*

The U. S. Pharmacopœia 1890 and the U. S. P. (8th Rev.) introduced "Stronger Orange Flower Water," providing for its dilution with an equal volume of distilled water to make "orange flower water." This plan enables American pharmacists to employ the imported "triple" water, as it is known in commerce. This retains its fragrance longer than a weaker water; morover, economy is effected through saving customs duty and freight, and a fresh, delicate water can be dispensed.

This preparation is also considered by the British Pharmacopœia as an object of importation. According to this authority, it is obtained from the flowers of the bitter orange tree; this is concurred in by our own official standard. In Italy and France, where it is largely made, the flowers of the bitter orange have long been preferred, as yielding the most fragrant product. It may be prepared in the most southern districts of our country from the fresh flowers; and these may be brought to the North for the same purpose, if previously incorporated with one-third or one-fourth of their weight of common salt. The proper method is to arrange the flowers and salt in successive layers in jars of stoneware or glass. They may also be preserved by means of glycerin. Notwithstanding, however, the facility of preparing this water here, it is generally imported from the south of France, whence it usually comes in cans of tinned copper.

L. Malenfant observed that fresh orange flowers, mixed with cold water, yield, on distillation over the naked fire, a milky water, possessing a somewhat empyreumatic odor and a strong, somewhat acrid taste. Kept for twelve or eighteen months in glass vessels covered with parchment, it loses its empyreuma, and after filtering has an agreeable odor and taste. If the flowers be mixed with boiling water and immediately distilled, the water is limpid, and gradually separates some thick oil of a brownish color; the water has the odor and taste of the flowers, but complicated with an odor of the still, which it loses after long keeping; it seems to alter less rapidly than that obtained by the former process. Distilled by steam, a limpid water of a pure odor and taste is at once obtained, free from empyreuma; it may be at once used, and keeps better in the light than when obtained by the two former processes. (*A. J. P.*, June, 1874.) Hesse and Zeitschel (*J. Pr. Chem.*, 1901, 525) found by exhausting with ether the orange flower water obtained in the distillation of the orange blossoms that the quantity of oil dissolved in the water represented about one-third of the total amount of oil from the blossoms. A distilled water of the leaves is also prepared, and sometimes a mixture of the leaves and flowers is employed. But this is a fraud, as the distilled water of the leaves never has the sweet perfume of that of the flowers. (*J. P. C.*, 4e sér., iii. 249.) Orange flower water is used exclusively on account of its agreeable odor as a flavoring agent.

Orange flower water is stored in large glass vessels or carboys in cool cellars by the manu-

facturers in Grasse, France, care being taken not to stopper them tightly, but simply cover the orifice with a piece of paper or coarse cloth.

Nitric, sulphuric, or hydrochloric acid produces a red coloration with orange flower water, particularly if the water be shaken with ether to take up the oil, and the acid added to the ethereal solution. (*P. J.*, 1878, 248.) It is used as a vehicle, and to flavor syrups and elixirs.

Off. Prep.—Syrupus Amygdalæ, *U. S.;* Syrupus Aurantii Florum, *U. S.;* Syrupus Calcii Lactophosphatis, *U. S.;* Syrupus Lactucarii, *U. S.*

AQUA AURANTII FLORUM FORTIOR. U. S. (Br.)

STRONGER ORANGE FLOWER WATER
[Triple Orange Flower Water]

(ă'quạ âu-răn'tĭ-ī flō'rŭm fōr'tĭ-ọr)

"Water saturated with the volatile oil of fresh orange flowers obtained as a by-product in the distillation of the oil of orange flowers. It should be kept in bottles loosely stoppered with a pledget of purified cotton, and in a dark place." *U. S.* The orange flower water of commerce is a saturated solution of the essential oil of the fresh flowers, and the British Pharmacopœia uses this in several preparations, terming it "Orange-flower water of commerce, undiluted." (See *Aqua Aurantii Florum,* p. 174.)

Orange flower water is nearly colorless, though often of a pale yellowish tint. "Stronger Orange Flower Water should be neutral to litmus paper, and have a strong odor of fresh orange flowers. It should be colorless and clear, or only faintly opalescent, not mucilaginous, and should give no reaction with hydrogen sulphide T.S. or ammonium sulphide T.S. (absence of *metallic impurities*)." *U. S.* From being kept in tinned copper cans, it sometimes contains metallic impurity, which is said to be chiefly lead carbonate, derived from the lead used as a solder in making the cans. The means of detecting metallic impurity are also mentioned under the general observations on distilled water. Much color, offensive odor, or mouldiness indicates impurity derived from the flowers in distillation.

Off. Prep.—Aqua Aurantii Florum, *U. S.;* Mistura Olei Ricini, *Br.;* Syrupus Aurantii Floris, *Br.;* Syrupus Calcii Lactophosphatis, *Br.;* Trochisci Acidi Tannici, *U. S.;* Trochisci Gambir, *U. S.;* Trochisci Krameriæ, *U. S.;* Trochisci Santonini, *U. S.*

AQUA CAMPHORÆ. U. S., Br.

CAMPHOR WATER

(ă'quạ căm'phọ-ræ)

Aqua Camphorata; Eau camphrée, *Fr. Cod.;* Kampherwasser, *G.;* Agua alcanforada, *Sp.*

* "Camphor, *eight grammes* [or 123½ grains]; Alcohol, *eight cubic centimeters* [or 130 minims]; Purified Talc, *fifteen grammes* [or 231 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Camphor in the Alcohol, triturate the solution with the Purified Talc, and, after allowing the greater part of the Alcohol to evaporate spontaneously, continue the trituration with the Water, gradually added; then pour the mixture upon a well-wetted filter, and pass the filtrate through the filter repeatedly until the Camphor Water is perfectly clear." *U. S.*

"Camphor, 70 *grains* (Imperial) or 5 grammes; Alcohol (90 per cent.), *a sufficient quantity;* Distilled Water, 1 *gallon* (Imp. meas.) or 5 litres. Dissolve the Camphor in a sufficient quantity of the Alcohol to form half a fluid ounce (or fifteen cubic centimetres) of the solution; add this in successive portions to the Distilled Water, shaking after each addition; finally agitate occasionally until all the Camphor is dissolved." *Br.*

In both of these processes the sole object is to effect a solution; water is capable of dissolving but a very small proportion of camphor, but the quantity varies with the method employed. The present official process is an improvement on former methods, for it undoubtedly secures a saturated solution easily. Magnesium carbonate is to be preferred to purified talc as a distributing agent were it not for the fact that it is slightly soluble in water. The present British process is more efficient than the old formula, a definite quantity of camphor being dissolved in a small quantity of alcohol and this solution gradually added to the proper quantity of water; it is questionable, however, whether it would not be advantageous to use an insoluble powder to aid in the solution and thus obtain quickly a clear liquid, as the water made by the British process is sometimes cloudy. In the former British process no trouble was taken even to comminute the camphor, or to shake it with the water, which was thus allowed to take up what it might be disposed to do by contact with the camphor contained in a bag. The solution thus effected was extremely feeble, containing probably less than one part in a thousand; this proportion, according to Berzelius, is taken up by water when triturated with camphor. It was, besides, of uncertain strength, varying with the size of the fragments of camphor. J. C. Pooley found that 120 grains of camphor, treated according to the former British official directions, gave, when cut into 4 pieces, 6 grains to half a gallon of water, but in 20 pieces gave 20 grains, or about one part to 1750 of water. (*P. J.*, 2d ser., vii. 162.) Wm. B. Addington proposed to add to the camphor just enough alcohol to dissolve it, and triturate the liquor with magnesia, during which process he affirmed that the alcohol evaporated (*A. J. P.*, xlv. 209); and F. T. Hartzell substituted ether for alcohol, a few drops of which enabled him to bring the camphor to an impalpable powder. (*Ibid.,*

xlvi. 233.) The camphor is separated from its aqueous solution by a solution of pure potassium hydroxide, and, according to Paris, by magnesium sulphate and several other salts. J. Murray proposes a solution of camphor and magnesium bicarbonate, which contains three grains of the former and six grains of the latter in each fluidounce.

Camphor water has this advantage over camphor in substance, that the latter is with difficulty dissolved by the liquors of the stomach; but it is too feeble a preparation for use when a decided effect is desired; it is, however, an excellent vehicle for the administration of more active substances.

Dose, half to one fluidounce (15 to 30 Cc.), repeated every one or two hours.

AQUA CARUI. Br.

CARAWAY WATER

(ă'quą căr'ù-ī)

Aqua Carvi; Eau Distillée de Carvi, *Fr.;* Kümmelwasser, *G.*

"Caraway Fruit, 1 *pound* (Imperial) or 500 grammes; Water, 2 *gallons* (Imp. meas.) or 10 litres. Distil one-half." *Br.*

Distilled Caraway Water has the flavor of the fruit or seeds, but is seldom used in the United States. The water made from the volatile oil (15 minims in a pint), in the same manner as is cinnamon water, is largely employed. It is used only as a vehicle.

AQUA CHLOROFORMI. U. S., Br.

CHLOROFORM WATER

(ă'quą ęhlō-rọ-fŏr'mī)

Eau de Chloroforme, *Fr.;* Chloroformwasser, *G.;* Agua chloroformada, *Sp.*

"Chloroform, Distilled Water, each, *a sufficient quantity.* Add enough Chloroform to a convenient quantity of Distilled Water, contained in a dark amber-colored bottle, to maintain a slight excess of the former, after the contents have been repeatedly and thoroughly agitated. When Chloroform Water is required for use, pour off the needed quantity of the solution, refill the bottle with Distilled Water and saturate it by thorough agitation, taking care that there be always an excess of Chloroform present." *U. S.* "Chloroform, 30 *minims* (Imperial measure) or 2.5 cubic centimetres; Distilled Water, sufficient to produce 25 *fluid ounces* (Imp. meas.) or 1000 cubic centimetres. Shake them together until the Chloroform is dissolved." *Br.*

The water should be fully saturated, in which case it should contain one-half per cent. of chloroform. The British preparation contains half the proportion of Chloroform present in the corresponding preparation of the British Pharmacopœia (1885). Chloroform water has been proved to be an excellent vehicle for administering active remedies, and, owing to its antiseptic properties, mixtures having it for a basis resist decomposition longer than those made with ordinary water.

Dose, one-half to two fluidounces (15 to 60 Cc.).

AQUA CINNAMOMI. U. S., Br.

CINNAMON WATER

(ă'quą cīn-ną-mō'mī)

Eau distillée de Cannelle, *Fr. Cod.;* Aqua Cinnamomi, *P. G.;* Zimmtwasser, *G.;* Acqua distillata di canella, *It.;* Agua destilada de canela, *Sp.*

* "Oil of Cinnamon, *two cubic centimeters* [or 32 minims]; Purified Talc, *fifteen grammes* [or 231 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Oil of Cinnamon with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Cinnamon Water is perfectly clear." *U. S.*

"Cinnamon Bark, bruised, 1 *pound* (Imperial) or 500 grammes; Water, 2 *gallons* (Imp. meas.) or 10 litres. Distil one-half." *Br.*

Of these processes, that of the U. S. Pharmacopœia is the easier, though the second, the British, may yield a sweeter product. On standing, cinnamon water, made from oil of Ceylon cinnamon, is apt to precipitate, owing to the gradual oxidation and formation of cinnamic acid, which is comparatively insoluble in water; this can be prevented, according to E. Backhaus, by passing a stream of carbon dioxide through the fresh water for a few minutes. We have never seen the precipitation successfully prevented, notwithstanding the application of numerous so-called preventatives; these usually delay the precipitation, but in a few weeks' time the cloudiness due to the formation of minute crystals of cinnamic acid invariably appears. When oil of cassia is used as directed in the U. S. P. (8th Rev.) process precipitation rarely occurs. (See *Oleum Cinnamomi.*) E. Holmes recommends glycerin as an excellent intermedium between the oil of cinnamon and water. Ten drops of glycerin will effect the solution of a drop of the oil in a fluidounce of water.

Cinnamon water is much used as a vehicle for other less agreeable medicines, but should be given cautiously in inflammatory affections. For ordinary purposes the U. S. preparation is sufficiently strong when diluted with an equal measure of water.

Off. Prep.—Infusum Digitalis, *U. S.;* Mistura Cretæ, *U. S., Br.;* Mistura Guaiaci, *Br.;* Mistura Olei Ricini, *Br.;* Mistura Spiritus Vini Gallici, *Br.;* Syrupus Aromaticus, *Br.;* Syrupus Cascaræ Aromaticus, *Br.*

AQUA CREOSOTI. U. S.

CREOSOTE WATER

(ă'quą crē-ọ-sō'tī)

Creasote Water; Eau créosotée, *Fr.;* Kreosotwasser, *G.*

* "Creosote, *ten cubic centimeters* [or 162 minims]; Distilled Water, *nine hundred and*

ninety cubic centimeters [or 33 fluidounces, 228 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Agitate the Creosote vigorously with the Distilled Water, and filter through a well-wetted filter. Creosote Water should be freshly prepared when dispensed." *U. S.*

This preparation contains 1 per cent., or about 4.8 minims, of creosote in each fluidounce, and affords a convenient method of administering that medicine. It is about the same strength as that formerly official. It may also be used with advantage as a gargle, a lotion, or mixed with cataplasms, to correct *fetor,* and gently stimulate *indolent surfaces.*

Dose, from one to four fluidrachms (3.75 to 15 Cc.).

AQUA DESTILLATA. U. S., Br.

DISTILLED WATER

(ă'quạ dĕs-tĭl-lā'tạ)

$H_2O = 17.88$

"Prepared by distillation from good natural potable water." *Br.*

Eau distillée, *Fr. Cod.;* Aqua distillata, *P. G.;* Destillirtes Wasser, *G.;* Acqua distillata, *It.;* Agua destilada, *Sp.*

* "Water, *one thousand volumes* [or 33 fluidounces, 6½ fluidrachms], to make *eight hundred volumes* [or about 27 fluidounces]. Distil the Water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first *one hundred volumes* [or 3½ fluidounces], and reject this portion. Then collect *eight hundred volumes* [or 27 fluidounces] and keep the Distilled Water in glass-stoppered bottles, which have been rinsed with hot distilled water immediately before being filled." *U. S.*

No natural water is sufficiently pure for certain pharmaceutical purposes; and hence the necessity of the above process for its distillation. It is best to reject the first portion which comes over, as this may contain carbon dioxide and other volatile impurities; and the last portion of the water ought not to be distilled, lest it should pass over with an empyreumatic taste. The distillation is usually performed with the ordinary still and worm; but, to avoid any impurity from the worm or the receiver, the condenser is directed in the U. S. Pharmacopœia to be of block tin or glass. Brande states that distilled water often derives from the still a foreign flavor, which it is difficult to avoid. He therefore recommends that a still and condenser be kept exclusively for distilling water; or, where this cannot be done, that steam be driven through the worm for half an hour, for the purpose of steaming it out, before it is used, the worm-tub having been previously emptied. J. N. Hurty prefers well water as the source of distilled water, and that it be boiled before collecting the distillate, to get rid of ammonia, and, to prevent access and growth of spores, that the water be heated to boiling before introducing it into the container, and that it be drawn off by a siphon tube reaching to the bottom of the vessel, the mouth of which is loosely stoppered with cotton. (*West. Drug.,* 1887, p. 4.) Even the use of pure tin, which is generally considered unexceptionable, does not give perfect security against impurity, as water distilled from metallic alembics with the head and worm of this metal has a peculiar odor which it retains for some time. Ordinary distilled water invariably contains ammonia, as may be proved by adding a few drops of Nessler's reagent. (See PART III.) In order to free distilled water from volatile nitrogenous bodies, it is necessary to redistil it after it has been placed in contact with potassium permanganate and potassium hydroxide. After about one-twentieth of the water has come over, the distillate is usually free from ammonia, and leaves no residue on evaporation. If traces of ammonia remain, acid potassium sulphate is added, and it is redistilled. (Stas.) Distilled water when kept long in glass vessels dissolves a minute quantity of the glass and the official test permitting 0.075 Gm. of residue in 1000 Cc. after evaporation to dryness, was inserted to avoid unnecessary severity in the test for a solvent used for pharmaceutical purposes.

Properties.—Distilled water, as usually obtained, has a vapid and disagreeable taste, and is not perfectly pure, water, to be rendered so, requiring to be distilled in silver vessels. The properties of pure water have already been given under the head of *Aqua.* Distilled water should undergo no change with hydrogen sulphide, or on the addition of tincture of soap, lead subacetate, barium chloride, ammonium oxalate, silver nitrate, or lime water. "A colorless, limpid liquid, without odor or taste, perfectly neutral to litmus paper. Distilled Water should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121), nor should the slightest turbidity result upon the addition to separate portions, of barium chloride T.S. (*sulphates*), silver nitrate T.S (*chlorides*), ammonium oxalate T.S. (*calcium*); nor should its transparency be affected when mixed with twice its volume of calcium hydroxide T.S. (absence of *carbonic acid*). It should give no reaction for nitrates, nitrites, or ammonia when tested as described under *Aqua.* When 1000 Cc. of Distilled Water are evaporated on a water-bath to dryness, not more than 0.075 Gm. of *residue* should remain. On heating to boiling 100 Cc. of Distilled Water, acidulated with 10 Cc. of diluted sulphuric acid, and subsequently adding 0.1 Cc. of tenth-normal potassium permanganate V.S., the color of the liquid should not be completely destroyed by boiling for ten minutes, nor should it wholly disappear if the vessel be afterwards set aside in a dark place, covered, for ten hours (absence of *organic* or *other oxidizable substances*)." *U. S.* It is needlessly

employed in some formulas, but is essential in others. The British Pharmacopœia requires distilled water to be "Colorless, tasteless, and odorless. 25 cubic centimetres evaporated in a platinum capsule should leave at most a scarcely visible residue (absence of dissolved solids). It should yield no reaction with the tests for the various metals, chlorides, nitrates, nitrites, or sulphates. It should not affect *litmus paper* (absence of acid or alkaline matter). The liquid obtained on boiling 100 cubic centimetres for three minutes with 1.0 cubic centimetre of *diluted sulphuric acid* and 0.1 cubic centimetre of a mixture of one part of *solution of potassium permanganate* and two parts of *water*, should retain its color for one hour (absence of more than traces of organic matter). 100 cubic centimetres mixed with 2 cubic centimetres of *solution of potassio-mercuric iodide*, should not afford a yellow tint more intense than that given by 0.25 cubic centimetre of *solution of ammonium chloride* (*Nessler's*) diluted with 50,000 cubic centimetres of ammonia-free *water* when viewed, under similar conditions, in a glass tube having a diameter of one inch (25 millimetres) (absence of more than 0.005 part of ammonia per million parts)." *Br.* As a rule, when small quantities of active medicines are to be given in solution, and in the preparation of collyria, distilled water should be directed. The following list contains the chief substances which require distilled water as a solvent: tartar emetic, corrosive sublimate, silver nitrate, barium and calcium chlorides, lead acetate and subacetate, potassium permanganate, iron and zinc sulphates, quinine sulphate, morphine sulphate, hydrochloride, and acetate, and, in general terms, all the alkaloids and their salts. Distilled water is used in preparing the official diluted acids, for absorbing gaseous ammonia, and for forming nearly all the official aqueous solutions.

AQUA FŒNICULI. U. S., Br.

FENNEL WATER

(ă'quạ fœ-nĭc'ŭ-lī)

Eau de Fenouil, *Fr.;* Aqua Fœniculi, *P. G.;* Fenchelwasser, *G.;* Acqua distillata di finocchio, *It.;* Agua de hinojo, *Sp.*

* "Oil of Fennel, *two cubic centimeters* [or 32 minims]; Purified Talc, *fifteen grammes* [or 231 grains]; Distilled Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Oil of Fennel with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Fennel Water is perfectly clear." *U. S.*

"Fennel Fruit, 1 *pound* (Imperial) or 500 grammes; Water, 2 *gallons* (Imp. meas.) or 10 litres. Distil one-half." *Br.*

Fennel water is a pleasant vehicle for other medicines, and useful when a mild aromatic is indicated. The process of the British Pharmacopœia, although more troublesome, furnishes a more delicate and agreeable water than does that of the U. S. Pharmacopœia. Used as a vehicle.

AQUA HAMAMELIDIS. U. S. (Br.)

HAMAMELIS WATER

(ă'quạ hăm-ạ-mĕl'ĭ-dĭs)

Liquor Hamamelidis, *Br.;* Solution of Hamamelis, Witchhazel water, Witchhazel extract; Eau distillée de hamamelis, *Fr.;* Hamameliswasser, *G.*

* "Hamamelis Bark, *ten thousand grammes* [or 22 pounds av.]; Water, *twenty thousand cubic centimeters* [or 42 pints]; Alcohol, *fifteen hundred cubic centimeters* [or 51 fluidounces]; to make *ten thousand cubic centimeters* [or 21 pints]. Macerate the Hamamelis Bark in the Water during twenty-four hours, then distil until *eighty-five hundred cubic centimeters* [or 17 pints, 15 fluidounces] of distillate are obtained, add the Alcohol, and mix thoroughly." *U. S.* "Fresh Hamamelis Leaves, 50 *ounces* (Imperial) or 1000 grammes; Water, 100 *fl. ounces* (Imp. meas.) or 2000 cubic centimetres; Alcohol (90 per cent.), 10 *fl. ounces* (Imp. meas.) or 200 cubic centimetres. Macerate in a still for twenty-four hours; then distil one-half." *Br.*

Hamamelis Water or, as it is popularly called, "Distilled Extract of Witchhazel," has been found on the market with very little alcohol in it, formaldehyde being used as a preservative; the official test is as follows: "If 1 Cc. of Hamamelis Water be added to 5 Cc. of sulphuric acid containing a little salicylic acid in solution, no red color should appear (absence of *formaldehyde*)." *U. S.*

Uses.—This water was probably introduced into the British Pharmacopœia and U. S. Pharmacopœia (8th Rev.) on account of the large demand for it which has grown out of the wide advertisements of a certain proprietary medicine, and the universally recognized need in American families for an embrocation which appeals to the psychic influence of faith. As the tannic acid of hamamelis bark does not come over into the distillate the water is therapeutically a mixture of water and alcohol. (See *Hamamelidis Cortex.*)

AQUA HYDROGENII DIOXIDI. U. S. (Br.)

SOLUTION OF HYDROGEN DIOXIDE
[Solution of Hydrogen Peroxide]

(ă'quạ hȳ-drọ-gĕ'nĭ-ĭ dī-ŏx'ĭ-dī)

"A slightly acid, aqueous solution of Hydrogen Dioxide [$H_2O_2 = 33.76$], which should contain, when freshly prepared, about 3 percent., by weight, of absolute Hydrogen Dioxide, corresponding to about 10 volumes of available oxygen. It should be kept in a cool place. Upon removing the stopper from the bottle

not more than a slight pressure should be observed." *U. S.* "An aqueous solution of hydrogen peroxide, H_2O_2, prepared by the interaction of water, barium peroxide, and a dilute mineral acid, at a temperature below 50° F. (10° C.)." *Br.*

Liquor Hydrogenii Peroxidi, *Br.,* Solution of Hydrogen Peroxide; Oxygenized Water, Oxygen Hydrate; Péroxide d'hydrogène; Soluté officinal d'eau oxygénée au dixiéme, *Fr. Cod.;* Wasserstoffhyperoxyd, Wasserstoffhyperoxidlösung, *G.;* Acqua ossigenata, *It.;* Agua oxigenada, *Sp.*

The extended use of this preparation, which was discovered by Thenard in 1818, has earned for it a place in the U. S. and British Pharmacopœias. It consists of water in which, by the presenting to it of oxygen in a nascent state, an additional atom of this element has combined with the hydrogen, forming the dioxide, $(HO)_2$, or H_2O_2.

The U. S. P. 1890 process (see U. S. D., 18th edition, p. 214) consisted in the decomposition of barium dioxide by phosphoric acid, barium phosphate being thrown down as a precipitate, hydrogen dioxide being found dissolved in the supernatant aqueous liquid; the barium phosphate is filtered out, and any trace of barium salt is finally removed by the cautious addition of sulphuric acid, which precipitates it as insoluble barium sulphate; the very fine precipitate which usually passes through the pores of filter paper is caught and held on the filter by the starch, and the clear solution may be adjusted to contain 3 per cent., *by weight,* of absolute hydrogen dioxide by the assay, which follows.

Assay.—"Dilute 10 Cc. of the Solution with sufficient distilled water to measure 100 Cc. Transfer 16.9 Cc. of this liquid (containing 1.69 Cc. of the solution) to a beaker, add 5 Cc. of diluted sulphuric acid, and then, from a burette, slowly add, with constant stirring, tenth-normal potassium permanganate V.S. until the liquid just retains a faint pink tint. Each Cc. of tenth-normal potassium permanganate V.S. consumed corresponds to 0.1 percent. of absolute Hydrogen Dioxide, or 0.329 volumes of oxygen. If the Solution be of full strength, 30 Cc. of tenth-normal potassium permanganate V.S. will be required." *U. S.*

For another method of preparing this Solution, see U. S. D., sixteenth edition, page 1887. According to Crismer, a pure solution may be made by dissolving barium peroxide in a slight excess of diluted hydrochloric acid (sp. gr. 1.10), and shaking the solution with an equal volume of ether. The ethereal layer is separated and shaken with a little water, which will take up most of the hydrogen peroxide, after the separation of which the ether is again shaken with the above separated solution of barium peroxide, and then with water as before. These operations are repeated five or six times. It is possible in this way to obtain solutions containing from 0.8 to 0.9 per cent. of the peroxide, which are perfectly neutral and free from foreign substances. (*Bull. Soc. Chim.,* 1891, 24.) Horlin (*Zeit. angew. Chem.,* 1902, 600) prepares the solution by adding at a low temperature with caution, sodium dioxide to a solution of hydrofluoric acid; hydrogen dioxide and sodium fluoride are produced, the solution is treated with aluminum fluoride, which results in producing the insoluble double fluoride of aluminum and sodium, which separates out. The official Solution is strong enough for most practical uses, for, although it can readily be made stronger, the difficulties of preserving it largely increase with its increased strength, and hence the Committee of Revision wisely fixed the standard at *ten volumes of available oxygen.* The British Pharmacopœia requires that the Solution shall indicate a yield of from *nine to eleven volumes* of oxygen when tested by the nitrometer test. (See page 180.)

Properties.—Solution of hydrogen dioxide was prepared by Regnault in a nearly pure state. As thus procured, it is a colorless liquid of a fluid consistence, of the sp. gr. 1.452, remaining liquid at zero, beginning to give out oxygen when heated above 15.5° C. (60° F.), and at a higher heat rapidly and sometimes explosively resolved into water and oxygen. But when diluted with water, with which it unites in all proportions, it is not decomposed under 37.7° C. (100° F.). It may be evaporated *in vacuo* at a gradually increasing temperature, a nearly pure hydrogen dioxide coming over at about 84° C. Wolffenstein states that he has prepared, after repeated fractioning, hydrogen peroxide (99.1 per cent.). (See *Ber. d. Chem. Ges.,* 1894, 3307. See also Schiloff's process, *Chem. News,* 1896, 38.) Crystallized hydrogen dioxide has been made by W. Staedel by applying a freezing mixture to a very strong solution of the dioxide and collecting the separated columnar crystals; it is a very active body, being decomposed with explosive violence on coming in contact with manganese dioxide (*Ph. Centralh.,* 1902, 546). The great facility with which it parts with oxygen renders it a powerful oxidizer; and the simple contact with various substances, as platinum, gold and silver, causes it to be resolved into oxygen and water. On the contrary, certain other substances, even though ordinarily evincing a strong affinity for oxygen, as phosphorus, for example, are unaffected by it, and there are a number of bodies which have the property not only of being unaffected by it, but of restraining its oxidizing influence on other bodies, while some salts, like silver oxide, are actually reduced by it. Traces of impurities modify the stability of hydrogen dioxide; acids increase, alkalies decrease, its stability. Some manufacturers add a certain proportion of oxalic acid to the solution of hydrogen dioxide to raise the apparent value of the product, as shown by the permanganate assay; for a method of detecting this fraud see a paper by G. Arth (*D. C.,* 1902, p. 141).

The official Solution is described as "a colorless liquid, without odor, slightly acidulous to the taste, and producing a peculiar sensation

and soapy froth in the mouth; liable to deteriorate upon keeping or protracted agitation. If the stopper in the bottle be replaced by a pledget of cotton, deterioration is retarded. When exposed to the air at the ordinary temperature, or when heated on a water-bath at a temperature not exceeding 60° C. (140° F.), the solution loses chiefly water. When rapidly heated, it frequently decomposes suddenly. On adding to 10 Cc. of water, in a test-tube, 1 drop of potassium chromate T.S., then 10 drops of diluted sulphuric acid, and pouring a few Cc. of ether on top, the subsequent addition of a few drops of Solution of Hydrogen Dioxide, even when considerably diluted, will cause a blue color to appear at the zone of contact of the two liquids. After shaking, the ether-layer will separate with a blue color. If to 25 Cc. of the Solution, 5 Cc. of tenth-normal potassium hydroxide V.S. be added, and the mixture be evaporated to about 10 Cc., and 3 drops of phenolphthalein T.S. added, not less than 2.5 Cc. of tenth-normal sulphuric acid V.S. should be required to discharge the red color of the solution after continued boiling (limit of *free acids*). If 20 Cc. of the Solution be evaporated to dryness upon a water-bath, and the drying completed at 120° C. (248° F.), not more than 0.03 Gm. of solid residue should remain (limit of *total solids*). If to 1 Cc. of the Solution, 1 Cc. of ammonia water be added, and the liquid evaporated to dryness upon a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see Part III, Test No. 17). If to 1 Cc. of the Solution, 1 Cc. of ammonia water be added and the mixture be evaporated to dryness upon a water-bath, the residue, when dissolved in 10 Cc. of distilled water containing 1 Cc. of diluted hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see Part III, Test No. 121). On evaporating to dryness, upon a water-bath, 50 Cc. of the Solution, previously rendered alkaline by sodium hydroxide T.S., transferring the dry residue to a watch-glass, moistening it with sulphuric acid, and setting the glass in a moderately warm place for a few hours, the surface of the glass, after being washed, should exhibit no sign of corrosion (absence of *hydrofluoric acid*). The addition of a few drops of diluted sulphuric acid to 10 Cc. of the Solution should produce no turbidity or precipitate (absence of *barium*)." *U. S.* "On adding a few drops to 8 or 10 cubic centimetres of water containing a drop of solution of potassium chromate, 10 drops of diluted sulphuric acid, and 2 or 3 cubic centimetres of ether, a blue layer will appear between the ethereal and aqueous liquids, and, after agitation, the ether will also become blue. 1 volume, treated in a brine-charged nitrometer with 10 or 12 times its bulk of a mixture of 1 volume of sulphuric acid, 2 volumes of a 5 per cent. solution of potassium permanganate, and 7 volumes of water, should afford, at normal temperature and pressure, not less than 18 and not more than 22 volumes of oxygen, indicating a yield of 9 to 11 volumes from the Solution of Hydrogen Peroxide. It should give no characteristic reaction with the tests for barium. Evaporated to dryness on a water-bath, not more than 0.5 per cent. of solid residue should remain." *Br.* Charles Rice suggests improvements in the method of assay which are practical (see *Am. Drug.*, 1892, 30). F. X. Moerk has proposed a rapid and effective method of assaying this solution (see *A. J. P.*, 1893, 65); J. F. Brown confirmed the value of Moerk's method (*P. J.*, 1896, 271). *Solution of hydrogen dioxide should be kept in a cool place, and not too tightly stoppered.* (A plug of absorbent cotton is often used.) Neglect of these precautions, particularly in hot weather, will be likely to result in an explosion and fracture of the bottle containing it, due to a brisk evolution of oxygen in a confined space, on account of the increased temperature.

Uses.—Many years ago B. W. Richardson of London, pointed out that hydrogen dioxide is a powerful physiological agent, which, when brought in contact with most animal tissues, or with sugar or starch, acts as an oxidizing agent. It does not, however, seem to be of value for affecting the general system, as it was found in the experiments of H. C. Wood to coagulate blood so rapidly when put into the blood-vessel that it does not seem possible for it to find entrance into the blood, and the former allegations of its possessing specific power in infective fevers have been completely disproven. It is useful only as a local remedy.

When hydrogen dioxide is brought in contact with the mucous membrane or ulcerated surfaces, albuminous coagulation is immediate, with the formation of a white coating and a rapid evolution of gas. It is a powerful antiseptic. The conclusions of Pane (*L. M. R.*, Jan. 1891) were that— 1. Hydrogen dioxide in a solution of 1 to 100 has an energetic disinfecting power. 2. The solution 1 to 1000 is a weak antiseptic, and inferior to the corresponding solution of corrosive sublimate. The solution of H_2O_2, in nutritive substances (1 to 352), not only impedes the development but after some days kills the spores of the bacillus of charbon. According to Sternberg, however, the bactericidal power of H_2O_2 has been greatly overestimated. He asserts that the results following the use of commercial solutions are due more to the sulphuric acid that they contain than to the dioxide. Gifford (*N. Y. M. R.*, 1888) found that a neutral solution containing 15 per cent. by volume of H_2O_2 killed the anthrax spores in 5 minutes and pus cocci in one minute. The same solution diluted with 4 parts of water did not kill pus cocci after thirty minutes exposure. The presence of large amounts of organic matter so rapidly reduces the peroxide that its disinfectant power is much lessened.

On account of its oxidizing properties, it is a powerful deodorant, rapidly destroying hydro-

gen sulphide and similar gases. When hydrogen dioxide is brought in contact with pus, rapid change occurs, with evolution of oxygen gas, and Pane found under the microscope that so soon as charged with gas the corpuscles become granular, lose their form, and break up into detritus. Marshall, however, believes that the evolved gas is carbon dioxide.

Its liquid form makes it especially adapted for infected wounds, putrid cavities and abscesses, which it will thoroughly cleanse. It cannot, however, take the place of such antiseptics as mercuric chloride, because its influence is so immediate and so fugacious, As a preventive antiseptic it is of little value. For disinfecting the hands and instruments of the surgeon it has the great advantage of immediate and powerful action, and of not staining the hands or clothing. By some surgeons it is said not to affect the instruments.

As a local application in specific *inflammations of the mucous membrane* hydrogen dioxide is of greatest value. In *scarlet fever* and *diphtheria* the official solution may be applied by mop to the pharynx, often with extraordinarily good results. Diluted one-half, it may be injected into the nasal cavities when they are affected. Injection of a solution of from 20 per cent. to full strength has received commendation in the treatment of *gonorrhœa* and *chancre.* The official solution may be used as a local styptic. It is not probable that hydrogen dioxide can produce general poisoning, but when employed too freely upon large internal sensitive surfaces it appears to be capable of causing death by the shock produced through the intense local irritation. Thus, Pane has shown that rabbits may be killed by injecting a strong solution into the peritoneal cavity. In a case reported by Laach (*L. L.,* Oct. 1886), six injections into the pleural cavity, each containing 0.8 cubic centimeter of a 3 per cent. solution of hydrogen dioxide, were administered, but at the seventh the patient complained of faintness, the pulse failed, respiration became oppressed, and death occurred in ten minutes. As a local application to mucous membranes, the official solution should be used; the stronger solutions are sometimes too irritating.

Solution of hydrogen dioxide has come to be a common commercial preparation in 10 or 15 per cent. aqueous solutions. It is used for the purpose of cleaning and bleaching old and stained engravings and oil paintings. The dioxide has also been used as an auricome for bleaching dark colored hair. It is employed, moreover, in increasing degree in the textile industries for bleaching. Lunge has proposed its use in the ready valuation of chlorinated lime or bleaching powder, which is decomposed by it with the simultaneous liberation of oxygen from both substances in equal amount.

Dose, as given in the U. S. Pharmacopœia, one fluidrachm (3.75 Cc.).

Off. Prep.—Mangani Dioxidum Præcipitatum, *U. S.*

AQUA LAUROCERASI. Br.

CHERRY-LAUREL WATER

(ă'quạ lâu'rō-çĕr'ạ-sī)

Eau distillée de Laurier-cerise, *Fr. Cod.;* Kirschlorbeerwasser, *G.;* Agua destilada de laurel-cerezo, *Sp.*

"Fresh Cherry-Laurel Leaves, 1 *pound* (Imperial) or 320 grammes; Water, 2½ *pints* (Imp. meas.) or 1000 cubic centimetres. Place the crushed Cherry-Laurel Leaves with the water in a retort; distil one pint (or four hundred cubic centimetres) of liquid; shake the product; filter, if necessary; adjust the strength of the finished product either by adding hydrocyanic acid or by diluting the distillate with Distilled Water, so that, when tested as described under 'Acidum Hydrocyanicum Dilutum,' it shall contain one-tenth per cent. of hydrocyanic acid, HCN." *Br.*

It is greatly to be regretted that this uncertain, dangerous, and troublesome preparation should retain its place in European pharmacopœias, inasmuch as it could easily be replaced by a flavored water containing a definite amount of a soluble cyanide.

As the cherry-laurel is little cultivated in the United States, the water is not official; but from several experiments by William Procter there is little or no room to doubt that a preparation identical in its effects might be made from the leaves of our common wild cherry, *Prunus serotina.* The imported cherry-laurel water, as found in commerce, is generally impaired by age, and not to be relied on.

A. Ripping of Rotterdam, proposes to make an artificial cherry-laurel water by adding 6 grammes of oil of cherry-laurel and 4.5 grammes of potassium cyanide to a half-litre of water, and distilling the mixture in a tubulated retort, a current of carbonic acid gas being passed through it at the same time. The distillate is afterwards diluted with distilled water so as to contain one-tenth per cent. of hydrocyanic acid. (*A. Pharm.,* 1876, pp. 526-531.)

Cherry-laurel leaves contain 65 per cent. of water, sufficient to provoke the reactions which result in the formation of a volatile oil and hydrocyanic acid. Water is very prone to hasten the conversion of the volatile oil into benzoic acid by oxidation, and it has been found by C. Umney (*P. J.,* x. 467) and by Moore (*Ibid.,* 604) that the water distilled without previous maceration is somewhat stronger in hydrocyanic acid and decidedly stronger in oil (Umney) than the official product. The strength of official cherry-laurel water is so uncertain as to render it ineligible. It ought to be a powerful preparation, about one-twentieth the strength of the official hydrocyanic acid (Br. Ph.), and yet in commerce it varies as 53 to 100 (Umney). The difference depends upon the age of the preparation, the mode of preparing, and the time of year at which the leaves are gathered. Garot (*Ann. Thér.,* 1843, 45) has found that the leaves yield only half as much in July as in

April. C. Umney obtained 1.26 grains of acid in 1000 grains in March, in July 1.08 grains, and in November 0.64 grains. (*P. J.*, x. 468.) Moore, in an elaborate series of experiments, obtained the largest product in July of one year and in October of the next. Leger (*Ibid.*, June, 1873) has found the maximum percentage in July, and also that different leaves taken from the same bush on the same day vary enormously, young leaves being much richer than the old ones. The proportion of hydrocyanic acid in the water diminishes with time. It has been ascertained by Deschamps that if a drop of sulphuric acid be added to a pint of the preparation it will keep unchanged for at least a year. It is best preserved by the entire exclusion of air and light. Lepage found that, preserved in full and perfectly air tight bottles, both this and bitter almond water remained unchanged at the end of a year; while if freely exposed to the air, they lost all their hydrocyanic acid and essential oil in two or three months. (*J. P. C.*, xvi. 346.) In view of the uncertain strength of the water as obtained from the leaves, it was proposed in France, in reference to the Codex then in preparation, to fix upon a definite proportion of hydrocyanic acid; and the percentage generally adopted was from 0.04 to 0.05. For Denigés's method of assaying the water, see *Proc. A. Ph. A.*, 1894, 556.

Uses.—Cherry-laurel water is employed in Europe as a sedative narcotic, identical in its properties with a diluted solution of hydrocyanic acid; but it is of uncertain strength, and should not be allowed to supersede the more definite preparation of the acid now in use. Its fraudulent use in Paris in the preparation of a cordial, in imitation of the genuine cherry cordial, made by fermentation and distillation, and like it called "*kirsch*," has been the subject of no little reprobation. (*J. P. C.*, 4e sér., i. 33, 1865.)

Dose, thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

AQUA MENTHÆ PIPERITÆ. U. S., Br.

PEPPERMINT WATER

(ă'quạ mĕn'thæ pīp-ẹ-rī'tæ)

Eau distillée de Menthe poivrée, *Fr. Cod.*; Aqua Menthæ Piperitæ, *P. G.*; Pfefferminzwasser, *G.*; Acqua distillata di menta piperita, *It.*; Agua destilada de menta piperita, *Sp.*

* "Oil of Peppermint, *two cubic centimeters* [or 32 minims]; Purified Talc, *fifteen grammes* [or 231 grains]; Distilled Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Oil of Peppermint with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Peppermint Water is perfectly clear." *U. S.*

"Oil of Peppermint, 77 *minims* (Imperial measure) or 10 cubic centimetres; Water, 1½ *gallons* (Imp. meas.) or 15 litres. Distil two-thirds." *Br.* Used as a vehicle.

AQUA MENTHÆ VIRIDIS. U. S., Br.

SPEARMINT WATER

(ă'quạ mĕn'thæ vīr'ị-dīs)

Eau de Menthe verte, *Fr.*; Römisch-Minzwasser, *G.*; Agua de yerba buena, *Sp.*

* "Oil of Spearmint, *two cubic centimeters* [or 32 minims]; Purified Talc, *fifteen grammes* [or 231 grains]; Distilled Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Oil of Spearmint with the Purified Talc, add the Distilled Water gradually with continued trituration, filter, and pass the filtrate through the filter repeatedly until the Spearmint Water is perfectly clear." *U. S.*

"Oil of Spearmint, 77 *minims* (Imperial measure) or 10 cubic centimetres; Water, 1½ *gallons* (Imp. meas.) or 15 litres. Distil two-thirds." *Br.*

There would seem to be no good reason for distilling the mint waters from their respective volatile oils, as directed in the British processes. If the fresh plants were available, a good source for a distilled water could be provided; but if a volatile oil must be used with its uncertainty of freshness always present, the quicker process of the U. S. P. is greatly preferable.

The two mint waters are among the most grateful and most employed of this class of preparations. Together with cinnamon water, they are used in this country, almost to the exclusion of all others, as the vehicle of medicines given in the form of mixture. They serve not only to conceal or qualify the taste of other medicines, but also to counteract their nauseating properties. Peppermint water is generally thought to have a more agreeable flavor than that of spearmint, but some prefer the latter. Their effects are the same. Used as a vehicle.

AQUA PIMENTÆ. Br.

PIMENTO WATER

(ă'quạ pī-mĕn'tæ)

Eau de piment de la Jamaïque, *Fr.*; Nelkenpfefferwasser, *G.*

"Pimento, bruised, 8 *ounces* (Imperial) or 250 grammes; Water, 2 *gallons* (Imp. meas.) or 10 litres. Distil one-half." *Br.*

Pimento water is an agreeable aromatic water, used as a vehicle.

AQUA ROSÆ. U. S., Br.

ROSE WATER

(ă'quạ rō'sæ)

Eau distillée de Rose, *Fr. Cod.*; Aqua Rosæ, *P. G.*; Rosenwasser, *G.*; Acqua distillata di Rose, *It.*; Agua destilada de rosas, *Sp.*

* "Stronger Rose Water, Distilled Water, each, *one volume* [or 1 pint]. Mix them immediately before use." *U. S.* "The rose water of commerce,[1] prepared by distillation from the flowers of Rosa damascena, *Linn.*, diluted, immediately before use, with twice its volume of Distilled Water." *Br.*

The British Pharmacopœia of 1898 abandoned the former process of distilling the leaves and followed the method adopted by the U. S. Pharmacopœia of diluting the so-called triple rose water of commerce with distilled water. This, however, does not make rose water identical in strength in these authorities, the U. S. preparation being about 17 per cent. the stronger.

Although domestic rose water of fair quality may be made by distilling fresh rose petals, it does not possess the strength or delicacy of the by-product obtained from abroad, as officially described under *Aqua Rosæ Fortior;* hence the above process of diluting this stronger rose water. The process of distilling the fresh petals of the hundred-leaved rose is sometimes practised. These are usually preferred in the recent state; but it is said that, when preserved by being incorporated with one-third of their weight of common salt, they retain their odor, and afford a water equally fragrant with that prepared from the fresh flowers. Indeed, Haselden prefers the salted roses, believing that the water prepared from them is less mucilaginous, less apt to become sour, and keeps its odor better than that prepared from the fresh flowers. (*P. J.*, xvi. 15.) It is not uncommon to employ the whole flower, including the calyx; but the product is less fragrant than when the petals only are used, as officially directed. A. Monthus states that the petals of the hundred-leaved rose are more odorous the nearer they are to the centre of the flower, and, contrary to what is said in the text, thinks that the calyx should not be rejected in preparing the distilled water. He maintains that so far from injuring the product it in fact contributes to its preservation, and that the water obtained from the whole flower is less liable to that mucosity which is the commencement of decomposition. This effect he ascribes to the astringent matter of the calyx, coagulating the mucilaginous matter of the petals, and preventing it from passing over in the distillation. (*J. P. C.*, 1863, p. 497.) Rose water is sometimes made by distilling together water and the oil of rose. This is best performed by dropping 10 drops of oil of rose on a sponge and adjusting it in the upper part of a still in the body of which a gallon of water is placed; the steam from the boiling water will carry over portions of the oil, and the distillate will thus be impregnated. Alpers (*Am. Drug.*, 1896, 384) prepares rose water by dropping 10 drops of oil of rose into a liter of hot distilled water, agitating and filtering. Rauschenberger improves the flavor by adding a trace of oil of cloves; 2.5 Gm. of oil of rose, 0.25 Gm. of oil of cloves are added to sufficient alcohol to make 100 Cc.; then 10 Cc. of this solution is added to 1000 Cc. of boiling water and the liquid cooled and filtered.

Rose water when properly prepared, has the perfume of the rose in great perfection. It is most successfully made on a large scale. Like the other distilled waters, it is liable to spoil when kept; and the alcohol which is sometimes added to preserve it is incompatible with some of the purposes to which the water is applied, and is even said to render it sour through acetous fermentation. It is best, therefore, to avoid this addition, and to substitute a second distillation. It may be kept in a bottle stoppered with a plug of absorbent cotton. This distilled water is chiefly employed, on account of its agreeable odor, in collyria and other lotions. It is wholly destitute of irritating properties, unless it contain alcohol.

Off. Prep.—Mistura Ferri Composita, *U. S.*, *Br.*

[1] "The rose water of commerce is a saturated solution of the essential oil of the rose flowers." *Br.*

AQUA ROSÆ FORTIOR. U. S. (Br.)

STRONGER ROSE WATER [Triple Rose Water]

(ă'quạ rō'şæ fŏr'tĭ-ọr)

Rose Water of Commerce,[1] *Br.*, Aqua Rosæ, *U. S.* 1880; Stärkeres Rosenwasser, *G.*

"Water saturated with the volatile oil of rose petals, obtained by distillation. Stronger Rose Water should be kept in bottles loosely stoppered with a pledget of purified cotton, and in a dark place." *U. S.*

This has been introduced for the purpose of making rose water. (See article next above.)

"Stronger Rose Water should be colorless and clear, not mucilaginous, and should have the odor of roses, free from empyreuma. It should give no reaction with hydrogen sulphide T.S. or ammonium sulphide T.S. (absence of *metallic impurities*)." *U. S.*

Off. Prep.—Aqua Rosæ, *U. S.*, *Br.;* Confectio Rosæ, *U. S.;* Unguentum Aquæ Rosæ, *U. S.*, *Br.*

AQUA SAMBUCI. Br.

ELDER-FLOWER WATER

(ă'quạ săm-bū'cī)

Eau distillée de sureau, *Fr.;* **Fliederblumen (Holunderblüthen) Wasser,** *G.*

"Fresh Elder Flowers, 10 *pounds* (Imperial) or 5000 grammes (or an equivalent quantity of the flowers preserved, while fresh, with common salt); Water, 5 *gallons* (Imp. meas.) or 25 litres. Distil one-fifth." *Br.*

Elder flowers yield very little oil upon distillation; and, if the water be needed, it may be best prepared from the flowers. Haselden prefers the salted flowers to the fresh, for the reason stated under rose water. The preparation is little used in this country.

AQUÆ. U. S.

WATERS [Medicated Waters]

(ă'quæ)

Aquæ stillatitiæ; Distilled Waters; Eaux Medicinales, *Fr. Cod.*; Eaux distillées, Hydrolats, *Fr.*; Aquæ Destillatæ, *P. G.*; Destillirte Wässer, *G.*; Acque distillate, *It.*

"The Medicated Waters, when prepared from volatile oils, are intended to be, as nearly as practicable, saturated solutions, which must be clear, and free from solid impurities. In the processes which follow, the solution of the volatile oils is facilitated by the use of purified talc; but the solution may, if preferred, be aided by replacing the purified talc by pulped or shredded filter paper; waters may also be made by the addition of volatile oils to hot water and separation of the excess of the former, or by the distillation of the drug or volatile oil with water, if by either of these methods the finished product corresponds in all respects with official requirements." *U. S.*

Under this head are included, in the U. S. Pharmacopœia, all preparations consisting of water holding volatile or gaseous substances in solution, many of which were formerly obtained by distillation, and some of which still continue to be so. They include the preparations formerly specially designated as "Distilled Waters," having been made by distilling water from plants or parts of plants containing volatile oil.

The Distilled Waters, as thus defined, hold a much more prominent position in the pharmacy of Europe, particularly of continental Europe, than in that of the United States; and a great deal of thought and elaborate investigation has been bestowed there upon the various conditions calculated to furnish the best products by the most convenient method. It would be doing injustice to the subject not to give it a distinct consideration in a work like the present.

Many vegetable substances impart their peculiar flavor to water distilled from them, and more or less of their medicinal properties. The Distilled Waters chiefly used are those prepared from aromatic plants, the volatile oils of which rise with the aqueous vapor and are condensed with it in the receiver. But as water is capable of holding but a small proportion of the oil in solution, these preparations are generally feeble, and are employed chiefly as pleasant vehicles or corrigents of other medicines.

In the preparation of the Distilled Waters, dried plants are sometimes used, because fresh plants are not to be had at all seasons; but the latter, at least in the instance of herbs and flowers, should be preferred if attainable. Flowers which lose their odor by desiccation may be preserved by incorporating them intimately with one-third of their weight of common salt, and in this state afford Distilled Waters of delicate flavor. Some pharmacists prefer to employ the salted flowers in certain instances, believing that the waters distilled from them keep better than when prepared from the fresh flowers. C. R. Tichborne discovered a method of preserving flowers which is said to answer even better than the use of salt. It consists simply in immersing the fresh flowers in glycerin, which preserves them with all their aromatic properties wholly unimpaired. The flowers, as of the elder, rose, and orange, should be gathered after full expansion, and packed firmly in wide-mouthed bottles or jars, but without crushing them. The glycerin is then to be poured on until it covers them, and the vessel closed. Tichborne has kept flowers in this way for two years, and at the end of that time procured from them Distilled Waters, of which the perfume has equalled that of the waters prepared from recent flowers. It is not necessary that the glycerin should be perfectly pure, but it should be without odor. (*P. J.*, 2d ser., vii. 135.)

The idea at one time prevailed, to a considerable extent, that Waters kept better if distilled from dried herbs than from fresh, and the opinion was true in regard to those prepared with the defective alembics of former times and by a naked fire; but experiment has sufficiently established the fact that, with a suitable apparatus, and a regular heat, the fresh herbs yield products which not only have a more agreeable odor of the plant, but keep quite as well as those from dried herbs.

It is necessary to observe certain practical rules in conducting the process of distillation. When the substance employed is dry, hard, and fibrous, it should be mechanically divided, and macerated in water for a short time previous to the operation. The quantity of materials should not bear too large a proportion to the capacity of the alembic, as the water might otherwise boil over into the receiver. The water should be brought quickly to the state of ebullition, and continued in that state until the end of the process. Care should be taken to leave sufficient water undistilled to cover the whole of the solid matter, lest a portion of the latter, coming in contact with the sides of the vessel, be decomposed by the heat, and yield empyreumatic products. Besides, when the operation is urged too vigorously, or carried too far, a slimy matter is apt to form, which adheres to the sides of the still above the water, and is thus exposed to igneous decomposition. To obviate these disadvantages, the heat may be applied by means of an oil bath, regulated by a thermometer, or of a bath of solution of calcium chloride, by which any temperature may be obtained between 100° C. (212°F.) and 132.2° C. (270° F.), according to the strength of the solution; or, when the process is conducted upon a large scale, by means of steam introduced under pressure into a space around the still termed a "jacketed body." To prevent the disagreeable effects of charring, and the excessive empyreumatic odor frequently noticed in Distilled Waters, caused by

the solid contents of the still coming into direct contact with the heated bottom, Remington devised an expedient which prevents the herb from touching the bottom and yet permits the water and steam to have free access to all parts of it. (See Pharmaceutical Still, under *Extracta.*)



A hemispherical No. 12 copper sieve with a handle and loosely fitting lid is filled with the herb and placed in the water in the still. If the bottom of the still be flat or nearly so, the rounded bottom of the cage must have a very slight point of contact, and thus charring will be prevented. A convenient mode of applying heat by steam is by means of a coil of metal tubing placed in the bottom of the still, having one end connected with a boiler, and the other passing out beneath or at the side, and furnished with a steam-cock, by which the pressure may be increased or the condensed water drawn off at will. If any volatile oil floats upon the surface of the Distilled Water, it may be separated.[1]

From a series of experiments made in Paris in reference to the best mode of applying heat, it was concluded that as regards the great majority of aromatics the direct application of steam was preferable, because the Distilled Waters prepared by means of it have a freshness of aroma that is wanting in the others, are always free from the odor of the still, are much more limpid, are less apt to deposit mucilaginous matter, and keep better; but that exceptions to the general rule are afforded by bitter almonds, cherry-laurel leaves, mustard, and horse-radish, in all of which the oil does not pre-exist in the plant, but is formed upon contact with water; by woods, barks, and roots, the tissue of which cannot be sufficiently penetrated by steam; and by roses. (*J. P. C.*, Mai, 1861, p. 364.) Later experiments have led to the conclusion that even these substances are most advantageously treated by distillation with steam, and that, in fact, there is no exception to the rule.

But, however carefully the process may be conducted, the Distilled Waters prepared from plants always have at first an unpleasant smoky odor. They may be freed from this by exposure for a short time to the air before being enclosed in well-stoppered bottles, in which they should be preserved. When long kept, a viscid ropy matter is apt to form in them, and they become sour. This result has been ascribed to other principles, which rise with the oil in distillation and promote its decomposition. To prevent this decomposition, rectified spirit is sometimes added to the water employed in its distillation. But this addition is inadequate, and is in fact injurious, as the alcohol by long exposure to the air undergoes the acetous fermentation. A better plan is to redistil the Waters. When thus purified, it is said that they may be kept for several years unchanged.

Robiquet considered the mucosity which forms in Distilled Waters to be the result of a vegetative process, for which the presence of air is essential. He stated that so long as the water is covered with a layer of essential oil it undergoes no change, but that the oil is gradually altered by exposure to the air, and, as soon as it disappears, the water begins to be decomposed. He stated that camphor exercises the same preservative influence over the Distilled Waters by resisting the vegetation, and that those in which the odor of camphor is developed keep better on that account. Finally, he observed that the more Distilled Water is charged with volatile oil, the more abundant is the mucosity when it has begun to form. Robiquet united with Henry and Guibourt, and with Virey, in recommending that all these waters, when intended to be kept for a considerable time, should be introduced, immediately after distillation, into bottles of a size proportionate to the probable consumption of the water when brought into use, and that the bottles should be quite filled, and then sealed or otherwise well stoppered, so as entirely to exclude the air. It is best that they should be small, and be closed with well-fitting glass stoppers. Thus treated, the Waters may be preserved without change for many years. (*J. P. C.*, xxi. 402.) This view is opposed to the experience of large producers of Distilled Waters; we have seen at Grasse hundreds of carboys stored away, containing distilled rose and orange flower waters, not only uncorked, but having only a thin piece of muslin laid over the lips to exclude dust. We were informed by the distillers that the waters retained their qualities for years far better when treated in this

[1] This direction is generally given; but, in a communication to the Pharmaceutical Society of Great Britain, Haselden recommends the excess of oil to be well shaken with the water, and the whole to be transferred to the stock vessel, where it may be allowed to rest, and the oil to separate. He thinks the water keeps better when thus treated, and the full strength is always insured. The stock vessel he prefers made of stoneware, and furnished with a tap placed two inches from the bottom, whereby the water may be drawn off clear when wanted for the ordinary shop bottles, the oil rising to the top, or sinking to the bottom, according to its sp. gr. (*P. J.*, xvi. 14, 15.)

It is of some importance to know the proportion which the aromatic submitted to distillation ought to bear to the amount of Distilled Water obtained. The following statement upon this point, based upon experiments, is contained in the *J. P. C.* (Mai, 1861, p. 367.) Fresh aromatic plants requiring one part of the plant for one of product: wormwood, black cherry, scurvy-grass, hyssop, cherry-laurel, lavender, balm, mint, peach leaves, roses, and sage;—fresh and dry aromatic plants requiring one part of the plant for two of product: bitter almonds, orange flowers, melilot, horse-radish, elder, and tansy;—dry and very aromatic plants requiring one part of the plant for four of product: angelica, green anise, juniper berries chamomile, canella, cascarilla, fennel, sassafras, linden flowers and valerian. Haselden prefers the process of distillation from the aromatic itself in the instances of dill, caraway fennel, cinnamon, and pimento, which are not apt to afford to the distilled water such matter as may cause it to become sour; but he prefers trituration for peppermint, spearmint, and pennyroyal waters. Haselden advises, however, that these waters should not be filtered, but that they should be prepared in quantity, allowed to settle, and drawn off as wanted. (*P. J.*, xvi. 14, 15.)

way than if stoppered tightly. We have frequently noticed microscopic plants belonging to the *Confervoideæ* in the Distilled Waters contained in shop bottles standing on the shelves in the dispensing room, and if it be desired to keep Distilled Waters, the only sure way is to destroy the spores and prevent the admission of fresh ones by placing the bottles, filled to the lip with the Distilled Water, into a bath of boiling water, and, when thoroughly sterilized by the heat, inserting a plug of purified cotton if for immediate use; or if the waters are to be kept for a longer period, the well soaked corks should be driven into the mouths of the bottles, and immediately tied down, the top of the bottle dipped into melted sealing wax, and the bottles stored in a cool place.

Another mode of preparing the Distilled Waters is to substitute the volatile oil, previously separated from the plant, for the plant itself in the process. This mode is directed in the British Pharmacopœia in several instances. It is said to afford a more permanent product than the preceding, but does not always preserve the flavor of the plant.

In relation to most of the aromatic waters, the U. S. Pharmacopœia formerly directed that water should be impregnated with the volatile oil by trituration with magnesium carbonate, and subsequently filtered. This was by far the most simple and easy process. The resulting solution is nearly pure and permanent, and is perfectly transparent, the magnesium carbonate being separated by the filtration. Magnesium carbonate is preferable to magnesium oxide, as the latter sometimes gives a brownish color to the liquid, and requires to be used in larger proportion. But both these substances are dissolved in minute quantities, and are apt to occasion a slight flocculent precipitate. They may also possibly prove injurious by decomposing certain substances given in very small doses, as salts of the alkaloids, mercuric chloride, and silver nitrate. The object of the magnesium carbonate is simply to enable the oil to be brought to a state of minute division, and thus presented with a larger surface to the action of the solvent. Precipitated calcium phosphate was used in the U. S. P. 1890 as a substitute for magnesium carbonate, but this has been shown to be slightly soluble in water; notwithstanding this objection, its use was sanctioned by the U. S. Pharmacopœia of 1890. W. S. Thompson of Washington, D.C., suggested the use of absorbent cotton as being free from all of these objections, and his views were substantially adopted by the Committee of Revision of the Pharmacopœia of 1880. E. V. Zoeller proposes to use a hand cotton-card to aid in pulling the filaments of cotton apart when a large quantity of medicated water is needed. (*N. R.*, 1883, p. 56.) Experience has shown, however, that the use of an insoluble powder to effect the minute division of the particles of oil, so as to present a large surface to the solvent, is a more practical and convenient method of making medicated waters. According to Robert Warington, this object may be better accomplished by porcelain clay, finely powdered glass or pumice-stone, which are wholly insoluble; and the London College employed finely powdered silica for the purpose. Talc or soapstone in powder, purified by washing with diluted hydrochloric acid, was adopted by the Committee on National Formulary (1888). (See *Talcum Purificatum;* also paper recommending it by Curtman, *Proc. A. Ph. A.*, 1887.) The U. S. P. (8th Rev.) recommends the use of purified talc, although several alternative processes are allowed; *i.e.*, the shaking of the oil with hot water until saturated and afterwards filtering; the use of paper pulp; or the distillation from the volatile oil or drug macerated in water, but the finished water must in all cases correspond to the product resulting from the use of talc. A very good way to make medicated waters when a volatile oil is directed, is that proposed by Percival, which is to heat the water required, pour it into a bottle and add the oil, cork tightly, shake occasionally until cool, then pour off and filter; this secures a medicated water free from foreign substances, and a saturated solution, most oils being more soluble in hot than in cold water. The Dublin College prepared its Waters by agitating an alcoholic solution of the oil with distilled water, and filtering. They consequently contained alcohol, and were liable to the objection, already mentioned, against the medicated waters thus impregnated. They were, besides, feeble in the properties of their respective oils. In the preparation of the aromatic waters by these processes, it is very important that the water should be pure. The presence of a sulphate causes a decomposition of the oil, resulting in the production of hydrogen sulphide and a carbonate, and the aromatic properties are quite lost. (See *A. J. P.*, xix. 303.) Hence the propriety of the official direction to employ distilled water.

The Distilled Waters are liable to contain various metallic impurities, derived from the vessels in which they are prepared or preserved. The metallic salts which have been found in them are those of iron, zinc, copper, and lead. With potassium ferrocyanide, iron will give a blue color, zinc and lead white precipitates, and copper a rose color followed by a chestnut brown precipitate. Sodium sulphide causes with salts of iron, copper, or lead, a brown discoloration more or less deep, followed by precipitates varying from brown to black; with those of zinc a white precipitate. The Distilled Waters may be freed from these impurities by animal charcoal, previously well purified. The charcoal should be strongly shaken, eight or ten times in the course of a day, with the impure Water, which should then be allowed to rest, and the next day be filtered. Five grains of the charcoal will be sufficient for a gallon of the Distilled Water. (*J. P. C.*, Nov. 1862, p. 416.) The volatile oils may be re-

covered from the Waters containing them, or at least may be transferred to a spirituous menstruum, by mixing olive oil with the water, adding a little solution of potassium hydroxide so as to form a soap, and a consequent emulsion with the liquid, and then neutralizing by an acid. The fixed oil will rise to the surface, bringing the volatile oil along with it. The latter may then be separated from the former by agitation with alcohol. (T. P. Groves, *P. J.*, Feb. 1864.)

ARAROBA. Br.

ARAROBA

(ăr-ą-rō'bą)

"A substance found in cavities in the trunk of Andira Araroba, *Aguiar*, freed as much as possible from fragments of wood, dried and powdered." *Br.*

Crude Chrysarobin, Goa Powder, Poh di Bahia; Poudre de Goa, *Fr.*; Goa-Pulver, *G.*

Under the name of Chrysarobin, or Araroba, a medicine has long been used in Brazil; it is exported in considerable quantities to Portugal, whence it found its way through the Portuguese colonies into Eastern commerce. In the East Indies it is usually known as Goa Powder. Indeed, the identity of the two powders was first proved in 1875 by J. F. Dasilva Lima. (*P. J.*, v.) It has been supposed to be yielded by certain lichens, but was shown by R. A. Monteiro to be obtained from a leguminous tree abundant in the forests of the Brazilian province of Bahia, which was referred by E. M. Holmes to the genus Cæsalpinia, but which was determined by studies made in its native forests by J. M. de Aguiar, to be an undescribed Andira.

Andira Araroba, Aguiar, is a large tree, attaining a height of 100 feet, with a smooth trunk and a spheroidal, not very bushy head. The wood is yellowish, with numerous longitudinal canals, besides abundant irregular interspaces or lacunæ, in which the chrysarobin is deposited. (See *P. J.*, ix. 755; x. 42, 814.) The oldest trees yield the largest amount of the powder; the parts containing it are finely chipped or scraped off. The workmen who procure it often suffer severely from irritation of the eyes and face. As first obtained, chrysarobin is stated to be of a pale primrose yellow, but it rapidly darkens with age, so that in commerce it varies from a dull ochre to a dark chocolate or maroon-brown. It is sometimes a rather fine powder, but is usually more or less agglomerated, and not rarely contains fragments of woody tissue. It has been stated that Goa powder of late years is much weaker in its properties than that formerly obtained; this has been attributed to the scraping of the product from immature or young trees. This statement was not confirmed by the analysis of ten samples from the London market by Duncan and Tweedie. (*P. J.*, 1892, 543.) Its taste is bitter. It is insoluble in water and most menstrua, but yields as much as 80 per cent. of its weight to solutions of caustic alkalies and to benzene. The British Pharmacopœia requires that it should yield to hot *chloroform* not less than 50 per cent. of pure chrysarobin. Attfield analyzed Goa powder, and found, along with 2 per cent. of resin, 5.5 per cent. of woody fibre, 7 per cent. of bitter extractive, and from 80 to 84 per cent. of what he considered to be chrysophanic acid; but Liebermann and Siedler showed that this was not chrysophanic acid at all, but a substance easily convertible into the acid, which substance they called *chrysarobin,* and gave to it the formula $C_{30}H_{28}O_7$. (See *Chrysarobinum.*)

ARGENTI CYANIDUM. U. S.

SILVER CYANIDE

(ăr-gĕn'tī cȳ-ăn'į-dŭm)

$AgCN = 132.96$

"It should contain not less than 99.9 per cent. of pure Silver Cyanide, corresponding to 80.48 percent. of metallic silver. It should be kept in dark amber-colored vials, protected from light." *U. S.*

Cyanuret of Silver; Argentum Cyanatum; Cyanure d'Argent, *Fr.*; Cyansilber, Silbercyanid, *G.*

A process for preparing this salt is no longer official.

In the process of the U. S. P. 1870 all the silver contained in a given weight of silver nitrate, placed in a receiver in solution, is converted into cyanide by hydrocyanic acid, produced from potassium ferrocyanide by the action of sulphuric acid,

$$AgNO_3 + HCN = HNO_3 + AgCN$$

The materials in the retort are sufficient to produce a little more hydrocyanic acid than is necessary to convert the whole of the silver in the receiver into cyanide; so that the complete decomposition of the silver nitrate is insured. (See U. S. D., 18th ed., p. 223). Silver cyanide readily undergoes decomposition if exposed to the action of light. According to Glassford and Napier, the best way of obtaining silver cyanide is to add potassium cyanide to a solution of silver nitrate so long as a precipitate is formed.

Properties.—Silver cyanide is officially described as "a white powder, without odor or taste, permanent in dry air, but gradually turning brown on exposure to light. Insoluble in water, alcohol, or cold nitric acid, but soluble in boiling nitric acid with evolution of hydrocyanic acid; also soluble in ammonia water, sodium thiosulphate T.S., and potassium cyanide T.S. When heated in a porcelain crucible the salt fuses, gives off cyanogen gas, and, on ignition, leaves a residue of metallic silver amounting to 80.48 percent. of its original weight." *U. S.*

Its best solvent is potassium cyanide solution. It has no medicinal uses, but is official solely for the purpose of making hydrocyanic acid.

Off. Prep.—Acidum Hydrocyanicum Dilutum, *U. S.*

ARGENTI NITRAS. U. S., Br.

SILVER NITRATE

(är-gĕn'tī nī'trās)

$AgNO_3 = 168.69$

"It should contain not less than 99.9 per-cent. of pure Silver Nitrate, and should be kept in dark amber-colored vials, protected from light." *U. S.* "A salt, $AgNO_3$, prepared by the interaction of nitric acid and silver." *Br.*

Nitrate of Silver, Lunar Caustic; Azotas (Nitras) Argenticus; Azotate d'Argent cristallisé, *Fr. Cod.*; Nitre lunaire, *Fr.*; Argentum Nitricum Crystallisatum, *P. G.*; Salpetersaures Silberoxyd, Silbersalpeter, Silbernitrat, *G.*; Nitrato di argento cristallizzato, *It.*; Nitrato argentico cristalizado, Nitrato de plata, *Sp.*

The U. S. and Br. Pharmacopœias do not give processes for making this salt. The U. S. Pharmacopœia 1870 gave the following: "Take of Silver, in small pieces, *two troyounces;* Nitric Acid *two troyounces and a half;* Distilled Water *a sufficient quantity.* Mix the Acid with a fluidounce of Distilled Water in a porcelain capsule, add the Silver to the mixture, cover it with an inverted glass funnel, resting within the edge of the capsule, and apply a gentle heat until the metal is dissolved, and red vapors cease to be produced; then remove the funnel, and, increasing the heat, evaporate the solution to dryness. Melt the dry mass, and continue the heat, stirring constantly with a glass rod, until free nitric acid is entirely dissipated. Dissolve the melted salt, when cold, in six fluidounces of Distilled Water, allow the insoluble matter to subside, and decant the clear solution. Mix the residue with a fluidounce of Distilled Water, filter through paper, and, having added the filtrate to the decanted solution, evaporate the liquid until a pellicle begins to form, and set it aside in a warm place to crystallize. Lastly, drain the crystals in a glass funnel until dry, and preserve them in a well-stoppered bottle. By evaporating the mother-water, more crystals may be obtained." *U. S.* 1870.

In the above process two details deserve notice. One of these is the direction to cover the materials in the evaporating dish, during the continuance of the reaction, with a glass funnel. This is in order to prevent the escape of fumes and to economize the nitric acid, a portion of which rises in vapor, and, being condensed on the inner surface of the funnel, falls again into the dish. The second detail is the fusion of the salt before being dissolved; the effect is to decompose any copper nitrate that might have been derived from the silver, which, if coin be employed, always contains copper. The heat decomposes the copper nitrate, and the comparatively insoluble oxide is formed, which remains on the filter when the mass is subsequently dissolved in water and filtered, the silver nitrate not being decomposed by the heat used.

A practical method used in Calcutta for separating the copper nitrate depends upon the fact that strong nitric acid only slightly dissolves silver nitrate in the presence of copper nitrate. The silver nitrate is crystallized out from the first solution as long as it can be obtained pure, and the bluish-green mother liquor is evaporated to dryness; the powdered salt, placed in a funnel stopped with asbestos, is percolated with nitric acid (sp. gr. 1.42). This washes out all of the copper nitrate, and the silver nitrate can be freed from the adhering nitric acid by heat. (*P. J.*, 1897, 61.)

During the solution of silver in nitric acid, part of the acid is decomposed and nitric oxide is given off, which becomes red by contact with the atmosphere, and the oxygen oxidizes the silver. This is taken up by the remainder of the acid, and produces silver nitrate in solution, which, by due evaporation, furnishes crystals of the salt. The silver should be pure, and the acid diluted for the purpose of promoting its action. If the silver contain copper, the solution will have a greenish tint, not disappearing on the application of heat; and if a minute portion of gold be present, it will be left undissolved as a black powder. The acid also should be pure. The commercial nitric acid, as it frequently contains both hydrochloric and sulphuric acids, should never be used. The hydrochloric acid gives rise to an insoluble chloride, and the sulphuric, to the sparingly soluble silver sulphate. It is desirable that pure silver, free from copper, should be used in this process. As silver coin always contains copper, it should be purified before being employed. For this purpose, according to the method of Lienau, it should be dissolved in nitric acid, and the solution precipitated by chlorine water, which throws down the silver only in the form of chloride. The precipitate is to be well washed with chlorine water, then dissolved in solution of ammonia, and precipitated by clean copper wire. The silver is deposited as a black powder, which, when washed with solution of ammonia, is perfectly pure. (*A. J. P.*, 1862, p. 368.) For an account of the manufacture of silver nitrate, see *D. C.*, 1887, p. 3.

Properties.—Silver nitrate is in "colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in the presence of organic matter; without odor, but having a bitter, caustic, and strongly metallic taste. Soluble in 0.54 part of water, and in 24 parts of alcohol at 25° C. (77° F.); in 0.1 part of boiling water, and in 5 parts of boiling alcohol. When heated in a porcelain crucible to about 200° C. (392° F.), the salt melts, forming a faintly yellow liquid, which, on cooling, congeals to a pure white, crystalline mass. At a higher temperature it is gradually decomposed with evolution of nitrous vapors." *U. S.*

"Soluble in ether and glycerin." *Br.* The solution stains the skin an indelible black color, and is itself discolored by the most minute portion of organic matter, for which it forms a delicate test. The affinity of this salt for animal matter is evinced by its forming definite compounds with albumin and fibrin. The solution also stains linen and muslin in a similar manner, and hence its use in making the so-called indelible ink. To remove these stains, W. B. Herapath advises to let fall on the moistened spots a few drops of tincture of iodine, which converts the silver into silver iodide. The iodide is then dissolved by a solution of sodium thiosulphate, made with from half a drachm to a fluidounce of water, or by a moderately diluted solution of potassium hydroxide, and the spots are washed out with warm water. Silver stains may also be taken out by a solution of two and a half drachms of potassium cyanide, and fifteen grains of iodine, in three fluidounces of water. H. Kraetzer recommends, instead of potassium cyanide, a solution of 10 parts ammonium chloride and 10 parts corrosive sublimate in 100 parts of water, with which the stains are said to be removed readily from the hands, and from linen, wool, and cotton without injuring the fabric. (*A. Pharm.*, 1880, 52.) Silver nitrate is incompatible with most spring and river waters, on account of a little common salt usually contained in them; with soluble chlorides; with hydrogen sulphide, sulphuric, hydrochloric, and tartaric acids, and their salts; with the alkalies and their carbonates; with lime water, and with astringent infusions. It is sometimes improperly prescribed in pill with tannic acid, by which it is decomposed. Silver nitrate is an anhydrous salt, consisting of one atom of silver, combined with the monatomic group characteristic of nitric acid.

Impurities and Tests.—Hydrochloric acid or a solution of sodium chloride, added in excess to one of silver nitrate, should throw down the whole of the silver as a white curdy precipitate (darkening on exposure to light), and nothing besides. This precipitate should be entirely soluble in ammonia. If not so, the insoluble part is probably lead chloride. If the supernatant liquid, after the removal of the precipitate, be discolored or precipitated by hydrogen sulphide, the fact shows the presence of metallic matter, which is probably copper or some remains of lead, or both. The solution, after precipitation by hydrochloric acid and filtration, should leave no residue when evaporated. A piece of the salt, heated on charcoal by the blow-pipe, melts, deflagrates, and leaves behind a whitish metallic coating. After all, the best sign of the purity of silver nitrate is the characteristic appearance of the crystals. "An aqueous solution of the salt is neutral to litmus paper, and yields, with hydrochloric acid, a white precipitate, which is readily dissolved by ammonia water, the liquid not acquiring a blue color (absence of *copper*). If 5 Cc. of an aqueous solution of the salt (1 in 10) be mixed with 20 Cc. of hot diluted sulphuric acid, and heated to boiling, no turbidity should be perceptible, and upon standing, no white precipitate should be deposited (absence of *lead*). If a portion of an aqueous solution (1 in 10) be completely precipitated by hydrochloric acid, filtered, and the filtrate evaporated to dryness, no residue should be left (absence of *foreign salts*). If 0.5 Gm. of Silver Nitrate, dissolved in 10 Cc. of distilled water, be well mixed with 30 Cc. of tenth-normal sodium chloride V.S. and 3 drops of potassium chromate T.S., not more than 0.4 Cc. of tenth-normal silver nitrate V.S should be required to impart to the liquid a permanent red color." *U. S.* "1 gramme dissolved in 15 cubic centimetres of *water* affords with *hydrochloric acid* a precipitate, which, when thoroughly washed and dried, should weigh 0.843 gramme. The filtrate, when evaporated to dryness on a water-bath, should leave no residue." *Br.*

Uses.—When silver nitrate in a pure state is brought in contact with a living tissue, it acts as an escharotic. Owing to the formation of a dense film of coagulated albumin, the depth of its action is very limited; the albuminous coating is at first white, but soon becomes blackish, owing to the reduction of the silver. The aqueous solution of the salt is, if not too strong, a local stimulant and astringent, and is very largely employed (20 grains in a fluidounce) in ordinary *angina*, or more concentrated (30 grains in a fluidounce) in *diphtheria*, and is also used in *inflammations of the urethral and conjunctival mucous membrane;* for the latter purpose the strength should usually not exceed one or two grains to the ounce. As a counter-irritant, stimulant, and alterative, or an escharotic in various *external ulcerations, morbid growths*, etc., silver nitrate finds a very wide use. It is largely employed, also, internally in *inflammations* and *ulcerations* of the *alimentary tract*, such as *subacute gastritis, pyrosis, ulcer of the stomach, chronic diarrhœa, catarrh of the gall ducts*, etc. In all stomachic diseases it should be given half an hour before eating, so as to reach as thoroughly as possible the gastric mucous membrane. Boudin of Marseilles, employed it in *typhoid fever*, and Wm. Pepper followed this practice with asserted brilliant results. As it has been found in all the tissues of the body, it is undoubtedly absorbed. It is soluble in peptones, and is probably so taken up, although some believe that it is converted in the stomach into a soluble double chloride with sodium or potassium. It is never used in practical medicine to produce an acute impression on the general system, but was at one time much employed as a slowly acting alterative in certain nervous affections, especially *epilepsy* and *chronic spinal inflammations*, such as *locomotor ataxia, spasmodic tabes, tabes dorsalis*, etc., but this method of treatment has about passed out of vogue. The occasional production of a slate-colored discoloration of the skin is a great drawback to the long-con-

tinued use of the nitrate, but it probably never occurs under a course of the remedy of less than two months. It affects also the mucous membrane, and, according to Branson (confirmed by Wm. Pepper), an indication of the approach of discoloration is furnished by the occurrence of a dark blue line on the edges of the gums, very similar to that produced by lead, but somewhat darker. When once produced, the discoloration seems to be permanent, although L. P. Yandell has reported two cases in which the discoloration of the skin disappeared during a course of potassium iodide. (*N. R.*, July, 1873.)

For internal exhibition, the physician should always prescribe the crystals, and never direct the fused nitrate, which may not be pure. Silver nitrate should always be given in pill, as the solution is decomposed by the liquids of the mouth. It should not be made up into pill with crumb of bread, as this contains common salt, but with some vegetable powder and mucilage, preferably powdered sugar of milk with an excipient of glycerite of starch. But, as all organic substances decompose it more or less, Vée proposes the use of inorganic matter, such as potassium nitrate, or preferably pure silica obtained by precipitating one of the silicates by an acid, and washing it. The least possible proportion of tragacanth may be used to give adhesiveness to the mass. (*J. P. C.*, Mai, 1864, p. 408.)

When ingested in sufficient dose, silver nitrate is a violent poison, and has several times caused death. The symptoms are those of toxic gastro-enteritis, with marked constitutional disturbance, especially coma, convulsions, paralysis, and profound alteration of the respiration. The treatment of the poisoning resolves itself into the use of the ordinary antidotes (common salt, soap, alkalies, etc.), and the use of stimulants to maintain the circulation if needed.

Dose, one-fourth to one-half grain (0.016 to 0.032 Gm.).

Off. Prep.—Argenti Nitras Fusus, *U. S.* (*Br.*); Argenti Nitras Mitigatus, *U. S.*, *Br.*

ARGENTI NITRAS FUSUS. U. S. (Br.)

MOULDED SILVER NITRATE [Fused Silver Nitrate, Lunar Caustic, Toughened Caustic]

(är-gĕn'tī nī'trās fū'sŭs)

Argenti Nitras Induratus, *Br.*; Fused Nitrate of Silver, Lapis Infernalis, Argentum Nitricum Fusum; Crayons d'Azotate d'Argent, *Fr. Cod.*; Azotas (Nitras) Argenticus Fusus; Azotate d'Argent fondu, Pierre infernale, *Fr.*; Gehärteter Höllenstein, Geschmolzenes Salpetersaures Silberoxyd, Silbernitrat, *G.*; Nitrato di argento fuso, *It.*; Nitrato argentico fundido, Piedra infernal, *Sp.*

* "Silver Nitrate, *one hundred grammes* [or 3 ounces av., 231 grains]; Hydrochloric Acid, *four grammes* [or 62 grains]. To the Silver Nitrate, contained in a porcelain dish, add the Hydrochloric Acid, and melt the mixture at as low a temperature as possible. Stir well, and pour the melted mass into suitable moulds. It should be kept in dark amber-colored vials, protected from light." *U. S.*

"Silver Nitrate, 475 *grains* (Imperial) or 95 grammes; Potassium Nitrate, 25 *grains* (Imp.) or 5 grammes. Fuse and mix thoroughly in a capsule of platinum or thin porcelain, and pour the melted mass into proper moulds." *Br.*

For most purposes it is desirable to have the silver nitrate less brittle than in its pure state. J. L. Smith of Louisville, Ky., found that this could be effected by adding a little silver chloride, which rendered the stick tough, without materially impairing its efficiency. E. R. Squibb proposed to accomplish the object by adding 40 grains of hydrochloric acid, with half a fluidounce of distilled water, to two ounces of silver nitrate, heating the mixture by means of a sand bath to dryness, and then melting and casting into moulds. (*Proc. A. Ph. A.*, 1858.) This process has been practically adopted in the U. S. Pharmacopœia. In order to keep the sticks from becoming discolored during the casting process, it is advisable to add a diluted nitric acid (1 in 5) occasionally to the melted nitrate, and carefully prevent the mass from becoming overheated. In the British process the "toughening" is effected by the addition of 5 per cent. of potassium nitrate. In our opinion, this is not as efficient as is the use of hydrochloric acid. As the salt while melting penetrates a common crucible, the fusion is performed in one of porcelain or platinum, the size of which should be sufficient to hold five or six times the quantity of the salt operated on, in order to prevent its boiling over. Sometimes small portions of the liquid are spurted out, and the operator should be on his guard against this occurrence. When the mass flows like oil, it is completely fused, and ready to be poured into the moulds. These should not be greased, as the organic matter would partially decompose the fused salt.

Properties.—Moulded silver nitrate, as prepared by the above process, is in the form of hard brittle sticks of the size of a goose quill, at first translucent, but quickly becoming gray or more or less dark under the influence of light, owing to the reduction of the silver, through organic matter or conversion through hydrogen sulphide contained in the atmosphere. That the change does not depend on the sole action of light has been proved by Scanlon, who finds that silver nitrate in a clean glass tube hermetically sealed undergoes no change by exposure to light. The sticks often become dark colored and nearly black on the surface, and when broken across, exhibit a crystalline fracture with a radiated surface. Fused silver nitrate, when pure, is wholly soluble in distilled water; but even fair samples of the moulded salt will not totally dissolve, a very scanty black powder being left of reduced silver, arising probably from the salt having been exposed to

too strong a heat in fusion. Stein (*S. W. P.*, 6, 10, 1877) recommends a plan for obtaining sticks of lunar caustic of special diameter or length by taking a glass tube or rod of the required outside diameter and wrapping around it moistened parchment paper, pasting the edges, tying the lower end, and drying. The melted lunar caustic is poured into the paper mould, held upright in a test tube, and allowed to cool by standing. *Elastic crayons* of silver nitrate may be made by taking a laminaria tent 1-10th of an inch (0.002 Mm.) in diameter, dipping it into thick mucilage, rolling it in finely powdered lunar caustic, and drying it. (Pajot.) Entirely black lunar caustic is sometimes seen in France, which contains about 2 per cent. of potassium nitrate and the same quantity of black manganese oxide. *Heller's caustic pencils* look like ordinary lead pencils, and consist of long, thin sticks of lunar caustic, encased in wood; they may be sharpened like lead pencils, and the point protected by a cap to prevent injury when not in use. "A white, hard solid, generally in the form of pencils or cones of a fibrous fracture, becoming gray or grayish-black on exposure to light in the presence of organic matter; odorless, and having a bitter, caustic, and strongly metallic taste. Soluble, with the exception of about 5 percent. of silver chloride, in 0.54 part of water, and in 24 parts of alcohol at 25° C. (77° F.); in 0.1 part of boiling water, and in 5 parts of boiling alcohol. The portion left undissolved by water should be completely soluble in ammonia water." *U. S.*

Impurities and Tests.—Moulded silver nitrate is liable to contain free silver from having been exposed to too high a heat, lead and copper nitrates from the impurity of the silver dissolved in the acid, and potassium nitrate from fraudulent admixture or otherwise. Free silver will be left undissolved as a black powder, after the action of distilled water. A very slight residue of this kind is hardly avoidable; but if there be much free silver it will be shown by the surface of a fresh fracture of one of the sticks presenting an unusually dark gray color. The mode of detecting lead and copper is explained under silver nitrate. (See *Argenti Nitras.*) "A clear, aqueous solution of Moulded Silver Nitrate, decanted from the insoluble portion, should be neutral to litmus paper, and should respond to the tests of identity and purity stated under *Argenti Nitras.* If 0.5 Gm. of Moulded Silver Nitrate, dissolved as completely as possible in 10 Cc. of water, be thoroughly mixed with 30 Cc. of tenth-normal sodium chloride V.S. and 3 drops of potassium chromate T.S., not more than 1.9 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red color." *U. S.* In order to detect potassium nitrate, a solution of the suspected salt should be treated with hydrochloric acid in excess, to remove silver, and with hydrogen sulphide, to throw down other metals if they happen to be present. The filtered liquid, if the salt be pure, will entirely evaporate by heat; if it contains potassium nitrate, this will be left, easily known by its properties as a nitrate. This impurity sometimes exists in moulded silver nitrate in large amount, varying, according to different statements, from 10 to 75 per cent. (See *Argenti Nitras Mitigatus.*) According to Christison, it may be suspected if the sticks present a colorless fracture. Pollacci (*J. P. C.*, 4e sér., xvii. 160), states that if silver nitrate, after having been heated in a porcelain capsule to redness and cooled, imparts an alkaline reaction to water, it contains nitre. In the Br. Pharmacopœia the following method is given for testing toughened silver nitrate for impurity; the British preparation contains no hydrochloric acid. "1 gramme, dissolved in 15 cubic centimetres of *water,* should yield with *hydrochloric acid* a precipitate which, when washed and dried, should weigh 0.8 gramme, and the filtrate when evaporated should leave a white residue."

Uses.—Moulded silver nitrate should be restricted to external use. Externally applied, the moulded nitrate acts variously as a stimulant, vesicant, and escharotic, and may be employed either dissolved in water or in the solid state. A drachm of the moulded salt, dissolved in a fluidounce of water, forms an escharotic solution, which may often be resorted to with advantage. But moulded silver nitrate is most frequently employed in the solid state; and, as it is not deliquescent nor apt to spread, it forms the most manageable caustic that can be used. If the moulded nitrate be rubbed gently over the moistened skin until this becomes gray, it generally vesicates, causing usually less pain than is produced by cantharides. The fused nitrate is also employed to destroy *strictures of the urethra, warts and excrescences, fungous flesh, incipient chancres,* and the surface of other *ulcers.*

It is often of service lightly applied, either in concentrated solution or in stick, to ulcers in expediting their cicatrization. It is very largely employed in the local treatment of *inflammations of the mucous membrane,* as in *cystitis, leucorrhœa, gonorrhœa, conjunctivitis, faucitis, laryngitis,* etc. In these cases the strength of the solution must be adapted to the susceptibility and the exact condition of the membrane. In cases of intense and especially of specific inflammations, the solution may be a saturated one, the object being to destroy the specific granulations; thus, in *gonorrhœal conjunctivitis,* and in virulent *diphtheria faucitis,* even the solid stick is used by some practitioners, whereas in ordinary conjunctivitis the strength should rarely be above one or two grains to the ounce, and in faucitis twenty to forty grains to the ounce. Strong solutions of silver nitrate are sometimes used for the *aborting of a gonorrhœa,* but the treatment is usually considered dangerous, as liable to increase the intensity of the inflammation if unsuccessful.

In the advanced stages of gonorrhœa a solution of three to five grains to the ounce may be injected.

Lunar caustic is also frequently used as a topical remedy in various superficial inflammations. The method originated in 1820, by John Higginbottom, of treating *erysipelas* by silver nitrate still finds favor with some of the profession. After thorough washing of the skin with soap and water, and afterwards with pure water, and subsequent drying, a concentrated solution of twenty grains of silver nitrate to a drachm of distilled water is applied freely on the inflamed surface and beyond it on the healthy skin by means of a linen mop. In various inflammations of the subcellular tissues silver nitrate often acts advantageously; thus, applied to the skin in sufficient concentration to blacken the surface, it will sometimes avert a *felon* or an *epididymitis*. It has been employed by injection for the radical cure of *hydrocele*, and in solid stick applied as a fine point to each *pustule of small-pox* upon the face for the prevention of pitting.

ARGENTI NITRAS MITIGATUS. U. S., Br.

MITIGATED SILVER NITRATE [Argenti Nitras Dilutus, Pharm. 1890, Diluted SilverNitrate, Mitigated Caustic]

(ăr-ǧĕn'tī nī'trăs mĭt-ĭ-gā'tŭs)

"It should contain not less than 33.3 percent. of pure Silver Nitrate." *U. S.*

Silver and Potassium Nitrate; Lapis infernalis nitratus; Crayons d'Azotate d'Argent mitigé, Pierre infernale diluée, *Fr.*; Argentum Nitricum cum Kalio nitrico, *P. G.*; Salpeterhaltiges Silbernitrat, Salpeterhaltiger Höllenstein, *G.*; Nitrato di argento fuso con nitrato di potassio, *It.*; Nitrato argentico mitigado, Piedra infernal mitigada, *Sp.*

* "Silver nitrate, *thirty grammes* [or 463 grains]; Potassium Nitrate, *sixty grammes* [or 2 ounces av., 51 grains]. Melt the salts together in a porcelain crucible, at as low a temperature as possible, stirring the melted mass well until it flows smoothly. Then pour it into suitable moulds. It should be kept in dark amber-colored vials, protected from light." *U. S.*

"Silver Nitrate, 1 *ounce* (Imperial) or 20 grammes; Potassium Nitrate, 2 *ounces* (Imp.) or 40 grammes. Fuse and mix thoroughly in a capsule of platinum or thin porcelain, and pour the melted mass into proper moulds." *Br.*

The introduction of these preparations grew out of the frequent demand for a fused silver nitrate which would not be so severe in its action as the pure article. The manufacturers have been furnishing for many years a "*No. 2 Lunar Caustic*," which contains 67 per cent. of pure silver nitrate; the diluted nitrate of the U. S. P. 1880 contained 50 per cent. of lunar caustic, but the present Pharmacopœia has further reduced the strength to 33.3 per cent., and it is now identical with the British preparation.

Properties.—Mitigated silver nitrate is officially described as "a white, hard solid, generally in the form of pencils or cones of a finely granular fracture, becoming gray or grayish-black on exposure to light in the presence of organic matter; odorless, and having a caustic, metallic taste. Its aqueous solution is neutral to litmus paper. Each of its constituents retains the solubility in water and in alcohol stated respectively under *Argenti Nitras* and *Potassii Nitras*. An aqueous solution of Mitigated Silver Nitrate yields with a slight excess of hydrochloric acid a white precipitate, which is readily soluble in ammonia water. The filtrate from this precipitate, when evaporated to dryness, yields a white residue which is completely soluble in water, and this solution, when concentrated, affords a white, crystalline precipitate with sodium bitartrate T.S. If 1 drop of diphenylamine T.S. be mixed with 5 Cc. of an aqueous solution of the salt in a test-tube, and sulphuric acid be carefully poured in, so as to form a separate layer, a blue color will appear at the line of contact. If to an aqueous solution of Mitigated Silver Nitrate a slight excess of ammonia water be added, it should neither assume a blue color (absence of *copper*), nor show any turbidity (absence of *lead* and *bismuth*.) If 1 Gm. of Mitigated Silver Nitrate, dissolved in 10 Cc. of water, be well mixed with 20 Cc. of tenth-normal sodium chloride V.S. and 3 drops of potassium chromate T.S., not more than 0.3 Cc. of tenth-normal silver nitrate V.S. should be required to impart to the liquid a permanent red color." *U. S.*

"White or grayish-white cylindrical rods or cones; freely soluble in *water*, but only sparingly so in *alcohol* (90 per cent.). . . 3 grammes dissolved in 15 cubic centimetres of *water* should afford with *hydrochloric acid* a precipitate, which, after washing with hot *water* and drying, weighs 0.843 gramme." *Br.*

Uses.—This preparation is used only externally. It is similar in its action to the fused nitrate, but less energetic.

ARGENTI OXIDUM. U. S., Br.

SILVER OXIDE

(ăr-ǧĕn'tī ŏx'ĭ-dŭm)

$Ag_2O = 230.12$

"It should contain 99.8 percent. of pure Silver Oxide, corresponding to not less than 92.9 percent. of pure metallic silver, and should be kept in dark amber-colored vials. Silver Oxide should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia." *U. S.*

"Silver Oxide, Ag_2O, is prepared by mixing solutions of silver nitrate and calcium hydroxide." *Br.*

Argentum Oxydatum, Argentic Oxide; Oxyde d'Argent, *Fr.*; Silberoxyd, *G.*

A process for preparing silver oxide has not been adopted in either of the present U. S. or Br. Pharmacopœias; that of the U. S. Pharmacopœia of 1870 is as follows: "Take of Nitrate of Silver *four troyounces;* Distilled Water *half a pint;* Solution of Potassa *a pint and a half,* or *a sufficient quantity.* Dissolve the Nitrate of Silver in the Water, and to the solution add Solution of Potassa so long as it produces a precipitate. Wash this repeatedly with water until the washings are nearly tasteless. Lastly, dry the precipitate and keep it in a well-stopped bottle, protected from the light." *U. S.* 1870.

Silver oxide was introduced into the U. S. Pharmacopœia of 1850, and was adopted in the Br. Pharmacopœia from the Dublin. In the processes for making it, silver nitrate is decomposed by potassium hydroxide or lime, the oxide being precipitated, and potassium nitrate or calcium nitrate, as the case may be, remaining in solution. When thus obtained, the oxide is an olive-brown powder. If the potassium hydroxide used be not wholly free from carbon dioxide the precipitated oxide will be contaminated with some silver carbonate. According to Borland of London, the carbonate is sometimes sold for the oxide. A third process for obtaining this oxide is that of Gregory, which consists in boiling the moist, recently prepared silver chloride with a very strong solution of potassium hydroxide (sp. gr. 1.25 to 1.30), when by double decomposition, silver oxide and potassium chloride are formed.

Properties and Tests.—"A heavy, dark brownish-black powder, liable to reduction by exposure to light, odorless, and having a metallic taste. Very slightly soluble in water, to which it imparts an alkaline reaction; insoluble in alcohol; it is readily and completely soluble in nitric acid without effervescence (absence of *carbonate* or *chloride*). When heated in a porcelain crucible to about 250° to 300° C. (482° to 572° F.), it is rapidly decomposed, with the evolution of oxygen, leaving a residue of metallic silver. The solution of the Oxide in nitric acid should be colorless, and should respond to the reactions and tests stated under *Argenti Nitras.* If 0.5 Gm. of the Oxide be ignited in a porcelain crucible, it should yield not less than 0.464 Gm. of pure metallic silver." *U. S.*

"A brown powder, which at a low red heat gives off oxygen and yields metallic silver. It dissolves in *nitric acid* without the evolution of any reddish fumes (absence of metallic silver). Each gramme, dissolved in *nitric acid,* should yield with *hydrochloric acid* a precipitate, which when thoroughly washed and dried, weighs 1.237 grammes. It should yield no characteristic reaction with the tests for lead, copper, or iron. Silver Oxide is liable to decompose with violence when mixed with creosote, phenol, potassium permanganate, and many other substances." *Br.* When its solution in nitric acid is precipitated by sodium chloride in excess, the supernatant liquid is not discolored by ammonium sulphide. The non-action of this test shows the absence of most foreign metals, especially copper and lead. It parts with its oxygen with great facility, being decomposed by many organic substances; in this way it causes sulphur, amorphous phosphorus, or tannin to take fire when rubbed together with it quite dry, in a mortar.

Uses.—This oxide has been proposed as a substitute for silver nitrate, as having the general therapeutic virtues of the latter, without its escharotic effect and its objectionable property of discoloring the skin. Experience, however, has shown that it will tint the skin. (*N. Y. M. J.,* June, 1869; *P. M. T.,* vi.) It may be used in gastric and other catarrhs but is inferior to the nitrate. If pills are ordered, they should not be made with honey, confection of rose, or other excipient containing glucose; and, indeed, most organic substances, especially in a moist state, deoxidize the oxide, reviving the silver. A case is recorded in which pills containing it exploded violently in the pocket of the patient. (See Jackson, *P. J.,* xi. 552.) An ointment from five to ten grains to the drachm, has been used as an application to *venereal sores,* and to the urethral membrane in *gonorrhœa;* it should be smeared on a bougie.

Dose, one grain (0.065 Gm.).

ARGENTUM

SILVER

(är-gĕn'tum)

Ag = 107.12

Argentum purificatum; Argent raffiné, Argent, *Fr.;* Silber, Raffinirtes Silber, *G.;* Argento, *It.;* Plata, *Sp.*

Silver is found at times in the metallic state, usually crystallized, also associated with gold, antimony, arsenic, or mercury; but usually it occurs as a sulphide, pure or mixed with other sulphides, as those of copper, lead, and antimony. It is sometimes found as a chloride.

The most productive mines of silver are found on this continent, being those of Mexico and Peru and our own Rocky Mountain States and Territories; the richest in Europe are those of Norway, Hungary, and Transylvania. Mines have been opened and profitably worked in California and Nevada, but at present it is chiefly Colorado and Montana which furnish the great bulk of the American silver production. Idaho, Utah, and Arizona also contain very rich silver deposits. The principal ore is the sulphide. The mineral containing silver which is most disseminated is argentiferous galena, which is lead sulphide containing a little silver sulphide. Argentiferous galena exists in several localities in the United States. Native silver is associated, in small quantities, with the native copper of the Lake Superior region, and a little of it has come into the market. The two metals, though more or less mixed, are yet quite distinct, never being alloyed to any con-

siderable extent, showing conclusively that the deposits have not undergone igneous fusion at any time, but that the metals have deposited from solution. The production of silver in the United States for 1902 was 55,500,000 troyounces, valued at $29,415,000; for 1903, 54,300,000 troyounces, valued at $29,322,000, and for 1904, 53,603,000 troyounces, valued at $30,982,534. The United States production is exceeded only by that of Mexico and these two countries furnish almost exactly two-thirds of the world's production of silver.

Extraction.—Silver is extracted from its ores by two principal processes, *amalgamation* and *cupellation*. When the ore is principally the sulphide, it is mixed with a tenth of sodium chloride and roasted in reverberatory furnaces. As fast as the sulphide is oxidized to sulphate, this reacts with the sodium chloride, forming silver chloride and sodium sulphate. The roasted mass is then reduced to very fine powder, mixed with half its weight of mercury, ⅓ of its weight of water, and about 1–17th of iron in flat pieces, and subjected for sixteen or eighteen hours to constant agitation in barrels turned by machinery. The chlorine combines with the iron, and remains in solution as iron chloride, while the reduced silver forms an amalgam with the mercury. The amalgam is then subjected to pressure in leather bags, through the pores of which the excess of mercury passes, a solid amalgam being left behind. This is then subjected to heat in a distillatory apparatus, by means of which the mercury is separated from the silver, which is left in a porous mass. In Peru and Mexico the process is similar to that above given, common salt and mercury being used; but slaked lime and iron sulphide are also employed, with little effect.

When argentiferous galenas are worked for the silver they contain, they are at first reduced, and the argentiferous lead obtained is fused on a large, oval, shallow vessel called a *test*, and exposed to the blast of a bellows, whereby the lead is oxidized, half vitrified, and driven off the test in scales, in the form of *litharge*. The operation being continued on successive portions of argentiferous lead, the whole of the lead is separated, and the silver, not being oxidizable, accumulates on the test as a brilliant fused mass, until its amount is sufficient to be removed. The time required for the separation is much abridged by the process of Pattinson. This consists in allowing the melted alloy to cool slowly, and separating the crystals which first form, consisting mainly of lead, by means of a perforated ladle. The residue is a very fusible alloy of lead and silver, in which the latter metal is in large proportion, and from which it can be easily separated by cupellation or other means.

Properties.—Silver is a white metal, very brilliant, tenacious, malleable, and ductile. In malleability and ductility it is inferior only to gold. It is harder than gold, but softer than copper. Its atomic weight is 107.12, symbol Ag, and sp. gr. from 10.4 to 10.5. What is termed "molecular silver" is obtained as a very fine powder, by reducing freshly precipitated silver chloride with formaldehyde in the presence of potassium carbonate. "*Colloidal silver*" is obtained by heating to 100° C. silver citrate in a stream of hydrogen or by passing an electric current between silver electrodes in water. It dissolves in water to a red solution which does not dialyze. Both these allotropic forms are converted into ordinary silver by fusion. Silver forms but one well-characterized oxide. Exposed to a full red heat, it enters into fusion (melting at 954° C.), and exhibits a brilliant appearance. It is not oxidized in the air, but contracts a superficial tarnish of silver sulphide by the action of hydrogen sulphide in the atmosphere, from which it may be freed by washing it with a strong solution of potassium cyanide, and, as soon as it becomes bright, washing it with water and drying it. (*Chem. News*, 1866, p. 12.) It is entirely soluble in diluted nitric acid. If any gold be present, it will remain undissolved as a dark-colored powder. From the nitric solution the whole of the silver may be thrown down by sodium chloride, as a white precipitate of silver chloride, characterized by being completely soluble in ammonia. If the remaining solution contain copper or lead, it will be precipitated or discolored by hydrogen sulphide. "The solution, deprived of silver by means of sodium chloride, and filtered, is not colored, *or but slightly so*, and is not precipitated by hydrosulphuric acid." *U. S.* 1870. "If ammonia be added in excess to a solution of the metal in nitric acid, the resulting fluid exhibits neither color nor turbidity" (*Br.* 1885); proving the absence of copper, lead, and other metals. "10 grains dissolved in a little nitric acid, the solution diluted with water, and diluted hydrochloric acid added in slight excess, yields a white precipitate which, when thoroughly washed, dried, and heated, weighs 13.25 grains." *Br.* 1885.

ARMORACIÆ RADIX. Br.

HORSERADISH ROOT

(ăr-mo-rā'cĭ-æ rā'dĭx)

"The fresh root of Cochlearia Armoracia, *Linn.*, collected from cultivated plants." *Br.*

Armoracia, Br. 1864; Raifort sauvage, Moutarde des Moines, Radis de Cheval, Cran de Bretagne, *Fr.*; Meerrettig, *G.*; Rabano rusticano (Raiz de), *Sp.*

Roripa Armoracia (L.), Hitchcock. *Cochlearia Armoracia* (L.), Willd., *Sp. Plant.* ii. 451; Woodv., *Med. Bot.* p. 400, t. 145. *Cochlearia rusticana*, Lam. *Armoracia sativa*, Bernheim.—The root of this plant is perennial, sending up numerous very large leaves from the midst of which a round, smooth, erect, branching stem rises two or three feet in height. The radical leaves are lance-shaped, waved, scolloped on the edges, sometimes pinnatifid, and stand upon strong footstalks. Those of the stem are

much smaller, without footstalks, sometimes divided at the edges, sometimes almost entire. The flowers are numerous, white, peduncled, and form thick terminal clusters. The calyx has four ovate, deciduous sepals, and the corolla an equal number of obovate petals, twice as long as the calyx, and inserted by narrow claws. The pod is small, elliptical, crowned with the persistent stigma, and divided into two cells, each containing from four to six seeds.

The horse-radish, indigenous to Western Europe, is to some extent naturalized in the United States, and is largely cultivated for culinary purposes.

The root, which is official in its fresh state, is long, conical at top, then nearly cylindrical for some inches, at last tapering, whitish externally, very white internally, fleshy, of a strong pungent odor when scraped or bruised, and of a hot, biting, somewhat sweetish, and sometimes bitterish taste. Its virtues are imparted to water and alcohol. They depend upon a *volatile oil,* which is dissipated by drying, the root becoming at first sweetish, and ultimately insipid and quite inert. Its acrimony is also destroyed by boiling. The oil may be obtained by distillation with water. It is colorless or pale yellow, heavier than water, very volatile, excessively pungent, acrid, and corrosive, exciting inflammation and even vesication when applied to the skin. Hubatka considers it as identical with the volatile oil of mustard. He combined it with ammonia and obtained crystals of *thiosinamin,* $NH_2.CS.N(C_3H_5)H$, which agreed with that produced from mustard oil. (*J. P. C.,* 3e sér., v. 42.) According to Gutret, only six parts of it are obtained from 10,000 of the root. Besides this principle, the fresh root contains, according to the same chemist, a bitter resin in minute quantity, sugar, extractive, gum, starch, albumen, acetic acid, calcium sulphate and acetate, water, and lignin. A. Hilger found in the ashes of the root of horse-radish the following: calcium, magnesium, potassium, a trace of sodium and iron in combination with sulphuric, hydrochloric, carbonic, phosphoric, and silicic acids. (*Chem. Cb.,* p. 597, 1878; *A. J. P.,* 1879, p. 21.) From observations made by F. L. Winckler, it may be inferred that *myronic acid* exists in the root combined with potassium hydroxide, and that it is from the reaction between this acid, *myrosine,* also existing in the root, and water, that the volatile oil is produced, in the same manner as oil of mustard from mustard seed. (See *Sinapis.*) Horse-radish when distilled with alcohol yields none of the oil. Buried in cool sand the root may be kept for some time without material injury.

It is said that if to the powder of the dried root which has become apparently inert, the emulsion of white mustard seed containing myrosine be added, it reacquires its original irritant properties; so that it is the myrosine and not the potassium myronate which is injured by drying. Hence the powdered root may be added with advantage to mustard in preparing cataplasms, pediluvia, etc. (*J. P. C.,* xxvii. 268.)[1]

Uses.—Horse-radish is highly stimulant, exciting the stomach when swallowed, and promoting the secretions, especially that of urine. Externally it is rubefacient. Its chief use is as a condiment to promote appetite and invigorate digestion.

Dose, half a drachm (2 Gm.) or more, grated or cut into small pieces.

Off. Prep.—Spiritus Armoraciæ Compositus, *Br.*

ARNICA. U. S., Br. Add.

ARNICA [Arnicæ Flores, Pharm. 1890, Arnica Flowers]

(ärʹnị-cạ)

"The dried flower-heads of *Arnica montana* Linné (Fam. *Compositæ*)." *U. S.*

Arnicæ Flores, *Br. Add.;* Leopard's Bane, Wolf's Bane, Mountain Tobacco; Fleurs d'Arnique, *Fr.;* Flores Arnicæ, *P. G.;* Wohlverleihblüthen, Arnicablüthen, Arnika, Blutblume, Gemsblume, Fallkraut, *G.;* Fiori di arnica, *It.;* Flor de arnica, *Sp.*

ARNICÆ RHIZOMA. Br.

ARNICA RHIZOME

(ärʹnị-çæ rhī-zōʹmạ)

"The dried rhizome and roots of Arnica montana, *Linn.*" *Br.*

Arnica Root; Racine d'Arnique, *Fr.;* Arnikawurzel, *G.;* Rhizoma di arnica, *It.;* Rizoma de arnica, *Sp.*

Arnica montana, Willd., *Sp. Plant.* iii. 2106; *B. & T.* 158.—This is a perennial herbaceous plant, having a woody, brownish, horizontal rhizome, from one to three inches long, and two or three lines thick, ending abruptly, and sending forth numerous slender fibres of the same color. The stem is about a foot high, cylindrical, striated, hairy, and terminating in one, two, or three peduncles, each bearing a flower. The radical leaves are ovate, entire, ciliated, and obtuse; those of the stem, which usually consist of two opposite pairs, are lance-shaped. Both are bright green, and somewhat pubescent on their upper surface. The flowers are yellow.

This plant is a native of the mountainous districts of Europe and Siberia, and is found,

[1] The French Codex contains a formula for a *Compound Syrup of Horse-radish* (*Sirop Antiscorbutique*), as follows: Scurvy-grass, water-cress, horse-radish (root), all fresh, of each, 100 parts, buckbean (marsh trefoil), dried, 10 parts, bitter orange peel 20 parts, cinnamon 5 parts, white wine 400 parts, sugar 500 parts. Thoroughly contuse and comminute the solid ingredients, macerate for 48 hours with the wine, and distil off 100 parts. Express and strain the residue from the distillation, clarify the liquid with white of eggs, and strain; add 300 parts sugar, and make into a syrup of sp. gr. 1.270 while boiling; with the rest of the sugar and sufficient water make a thick syrup, mix this with the other syrup, allow to cool, then add the distilled essence. *Iodized Syrup of Horse-radish* may be made by adding one part of tincture of iodine to ninety-nine parts of the compound syrup above.

according to Nuttall, in the northern regions of this country, west of the Mississippi. It has been introduced into England, and might no doubt be cultivated in the United States. The flowers, leaves, and root are employed; but the flowers only are official in the U. S. P. (8th Rev.).

Properties.—The whole plant, when fresh, has a strong, disagreeable odor, which is apt to excite sneezing, and is diminished by drying. The taste is acrid, bitterish, and durable. The dried rhizome is cylindrical, contorted, and marked by scars from the insertion of the leaves. Water extracts its virtues. The Pharmacopœia thus describes the flowers:

"Subglobular, about 2 Cm. long; involucre campanulate-turbinate; bracts in 1 to 2 ranks, oblong, dark green, pubescent; receptacle slightly convex, deeply pitted, densely short-hairy; rays about 16, bright yellow, the ligulate portion 2 to 2.5 Cm. long, nearly 6 Mm. broad, 3-toothed, 7- to 9-nerved, pistillate; disk flowers perfect, 5-toothed, of a deeper yellow, their akenes nearly 6 Mm. long, slender, tapering sharply to the base, flattened, 5-ribbed, pubescent, the pappus nearly a half longer than the akene, of a single circle of nearly white barbellate bristles; odor characteristic and agreeable; taste bitter." *U. S.*

The U. S. 1890 description of the rhizome was as follows:

"Rhizome about 5 Cm. [two inches] long, and 3 or 4 Mm. [one-eighth to one-sixth inch] thick; externally brown, rough from leaf-scars; internally whitish, with a rather thick bark, containing a circle of resin-cells, surrounding the short, yellowish wood-wedges, and large, spongy pith. The roots numerous, thin, fragile, grayish-brown, with a thick bark containing a circle of resin-cells. Odor somewhat aromatic; taste pungently aromatic and bitter." *U. S.* 1890.

Bastick (*P. J.*, x. 389) separated what he believed to be an alkaloid from the flowers, to which he gave the name of *arnicine*. The *arnicin* of Walz (*N. Jahrb. Pharm.*, xiii), extracted from both the root and the flowers, is a different substance; it is an amorphous yellow mass of acrid taste, slightly soluble in water, freely in alcohol or ether, and dissolving also in alkaline solutions. It is precipitable from its alcoholic solution by tannic acid or by water. Walz assigns to arnicin the formula $C_{20}H_{30}O_4$; other chemists that of $C_{35}H_{54}O_7$. Arnicin has not been proved to be a glucoside, although it is decomposed by diluted acids. Sigel (1873) obtained from dried arnica root about ½ per cent. of essential oil, and 1 per cent. from the fresh; the oil of the latter had a sp. gr. of 0.999 at 18° C. (64.4° F.). The oil was found to be a mixture of various bodies, the principal being the *dimethyl ether of thymohydroquinone*, $C_{10}H_{12}\begin{cases}OCH_3\\OCH_3,\end{cases}$ boiling at about 235° C. (445° F.), and with this, *phloryl isobutyrate* to the extent of one-fifth of the oil, and the *methyl ether of a phlorol.* (*Pflanzenstoffe*, 2d ed., p. 1530. See also Gildemeister and Hoffmann, *Die Aetherische Oele*, p. 900.) The water from which the oil separates contains *isobutyric acid*, probably also a little *angelic* and *formic acids*, but neither capronic nor caprylic acid, which had been pointed out by Walz. Arnica root contains *inulin*, which Dragendorff extracted from it to the extent of about 10 per cent. (*Pharmacographia*, 2d edition, p. 391.)

Uses.—Arnica is an active irritant, which is capable when taken in overdose of producing symptoms of violent toxic gastro-enteritis, with great nervous disturbance, reduction or increase of the pulse rate, and collapse. In a number of cases of severe or even fatal poisoning by it, the symptoms have been burning pains in the stomach, vomiting, choleraic diarrhœa, giddiness, intense muscular weakness, dilated pupils, finally complete insensibility and collapse. In some cases the disturbances of the gastro-intestinal canal have been absent, and the symptoms have chiefly been of cerebral origin. An ounce of the tincture (*L. L.*, Nov. 1864) has produced serious but finally not fatal symptoms.

Arnica has been used in Germany in the treatment of *palsies* and various other diseases, but we have very little positive knowledge concerning its action upon the system, and there is no sufficient reason for believing that it is valuable in the treatment of internal diseases. It is largely employed externally in the treatment of *bruises* and *sprains*, generally in the form of the tincture.

The powdered flowers and leaves are employed as a sternutatory; and the inhabitants of Savoy and the Vosges are said to substitute them for tobacco. They may be given in substance or infusion. The dose of the powder is from five to twenty grains (0.33 to 1.3 Gm.), frequently repeated. The infusion may be prepared by digesting an ounce of the flowers in a pint of water, of which from half a fluidounce to a fluidounce (15 to 30 Cc.) may be given every three hours. It should always be strained through linen, in order to separate the fine fibres, which might irritate the throat. A tincture prepared from the flowers is largely used externally in this country as a domestic remedy in *sprains*, *bruises*, etc. A tincture of the root is official in the British Pharmacopœia; this would be preferable for internal use. (See *Tinctura Arnicæ.*)

Dose, of the flowers, fifteen grains (1 Gm.).

Off. Prep.—Tinctura Arnicæ, *U. S.* (from flowers); Tinctura Arnicæ, *Br.* (from rhizome).

ARSENI IODIDUM. U. S. (Br.)

ARSENOUS IODIDE [Arsenic Iodide]

(är'sẹ-nī ī-ŏd'ị-dŭm)

$AsI_3 = 452.10$

"It should contain not less than 82.7 percent. of iodine, and 16.3 percent. of metallic arsenic. Arsenous Iodide should be kept in amber-

colored, glass-stoppered vials, in a cool place, carefully protected from the light." *U. S.*

"Arsenious Iodide, AsI_3, may be obtained by the direct combination of iodine and arsenium." *Br.*

Arsenii Iodidum, *Br.;* Arsenici Iodidum, *U. S.* 1870; Iodide of Arsenic, Arsenious Iodide; Iodure d'Arsenic, *Fr.;* Arsenicum jodatum, Arsenik Jodür, Arsentrijodid, *G.*

This iodide was introduced into the U. S. Pharmacopœia for the purpose of being used in preparing the solution of arsenous and mercuric iodides. It may be made by the direct combination of its constituents, with the aid of a gentle heat, but this form readily decomposes, the iodine subliming and condensing in crystals upon the upper portion of the bottle containing it. The orange red crystalline powder now official is much more permanent.

The U. S. process of 1870 is as follows: "Take of Arsenic *sixty grains;* Iodine *three hundred grains.* Rub the Arsenic in a mortar until reduced to a fine powder; then add the Iodine, and rub them together until they are thoroughly mixed. Put the mixture into a small flask or a test-tube, loosely stopped, and heat it gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine, which may have condensed on its surface, may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and, when it is cold, break it into pieces, and keep it in a well-stopped bottle." *U. S.* 1870. J. F. Babcock (*Proc. A. Ph. A.,* 1875, p. 693) proposes to make it by placing a troyounce of iodine in a suitable vessel with 10 or 12 fluidounces of water, and passing hydrogen sulphide through until the iodine color is entirely gone; then filtering, heating the filtrate until the odor of hydrogen sulphide has been dissipated; then adding a quarter of a troyounce of arsenic trioxide, heating until dissolved, filtering, and evaporating to dryness.

$$As_2O_3 + 6HI = 2AsI_3 + 3H_2O$$

Nickle's process enables the operator to obtain the salt in a crystalline condition. Arsenic and iodine in equivalent proportions are heated together with carbon disulphide in a flask, to which an upright condenser is attached, until the iodine color disappears. The solution is then evaporated to the crystallizing point.

In the *Ber. d. Chem. Ges.,* 1881, 2643, may be found a process for obtaining this salt chemically pure, by making a hot solution of arsenic trioxide in hydrochloric acid, and mixing it with a concentrated solution of potassium iodide, whereupon the triiodide separates as a crystalline powder; this may be washed with hydrochloric acid, sp. gr. 1.120, until a portion of the washings on evaporation ceases to leave a residue of potassium chloride.

Properties.—Arsenous iodide is described as "an orange-red, inodorous, crystalline powder, stable when protected from direct sunlight and kept in a cool place. Soluble, with partial decomposition, in about 12 parts of water, and in about 28 parts of alcohol at 25° C. (77° F.); completely soluble in chloroform, carbon disulphide, or ether. No loss of iodine occurs when Arsenous Iodide is heated upon a water-bath, but at higher temperatures it completely volatilizes. When warmed with a few drops of nitric acid, brown vapors of nitrous oxide are evolved, followed by violet vapors of iodine. The aqueous solution has a yellow color, is neutral to litmus paper, and upon standing gradually decomposes into arsenous and hydriodic acids. If hydrogen sulphide T.S. be added to an aqueous solution of Arsenous Iodide acidulated with hydrochloric acid, a lemon-yellow precipitate of arsenous sulphide is produced. If 0.5 Gm. of Arsenous Iodide and 2 Gm. of sodium bicarbonate be dissolved in 50 Cc. of water, not less than 21.9 Cc. of tenth-normal iodine V.S. should be required to impart a slight yellow tint to the solution." *U. S.* It has a tendency to decompose even at ordinary temperatures, iodine separating and volatilizing, oxygen being absorbed and arsenic trioxide formed.

Uses.—Following the suggestion of Biett arsenous iodide has been somewhat extensively used in the treatment of *lupus* and other skin conditions in which a powerful stimulant is desired; Biett employed the ointment of the strength of three grains to the ounce. The iodide has also been given internally as an alterative, in *cancer,* in *scrofula, lepra,* etc., and probably does not differ in its action from other preparations of arsenic. In large doses it acts as a violent gastro-intestinal irritant and poison.

Dose, one-tenth of a grain (0.006 Gm.).

Off. Prep.—Liquor Arseni et Hydrargyri Iodidi, *U. S.* (*Br.*)

ARSENI TRIOXIDUM. U. S. (Br.)

ARSENIC TRIOXIDE [Acidum Arsenosum, Pharm. 1890, Arsenous Acid, Arsenous Anhydride, Arsenous Oxide, White Arsenic]

(är'sẹ-nī trī-ŏx'ĭ-dŭm)

$As_2O_3 = 196.44$

"It should contain not less than 99.8 percent. of pure Arsenic Trioxide." *U. S.* "Arsenious Anhydride, or arsenious oxide, As_4O_6, is obtained by roasting certain arsenical ores." *Br.*

Acidum Arseniosum, *Br.;* Arsenious Acid, Arsenicum Album, *Ed.;* Arsenious Oxide, Arsenic, Arsenious Anhydride; Acide arsénieux, *Fr. Cod.;* Arsenic blanc, Fleurs d'Arsenic, *Fr.;* Acidum Arsenicosum, *P. G.;* Arsenigesaure, Arsenichte Saure, Weisser Arsenik, *G.;* Anidride arseniosa, Acido arsenioso, Arsenico bianco, *It.;* Anhidrido arsenioso, Arsenico blanco, *Sp.;* Arsenik, *Dan., Swed., Pol.*

Arsenic trioxide is prepared in Bohemia and Saxony, where it is procured on a large scale as a collateral product during the smelting of cobalt ores, which are almost invariably accompanied by arsenic, and in England from the mineral *arsenopyrite,* also called *mispickel* or

arsenical iron, which is associated with the ores of tin and copper. The German process is that usually quoted as the older and better known. According to this, the ores are roasted in reverberatory furnaces with long horizontal flues. The arsenic is converted by combustion into arsenic trioxide, which rises in vapor and condenses on the sides of the flues. In this state it is impure, and requires a second sublimation, which is performed in cast iron vessels, fitted with conical heads of the same material, having an opening at the summit. The vessels are placed over a furnace, and brought to a red heat, when a portion of the impure arsenic trioxide is thrown in through the opening, which is immediately stopped. This portion being sublimed, a second portion is introduced in a similar manner. Finally, the vessels are allowed to cool; and upon removing the heads the purified oxide is found attached to them, in vitreous layers, at first as transparent as glass, but gradually becoming, by contact with the air, opaque at their surface. These are broken into fragments of a convenient size, and thus enter commerce. The arsenic trioxide so obtained is generally packed in casks, containing from two to five hundred pounds, and is shipped principally from the ports of Hamburg and Bremen. The English process differs somewhat in its details, and essentially in its final product, which is fine and crystalline rather than amorphous. In this process the crude arsenic of the first sublimation is refined by introducing it into another furnace or series of furnaces, where it is again volatilized by the heat. When it condenses in the long series of chambers through which the vapors are carried, it is, if the process be fully successful, in the form of a perfectly white crystalline solid, which needs only to be ground and packed into kegs to be made ready for the market. The unground arsenic is, as stated, all in the *crystalline* condition, the temperature of the chambers being too low to permit the formation of the glassy variety.

Properties.—Arsenic trioxide is entirely volatilized by heat. As the German make of arsenic occurs in commerce, it is in masses, with a vitreous fracture, and of a milk-white color externally, but, internally, often perfectly transparent. As first sublimed, the whole mass is transparent; but it gradually becomes white and opaque, the change proceeding progressively from the surface inwards. This change has not been well explained, but probably depends upon the absorption of moisture, causing a gradual passage of the acid from the amorphous to the crystalline state. (Pereira.) Hence the masses "usually present a stratified appearance, caused by the presence, in separate layers, of the crystalline and opaque and of the amorphous and vitreous allotropic modifications of arsenious anhydride." *Br.* The U. S. Pharmacopœia (8th Rev.) describes arsenic trioxide as follows: "A heavy solid occurring either as an opaque, white powder, or in irregular masses of two varieties: one, amorphous, transparent, and colorless, like glass; the other, crystalline, opaque, and white, resembling porcelain. Frequently the same piece has an opaque, white, outer crust enclosing the glassy variety. Contact with moist air gradually changes the glassy into the white, opaque variety. Both are odorless and tasteless." *U. S.* According to Guibourt, the sp. gr. of the transparent variety is 3.73, of the opaque 3.69. The experiments, however, of J. K. Mitchell and Durand make the density of the former variety from 3.208 o 3.333. The English make of arsenic is always powdered, and, under a lens, is seen to consist of small crystals perfect in form, or of small fragments of larger crystals. In a poisoning case in 1880 (State of Conn. vs. Hayden) much was made to hinge upon the differences observed between this crystalline English arsenic and the commoner amorphous or German arsenic. (*Microscop. Exam. of Samples of Commercial Arsenic,* E. S. Dana. F. D. Linn & Co., Publishers, Jersey City, 1880.) As it occurs in commerce for medicinal use, it is often in the form of a white powder, almost as fine as flour. In this state it is sometimes adulterated with powdered lime or chalk, or calcium sulphate or arsenite, a fraud which is very easily detected by exposing the powder to a heat sufficient to evaporate the arsenic trioxide, when these impurities will be left behind. In consequence of the liability of the oxide to contain impurities when in powder, it was directed in the U. S. Pharmacopœia of 1870 to be kept in masses, so that the apothecary may powder it for himself as it is wanted. It has been erroneously stated to have an acrid taste. Christison asserts that it possesses hardly any taste, inasmuch as it produces merely a faint sweetish impression on the palate. In strong hot solution, it has an austere taste, most nearly resembling that of zinc sulphate. (Mitchell and Durand.) It has no odor, even in vapor; but when thrown on ignited charcoal it emits a garlicky odor, in consequence of its deoxidation, and the volatilization of the reduced metal. Its point of sublimation, according to Berzelius, is at an incipient red heat; but, according to Mitchell and Durand, it is lower than that of metallic arsenic, being only 218° C. (425° F.). In the British Pharmacopœia it is said to be entirely volatilized at a temperature not exceeding 204.4° C. (400° F.). Taylor gives the subliming point at 188° C. (370° F.); Wm. A. Guy states that arsenic trioxide rises in vapor at about 138° C. (280° F.) (*P. J.*, Feb. 1868). When slowly sublimed it condenses in regular octahedral crystals of a sparkling lustre. It may also be obtained crystallized in fine octahedra by the slow cooling of a solution of the oxide in boiling diluted hydrochloric acid. (*J. P. C.*, 1873, p. 246.) "0.25 gramme, dissolved quickly in boiling *water* with five times its weight of *sodium bicarbonate,* should, after the cooled solution is well shaken with three successive drops of *hydrochloric acid,*

discharge the color of 50.8 to 50.9 cubic centimetres of the *volumetric solution of iodine.*" *Br.*

"In cold water both varieties dissolve very slowly, the degree of solubility varying according to conditions and time, the glassy variety requiring about 30, the porcelain-like or crystalline powder about 100 parts of water at 25° C. (77° F.). Both are slowly but completely soluble in 15 parts of boiling water. In alcohol, Arsenic Trioxide is but sparingly soluble, but it is soluble in about 5 parts of glycerin. Oil of turpentine dissolves only the glassy variety. Both varieties are freely soluble in hydrochloric acid, and in solutions of alkali hydroxides and carbonates." *U. S.* "It is soluble in 100 parts of cold *water,* in 10 parts of boiling *water,* and in 5 parts of *glycerin;* it is moderately soluble in solutions of alkaline hydroxides and carbonates, in *hydrochloric acid,* and in mixtures of that acid and *water.*" *Br.* The following is given on the authority of Bussy. The transparent variety dissolves much more rapidly than the opaque. By prolonged ebullition with water, the opaque variety attains the same solubility as the transparent, and may be supposed to be converted into the latter. Thus, at the boiling temperature, a pint of water dissolves 807 grains of either variety. The transparent variety, in cold saturated solution, gradually lessens in solubility, until it reaches the solubility of the opaque, no doubt in consequence of being changed into the latter. Pulverization lessens the solubility of the transparent variety, without affecting that of the opaque. The mixture of the two varieties of the oxide in the same solution serves to explain the anomalies heretofore observed in its solubility. (*J. P. C.*, Nov. 1847.)[1] "When slowly heated in a test-tube, Arsenic Trioxide yields a sublimate of minute, brilliant, transparent, octahedral crystals. When heated rapidly to about 200° C. (392° F.), the amorphous variety fuses, then sublimes, while the crystalline variety sublimes without fusing; no residue should remain after sublimation. When covered with charcoal in an ignition-tube, and strongly heated, Arsenic Trioxide is deoxidized, and metallic arsenic is deposited on the cooler portion of the tube as a mirror having a metallic lustre. Cupric ammonium sulphate T.S. produces in an aqueous solution a bright green precipitate. If the green precipitate be dissolved in ammonia water, a deep blue-colored solution should be produced. An aqueous solution of Arsenic Trioxide has a faintly acid reaction upon blue litmus paper. Silver ammonium nitrate T.S. produces in an aqueous solution a lemon-yellow precipitate, which dissolves on the addition of ammonia water; when this solution is heated, metallic silver is deposited (distinction from *arsenic acid.*) Hydrogen sulphide T.S. colors a solution of Arsenic Trioxide yellow; if a few drops of hydrochloric acid be added, it precipitates lemon-yellow arsenic trisulphide, which should be completely soluble in ammonium carbonate T. S. (absence of *antimony, tin,* and *cadmium*). When Arsenic Trioxide is carefully heated in a dry test-tube of hard glass, it should sublime without leaving a residue, and the sublimate should not at first show a yellow color (absence of *non-volatile matter* and of *arsenous sulphide*). If 1 Gm. of Arsenic Trioxide be dissolved in 10 Cc. of ammonia water, with the aid of a gentle heat, a colorless solution should be produced. If 0.1 Gm. of Arsenic Trioxide be dissolved, together with 1 Gm. of sodium bicarbonate, in 20 Cc. of water, by the aid of a gentle heat, it should decolorize not less than 20.3 (20.32) Cc. of tenth-normal iodine V.S. (corresponding to at least 99.8 percent. of pure Arsenic Trioxide." *U. S.* "Its aqueous solution, which is odorless, tasteless, and faintly acid to *litmus,* gives with *solution of silver ammonio-nitrate* a canary-yellow precipitate readily dissolved by *solution of ammonia* and by *nitric acid.* Sprinkled on ignited charcoal, it emits an alliaceous odor. It is volatilized at 400° F. (204.4° C.). . . It should yield no characteristic reaction with the tests for lead, cadmium, antimony, tin, or sulphides. It should dissolve completely in *solution of ammonia,* and the resulting liquid when diluted with an equal volume of *water* and acidulated with *hydrochloric acid* should not have a yellow color (absence of arsenious sulphide)." *Br.*

Uses.—The official preparations of arsenic are all of them, when in sufficient concentration, violent irritants or escharotics. Taken internally in sufficient dose they are exceedingly poisonous to both man and the lower animals. When properly administered they are alteratives, affecting in some unknown way the nutrition, especially of the nervous system. They are often of service in simple *nervous debility,* but are especially useful in *chorea* and in *chronic malaria.* When given for their tonic effect only, they should be used in doses so small as not to cause any general symptoms; but when a specific action, as in chorea, is desired, it is proper to begin with small doses and rapidly increase them until the limit of tolerance is reached. Not rarely, such doses produce gastro-intestinal irritation, especially pain and diarrhœa. To avoid this as much as possible, the remedy should be given after meals. When either gastro-intestinal irritation or the more peculiar effects of arsenic are caused, the dose should at once be lessened. The specific symptoms of *arsenicalism* are a general disposition to œdema, especially of the face and eyelids, a feeling of stiffness in these parts, itching of the skin, tenderness of the mouth, loss of

[1] Experiments of M. L. A. Buchner on the solubility of arsenic trioxide in its various forms gave the following results. A liter of water saturated at 15° C. with crystallized arsenic trioxide contains gr. 2.821; with the amorphous and vitreous variety, gr. 9.306; while the same solutions, made by boiling and then allowed to cool for 24 hours, down to 15° C., contain of the crystallized oxide gr. 27.839 per liter, and of the amorphous and vitreous, gr. 34.056 per liter. These results serve to confirm those obtained by Bussy which are referred to in the text. (*J. P. C.*, 1873, p. 247.)

appetite, and uneasiness and sickness of the stomach. The peculiar swelling produced is called *œdema arsenicalis.* In some instances the internal use of arsenic causes a rash not unlike that of measles, and, as in that affection, attended with catarrhal symptoms. (Tilbury Fox, *M. T. G.,* March, 1868.) Sometimes salivation is produced, and occasionally the hair and nails fall off. It is stated by Charcot that he has seen, in two cases, decided anaphrodisiac effects from the prolonged use of arsenic, which disappeared several months after its discontinuance, and in one instance returned upon its resumption. (*Ann. Thér.,* 1865, p. 267.)

Arsenic trioxide has been exhibited in a great variety of diseases, the principal of which are *scirrhus* and *cancer,* especially cancer of the lip; anomalous *ulcers;* various *cutaneous diseases; intermittent fever; chorea; chronic rheumatism,* particularly those forms of it attended with pains in the bones; *rheumatic gout;* diseases of the bones, especially *nodes,* and firm swellings with deformity of the small joints of the hands; *chronic syphilitic affections; frontal neuralgia; hemicrania;* intermittent *neuralgic pains* of the stomach and bowels. In intermittent fever it is inferior only to cinchona bark and its alkaloids; and probably no remedy surpasses or even equals it in *rheumatic gout.* In cutaneous affections, especially those of a scaly character, as *lepra* and *psoriasis,* it is an invaluable remedy. There would seem to be no objection against the very protracted use of this remedy in disease. Many years since, Tschudi drew attention to the so-called "*arsenic-eaters*" of Styria and the Tyrol. The habits of these people have been grossly exaggerated by some, while by others their existence has been denied, but the truth is that among the lower orders in the countries mentioned, there are many persons who habitually take small amounts of the poison. According to the report of a government commission, the dose of 0.62 grain is rarely exceeded. The "ratsbane-eaters" are said not to suffer in their health, and to be unusually strong and vigorous people.

The external application of arsenic has been principally restricted to *cancer,* and anomalous and malignant ulcers, especially of the kind denominated *noli me tangere.* Dupuytren used with advantage a powder composed of one part of arsenic trioxide and twenty-four parts of calomel, as a topical application to *herpes exedens,* and to the foul *ulcers* occurring after mercurial treatment.

Arsenic is the chief ingredient in nearly all the empirical remedies for the cure of *cancer* by external application. *Plunket's caustic,* a remedy of this kind of great celebrity, consisted of the *Ranunculus acris* and *Ranunculus flammula,* each an ounce, bruised and mixed with a drachm of arsenic trioxide and one hundred grains of sulphur. The whole was beaten into a paste, formed into balls, and dried in the sun. When used these balls were rubbed up with yolk of egg, and spread on pig's bladder. The use of the vegetable matter is to act upon the cuticle, for, unless this is done, the arsenic will not act. In *onychia maligna,* Luke of London, regarded an ointment composed of two grains of arsenic trioxide and an ounce of spermaceti ointment as almost a specific. (Pereira, *Mat. Med.*)

In Paris, an *arsenical paste* of the following composition has been used as an application to malignant *ulcers*:—red sulphide of mercury 70 parts; dragon's blood 22 parts; arsenic trioxide 8 parts. It is applied, made up into a paste with water. Pain produced by this composition is very severe, and its application dangerous. The *arsenical paste of Frère Côme* has been applied advantageously by Biett to the ulcerated surfaces in *yaws.* The precaution was used of not applying it, at one time, over a surface larger than that of half a dollar. This paste is made by mixing water with a powder consisting of ten grains of arsenic trioxide, forty grains of red sulphide of mercury, and ten grains of powdered animal charcoal. The practice of sprinkling unmixed arsenic trioxide on ulcers is fraught with the greatest danger; S. Cooper characterizes it as a murderous practice.

Febure's remedy for cancer consisted of ten grains of arsenic trioxide, dissolved in a pint of distilled water, to which were added an ounce of extract of conium, three fluidounces of solution of lead subacetate, and a fluidrachm of tincture of opium. With this the cancer was washed every morning. Febure's formula for internal exhibition was, arsenic trioxide two grains, rhubarb half an ounce, syrup of chicory q. s., distilled water sufficient to make a pint. Of this mixture, a tablespoonful, containing about the sixteenth of a grain of the oxide, was given every night and morning. The dose was gradually increased to six tablespoonfuls.

Arsenic trioxide may be given in doses of from one-fiftieth to one-twentieth of a grain (0.001 to 0.003 Gm.), three times a day, in the form of pill. It is often combined with opium, which enables the stomach to bear the medicine better. The *Asiatic pills,* so called, consist of arsenic trioxide and black pepper, in the proportion of 1 part of the former to 80 parts of the latter. A preparation much used on the continent of Europe is *Boudin's solution,* which is simply an aqueous solution of arsenic trioxide with the addition of wine, and is made by boiling one gramme (15.4 grains) of the oxide with one liter (2.1 pints) of distilled water till entirely dissolved, then cooling, filtering, adding enough distilled water to supply the loss, and finally mixing with one liter of white wine. Of this solution a fluidounce contains about one-quarter of a grain of arsenic trioxide.

Dose, of arsenic trioxide, one fiftieth to one twentieth of a grain (0.001 to 0.003 Gm).

Properties of Arsenic Trioxide as a Poison.—Arsenic trioxide, in an overdose, whether internally or externally, acts with very great energy, and generally destroys life in a short time; but in rare instances no well-marked symptoms

have been developed until eight or nine hours after the ingestion of the poison. Edward Hartshorne relates a case of recovery in which at least a drachm of arsenic trioxide had been swallowed, and where the symptoms of poisoning were delayed for sixteen hours. (*Med. Examiner,* 1855, p. 707.) The symptoms produced by the poison are—an austere taste; fetid state of the mouth; frequent ptyalism; continual hawking; constriction of the pharynx and œsophagus; the sensation of the teeth being on edge; hiccough; nausea; anxiety; frequent sinkings; burning pain at the præcordia; inflammation of the lips, tongue, palate, throat, bronchi, and œsophagus; irritable stomach, so as not to be able to support the blandest drinks; vomiting of matters, sometimes brown, at other times bloody; profuse serous or bloody stools; small, frequent, and irregular pulse, but occasionally slow and unequal; palpitations; syncope; insatiable thirst; burning heat over the whole body, or a sensation of icy coldness; difficult respiration; cold sweats; suppression of urine, or scanty, red, bloody, and sometimes albuminous urine; change in the countenance; a livid circle around the eyelids; swelling and itching of the body; livid spots over the surface, and occasionally a miliary eruption; prostration of strength; loss of feeling, especially in the feet and hands; delirium, convulsions, often accompanied with insupportable priapism; falling off of the hair, detachment of the cuticle, etc. In some cases there is inflammation with burning pain in the urino-genital organs. It is very rare to observe all these symptoms in the same individual. Sometimes, indeed, they are nearly all wanting, death taking place without any pain or prominent symptoms. Occasionally the phenomena have a perfect resemblance to those of Asiatic cholera in the stage of collapse. In rare cases stupor is a very prominent symptom and the diarrhœa may not be pronounced. After death, the morbid appearances are various. In some instances no vestige of lesion can be discovered. The appearances however, in the generality of cases, are the following: the mouth, stomach, and intestines are inflamed; the stomach and duodenum exhibit spots resembling eschars, and perforations of all their coats; and the villous coat of the former is in a manner destroyed, and reduced to the consistence of a reddish-brown pulp. Wide-spread fatty degeneration has also been noted. In cases of recovery, it has been a question how long it takes for the poison to be eliminated from the system. In an instance reported by D. Maclagan, in which about two drachms of the poison had been swallowed, and in which magnesia was used successfully as an antidote, arsenic was detected in the urine by Marsh's test as late as the twentieth day.

A chronic form of arsenical poisoning, yet sometimes serious in its consequences, has resulted in many instances from the inhalation of the air of apartments lined with green wall paper, which owes its color to copper arsenite, and from which a fine poisonous dust sometimes escapes when the paper has not been well prepared. (See *Chem. News,* March 24, 1860.) The burning of green tapers is sometimes attended with an arsenical odor, and chemical examination has shown that, in relatively rare instances, they sometimes contain arsenic trioxide in injurious quantities. (*L. L.,* 1873, p. 715.) Death has also resulted, in more than one instance, from working in the manufacture of green artificial leaves. (*Chem. News,* Nov. 30, 1861.) Ulceration of the anus has resulted from the habitual use of green paper. In 1900, there occurred an epidemic of chronic arsenic poisoning in Manchester, England, which arose from beer prepared from arsenical glucose. The symptoms of chronic arsenic poisoning are too protean to permit of detailed description. The most important are: peripheral neuritis, inflammation or overgrowth of skin and dermal appendages with irritation at the point of entrance; thus when from inhalation of arsenical dust there is laryngitis and bronchitis; when it finds entrance through the alimentary canal, gastric disturbance and diarrhœa.

In view of the numerous accidents and crimes caused by the use of arsenic trioxide, its sale should be regulated by law in all the States of the Union. In 1851 an act for this purpose in England was passed by the British Parliament.

There can be no doubt that, when applied to any ulcerated surface, arsenic may be absorbed with fatal result; death has indeed occurred in a number of cases from the use of arsenic as an escharotic to tumors, cancerous ulcers, etc. As indicated by Blackader, absorption is less likely to follow the use of large than of small quantities, the larger amount probably killing the part to which it is applied, and thereby preventing absorption. If this dangerous caustic be used at all, it should be in accordance with these facts. Harles's observations also seem to show that when the surface is that of a chronic ulcer, either simple or malignant, absorption is less prone to occur than from a fresh wound.

Treatment of Poisoning by Arsenic Trioxide. If the antidote (see *Ferri Hydroxidum cum Magnesii Oxido*) be not directly at hand, free vomiting should be induced by the finger, the feather part of a quill, and the administration of an emetic; or the poison may be removed by the use of the stomach tube. Demulcent drinks should be freely given, such as milk, white of eggs and water, or flour and water, which serve to encourage the vomiting and to envelop the poison.

The antidote having been faithfully applied, the subsequent treatment consists in the administration of mucilaginous drinks, and the treatment of symptoms as they arise. Convalescence is generally long and distressing; usually dyspeptic symptoms mark the presence of gastro-intestinal inflammation or even ulceration, while not rarely violent neuralgic pains, with loss of power, wasting of the muscle, and other trophic changes, show that a peripheral neuritis has

been produced; hence it is of the greatest importance to attend to the diet, which should consist exclusively of milk, gruel, cream, rice, and similar bland articles.

The antidote above referred to is *ferric hydroxide* or preferably *ferric hydroxide with magnesium oxide,* in the *moist* or *pulpy* state. As soon as it is ready, it must be given in doses of a tablespoonful to an adult, of a dessertspoonful to a child, every five or ten minutes, until the urgent symptoms are relieved. It is calculated that the quantity taken should be at least twelve times the supposed amount of the poison swallowed; but, as the antidote is perfectly innocent, it is prudent to give it in larger quantities. According to the experiments of E. Riegel, one part of arsenic trioxide in solution is so fully precipitated by ten parts of the dry oxide, that, after its action, not a trace of the poison can be detected, even by Marsh's test. Its efficacy is, of course, greater, the sooner it is administered after the ingestion of the poison; but even after delay its use will prove advantageous, so long as any portion of the poison still remains in the stomach. Ferric hydroxide acts by producing with the poison, by a transfer of oxygen from the oxide to the acid, an insoluble, and therefore inert, ferrous arsenate:

$$4Fe(OH)_3 + As_2O_3 = Fe_3(AsO_4)_2 + 5H_2O + Fe(OH)_2$$

This antidote was discovered by Bunsen and Berthold of Göttingen, in 1834; and its efficacy has been abundantly confirmed by experiments on inferior animals, and by its successful application to numerous cases of poisoning in the human subject. Various observations have been made as to the best forms of the ferric hydroxide for use, but as long ago as 1842 Wm. Procter (*A. J. P.,* xiv. 29) proved that the hydroxide gradually decreases in its power of neutralizing arsenic trioxide the longer it is kept, and that this decrease in power is more rapid when it is mixed with much water than when in the form of a thick magma. The cause of this diminution of neutralizing power, by being kept, is explained by the experiments of Wittstein. This chemist found that ferric hydroxide, recently precipitated, dissolves readily in acetic and other vegetable acids in the cold, but becomes nearly insoluble when kept for some time under water. It should be an invariable rule to prepare the antidote at the time it is wanted from materials always kept at hand. A very efficient antidote may be made by precipitating the tincture of ferric chloride with sodium bicarbonate.

Dialyzed iron has been frequently suggested as an antidote for arsenic (*P. M. T.,* Dec. 8, 1877; *A. J. P.,* Jan. 1878), especially if its administration be followed by a dose of common salt, which precipitates the ferric hydroxide in the stomach; but E. Hirschsohn (Dorpat, Russia) cautions against the use of dialyzed iron, because his experiments show that the resulting combination parts with its arsenic in the presence of acids much more readily than does the *Antidotum Arsenici* of the Russian Pharmacopœia—made by diluting one ounce of solution of ferric sulphate with four fluidounces of water, then adding a mixture of three drachms of calcined magnesia with four fluidounces of water. (See *Ferri Hydroxidum cum Magnesii Oxido.*)

Köhler of Halle, believes saccharine oxide of iron in solution is preferable to all other preparations, in poisoning by arsenic trioxide. This forms, like the hydrated powder, an insoluble compound with the acid. He bases his opinion upon experiments with the lower animals, and gives the details of a case in which it proved successful in the human subject after the swallowing of more than half a drachm of the oxide in powder. He gave a large teaspoonful of the saccharine oxide with a drachm of water immediately afterwards, which was repeated every 15 minutes for two hours, followed by an emetic dose of ipecacuanha, and then repeated every half hour. The patient recovered. (*B. F. M. R.,* 1870.)

Bussy has proposed light magnesia, or the kind which has not been too strongly calcined, as well as recently precipitated gelatinous magnesia, as an antidote for arsenic trioxide; and a case is given by him in which it appeared to prove efficacious. (*J. P. C.,* x. 81.) The dense kind has very little efficacy. Christison saw a case in which this antidote seemed very serviceable. A successful case is also reported by Cadet de Gassicourt (*J. P. C.,* Mars, 1848), and another by E. Bissell of Norwalk, Conn. (*Am. J. M. S.,* July, 1848). For the full precipitation of arsenic trioxide, eighteen times its weight of anhydrous magnesia are required. (E. Riegel.) Like the ferric hydroxide, the magnesia antidote should be made extemporaneously by mixing diluted solution of ferric sulphate with magnesia mixture. Schroff has made some experiments on rabbits to determine the comparative efficacy, as antidotes, of the ferric hydroxide and magnesia, and gives the preference to the latter. The hydrated magnesia is best prepared extemporaneously by quickly forming a solution of magnesium sulphate, and precipitating this by ammonia water, which is preferable to potassium hydroxide, as any portion of the latter, remaining in the preparation, might act injuriously by favoring the solubility of the arsenic trioxide. Notwithstanding these statements, however, it is asserted by T. and H. Smith of Edinburgh, on the basis of experiment, that magnesia is incapable of neutralizing arsenic trioxide, and is useless as an antidote (*P. J.,* 1865, p. 144), and that it should not be depended upon when the ferruginous antidote is attainable. The best antidote known is the combination of ferric hydroxide with magnesium oxide, now recognized by the U. S. Pharm.

Reagents for detecting Arsenic Trioxide. As arsenic is so frequently employed for criminal purposes, it becomes important to detect its presence in medico-legal investigations.

Having obtained general indications of the presence of arsenic, the first step is to separate the organic matters. In a communication to the Paris Academy, Blondlot of Nancy, asserted, as the result of numerous experiments, that the smallest quantity of oily or fatty matter has the effect of diminishing, even to one-twentieth, the solubility of arsenic trioxide, and consequently of very much increasing the difficulty of detecting it. (See *A. J. P.*, 1860, p. 220.)

The following are the directions given by Wormley (*Micro-Chemistry of Poisons,* 2d ed., p. 299) for separating the organic principles. After the addition of water, if necessary, the mass is intimately mixed with about one-eighth of its volume of pure hydrochloric acid, and maintained at near the boiling temperature until the organic solids are entirely disintegrated. The mixture is then allowed to cool, transferred to a clean muslin strainer, and the matters retained by the strainer washed with water; the strainer with its contents may be reserved for future examinations. The strained liquid is concentrated at a moderate heat if necessary, allowed to cool, and again filtered.

A given portion of the filtrate thus obtained is examined by the method of Reinsch (see page 205), successive slips of the copper being added as long as they receive a deposit. Any pieces of the metal that have thus become coated, after being thoroughly washed and dried, are heated in a suitable reduction tube, and the result examined in the usual manner. Another portion, or the whole of the remaining filtrate, may be exposed for several hours to a slow stream of the hydrogen sulphide gas, then gently warmed, and allowed to stand until the supernatant liquid has become perfectly clear. The precipitate thus produced is collected upon a small filter, washed, and, while still moist, digested with pure ammonia water, this liquid will readily dissolve any arsenic sulphide present, while the organic matter may remain undissolved. The ammoniacal solution is filtered, and the filtrate carefully evaporated at a moderate heat to dryness. Should the residue contain organic matter and only a minute quantity of the sulphide, it may require further purification before its arsenical nature can be determined.

In order to facilitate the detection of arsenic in the solid tissues, as the liver, spleen, stomach, etc., it is necessary first to destroy the animal matter, and then to dissolve out the poison. Various agencies have been resorted to for this purpose, but the method of Fresenius and Babo is generally accepted as the best. According to this, the finely divided fragments of solid matter are heated with pure hydrochloric acid, and potassium chlorate is added from time to time until the mass becomes homogeneous and of a light yellow color. It is then heated until the odor of chlorine has disappeared. After filtration any arsenic present will exist in the filtrate as arsenic acid. This is reduced by sulphurous acid gas or a solution of sodium bisulphite, so that the arsenic is brought to the condition of arsenous acid, in which state it is more readily acted upon by hydrogen sulphide gas.

After thorough precipitation of the sulphide and purification of this precipitate by treatment with ammonia as already described, if the residue from the evaporation of the ammonia still contains organic matter mixed with the arsenous sulphide, it is best purified as follows. Treat the residue with a small quantity of concentrated nitric acid, and evaporate the mixture again to dryness, this operation with nitric acid being repeated, if necessary, until the moist residue has a yellow color. The residue is then moistened with a few drops of a concentrated solution of caustic soda, a small quantity of pure powdered sodium carbonate and sodium nitrate added, and the well mixed mass cautiously evaporated to dryness; the heat is then very gradually increased until the mass becomes colorless, when the organic matter will have been entirely destroyed. The nitric acid and the soda compounds employed should be free from chlorine, or a portion of the arsenic may be volatilized as chloride. (Wormley, *Micro-Chemistry of Poisons,* 2d ed., p. 303.)

Another method of separating arsenic in solution from organic matters, now frequently employed, is by the process of dialysis, invented by Graham. (See *Dialysis.*) By means of an instrument called the dialyzer, aqueous solutions of saline and other crystallizable substances may be separated from those not crystallizable, such as gelatinous, albuminous, mucilaginous, and amylaceous liquids, the latter refusing to pass through a diaphragm of some porous substance, which is readily permeable by the former. Thus, a circular piece of parchment paper, folded in the form of a common filter, is placed in a vessel containing distilled water; the suspected liquid, having been heated so as to effect a more complete solution of the arsenic, is poured into the filter, and the vessel set aside for twenty-four hours. At the end of this time, the crystallizable matter, including the arsenic, will have, to a great extent, passed through into the distilled water, leaving the organic matters behind, and a solution will have been obtained in a condition fit for the application of the different tests.

The passage of the arsenic through the membrane is, however, rarely a complete one, and the test cannot allow us to dispense with more thorough methods of examination.

Following up a suggestion of Clarke of Aberdeen, that arsenic might be separated by taking advantage of the volatility of its chloride, Andrew Fyfe of the same place, applied the principle to the detection of the metal when mixed with organic matter. For this purpose, he heated the arsenical liquid with sulphuric acid, free from arsenous acid, in a flask to which a bent tube and cooled receiver were adapted. When the mixture was brought to the

boiling point, a little dried sea salt was added, the receiver was connected, and the distillation continued for some time. Hydrochloric acid was evolved, which, by reacting with the arsenous acid, produced arsenic trichloride, which distilled over free from organic matter. The arsenic trichloride was then precipitated by a stream of hydrogen sulphide gas to obtain the yellow arsenic trisulphide, or subjected to the action of Marsh's test. (*Philos. Mag.*, 4th series, ii. 487.) By keeping present a larger amount of salt than can be decomposed by the sulphuric acid, the formation of sulphurous acid is avoided, and there is no danger of converting arsenous acid into the arsenic compound, as is the case in the presence of free chlorine. Arsenic acid is not converted into a volatile chloride, and would therefore escape detection in this process. Indeed, it is proposed to distinguish between arsenous and arsenic acids in mixtures by this reaction. After all the arsenous acid has been distilled off as arsenous chloride, the arsenic acid can be reduced by sulphurous acid and then distilled for itself. (*Handwörterbuch der Chem.*, i. 746.) The reduction of arsenic acid to arsenous acid is very conveniently effected, according to E. Fischer, by ferrous chloride used in connection with hydrochloric acid. (*Ber. d. Chem. Ges.*, xiii. 1778.) Penny and W. Wallace bear testimony to the value of the plan of converting the arsenic into trichloride, as a means of separating the metal from organic matter, but think it will be found more convenient to produce the trichloride by the direct agency of hydrochloric acid than by sulphuric acid and sodium chloride as recommended by Fyfe.

The method of testing for arsenic proposed by Marsh, is perhaps the best known of the arsenic tests. It consists in taking advantage of the power which nascent hydrogen possesses of decomposing the acids and arsenic, with the result of forming water and hydrogen arsenide, as illustrated by the subjoined reaction:

$$As_2O_3 + (H_2)_6 = (H_3As)_2 + (H_2O)_3$$

Any compound of arsenic other than those containing sulphur may now be added to the materials for generating hydrogen (pure diluted sulphuric acid and zinc), contained in a self-regulating generator of hydrogen. Canudas y Salva prevents the possible explosion of the apparatus, resulting from the ignition of the hydrogen before all the air has been expelled, by placing in the lateral exit tube two metallic meshes, enclosing between them very loose cotton. (*N. R.*, April, 1878.) Fresenius proposed the same years ago. If the added material contains arsenic, the nascent hydrogen will combine with the metal, and the nature of the compound gas formed may be ascertained by burning a jet of it from a fine jet-pipe connected with the generator. The flame will have a characteristic bluish-white color; and, by holding a porcelain plate against it, a thin film of metallic arsenic, forming a brownish-black stain, will be deposited. To remove every source of fallacy it is necessary to be sure of the purity of the materials for generating the hydrogen by a preliminary trial of the gas before the suspected liquid is added, as zinc and sulphuric acid are both liable to contain arsenic. This trial is made by holding a plate against the burning hydrogen, which, if pure, will produce no stain. The pieces of zinc employed should be changed after every experiment. Magnesium or aluminum may be advantageously substituted for zinc, as they contain no arsenic, or, still better, sodium amalgam (made by adding about 5 per cent. of metallic sodium to some warmed mercury), as proposed by E. W. Davy. This can be used then in a neutral solution, the evolution of nascent hydrogen being due to the decomposition of the water by the sodium.

If the sulphuric acid used to act upon the zinc contains nitrous compounds, the liberation of arsenic may be prevented. To obviate this difficulty a solution of stannous chloride in hydrochloric acid should be added towards the end of the operation. This liberates any arsenic present because of its reducing action, and arsine will be formed from it.

Still another modification is Fleitmann's test, in which the use of zinc, magnesium, or aluminum is retained, but the development of nascent hydrogen is brought about by the addition of potassium or sodium hydroxide. Under these circumstances hydrogen arsenide is produced, but hydrogen antimonide cannot be formed. A modification of Marsh's apparatus consists in having the tube which delivers the hydrogen arsenide narrowed in several places. If, then, while the gas is passing, heat be applied a little this side of the narrowed place, the compound is decomposed and a bright mirror of metallic arsenic is deposited in the contraction. As a very small deposit can be changed subsequently into trioxide or sulphide, both of which are characteristic, this test is quite delicate.

It has been objected to Marsh's test, that antimony forms a compound with hydrogen, very similar to hydrogen arsenide, both in the color of its flame, and in the metallic spot which it deposits during combustion on cold surfaces. Still, the two metals may be distinguished by acting on the metallic spot with a drop or two of fuming nitric acid, with the aid of heat. Arsenic will thus be converted into soluble arsenic acid (which forms a brick-red precipitate on the addition of silver nitrate solution) while antimony is changed into insoluble antimonic acid. Another way of distinguishing them is to apply to the stain a solution of sodium hypochlorite, which instantly dissolves the arsenical spot, without affecting that of antimony, or solution of stannous chloride, which has no action on metallic arsenic, while it dissolves slowly but completely the antimony stain. (Blyth, *Poisons, Effects and Detection*, p. 526.) Sodium nitroprusside also,

while it has no effect upon arsenic spots, will dissolve those of antimony completely and easily. (*Handwörterbuch der Chem.*, i. 757.) In case the metallic mirror is obtained in the tube by Berzelius's modification of Marsh's test, a stream of hydrogen sulphide may be passed, while immediately behind the stain a gentle heat is applied. Arsenic is changed thereby to yellow sulphide, while antimony produces an orange or black sulphide; if dry hydrochloric acid gas is now transmitted, the arsenical sulphide is unchanged, while antimony sulphide is converted into chloride of antimony, which volatilizes without the application of heat. (Blyth, *loc. cit.*) Ammonium sulphide dissolves the arsenical spot with difficulty, leaving on evaporation a yellow stain; it readily dissolves the antimonial, and yields an orange-red spot. Marsh's test may be still further modified as proposed by Lassaigne. The current of hydrogen arsenide is conducted into solution of silver nitrate, when it is decomposed according to the reaction:

$$AsH_3 + 6AgNO_3 + 3H_2O = H_3AsO_3 + 6HNO_3 + 3Ag_2$$

Here arsenous acid is formed, which goes into solution, and metallic silver separates. Hydrogen antimonide passed into silver nitrate solution produces a black precipitate of silver antimonide, in which all the antimony is contained.

Gutzeit's modification of this test is to carry out the reaction in a test tube, which is then covered by paper moistened with silver nitrate. A black stain indicates the presence of arsenic. Ritsert (*Ph. Ztg.*, 1889, 368) has increased the delicacy of this by using ammoniacal silver nitrate. It is asserted that 0.0005 milligramme of arsenous oxide will cause a brown stain.

The Modified Gutzeit's Test (U. S. Pharm., 8th Rev., see PART III, No. 17), in testing for the presence of traces of arsenical impurity in official chemicals, uses paper which has been moistened with alcoholic mercuric chloride solution and dried, as the cap at the end of the test tube. Zinc and hydrochloric acid, previously tested for purity in a blank experiment, are used, and the solution supposed to contain arsenic is heated with a solution of sulphurous acid to reduce the arsenic compound to the condition of arsenous acid, and any excess of sulphur dioxide boiled off. If, under these circumstances, the hydrogen evolved contains hydrogen arsenide, a distinct yellow or orange spot will be formed upon the mercuric chloride paper cap. One part of arsenic in 100,000 is readily recognized by the test. Antimony, under the same conditions, produces a dark gray to brownish-black coloration, and sulphur compounds a black stain. Bettendorf's test, as used in the *Pharm. Germ.*, ed. iv., depends on the fact that a concentrated solution of stannous chloride will cause the separation of metallic arsenic from arsenous acid even in the cold, and from arsenic acid on heating. As adopted by the U. S. Pharmacopœia (8th Rev.), fifteen minutes heating of the test tube containing the mixture, by immersion in a bath of boiling water, followed by standing for one hour, is prescribed. In the absence of arsenic, no trace of brownish color should appear.

Reinsch has proposed a method of detecting arsenic in organic liquids, which is extremely delicate and at the same time has the merits of facility and celerity. It consists in acidulating the suspected liquid with hydrochloric acid, which converts the arsenous acid into the trichloride, and boiling in it, for ten minutes, a slip of copper foil, on which the arsenic is deposited as an alloy consisting of one part arsenic to five parts copper; and then separating it in the state of arsenous acid, by subjecting the copper, cut into small pieces, to a low red heat in the bottom of a small glass tube. The peculiar crystalline appearance of arsenous acid, mentioned in the preceding page, is conclusive of its presence, and, besides, if collected and dissolved in water it will answer to the ordinary tests for the poison. The merit of Reinsch's procedure is not so much that it gives a characteristic deposit on the copper—for bismuth, tin, zinc, and antimony also give deposits—as that the copper collects all the arsenic from the organic liquid, and presents it in a convenient form for applying the liquid and subliming tests. But Reinsch's method is not without its fallacies. Thus, it has been ascertained that the presence of a nitrate or chlorate in the suspected material prevents the characteristic action of the arsenic on the copper until the whole of these substances have been consumed by reaction with the metal. Besides, both hydrochloric acid and copper are liable to contain arsenic, and therefore to afford fallacious results. This, however, is less true of the hydrochloric acid prepared in this country than of the European, as the sulphuric acid employed in its preparation here is obtained generally from native sulphur, instead of from pyrites as abroad. Nevertheless, no conclusion from Reinsch's test can be certainly relied on unless the hydrochloric acid has been ascertained to be free from arsenic. With the copper there is less risk, as the arsenic in it can act only by solution of the copper itself, and this is known by the green color imparted to the liquid; so that, if the arsenical deposit should be produced without discoloration of the liquid, the indication of the presence of the poison may be considered as satisfactory. (Odling and Taylor.)

The compounds of arsenic and sulphur do not respond directly to the influence of nascent hydrogen, and hence cannot be indicated by the Marsh and similar tests. In such cases the test of Fresenius and von Babo is used. The suspected material, previously dried, is rubbed up thoroughly with a mixture of three parts of dry sodium carbonate and 1 part of potassium cyanide, and introduced into a small dry test tube, so as to make a layer of about one-fourth of an inch in depth. On heating the end of

the tube until the contents are fused, a ring-like mirror of metallic arsenic will form, a short distance above the heated spot.

It has been shown by Malaguti and Sarzeau that for the detection of minute quantities of arsenic in exhumed bodies the best method of proceeding is to distil the viscera with aqua regia, made by mixing one part of nitric with three of hydrochloric acid. The animal matter (the liver, for example), cut into small pieces, is dried by a gentle heat, and mixed with a quantity of the aqua regia equal to the weight of the matter before it was dried. The mixture is distilled, and the arsenic, if present, comes over in the form of the volatile trichloride, which may be converted into the trisulphide in the usual manner.

Arsenic may be detected in exhumed bodies long after death. Blondlot found it in the brain of a body that had been buried twenty years. In this case it was ascertained that no arsenic existed in the earth of the cemetery. (See *B. F. M. R.*, 1855, p. 222.) It is necessary also to be guarded against the possible presence, about the body, of metals which may contain arsenic, as, for example, brass and copper. L. A. Buchner has found, in the intestines of persons who had been poisoned with arsenic trioxide, examined some months after death, the poison in the state of yellow arsenic sulphide, into which it had been converted by the hydrogen sulphide developed by the putrefactive process that had taken place in the bowels, showing that even in poisonous doses arsenic has not always the property of preserving the body from corruption. (*Neues Repertorium*, xvii. 21.)

Dose, of arsenic trioxide, one-fiftieth to one-twentieth of a grain (0.0013 to 0.003 Gm.).

Off. Prep.—Liquor Acidi Arsenosi, *U. S.* (*Br.*); Liquor Potassii Arsenitis, *U. S.* (*Br.*)

ARSENUM.

ARSENIC

(är'sẹ-nŭm)

As = 74.4

Arsenicum, *U. S.* 1870: Arsenium; Arsenic, *Fr.*; Arsen, Arsenik, *G.*; Arsenico, *It.*, *Sp.*

This metal was introduced into the U. S. and Dublin Pharmacopœias in 1850, for the purpose of being used to form arsenous iodide, and the solution of arsenous and mercuric iodide, at that time two new salts of those works. It has been rejected by the compilers of the U. S. and the British Pharmacopœias. The Dublin College gave the following formula:

"Take the White Oxide of Arsenic of Commerce two drachms [*Dub. weight*]. Place the Oxide at the sealed end of a hard German glass tube, of about half an inch in diameter and eighteen inches long, and, having covered it with about eight inches of dry and coarsely pulverized charcoal, and raised the portion of the tube containing the charcoal to a red heat, let a few ignited coals be placed beneath the Oxide, so as to effect its slow sublimation. When this has been accomplished, the metallic arsenic will be found attached to the interior of the tube at its distant or cool extremity.

"In conducting this process, the furnace used in the performance of an organic analysis should be employed, and the fuel should be ignited charcoal. It will be proper also to connect the open extremity of the tube with a flue, for the purpose of preventing the possible escape into the apartment of arsenical vapors; and, with the view of keeping it from being plugged by the metal, to introduce occasionally into it, as the sublimation proceeds, an iron wire through a cork, fixed (but not air-tight) in its open extremity."

In the above process, the white oxide (arsenic trioxide) is reduced by the agency of ignited charcoal, which attracts the oxygen of the oxide, and revives the metal. On the large scale, metallic arsenic is generally obtained by heating arsenical pyrites ($FeAs,FeS_2$) in earthen tubes, when the metal sublimes, and two molecules of ferrous sulphide, FeS, are left.

Properties.—Arsenic is a brittle, crystalline metal, of a steel-gray color, and possessing much brilliancy when recently broken or sublimed. Exposed to the air, its surface becomes dull and blackish. Its texture is granular, and sometimes a little scaly. Rubbed on the hands, it communicates a peculiar odor, but it is devoid of taste. Its sp. gr. is about 5.73 (5.88). When heated to about 180° C. (356° F.) it sublimes, giving rise to white vapors having a garlicky odor.[1] An amorphous modification results from the decomposition of hydrogen arsenide by heat, the arsenic appearing as a dark brown deposit. There is also a yellow modification which is formed when arsenic vapor is strongly cooled. It resembles yellow phosphorus, as it is soluble in carbon disulphide and oxidizes in the air with luminosity. Its atomic weight is 74.4. It forms two combinations with oxygen, arsenous and arsenic oxides, As_2O_3 and As_2O_5 respectively, to each of which the corresponding acid is known, and three with sulphur, namely, the disulphide, or realgar, As_2S_2; the trisulphide, or orpiment, As_2S_3, corresponding in composition to arsenous oxide; and the pentasulphide, As_2S_5, corresponding to arsenic oxide. (See *Arseni Trioxidum;* also *Realgar* and *Orpiment* in PART II of this work.) *Arsenic oxide* is obtained by distilling off a mixture of twelve parts of nitric and one of hydrochloric acid from four parts of arsenic trioxide, until the whole acquires the consistence of a thin syrup. The liquid is then poured

[1] The statement that arsenic on being heated sufficiently, passes at once into the state of vapor without fusing was disproved by experiments of Dunnington and Odger, made under direction of Mallet of the U. of Va. They succeeded in fusing arsenic without great difficulty. (*Chem. News*, Aug. 30, 1872.)

into a porcelain dish, and evaporated at a moderate heat. Suddenly the arsenic oxide concretes into an opaque white mass, which should be transferred, while warm, to a well-stoppered bottle. Arsenic oxide is white, solid, deliquescent, and soluble in six parts of cold and two of boiling water. It forms several acids, corresponding to the several varieties of phosphoric acid, to which it bears a close analogy. With silver nitrate it gives a brick-red precipitate of silver arsenate. As a poison it is even more virulent than arsenous oxide. It consists of two atoms of arsenic and five of oxygen (As_2O_5).

The world's supply of arsenic and arsenic compounds at the present time is obtained from Germany, Spain, England and Canada, although in Montana and Washington considerable quantities of arsenic are being produced as a by-product in the smelting of copper ores. In 1903 the German production of arsenic was 2768 metric tons; that of Spain, 1088 tons; of England, 917 tons, and of Canada, 233 tons, while the United States produced 554 tons. The importations of arsenic, arsenous oxide, and arsenic sulphides into the United States for 1903 amounted to 8,357,661 lbs., valued at $294,602.

Arsenic is much diffused. Besides being present in a great many minerals, it has been detected, in minute proportion, in the earth of cemeteries by Orfila; in certain soils and mineral waters by Walchner; in the ashes of various plants by Stein; in various mineral coals; also in the incrustation formed in the boiler of a sea-going steamer, by Daubrée. Recently it has been found in minute quantities in many plants and even in the tissues of the human body.

ASAFŒTIDA. U. S. (Br.)

ASAFETIDA

(ăs-ą-fœt'ĭ-dą)

"A gum-resin obtained from the root of *Ferula fœtida* (Bunge) Regel, and probably other species of *Ferula* (Fam. *Umbelliferæ*)." *U. S.* "A gum-resin obtained by incision from the root of Ferula fœtida, *Regel;* and probably other species." *Br.*

Asafetida, *Br.;* Stercus Diaboli, Cibus Deorum; Gummi-resina Asafœtida; Asa fœtida, Asse-fétide, Assafœtida, *Fr.;* Asa fœtida, *P. G.;* Asant, Stinkasant, Teufelsdreck, *G.;* Assa fetida, *It.;* Asafetida, *Sp.;* Ungoozeh, *Pers.;* Hilteet, *Arab.;* Hing, *India;* Angusa-kema, *Afgh.*

Concerning the genus Ferula there has been much dispute by botanists, but at present a much wider range is given to it than formerly. H. Falconer (*Tr. Linn. Soc.,* xx. 285) separated from it the genus *Narthex,* relying chiefly upon the distinctness of the vittæ as characteristic, while Bunge separated the genus *Scorodosma* on account of the absence of vittæ. According, however, to Bentham and Hooker, the vittæ in Bunge's type specimens are no more inconspicuous than in various other species of the genus; and, further, the vittæ vary so much that no generic character can be drawn from them. The genus Ferula is a very difficult one to characterize briefly, see Bentham and Hooker, *Genera Plantarum,* i. 917.

Ferula fœtida, Regel, *F. Scorodosma,* Bentham and Hooker, *Scorodosma fœtidum,* Bunge, *Ferula Assafœtida,* L., of Boissier (*Flora Orientalis,* ii. 994), is a coarse umbelliferous plant, growing from five to seven feet high, with a large fleshy root, the crown of which is covered with coarse bristly fibres, and gives origin to large bipinnate radical leaves and a nearly naked stem which has only a few bipinnate leaves without wide sheathing petioles, and ends at the top in very numerous umbels. The flat-winged fruit have the vittæ almost obsolete. This plant was first discovered in the sandy desert near the sea of Aral, by Lehmann, in 1844. Bunge found it in Persia about twenty years later. It would seem to be native all through Afghanistan.

Ferula Assafœtida, Willd., *Sp. Plant,* i. 1413. *B. & T. Ferula Narthex,* Boiss. *Narthex Assafœtida,* Falconer.—This plant, which was formerly recognized officially as a source of asafetida, was first described from actual observation by H. Falconer, who found it near Kashmir, and has long been successfully cultivated in the Edinburgh Botanical Gardens. It is distinguished from the true asafetida plant by the greater height of the stem (6 to 10 feet), and by the numerous stem leaves furnished with wide sheathing petioles. The flowers are pale yellow, and the oval fruit thin, flat, foliaceous, and reddish brown, with pronounced vittæ. It yields a milky juice having a powerful odor of asafetida.

It is possible that asafetida is obtained from various species of Ferula, yet the bulk of the drug probably comes from the official plant. This plant does not agree with the description given by E. Kaempfer of the plant which he observed in 1687, and to which he gave the name of *Assafœtida disguinensis,* although Falconer considers the latter plant as identical with his *Narthex Assafœtida,* and Borszczon, who studied *F. Scorodosma,* growing wild in the neighborhood of the Caspian Sea, believes this plant the same as that described by Kaempfer. It is very likely that the difficulty of identification is due to inaccuracies in the original figure of Kaempfer. *F. persica,* W., *F. alliacea,* Boiss., *F. Assafœtida,* L., *Assafœtida disguinensis,* Kaempf., *F. Narthex,* Boiss. (*Narthex Assafœtida,* Falc.), have had official recognition. E. M. Holmes's discussion of the asafetida plants (*P. J.,* ser. iii. xix., 1888-9) still remains our chief source of information on the subject. *Ferula Jæschkeana,* Vatke, which has been believed to be the source of asafetida, according to E. M. Holmes, has, at least in its dried state, not the slightest odor of asafetida, and indeed yields a strongly celery-scented juice. (*P. J.,* 1894, xxv.).

The asafetida plants are indigenous to Western Afghanistan and Eastern Persia. In 1687 the collection of asafetida was witnessed by Kaempfer, whose description of the method is very similar to that given by H. W. Bellew in 1872, and by J. E. T. Aitchinson in 1884. According to Aitchinson, the high plains of Afghanistan, two to four thousand feet above the sea, are arid and bare in winter, but in the early summer are covered with a thick growth of *Ferula fœtida, Dorema ammoniacum,* and *Ferula galbaniflua.* The great cabbage-like heads of the asafetida plant, representing the primary stage of the flower heads covered over by the stipules of its leaves, are eaten raw by the natives as a sort of green. In June the asafetida is obtained. The root stock is first laid bare to the depth of a couple of inches, those plants only which have not reached their flower bearing stage being selected. A slice is then taken from the top of the root stock, which is immediately covered with twigs and clay, forming a sort of dome, with an opening towards the north, so that the sun cannot get at the exposed root. About five or six weeks later, a thick, gummy, not milky, reddish substance found upon the exposed surface of the root in more or less irregular lumps is scraped off with a piece of iron hoop or removed with a slice of the root and at once placed in a leather bag. The asafetida is conveyed to Herat, where it is adulterated with red clay before being sent into commerce. It is brought to this country directly from India, whither it is conveyed from Bushire and down the Indus, or by the route of Great Britain. It sometimes comes in mats, but more frequently in cases, the former containing eighty or ninety pounds, the latter from two hundred to four hundred pounds. Asafetida is sometimes also imported in casks.

The fruit of the asafetida is said to be sent to India, where it is highly esteemed as a medicine.

Properties.—As found in commerce, asafetida is in irregular masses, softish when not long exposed, of a yellowish or reddish-brown color externally, exhibiting when broken an irregular, whitish, somewhat shining surface, which soon becomes red on exposure, and ultimately passes into a dull yellowish-brown. This change of color is characteristic of asafetida, and is ascribed to the influence of air and light upon its resinous ingredient. The masses appear as if composed of distinct portions agglutinated together, sometimes of white, almost pearly tears, embedded in a darker, softer, and more fetid paste. Occasionally the tears are separate, though rarely in the commerce of this country. They are roundish, oval, or irregular, and generally flattened, from the size of a pea to that of a large almond, sometimes larger, yellowish or brownish externally and white within, and not unlike ammoniac tears, for which they might be mistaken except for their odor, which, however, is weaker than that of the masses. A very fine variety of asafetida is spoken of by Bellew as being procured from the leaf bud in the centre of the root. It does not come into European commerce, but is the *Kandaharee Hing* of the Indian bazaars. (*P. J.*, viii. 103.) It occurs in moist flaky pieces and tears, yielding a reddish-yellow oil on pressure, and mostly mixed with the remains of leaf buds. The ordinary asafetida of the Indian bazaars is known in the superior grade as *Hing,* in the inferior grade as *Hingra.* The odor of asafetida is alliaceous, fetid, and tenacious; the taste, bitter, acrid, and durable. The effect of time and exposure is to render it more hard and brittle, and to diminish the intensity of its odor and taste, particularly the former. Kaempfer assures us that one drachm of the fresh juice diffuses a more powerful odor through a close room than one hundred pounds of the drug as usually kept in the stores. The color, which is at first white, becomes pink, and finally the well known brown, on exposure. Asafetida softens by heat without melting, and is difficult of pulverization. Its sp. gr. is 1.327. (Berzelius.) It is inflammable, burning with a clear, lively flame. It yields all its virtues to alcohol, and forms a clear tincture, which becomes milky on the addition of water. "The freshly fractured surface becomes greenish on the application of a few drops of a 40 percent. nitric acid solution; becoming hard and brittle by drying; odor persistent, alliaceous; taste bitter, alliaceous, and acrid. When triturated with water, Asafetida yields a milk-white emulsion which becomes yellowish on the addition of ammonia water. Not less than 50 percent. should dissolve in alcohol. When incinerated, Asafetida should yield not more than 10 percent. of ash." *U. S.* "Asafetida should contain not less than 65 per cent. of matter soluble in *alcohol* (90 per cent.), and should yield not more than 10 per cent. of ash when incinerated." *Br.*

Much commercial asafetida of prime appearance, fails to come up to the requirements of the U. S. Pharmacopœia. Large quantities are said to be returned from the United States ports to Europe on account of their failure to contain the proper percentage of material soluble in alcohol, and in reducing the requirements from 60 to 50 per cent. the revisers of the Pharmacopœia have only yielded to a slight extent to the necessities of the situation. Macerated in water it produces a turbid red solution, and triturated with that fluid it gives a white or pinkish milky emulsion of considerable permanence. Touched with nitric acid (sp. gr. 1.2) the tear becomes of an evanescent green color. "If a small fragment be strongly heated in a dry test-tube, the contents of the tube, after cooling, yield with boiling *water* a solution which when largely diluted and made alkaline with *solution of ammonia* exhibits a blue fluorescence." *Br.* In 100 parts, Pelletier found 65 parts of resin, 19.44 of gum, 11.66 of bassorin, 3.60 of volatile oil, with traces of acid calcium

malate. J. Polásek examined the pure tears of *Asafœtida amygdaloides,* finding the following constituents: 61.40 per cent. of resin soluble in ether, which is regarded by him to be the ferulaic acid ester of *asaresino-tannol;* 0.60 per cent. of resin insoluble in ether, regarded to be free asaresino-tannol; 25.10 per cent. of gum; 6.70 per cent. of volatile oil; 0.06 per cent. of vanillin; 1.28 per cent. of free *ferulaic acid;* 2.36 per cent. moisture; 2.50 per cent. impurities. *Asaresino-tannol* has the composition corresponding to the formula $C_{24}H_{35}O_5$. The author has prepared a benzoyl derivative, $C_{24}H_{33}O_5.C_6H_5CO$, and an acetyl derivative, $C_{24}H_{33}O_5.CH_3CO$, which prove it to contain a hydroxyl group,—viz., $C_{24}H_{33}O_4.OH$. Umbelliferone was obtained as a secondary product of hydrolysis with sulphuric acid from asaresino-tannol, and was also obtained from ferulaic acid synthetically, guaiacol being produced at the same time. By nitrification of asaresino-tannol, picric acid is produced. (*A. Pharm.,* 235, March, 1897, 125, 132.) The odor of the gum-resin depends on the *volatile oil,* which may be procured by distillation with water or alcohol, and amounts to from 6 to 9 per cent., according to Flückiger. It is lighter than water, colorless when first distilled, but becomes yellow with age, of an exceedingly offensive odor, and of a taste at first flat, but afterwards bitter and acrid. Hlasiwetz (*Ann. Ch. Ph.,* 71, 23) considers it a mixture, in variable proportions, of the sulphide and disulphide of a compound radical consisting of carbon and hydrogen (C_6H_{11}). Allyl persulphide, which is sublimed when oil of mustard is heated with potassium persulphide, is said by Wertheim to have an extremely intense odor of asafetida, a fact which justifies the supposition that it may be identical with the oil of that gum-resin. (Gmelin, ix. 377.) Semmler, in a later study (*Ber. d. Chem. Ges.,* 23, p. 3530, and 24, p. 78), states that it contains *pinene* and a second terpene in smaller amount, and in the higher boiling fractions, a disulphide, $C_7H_{14}S_2$; a disulphide, $C_{11}H_{20}S_2$; a body $(C_{10}H_{16}O)_n$; a disulphide, $C_8H_{18}S_2$; and $C_{10}H_{18}S_2$.

The resin is, according to Hlasiwetz and Barth (*Ann. Ch. Ph.,* 138, 61), a mixture containing *ferulaic acid,* $C_{10}H_{10}O_4$, crystallizing in iridescent needles, and obtained by precipitating the alcoholic solution with lead acetate, washing the precipitate, and decomposing it with diluted sulphuric acid. Submitted to dry distillation, the resin yields *umbelliferone,* $C_9H_6O_3$, and blue-colored oils. Fused with potassium hydroxide, ferulaic acid yields oxalic acid and carbon dioxide, several acids of the fatty series, and protocatechuic acid. The resin itself treated in like manner, after it has been freed from gum, yields resorcinol. Tschirch (*Harze und Harzebehälter,* 1900, p. 234) states that the resin is the *ferulaic ester of asaresino-tannol* containing some free *ferulaic acid,* and some *vanillin,* which latter is a product of the oxidation of the ferulaic acid.

Impurities and Adulterations.—Asafetida is often purposely adulterated; it frequently comes of inferior quality, and mixed with various impurities, such as sand and stones. Portions which are very soft, dark brown, or blackish, with few or no tears, and indisposed to assume a red color when freshly broken, should be rejected. We have been informed that a case seldom comes without more or less of this inferior asafetida, and of many it forms the larger portion. It is sold chiefly for horses. A factitious substance, made of garlic juice and white pitch with a little asafetida, has occurred in commerce. Asafetida is said to be usually mixed with wheat or barley flour or with earthy matters at the place of its production, the impurities sometimes exceeding 30 per cent. *Hingra* of the Bombay bazaars is a very stony variety, composed largely of earthy matter.

J. U. Lloyd, after examining a large number of samples of commercial asafetida, was convinced that it is impracticable to obtain the crude drug of the official standard, gypsum, carbonates, and other insoluble matters being present in large amounts. He did not find white turpentine or rosin in any of the samples; exhausting asafetida with alcohol and evaporating the alcohol carefully, he obtained an extract for which he proposed the name of *Purified Asafetida.* (*Ph. Rev.,* 1896.) H. William Jones (*Y. B. P.,* 1900, 503) purifies asafetida by pouring a concentrated alcoholic solution into water slightly acidulated with hydrochloric acid, collecting the precipitate, washing and drying it.

Asafetida is sometimes kept in a powdered state, but this is objectionable, as the drug is thus necessarily weakened by the loss of volatile oil, and is more liable to adulteration.

Uses.—Asafetida acts primarily as a stimulant antispasmodic, and as an efficient expectorant and feeble laxative. Some consider it also emmenagogue and anthelmintic. Its volatile oil is undoubtedly absorbed, as its peculiar odor may be detected in the breath and the secretions. As an antispasmodic, it is employed in the treatment of *hysteria, hypochondriasis, convulsions* of various kinds, *spasm of the stomach and bowels* unconnected with inflammation, and in numerous other nervous disorders of a merely functional character. From the union of expectorant with antispasmodic powers, it is highly useful in *spasmodic pectoral affections,* such as *whooping cough* and *asthma,* and in certain *infantile coughs* and *catarrhs,* complicated with nervous disorder, or with a disposition of the system to sink. In *catarrhus senilis;* in the secondary stages of *peripneumonia notha, croup, measles,* and *catarrh;* in *pulmonary consumption;* in fact, in all cases of *subacute* or *chronic disease of the chest* in which there is want of due nervous energy, asafetida may be occasionally prescribed with advantage. In the form of enema, it is useful in cases of *inordinate accumulation of air in the bowels,* and also in the *hysteric paroxysm* and

other functional convulsions. Its laxative tendency is often advantageous, and it may be usefully combined with cathartics in *flatulent constipation.*

It appears to have been known in the East from very early ages, and, notwithstanding its repulsive odor, is at present much used in India and Persia as a condiment. Persons soon habituate themselves to its odor, which they even learn to associate pleasantly with the agreeable effects experienced from its internal use. Children with whooping cough sometimes become fond of it.

Asafetida may be given in pill or emulsion. The tincture is official, and is much used. When given by injection, the gum-resin should be triturated with warm water. From half a drachm to two drachms (2 to 7.7 Gm.) may be administered at once in this way. It may also sometimes be conveniently used in the form of a suppository, or plaster. (See *Emplastrum Asafœtidæ*, 18th ed. U. S. D., p. 238.) A syrup has been recommended in which the fetid odor of the drug is disguised by the use of the infusion of wild cherry bark.[1] (See *A. J. P.*, 1871, p. 397.)

Dose, of asafetida, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Emulsum Asafœtidæ, *U. S.;* Pilula Aloes et Asafetidæ, *Br.;* Pilulæ Asafœtidæ, *U. S.;* Pilula Galbani Composita, *Br.;* Spiritus Ammoniæ Fetidus, *Br.;* Tinctura Asafœtidæ, *U. S., Br.*

ASPIDIUM. U. S. (Br.)

ASPIDIUM [Male Fern]

(ȧs-pĭd'ĭ-ŭm)

"The dried rhizome of *Dryopteris Filix-mas* (Linné) Schott, or of *Dryopteris marginalis* (Linné) Asa Gray (Fam. *Filices*)." *U. S.*
"The rhizome of Aspidium Filix-mas, *Swartz.* Collected late in the autumn, divested of its roots, leaves, and dead portions, and carefully dried. Male Fern should not be kept more than a year." *Br.*

Filix Mas, *Br.,* and *U. S.* 1870; Stipites aspidii, Radix Filicis maris, Male Shield Fern, Knotty or Sweet Brake, Basket Fern, Bear's-paw Root; Fougère Mâle, *Fr.;* Rhizoma Filicis, *P. G.;* Wurmfarnwurzel, Waldfarnwurzel, Johanniswurzel, Farnwurzel, *G.;* Felce maschio, *It.;* Helecho macho (Rhizoma de), *Sp.*

As the term Dryopteris was first used by Amman in 1739, and applied in 1763 by Adanson, as the name of the genus to which the Aspidium was applied in 1800 by Swartz, the use of the generic term Dryopteris would seem to be necessitated by the ordinary laws of botanic nomenclature. The synonyms of the male fern are extraordinarily numerous. We append some of them: *Aspidium Filix-mas,* of many authors; *Polypodium Filix-mas,* Linn.; *Polystichum Filix-mas,* Roth.; *Nephrodium Filix-mas,* Rich.; *Lastrea Filix-mas,* Presl.; *Tectarea Filix-mas,* Cavan.; *Dryopteris Filix-mas* (L.), Schott; *Lophodium Filix-mas,* Newm.; *Polypodium nemorale,* Salisb.; *Polystichum durum et induratum,* Schur.; *Polystichum abbreviatum,* De Candolle; *Aspidium mildeanum,* Göppert; *Dryopteris affinis; Polypodium heleopteris.* Under the name of *inkomankomo* or *uncomocomo,* the rhizome of *Aspidium athamanticum* (Hook.), Kuntze, has long been used by the South African Kaffirs, and has entered European commerce as *pannum.* The male fern has a perennial, horizontal root or rhizome, from which numerous annual fronds or leaves arise, forming tufts from a foot to four feet in height. The stipe, or footstalk, and midrib are thickly beset with brown, tough, transparent scales; the frond itself is oval-lanceolate, acute, pinnate, and of a bright green color. The pinnæ or leaflets are remote below, approach more nearly as they ascend, and run together at the summit of the frond. They are deeply divided into lobes, which are of an oval shape, crenate at the edges, and gradually diminish from the base of the pinna to the apex. The fructification is in small dots on the back of each lobe, placed in two rows near the base, and distant from the edges. The plant is a native of Europe, Asia, and the north of Africa. It is also found in some of the Polynesian islands, and grows in British America, following the Rocky Mountain chain through Mexico, Venezuela, etc., as far south as Peru.

In the Eastern United States it is replaced by *D. marginalis* and *D. Goldieana* (Hook.), A. Gray. D. marginalis has an ovate oblong frond, one or two feet long, with lanceolate pinnæ, with broad almost sessile bases and oblong obtuse crowded pinnules. It differs from *D. Filix-mas* by having its fruit dots upon the margin of its evergreen fronds.

It is probable that most species of the genus, if not of the family, are medicinally active. J. L. Patterson (*A. J. P.*, 1875) found that the *D. marginale* contained all of the active principles of *D. Filix-mas,* and Chas. H. Cressler has demonstrated the activity of its oleoresin. (*Ibid.*, 1878.) According to V. Penndorf (*Ap. Ztg.*, 1903), in Germany the rhizomes of *D. spinulosum* and *Athyrium Filix-fœmina* are frequently found mixed with those of the true male fern, in quantities varying from five to ninety per cent. The rhizomes of *D. Filix-fœmina* are readily recognized by having only two large dumb-bell shaped steles. The rhizomes of *D. spinulosum* closely resemble those of the genuine drug, but it is stated that they can be distinguished by the numerous small glands found on the margin of their scales, the scales of *D. Filix-mas* having only two upon each. On account of this substitution, many

[1] J. W. Wood prepares *syrup of asafetida* by dissolving 256 grains of asafetida in two fluidounces of glycerin by the aid of a gentle heat, and straining. He then dissolves 15 drops oil of wintergreen, 5 drops oil of cinnamon, and 1 drop oil of bitter almond, in three fluidrachms of 95 per cent. alcohol, and adds to it the above, together with enough simple syrup to make one pint. Each fluidrachm represents two grains of asafetida. (*A. J. P.*, 1874.)

of the German extracts of the male fern are said to contain *aspidin*, a yellow crystalline substance having a melting point of 124° to 125° C., which is found only in *D. spinulosum.* (*Ap. Ztg.*, 1903.) Lauren of Helsingsfors states that the extract of *A. spinulosum* is a very active tænicide, and is less apt to produce disagreeable sensations in the patient than is the official drug. He gives the dose as 60 grains (3.9 Gm.), followed by a laxative, and states that some Finnish apothecaries are especially noted for their fern extracts, because they use only the rhizome of *A. spinulosum.* (*Ap. Ztg.*, 1903.) On the Pacific slope the indigenous *A. rigida*, Underw., is locally used against the tapeworm, and W. J. Bowman has found in it filicic acid and resin. Popular belief has long ascribed tænicidal virtues to our native *Asplenium Filix-fœmina.* It occurs in conical pieces from 8 to 13 centimeters long, 2 to 5 centimeters in diameter, of a reddish-brown color, covered with root fibres and leaf scars. According to R. Kürsten (*P. J.*, xxii., 1891), its active principle is closely allied to filicic acid, differing in being especially soluble in strong alcohol, in subliming at 80° C., and in not yielding isobutyric acid when heated in a sealed tube with water. *Pannic acid* crystallizes in thin, shining, light yellow, rectangular prisms, melting at 187° C. (368.6° F.).

Heffter (*A. E. P. P.*, 1897, 458) finds three well characterized and crystallized principles in pannum: *flavopannin*, $C_{21}H_{26}O_7$, crystallizing in citron-yellow prisms, melting at 151° C., and soluble in ether, benzene, acetic ether, acetone, and boiling methyl and ethyl alcohols, insoluble in petroleum ether and water; *albopannin*, $C_{21}H_{24}O_7$, crystallizing in silky-white needles, which melt at 147° C.; and *pannol* (pannic acid of Kürsten), $C_{11}H_{14}O_4$, fusing at 192° C., which is easily soluble in hot glacial acetic acid and acetone, more difficultly soluble in alcohol and ether, and very slightly soluble in petroleum benzin, benzene, and water. The alcoholic solution is colored intensely dark green with ferric chloride. Heffter compares these three compounds with the three obtained from *D. Filix-mas*, and finds a close chemical and therapeutic correspondence between *aspidin* and *flavopannin*, between *albaspidin* and *albopannin*, and between *aspidinol* and *pannol.* According to the experiments of A. Heffter, both *flavopannin* and *albopannin* are powerful muscle poisons, directly affecting the heart. (*A. E. P. P.*, Bd. xxxviii.)

According to Peschier of Geneva, Aspidium deteriorates rapidly when kept, and in about two years becomes entirely inert. The rhizomes of other species of fern are frequently substituted for the official, and in the dried state it is difficult to distinguish them. The varying results reported by physicians when using this drug, can undoubtedly be ascribed to the employment of spurious male fern, or old brownish rhizomes which should have been thrown away.

Properties.—As taken from the ground, the rhizome consists of a long cylindrical caudex, around which are closely arranged, overlapping each other like the shingles of a roof, the remains of the leafstalks or stipes, which are an inch or two in length, from two to four lines thick, somewhat curved and directed upwards, angular, brown, shining, and surrounded near their origin from the rhizome with thin silky scales of a light brown color. From between these remains of the footstalks emerge numerous small radical fibres. The whole rhizome, thus constituted, presents a somewhat flexible, cylindrical mass, one or two inches thick, and from three inches to a foot or more in length. In this form, however, it is not usually found in commerce. The whole is ordinarily broken up into fragments, consisting of the separated remains of the leafstalks before described, with a small portion of the substance of the rhizome attached to their base, where they are surrounded by the silky scales. These fragments, as seen in commerce, often appear as if long kept, and are probably, in general, much deteriorated by time. The official description is as follows: "Before being peeled, 10 to 15 Cm. long by 5 to 7 Cm. thick, including the densely imbricated, dark brown, cylindraceous, slightly curved stipe-bases and the dense mass of brownish, glossy, transparent, soft, chaffy scales; when peeled, 1 to 2 or 3 Cm. thick, cylindraceous and nearly straight, or curved and tapering towards one end, roughly scarred with remains of the stipe-bases, or bearing several coarse longitudinal ridges and grooves; pale green when first peeled, becoming pale brown; fracture sharp, pale green, the texture rather spongy, exhibiting from 6 to 10 steles in a loose and interrupted circle; odor disagreeable; taste bitter-sweet, astringent, acrid, and nauseous. The chaff, together with the dead portions of the rhizome and stipes, should be removed, and only such portions used as have retained their internal green color. Powdered Aspidium should be freshly prepared and have a bright green color." *U. S.* In collecting male fern, all the black discolored portions should be cut away, the fibres and scales separated, and only the sound green parts preserved. These should be immediately but carefully dried, and then pulverized; and the powder should be kept in small well-stoppered glass bottles.

Microscopic examination shows that it is composed of polyhedral, porous-walled cells and vascular bundles containing scalariform ducts; in *D. Filix-mas* ten of these bundles are larger than the others, and are arranged in an attempted circle near to the surface; while in *D. marginale* there are only six bundles in the circle. It has been analyzed by H. Bock, who gives as its constituents volatile oil, fixed oil, resin, starch, vegetable jelly, albumen, gum, sugar, tannic and gallic acids, pectin, lignin, and various salts. (See *A. J. P.*, xxiv. 64.) Peschier ascertained that its active properties reside in the ethereal extract, which is the fixed oil in an impure state, containing

volatile oil, resin, coloring matter, etc. It is a thick dark liquid, with the odor of the fern, and a nauseous, bitterish, somewhat acrid taste. E. Luck found in it a peculiar acid, which he denominated *filicic acid*. Daccomo gives to filicic acid the formula $C_{14}H_{16}O_5$, and finds in addition a white waxy substance, melting at 80° C., with the formula $(C_{13}H_{26}O)_n$, glucose, tannin, a red coloring matter (*filix red*), a green oil which he separated into several fractions, and two resins, one brick-red, melting at 85° to 93° C., the other black and plastic. He considers that filicic acid is probably an isobutyric acid derivative of hydroxynaphthaquinone. Poulson (*A. E. P. P.*, 1891) states that, when pure, crystalline, inactive filicic acid is dissolved in alkalies and reprecipitated by an acid, the amorphous precipitate possesses the active properties of the extract. He thinks that the inactive crystalline body is an anhydride or lactone of the amorphous filicic acid, and should be called *filicin*. Böhm announced three additional substances which he named *flavaspidic acid, albaspidin* and *aspidinol*. Kraft (*Ph. Ztg.*, **1903**, p. 275) confirms this and finds in addition, *flavaspidin*, and an amorphous acid which he names *filmaron*, which pharmacological examination has proven conclusively to be the true anthelmintic constituent of male fern. *Filmaron* is a bright yellowish-brown powder, insoluble in water, difficultly soluble in cold alcohol, but very soluble in other general solvents. The rhizome contains about 5 per cent. of *filmaron*. Its formula is $C_{47}H_{64}O_{16}$. The other different constituents seem to be largely decomposition products of filmaron. For an assay method for male fern extract, see *Am. Drug.*, 1897, 73.

Uses.—Male fern was used by the ancients, and is mentioned as a vermifuge in the works of Dioscorides, Theophrastus, Galen, and Pliny, and by some of the earlier modern writers. But it does not appear to have been generally known till about the year 1775, when the King of France purchased from Madame Nouffer, the widow of a Swiss surgeon, a secret remedy for *tape worm*, which proved to be the powdered root of the male fern. The oleoresin of male fern is a very efficient **tænicide**, and is also much used against the *anchylostoma*. According to the experiments of W. Straub (*A. E. P. P.*, xlviii, 1902), the active principles of male fern are violent muscular poisons, and probably kill the tape worm by acting directly upon their muscle cells. It is, however, in overdose a distinct poison, Katayama and Okamoto (*Sei-i-kwai*, July, 1892) having collected from literature twenty-two cases of poisoning by it, of which five proved fatal. Six drachms have caused death. (*L. L.*, 1882.) The symptoms have been vomiting, diarrhœa, vertigo, headache, tremor, cold sweat, dyspnœa, cyanosis, mania, coma, convulsions. In nearly half of the cases there was amblyopia, or even amaurosis, with dilated, fixed pupils; the loss of sight is usually temporary, but has proved permanent. Katayama and Okamoto succeeded in producing blindness in the lower animals. They believe that the use of castor oil with the male fern notably increases the absorption of the extract. Prevost and Binet have found that in the lower animals, given hypodermically, the oleoresin produces violent dyspnœa and death from arrest of the heart in systole, and Fröhner has found parenchymatous nephritis in animals fatally poisoned by it. For the expulsion of *tape worm*, the patient should live upon milk and a little bread for one day, and the following morning take a full dose, one-half to one fluidrachm (1.8 to 3.75 Cc.) of the oleoresin, fasting, and repeating it in two or three hours. At noon the patient may resume the use of food, and in the evening a brisk cathartic should be given. Male fern is said (with doubtful accuracy) to prove more effectual against the tape worm of the Swiss (*Bothriocephalus latus*) than against *Tænia solium*, which is more frequent in France and England. (Bremser.)

Dose, one to two drachms (3.9 to 7.7 Gm.).

Off. Prep.—Oleoresina Aspidii, *U. S.* (*Br.*).

ATROPINA. U. S., Br.

ATROPINE

(ăt-rō-pī′nă)

$C_{17}H_{23}NO_3 = 287.04$

"An alkaloid obtained from *Atropa Belladonna* Linné (Fam. *Solanaceæ*) and from other plants of the same family. As it occurs in commerce, it is usually accompanied by a small amount of hyoscyamine, from which it cannot be readily separated. It should be kept in amber-colored, well-stoppered vials." *U. S.* "An alkaloid, $C_{17}H_{23}NO_3$, obtained from Belladonna Leaves or Root." *Br.*

Atropia; Atropine, *Fr. Cod.*; Atropinum, *P. G.*; Atropin, *G.*; Atropina, *It., Sp.*

Because atropine cannot profitably be manufactured on a small scale, both Pharmacopœias have omitted the processes of preparation, and furnish only qualitative tests. For the U. S. process of 1870, see U. S. D., 14th edition.

Properties and Tests.—Atropine is in " white rhombic prisms, more or less elongated in the direction of the major axis as they contain more or less hyoscyamine; odorless; possessing a bitter, acrid taste (*it should be tasted with the utmost caution and only in dilute solution*). Atropine shows an alkaline reaction with litmus, phenolphthalein, and hematoxylin T.S. Pure atropine chloraurate melts at 136° C. (276.8° F.). Pure hyoscyamine chloraurate melts at 160° C. (320° F.). Pure hyoscine chloraurate melts at 197° C. (386.6° F.). Atropine chloraurate alone melts under boiling water. At about 113.8° C. (237° F.) Atropine melts, forming a colorless liquid; the melting point of Atropine free from hyoscyamine is about 115.8° C. (240.4° F.). When ignited, it is consumed without leaving a residue.

Soluble in 450 parts of water, 1.46 parts of alcohol, 16.6 parts of ether, and 1.56 parts of chloroform at 25° C. (77° F.); soluble in 86.7 parts of water at 80° C. (176° F.); and in 0.9 part of alcohol at 60° C. (140° F.). On adding sulphuric acid to Atropine, no color should be produced (absence of *readily carbonizable organic impurities*), nor should any color be developed upon the subsequent addition of nitric acid (absence of, and difference from, *morphine*). In a solution of Atropine in hydrochloric acid, platinic chloride T.S. produces no precipitate (difference from *most other alkaloids*). Gold chloride T.S. yields a yellow, lustreless precipitate in such a solution. If a few crystals of Atropine be placed in a porcelain dish on a water-bath with a few drops of nitric acid, and heated to dryness, a yellow residue will be produced; if on cooling a few drops of alcoholic potassium hydroxide T.S. and a fragment of potassium hydroxide be added, an intense violet color is produced; hyoscyamine and hyoscine will produce the same color, but the presence of strychnine masks the reaction. If a crystal of Atropine be added to a few drops of sulphuric acid containing 1 drop of creosol, a pink color should be produced, which is not dissipated by the addition of 0.5 Gm. of hydrated chloral (distinction from *other alkaloids, hyoscyamine* producing a brown color and *strychnine* a black, *hyoscine* remaining colorless). If a small quantity of Atropine, or one of its salts, be heated with a few Cc. of sulphuric acid, a peculiar odor, recalling that of a mixture of rose, orange flower, and melilot, will become noticeable. The addition of a few fragments of potassium dichromate will change this odor to that of bitter almond." *U. S.* The British Pharmacopœia states that atropine is "soluble in 300 parts of *water*, readily soluble in *alcohol* (90 per cent.), in *chloroform*, and in *ether*. . . Melting point 239° to 240° F. (115° to 115.5° C.). . . When moistened with *fuming nitric acid* and evaporated to dryness on a water-bath, the residue gives with freshly prepared alcoholic solution of *potassium hydroxide* a fugitive reddish-violet coloration. It leaves no ash when burned with free access of air (absence of mineral matter)." *Br.* For further information, see *Belladonna;* also *A. J. P.*, 1884, 206.

It is inflammable, giving off an odor like that of benzoic acid, and, when burned in the open air, leaves no residue. By distilling it with potassium dichromate and sulphuric acid, E. Pfeiffer succeeded in obtaining crystals of benzoic acid and propylamine. (*A. J. P.*, 1864, 226.) Kraut, by heating it with baryta water, succeeded in obtaining a peculiar acid and peculiar base, the former of which he calls *tropic acid*, $C_9H_{10}O_3$, melting at 117° C., and oxidizable by diluted potassium permanganate to bitter almond oil and benzoic acid, and the latter *tropine*,[1] $C_8H_{15}NO$, melting at 62° C. (*Ibid.*, 232.) Ladenburg (*Ber. d. Chem. Ges.*, 12, 942, and 13, 104) has succeeded in effecting the synthesis of atropine from these two constituents, which, when heated over a water bath in the presence of diluted hydrochloric acid, unite to form the alkaloid; later (*Ph. Ztg.*, 1902, 355), he produced tropine by the direct action of hydrobromic acid on tropidine. Willstätter produced tropidine synthetically and the following synthetic chain was completed: Glycerin, glutaric acid, suberone, tropidine, tropine, tropic acid, and atropine. Ladenburg also succeeded in forming a series of compound esters of tropine with other organic acids to which the general name of *tropeines* has been given. Some of these have pronounced toxic effects, and one (homatropine) has found use as a valuable substitute for atropine. The list of artificial tropeines thus prepared includes:

Benzoyl-tropeine, $C_{15}H_{19}NO_2 + 2H_2O$, not mydriatic; *salicyl-tropeine,* $C_{15}H_{19}NO_3$, strong base, weak poisonous action; *m-oxybenzoyl-tropeine,* $C_{15}H_{19}NO_3$; *p-oxybenzoyl-tropeine,* $C_{15}H_{19}NO_3 + 2H_2O$; *phenylacet-tropeine,* $C_{16}H_{21}NO_2 + H_2O$; *oxytoluyl-tropeine* (homatropine), $C_{16}H_{21}NO_3$, has mydriatic action, and is less poisonous than atropine; *cinnamyl-tropeine,* $C_{17}H_{21}NO_2$, strong base, but without mydriatic action; *atropyl-tropeine,* $C_{17}H_{21}NO_2$; *atrolactyl-tropeine,* $C_{17}H_{23}NO_3$, has similar action to atropine; *phthalyl-tropeine,* $C_{24}H_{32}N_2O_4$; *lactyl-tropeine,* $C_{11}H_{19}NO_3$.

Hinterberger states that an alcoholic solution of atropine, when cyanogen is passed through it, assumes a blood-red color, and, on spontaneous evaporation, deposits a red, syrupy liquid insoluble in water. (Gmelin.) The detection of atropine in small quantity is a matter of great difficulty; the best test is the physiological, which consists in placing the suspected liquid in the eye of a cat, or other animal, when, if the alkaloid be present, dilatation of the pupil will occur. According to Brunner, the best chemical test is the aromatic odor which is produced by adding the alkaloid and a little water to a hot mixture of sulphuric acid and potassium dichromate or ammonium molybdate. (*P. J.*, iv. 385.) Fabris believes that strychnine in the presence of atropine interferes with the toxicological identification of the latter by chemical tests, but a physiological test

[1] The physiological action of *tropine hydrochloride* has been partially investigated by H. G. Beyer. (*Med. News*, Aug. 27, 1887.) He concludes that it gives rise to vasomotor constriction by exciting the vasomotor constrictors, and that it sometimes causes vasomotor dilatation by exciting vasomotor dilator nervous elements. As the result of an elaborate series of experiments, Gottlieb (*A. E. P. P.*, Bd. xxxii., 1896) has reached the conclusions: First, that some of the tropeines not only differ quantitatively in their action from atropine, but are wanting in the peripheral action of that alkaloid: such are *acetyl-tropine* and *succinyl-tropine*. Second, as far as our knowledge goes, there seems to be a complete parallelism in the action of the tropines and the tropeines on the ends of the vagi in the heart and the pupils. (This influence can be seen in certain fatty acid esters, and may be wanting in some aromatic tropeines.) Third, the tropines and the less poisonous tropeines are cardiac stimulants, an influence not shared by atropine. [This latter assertion is probably incorrect.] The influence upon the heart probably consists in an increasing of the excitability of the motor heart ganglia.

reveals the presence of both alkaloids. (*B. S. Ph. Br.*, 1894.) Wormley made comparative examinations of various tests for atropine, hyoscyamine, and hyoscine. (*A. J. P.*, 1894, 513.)

Uses.—The local and general effects of atropine on the system are precisely those of belladonna. It is, however, more speedy in its operation, probably in consequence of its easier absorption. Thus, the poisonous action of belladonna is seldom experienced in less than half an hour, while that of atropine shows itself violently in fifteen or twenty minutes. The most prominent effects from small remedial doses are dryness and stricture of the throat, and slight uneasiness of the head, with confusion or giddiness; from somewhat larger doses, dilatation of the pupil, some dimness of vision, frontal headache, hurried respiration, slight delirium, flushed face, and sometimes a scarlet rash. After poisonous doses the above symptoms occur in a more aggravated form. Two distinct stages of the poisoning can usually be noted. At first there is great dimness or total temporary loss of vision, excessive dilatation of the pupil, headache, delirium, which is always talkative and may be violent, an enormous increase in the frequency of the pulse, which is also small and hard, an elevation of the bodily temperature, and decided increase of the rate of respiration. Subsequently the second stage develops, and paralytic symptoms set in; the delirium gives way to stupor, restlessness to paralytic weakness, the pulse becomes very feeble, the surface cold, the respirations grow more and more shallow, and death from failure of both respiration and circulation occurs.

In some instances violent convulsions have occurred; nausea and vomiting, and even diarrhœa, are occasionally produced. In a case recorded by J. Andrew two-thirds of a grain of atropine occasioned the most alarming symptoms, which continued for several days (*Ed. M. J.*, xiv. 34); and a lady under the care of Roux of Brignolles, took somewhat more than a grain, with the same alarming symptoms (*Ann. Thér.*, 1861, p. 14), though in both cases recovery took place under treatment. In a child three years old less than half a grain was followed by similar dangerous symptoms and the same favorable result. (*M. T. G.*, Dec. 1850, p. 601.)

The external use of atropine is not without danger, unless great caution be observed. A case is on record in which an ointment composed of three grains of the sulphate and two drachms of lard, applied upon a vesicated surface on the neck, produced in a few minutes the most violent symptoms of belladonna poisoning, ending in death in two hours. (*Ann. Thér.*, 1867, p. 9.) The alkaloid will produce its characteristic constitutional effects when applied to the skin denuded of the epidermis, or to a mucous membrane, as of the rectum, vagina, etc., and especially when injected into the subcutaneous areolar tissue.

The treatment for atropine poisoning is the same as that for belladonna, the most prominent measures being evacuation of the stomach, cold applications to the head, the preparations of opium internally, and stimulants when the strength is failing. As the value of atropine in opium poisoning, which seems unquestionable, is due to its influence on the respiratory centres, it is far from certain that opium is of any proportionate advantage in poisoning by belladonna, etc. Pilocarpine and physostigmine are also physiological antagonists to atropine and may be rationally used. The official compound solution of iodine has been given as a chemical antidote to atropine, and with asserted advantage. It acts by forming an insoluble compound with the alkaloid. (See *Belladonna.*)

Atropine is eliminated by the kidneys, and may produce increased diuresis but usually there is, in cases of poisoning, retention of urine from vesical paralysis. The increase of the heart's action by atropine is chiefly due to its paralyzing the peripheral vagi, the inhibitory nerves of the heart; the final cardiac failure which takes place when poisonous doses have been taken is apparently the result of a direct depressant action on the heart muscle. Upon the vasomotor centres atropine in a moderate dose acts as a stimulant, thereby causing a great rise of the arterial pressure. After poisonous doses the primary vasomotor spasm is followed by dilatation of the vessels and great fall of the arterial pressure. Paralysis of the motor nerves is one of the most marked effects of the poison; upon the afferent nerves the poison seems to have but little influence. On all non-striated muscle atropine exerts a very powerful influence, and it is probable, although not certain, that while in poisonous amount it lessens and finally paralyzes intestinal movements by a direct action upon the muscular coats, in small doses it increases peristalsis by paralyzing the inhibitory nerves which control this intestinal function. The action of the drug upon the respiratory centres is a very important one, atropine being in moderate doses one of the most powerful and persistent stimulants to the respiratory centres known. The asphyxia of belladonna poisoning is certainly in large measure due to the paralysis of the nerve-trunks which the poison produces, although it is also probable that the first period of excitation of the respiratory centres is followed by one of depression.

Atropine chiefly depends for its therapeutic powers upon—1st, its sedative action upon the peripheral nerves; 2d, its stimulant action on the respiratory centres; 3d, its influence upon the heart and vasomotor centres; 4th, its effects upon glandular structures. By virtue of its first-mentioned power it is useful in *spasmodic diseases,* such as *whooping cough, dysmenorrhœa, local spasm,* etc. As the action is upon the nerve trunks, the remedy is much more effective when it can be applied locally, as by

atomization in *whooping cough* and *asthma,* or by hypodermic injection in *wry neck.* As atropine has some influence upon the afferent nerves, it has some power of relieving *pain;* but for this action to be marked, direct application is necessary. On account of its influence upon respiration, it is invaluable in *narcotic poisonings* and other bodily conditions with failure of this function. In *shock* and other similar states in which vasomotor paralysis is an important part of the morbid condition, it is a very useful stimulant. On account of the paralyzing influence which it has upon the inhibitory intestinal nerves, atropine may be used as an adjuvant to more decided laxatives.

On the glandular system atropine exerts a decided influence, its effect upon the salivary and perspiratory glands being at present best understood. The remarkable action which it has in checking the functional activity of these glands is probably exerted through the nervous system, for in Keuchel's experiments it was distinctly proved that the chorda tympani nerve, excitation of which normally provokes salivation, is paralyzed in atropine poisoning. In *ptyalism* and in *colliquative sweats* the most prompt effects can be obtained from the hypodermic use of atropine. The hypodermic dose of atropine may be set down as the one-hundredth of a grain (0.0006 Gm.), the dose by the mouth as the one-seventy-fifth of a grain (0.0008 Gm.), although in serious cases these amounts may be much exceeded. Thus in *ileus* German clinicians have given as high as the one-twentieth of a grain (0.003 Gm.) as a dose. On the other hand in susceptible persons, one-hundredth of a grain (0.0006 Gm.) will produce decided dryness of the throat, and one-fiftieth of a grain (0.0013 Gm.) is alleged to have caused toxic symptoms. As atropine itself is nearly insoluble, the sulphate should always be preferred. For application to the sound skin, the form of ointment or oleate is most convenient. The ointment may be made by rubbing a grain of the alkaloid first with four minims of alcohol, and then with a drachm of lard. The oleate is now official. Glycerin has been recommended as a vehicle for atropine for external use, and may be incorporated with it in the same proportion.

A solution of atropine upon being dropped into the eye produces dilatation of the pupil after ten or fifteen minutes, without causing congestion or inflammation; and the dilatation will usually continue for three or four days. It is said that the dilatation is sometimes followed by contraction of the pupil, especially when the dose is large. When solution of atropine sulphate is used for *dilating the pupil,* it may be either dropped into the eye within the lower lid, or introduced on small slips of paper previously saturated with the solution and dried, or, what is still more convenient, by means of minute circular disks of gelatin, made by mixing the solution with gelatin and evaporating so as to produce a thin film, which is to be cut into circular pieces. (See *Lamellæ Atropinæ.*) These have the advantage over paper that they do not require to be subsequently removed from the eye.

Atropine may be administered internally for all the purposes for which belladonna is given; and it is very largely used as a local remedy, for application to the eye, or to the surface of the body, or for subcutaneous injection; and for these purposes it has the advantage over the ordinary preparations of belladonna of greater precision of dose, quickness of action, and neatness and cleanliness.

The solution of atropine or its salts[1] is very prone to have developed in it a fungous growth with consequent decomposition of the alkaloid.

Dose, of atropine, one two-hundredth to one one-hundreth of a grain (0.0003 to 0.0006 Gm.).

Off. Prep.—Oleatum Atropinæ, *U. S.;* Unguentum Atropinæ, *Br.*

ATROPINÆ SULPHAS. U. S., Br.

ATROPINE SULPHATE

(ăt-rọ-pī'næ sŭl'phăs)

$(C_{17}H_{23}NO_3)_2.H_2SO_4 = 671.43$

"The sulphate $[SO_2(OH)_2.(C_{17}H_{23}NO_3)_2]$ of an alkaloid obtained from *Atropa Belladonna* Linné (Fam. *Solanaceæ*), and from other plants of the same family. As it occurs in commerce, it usually contains a small amount of hyoscyamine sulphate, from which it cannot be readily separated." *U. S.* "Atropine Sulphate, $(C_{17}H_{23}NO_3)_2H_2SO_4$, may be obtained by neutralizing Atropine with Diluted Sulphuric Acid." *Br.*

Sulphate of Atropia; Sulfate d'Atropine, *Fr. Cod.;* Atropinum Sulfuricum, *P. G.;* Schwefelsaures Atropin, Atropinsulfat, *G.;* Solfato di atropina, *It;* Sulfato de atropina, *Sp.*

Neither the U. S. nor Br. Pharmacopœias give a process for preparing this salt. The official formula of 1870 is essentially the process of Ch. Maitre, which is as follows: "Take of Atropia, *sixty grains;* Stronger Ether, *four fluidounces and a half;* Sulphuric Acid, *six*

[1] *Atropinæ Salicylate.*—This salt is alleged to have advantages over the sulphate, mainly because of its more rapid and efficient action, provided it be pure and perfectly neutral. It may be prepared by Frederici's process, which is to dissolve 23 parts of atropine in pure alcohol by a gentle heat, and to add enough salicylic acid (about 18 parts) to render the solution neutral, which is determined by the use of litmus paper. The solution is carefully evaporated, and finally dried in a drying oven. It is deliquescent, and should be kept in securely stoppered vials. The dose is the same as that of the sulphate.

Atropinum Santonicum, a compound of atropine and santonic acid, is described by Bombelon (*Ph. Ztg.,* April, 1886) as an amorphous non-hygroscopic powder, readily soluble in water, which presents advantages over all other atropine salts in being non-irritating, and also in affording a solution which is stable if kept in yellow glass bottles to avoid the formation of photo-santonic acid. One drop of a solution of 0.01 Gm. in 20 Gm. of water is sufficient to dilate the pupil, the dilatation disappearing in from twelve to twenty-four hours. The powder should be kept in amber-colored vials to protect it from the light.

grains; Stronger Alcohol, *a fluidrachm.* Dissolve the Atropia in the Ether; then mix the Acid and Alcohol, and add the mixture, drop by drop, to the ethereal solution until the Atropia is saturated. Allow the liquid to stand until the precipitate formed is deposited. Then decant the ether, and expose the residue to spontaneous evaporation until the salt is dry." *U. S.* 1870. Atropine being soluble in ether, while its sulphate is insoluble in that fluid, a convenient method is afforded for preparing the sulphate with little evaporation. By adding the mixed acid and alcohol to the ethereal solution, the sulphate is formed, and, being insoluble in the ether, is deposited, while the little left dissolved in the alcohol is obtained by spontaneous evaporation. The quantity of acid added is intended to be just sufficient to saturate the alkaloid; but if the saturation should not be exact, it would be easy to render it so by the addition of a little more alkaloid or a little more acid, as required.

From the great facility with which atropine undergoes change, much caution is necessary in preparing its salts, and the process was arranged in reference to this caution. Upon the addition of the mixed acid and alcohol to the ethereal solution, the liquid becomes milky, and deposits on the sides of the vessel a copious precipitate of a viscid appearance, which soon dries upon the decantation of the ether and the placing of the vessel in a drying-room. To succeed with this process it is necessary that the liquids employed should be carefully freed from water, the sulphuric acid being monohydrated, and that the temperature should be kept as low as possible. There should be no excess of acid; and, if such an excess should be found upon applying the test of litmus paper, the solution should be neutralized by a portion of reserved solution of atropine. (*A. J. P.*, xxviii. 361; from *Répert. de Pharm.*)

Properties.—"A white crystalline powder or microscopical needles and prisms (the form of the latter being probably due to the hyoscyamine present); odorless, having a very bitter, nauseating taste, and permanent in the air. *It should be tasted with the utmost caution, and only in dilute solution.* Soluble in 0.38 part of water, 3.7 parts of alcohol, 2140 parts of ether, and in 620 parts of chloroform at 25° C. (77° F.); soluble in 0.22 part of water at 80° C. (176° F.), and in 1.9 parts of alcohol at 60° C. (140° F.). At about 189.9° C. (373.8° F.) Atropine Sulphate melts; when free from hyoscyamine it melts at about 188° C. (370.4° F.). When ignited it chars, emits acrid vapors, and is rapidly and completely consumed. On adding potassium hydroxide T.S. to a solution of Atropine Sulphate, a white precipitate of atropine is obtained, which should respond to the reactions and tests given under *Atropina.*" *U. S.* "Soluble in 10 parts of *alcohol* (90 per cent.) and in 1 part of cold *water,* forming solutions which are neutral to *litmus,* and which, even when considerably diluted, if applied to the eye will dilate the pupil. It is insoluble in *ether* and in *chloroform.* It yields the characteristic reactions with the tests for sulphates. Melting point 361.4° F. (183° C.)." *Br.*

If it be required to procure the sulphate in the form of crystals, which may sometimes be desirable to avoid adulteration, the process of Laneau may be employed. A solution of crystallized atropine in absolute alcohol, in the proportion of 2.89 parts of the former to 4 parts of the latter by weight, having been made with the assistance of a gentle heat, 0.4 part of sulphuric acid of the sp. gr. 1.85, diluted with 3 parts of absolute alcohol, is to be gradually added, and stirred with a glass rod, until saturation, as shown by test paper, is effected. The solution is then allowed to evaporate spontaneously, and the thinner the stratum the sooner will the process be completed. The crystals are in colorless needles more or less interlaced. (See *A. J. P.*, 1863, p. 315.)

Uses.—The effects of the salt on the system are precisely the same as those of atropine, and it may be used in the same dose. Its great advantage over the alkaloid is its solubility in water. A one per cent. solution is said to be instantaneously efficacious in *toothache,* applied to the denuded dental pulp, and also to produce complete insensibility of the dental nerves, in cases in which an artificial tooth is inserted in a living root. (*Ann. Thér.*, 1861, p. 19.)

Dose, one two-hundredth to one one-hundredth of a grain (0.0003 to 0.0006 Gm.).

Off. Prep.—Lamellæ Atropinæ, *Br.;* Liquor Atropinæ Sulphatis, *Br.*

AURANTII AMARI CORTEX. U. S. (Br.)

BITTER ORANGE PEEL

(âu-rān'tĭ-ī ą-mā'rī cŏr'tĕx)

"The dried rind of the unripe fruit of *Citrus vulgaris* Risso (Fam. *Rutaceæ*)." *U. S.* "The fresh outer part of the pericarp of Citrus Aurantium, var. Bigaradia;" also "The dried outer part of the pericarp of Citrus Aurantium, var. Bigaradia." *Br.*

Aurantii Cortex Recens, Aurantii Cortex Siccatus, *Br.;* Aurantii Pericarpium; Cortex Aurantiorum, Cortex Pomorum Aurantii; Seville Orange Peel, Wild Orange Peel; Ecorce (Zestes) d'Oranges amères, Ecorce de Bigarade, *Fr.;* Cortex Aurantii Fructus, *P. G.;* Pomeranzenschale, *G.;* Corteccia di arancio amaro, *It.;* Corteza de naranja amarga, *Sp.*

Under the name of *Aurantii Cortex Indicus,* Indian Orange Peel, the British Addendum recognizes the bitter orange peel obtained from varieties of the Citrus Aurantium, grown in India and Ceylon. (See next article.)

Off. Prep.—Fluidextractum Aurantii Amari, *U. S.;* Infusum Aurantii, *Br.;* Infusum Aurantii Compositum, *Br.* Infusum Gentianæ Compositum, *Br.;* Spiritus Armoraciæ Compositus, *Br.;* Tinctura Aurantii Amari, *U. S.* (*Br.*); Tinctura Cinchonæ Composita, *U. S., Br.;* Tinctura Gentianæ Composita, *U. S., Br.*

AURANTII DULCIS CORTEX. U. S.

SWEET ORANGE PEEL

(âu-răn'tĭ-ī dŭl'cĭs cŏr'tĕx)

"The recently separated outer rind of the ripe fruit of *Citrus Aurantium* Linné (Fam. *Rutaceæ*)." *U. S.*

Cortex Aurantiorum Dulcium; Ecorce (Zestes) d'Oranges douces, *Fr.;* Apfelsinenschalen, *G.;* Scorze del frutto dell' arancio, *It.;* Corteza de naraja dulce, *Sp.*

The U. S. Pharmacopœia includes two kinds of orange peel, bitter and sweet, the former obtained from Citrus vulgaris, Risso (*C. amara* (L.), Lyons, *C. Bigaradia,* Loisel.); the latter from Citrus Aurantium, L. (*Aurantium olyssiponense,* Tourne; *Citrus dulcis,* Pers.); on the other hand, the British Pharmacopœia recognizes bitter orange peel in two forms, the fresh and the dried, under the respective names of Aurantii Cortex Recens, fresh bitter orange peel, and Aurantii Cortex Siccatus, dried bitter orange peel; but the orange peel which is called sweet by the U. S. Pharmacopœia—*i.e.,* Citrus Aurantium—is termed C. Aurantium var. Bigaradia, bitter orange peel, by the British authority.

This very interesting genus is composed of small evergreen trees, with ovate or oval-lanceolate and shining leaves, odoriferous flowers, and fruits which usually combine beauty of color with a fragrant odor and grateful taste. They are all natives of warm climates. Though the species are not numerous, great diversity exists in the character of the fruit; and many varieties, founded upon this circumstance, are noticed by writers. In the splendid work on the natural history of the *Citrus* by Risso and Poiteau, 169 varieties are described under the eight following heads: 1, sweet oranges, 2, bitter and sour oranges, 3, bergamots, 4, limes, 5, shaddocks, 6, lumes, 7, lemons, and 8, citrons. Of these it is difficult to decide which have just claims to the rank of distinct species and which must be considered merely as varieties. Those employed in medicine may be arranged in two sets, of which the orange, *C. Aurantium,* and the lemon, *C. medica,* are respectively the types, the former characterized by a winged, the latter by a naked or nearly naked petiole. The form and character of the fruit, though not entirely constant, serve as the basis of subdivisions. *C. Decumana,* which yields the *shaddock,* agrees with *C. Aurantium* in the form of its petiole.

Citrus Aurantium, Willd., *Sp. Plant.* iii. 1427; *B. & T.* 51.—The orange tree grows to the height of about thirty feet. Its stem is rounded, much branched, and covered with a smooth, shining, greenish-brown bark. In the wild state, and before inoculation, it is often furnished with axillary spines. The leaves are ovate, pointed, entire, smooth, and of a shining pale green color. When held between the eye and the light, they exhibit numerous small transparent vesicles, filled with volatile oil, and, when rubbed between the fingers, are highly fragrant. Their footstalks are about an inch long, and have wings or lateral appendages. The flowers, which have a delightful odor, are large, white, and attached by short peduncles, singly or in clusters, to the smallest branches. The calyx is saucer-shaped, with pointed teeth. The petals are oblong, concave, white, and beset with numerous small glands. The filaments are united at their base in three or more distinct groups, and support yellow anthers. The germen is roundish, and bears a cylindrical style, terminated by a globular stigma. The fruit is a spherical berry, often somewhat flattened at its base and apex, rough, of a yellow or orange color, and divided internally into a number of vertical cells, each containing from two to four seeds, surrounded by a pulp. The rind of the fruit consists of a thin exterior layer, abounding in vesicles filled with a fragrant volatile oil, and of an interior one, which is thick, white, spongy, insipid, and inodorous. There are two varieties of *C. Aurantium,* considered by some as distinct species. They differ chiefly in the fruit, which in one is sweet, in the other is sour and bitterish and often has a darker and rougher rind. The first retains the original title, the second (the Seville orange) is called *Citrus vulgaris* by De Candolle, and *C. Bigaradia* by Risso. A variety of the orange, called the *Mandarin Orange* (*Citrus Bigaradia sinensis* or *C. Bigaradia myrtifolia*), which is probably a native of China, but cultivated in Sicily, the south of Italy, and Florida, bears a fruit much smaller than the common orange, round, but flattened above and below, with a smooth, thin, delicate rind, and a very sweet delicious pulp. A volatile oil is obtained from the rind by expression, of a yellow color, a very bland agreeable odor, different from that of the orange or lemon, and a not unpleasant taste, like that of the rind. When freed from coloring matter by distillation, it was found by M. S. de Luca to be a pure hydrocarbon, with the formula $C_{10}H_{16}$. (*J. P. C.,* 3e sér., xxxiii. 52.) This constituent is now recognized as *d-limonene.*

This beautiful evergreen, in which the fruit is mingled, in every stage of its growth, with the blossoms and foliage, has been applied to numerous purposes of utility and ornament. A native of China and India, it was introduced into Europe at a very early period, was transplanted to America soon after its first settlement, and is now found in every civilized country where the climate is favorable. The fruit is brought to us chiefly from California, Florida, Southern Europe, and the West Indies. The Florida and Havana oranges are the sweetest. A seedless variety termed the *navel orange* is rapidly replacing all others in cultivation.

Various parts of the plant are used medicinally. The leaves, which are bitter and aromatic, are employed in some places in the form of infusion as a gently stimulant diaphoretic. They yield by distillation with water a volatile

oil, which is said to be often mixed by the distillers with the oils obtained from the flowers and unripe fruit. In regard to polarized light it has a rotary power to the left, which is considerably weakened by the prolonged action of heat. (Chautard, *J. P. C.*, 3e sér., xliv, 28.) The fresh flowers may be kept for some time by mixing them well with half their weight of sodium chloride, pressing the mixture in a suitable jar, and keeping it well closed in a cool place. They were formerly recognized by the U. S. P. under the name of *Aurantii Flores*, and were officially described as "about half an inch (12 mm.) long; calyx small, cup-shaped, five-toothed; petals five, oblong, obtuse, rather fleshy, white and glandular-punctate; stamens numerous, in about three sets; ovary globular, upon a small disk, with a cylindrical style, and a globular stigma; odor very fragrant; taste aromatic and somewhat bitter." *U. S.* 1880. The dried flowers are used on the continent of Europe as a gentle nervous stimulant, in the form of infusion, two drachms to the pint of boiling water, taken in the dose of a teacupful. The flowers should be dried in the shade, at a temperature between 24° C. (75° F.) and 35° C. (95° F.).

An oil is obtained also from the flowers by distillation, which is called *oil of neroli*, and is much used in perfumery, and in the composition of *liqueurs*. It is an ingredient of the famous Cologne water. That obtained from the flowers of the Seville or bitter orange (*C. vulgaris*) is deemed the sweetest. It was introduced into the Edinburgh Pharmacopœia, with the title of *Aurantii Oleum*, to serve for the preparation of orange flower water. Soubeiran considers this oil rather as a product of the distillation than as pre-existing in the flowers. The fact may thus be explained that orange flower water made by dissolving even the finest neroli in water has not the precise odor of that procured by distillation from the flowers.

The fruit is applied to several purposes. Small unripe oranges, about the size of a cherry or less, previously dried, and rendered smooth by a turning-lathe, are sometimes employed to maintain the discharge from issues. They are preferred to peas on account of their agreeable odor, and by some are thought to swell less with the moisture; but this is denied by others, and it is asserted that they require to be renewed at the end of twenty-four hours. These fruits are sometimes found in commerce under the name of *orange berries*. They are of a grayish or greenish-brown color, fragrant odor, and bitter taste, and are said to be used for flavoring cordials. A volatile oil is obtained from them by distillation, known to the French by the name of *essence de petit grain*, and employed for similar purposes with that of the flowers. The oil, however, which now goes by this name is said to be distilled from the leaves, and those of the bitter orange yield the best. The oils from the unripe and the ripe fruit have a rotating power to the right, the latter much greater than the former; and this property might serve to distinguish them from the oil of the leaves. Several of the oils from the *Rutaceæ* deposit a crystalline substance, differing from camphor. (Chautard.) The juice of the Seville orange is sour and bitterish, and forms with water a refreshing and grateful drink in febrile diseases. It is employed in the same manner as lemon juice, which it resembles in containing citric acid, though in much smaller proportion. The sweet orange is more pleasant to the taste, and is extensively used as a light refrigerant article of diet in inflammatory diseases, care being taken to reject the membranous portion. The best mode of separating the outer rind, when its desiccation and preservation are desired, is to pare it from the orange in narrow strips with a sharp knife, as we pare an apple. When the object is to use the fresh rind for certain pharmaceutical purposes, as for the preparation of the *confection of orange peel*, it is best separated by a grater, carefully avoiding the grating of the white portion which contains the bitter principle. The dried peel sold in the shops is usually that of the Seville orange, and is brought chiefly from countries adjacent to the Mediterranean.

Properties.—Orange peel has a grateful aromatic odor, which depends upon the volatile oil contained in its vesicles, and a warm bitter taste. Bitter orange peel occurs "in narrow, thin bands, or in quarters; epidermis of a brownish-green color; outer layer with numerous oil reservoirs; inner layer spongy, light yellowish-brown; odor fragrant; taste aromatic and bitter." *U. S.* The Br. Pharmacopœia requires that the outer surface both of the fresh and of the dried bitter orange peel shall be of a deep orange-red color, and rough and glandular. As lemon peel is sometimes substituted for orange peel, a means of distinguishing between them has been devised by E. G. Clayton (*An.*, xix. 134), which is to touch small fragments of peel with a glass rod dipped in hydrochloric acid. Orange peel is colored a rich, dark green; the color of lemon peel is unaffected. The sweet peel is described officially as having the "outer surface orange-yellow, with numerous oil reservoirs; odor highly fragrant; taste pungently aromatic." *U. S.* Both orange peels yield their sensible properties to water and alcohol. The bitter principle, *hesperidin*, $C_{22}H_{26}O_{12}$, was discovered by Lebreton in 1828, but its character as a glucoside was first established by Hilger and Hoffmann. (*Ber. d. Chem. Ges.*, 9, 26, 685.) Treated with diluted acids it yields *hesperetin*, $C_{16}H_{14}O_6$, and glucose. It is crystalline (fusing point 250° to 251° C.), and may be prepared by Paterno and Briosi's process, as follows: The cut and bruised oranges are covered with diluted alcohol, solution of potassium hydroxide added in excess, the liquor filtered after two days, an impure hesperidin precipitated by hydrochloric acid; the precipitate is boiled with acetic acid for ten minutes, and, after cooling, filtered from the resinous mass

left. The hesperidin gradually separates from the filtrate upon standing, in white fine needles. From 4000 oranges about 6 ounces av. of the principle were obtained. (*Ber. d. Chem. Ges.*, 1876, 250–252.) Tanret found in the rind of the bitter orange, 1, a crystalline acid, $C_{44}H_{28}O_{14}$; 2, a non-crystalline resinous body; 3, *hesperidin;* 4, *isohesperidin*, a crystalline glucoside isomeric with hesperidin; 5, *aurantiamarin*, another glucoside to which, in part, the bitterness of the peel is due. (*P. J.*, 1886, 839.) Orange peel contains also albumen, gum, resin, a trace of fixed oil, volatile oil, and a principle resembling tannin in its action on salts of iron. The bitter principles are much more abundant in the white spongy inner portion of the peel than in the outer yellowish layer. The volatile oil, *Oleum Aurantii Corticis*, U. S., may be obtained by expression from the fresh grated rind, or by distillation with water. It is imported into the United States in tinned copper cans. It has properties resembling those of the oil of lemons, but spoils more rapidly on exposure to the air, acquiring a terebinthinate odor. The perfumers use it in the preparation of Cologne water, and for other purposes; and it is also employed by the confectioners. According to Imbert-Gourbeyre, persons who are much exposed to the inhalation of the oil of bitter oranges are apt to be affected with cutaneous eruptions, and various nervous disorders, as headache, tinnitus aurium, oppression of the chest, gastralgia, want of sleep, and even muscular spasm. (*Ph. Cb.*, Feb. 1854, 128.)

Uses.—Bitter orange peel is a mild tonic, carminative, and stomachic; the sweet is simply aromatic; but neither is much used alone. They are chiefly employed to communicate a pleasant flavor to other medicines, to correct their nauseating properties, and to assist their stimulant impression upon the stomach. They are a frequent and useful addition to bitter infusions and decoctions, such as those of gentian, quassia, calumba, and Peruvian bark. It is obviously improper to subject orange peel to the action of heat, as the volatile oil is thus driven off. Violent colics, convulsions, and even death have been caused in children by eating large quantities of the rind. When orange peel is used simply for its agreeable flavor, the rind of the sweet orange is preferable; as a tonic, that of the Seville orange.

Dose, from half a drachm to a drachm (2 to 3.9 Gm.).

Off. Prep.—Syrupus Aurantii, *U. S.*, *Br.* (from Tincture); Tinctura Aurantii Dulcis, *U. S.*

AURI ET SODII CHLORIDUM. U. S.

GOLD AND SODIUM CHLORIDE

(âu'rī ĕt sō'dī-ī ȼhlō'rī-dŭm)

"A mixture of equal parts, by weight, of anhydrous Gold Chloride [$AuCl_3 = 301.24$] and anhydrous Sodium Chloride [$NaCl = 58.06$], representing not less than 30 percent. of metallic gold. It should be kept in well-stoppered, amber-colored vials." *U. S.*

Chlorure d'Or et de Sodium, *Fr. Cod.*; Chloroaurate de Soude, *Fr.*; Natriumgoldchlorid, *G.*; Cloruro di oro e sodio, *It.*

Gold and sodium chloride may be prepared by dissolving gold in nitrohydrochloric acid, evaporating the solution to dryness, weighing, and dissolving the dry mass in eight times its weight of distilled water. To this solution a weight of pure decrepitated common salt equalling that of the dry gold chloride is added, previously dissolved in four parts of water. The mixed solutions are then evaporated to dryness, being in the meantime constantly stirred with a glass rod. A process for making this salt from gold coin without requiring the preliminary purification necessary in the above process may be found in *Proc. A. Ph. A.*, 1882, p. 311. (See Kebler's paper, *A. J. P.*, 1900, 325; and one by Averkief, *Chem. News*, 1903, 84.)

Properties.—The pure crystallized salt, $AuCl_3,NaCl.2H_2O$, is of a golden-yellow color, and is in the form of prismatic crystals. The mixture of the U. S. P. is described as "an orange-yellow powder, odorless, having a saline and metallic taste, and deliquescent when exposed to damp air. The compound is very soluble in water, and at least one-half of it should be soluble in cold alcohol. When exposed to a red heat, it is decomposed, and metallic gold is separated. A fragment of the compound imparts a persistent, intensely yellow color to a non-luminous flame. Its aqueous solution has a slightly acid reaction, and yields with silver nitrate T.S. a white precipitate insoluble in nitric acid and soluble in ammonia water. On bringing a glass rod moistened with ammonia water close to a portion of Gold and Sodium Chloride, no white fumes should make their appearance (absence of *free hydrochloric acid*). If 0.5 Gm. of Gold and Sodium Chloride be dissolved in 25 Cc. of water, in a porcelain dish, the solution made alkaline by the addition of 5 Cc. of potassium hydroxide T.S., and, after the addition of 5 Cc. of solution of hydrogen dioxide, heated for about one hour on a water-bath, a precipitate of metallic gold will be obtained, which, when washed with water slightly acidulated with hydrochloric acid, dried, and ignited, should weigh not less than 0.15 Gm. (corresponding to at least 30 percent. of metallic gold). The filtrate from the precipitated gold should not be affected by hydrogen sulphide T.S., nor, after being supersaturated with ammonia water, by ammonium sulphide T.S. (absence of *metallic impurities*)." *U. S.*

Uses.—The precise action of this salt upon the system is not known, but it is thought to affect the general nutrition, and to be therefore alterative. By many gynæcologists it is believed to have a specific direction to the genital organs, and it is used in *hysteria, ovarian irritation* and *neuralgia, chronic ovaritis*, and even *chronic uterine inflammation*. It has also been

commended in *syphilis, chronic rheumatism, diabetes mellitus,* and other chronic disorders affecting nutrition. The double salt of gold and sodium chloride has recently been very largely used in the treatment of the *alcoholic habit.* It is believed to be the basis of the notorious "*Keeley cure,*" which, according to the best information obtainable, seemingly reliable, consists in chief part of the administration of ascending doses of the double chloride, with hypodermic injections in the interim (one every three hours) of very minute doses of atropine and strychnine. It would seem certain that no medication can suffice for moral reformation, but there is considerable evidence to show that the treatment just spoken of, by toning up the nervous system and bringing about a general increase of nutritive tone, may aid those who are determined upon reform.

Dose, one-twelfth to one-quarter of a grain. (0.005 to 0.016 Gm.).

AURUM

GOLD

(äu′rŭm)

Or, *Fr.;* Gold, *G.;* Oro, *It., Sp.*

The preparations of gold were introduced into medical practice in 1810 by Chrestein of Montpellier. They have been especially recommended in various chronic diseases of the nervous system and skin, also in inveterate constitutional syphilis and allied disorders. The U. S. Pharmacopœia recognizes one preparation (see p. 219). For a discussion of the various non-official preparations which have been used in medicine, see *Gold,* PART II.

BALSAMUM PERUVIANUM. U. S., Br.

BALSAM OF PERU

(bâl′sa-mŭm pe-rū-vī-ā′nŭm)

"A balsam obtained from *Toluifera Pereiræ* (Royle) Baillon (Fam. *Leguminosæ*)." *U. S.* "A balsam exuded from the trunk of Myroxylon Pereiræ, *Klotzsch,* after the bark has been beaten and scorched." *Br.*

Balsamum Peruvianum Nigrum, Balsamum Indicum; Baume des Indes, Baume de Pérou noir, Baume de Sonsonate, *Fr.;* Balsamum peruvianium, *P. G.;* Peruvianischer Balsam, Indischer Balsam, Perubalsam, *G.;* Balsamo peruviano, Balsamo del Peru, *It.;* Balsamo del Peru liquido, Bálsamo de San Salvador, Balsamo negro, *Sp.*

De Candolle and other botanists considered that the genera Myroxylon and Toluifera of Linnæus are not distinct from Myrospermum of Jacquin, but it is now generally recognized that the two Linnæan genera are, taken together, entitled to rank as a single genus. To this the title of Myroxylon has been generally applied by botanists following Bentham and Hooker, but Baillon (*Natural History of Plants,* vol. ii. 366) seems to be in accord with the generally accepted rules of botanical nomenclature in preferring the name Toluifera. In regard to the species now under consideration there has been much discussion, and although the plant is now well known botanically, botanists are not agreed as to its specific distinctness, Ruiz (*Flora Peruviana*), Carson (*A. J. P.,* 1860, p. 297), Baillon, and others believing it to be identical with the tree which yields balsam of Tolu. Flückiger and Hanbury (*Pharmacographia,* 2d ed., 205) give the following points of difference: in *M. Pereiræ* the branches come off near the ground, the calyx is widely cup-shaped, and shallow, the racemes loose, 6 to 8 inches long, and the legume much narrowed at its base; while in *M. toluifera* the trunk does not branch for 30 or 40 feet, the calyx is rather tubular, the racemes dense and 3 to 4½ inches long, the legume scarcely narrowed at the base. Besides the official species, there are others of the genus which possess medicinal virtues, and have been more or less employed. (See 14th ed. U. S. D.) The pod of *M. frutescens,* Jacq., growing in Trinidad, is popularly used in that island as a carminative, and externally, in the form of a tincture, as a lotion in rheumatic pains, and by incisions in the stem a small quantity of balsamic juice is obtained not distinguishable from balsam of Tolu. (*P. J.,* Sept. 1862, p. 108.) Another species is known in Paraguay under the name of *quino-quino,* the bark of which is used, in powder and decoction, as a remedy in wounds and ulcers, and from the trunk of which a juice is obtained which in its concrete state closely resembles dried balsam of Peru. (*P. J.,* Oct. 1862, p. 183.) A product of *T. peruiferum,* sometimes known as *Brazilian balsam* or as *Oleo-balsam* has been offered for sale as genuine Peru balsam. In bulk it is of a dark brown color, but in thin layers it is dark red. Its odor is smoky, feebly fragrant; its taste slightly pungent, leaving a choking, disagreeable, persistent feeling. It is entirely soluble in ether and in rectified spirits. It also mixes with castor oil in all proportions, and forms with carbon disulphide a clear light brown solution with residue, also a deposit, in its chloroform solution, which becomes a powdery precipitate upon standing. At 17° C. its specific gravity is 1.031. Its general constitution is very similar to that of balsam of Peru, containing volatile oil, myroxylin, cinnamic and tannic acids, and resin. (*P. J.,* 3d ser., xi. 818.) It is especially to be distinguished from Peru balsam by its behavior with sulphuric acid. When Peru balsam is treated with sulphuric acid, and cold water poured upon it, a beautiful violet color is imparted to the surface, and the whole mass has a bright shade. The same procedure yields with the oleo-balsam a gray mass. For further information see *P. J.,* xv. 771.

Toluifera Pereiræ; Myroxylon Pereiræ, Klotzsch; *Myrospermum Pereiræ,* Royle et Auctores; and "*Myrospermum of Sonsonate,*" Periera. This is a handsome tree, with a straight, round, lofty stem, a smooth ash-colored bark, and spreading branches at the top. The leaves are alternate, petiolate, and unequally pinnate.

The leaflets are from five to eleven, shortly petiolate, oblong, oval-oblong, or ovate, about three inches long by somewhat less than an inch and a half in breadth, rounded at the base, and contracting abruptly at top into an emarginate point. When held up to the light they exhibit, in lines parallel with the primary veins, beautiful rounded and linear pellucid spots. The common and partial petioles and midribs are smooth to the naked eye, but when examined with a microscope are found to be furnished with short hairs. The fruit, including the winged footstalks, varies from two to four inches in length. At its peduncular extremity it is rounded or slightly tapering; at the top enlarged, rounded, and swollen, with a small point at the side. The mesocarp, or main investment of the fruit, is fibrous, and contains in distinct receptacles a balsamic juice, which is most abundant in two long receptacles or vittæ, one upon each side. The yellowish-white beans yielded to Rother (*P. J.*, xv. 244) two per cent. of coumarin; the husks, a brown, extremely bitter, somewhat acrid resin. A gum-resin exudes in small quantities from the trunk of the tree, which, though containing, besides gum and resin, a small proportion of volatile oil, is distinct from the proper balsam, and yields no cinnamic acid. (Attfield, *P. J.*, Dec. 1863.) The valuable wood of the tree resembles mahogany.

This tree grows in Central America, in the State of San Salvador, upon the Pacific coast. It is found in the wild forests, singly or in groups, but the trees are owned by individuals. Charles Dorat states that it is never found at a greater height on the mountains than one thousand feet, that it begins to be productive after five years, and continues to yield for thirty years or more, and that the aroma of its flower is perceived at the distance of one hundred yards. (*A. J. P.*, xxxii.) The balsam is collected by the aborigines, on lands reserved to them, within a small district denominated the Balsam Coast, extending from Acajutla to La Libertad. Early in November or December the bark is beaten on four sides of the trunk, so as to separate it from the wood without breaking it, intermediate strips being left sound, in order not to destroy the life of the tree. The bruised bark soon splits, or cuts are made in it. Five or six days after the beating the injured surface is set on fire, and about a week later the bark, if it has not fallen off spontaneously, is removed. The juice now begins to exude freely from the exposed wood, which the natives cover with rags. The latter, when saturated, are boiled in water in large jars, and the liquid allowed to stand, whereupon the water rises to the top, and is poured off, leaving the balsam, which is put into calabashes or bladders. Seven to ten days later a second flow of balsam occurs, and is secured as before. Subsequently the exposed parts are scraped or otherwise wounded, and a third balsam is obtained. These three grades of balsam are said to be known respectively as *Tagauzonte, balsam de trapo, balsamo de contrapique.* The balsam is then taken for sale to the neighboring towns, where it is purified by subsidence and straining and put into jars or metallic drums for exportation. The destroyed bark is said to renew itself in two years, so that by care a tree can be worked for a long time; two pounds is stated to be the average yearly yield. In 1861 the tree was introduced in Ceylon with complete success.

A substance called *white balsam* (*Balsamo blanco*) is procured from the fruit. This has been confounded with the balsam of Tolu, but is wholly distinct. It is of a semi-fluid or soft-fluid consistence, somewhat granular, and, on standing separates into a white, resinous, crystalline deposit, and a superior, translucent more fluid portion. The odor, though quite distinct from that of the balsams of Tolu and Peru, is not disagreeable. Stenhouse has obtained from it a peculiar resinous body, readily crystallizable, and remarkably indifferent in its chemical affinities, which he denominated *myroxocarpin.* (*P. J.*, x. 290.) Tschirch (*Harze und Harzbehälter*, 1900, p. 166) gives the compound the name *myroxoresene*, and the formula, $C_7H_{10}O$. Dorat, however, denies that the white balsam is produced by the same tree, or in the same vicinity.

Another substance obtained from the same tree, and much used in Central America, is a tincture of the fruit made by digesting it in rum. It is called *balsamito* by the inhabitants, and is said to be stimulant, anthelmintic, and diuretic. It is also used as an external application to gangrenous or indolent ulcers, and as a wash to the face to remove freckles. According to Dorat, the balsamito is not the tincture, but an alcoholic extract of the young fruit. Neither this nor the white balsam reaches the markets of this country.

Balsam of Peru was named from its place of exportation, and it was long thought to be a product of Peru. It is now shipped partly from the Pacific coast, and partly from the Balize or other Atlantic ports, whither it is brought across the country. It was Guibourt who first made known the fact of its exclusive production in Central America. As imported, it is usually in tin canisters, with a whitish scum on its surface, and more or less deposit, which is dissolved with the aid of heat.

Properties.—Balsam of Peru is viscid like syrup or honey, of a dark reddish-brown color, a fragrant odor, and a warm bitterish taste, leaving, when swallowed, a burning or prickling sensation in the throat. When exposed to flame it takes fire, diffusing a white smoke and fragrant odor. Containing resin, volatile oil, and both benzoic and cinnamic acids, it is properly considered a balsam, though probably somewhat altered by heat. "A viscid liquid of a dark brown color; free from stringiness or stickiness; transparent and reddish-brown in thin layers; of an agreeable vanilla-like odor and

a bitter, acrid taste, with a persistent aftertaste. When swallowed, it leaves a burning sensation in the throat. It does not harden on exposure to the air. Specific gravity: 1.140 to 1.150 at 25° C. (77° F.). Completely soluble in absolute alcohol, chloroform, and glacial acetic acid; only partially soluble in ether and petroleum benzin; soluble in 5 parts of alcohol, with not more than a slight opalescence." *U. S.* Boiling water extracts the acid. The oily liquid which separates on agitating Peru balsam with potassium or sodium hydroxide, called *Peru balsam oil* by Stolze, and *cinnamein* by Frémy, may be separated by fractional distillation into three portions,—viz., *benzyl alcohol*, C_7H_8O, passing over at about 200° C. (392° F.); *benzyl benzoate*, $C_7H_5O_2.C_7H_7$, the principal portion boiling at 303° to 304° C. (577.5° to 579° F.); and *benzyl cinnamate*, $C_9H_7O_2.C_7H_7$, passing over at about the boiling point of mercury. The crude oil likewise contains small quantities of free cinnamic and benzoic acids, resulting from the decomposition of the benzylic ether by the alkali used in separating it. According to Kraut (*Ann. Ch. Ph.*, 153, p. 129), the benzyl cinnamate constitutes nearly 60 per cent. of the balsam; but Trog (*A. Pharm.*, 1894, 70-98) states that it is the benzyl benzoate which makes up the bulk of the oily portion and amounts to from 63 to 64 per cent. Tschirch (*loc. cit.*) states that in the sample of Peru balsam investigated by him benzyl benzoate was the main constituent, but small amounts of benzyl cinnamate were also present, and he considers that the relative proportions of the two esters may vary greatly in different samples of the balsam. The odor of the balsam Tschirch considers to be due to the *peruviol*, $C_{13}H_{22}O$, discovered by Thoms.

Peru balsam appears to contain only a single resin, yielding, by analysis, 66.3 to 67.25 per cent. of carbon, and 6.22 to 6.32 per cent. of hydrogen (Kraut, *loc. cit.*). This resin separated from the alkaline solution of the balsam by hydrochloric acid is brown, has a faint odor of vanilla, and when fused with potash yields protocatechuic acid, together with a little benzoic acid. Tschirch has studied this resin and finds it to be the *cinnamic ester* of an alcoholic body called *peru-resino-tannol*, with the formula $C_6H_5.CH.COOC_{18}H_{29}O_4$. The tree also exudes a gum-resin, which, according to Attfield (*P. J.*, 1864, p. 248), contains 77.4 per cent. of a resin, and is non-aromatic, devoid of cinnamic acid, and entirely distinct from balsam of Peru. The leaves of the tree contain a fragrant oil. Like benzoin, balsam of Peru appears to be a pathological product.

The balsam is said to be adulterated in Europe (especially at Bremen) with castor oil, copaiba, Canada turpentine, etc. (*P. J.*, xii. 549), and a factitious substance has been sold in this country for the genuine balsam, prepared by dissolving balsam of Tolu in alcohol. This may be distinguished by its taking fire readily and burning with a blue flame. (*N. Y. J. Pharm.*, i. 133.) The British Pharmacopœia gives the following tests. "1 volume is soluble in 1 volume of *alcohol* (90 per cent.), but on the further addition of 2 or more volumes of the *alcohol*, the mixture becomes turbid. Specific gravity between 1.137 and 1.150. 10 drops triturated with 0.4 gramme of *lime* produce a permanently soft mixture (absence of copaiba and resins); and this, on being warmed until all volatile matter is given off and until charring commences, gives no fatty odor (absence of castor oil and other fatty oils). It should not diminish in volume when shaken with an equal bulk of *water* (absence of ethylic alcohol). About 40 per cent. of resin should separate when one part of the Balsam is treated with three parts of *carbon bisulphide;* and the clear supernatant liquid should be of a pale brown color with only a slight fluorescence (absence of gurjun balsam). If 5 grammes of the Balsam be shaken with 5 cubic centimetres of a solution of *sodium hydroxide* of specific gravity 1.16, and then washed with three successive quantities, each of 15 cubic centimetres, of Purified Ether, and the Ether removed, the residue (after cautious drying until the loss, in two weighings at 5 minutes' interval, does not exceed one centigramme) should weigh between 2.85 and 3 grammes. To this weighed residue 20 cubic centimetres of *normal volumetric alcoholic solution of potassium hydroxide* and 40 cubic centimetres of *alcohol* (90 per cent.) are to be added and the whole saponified under a reflux condenser for one hour. Thus treated, the residue above specified should combine with from 11.9 to 12.8 cubic centimetres of the *normal volumetric alcoholic solution of potassium hydroxide* (presence of a sufficient proportion of cinnamein). The amount of uncombined alkali may be determined in the usual way by means of titration with the *volumetric solution of sulphuric acid." Br.* For additional tests, see *Proc. A. Ph. A.*, 1894, 903; also 1895, 866, and *D. C.*, 1898, 60. A method of detecting castor oil, proposed by Wagner, is to expose a small portion of the suspected balsam to distillation until somewhat more than one-half has passed, to shake the distillate with baryta water, to remove by means of a pipette the layer of oil floating on the surface, and to shake this with a concentrated solution of sodium bisulphite. If castor oil be present, the liquid will immediately become a crystalline mass. (*A. J. P.*, xxx. 570.) The official tests of purity are as follows: "Water, when agitated with the Balsam, shows an acid reaction to blue litmus paper. If 10 drops of the Balsam be triturated with 20 drops of sulphuric acid, a tough, homogeneous, brownish-red mass should result, which, when washed with cold water, should develop a violet color upon its surface, and, when drained, be converted into a brittle resinous mass (absence of *fixed oils*). If 1 Gm. of the Balsam be shaken with 5 Cc. of petroleum benzin, the mixture warmed on a water-bath for ten minutes, and a sufficient quantity

of the solvent added to replace loss by evaporation, then if 2 Cc. of the benzin solution be evaporated, and treated with a drop of nitric acid (sp. gr. 1.42), a permanent green or bluish-green color should not be produced (absence of *rosin*). The remaining 3 Cc. of the benzin solution when shaken with an equal volume of an aqueous solution of copper acetate (1 in 1000) should not be colored green or bluish-green (absence of *rosin, turpentine, storax, fatty oils,* etc.). On mixing the Balsam with half its volume of calcium hydroxide and heating for half an hour on a water-bath, a solid mass should not be formed (absence of *rosin, storax,* or *copaiba*). If 1 Gm. of the Balsam be dissolved in 100 Cc. of alcohol and 1 Cc. of phenolphthalein T.S. be added, not more than 2 Cc. of half-normal alcoholic potassium hydroxide should be required to produce a pink color (limit of *acid resins*). Mix 3 Gm. of the Balsam with 30 Cc. of sodium hydroxide T.S. and shake the mixture for a few minutes with 60 Gm. of ether. Transfer 51.5 Gm. of the ether-solution to a flask and evaporate to dryness. The residue, when dried to constant weight by a gentle heat, should weigh not less than 1.4 Gm. (presence of at least 56 percent. of *cinnamein*). If this residue be dissolved in 25 Cc. of alcohol, then mixed with 25 Cc. of half-normal alcoholic potassium hydroxide V.S., and heated carefully during half an hour on a water-bath, it should require not more than 13.2 Cc. of half-normal hydrochloric acid V.S. to exactly neutralize the liquid, 1 Cc. of phenolphthalein T.S. being used as indicator." *U. S.* Flückiger relies upon the specific gravity, which should be between 1.140 and 1.145, and the *lime test,* in which 10 drops of the balsam are shaken with 6 grains (0.4 Gm.) of slaked lime, forming, if there be no adulteration, a soft mixture, which does not harden. *Grote's test* consists in shaking 3 drops of balsam with 2 Cc. of official ammonia water; if, after standing, the mixture solidifies, rosin or other adulterant is present; benzoin, storax, and certain other substances cannot be detected by this test. (*A. J. P.,* 1881, 302, 361.)

As stated by Trog and others, the percentage of cinnamein should approximate 60. The saponification number should be between 235 and 238.

Uses.—This balsam is a warm stimulating stomachic and expectorant, and has been recommended in *chronic catarrhs,* certain forms of *asthma, phthisis,* and other *pectoral complaints* attended with debility. As an external application it has been found beneficial in *chronic indolent ulcers* and in *local tuberculosis of skin, bone, larynx,* etc. It is best administered diffused in water with sugar and the yolk of egg or gum arabic, or in smaller doses dropped on a lump of sugar. When prescribed[1] as an addition to expectorant mixtures, sufficient mucilage of acacia should be ordered with it to suspend it properly.

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

[1] In the case of alleged fatal poisoning in a child six days old, reported by Lohaus (*Th. M.,* March, 1892), it does not seem probable that the Peru balsam was the cause of the symptoms.

BALSAMUM TOLUTANUM. U. S., Br.

BALSAM OF TOLU

(bâl'sạ-mŭm tō-lū-tā'nŭm)

"A balsam obtained from *Toluifera Balsamum* Linné (Fam. *Leguminosæ*)." *U. S.* "A balsam obtained by making incisions in the trunk of Myroxylon Toluifera." *Br.*

Balsamum Americanum; Baume de Tolu, Baume de Carthagène, *Fr.;* Balsamum Tolutanum, *P. G.;* Tolubalsam, *G.;* Balsamo Tolutano, Balsamo del Tolu, *It.;* Bálsamo de Tolu, *Sp.*

Although Linnæus described this tree as a distinct species, Ruiz, one of the authors of the *Flora Peruviana,* considered it identical with *Myroxylon peruiferum;* but Achille Richard determined that it was distinct, and gave it the specific name of *toluiferum,* which was formerly adopted in both the Br. and U. S. Pharmacopœias. Very properly, however, the revisers of the U. S. P. have returned to the Linnæan name.

The balsam is said to be produced normally in the tree only in young growing tissues such as the young twigs and leaves, and to be formed in the older tissues only as the result of injuries received. It is procured by making V-shaped incisions in the trunk quite through the bark. The juice is received in small calabash cups, which are inserted in slight excavations beneath the point of the two vertical incisions meeting at the lower end; and Weir has seen as many as twenty cups at a time on one tree. The collectors go from tree to tree, emptying the cups into flasks of raw hide. In these skin vessels the juice is taken to the different ports on the river, where it is transferred to tin cans. It is brought from Carthagena in calabashes or baked earthen jars, or in tin or glass vessels.

Properties.—As first imported, balsam of Tolu has a soft tenacious consistence, which varies considerably with the temperature. By age it becomes hard and brittle like rosin. It is shining, translucent, of a reddish or yellowish brown color, a highly fragrant odor, and a warm, somewhat sweetish and pungent, but not disagreeable taste. Exposed to heat, it melts, inflames, and diffuses an agreeable odor while burning. It is entirely soluble in volatile oils. The official description is as follows: "A yellowish-brown, plastic solid, becoming brittle when old, dried, or exposed to cold. It is transparent in thin layers, has a pleasant, aromatic odor, recalling that of vanilla, and a mild, aromatic taste." *U. S.* "When pressed between pieces of glass with the aid of heat, it exhibits, when examined with a lens, an abundance of crystals." *Br.* The U. S. Pharmacopœia gives the following tests of purity. "Readily soluble in alcohol, the solution showing an acid reaction

to blue litmus paper; also soluble in chloroform and the solutions of the fixed alkalies; almost completely soluble in ether, but nearly insoluble in water and petroleum benzin; partially soluble in carbon disulphide. If 0.5 Gm. of the Balsam be shaken with 25 Cc. of carbon disulphide and allowed to stand for thirty minutes, and the liquid then filtered, the residue obtained by evaporating the filtrate to dryness, when dissolved in glacial acetic acid, should not yield a green color on the addition of a few drops of sulphuric acid (absence of *rosin*). If 1 Gm. of the Balsam be shaken with 8 Cc. of petroleum benzin for five minutes, the supernatant liquid should not be colored green when shaken with an equal volume of an aqueous solution of copper acetate (1 in 1000) (absence of *rosin* and *copaiba*). If to 1 Gm. of the Balsam dissolved in 50 Cc. of alcohol, 1 Cc. of phenolphthalein T.S. be added, not less than 4 Cc. nor more than 6 Cc. of half-normal alcoholic potassium hydroxide V.S. should be required to produce a red color (limit of *acidity*); if to this liquid more half-normal alcoholic potassium hydroxide V.S. be added, until the total amount has reached exactly 20 Cc., and the liquid heated in a water-bath for half an hour, and allowed to cool, then not less than 13.2 Cc. nor more than 14.5 Cc. of half-normal sulphuric acid V.S. should be required to neutralize the excess of potassium hydroxide V.S., phenolphthalein T.S. being used as indicator (limit of *saponifiable substances*)." *U. S.* "It is soluble in *alcohol* (90 per cent.) and the solution has an acid reaction. If 5 grammes are gently warmed with two successive portions of 25 and 10 cubic centimetres of *carbon bisulphide*, the solution should yield, when evaporated to dryness, a distinctly crystalline residue which should require not less than one-third of its weight of *potassium hydroxide* for its saponification (presence of a sufficient proportion of benzoates and cinnamates)." *Br.* The carbon disulphide test is based upon Braithwaite's researches upon spurious balsams of Tolu. (See *P. J.*, 1895, 145; also 1897, 307.)

Boiling water extracts its acid. Distilled with water it affords a small proportion of volatile oil, and, if the heat be continued, an acid matter sublimes. Hatchett states that when dissolved in the smallest quantity of solution of potassium hydroxide it loses its own characteristic odor and acquires that of the clove pink. G. L. Ulex gives as a test of the purity of the balsam, that if heated in sulphuric acid it dissolves without disengagement of sulphurous acid, and yields a cherry-red liquid. (*A. Pharm.*, Jan. 1853.) A modification of this test is that of R. A. Cripps (*P. J.*, xix. 1888) who states that by a comparative test of the suspected balsam with a pure specimen 1 per cent. of storax or other resinous adulterant can be detected. Thirty grammes of the sample are digested in carbon disulphide for fifteen minutes with gentle warmth, the clear liquid decanted, evaporated to dryness, and dissolved in sulphuric acid. A bright red rose color is produced, remaining rose for a length of time if the balsam be pure, rapidly becoming brown if the balsam has been adulterated. The balsam is a mixture of volatile oil, free acid, and resin. The volatile oil is obtained by distilling the balsam with water, and may amount to a little over 1 per cent. This oil is chiefly *tolene*, $C_{10}H_{16}$, boiling at 170° C. (338° F.), and rapidly hardening by absorption of oxygen from the air. The free acid, according to Deville and Scharling, consists of benzoic and cinnamic acids, which statement has been confirmed by Flückiger (*Pharmacographia*, 2d ed., 204). Buse (*Ber. d. Chem. Ges.*, 1876, 833) has shown that the benzylic esters of these two acids are present in the balsam, the benzyl cinnamate in larger amount.

Tschirch (*Harze und Harzbehälter*, 1900, p. 173) found that the ester mixture in Tolu balsam amounted to 7.5 per cent. against 62 to 64 per cent. in Peru balsam. Trommsdorff obtained 88 per cent. of resin, 12 of acid, and only 0.2 of volatile oil. According to Heaver, the balsam yields by distillation about one-eighth of its weight of pure cinnamic acid. The acid distils over in the form of a heavy oil, which condenses into a white crystalline mass. It may be freed from empyreumatic oil by pressure in bibulous paper, and subsequent solution in boiling water, which deposits it in minute colorless crystals upon cooling. (*A. J. P.*, xv. 77.) A later investigation by Tschirch and Oberländer shows that the resinous portion of the balsam consists of *tolu-resino-tannol* in combination with cinnamic and benzoic acids, the latter in small proportions only. It contains, in addition, 7.5 per cent. of an aromatic, acid, oily liquid, composed mainly of benzyl benzoate, with a little benzyl cinnamate and a trace of vanillin. (*A. Pharm.*, 1894, 599.) A factitious balsam described by R. V. Mattison (*A. J. P.*, 1876, 51) contained 63 per cent. of storax.

Uses.—Balsam of Tolu is a feeble stimulant expectorant; the syrup of Tolu is much used, on account of its agreeable flavor, as the basis of cough mixtures. Old and obstinate *catarrhs* are said to be sometimes greatly relieved by the inhalation of the vapor proceeding from an ethereal solution of this balsam. The best form of administration is that of emulsion, made by triturating the balsam with mucilage and loaf sugar, and afterwards with water.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Syrupus Tolutanus, *U. S.* (from the tincture), *Br.*; Tinctura Benzoini Composita, *U. S.*, *Br.*; Tinctura Tolutana, *U. S.*, *Br.*

BARIUM

BARIUM

(bâr'ĭ-ŭm)

Ba = 136.04

Baryum, *Fr.*, *G.*

This is the metal present in the earth baryta. It was first obtained in 1808 by Sir H. Davy,

who described it as a difficultly fusible metal, of a silvery-gray color, decomposing water readily, and considerably heavier than sulphuric acid. When exposed to the air, it instantly becomes covered with a crust of barium oxide. Barium chloride, barium dioxide, and barium carbonate were formerly official.

Barium oxide or *baryta* may be obtained from the native carbonate by intense ignition with carbonaceous matter, or from the native sulphate by ignition with charcoal, which converts it into barium sulphide, subsequent solution of the sulphide in nitric acid, and strong ignition of the nitrate formed, to dissipate the acid. As thus obtained, it is an anhydrous solid, caustic, alkaline, difficultly fusible, and of a grayish-white color. Recently it has been obtained at Niagara Falls by a reaction in which, at the temperature of the electric arc, a small amount of the sulphide obtained by the reducing action of charcoal is made to react with an excess of unchanged sulphate,

$$3BaSO_4 + BaS = 4BaO + 4SO_2$$

Its sp. gr. is about 4. It acts on the animal economy as a poison. When sprinkled with water it slakes like lime, becomes hot, and is reduced to the state of a white pulverulent hydroxide. The same hydroxide is formed in mass when the anhydrous earth is made into a paste with water and exposed to a red heat in a platinum crucible. The excess of water is expelled, and the hydroxide undergoing fusion, may be poured out and allowed to congeal. Barium hydroxide dissolves in water, and forms the reagent called *baryta water*. A boiling saturated solution, as it cools, yields crystals of barium hydroxide containing eight molecules of water of crystallization.

Baryta consists of one atom of barium and one of oxygen. Its chemical formula, is, therefor, BaO. When barium oxide is heated in a current of oxygen or air, it takes up an atom of oxygen and is changed into barium dioxide, BaO_2. When this is heated somewhat higher, it gives off the extra atom of oxygen and becomes BaO again. This power of taking up oxygen from the air and giving it up at a somewhat higher heat is now utilized on a commercial scale in the Brin process for making oxygen, and it is found that this change from BaO to BaO_2 and back again can be effected at one and the same temperature by simply heating first under pressure and then by exhausting and reducing below the normal atmospheric pressure. Barium dioxide is also of growing importance as the material from which hydrogen dioxide, H_2O_2 is made.[1] *Barium carbonate,* $BaCO_3$, is the native carbonate, a rare mineral, discovered in 1783 by Withering, in honor of whom it is called *witherite*. It is found in Sweden and Scotland, but most abundantly in the lead mines of Northern England. It occurs usually in grayish, or pale yellowish-gray, fibrous masses, but sometimes crystallized. Its sp. gr. varies from 4.2 to 4.4. It is generally translucent, but sometimes opaque. It effervesces with acids, and, before the blow-pipe, melts into a white enamel without losing its carbon dioxide. It is distinguished from strontium carbonate, with which it is most liable to be confounded, by its greater specific gravity, and by its yielding a light greenish and not a reddish flame upon the burning of alcohol impregnated with its solution in hydrochloric acid. The presence of strontium is indicated by a reddish flame.

When pure, barium carbonate is entirely soluble in hydrochloric acid. Any barium sulphate present is left undissolved. If neither ammonia nor hydrogen sulphide produces discoloration or a precipitate in the hydrochloric acid solution, the absence of aluminum, iron, copper and lead is shown. Lime may be detected by adding an excess of sulphuric acid, which will throw down the baryta as a sulphate, and afterwards testing the clear liquid with sodium carbonate, which, if lime be present, will produce a precipitate of calcium carbonate.

Barium carbonate acts as a poison on the animal economy. Its only pharmaceutical use is to prepare barium chloride. (For *Barium Chloride* and *Barium Sulphate,* see PART II.)

BELLADONNÆ FOLIA. U. S., Br.

BELLADONNA LEAVES

(bĕl-lą-dŏn'næ fō'lī-ą)

"The dried leaves of *Atropa Belladonna* Linné (Fam. *Solanaceæ*), yielding, when assayed by the process given below, not less than 0.35 percent. of mydriatic alkaloids." *U. S.* "The fresh leaves and branches of Atropa Belladonna, *Linn.,* collected when the plant is in flower." *Br.* (See next article.)

Folia (s. Herba) Belladonnæ, Black Cherry, Poison black cherry, Deadly Nightshade, Doft-berry, Dwayberry, Devale (Dwale), Mad, Great Morel, Mekilwort; Feuilles de Belladone, *Fr.;* Folia Belladonnæ, *P. G.;* Belladonnablätter, Tollkirschen-Blätter, Wolfskirschen-Blätter, Tollkraut, *G.;* Foglie di belladonna, *It.;* Hoja de belladona, *Sp.*

[1] *Barium Dioxide* or *Peroxide* (BaO_2) was recognized by the U. S. P. of 1890 but was dropped in the 8th decennial revision. It was officially described as "a heavy, grayish-white, or pale yellowish-white, amorphous, coarse powder, odorless and tasteless. When exposed to the air, it slowly attracts moisture and carbon dioxide, and is gradually decomposed. Almost insoluble in cold water, with which, however, it forms a definite hydrate, and to which it imparts a decidedly alkaline reaction. Hydrochloric, phosphoric, and most other mineral acids decompose it, producing the corresponding barium salts, and hydrogen dioxide, which remains in solution for a considerable time, if the reaction has taken place in the cold, and an excess of the acid be present. When heated to a bright red heat, Barium Dioxide fuses, loses oxygen, and is reduced to barium oxide. Barium Dioxide should be dissolved by diluted hydrochloric or phosphoric acid without leaving more than a trace of residue. If 2.11 Gm. of Barium Dioxide be dissolved, as completely as possible, in ice-cold water to the volume of 25 Cc., with the aid of 7.5 Cc. of phosphoric acid, and 5 Cc. of this solution (corresponding to 0.422 Gm. of the Dioxide) be measured off for assay, it should require not less than 40 Cc. of potassium permanganate decinormal volumetric solution to impart to the liquid a permanent pink tint, corresponding to not less than 80 per cent. of pure Barium Dioxide (each Cc. of the volumetric solution indicating 2 per cent. of the latter)." *U. S.* 1890.

Barium dioxide is not used in the practice of medicine.

Off. Prep.—Emplastrum Belladonnæ, *U. S.* (from extract); Extractum Belladonnæ Foliorum, *U. S.;* Extractum Belladonnæ Viride, *Br.;* Succus Belladonnæ, *Br.;* Pilulæ Laxativæ Compositæ, *U. S.* (from extract); Pilulæ Podophylli, Belladonnæ et Capsici, *U. S.* (from extract); Tinctura Belladonnæ Foliorum, *U. S.;* Unguentum Belladonnæ, *U. S.* (from extract).

BELLADONNÆ RADIX. U. S., Br.

BELLADONNA ROOT

(bĕl-la-dŏn'næ rā'dix)

"The dried root of *Atropa Belladonna* Linné (Fam. *Solanaceæ*), yielding, when assayed as directed below, not less than 0.5 percent. of mydriatic alkaloids." *U. S.* "The root of Atropa Belladonna, *Linn.*, collected in the autumn, and dried." *Br.*

Racine de Belladone, Belladone, *Fr.;* Gemeine Tollkirsche, Wolfskirsche, Tollkirschen-Wurzel, Wolfskirschen-Wurzel, *G.;* Radice di Belladonna, Belladonna, *It.;* Raiz de Belladona, Belladona, Belladama, *Sp.*

Atropa Belladonna, Willd., *Sp. Plant.* i. 1017; Carson, *Illust. of Med. Bot.* ii. 19, pl. lxv.; *B. & T.* 193.—The belladonna, or *deadly nightshade*, is an herbaceous perennial, with a fleshy, creeping root, from which rise several erect, round, purplish, branching stems, to the height of about three feet. The leaves, which are attached by short footstalks to the stem, are in pairs of unequal size, oval, pointed, entire, of a dusky green on their upper surface, and paler beneath. The flowers are large, bell-shaped, pendant, of a dull reddish color, with solitary peduncles, rising from the axils of the leaves. The fruit is a roundish berry with a longitudinal furrow on each side, at first green, afterwards red, ultimately deep purple and containing, in two cells, numerous seeds and a sweetish violet colored juice. The calyx adheres to the base of the fruit.

The plant is a native of Europe, where it grows in shady places, along walls, and amidst rubbish, flowering in June and July, and ripening its fruit in September. It grows vigorously under cultivation in this country, and retains all its activity, according to the observations of Alfred Jones. (*A. J. P.*, xxiv. 106.) All parts of it are active. The leaves and roots are directed by the United States and British Pharmacopœias, the latter including the branches, which, if young, are probably not less efficient. The leaves should be collected in June or July, when the plant is in flower, the roots in the autumn or early in the spring, and from plants three years old or more. Leaves which have been kept long should not be used, as they undergo change through absorption of atmospheric moisture, emitting ammonia, and probably losing a portion of their active nitrogenous matter. It has been affirmed that the finest looking leaves are to be rejected, as probably being those of cultivated plants, and inferior in strength to the smaller and less sightly leaves of the wild plant. (*A. J. P.*, xxvii. 455.) This is, however, probably an error, as the analyses made by A. W. Gerrard (*P. J.*, xv. 153) show that while the wild belladonna plant contains a little more alkaloid than the cultivated, the difference is not sufficient to be of material consequence. The same investigator found that the leaf yields the alkaloid most abundantly, the root, fruit, and stem being the next in order, and that the period of flowering (between two and four years of age), is the best time for collecting the plant. The dried leaves as they occur in the American market vary remarkably in the percentage of alkaloid; the best are fully equal to the finest English leaves. Specimens which contain much stem or are musty should always be rejected, as weak in active principle. Holmes has found in the English market the root of *Medicago sativa* used as an adulterant. (*P. J.*, 1882.)

Properties.—Officially the leaves are described as "usually of a dull brownish-green color, the leaves much wrinkled and matted together, frequently with the flowering tops intermixed; leaves from 6 to 20 Cm. long, 4 to 12 Cm. broad, broadly ovate, apex acute, margin entire, narrowed into the petiole, upper surface brownish-green, lower surface grayish-green, epidermis more or less papillose, particularly on the under surface; odor distinctly narcotic, especially on moistening; taste somewhat bitter and acrid. The powder is characterized by few hairs and numerous, small, arrow-shaped crystals of calcium oxalate." *U. S.* "The transverse section of the leaf exhibits bi-collateral vascular bundles; the mesophyll contains numerous cells filled with very minute crystals of calcium oxalate." *Br.* The roots occur "in cylindrical or somewhat tapering, longitudinally wrinkled pieces, 1 to 2.5 Cm. thick, the bark somewhat incurved at the edges of roots which have been split before drying; externally pale brownish-gray, dusty or mealy, outer layers of the periderm rather soft, frequently abraded, and thus showing lighter patches; fracture nearly smooth, mealy, and emitting a characteristic puff of dust; internally whitish, the older roots showing medullary rays near the bark; nearly inodorous; taste sweetish, afterwards bitterish and strongly acrid. The powder contains relatively few sclerenchymatous fibres and numerous starch grains which are single or 2- to 3-compound, somewhat spherical, and 0.005 to 0.010 Mm. in diameter." *U. S.* The bark of the belladonna root is thick, presenting immediately under the epidermis a dark line composed of from six to eight layers of tabular cells. The bark itself is composed entirely of parenchymatous cells, more or less filled with muller shaped starch grains, which are often united in the cells into compound grains. Bundles of raphides, probably of calcium oxalate, are usually very evident. In va-

rious parts of Europe both the leaves and the root of belladonna are adulterated with the similar products of a Phytolacca, which has been variously supposed to be the *Phytolacca decandra* of North America which has become naturalized in Southern Europe; the *P. violacea* of Southwestern Europe, and the *P. abyssinica* which is said to grow on the Riviera. The leaves and general appearance resemble those of belladonna but are to be recognized by their upper surfaces being without hairs and brighter than in the official plant. Moreover, according to E. M. Holmes, the epidermal cells of the true belladonna leaves are irregular, with sinuate walls, and the stomata are rounded; while epidermal cells in the phytolacca are polygonal and the stomata elliptical. The dried phytolacca root resembles superficially that of belladonna, but according to E. M. Holmes may readily be distinguished by the epidermis not being easily abraded with the finger nail, by the general concentric structure, and by the fact that the rings readily separate into fibrous laminæ when the root is broken, the true belladonna root having a short, not at all fibrous, fracture, and even in the oldest roots not separating into laminæ. The histology of the phytolacca root is also, according to Greenish, characteristic; the raphides are acicular instead of being, as in belladonna, sandy crystals, and the root itself is generally characterized by the alternating distinctly separate rings of wood and bast tissue. Scopola root, which is now official, has been largely used by manufacturers of belladonna plasters in the place of belladonna root (see *Scopola.*) Hirtz of Strasburg, inferred from his experiments that the root yields an extract five times stronger than that obtained from the leaves, but did not determine the relative yield of extract, while Lefort obtained from young roots 0.6, from old roots 0.25, and from dried leaves 0.44 per cent. of atropine; Dragendorff obtained 0.66 from dried leaves, and 0.4 per cent. from the roots. (*Jahresb.*, 1874, p. 96.) Both the leaves and root, as well as all other parts of the plant, impart their active properties to water and alcohol. Brandes rendered it probable that these properties reside in a peculiar alkaline principle which he supposed to exist in the plant combined with an excess of malic acid and appropriately named *atropine.* Besides atropine malate, Brandes found in the dried herb two principles, a green resin (chlorophyll), wax, gum, starch, albumen, lignin, and various salts. The alkaloidal principle was first, however, procured in a state of purity by Mein, a German apothecary, who extracted it from the root. Ladenburg (1879 to 1884) exhaustively studied the several sources of atropine and the allied alkaloids that exert a mydriatic action. It is now recognized that there are two alkaloids, *atropine* and *hyoscyamine,* which possess the common formula $C_{17}H_{23}NO_3$, *hyoscine* or *scopolamine,* $C_{17}H_{21}NO_4$, and in belladonna root, *belladonine,* $C_{17}H_{21}NO_2$. Of these, atropine occurs in the *Atropa Belladonna* and in *Datura Stramonium,* hyoscyamine in these plants and also in *Hyoscyamus niger* and *Duboisia myoporoides;* hyoscine is found in *Hyoscyamus niger* (and under the name of scopolamine in *Scopola carniolica*), and belladonine in belladonna root alone. The first of the alkaloids of the formula $C_{17}H_{23}NO_3$, *atropine,* fuses when pure at 115.8° C. (240.4° F.), and forms a double gold chloride, fusing at 135° C. to 137° C. (275° F. to 278.6° F.); the second, the alkaloid known under the several names of *hyoscyamine* and *daturine,* fuses at 108.5° C. (227.5° F.), and yields a gold salt fusing at 160° C. to 162° C. (320° F. to 323.6° F.); on the other hand *hyoscine* $C_{17}H_{21}NO_4$ has been obtained as yet only in the form of a syrup, but forms a crystalline gold salt, which fuses at 198° C. to 200° C. (388.4° F. to 392° F.), and is less soluble than the hyoscyamine gold salt; hyoscine forms readily crystallizable salts, especially the hydrobromide. In *Duboisia myoporoides* (see PART II) the chief alkaloid present seems to be the second of these, and the complete identity of it with the purified alkaloid of hyoscyamus has been established by Ladenburg, both by analysis of the free alkaloid and its salts, and by study of the action of different reagents upon it. Hyoscyamine is more soluble in water and diluted alcohol than is atropine, and, as already stated, forms a gold salt of different fusing point. Its decomposition products under the influence of caustic baryta or hydrochloric acid are the same as those of atropine,—viz., *tropine* and *tropic acid.* Hübschmann (*Schweiz. Zeits. Pharm.*, 1858, 123) and Kraut (*Ann. Ch. Ph.*, 148, 236) both described, under the name of *belladonine,* a second alkaloid extracted from belladonna root. This *belladonine* and another alkaloid, *atropamine,* found at times in belladonna root, and obtained from the by-products of the manufacture of atropine, possess the formula $C_{17}H_{21}NO_2$, and are considered as anhydro-atropines. Both bases form varnish-like masses. Merck has isolated a base isomeric with Hesse's atropamine, which has been termed *apoatropine,* the salts of which are easily crystallizable. He asserts that atropamine and apoatropine are identical. Hesse, on the other hand, denies this assertion. (*Ann. Ch. Ph.*, 271, 10.) For the mode of preparing atropine, and its properties, see *Atropina,* page 212. Dunstan and Ransom have devised processes for isolating the alkaloids from the root and leaves which they assert are simple and accurate. (See *A. J. P.*, 1884, 277; *Proc. A. Ph. A.*, 1886, 392.) A. W. Adams states that only 53 per cent. of the atropine in belladonna leaves can be separated by these processes. (*Am. Drug.*, 1891, 328.) For other assays of belladonna leaves and root, and comments, see Schwickerath (*Ph. Rund.*, 1893, 282); Keller (*Ph. Ztg.*, 1894, 345); Moerk (*A. J. P.*, 1899, 105); La Wall and Pursell (*A. J. P.*, 1899, 394); Puckner (*Ph. Rev.*, 1898, 180, 324; 1902, 457); Bird, (*P. J.*, 1900, 195); Keb-

ler (*Am. Drug.*, 1902, 215); Schmidt (*Ap. Ztg.*, 1900, 13.) The British Pharmacopœia has adopted a process of assay for these alkaloids. (See *Extractum Belladonnæ Liquidum.*) The U. S. P. (8th Rev.) adopted assays for both belladonna leaves and the root which are as follows:

Assay of Belladonna Leaves.—"Belladonna Leaves, in No. 60 powder, *ten grammes,* Chloroform, Ether, Normal Sulphuric Acid V.S., Ammonia Water, Distilled Water, Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., or Iodeosin T.S., each, *a sufficient quantity.* Place the Belladonna Leaves in an Erlenmeyer flask, and add 50 Cc. of a mixture of chloroform 1 part and ether 4 parts (both by volume). After inserting the stopper securely allow the flask to stand ten minutes, then add 2 Cc. of ammonia water mixed with 3 Cc. of distilled water, and shake the flask well at frequent intervals during one hour. Then transfer as much as possible of the contents of the flask to a small percolator which has been provided with a pledget of cotton packed firmly in the neck and inserted in a separator containing 6 Cc. of normal sulphuric acid V.S. diluted with 20 Cc. of distilled water. When the liquid has passed through the cotton, pack the Belladonna Leaves firmly in the percolator with the aid of a glass rod, and having rinsed the flask with 10 Cc. of the chloroform-ether mixture, transfer the remaining contents of the flask to the percolator, by the aid of several portions (5 Cc.) of the chloroform-ether mixture, and continue the percolation with successive small portions of the same liquid (using in all 50 Cc.). Next, shake the separator well for one minute, after securely inserting the stopper, and when the liquids have completely separated, draw off the acid solution into another separator. Add to the chloroform-ether mixture 10 Cc. of sulphuric acid mixture of the same strength as that previously used, agitate well, and again draw off the acid solution into the second separator; repeat this operation once more, drawing off the acid solution as before; introduce into the acid solutions contained in the second separator a small piece of red litmus paper, then add ammonia water until the liquid is distinctly alkaline, and shake out with three successive portions of chloroform 15, 15, and 5 Cc.; collect the chloroform solutions in a beaker, place it on a water-bath containing warm water, and allow the chloroform to entirely evaporate. Dissolve the residue in 3 Cc. of ether, and let this also evaporate completely. To the alkaloidal residue add 3 Cc. of tenth-normal sulphuric acid V.S. and 5 drops of hematoxylin T.S. (or iodeosin T.S.), then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 3 (the 3 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0287 and this product by 10; the result will be the percentage of total mydriatic alkaloids contained in the Belladonna Leaves." *U. S.*

Assay of Belladonna Root.—"The method to be employed is identical with that given under Belladonna Leaves, using *ten grammes* of Belladonna Root in No. 60 powder." *U. S.* W. Will published (*A. Phys.*) in 1888 the results of an investigation undertaken at the request of the Schering manufactory to determine why the proportion of hyoscyamine and atropine in a root seems to vary with the method of working, and reached the surprising conclusion that hyoscyamine can be changed into atropine under a variety of circumstances, such as fusion, action of weak soda solution (even at ordinary temperature), and of ammonia. The conversion of the optically active hyoscyamine into the optically inactive atropine, the alteration of fusing point in the two alkaloids, and of their double gold chloride salts, all confirm the results of the investigation. (*Ber. d. Chem. Ges.*, 1888, p. 1717.) The results were also confirmed by Schmidt. They were at first doubted by Ladenburg, but seem now to be admitted, the two alkaloids being stereo-isomeric, and capable of such change.

Uses.—The action of belladonna upon the system is that of atropine. (See p. 214.) All parts of the plant are poisonous. It is not uncommon, in countries where it grows wild, for children to pick and eat the berries, allured by their fine color and sweet taste. Soon after the poison has been swallowed, its peculiar influence is experienced in dryness of the mouth and fauces, burning in the throat and stomach, great thirst, difficult deglutition, loss of vision, vertigo, and intoxication or delirium, with violent gestures and sometimes fits of laughter, followed by coma. A feeble pulse, cold extremities, subsultus tendinum, deep coma or delirium, and sometimes convulsions, precede death. To obviate the poisonous influence of the belladonna the most effectual method is to evacuate the stomach as speedily as possible, by means of emetics or the stomach tube, and afterwards to cleanse the bowels by purgatives and enemata. The infusion of galls and compound solution of iodine have been recommended as antidotes. Both morphine and pilocarpine are to some extent physiologically antagonistic to atropine, and have been found very useful in belladonna poisoning. (See *B. M. J.*, Feb. 1890.) They should be given hypodermically.

Belladonna has been used as a medicine from early times. The leaves were first employed externally to discuss *scirrhous tumors* and heal *cancerous* and other *ill-conditioned ulcers,* and were afterwards administered internally for the same purpose. Belladonna has acquired considerable credit as a preventive of *scarlatina,*—an application of the remedy first suggested by the author of the homœopathic doctrine,—but it is absolutely devoid of any such power. For further information, see *Atropina.*

The extract is much used locally. Rubbed upon the areola of the breast, it has been found to arrest the *secretion of milk;* upon the abdomen, to relieve the *vomiting of pregnancy,* and other irritations sympathetic with the gravid uterus. In *cardiac diseases* the plaster is often applied with advantage over the heart. The decoction or extract, applied to the neck of the uterus, is asserted to have hastened *tedious labor* dependent on rigidity of the os cervicis; and spasmodic *stricture of the urethra, neck of the bladder,* and *sphincter ani, anal fissures,* and painful *uterine affections,* have been relieved by the local use of the extract, either smeared upon bougies or administered by injection. In the latter mode it has relieved *strangulated hernia.* It is asserted also to be useful in *paraphimosis.* The inhalation of the vapor from a decoction of the leaves or extract has been recommended in *spasmodic asthma.* For this purpose, two drachms of the leaves, or fifteen grains of the aqueous extract, are employed to the pint of water. A much better plan is to smoke the dried leaves in the form of a cigarette or in a pipe. Relief is said to have been obtained in *phthisis* by smoking the leaves, infused when fresh in a strong solution of opium, and then dried.

Belladonna should never be given in substance, but in the form of extract or tincture, or, when accuracy or quickness of action is desired, of atropine. (See *Atropina.*)

Dose, one grain (0.065 Gm.).

Off. Prep.—Emplastrum Belladonnæ, *Br.* (from liquid extract); Extractum Belladonnæ Alcoholicum, *Br.* (from liquid extract); Fluidextractum Belladonnæ Radicis, *U. S.* (*Br.*); Linimentum Belladonnæ, *Br.* (from liquid extract); Suppositoria Belladonnæ, *Br.* (from alcoholic extract); Tinctura Belladonnæ, *Br.* (from liquid extract); Unguentum Belladonnæ, *Br.* (from liquid extract).

BENZALDEHYDUM. U. S.

BENZALDEHYDE

(bĕn-zăl-dē-hȳ′dŭm)

$C_7H_6O = 105.25$

"An aldehyde, produced artificially, or obtained from natural oil of bitter almond or other oils, and containing not less than 85 percent. of pure Benzaldehyde [$C_6H_5.COH$]. It should be kept in small amber-colored, well-stoppered bottles." *U. S.*

Benzoic aldehyde; Oleum Amygdalarum Æthereum Sine Acido Prussico; Oleum Amygdalarum Æthereum Artificiale; Aldéhyde Benzoique, *Fr.;* Benzaldehyd, Künstliches Bittermandelöl, *G.*

Preparation.—Benzaldehyde is the first in the series of aromatic aldehydes, being the first oxidation product of benzyl alcohol, $C_6H_5.CH_2OH$, and going in turn into the fuller oxidation product, benzoic acid, $C_6H_5.COOH$. It is mainly produced artificially from toluene by the following reactions:

$$C_6H_5.CH_3 + 2Cl_2 = C_6H_5.CHCl_2 + 2HCl$$
$$C_6H_5.CHCl_2 + HOH = C_6H_5.COH + 2HCl$$

Exposed to the air, benzaldehyde tends to pass by oxidation into benzoic acid, which latter is therefore liable to be found as a contamination of the sample of benzaldehyde if not freshly rectified. Benzaldehyde is officially described as "a colorless, strongly refractive liquid, having a bitter-almond-like odor, and a burning, aromatic taste. Specific gravity: about 1.045 at 25° C. (77° F.). Sparingly soluble in water (1 in 300); soluble, in all proportions, in alcohol, ether, and fixed and volatile oils. Boiling point: 179° to 180° C. (354.2° to 356° F.); optically inactive. If 10 drops of Benzaldehyde, dissolved in a little alcohol, be shaken with a few drops of a strong solution of sodium hydroxide, then with a little ferrous sulphate T.S., and finally mixed with a slight excess of hydrochloric acid, a blue precipitate should not be produced (absence of *hydrocyanic acid*). If the looped end of a piece of clean copper wire be held in a non-luminous flame until it glows, then cooled, and the loop dipped into Benzaldehyde, ignited, and held so that the liquid burns outside of the flame, then if the loop be slowly brought in contact with the lower outer edge of the flame, no green tinge should be discernible (absence of *chlorinated products*). If a small strip of filter paper folded in the form of a taper and saturated with Benzaldehyde be placed in a small porcelain dish, and a clean beaker, moistened on the inner surface with distilled water, be inverted over the smaller dish immediately after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S. (absence of *chlorinated products*)." *U. S.*

Assay.—"Introduce into a tared 150 Cc. flask 10 Cc. of purified kerosene, note the exact weight, add 12 drops of Benzaldehyde, and again note the weight; add 20 Cc. of distilled water with 6 drops of phenolphthalein T.S., and then neutralize the solution exactly by the addition of tenth-normal sodium hydroxide V.S., agitating the flask thoroughly. Add from a burette, gradually, a solution of sodium sulphite (1 in 5), alternating with half-normal hydrochloric acid V.S. from a second burette, until 10 Cc. of the sodium sulphite solution have been added, and enough half-normal hydrochloric acid V.S. to maintain the neutrality of the mixture; after adding a few drops of phenolphthalein T.S., and agitating the flask frequently, allow it to stand two hours to insure a permanent condition of neutrality, and then note the number of cubic centimeters of the half-normal hydrochloric acid V.S. used. Carry out a blank test, identical with the foregoing, except that the Benzaldehyde is omitted, and note the amount of half-normal hydrochloric acid V.S. consumed. Subtract the number of cubic centimeters required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.0526

Gm. of Benzaldehyde. To find the percentage, multiply the above difference by 0.0526, and this product by 100, and divide by the weight of the Benzaldehyde taken." *U. S.*

Uses.—Benzaldehyde is used as a flavoring agent, in place of the oil of bitter almond, from which it differs in containing no hydrocyanic acid; it is often called artificial or synthetic oil of bitter almond. (See *Oleum Amygdalæ Amaræ.*) It is not poisonous if pure.

Dose, half to one minim (0.03 to 0.06 Cc.)..

BENZINUM. U. S.

PETROLEUM BENZIN

(bĕn-zī'nŭm)

"A distillate from American petroleum consisting of hydrocarbons, chiefly of the marsh-gas series [C_5H_{12},C_6H_{14}, and homologous compounds]. It should be carefully kept in well-stoppered bottles or tin cans, in a cool place, remote from lights or fire." *U. S.*

Benzin, Petroleum Ether; Æther Petrolei; Esprit (naphte, Ether) de Pétrole, *Fr.;* Benzinum Petrolei, *P. G.;* Petroleumbenzin, Petroläther, *G.;* Benzina del petrolio, *It.*

This useful product of petroleum was first introduced into the U. S. Pharmacopœia 1880; it is obtained in the process of purifying petroleum by fractional distillation (see *Petroleum,* PART II), and it is defined in the Pharmacopœia as "a transparent, colorless, diffusive liquid, of a strong, characteristic odor, slightly resembling that of petroleum, but much less disagreeable, and having a neutral reaction. Petroleum benzin is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently. Specific gravity: 0.638 to 0.660 at 25° C. (77° F.). Insoluble in water; soluble in about 6 parts of alcohol, and readily soluble in ether, chloroform, benzene, volatile oils, and fixed oils with the exception of castor oil. Boiling point; 45° to 60° C. (113° to 140° F.). If 5 drops of Petroleum Benzin be added to a mixture of 40 drops of sulphuric acid and 10 drops of nitric acid, in a test-tube, the liquid warmed for about ten minutes, and then set aside for half an hour, on diluting it, in a shallow dish, with water, it should not evolve the bitter-almond-like odor of nitro-benzene (difference from, and absence of, *benzene*)." *U. S.* Petroleum benzin must be carefully distinguished from benzene (official in the British Pharmacopœia under the name of *Benzol* and a reagent in the U. S. P.), a product derived from coal tar. Although the U. S. Pharm. gives a test to distinguish an admixture with benzene, this adulteration of petroleum benzin is hardly likely to take place here in the near future, because of the great difference in price. The principal consumption of petroleum benzin at present is in the arts as a solvent, especially as a substitute for oil of turpentine, which it resembles very much in its solvent properties. In pharmacy it has been used to deprive powdered drugs of their fixed oil by percolation (see *Charta Sinapis*); to obtain volatile oils by percolating the oily drug with the benzin and subsequently evaporating the mixture spontaneously; as a substitute for ether in making oleoresins; and for many other purposes to which it is adapted on account of its powers as a solvent. Petroleum benzin is a good solvent for fats, resins, rubber, and some of the alkaloids.

Dragendorff recommends the rectification of benzin by fractional distillation from lard, collecting the portion which distils below 45° C. We have found petrolatum to be efficient in retaining the impurities in the still. A process is now official for its purification, based upon a method proposed by Geo. M. Beringer (see *Benzinum Purificatum.*)

Off. Prep.—Benzinum Purificatum, *U. S.;* Charta Sinapis, *U. S.*

BENZINUM PURIFICATUM. U. S.

PURIFIED PETROLEUM BENZIN

(bĕn-zī'nŭm pū-rĭ-fĭ-cā'tŭm)

"Potassium Permanganate, *ten grammes* [or 154 grains]; Sodium Hydroxide, *two grammes* [or 31 grains]; Sulphuric Acid, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Petroleum Benzin, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Water, *a sufficient quantity.*

Add the Acid to *five hundred and fifty cubic centimeters* [or 18 fluidounces, 287 minims] of Water, and when the mixture has become cold, pour it into a bottle having the capacity of about two liters. Add *eight grammes* [or 123 grains] of Potassium Permanganate and agitate until it is dissolved, then add the Petroleum Benzin, in four portions, shaking the liquid after each addition. Allow the liquids to remain in contact for twenty-four hours, shaking the bottle at frequent intervals; then decant the Petroleum Benzin into another bottle of the same capacity, and having dissolved *two grammes* [or 31 grains] of Potassium Permanganate in *two hundred and forty cubic centimeters* [or 8 fluidounces, 55 minims] of Water, in which the Sodium Hydroxide has previously been dissolved, mix the liquids and agitate the mixture frequently during several hours, then decant, repeat the washing with Water, and again decant the Purified Petroleum Benzin." *U. S.*

Purified petroleum benzin was introduced into the U. S. Pharmacopœia (8th Rev.), and is used mainly as a solvent. The official method of purification is based upon the process suggested by Geo. M. Beringer (*A. J. P.,* 1890, 6), and is intended to remove sulphur compounds and other impurities. The official tests are as follows: "On evaporating 10 Cc. of Purified Petroleum Benzin from a piece of clean filtering paper, no greasy stain should remain, and the odor should not be disagreeable or notably sul-

phuretted; no residue should be left upon evaporating Purified Petroleum Benzin from a warmed dish (absence of *heavy hydrocarbons*). When it is boiled for a few minutes with one-fourth its volume of spirit of ammonia and a few drops of silver nitrate T.S., the liquid should not turn brown (absence of *pyrogenous products* and *sulphur compounds*). Purified Petroleum Benzin should have an ethereal or faint petroleum-like odor, and should respond to the tests given under *Benzinum.*" *U. S.*

Uses.—Benzin is not used in practical medicine but has produced in a number of cases sub-acute or chronic poisoning. In the latter class the symptoms have been headache, giddiness, numbness and paræsthesia of the extremities, vomiting, loss of memory, general weakness, especially in the legs, tenderness and pain along the nerve trunks, and progressive anæmia. In acute cases it causes a peculiar intoxication having the appearance at the onset of an attack of hysteria with laughing, tremors, mydriasis, nystagmus, loss of power in the legs and bladder, failing heart action, delirium, coma and death. In nine fatal cases of chronic poisoning by petroleum benzin, Santesson found a wide-spread fatty degeneration affecting especially the liver, kidneys and cardiac muscles.

Off. Prep.—Opium Deodoratum, *U. S.;* Tinctura Lactucarii, *U. S.;* Tinctura Opii Deodorati, *U. S.*

BENZOINUM. U. S., Br.

BENZOIN

(bĕn-zo-ī'nŭm)

"A balsamic resin obtained from *Styrax Benzoin* Dryander, and another unidentified species of *Styrax* (Fam. *Styraceæ*)." *U. S.* "A balsamic resin obtained from Styrax Benzoin, *Dryand.;* and probably from other species of Styrax, *Linn.* Known in commerce as Siam and Sumatra benzoin." *Br.*

Resina Benzoe, Asa Dulcis; Gum Benjamin; Benjoin, *Fr.;* Benzoë, *P. G.;* Benzoëharz, *G.;* Benzoino, *It.;* Benjui, *Sp.*

The botanical source of benzoin was long uncertain. At one time it was generally supposed in Europe to be derived from the *Laurus benzoin* of this country. This error was corrected by Linnæus, who, however, committed another in ascribing the drug to *Croton Benzoë,* a shrub which he afterwards described under the name of *Terminalia Benzoin.* Dryander was the first who ascertained the true benzoin tree to be a *Styrax.* (*Lond. Phil. Tran.,* lxxvii.)

Styrax Benzoin, Willd., *Sp. Plant.* ii. 623; *B. & T.* 169.—This is a tall tree of quick growth, sending off many strong round branches, covered with a whitish downy bark. Its leaves are alternate, entire, oblong, pointed, smooth above, and downy beneath. The flowers are in compound, axillary clusters, nearly as long as the leaves, and usually hang, all on the same side, upon short slender pedicels.

S. Benzoin, Dryand., or *Benjamin-tree,* is a native of Sumatra, Java, Borneo, and other islands in the vicinity. By wounding the bark near the origin of the lower branches, a juice exudes, which hardens upon exposure and forms the *Sumatra benzoin* of commerce. According to the researches of A. Tschirch (*Journ. Roy. Microscop. Soc.,* 1890), the exudation is purely the result of pathological processes, the plant containing no resin receptacles. The trees, which are either wild or cultivated, are deemed of a proper age to be wounded at six years, when the trunks are usually about seven or eight inches in diameter. The operation is performed annually, and the product on each occasion from one tree never exceeds three pounds. The juice which first flows is the purest, and affords the whitest and most fragrant benzoin.

The tree which yields the Siam benzoin is a native of the mainland, and resembles, though specifically distinct from, *Styrax Benzoin.* It is stated to grow in an extremely circumscribed locality, on the bank of the river Mekong, occurring on high ground in clusters of from fifty to sixty trees. According to E. M. Holmes, its leaves are thinner and less distinctly venated than are those of the true *Styrax Benzoin.* In July and August the Siam trees are notched, and from these notches three months later the hardened benzoin is picked out. (See *Kew Bulletin,* 1895.)

Siam benzoin is usually imported in cubical blocks, which take their form from the wooden boxes in which the soft resin has been packed. It is brittle, with a peculiar, vanilla-like fragrance, but bitter taste. It may be a compact mass, containing more or less numerous opaque white tears embedded in a rich amber-colored translucent resin, mixed to a greater or less extent with bits of bark, wood, etc. In some specimens these tears are exceedingly small, in others almost wanting. The finest variety is composed almost entirely of these tears, loosely agglutinated together. *Sumatra benzoin* is sent into commerce chiefly from Acheen in Sumatra. It differs from the Siam varieties in having a much grayer color; the resin is grayish brown, the tears are usually fewer than in the finer variety, and the bits of wood, etc., more abundant. The odor differs from, and is less agreeable than, that of Siam benzoin. *Palembang benzoin* resembles Sumatra benzoin, but is somewhat more transparent, and is stated to yield a larger percentage of benzoic acid. It is also asserted that it can be distinguished by its tincture, when dropped into water, not producing milkiness, but a flocculent deposit. *Penang benzoin* also resembles Sumatra benzoin, but has an odor which is more like that of storax, and it is probably not yielded by the *Styrax Benzoin;* possibly it is the product of one of the Sumatran species, *S. subdenticulata* and *S. Porterianum.* For an account of the cultivation and collection of benzoin in Sumatra, by L. M. Vonck, see *C. D.,* 1891, 486–488; also *D. C.,* 1891, 258. Lüdy made an investigation of the

bark and wood of a benzoin tree which was brought from Java by Tschirch. He reached the conclusion that benzoin balsam was produced from the tannin of the bark. (*A. Pharm.*, 1893, 43, 95.)

Properties.—Benzoin has a fragrant odor, with very little taste, but when chewed for some time leaves a sense of irritation in the mouth and fauces. It breaks with a resinous fracture, and presents a mottled surface of white and brown or reddish brown; the white spots being smooth and shining, while the remainder, though sometimes shining and even translucent, is usually more or less rough and porous, and often exhibits impurities. In the inferior kinds the white spots are very few, or entirely wanting. Benzoin is easily pulverized, and, in the process of being powdered, is apt to excite sneezing. Its sp. gr. is from 1.063 to 1.092. "In pebble-like bodies or tears, mostly 0.5 to 5 Cm. long and about one-fourth as thick, slightly flattened, straight or curved, yellowish- to rusty-brown externally, milky-white on fresh fracture, separate or very slightly agglutinated (Siam Benzoin), or embedded in a dry resinous mass, which varies from reddish-brown to reddish-gray or grayish-brown; opaque or slightly translucent and more or less lustrous (Sumatra Benzoin); brittle, becoming soft on warming, and yielding benzoic acid on sublimation; odor agreeable, balsamic (vanilla-like in the Siam variety); taste slightly acrid. Benzoin is almost wholly soluble in 5 parts of warm alcohol, the solution showing an acid reaction to blue litmus paper; soluble in solutions of sodium or potassium hydroxide. It should not, on incineration, yield more than 2 percent. of ash." *U. S.* "It is almost entirely soluble in *alcohol* (90 per cent.) and in *solution of potassium hydroxide.*" *Br.* When heated it melts, and emits thick, white, pungent fumes, which excite coughing when inhaled, and consist chiefly of benzoic acid. It is wholly soluble, with the exception of impurities, in alcohol, and is precipitated by water from the solution, rendering the liquid milky. It yields to boiling water a notable proportion of benzoic acid. Lime water and the alkaline solutions partially dissolve it, forming benzoates, from which the acid may be precipitated by the addition of other acids. Its chief constituents are resin and benzoic acid, and it therefore belongs to the balsams. The white tears and the brownish connecting medium are said by Stolze to contain nearly the same proportion of acid, which, according to Bucholz, is 12.5 per cent., to Stolze, 19.8 per cent. In a more recent examination by Kopp, the white tears were found to contain from 8 to 10 per cent. of acid, and the brown 15 per cent. (*J. P. C.*, 3e sér., iv. 46.) The resin is of three kinds, one extracted with the benzoic acid by a boiling solution of potassium carbonate in excess, another dissolved by ether from the residue, and the third affected by neither of these solvents. Besides benzoic acid and resin, the balsam contains a little extractive and traces of volatile oil. Benzoin retards the oxidation of fatty matters, and thus tends to prevent rancidity.

The percentage of soluble matter required to be present by the U. S. Pharm. in benzoin is very high, and if rigidly enforced by the customs would exclude Sumatra benzoin in all but its very finest varieties. Robt. C. Pursel and Willard Graham obtained from 5 commercial varieties of Sumatra benzoin, in the American market, an average of 86 per cent. of soluble matter. (*Proc. Pennsylvania Pharm. Assoc.*, 1902.) John Barclay in England found the average of ten samples to be 69.9 per cent. (*P. J.*, Jan. 1903).

It appears from various researches that benzoin, besides its own characteristic acid, often contains also cinnamic acid, which is found more especially in the white tears. Indeed, Hermann Aschoff obtained from some benzoin of Sumatra a pure cinnamic acid, without any benzoic; and Kolbe and Lautermann, upon examining a specimen of the tears, discovered what they at first supposed to be a peculiar acid, but which on further investigation proved to be a mixture of cinnamic and benzoic acids. H. Beckurts and W. Brueche confirm the statement that Siam benzoin contains no cinnamic acid, which is usually present in Sumatra benzoin. They found the specific gravity from 1.120 to 1.171; ash from 0.05 to 2.38 per cent.; portion insoluble in alcohol from 2.1 to 9 per cent. On the other hand, Tschirch and Lüdy (*A. Pharm.*, 1893, 500) extracted benzoic acid from Siam benzoin by the wet process. They found Sumatra benzoin to contain esters which yielded by saponification 32.9 per cent. of cinnamic acid, the proportion of esters being *benzoresinol cinnamate*, 7.4 per cent., and *resinotannol cinnamate*, 92.6 per cent., at least 75 per cent. of Sumatra benzoin consisting of cinnamates yielding from 20 to 24 per cent. of cinnamic acid. (See also *A. Pharm.*, 1893, 461; *A. J. P.*, 1893, 223; and *J. P. C.*, 1894, 172). In a later research they found that Siam benzoin did not contain cinnamic acid, either free or in combination as ester. Besides some free benzoic acid and vanillin it contains only esters of benzoic acid. These, on saponification, yielded 38.2 per cent. of *benzoic acid*, 56.7 per cent. of *isoresinotannol*, and 5.1 per cent. of *benzoresinol* (Tschirch, *Harze und Harzbehälter*, 1900, p. 155). Benzoin may be rapidly tested for cinnamic acid by heating a small quantity with a little soda and water and warming the filtrate with potassium permanganate, when the odor of bitter almond will be developed. (*A. Pharm.*, 1892, ccxxx.)

Aschoff recommends the following method of detecting cinnamic acid. Boil the benzoin with milk of lime, filter, decompose with hydrochloric acid, and add either potassium dichromate with sulphuric acid, or potassium permanganate, when, if cinnamic acid be present, the odor of oil of bitter almond will be perceived.

Rump (1878) treated Siam benzoin with caustic lime, precipitated the benzoic acid with hydrochloric acid, and agitated the liquid with ether. The latter on evaporating afforded a mixture of benzoic acid and *vanillin*, $C_8H_8O_3$. Subjected to dry distillation, benzoin affords as the chief product benzoic acid, together with empyreumatic products, among which Berthelot has proved the presence (in Siam benzoin) of *styrol*, C_8H_8. The latter was also obtained in 1874 by Theegarten from Sumatra benzoin by distilling it with water. (*Ber. d. Chem. Ges.*, 1874, p. 727.)

Uses.—Benzoin is stimulant and expectorant, and was formerly employed in pectoral affections; but, except as an ingredient of the compound tincture of benzoin, it has fallen into disuse. Trousseau and Pidoux recommend strongly its inhalation in *chronic laryngitis*. Either the air of the chamber may be impregnated with its vapor by placing a small portion upon some live coals, or the patient may inhale the vapor of boiling water to which the balsam has been added. It is occasionally employed in pharmacy for the preparation of benzoic acid (see *Acidum Benzoicum*); the milky liquor resulting from the addition of water to its alcoholic solution is sometimes used as a cosmetic, under the impression that it renders the skin soft. A tincture has been strongly recommended in *anal fissure*. In the East Indies, the balsam is burnt by the Hindus as a perfume in their temples of worship.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Adeps Benzoinatus, *U. S.* (*Br.*); Tinctura Benzoini, *U. S.*; Tinctura Benzoini Composita, *U. S.*, *Br.*; Unguentum Cetacei, *Br.*

BENZOL. Br.

BENZOL

(bĕn′zŏl)

$C_6H_6 = 77.46$

"A mixture of homologous hydrocarbons obtained from light coal-tar oil. It contains about 70 per cent. of benzene, C_6H_6, and 20 to 30 per cent. of toluene, C_6H_5,CH_3." *Br.*

Benzene, Benzole, Phenyl Hydride, Benzen; Benzene, *Fr.*; Phenylwasserstoff, Steinkohlenbenzin, *G.*; Benzolo, *It.*

Benzol (Benzene, U. S. P. reagent) must not be confounded with the commercial article *benzin*, which is a mixture of various hydrocarbons of light specific gravity, obtained in the distillation of petroleum. (See *Benzinum*.) Originally the two names benzol and benzin were applied to the same substance, but after the discovery of petroleum it was found that the liquid obtained by distillation from coal tar was quite different from that obtained from petroleum. In the United States it has become the custom to call the liquid obtained by the fractional distillation of petroleum having the specific gravity 0.638 to 0.660, *benzin*. It is unfortunate that in Europe, and on the Continent especially, the term benzin is used for both liquids. The two substances are essentially different, although resembling each other somewhat in their solvent powers. Benzol is a definite hydrocarbon of fixed constitution, petroleum benzin a complex body of varying constitution. Benzol can be frozen; petroleum benzin has never yet been congealed. Petroleum benzin boils at from 45° to 60° C. (113° to 140° F.), while benzol boils at 79° to 80° C. Benzol can be converted into nitrobenzol, and by further treatment into aniline colors; petroleum benzin cannot. When petroleum benzin is shaken in the cold with one-third of its volume of fused crystals of absolute phenol, the latter remains undissolved, while benzol is miscible with absolute phenol in all proportions. (Allen.) According to Pusch, benzol can be distinguished from petroleum benzin by the fact that benzol forms a violet-red and petroleum benzin a raspberry-colored solution with iodine. (*A. J. P.*, xlvii. 268.) Although the term *Benzene* is given above as one of the synonyms of *Benzol*, its use abroad is gradually becoming limited to the pure hydrocarbon, C_6H_6, while *Benzol* is applied to the mixture of benzene with its homologues *toluene, paraxylene, metaxylene, mesitylene, pseudo-cumene*, etc., as in the Br. Pharm.

Benzol was discovered by Faraday in the condensed liquid from oil gas, and was next obtained by Mitscherlich by distilling benzoic acid with lime. It was afterwards discovered by Hofmann as a constituent of coal gas tar. This tar, when distilled, furnishes *coal naphtha* or light oil of tar, a complex substance, containing a number of hydrocarbons, among which is benzol. Upon distilling this naphtha from a metallic still, surmounted by an open vessel filled with water, and containing a worm terminating in a refrigerated receiver, the benzol will pass over and condense in the receiver; while the other substances associated with it, having higher boiling points, will condense in the worm and fall back into the still. The benzol is then purified by distillation at a heat between 80° C. and 90° C. (176° F. and 194° F.), and by subjecting the product to a new distillation from one-fourth of its volume of sulphuric acid. E. Kopp purifies benzol by taking advantage of its high congealing point. He exposes the impure mixture containing it to a degree of cold sufficient to solidify it (—15° C. or 5° F.), presses the congealed mass to separate the liquid hydrocarbons, allows it to become fluid, then again freezes and presses it, and thus obtains it almost entirely pure, when it is known as "crystallizable benzene." He obtains the impure mixture containing the benzol by decomposing the heavier tar oils by a high degree of heat. (*Chem. News*, May 14, 1864, p. 229.)

Calvert of Manchester, purifies coal naphtha, so as to render it a sufficiently pure benzol to be usefully applied to the purpose of removing fatty and oily matters from animal and vegetable substances, by subjecting it to the action

of sulphuric acid, added in small quantities, so long as coloration is produced, then washing it with pure water, and afterwards subjecting it to distillation in an ordinary still. The sulphuric acid combines with the less volatile hydrocarbons present, which interfere with the solvent power of the benzol.

Prolonged treatment with sulphuric acid is also necessary to free the benzol from *thiophene*, C_4H_4S, an impurity which to the extent of about 0.6 per cent. is always present in commercial benzol. Its complete removal from the benzol is to be tested for by the *indophenin reaction* (blue coloration in presence of concentrated sulphuric acid and a small quantity of isatine). (See *Benzene*, PART III.)

In consequence of the great volatility and extreme inflammability of benzol and its attendant hydrocarbons, much care is necessary both in their preparation and in their subsequent use in order to avoid any possible exposure to flame. Very serious accidents have taken place from want of the proper caution in this respect.

Properties.—Benzol or benzene is a colorless limpid liquid, possessing an agreeable odor. Its sp. gr. is 0.85, congealing point 0° C. (32° F.), and boiling point 80° C. (176° F.). The British Pharmacopœia describes it as "a colorless volatile liquid free from opalescence, with a strong characteristic odor. Specific gravity from 0.880 to 0.888. It should begin to distil at 176° F. (80° C.), and about 90 per cent. of the whole should pass over at a temperature below 212° F. (100° C.). It should wholly distil below 248° F. (120° C.)." *Br.* Its powers as a solvent are very extensive. Among the substances soluble in it are sulphur, phosphorus, and iodine, and most resins and fats. It dissolves quinine, but not cinchonine, with which it forms a bulky gelatinous mass. Morphine and strychnine are sparingly soluble. Its solvent power over some of the organic alkaloids led John Williams of London, to employ it in extracting them. Dragendorff has corroborated and extended this use of benzol for obtaining the alkaloids, whose salts are, however, not usually soluble in the menstruum. Benzol is also a solvent of many of the resins, of mastic, camphor, wax, fatty and oily substances, essential oils, caoutchouc, and gutta-percha. It often becomes a matter of great importance commercially to test the purity of commercial benzol, and a very thorough method of assay based on fractional distillation is proposed by A. H. Allen, in his *Commercial Organic Analysis*, 1882. The following method, originating with Schorlemmer, is based on the conversion of this hydrocarbon into aniline, and of that into one of the characteristic colors derived from it. That part of the mixture which volatilizes at 150° C. (302° F.) is operated on. This is treated with fuming nitric acid, which, if benzol be present, gives rise to a nitrobenzol with its bitter-almond odor. The nitrobenzol is then converted by the action of granulated tin and hydrochloric acid into aniline, which is isolated by distilling the product with potassium hydroxide. The aniline floats on the top of the liquid that passes. A little of this gives with sodium hypochlorite a fine purple color; and a drop of it, if heated with a little corrosive sublimate, will yield the beautiful color of rosaniline. (*J. P. C.*, 4e sér., ii. 177.) According to Balls, magnesium ribbon, with the addition of a few drops of solution of platinic chloride, rapidly and completely reduces nitrobenzene in alcoholic solution to aniline, giving a solution which can be at once decanted and tested with bleaching powder. (Allen.)

Uses.—It has been asserted by Naunyn, Wiederhold, and Possoz that benzol is an active germicide; but A. Chassevant found that it has no power of destroying the vitality of spores. (*Archiv. d. Pharmacodyn.*, vol. ii., 1896.) In Chassevant's experiments it rapidly produced complete coma in the lower animals, with muscular relaxation and greatly lowered temperature (10° C. without death). In the early stages of the poisoning, convulsions and very rapid breathing were noticed. From one to two fluidounces of it are stated to have caused in man exhilaration and vertigo, followed by sleep and delirium (*J. P. C.* 1861), but it is of little value in practical medicine. In the attempt to use it as an anæsthetic, Simpson of Edinburgh, found that it caused violent constrictive headache and was scarcely capable of producing insensibility. According to Chassevant, it depresses arterial pressure by dilating the vessels, and acts most unfavorably on persons suffering from arterio-sclerosis or heart disease. According to Reynal, a mixture of ten parts of benzol, five of soap, and eighty-five of water is very destructive to parasites, and does not affect the skin or the general system. Guyot states (*B. M. J.*, 1897) that the habitual exposure to the fumes of benzol during its manufacture produces a chronic poisoning, characterized by uncertainty of gait, mental disturbance, wandering delirium, loss of sexual power, and epileptiform convulsions. According to Chassevant, *toluene* acts like *benzene*, but *xylene* is much more toxic, rapidly producing coma.

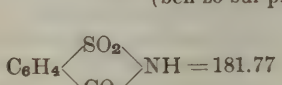
Dose, from ten minims to half a fluidrachm (0.6 to 1.8 Cc.).

Off. Prep.—Charta Sinapis, *Br.*; Liquor Caoutchouc, *Br.*

BENZOSULPHINIDUM. U. S. (Br.)

BENZOSULPHINIDE SACCHARIN

(bĕn-zō-sŭl-phĭ-nī'dŭm)



"The anhydride of ortho-sulphamide-benzoic acid (benzoyl sulphonicimide)." *U. S.* "Gluside, or benzoyl sulphonimide, is a sweet imide

derivable from toluene. Its constitution is represented by the formula $C_6H_4<\begin{matrix}CO\\SO\end{matrix}>NH$." *Br.*

Glusidum, *Br.;* Gluside, Saccharin, Neo-Saccharin; Glucusimide; Benzoyl-Sulphonicimide, $C_6H_4COSO_2NH$; Anhydro-orthosulphamidebenzoic Acid; Glukusin; Acide Anhydro-orthosulfamide-benzoique, *Fr. Cod.;* Sulfinide-benzoique, Sucre de Houille, *Fr.;* Benzoësauresulfimid, Sycose, Sacharol, Toluolsüss, Zuckerin, *G.;* Sacarina, *Sp.*

Preparation.—This artificial sweetening substance, which is known commonly as "saccharin," is made from toluene by first forming the ortho-sulphonic acid $C_6H_4\begin{cases}SO_3H\\CH_3\end{cases}$; from this the sulphamide $C_6H_4\begin{cases}SO_2NH_2\\CH_3\end{cases}$; from this, by oxidation, the sulphamide-benzoic acid $C_6H_4\begin{cases}SO_2NH_2\\COOH\end{cases}$, of which the anhydride is the official compound. When dissolved in alkaline hydroxide solutions the salt of the sulphamide-benzoic acid is formed as $C_6H_4\begin{cases}SO_2NH_2\\COONa\end{cases}$. (The reader is referred to *Soluble Saccharin,* PART II.)

Properties.—A white powder, melting at 200° C. with partial decomposition, evolving the odor of bitter almonds. It is soluble in water, from which it can be crystallized; also in alcohol, ether, glycerin, and glucose. Its taste in diluted solutions is intensely sweet, so that 1 part of saccharin will sweeten quite strongly 10,000 parts of water. Saccharin may be detected in sugar solutions by extracting with ether, evaporating, and fusing the residue, which, if saccharin, will melt at about 220° C., and fused with potassium nitrate and sodium carbonate will show sulphuric acid. The weight of $BaSO_4$ obtained in this way from 100 Gm. of sugar multiplied by 0.785 will give the weight of saccharin extracted.

The aqueous solution of saccharin has a distinctly acid reaction and forms salts. Its most remarkable property is its sweet taste, which is said to be three hundred times more intense than that of sugar. The commercial product, according to Pope, frequently contains para-sulphamide-benzoic acid, from which impurity it can be freed by recrystallization, acetone being used as the solvent. Hefelman has furnished a process for assaying saccharin. (See *Proc. A. Ph. A.,* 1895, 701.) The difference in melting points of pure saccharin and para-sulphamide-benzoic acid is also used for distinguishing them; the former melts at 220° C. and the latter at 286.5° C. (*Ph. Cb.,* 1896, 279.)

Saccharin is officially described as "a white crystalline powder, nearly odorless, having an intensely sweet taste even in dilute solutions. Soluble in 250 parts of water, and in 25 parts of alcohol, and but slightly soluble in ether or chloroform at 25° C. (77° F.); soluble in 24 parts of water at 100° C. (212° F.). It is easily soluble in ammonia water, in alkali hydroxide solutions, and in a solution of sodium bicarbonate, with the evolution of carbon dioxide. Heated between 219° and 220° C. (426.2° and 428° F.) it melts, and at higher temperatures burns with an odor of oil of bitter almond, without leaving a weighable residue (absence of *inorganic impurities*). If 0.2 Gm. of Benzosulphinide be dissolved with agitation in 10 Cc. of pure sulphuric acid, and the solution kept at a temperature of from 48° to 50° C. (118.4° to 122° F.), on a water-bath, it should not, within ten minutes, show a brown color (absence of *carbohydrates*). If 0.2 Gm. of Benzosulphinide be dissolved in 5 Cc. of potassium hydroxide T.S., the solution should be clear, and not become colored, even on prolonged heating (absence of *glucose*). A similar solution mixed with 5 Cc. of alkaline cupric tartrate V.S. should not, on heating, deposit any red cuprous oxide (absence of *glucose* or *milk-sugar*). If to a hot aqueous solution of Benzosulphinide, ferric chloride T.S. be added, drop by drop, no precipitation or violet color should appear (absence of *benzoic* or *salicylic acids*)." *U. S.*

The British Pharmacopœia furnishes the following characters and tests: "A light, white, minutely crystalline powder, having an intensely sweet taste in dilute solutions. When heated it fuses, and then sublimes with partial decomposition. It is soluble in 400 parts of cold *water,* in 24 parts of boiling *water,* in 25 parts of *alcohol* (90 per cent.), and but slightly in *ether* or *chloroform.* It is very soluble in diluted *solution of ammonia;* also in solution of *sodium bicarbonate,* with evolution of carbonic anhydride. A warm solution of *sodium bicarbonate,* when neutralized with Gluside and evaporated to dryness, yields 'soluble gluside' or 'soluble saccharin,' which is very soluble in *water,* 100 parts of Gluside yielding nearly 113 parts of neutral 'soluble gluside.' Neither Gluside nor soluble gluside is blackened by *sulphuric acid,* even when the mixture is gently warmed for a short time (absence of sugar, etc.). On evaporating either variety with excess of *solution of potassium hydroxide,* maintaining the residue in a state of semi-fusion for a few minutes, cooling, dissolving in *water,* faintly acidulating with *hydrochloric acid,* and adding a few drops of *test-solution of ferric chloride,* a reddish-brown or purplish color is produced. A solution of 0.5 gramme of Gluside in 80 cubic centimetres of warm *water,* set aside for 12 hours, deposits tabular crystals which melt between 426° F. and 428° F. (218.8° C. and 220° C.); and it should not, even when briskly shaken, deposit crystals melting at a higher temperature (absence of sulphamidobenzoic acid)." *Br.*

Uses.—Taken internally, saccharin is rapidly absorbed and eliminated unchanged through the kidneys. It is almost free from general physiological activities, Mosso and Aducco having given 75 grains to a man without sensible effect. It is a very feeble antiseptic but appears to

have no action upon gastric digestion. On account of its lack of active properties and its sweet taste it affords a valuable substitute for sugar in *diabetes, obesity,* and other diseases in which that food is contra-indicated. Saccharin may either be administered in the form of solution in glycerin, or its salt may be employed.

Dose, three to five grains (0.2 to 0.32 Gm.).

BERBERIS. U. S.

BERBERIS [Berberis Aquifolium, Oregon Grape Root]

(bĕr'bę-rĭs)

"The rhizome and roots of *Berberis Aquifolium* Pursh, and other species of Berberis (Fam. *Berberidaceæ*)." *U. S.*

Rocky Mountain Grape; California Barberry, Holly-leaf Barberry.

The *Oregon grape* is a tall shrub, about 6 to 7 feet high, with evergreen, coriaceous, bright and shining leaves, and having numerous small, yellowish-green flowers in the early Spring, and later clusters of purple berries containing an acid pulp. It is a native of the mountain-states on both the east and west sides of the Rockies. (See *Berberis,* PART II.) For a description of the bark of *B. artistata,* D. C. (*Nepaul barberry*), by Hartwick, see *Ph. Rev.,* 1896, 232.

The root of berberis occurs in pieces about a foot long, one-fourth of an inch thick, of a brownish exterior, but yellowish within, yielding a bright lemon-colored bitter powder. It is officially described as "in more or less knotty, irregular pieces of varying length and from 3 to 20 Mm. in diameter; bark from ½ to 2 Mm. thick; wood yellowish, distinctly radiate with narrow medullary rays, hard and tough; rhizome with a small pith; odor distinct; taste strongly bitter. Pieces without the bark should be rejected." *U. S.*

Berberis contains the alkaloids *berberine,* $C_{20}H_{17}NO_4$; *oxyacanthine,* $C_{18}H_{19}NO_3$; and *berbamine,* $C_{18}H_{19}NO_3$, together with phytosterin, gum, fat, resin and wax. Berberine and oxyacanthine were isolated by H. B. Parsons (*N. R.,* 1882, 83), the percentage of the former is said to be 2.35 and of the latter 2.82. Jungk and Stubbe investigated the alkaloids from berberis, and found that the three alkaloids in *B. Aquifolium* are identical with those found in *B. vulgaris.* Rüdel examined and described these alkaloids (*J. C. S.,* 1892, 641). Gordin and Merrell (*Proc. A. Ph. A.,* 1901, 228), objected to the method of Gaze (*Chem. Ch.,* 1890, 590) for making berberine from acetone-berberine (see *Hydrastis*).

Uses.—Both the berries and the roots of the *Berberis Aquifolium* have been strongly recommended by various clinicians as alterative, laxative, tonic, and diuretic; very useful in chronic *syphilitic* and *scrofulous cachexias,* in *chronic skin diseases,* especially of the scaly type, in the convalescence from *malarial* and other *fevers,* and in *chronic uterine disease.* By some they are believed to have a distinct action upon the liver, and to be valuable in *chronic hepatitis.*

Dose, twenty to thirty grains (1.3 to 2 Gm.), of the fluidextract, ten to thirty minims (0.6 to 1.8 Cc.).

Off. Prep.—Fluidextractum Berberidis, *U. S.*

BETANAPHTHOL. U. S. (Br.)

BETANAPHTHOL [Naphtol, Pharm. 1890, Naphthol]

(bē-tą-năph'thŏl)

$C_{10}H_7OH = 142.98$

"A monatomic phenol occurring in coal-tar, but usually prepared from naphthalene. Betanaphthol should be kept in dark amber-colored, well-stoppered bottles." *U. S.* "Beta-naphthol, or beta-mono-hydroxy-naphthalene, $C_{10}H_7OH$, is usually prepared from naphthalene-sulphonic acid." *Br.*

Naphthol, *Br.; β*-Naphthol, Beta-mono-hydroxy-naphthalene, Iso-naphthol; Naphtol *β, Fr. Cod.;* Naphtholum, *P. G.;* Beta-Naphtholum, *G.;* Naftol *β, It.*

Preparation.—On digesting four parts of naphthalene with three parts of sulphuric acid at 80° C. there is formed *α-* and *β-naphthalene sulphonic acids,* $C_{10}H_7SO_3H$, which may be separated by means of the barium or lead salts. When heated with sulphuric acid, the *α* acid passes into the *β* variety; therefore the latter acid is exclusively produced at higher temperatures (160° C.). Both of the naphthalene sulphonic acids, when fused with alkaline hydroxides, yield the corresponding naphthols, which are designated as *α-* and *β-naphthol,* respectively. The second of these, beta naphthol, is the official naphthol, $C_{10}H_7OH$. It bears to naphthalene the same relation that phenol does to benzene. It is officially described as in "colorless or pale buff-colored, shining crystalline laminæ or a white or yellowish-white crystalline powder, having a faint phenol-like odor and a sharp and pungent but not persistent taste. Permanent in the air. Soluble in about 950 parts of water, and in 0.61 part of alcohol at 25° C. (77° F.); in about 75 parts of boiling water, and very soluble in boiling alcohol; easily soluble in ether, chloroform, or solutions of alkali hydroxides. Betanaphthol melts at 122° C. (251.6° F.) and boils at 286° C. (546.8° F.). It sublimes readily when heated; when in alcoholic or aqueous solution, it is volatilized with the vapor of alcohol or water. On ignition it leaves no residue. It is neutral to litmus paper which has been moistened with alcohol. A cold saturated aqueous solution of Betanaphthol when mixed with ammonia water exhibits a faint bluish fluorescence. On adding about 0.1 Gm. of Betanaphthol to about 5 Cc. of an aqueous solution of potassium hydroxide (1 in 4), then about 1 Cc. of chloroform, and gently warming the mixture, the aqueous layer will acquire a blue tint, changing afterwards to green and brown. Ferric chloride T.S. colors an aqueous solution greenish, and after some

time causes the separation of white flakes, which turn brown upon the application of heat. Betanaphthol should dissolve in 50 parts of ammonia water without leaving a residue (absence of *naphthalene*), and the solution should not have a deeper color than pale yellow (absence of *other organic impurities*). An aqueous solution of Betanaphthol on the addition of chlorinated lime should show a pale yellow color and not a dark violet (distinction from, and absence of, *alphanaphthol*). An aqueous solution of Betanaphthol on the addition of a few drops of iodine T.S., followed by sodium hydroxide T.S. in excess, should show no color (distinction from, and absence of, *alphanaphthol,* which produces an intensely violet color.)" *U. S.*

The British Pharmacopœia describes it as "in white or nearly white crystalline laminæ, or in powder. It has a sharp, pungent taste, and an odor resembling phenol. Soluble in about 1000 parts of cold *water,* in 75 parts of boiling *water,* in less than 2 parts of cold *alcohol* (90 per cent.), and very soluble in boiling *alcohol* (90 per cent.), *ether, chloroform* or *solution of sodium hydroxide.* Melting point 251.6° F. (122° C.). On the addition of 1 drop of *solution of ammonia* to a hot saturated aqueous solution of Beta-naphthol a blue fluorescence is developed. A cold saturated aqueous solution gives a white turbidity with *solution of chlorine,* which, on the addition of excess of *solution of ammonia,* gives place to a green or brown coloration. 0.1 gramme of Beta-naphthol dissolved in 10 cubic centimetres of boiling *water,* and treated with 10 drops of a 3 per cent. aqueous solution of *ferric chloride,* gives a white precipitate becoming brown, but not violet (absence of alpha-naphthol). Beta-naphthol should be neutral to *litmus paper* moistened with *alcohol* (90 per cent.), and should leave no residue on heating to redness (absence of mineral impurities)." *Br.* For Yvon's tests to distinguish between alpha and betanaphthol, see *Proc. A. Ph. A.,* 1892, 955; see also *Chem. News,* 1892, 18. For Liebman's test for the presence of alphanaphthol, see *M. R.,* 1897, 281.[1]

Uses.—It was claimed by Bouchard and Maximovitch for betanaphthol, that it is an active germicide, practically non-toxic to the human being. More recent researches seem, however, to show that while it is extraordinarily free from poisonous effects upon the higher animals, its influence on pathogenetic germs is also feeble. In internal medicine it has been used—in *dilatation of the stomach* and in *intestinal diseases* of all kinds—for the purpose of checking fermentative changes in the alimentary canal, and has maintained itself as one of the best of this unsatisfactory class of remedies. In *typhoid fever* it is alleged to be especially serviceable. Externally, it has been used dissolved in oil or alcohol by Kaposi and later dermatologists in the treatment of *eczema, ichthyosis, favus,* and other skin diseases. Its solution has also been employed largely by surgeons for the washing out of pathological cavities. The employment of it intravenously or by the mouth, for the purpose of destroying germs in the blood in zymotic diseases, has established its non-utility in these affections. Large doses of it are likely to disturb the stomach. The following formulas may be used in making the solutions: 1, *Weak solution,* for parts in which mucous membranes are exposed: β-naphthol, 5 grammes; alcohol at 60° F., 1 liter. 2. *Ordinary solution:* β-naphthol, 15 grammes; alcohol at 60° F., 1 liter. 3. *Strong solution,* for touching diseased portions of the skin, or septic excoriations: β-naphthol, 15 to 500 grammes per liter. 4. *Solution for interstitial injections, or closed septic cavities:* β-naphthol, 5 grammes; alcohol at 90° F., 33 grammes; hot distilled water, to make 100 cubic centimeters; filter, and use warm. A few drops may be injected into indurated glands or abscesses.

Dose, two to five grains (0.13 to 0.32 Gm.) best administered in capsule.

BISMUTHI CITRAS. U. S.

BISMUTH CITRATE

(bĭs-mū'thī cī'trăs)

$BiC_6H_5O_7 = 394.52$

"Bismuth Citrate should yield not less than 58 percent., nor more than 60 percent., of pure bismuth oxide." *U. S.*

Citrate of Bismuth; Bismuthum Citricum; Citrate de Bismuth, *Fr.;* Citronensaures Wismuth, Wismutcitrat, Citronensaures Wismutoxyd, *G.*

[1] *Alphanaphthol.*—According to Maximovitch, alphanaphthol has the same action upon pathogenetic germs and upon the higher animals as has betanaphthol, having the superiority over the other compound, however, of being less poisonous to the higher animals in proportion to its germicidal power. It may be used in the same strength of solution and the same dose as Betanaphthol. Alphanaphthol has been proposed as a test for sugar in urine. Posner and Epenstein have studied the action of the test, and considered it to be free from many of the objections raised against other tests for sugar. The test depends upon the fact that a solution of sugar, in the presence of pure concentrated sulphuric acid and a solution of alphanaphthol, gives a violet-colored reaction, due, according to Udransky, to the separation of furfurol. This reaction occurs not only with sugars, but with all carbohydrates and with certain albuminoids; hence *the urine must be free from albumin.* The test is said to be extremely sensitive, showing *one-hundredth of one per cent.* of sugar. The urine *must always be previously diluted. Winkler's test* for hydrochloric acid in the stomach is performed as follows: 5 Gm. of alphanaphthol are dissolved in 100 Cc. of alcohol, to which is added from 0.5 to 1.0 Gm. of grape sugar. A mixture of the filtered gastric juice is then evaporated with a few drops of the reagent in a porcelain dish on a water bath; if free hydrochloric acid be present, a bluish-violet marginal zone will appear and rapidly become inky black.

Various compounds of naphthol have been proposed in medicine. The substance recommended by Polaillon, under the name of *microcidin,* as being ten times more powerful than phenol and less toxic than betanaphthol, is said to be *sodium naphthol.* (Helbing's *Mod. Mat. Med.,* 79.)

Betol (or *β-naphthyl salicylate*) is specially treated under PART II.

Benzonaphthol; or *β-naphthyl benzoate,* is a compound of benzoyl and β-naphthol, which in the intestinal tract, theoretically at least, is split up into these constituents. It has been given in doses of from ten or fifteen grains up to ninety grains a day. (See *Benzonaphthol,* PART II.)

* "Bismuth Subnitrate, *one hundred grammes* [or 3 ounces av., 231 grains]; Citric Acid, *seventy-five grammes* [or 2 ounces av., 282 grains]; Distilled Water, *a sufficient quantity.* Mix the Bismuth Subnitrate and the Citric Acid with *four hundred cubic centimeters* [or 13½ fluidounces] of Distilled Water, and heat on a bath of boiling water, with frequent stirring, until a drop of the mixture yields a clear solution with ammonia water. Then add *five thousand cubic centimeters* [about 11 pints] of Distilled Water, allow the suspended matter to deposit, wash the precipitate, first by decantation, and afterwards on a strainer, with Distilled Water, until the washings are tasteless, and dry the residue at a gentle heat." *U. S.*

As citric acid ($H_3C_6H_5O_7$) is tribasic, one atom of bismuth, being trivalent, will exactly replace the three hydrogen atoms of the citric acid and form a neutral bismuth citrate. When bismuth subnitrate is boiled with a solution of citric acid it is decomposed, the nitric acid is replaced by the citric acid, and the insoluble bismuth citrate is formed; the completion of the process is known by the mixture yielding a clear solution with ammonia water.

Properties.—It is officially described as "a white, amorphous or micro-crystalline powder, odorless and tasteless, and permanent in the air. Insoluble in water or alcohol, but soluble in ammonia water, and in solutions of alkali citrates. When strongly heated the salt chars, and, on ignition, leaves a more or less blackened residue having a yellow surface, and soluble in warm nitric acid; this solution, when dropped into a large excess of water, occasions a white turbidity. A solution of 1 Gm. of Bismuth Citrate in ammonia water, when treated with hydrogen sulphide in excess, yields a black precipitate. If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it boiled with an excess of lime water, yields a white precipitate. If another portion of the cooled filtrate be mixed with an equal volume of concentrated sulphuric acid, and again cooled, no brown or brownish-black color should appear around a crystal of ferrous sulphate dropped into the liquid (limit of *nitrate*). Three Gm. of Bismuth Citrate, after ignition, should not respond to Bettendorf's Test for *arsenic* (see Part III, Test No. 16). If 3 Gm. of the salt be ignited, the residue dissolved in just a sufficient quantity of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. If the filtrate separated from this precipitate be evaporated on a water-bath to 30 Cc., the liquid again filtered, and the new filtrate divided into portions of 5 Cc. each, these should respond to the tests for purity described under *Bismuthi Subcarbonas* (absence of *lead, copper, silver, chlorides,* and *sulphates*). If 1 Gm. of Bismuth Citrate be thoroughly ignited in a porcelain crucible, and, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warming until complete solution is effected, then evaporating to dryness, and again igniting, a residue of bismuth oxide should be left weighing not less than 0.58 Gm. nor more than 0.6 Gm." *U. S.*

Uses.—This salt is employed solely for pharmaceutical purposes.

Off. Prep.—Bismuthi et Ammonii Citras, *U. S.*

BISMUTHI ET AMMONII CITRAS. U. S.

BISMUTH AND AMMONIUM CITRATE
[Bismuth Ammonio-Citrate]

(bĭz-mŭ'thī ĕt ăm-mō'nī-ī cī'trās)

"Bismuth and Ammonium Citrate should yield not less than 48 percent. of pure bismuth oxide." *U. S.*

Bismuthi Ammonio-citras; Bismuthum Citricum Ammoniatum; Citrate of Bismuth and Ammonium; Citrate de Bismuth et d'Ammoniaque, *Fr.*; Citronensaures Wismutoxyd-Ammonium; Wismutammoncitrat, Citronensaures Wismutammonium, *G.*

* "Bismuth Citrate, *one hundred grammes* [or 3 ounces av., 231 grains]; Ammonia Water, Distilled Water, each, *a sufficient quantity.* Mix the Bismuth Citrate with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Distilled Water and rub it to a smooth paste, heat the mixture on a water-bath, and gradually add Ammonia Water until the salt is dissolved and the liquid is neutral or has only a faintly alkaline reaction. Then filter the solution, evaporate it on a water-bath to a syrupy consistence, and spread it upon plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in amber-colored, well-stoppered bottles, protected from light." *U. S.*

The British Pharmacopœia (1898) does not recognize this salt, which has been used quite extensively during the last twenty years, principally for preparing extemporaneously the London Liquor Bismuthi originally suggested by Schacht. (See *Liquor Bismuthi et Ammoniæ Citratis.*)

Properties.—The U. S. Pharmacopœia (8th Rev.) describes it as in "shining, pearly or translucent scales, odorless, having a metallic taste, and becoming opaque with loss of ammonia on exposure to the air. Very soluble in water, and sparingly soluble in alcohol. When strongly heated the salt fuses, and finally leaves a blackened residue, having a yellow surface, and soluble in warm nitric acid. The acid solution, when dropped into a large excess of water, occasions a white turbidity. The aqueous solution of the salt is neutral or faintly alkaline to litmus paper. When boiled with a slight excess of sodium hydroxide T.S. it evolves ammonia, and its aqueous solution, when treated with hydrogen sulphide, yields a black precipitate. If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it, boiled with an excess of lime water, yields a white precipitate. If another portion of the cooled filtrate be mixed with an equal volume of concentrated sulphuric

acid (free from nitrous compounds) and again cooled, no brown or brownish-black color should appear around a crystal of ferrous sulphate dropped into the liquid (absence of *nitrate*). If 3 Gm. of the salt be ignited and the residue dissolved in just a sufficient quantity of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. If the filtrate separated from this precipitate be evaporated on a water-bath to 30 Cc., the liquid again filtered, and the new filtrate divided into portions of 5 Cc. each, these should respond to the tests for purity described under *Bismuthi Subcarbonas.* Three Gm. of Bismuth and Ammonium Citrate, after ignition, should not respond to Bettendorf's Test for *arsenic* (see PART III, Test No. 16). If 1 Gm. of Bismuth and Ammonium Citrate be thoroughly ignited in a porcelain crucible, and if, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warmed until complete solution is effected, then evaporated to dryness, and again ignited, the residue of bismuth oxide should weigh not less than 0.48 Gm." *U. S.* As frequently seen in commerce it is not entirely soluble in water; this is due to the loss of ammonia through exposure, and a few drops of ammonia water added to the turbid solution are generally sufficient to restore its transparency. The Committee of Revision very properly omitted to give its chemical formula, as it is by no means proved that it has a definite composition. It is believed by some to be a true double citrate, $BiC_6H_5O_7(NH_4)_3C_6H_5O_7$. On the other hand, Bartlett (*Zeit. An. Chem.*, 1865, p. 305) obtained on evaporation of the ammoniacal solution $BiC_6H_5O_7.NH_3 + 3H_2O$, and Rother (*Jahresb.*, 1876, p. 564) obtained on crystallizing from warm ammonia $BiC_6H_5O_7.3NH_3 + 3H_2O$. "Ten grains dissolved in water, and treated with sulphuretted hydrogen in excess, yield a precipitate which, when washed and dried, weighs about six and a half grains." *Br.* (1885).

Uses.—This salt differs from the older preparations of bismuth in its solubility, and probably is for this reason more rapid, more astringent, and more irritant in its action. In cases of *irritation* or *inflammation* of the *gastro-intestinal mucous membrane* it is very much inferior to the insoluble preparations, but when there is relaxation with excessive discharges it may usefully be employed.

Dose, one to three grains (0.065 to 0.20 Gm.).

BISMUTHI OXIDUM. Br.

BISMUTH OXIDE

(bĭs-mū'thī ŏx'ĭ-dŭm)

$Bi_2O_3 = 461.44$

"Bismuth Oxide, Bi_2O_3, may be prepared by boiling bismuth oxynitrate with solution of sodium hydroxide." *Br.*

Bismuth Trioxide; Bismuthum Oxydatum, Oxydum Bismuthicum; Oxyde de Bismuth, *Fr.;* Wismutoxyd, *G.*

Bismuth subnitrate is decomposed by solution of sodium hydroxide in this process, bismuth hydroxide being formed, which is precipitated, while sodium nitrate remains in solution.

$$2BiNO_4.H_2O + 2NaHO = Bi_2 6HO \text{ (or } Bi_2O_3.3H_2O) + 2NaNO_3$$

At the temperature of 100° C. (212° F.) the bismuth hydroxide is decomposed, water is liberated, and the anhydrous oxide is left.

Properties.—Bismuth oxide is a powder of a dull lemon-yellow color, insoluble in water, but soluble without effervescence in nitric acid, mixed with half its volume of water. The British Pharmacopœia 1898 describes it as "a slightly brownish-yellow powder. It should answer to the general characters and tests enumerated under 'Bismuth Oxycarbonate.' Each gramme should yield 1.1 grammes of bismuth sulphide. Heated to incipient redness it is scarcely diminished in weight (absence of bismuth oxycarbonate, bismuth oxynitrate, and moisture)." *Br.*

Uses.—Bismuth oxide resembles bismuth subnitrate in its medicinal properties, and may be administered in similar doses.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

BISMUTHI SUBCARBONAS. U. S. (Br.)

BISMUTH SUBCARBONATE

(bĭs-mū'thī sŭb-cär'bo-năs)

"Bismuth Subcarbonate should yield not less than 90 percent. of pure bismuth oxide." *U. S.*

"Bismuth Oxycarbonate, $(Bi_2O_2CO_3)_2,H_2O$, may be prepared by the interaction of bismuth nitrate and ammonium carbonate." *Br.*

Bismuthi Carbonas, *Br.*, Carbonate of Bismuth, Oxycarbonate of Bismuth, Bismuthyl carbonate; Bismuthum Subcarbonicum, Subcarbonas Bismuthicus; Souscarbonate de Bismuth, *Fr.;* Basisches Kohlensaures Wismutoxyd, Wismutsubcarbonat, *G.*

A process for this salt is no longer official; that of the U. S. P. 1870 is given below.[1]

[1] "Take of Bismuth, in pieces, *two troyounces;* Nitric Acid *eight troyounces and a half;* Water of Ammonia *five fluidounces;* Carbonate of Sodium *ten troyounces;* Distilled Water *a sufficient quantity.* Mix four troyounces and a half of the Nitric Acid with four fluidounces of Distilled Water in a capacious glass vessel, and, having added the Bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with ten fluidounces of Distilled Water, stir it thoroughly, and, after twenty-four hours, filter through paper. To the filtered liquid, previously diluted with an equal measure of Distilled Water, slowly add the Water of Ammonia, constantly stirring. Transfer the whole to a strainer, and after the precipitate has been drained, wash it with two pints of Distilled Water, and drain it again. Then place the precipitate in a proper vessel, add the remainder of the Nitric Acid, and afterwards four fluidounces of Distilled Water, and set the solution aside. At the end of twenty-four hours, filter through paper. Dissolve the Carbonate of Sodium in twelve fluidounces of Distilled Water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and after the precipitate has been drained, wash it with Distilled Water until the washings pass tasteless. Lastly, press, dry it on bibulous paper with a gentle heat, and rub it into powder." *U. S.* 1870.

This preparation was first made official in the 1860 edition of the U. S. Pharmacopœia. As metallic bismuth generally contains arsenic, it is very important to provide that this should be left behind, in the processes for making its medicinal preparations. It is on this account that the formula of the U. S. P. 1870 was so elaborate. The bismuth is first dissolved in nitric acid, a portion of which oxidizes the metal, with the evolution of nitrous vapors, while another portion combines with the oxide produced to form bismuth nitrate. At the same time the arsenic is also oxidized at the expense of the nitric acid, and unites with a portion of the oxidized metal so as to produce bismuth arsenate. Both of these salts, therefore, are contained in the solution, which is very concentrated. Both have the property, when their solution is diluted with water, of separating into two salts, one an insoluble subsalt which is deposited, and the other a soluble acid salt which is held in solution. But the arsenate is more disposed to the change than the nitrate, and requires for the purpose a smaller amount of water of dilution. Hence the first direction, after the metal has been dissolved, is to add a moderate quantity of distilled water, insufficient to cause the decomposition of the nitrate. From this diluted solution the insoluble subarsenate is slowly deposited, so as, in the course of twenty-four hours, to free it almost if not entirely from the poisonous metal. This is separated by filtration, and the solution is now diluted with a much larger quantity of distilled water, which causes a copious deposition of bismuth subnitrate. But, in order not to waste the acid nitrate remaining in solution, this is decomposed by ammonia, which takes most of the nitric acid, and precipitates the bismuth combined with the remainder, in the form of subnitrate. The whole of the precipitated subnitrate, thus freed from arsenic, is redissolved in nitric acid, and the solution of the nitrate now obtained, being diluted with just so much water as to produce a commencing precipitation of subnitrate, is freed by filtering from the small quantity formed, and slowly added to a solution of sodium carbonate. An interchange takes place; sodium nitrate and bismuth carbonate are formed, the former of which remains in solution, and the latter is deposited. This part of the process tends still further to get rid of the arsenic, for if any of the arsenic acid or bismuth arsenate existed in the solution the poisonous acid would combine with the soda, and, thus forming a soluble salt, would be retained by the water. Nothing now remains but to wash, dry, and powder the precipitate.

The British (1885) process (see U. S. D., 17th ed., p. 265) is more simple, because, using bismuth already purified, it is without the preliminary measures taken in the U. S. process to separate the arsenic.

Properties.—Bismuth subcarbonate is "a white or pale yellowish-white powder, of somewhat varying chemical composition, odorless and tasteless, and permanent in the air. Insoluble in water or alcohol, but completely soluble in nitric or hydrochloric acid, with copious effervescence. When heated to redness the salt loses water and carbon dioxide, and should leave not less than 90 percent. of a yellow residue, which is soluble in nitric or hydrochloric acid and blackened by hydrogen sulphide T.S." *U. S.* Its sp. gr. is about 4. It effervesces with acids, and, when exposed to heat, loses 9.5 per cent. of its weight (*U. S.* 1870) in consequence of the escape of carbon dioxide, and is converted into the anhydrous trioxide, of a light yellow color. When mixed with sulphuric acid, and subjected to Marsh's test, it should yield no arsenic, or merely a trace.

Tests.—"If a solution of 0.3 Gm. of the salt in 10 Cc. of diluted nitric acid be treated with 0.1 Cc. of tenth-normal silver nitrate V.S., and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of the reagent (limit of *chlorides*). If 3 Gm. of the salt be dissolved in just a sufficient quantity (about 4 Cc.) of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. After filtering, and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc. each, these should respond to the following tests: On mixing one portion with an equal volume of diluted sulphuric acid, it should not become cloudy (absence of *lead*). If another portion be precipitated with a slight excess of ammonia water, the supernatant liquid should not exhibit a bluish tint (absence of *copper*). Other portions should not be affected by barium nitrate T.S. (*sulphate*), nor yield with hydrochloric acid a precipitate which is insoluble in a slight excess of the latter (*silver*). If 1 Gm. of the salt be boiled with 10 Cc. of a mixture of equal parts of acetic acid and water, the solution cooled and filtered, and the filtrate freed from bismuth by hydrogen sulphide, boiled, and again filtered, the last filtrate should leave no residue on evaporation (absence of *alkalies* and *alkali earths*). On boiling 1 Gm. of the salt with 10 Cc. of potassium hydroxide T.S., it should not evolve the odor of ammonia. If 0.05 Gm. of Bismuth Subcarbonate be agitated with 5 Cc. of a mixture of equal parts of water and ferrous sulphate T.S., and then cautiously poured over 5 Cc. of sulphuric acid (free from nitrous compounds), so as to form a layer above, no brownish-red zone should form at the line of contact of the two liquids (limit of *subnitrate*). Two Gm. of Bismuth Subcarbonate should not respond to Bettendorf's Test for *arsenic* (see PART III, Test No. 16). If 1 Gm. of Bismuth Subcarbonate be thoroughly ignited at red heat in a porcelain crucible, the residue of bismuth oxide should weigh not less than 0.9 Gm." *U. S.* The British Pharmacopœia describes it as follows: "A whitish powder, the general chemical characters and reactions of which are similar to those of Bis-

muth Oxide and Bismuth Oxynitrate. All three compounds are heavy powders insoluble in *water,* but soluble in *nitric acid* diluted with half its bulk of *water.* Each yields the reactions characteristic of bismuth. When either is dissolved in a little *hydrochloric acid,* the solution diluted with *water* slightly acidulated with the same acid, and then excess of *hydrogen sulphide* passed through the liquid, a brownish-black precipitate of bismuth sulphide falls. This precipitate, when rapidly washed on a counterpoised filter with *water,* and quickly dried at 212° F. (100° C.), serves for the estimation of the amount of bismuth present in the compound. These bismuth salts, when suitably treated, should yield no characteristic reaction with the tests for silver, lead, copper, arsenium, iron, zinc, calcium, magnesium, chlorides, or sulphates, nor with the tests for selenium or tellurium. Bismuth Oxycarbonate affords the reactions characteristic of carbonates, but not more than the slightest reactions with the tests for nitrates. Each gramme of it should yield 0.99 gramme of bismuth sulphide when treated as described above." *Br.*

Uses.—This salt was brought into notice by Hannon of Brussels (*Ann. Thér.,* 1857, 214), on the ground that it was more tonic than the subnitrate; it is, however, exactly equivalent to the latter salt in therapeutic action.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Trochiscus Bismuthi Compositus, *Br.*

BISMUTHI SUBGALLAS. U. S.

BISMUTH SUBGALLATE

(bĭs-mū'thī sŭb-găl'lās)

"Bismuth Subgallate should yield not less than 52 percent., nor more than 57 percent., of pure bismuth oxide." *U. S.*

Dermatol; Bismuthyl Gallate; Gallate Basique de Bismuth, *Fr. Cod.*; Sousgallate de Bismuth, *Fr.;* Bismutum subgallicum, *P. G.;* Basisches Wismutgallat, *G.;* Gallato basico de bismuto, *Sp.*

Preparation.—Bismuth Subgallate was originally prepared by Bley in 1841; Fischer again prepared and described it in 1891. It was introduced to the medical profession under the proprietary name of "Dermatol," but as it was found to be bismuth monogallate, it is now known under its chemical name. Its composition has been stated to be $C_6H_2(OH)_3.COOBi(OH)_2$. F. T. Greene proposes the following process. Normal bismuth nitrate, 1 oz. av.; glacial acetic acid, 2 fl. oz. or q. s.; gallic acid, 250 grains. Dissolve the normal bismuth nitrate in the glacial acetic acid; add a pint of water. If bismuth salts should precipitate, add more glacial acetic acid until clear. Filter off impurities. Dissolve the gallic acid in a pint of warm water; mix the solutions; allow the precipitate to subside; decant; wash by decantation with warm water until washings no longer show acid reaction. Dry at 100° C.; rub to powder. See *Ph. Rund.,* 1896, 85; *Ph. Ztg.,* 1901, 1033.

Properties.—It is officially described as "an amorphous, bright yellow powder, somewhat variable in chemical composition, without odor or taste, and permanent in the air. Insoluble in water, alcohol, and ether; readily soluble with decomposition in hydrochloric, nitric, and sulphuric acids, if these be heated; insoluble in very dilute mineral acids; readily soluble in solutions of the alkali hydroxides, forming a clear yellow-colored solution, which rapidly changes to a deep red. When heated to 120° C. (248° F.) the salt loses from 5 to 7 percent. of water, and on subsequent heating to redness it at first chars, finally leaving a yellow residue, which is soluble in hydrochloric and nitric acids and is blackened by ammonium sulphide T.S. Upon thoroughly agitating 0.1 Gm. of Bismuth Subgallate with an excess of hydrogen sulphide T.S., a black precipitate results; upon filtering and then boiling the filtrate to remove the dissolved gas, the cold filtrate, after the addition of 1 drop of ferric chloride T.S., will assume a blue-black coloration. If 0.5 Gm. of the salt be well shaken with 5 Cc. of alcohol and filtered at once, the filtrate should not turn moistened blue litmus paper red (absence of *free gallic acid*). If 0.5 Gm. of Bismuth Subgallate be well mixed with 5 Cc. of diluted sulphuric acid, 5 Cc. of ferrous sulphate T.S. added, and this mixture cautiously poured, without shaking, over 5 Cc. of sulphuric acid (free from nitrous compounds) contained in a test-tube, no brown ring should form after standing for ten minutes (limit of *nitrate*). If 3 Gm. of Bismuth Subgallate be ignited in a porcelain crucible, and, after cooling, nitric acid be cautiously added to the residue drop by drop, warming until it is dissolved, then evaporating to dryness and again igniting and cooling, the residue, after cautiously dissolving in nitric acid by the aid of gentle heat, should, after concentrating to about 4 Cc., be poured into 100 Cc. of water, and after filtering and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc., then each of these should respond to the tests for purity described under *Bismuthi Subcarbonas.* The residue resulting from the ignition and subsequent treatment of 2 Gm. of the salt, as described below, should not respond to Bettendorf's Test for *arsenic* (see PART III, Test No. 16). If 1 Gm. of Bismuth Subgallate be thoroughly ignited in a porcelain crucible, and, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warming until complete solution has been effected, this, upon evaporating to dryness and again igniting, should leave a residue of bismuth oxide weighing not less than 0.52 Gm. nor more than 0.57 Gm." *U. S.*

Uses.—Bismuth subgallate was originally introduced into medicine as a substitute for iodoform in the treatment of *eczema* and other skin diseases, and in surgical dressings. It does not, however, act like iodoform, and is only a feeble germicide which resembles closely in all its

medicinal activities the older insoluble preparations of bismuth, than which it is, however, thought by some practitioners to be more astringent, and therefore preferable in *diarrhœa;* otherwise its rank in internal medicine is precisely that of the subnitrate.

Dose, seven to thirty grains (0.45 to 2.0 Gm.).

BISMUTHI SUBNITRAS. U. S., Br.

BISMUTH SUBNITRATE BISMUTH OXYNITRATE

(bĭs-mū'thī sŭb-nī'trăs)

"Bismuth Subnitrate should yield not less than 80 percent. of pure bismuth oxide." *U. S.* "Bismuth Oxynitrate, $BiONO_3,H_2O$, is prepared by the interaction of bismuth nitrate and water." *Br.*

Subnitrate of Bismuth; Bismuthum Album, *Br.* 1864; Bismuthyl Nitrate; Magistery of Bismuth; White Bismuth; Bismuthum Hydrico-nitricum, Magisterium Bismuthi, Subazotas (s. Subnitras) Bismuthicus; Azotate (sous) de Bismuth, *Fr. Cod.;* Sous-nitrate de Bismuth, *Fr.;* Bismutum subnitricum, *P. G.;* Basisches Salpetersaures Wismutoxyd, Basisches Wismutnitrat, Wismutsubnitrat, *G.;* Nitrato basico di bismuto, *It.;* Nitrato (sub) bismutico, Magisterio de bismuto, *Sp.*

A process for bismuth subnitrate is no longer official in the U. S. or Br. Pharmacopœias. The process of the U. S. P. (1870) is given in the foot-note.[1]

The alterations from the old process in the U. S. P. formula of 1870 were based upon the wish to get rid of any arsenic that might be present in the bismuth used. This is accomplished by first preparing the carbonate, by adding the nitric acid solution of bismuth to a solution of sodium carbonate in excess, whereby most of the arsenic is retained in the solution, probably as sodium arsenate, while the insoluble carbonate is precipitated. This is dissolved, with the aid of heat, in nitric acid, so as to make a very concentrated solution of the nitrate, to which, when cold, just enough water is added to begin to produce a permanent turbidity. The object of this is to allow any arsenic that may be still present to be deposited, which happens for reasons stated in explaining the process for procuring the subcarbonate. (See page 240.) The deposited matter having been precipitated, only the pure nitrate remains in solution, which is made to yield the subnitrate by large dilution with water, and still more completely by the addition of ammonia.

In the former British formula, the method pursued was that of dissolving the bismuth, which has been previously purified, in nitric acid somewhat diluted, concentrating the solution, and precipitating by adding it to a large quantity of water. When bismuth is added to diluted nitric acid, red fumes are copiously given off, and the metal, oxidized by the decomposition of part of the nitric acid, is dissolved by the remainder so as to form a solution of bismuth trinitrate. It is unnecessary to have the metal in powder, as it dissolves with great facility when added to the acid in fragments. When the solution is completed, the liquor should be added to the water, and not the water to the solution. In order to have a smooth light powder, which is most esteemed, the precipitate should be well washed to remove every trace of free nitric acid, and dried as speedily as possible. In the use of this formula it is taken for granted that the bismuth has been ascertained to be free from arsenic; and if it prove upon the application of Marsh's test to be otherwise, means should certainly be employed to purify it before using it. Methods for this purpose are mentioned under *Bismuthum.* Should the subnitrate or subcarbonate be ascertained to contain arsenic, it may, as suggested by Herapath, be purified by boiling it with solution of sodium hydroxide twice successively, then thoroughly washing the residue, which will be yellow oxide of bismuth, dissolving it again in nitric acid, and precipitating by water as before. (*Chem. News,* 1863, p. 77.) In the washing of bismuth subnitrate, the salt is asserted to lose a portion of its nitric acid; and the change may be considerable, if the washing be continued so long as the liquid comes away in any degree acidulous. It has been ascertained by Julius Löwe that this effect may be avoided by washing with a very diluted solution of ammonium nitrate, containing one part in 500 parts of water. (*Chem. Gaz.,* March 15, 1859, 119.)[2] A. de

[1] Take of Bismuth, in pieces, *two troyounces;* Nitric Acid *eight troyounces and a half;* Carbonate of Sodium *ten troyounces;* Water of Ammonia *five fluidounces;* Distilled Water *a sufficient quantity.* Mix four troyounces and a half of the Nitric Acid with four fluidounces of Distilled Water, in a capacious glass vessel, and, having added the Bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with ten fluidounces of Distilled Water, stir it thoroughly, and, after twenty-four hours, filter through paper. Dissolve the Carbonate of Sodium in twenty fluidounces of Distilled Water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with Distilled Water until the washings pass tasteless, and drain again as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the Nitric Acid, and afterwards four fluidounces of Distilled Water, and set the solution aside. At the end of twenty-four hours, filter through paper, and to the filtered liquid, previously diluted with four pints of Distilled Water, slowly add the Water of Ammonia with constant stirring. Transfer the whole to a strainer, and after the precipitate has been drained, wash it with two pints of Distilled Water, drain it again, and press out as much of the liquid as possible. Lastly, dry it upon bibulous paper with a gentle heat, and rub into powder." *U. S.* 1870.

[2] In order to avoid the handling of large volumes of liquid, as well as the loss of bismuth by the production of soluble salts, A. Lalieu proposes the following process, which, he says, yields a much larger, purer, and denser product: 200 grammes of bismuth are dissolved in a sufficient quantity of nitric acid; the clear solution is decanted and poured into about 8 liters of water containing 500 grammes of ammonia water. The precipitate is washed, transferred to a dish and 50 to 60 grammes of caustic soda, dissolved in a little water, are added to it. The dish is then exposed for 15 to 20 minutes to the heat of a water bath, and the contents stirred up several times. After having again become cold, the super-

Schulten obtained *crystallized bismuth subnitrate,* $5Bi_2O_3.5N_2O_5.9H_2O$, by dissolving 50 Gm. of bismuth subnitrate in 50 Cc. of nitric acid (sp. gr. 1.2) and adding 300 Cc. of water while stirring; the crystals which are produced are pressed between folds of filter paper and dried. (*Chem. News,* 1904, 87.) *Bismuth nitrate,* a crystalline salt ($Bi3NO_3.5H_2O$), is deposited from a solution of bismuth in nitric acid. Bismuth nitrate has been used by Balmanno Squire dissolved in glycerin, under the name of *Glycerole of Nitrate of Bismuth.* (*P. J.,* Nov. 11, 1876.) W. W. Moorhead prepares it by taking two troyounces of crystalline bismuth nitrate and dissolving in sufficient glycerin to make eight fluidounces. No heat should be used. This preparation can be diluted with an equal bulk or less of water, or one part can be added to forty-eight of water without precipitation, but one part to twelve, eight, or six of water soon precipitates. (*A. J. P.,* 1877, p. 98; also pp. 23 and 89.)

Properties.—Bismuth subnitrate is "a white powder, of somewhat varying chemical composition,[1] odorless and almost tasteless, and permanent in the air. Almost insoluble in water, and insoluble in alcohol, but readily soluble in nitric or hydrochloric acid. When heated to 120° C. (248° F.) for twelve hours the salt loses not over 3 percent. of moisture; when subsequently heated to redness it evolves nitrous vapors, leaving not less than 80 percent. of its weight of a yellow residue, which is soluble in nitric or hydrochloric acid and blackened by hydrogen sulphide. When brought in contact with moistened blue litmus paper the salt shows a slightly acid reaction. On adding 3 Gm. of the salt to 3 Cc. of warm nitric acid no effervescence should occur (absence of *carbonate*), and no residue should be left (absence of *insoluble foreign salts*). If this solution be poured into 100 Cc. of water, a white precipitate is produced. If the filtrate separated from this precipitate be evaporated on a water-bath to 30 Cc., the liquid again filtered, and the new filtrate divided into portions of 5 Cc. each, these should respond to the tests for purity described under *Bismuthi Subcarbonas.* On boiling 0.1 Gm. of the salt with 5 Cc. of potassium hydroxide T.S., no odor of ammonia should be perceptible. If 2 Gm. of the salt be heated in a porcelain crucible until nitrous vapors cease to be evolved, the residue of bismuth oxide, when cold, should weigh not less than 1.6 Gm., and should not respond to Bettendorf's Test for *arsenic* (see PART III, Test No. 16)." *U. S.* The British Pharmacopœia describes it as "a heavy white inodorous powder consisting of minute crystalline scales, with not more than a slight action on *litmus.* It should answer to the general characters and tests enumerated under 'Bismuth Oxycarbonate.' Each gramme should yield 0.84 gramme of bismuth sulphide. It should afford only the slightest reactions with the tests for carbonates. If 1 gramme be dissolved in *nitric acid* and the liquid mixed with a solution of about 2 grammes of *citric acid* and sufficient *solution of ammonia* to give decided alkalinity, no precipitate or opalescence should be produced by boiling the mixture while still faintly alkaline (absence of calcium phosphate)." *Br.* It is readily soluble in the strong acids, from which it is precipitated by water. The fixed alkalies dissolve it sparingly, and ammonia more readily. It is darkened by hydrogen sulphide gas, but not by exposure to light, unless it contains a little silver, or is subjected to the influence of organic matter. If the nitric solution is not precipitated by diluted sulphuric acid, it is free from lead. It sometimes contains arsenic, which may be detected by acting on it with pure sulphuric acid, evaporating to dryness, dissolving in hot distilled water, and testing a part of the solution by Marsh's apparatus. By this method Lassaigne detected one-sixth of 1 per cent. of arsenic in a sample of subnitrate sold in Paris. Glénard proposed two other methods of searching for arsenic in the subnitrate, one merely qualitative, the other quantitative. The first consists in strongly heating a mixture of the suspected salt with potassium acetate. The least trace of arsenic will be detected by the strong and offensive odor produced, owing to the formation of cacodyl. In the second, the bismuth subnitrate is heated with pure hydrochloric acid. If arsenic be present it will rise in vapors in the form of chloride. These should be carefully collected and condensed and then treated with an excess of hydrogen sulphide. The arsenic sulphide precipitated will be the measure of the metal. (*Ann. Thér.,* 1868, p. 176.) Lassaigne has found as much as 27 per cent. of bismuth chloride in this preparation, when obtained by precipitating, with water, a solution of bismuth in a mixture of nitric and hydrochloric acids. The same impurity is introduced, to a small extent, by using common water containing chlorides; and bismuth subsulphate renders the preparation impure, when the water used contains calcium sulphate. These facts show the necessity of using distilled water. As regards the origin of the chlorine sometimes existing in commercial bismuth subnitrate, it was asserted by R. C. Tichborne to be a common practice with the manufacturer, in order to save the bismuth existing in the mother liquor after the deposition of the subnitrate, to precipitate

natant liquor is poured off, the precipitate is thoroughly washed, and a quantity of nitric acid, representing 48.5 grammes of anhydrous nitric acid (to be determined from the sp. gr., etc.), is added to it in small portions at a time, and under constant stirring. If, during this addition, the mass should become too thick, a little water may be added, but not enough to destroy the pasty consistence of the mass. The dish is then replaced for a few minutes on the water bath, and the mass well stirred. The latter, which had been yellow, soon becomes perfectly white, and somewhat more liquid. It is then diluted with a little water, the precipitate collected on a filter placed on a muslin strainer, washed, drained, pressed, and dried. The product amounts to about 265 grammes. (*L'Union Pharm.,* No. 8; *N. R.,* Nov. 1878.)

[1] The British Pharmacopœia gives the following chemical composition: $BiONO_3,H_2O$.

it with sodium chloride, thus obtaining an insoluble bismuth oxychloride, which is then added to the previous product. (*P. J.*, 1860, 413.) For the modes of detecting and separating it, the reader is referred to the *Chem. News* (1863, p. 109). The metal thallium is said to be present in some specimens of the pharmaceutical preparations of bismuth, while the fetid odor of the breath so often produced when the subnitrate is administered is believed to be due to traces of tellurium. (Brownen, *P. J.*, Oct. 16, 1875.) It has also been said that the arsenic usually present in minute quantities is the cause of the garlicky odor of the breath. E. R. Squibb (*Ephem.*, Sept. 1882) states, however, that the "bismuth breath" has been noticed in patients who were taking a preparation of bismuth in which the absence of both tellurium and arsenic was conclusively shown. The cause of the peculiar odor is, therefore, at present doubtful. Calcium phosphate has been ascertained to be an occasional adulteration of the subnitrate. A ready method of detecting it suggested by Roussin, has proved to be fallacious, and may lead to false decisions as to the presence of the phosphate. There can be no difficulty in detecting the adulteration by the U. S. P. tests. Bismuth subnitrate was called by the earlier chemists *magistery of bismuth.* It is incompatible with potassium iodide (slowly forming a brick-red bismuth iodide) and with alkaline bicarbonates. For examination of commercial bismuth subnitrate by Curtman, see *A. J. P.*, 1896, 422; *Ph. Era*, 1896, 43; also a paper by F. A. Upsher Smith (*P. J.*, 1900, 15).

Uses.—The great insolubility of bismuth subnitrate has led to the belief that it is not absorbed in the gastro-intestinal tract, but the finding of it by Orfila in the spleen and liver, by Lewald in the milk, by Bergeret and Mayençon and other chemists in the urine, proves that the slow absorption of the drug does take place. The largest doses, however, given internally, never produce any general sensible effect upon the system, the remedy being employed solely for its soothing, sedative, feebly astringent influence upon the mucous membrane. It is very useful in *subacute gastritis, gastralgia, pyrosis,* and allied *stomachic disease,* in which affections it should be given before or just after meals; when given one to two hours after meals, the subnitrate escapes with the contents of the stomach into the intestines, and is very useful in conditions of *irritation of the intestinal mucous membrane.* It may be employed in *diarrhœas of irritation,* and even in *dysentery,* but in *diarrhœas of relaxation* it is of little service. Its use produces dark green or blackish discoloration of the stools. Bismuth subnitrate is also a very useful topical application in various mucous inflammations, other than gastro-intestinal; thus, it is used with advantage by injection (5 to 20 gr. to 1 fl. oz. of mucilage) in the first stage of *gonorrhœa,* in *leucorrhœa,* in *dysentery,* and in *rectal irritation,* and by snuffing in *coryza,* etc. The dose of bismuth subnitrate is from five to forty grains (0.32 to 2.6 Gm.), three or more times a day, the large dose being employed in *diarrhœa.* Even in much larger amounts than those mentioned the medicine is practically safe; the symptoms described by Orfila and other early toxicologists as produced by it having been undoubtedly due to irritant impurities which formerly existed in the drug.

As has been shown by Theodore Kocher, even the insoluble preparations of bismuth are active antiseptics, and they were for a time much used in Germany in the treatment of *wounds.* It was claimed for them that they acted like iodoform and were not capable of producing poisonous symptoms. Further experience has shown, however, that this is incorrect; that when applied in large quantities to extensive wounded surfaces they are capable of yielding so much bismuth to absorption as to produce a poisoning, which is characterized by acute stomatitis, with a peculiar black discoloration of the mucous membrane, usually beginning upon the borders of the teeth, but spreading over the whole mouth, followed by an intestinal catarrh, with pain and diarrhœa; in severe cases desquamative nephritis, as shown by albuminous urine and epithelial tube casts, may also occur.

Dose, five to thirty grains (0.32 to 2.0 Gm.).

Off. Prep.—Bismuthi Citras, *U. S.;* Liquor Bismuthi et Ammonii Citratis, *Br.*

BISMUTHI SUBSALICYLAS. U. S. (Br.)

BISMUTH SUBSALICYLATE

(bĭs-mŭ'thī sŭb-săl-ĭ-cȳ'lăs)

"Bismuth Subsalicylate should yield not less than 62 nor more than 64 percent. of pure bismuth oxide." *U. S.* "Bismuth Salicylate, or oxysalicylate, $C_6H_4.OH.COO.BiO$ may be prepared by the interaction of bismuth nitrate and sodium salicylate." *Br.*

Bismuthi Salicylas, *Br.;* Bismuth Salicylate; Bismuthyl Salicylate, Bismuth Oxysalicylate; Salicylate Basique de Bismuth, *Fr. Cod.;* Sous-salicylate de Bismuth, *Fr.;* Bismutum subsalicylicum, *P. G.;* Basisches Wismutsalicylat (salicylsaures Wismutoxyd), Wismutsubsalicylat, *G.;* Salicilato de bismuto, *Sp.*

Preparation.—This salt is a bismuthyl salicylate of definite composition, the bismuth oxide resulting from its ignition being about 64 per cent. Samples which show a higher percentage than this either contain bismuth subnitrate or hydroxide. It may be made by Wolff's process, by diluting a glycerin solution of crystallized bismuthous nitrate with one or two parts of water, and decomposing this with a concentrated aqueous solution of sodium salicylate, then washing the precipitate well with hot water and carefully drying. Another method for its preparation will be found in *A. J. P.*, 1891, 401. Fischer and Grützner (*A. Pharm.*, 1894, 680) object to the variable composition of commer-

cial bismuth salicylate, and recommend the following process for making a basic salt of constant composition. Crystallized bismuth nitrate is dissolved in four times its weight of diluted acetic acid, the solution diluted with about forty times its weight of water, and the bismuth precipitated as hydroxide by ammonia water. The precipitate is washed and mixed with the molecular proportion of salicylic acid. After heating on a water bath, a magma of crystals of basic bismuth salicylate is formed; these are drained and dried. B. Fischer recommended the following process: one molecule each of salicylic acid and freshly precipitated bismuth hydroxide are heated together with the necessary amount of water on the water bath; filter, collect and dry the residue at 80° to 100° C. (176° to 212° F.) on porous tiling. (*Ph. Centralh.,* 1895, 92, 169.) Duyk prepares bismuth salicylate as follows: 100 Gm. of pure bismuth subnitrate are treated for one or two days with one liter of water, to which 50 Gm. of ammonia water have been added. After shaking sufficiently the subnitrate is completely changed into an oxide, which is collected and carefully washed with water. This oxide, after expression, is heated, under constant stirring, with 25 Gm. powdered salicylic acid on a water bath. After the union has been effected, the salicylate is washed and dried at a gentle heat (*B. S. Ph. Br.,* 1891). Thibault prefers the use of crystallized bismuth nitrate and solution of sodium hydroxide to precipitate the bismuth hydroxide (*Bull. Soc. Chem.,* xxv. No. 16).

Properties.—Bismuth subsalicylate, termed bismuth salicylate in the British Pharmacopœia, was introduced into the U. S. Pharmacopœia (8th Rev.) for the first time and is officially described as "a white, or nearly white, amorphous or crystalline powder, odorless, tasteless, and permanent in the air. Almost insoluble in cold water; upon prolonged boiling with water a portion of the salicylic acid passes into solution with the formation of a more basic bismuth salicylate. It is partly soluble with decomposition in hydrochloric and nitric acids, a white, flocculent precipitate of salicylic acid separating. When heated at 120° C. (248° F.) Bismuth Subsalicylate should not lose more than 1 percent. of water, and on subsequently heating to redness it at first chars, finally leaving a yellow residue, which is soluble in hydrochloric or nitric acid and is blackened by ammonium sulphide T.S. When Bismuth Subsalicylate is agitated with a solution of 5 drops of ferric chloride T.S. in 10 Cc. of water, a deep violet-blue coloration is produced. If 1 Gm. of Bismuth Subsalicylate be thoroughly agitated with 10 Cc. of diluted hydrochloric acid and filtered, the residue, after washing and drying, should conform to the reactions and tests given under *Acidum Salicylicum.* Upon pouring the filtrate into an excess of water, a heavy white precipitate of basic bismuth chloride should be obtained. If 1 Gm. of the salt be agitated with 5 Cc. of chloroform, and the liquid filtered through a double filter of fine texture into 5 Cc. of water containing 3 drops of ferric chloride T.S., no violet zone should form within five minutes at the line of contact of the two liquids (absence of *free salicylic acid*). If 3 Gm. of Bismuth Subsalicylate be ignited in a porcelain crucible, and, after cooling, nitric acid be cautiously added to the residue, solution should be complete if gently heated; if this solution, after concentrating to about 4 Cc., be poured into 100 Cc. of water, and after filtering and evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing this filtrate into portions of 5 Cc., then each of these should respond to the tests for purity described under *Bismuthi Subcarbonas.* If 0.2 Gm. of Bismuth Subsalicylate be triturated with 0.3 Gm. of sodium salicylate and 5 Cc. of distilled water, and carefully poured, without mixing, over 5 Cc. of sulphuric acid (free from nitrous compounds) contained in a test-tube, no pink to brownish-red zone should form immediately (limit of *nitrates*). The residue resulting from the ignition and subsequent treatment of 2 Gm. of the salt, as described below, should not respond to Bettendorf's Test for *arsenic* (see PART III, Test No. 16.). If 1 Gm. of Bismuth Subsalicylate, dried at 120° C. (248° F.), be thoroughly ignited in a porcelain crucible, and, after cooling, 5 Cc. of nitric acid be added to the residue, drop by drop, warming until complete solution has been effected, this, upon evaporating to dryness and again igniting, should leave a residue of bismuth oxide weighing not less than 0.62 Gm. nor more than 0.64 Gm." *U. S.* The British Pharmacopœia describes this salt as "a white or nearly white amorphous powder, insoluble in *water.* It affords the reactions characteristic of bismuth. Diluted *test-solution of ferric chloride* is colored violet when Bismuth Salicylate is introduced. It should yield only the faintest characteristic reaction with the copper test for nitrates. *Alcohol* (90 per cent.), with which Bismuth Salicylate has been shaken, should not give a violet color with *test-solution of ferric chloride* (absence of free salicylic acid). Decomposed by heating with *solution of sodium carbonate,* the liquid portion of the resulting mixture, if containing not less than 1 per cent. of salicylate, affords a yellowish-brown precipitate on the addition of *solution of uranium nitrate* (distinction from carbolates and sulphocarbolates). Each gramme of Bismuth Salicylate should yield 0.7 gramme of bismuth sulphide. When heated, salicylic acid volatilizes and 62 to 64 per cent. of bismuth oxide remains. It should be free from the impurities indicated under 'Bismuth Oxycarbonate.'" *Br.*

Uses.—Bismuth subsalicylate was originally proposed as an intestinal antiseptic and feeble astringent, and has been used to a considerable extent in the treatment of chronic *intestinal catarrhs* and subacute *diarrhœas* with marked tendency to intestinal fermentation; also as a

local antiseptic remedy for *wounds* and various inflammations of the mucous membrane. We have never been able to perceive that it is more effective or different in its action from the older preparations of the metal.

Dose, from ten to twenty grains (0.65 to 1.3 Gm.), every four to eight hours.

BISMUTHUM.

BISMUTH

(bĭs-mū'thŭm)

Bi = 206.9

Etain de Glace, Bismuth, *Fr.;* Wismuth, Wismut, *G.;* Bismuto, *It., Sp.*

Bismuth occurs usually in the metallic state, occasionally as a sulphide or a telluride, and rarely as an oxide. It is found largely in Saxony, Schneeberg being the chief point of production. It has been found, mainly as telluride of bismuth, in Colorado with gold and silver ores. Small quantities have been found in Utah and Wyoming. It has also been discovered in Southern Australia, from whence a quantity of it has been sent into commerce. It is obtained almost entirely from native bismuth, which is heated by means of wood or charcoal, whereby the metal is fused, and separated from its gangue. Most of the bismuth of commerce comes from Saxony, although it is now also largely mined in Bolivia. The bismuth ore from South America is said to be naturally free from arsenic, and to be therefore preferable for pharmaceutical purposes.

As the production of bismuth in the world far exceeds the demand, there is no regular American production, much of that which accompanies the gold and silver in the ore being allowed to go to waste in the slag.

Bismuth was first recognized as a metal by Agricola in 1520. Before that period it was confounded with lead. It is a brittle, pulverizable, brilliant metal, of a crystalline texture, and of a white color with a slight reddish tint. Its crystals are rhombohedral, but with an angle of 87° 40′, which makes it difficult to distinguish them from cubes, in which the angle would be 90°. Indeed, many books still refer to it as cubical in form. It undergoes but a slight tarnish in the air. Its sp. gr. is 9.8 (B. P. 1885, purified 9.83), melting point 264° C. (507° F.). When impure bismuth solidifies after fusion, globules of the metal, nearly pure, are thrown up from the mass. This takes place when the metal contains as much as 50 per cent. of impurity. The same phenomenon does not occur when pure bismuth is melted. (R. Schneider.) At a high temperature, in close vessels, bismuth volatilizes, and may be distilled over. When heated in the open air to a full red heat, it takes fire, and burns with a faint blue flame, forming an oxide of a yellow color. This is the *trioxide,* and consists of two atoms of bismuth and three of oxygen. There is another compound of bismuth and oxygen consisting of two atoms of the former and five atoms of the latter, which is called *bismuthic oxide,* Bi_2O_5. It is obtained in the form of a hydroxide by boiling bismuth nitrate in solution of potassium hydroxide, washing the precipitate, and mixing it while moist with solution of potassium hydroxide into which chlorine is passed. A mixture of bismuthous and bismuthic oxides is precipitated, from which the former is separated by digestion with nitric acid. The hydroxide remaining, when washed and dried, is in the form of a red powder, which gives up its water at 130° C. (266° F.), and at a higher heat loses oxygen. Bismuth is acted on feebly by hydrochloric acid, but violently by nitric acid, which dissolves it with a copious liberation of red fumes. Sulphuric acid, when cold, has no action on it, but at a boiling heat effects its solution with the liberation of sulphurous acid. As it occurs in commerce, it is generally contaminated with other metals, among which are arsenic in minute quantity, traces of silver, cadmium, nickel, lead and iron, and sometimes a very small proportion of thallium. Claassen has found in so-called "purissimus" bismuth, lead, copper, and iron, and in one sample of bismuth, sold as suitable for scientific purposes, he obtained from 500 grammes 10 grammes of lead chloride. (*Ap. Ztg.,* 1891, p. 121; see also *Chem. News,* 1892, lxv. 28.) It may be purified from all contaminating metals by dissolving the bismuth of commerce in diluted nitric acid, precipitating the clear solution by adding it to water, and reducing the white powder thus obtained with black flux. The same precipitate is obtained by adding ammonia to the nitric solution; if the supernatant liquid is blue, the presence of copper is indicated; if the precipitate is yellowish, iron is present. The British Pharmacopœia (1885) contained a process for purifying bismuth which was not introduced in the 1898 edition of the same authority. (See U. S. D., 17th ed., p. 270.)

Uses.—Bismuth is not used in medicine in an uncombined state, but is employed pharmaceutically to obtain bismuth subcarbonate, subnitrate, subgallate, subsalicylate and other medicinal preparations formed from this metal. In the arts its oxychloride is used to form a cosmetic for the complexion, called *pearl white,* and the metal as an ingredient of the best pewter.

BROMOFORMUM. U. S.

BROMOFORM

(brō-mo-för'mŭm)

"A liquid consisting of 99 percent., by weight, of absolute Bromoform [$CHBr_3$ = 250.99], and 1 percent. of absolute alcohol. It should be kept in dark amber-colored, glass-stoppered bottles, in a cool place, protected from light." *U. S.*

Tribrommethane, Formyl Tribromide; Bromoformium, *P. G.;* Bromoform, Tribrommethan, *G.;* Bromoformo, *Sp.*

This compound, the analogue of chloroform, is prepared by methods similar to those used for the manufacture of chloroform. It is made, for instance, by the action of bromine in the presence of calcium hydroxide upon alcohol or acetone, or by the decomposition of bromal (the analogue of chloral) by alkalies. It is found as an impurity, at times, in commercial bromine.

Bromoform is officially described as "a heavy, transparent, colorless, mobile liquid, with an ethereal odor, and a penetrating, sweet taste resembling that of chloroform. Specific gravity: 2.808 at 25° C. (77° F.). Very slightly soluble in water, but soluble in all proportions in alcohol, ether, benzene, petroleum benzin, and in the fixed and volatile oils. Bromoform is slightly volatile at ordinary temperatures, boils at 148° C. (298.4° F.), and solidifies at 6° C. (42.8° F). It is not inflammable, but when vaporized by the application of heat, its vapor may be burned. If 10 Cc. of Bromoform be evaporated in a dish over a naked flame, no solid residue should remain. If 10 Cc. of Bromoform be well shaken with 10 Cc. of distilled water, and the liquids, upon standing, be allowed to separate completely, the water removed from the layer of Bromoform should be neutral to blue litmus paper (absence of *free acid*), and a portion should not produce a turbidity when treated with silver nitrate T.S. (absence of *bromides* and *brominated compounds*), and another portion treated with potassium iodide T.S. should not be tinted blue upon the addition of starch T.S. (absence of *free bromine*). If 10 Cc. of Bromoform be well shaken with 10 Cc. of distilled water, and the liquids, upon standing, be allowed to separate completely, the water removed from the Bromoform, treated with an excess of ammonia water, and then with a solution of iodine and ammonium iodide, until the black precipitate of nitrogen iodide, which may sometimes form, slowly disappears, it should not become milky in appearance, due to the separation of iodoform, which may be recognized by its odor (absence of *acetone*)." *U. S.*

Uses.—As long ago as 1849, Nunneley and Schuchard suggested the use of bromoform as a general anæsthetic. The later experience of practical surgeons has shown, however, that although bromoform produces a rapid narcosis when inhaled, its employment is attended with excessive danger. When taken internally by the mouth it is capable of acting like the older bromides, over which, however, it has no advantages and than which it is probably more dangerous. In the recorded cases of poisoning by it the symptoms have been pallor, titubation, dilatation of the pupils, coma, heart failure and collapse.

The original statement by Stepp, that bromoform is especially efficient in *whooping cough*, has been confirmed by various clinicians. Stepp administered in a teaspoonful of water to children three or four weeks old, one drop three or four times daily; in older, nursing children, three drops; in children from two to four years of age, four to five drops three or four times daily; up to seven years of age six to seven drops three or four times daily. These doses are, however, probably dangerous. Three drops are said to have produced very serious symptoms in a child of four years, and two drops in one of fifteen months. For cases of poisoning see *Cb. I. M.*, No. 50, 1902; *B. M. J.*, vol. i, 1900; *T. G.*, 1903; *Ap. Ztg.*, July, 1898, March 24, 1900.

Dose, one to five minims (0.06 to 0.3 Cc.), best administered in capsules, dropped on sugar, or mixed with an equal quantity of olive oil and emulsified.

BROMUM. U. S.

BROMINE

(brō′mŭm)

Br = 79.36

"It should contain not less than 97 per-cent. of pure Bromine, and be kept in protected glass-stoppered bottles, in a cool place." *U. S.*

Brominium, *U. S.* 1870; Brome, *Fr. Cod.;* Bromum, *P. G.;* Brom, *G.;* Bromo, *It., Sp.*

Bromine is an elementary body, possessing many analogies to chlorine and iodine. It was discovered in 1826 by Balard of Montpellier, in the bittern of sea salt works, in which it exists as a magnesium bromide. Since then it has been found in the waters of the ocean, in certain marine animals and vegetables, in various aquatic plants, as the water cress, in numerous salt springs, and in the mineral kingdom. It has also been detected by Mène in the coal gas liquor of the Paris gas works. In the United States it was first obtained by Silliman, who found it in the bittern of the salt works at Salina, in the State of New York. It was discovered in the salt wells near Freeport, Pa., by David Alter, and is now obtained in largest amount from the brines of Ohio, Pennsylvania, Michigan, and West Virginia. The chief works are located at Parkersburg and Mason City, W. Va.; Pomeroy, Ohio, and Midland County, Mich. The annual production of bromine in the United States for the last few years has been as follows: 1903, 598,500 lbs., valued at $167,580; in 1904, 897,100 lbs., valued at $269,130; and in 1905, 899,434 lbs., valued at $139,432. The bromides contained in the mother liquors of the salt wells are oxidized by manganese dioxide in West Virginia and Ohio, while potassium chlorate is the favorite oxidizing agent in Michigan, because of the large proportion of calcium chloride in the liquor. Much is also produced in the latter State by electrolytic processes.

Preparation.—The original salt liquor or brine is pumped out of the ground at 9° B., evaporated to about 15° in large iron pans, then allowed to settle, and is further evaporated in wooden tanks heated by steam pipes to the

point of crystallization of the salt. These tanks, five in number, are placed at different elevations, one above the other. Each day the liquor is run off from No. 1, the highest, to No. 2, next day to No. 3, and so on until it reaches No. 5, the crystallized salt being removed from each tank after draining off the liquor. The brine which reaches No. 5 is bittern, and consists chiefly of calcium, magnesium, sodium, and some aluminum chlorides, with varying percentages of sodium and calcium bromides.

The bittern marking 30° to 38° B. is evaporated to about 45° B. By this further evaporation an additional percentage of impure salt is removed; the liquor is then run into stone stills, materials for generation of chlorine added, and heat applied by means of steam until the bromine has been all eliminated and vaporized. It is condensed and collected in cooled receivers. (*Proc. A. Ph. A.*, 1877, p. 448.) A bromine still is figured in *N. R.*, April, 1877; see also *N. R.*, 1883, 108; *Am. Drug.*, 1884, 121. The chief source of the bromine abroad is at Stassfurt in Germany, where the magnesium bromide remains as a residue in the working of the potassium salts. The bromine is extracted from the solution of bromide in a continuous process by the joint action of chlorine gas and steam.

Bromine has also been obtained from sea weeds by carbonizing them, lixiviating the carbonaceous residue, and then separating the ingredients, among which are iodine and bromine. For details, see *Chem. News* (July 6, 1866, p. 2). More than two-thirds of the bromine of commerce is used for the manufacture of bromides for medicinal use, and for photography; the remainder is used for aniline colors.

Properties.—Bromine is a volatile liquid, of a dark red color when viewed in mass, but hyacinth-red in thin layers. Its taste is very caustic, and its odor intensely strong and disagreeable, having some resemblance to that of chlorine.[1] Its sp. gr. is very nearly 3 (2.99) *U. S.*, 2.97 to 3.14, *Br.* (1885). At —24.5° C. (—12° F.), Baumhauer,[2] (—7.2° C., Philipp) it becomes a hard, brittle, crystalline solid, having a dark leaden color, and a lustre nearly metallic. It boils at about 63° C. (145.4° F.), forming a reddish vapor resembling that of nitrous acid, and of the sp. gr. 5.54. It evaporates readily, a single drop being sufficient to fill a large flask with its peculiar vapor.

Bromine is sparingly soluble in water [in 28 parts at 25° C. (77° F.), *U. S.*], to which it communicates an orange color, more soluble in alcohol, and still more so in ether, chloroform, and carbon disulphide. By the aid, however, of potassium bromide, it may be dissolved to any desirable extent in water. Its alcoholic and ethereal solutions lose their color in a few days, and become acid from the generation of hydrobromic acid. It bleaches vegetable substances like chlorine, destroys the color of indigo sulphate, and decomposes organic matters. Its combination with starch has a yellow color. It corrodes the skin and gives it a deep yellow stain. Bromine is intermediate in its affinities between chlorine and iodine, since its combinations with metals are decomposed by chlorine, while, in its turn, it decomposes those of iodine. It forms acids which are analogous in properties and composition to the corresponding acids of chlorine and iodine. It combines also with chlorine, forming bromine chloride, which probably has the formula $BrCl_5$. This is prepared by passing chlorine through bromine, and condensing the vapors at a low temperature. It is a reddish-yellow liquid, very volatile, soluble in water, with a penetrating odor and disagreeable taste.

Commercial bromine sometimes contains as much as 6 or 8 per cent. of *carbon tetrabromide*, as ascertained by Poselger. He discovered the impurity by submitting some bromine to distillation, during the progress of which the boiling point rose to 120° C. (248° F.). The residuary liquid at this temperature was colorless, and when freed from a little bromine, proved to be carbon bromide, as an oily, aromatic liquid. It is stated by T. L. Phipson that he has found in commercial bromine, accounted pure, a notable amount of cyanogen, and that it may be detected as follows. Take of iron filings and bromine, of each, half an ounce; add to the filings 2 or 2.5 ounces of water; introduce the bromine very gradually, stirring steadily; filter rapidly while warm from the reaction; and put the filtered liquid in a partially closed bottle. In the course of some hours a deposit of iron ferricyanide (Berlin blue) will have formed, and may be collected on a filter. In about two days the whole of the cyanogen will be deposited. In the samples of bromine thus examined he had found from 0.5 to 1 per cent. of cyanogen. (*Chem. News*, 1873, p. 51.) Chlorine and iodine are frequently found in bromine, the former being more common in American and the latter in German bromine.

The U. S. P. gives the following description, with tests for the purity of bromine. "A heavy, dark brownish-red, mobile liquid evolving, even at ordinary temperatures, reddish fumes, highly irritating to the eyes and lungs, and having a peculiar suffocating odor, resembling that of chlorine. Specific gravity: 2.990 to 3.000 at 15° C. (59° F.). Boiling point, 63° C. (145.4° F.). Soluble in 28 parts of water at 25° C. (77° F.), and readily soluble in alcohol or ether (with gradual decomposition of these liquids); also in carbon disulphide, and in chloroform, with a deep reddish-yellow color. On exposure to air or to heat, it is completely volatilized without leaving any residue.

[1] Inhaled in the form of vapor it produces great irritation, and endangers asphyxia through spasm of the glottis. A case which had nearly proved fatal was apparently saved by throwing steam sufficiently cooled into the larynx. (G. P. Duffield, *A. J. P.*, 1868, p. 288.)

[2] See *A.J.P.*, Oct. 1872, p. 452. The higher degree usually given in chemical works is ascribed by Baumhauer to the presence of water in the bromine examined.

It destroys the color of solutions of litmus and indigo, and imparts a yellow color to solution of starch. If Bromine be added to an excess of potassium hydroxide T.S., it should combine to form a permanently clear liquid, without the separation of oily drops (absence of *organic bromine compounds*)." If an aqueous solution of Bromine be shaken with a slight excess of reduced iron until it becomes nearly colorless, the filtered liquid, on the addition of a small amount of ferric chloride and of starch T.S., should not assume a blue color (absence of *iodine.*)" *U. S.*

In testing for bromine in mineral or saline waters, the water is evaporated in order to crystallize most of the salts. The solution, after having been filtered, is placed in a narrow tube, and a few drops of strong chlorine water are added. If this addition produces an orange color, bromine is present. The water examined, in order that the test may succeed, must be free from organic matter, and the chlorine not be added in excess. Bromine may be detected in marine vegetables by carbonizing them in a covered crucible, exhausting the charcoal, previously pulverized, with boiling distilled water, precipitating any alkaline sulphide present in the solution by zinc sulphate, and then adding successively a few drops of nitric acid and a portion of ether, shaking the whole together. If bromine be present it will be set free and dissolve in the ether, to which it will communicate an orange color. (Dupasquier.) According to Reynoso, a more delicate test is furnished by hydrogen dioxide, which liberates bromine from its compounds without reacting on it when free. The mode of procedure is as follows. Put a piece of barium dioxide in a test tube, and add successively, distilled water, pure hydrochloric acid, and ether. The materials are here present for generating hydrogen dioxide; and as soon as bubbles are seen to rise to the surface, the substance suspected to contain bromine is added, and the whole shaken together. If a bromide be present, the hydrochloric acid will give rise to hydrobromic acid; and the hydrogen dioxide, acting on this, will set free the bromine, which will dissolve in the ether, and give it a yellow tint and the odor of bromine.

Uses.—Bromine was formerly employed as an alterative in *bronchocele, scrofulous tumors* and *ulcers, syphilis, diseases of the skin,* and other chronic affections, but at present it is very rarely used. About six minims (0.4 Cc.) of an aqueous solution containing one part of bromine to forty of distilled water may be taken several times a day in water. Locally in its concentrated state it is a very powerful and deep caustic. When used as a wash for *ulcers,* from ten to forty minims may be added to a pint of water. The use of bromine as a caustic in *hospital gangrene* was proposed by Goldsmith during the Civil War, and became universal in the army hospitals. Applied pure by means of a glass rod, it destroyed the diseased tissues more rapidly and thoroughly than did even strong nitric acid. Of the compounds of bromine, the potassium, ammonium, iron, and mercury bromides have been chiefly used. Some of them have been found to exercise a remarkable influence in allaying *nervous irritation,* and are now much employed for that purpose. See these titles respectively in the different parts of this work.[1] *Bromine chloride* has been used in *cancer* by Landolfi of Naples, both externally as a caustic and internally; but a committee of the French Academy reported decidedly against it.

J. Lawrence Smith of Louisville, Ky., proposed the following as a convenient formula for a solution of bromine. Dissolve 160 grains of potassium bromide in two fluidounces of water, add one troyounce of bromine, and, stirring diligently, pour in sufficient water to make the solution measure four fluidounces. The solution should be kept in accurately stoppered bottles. This is a suitable preparation for application to hospital gangrene, and may be diluted to any desirable extent with water. (*A. J. P.,* 1863, p. 202.)

Bromine is a very active germicide, but as such is not of practical value. In overdoses it is a corrosive poison. About an ounce ingested caused violent inflammation of the lips, mouth, tongue, and œsophagus, with incessant burning pain, followed, in two hours and a half, by prostration, ending in death. (Snell, *N. Y. Journ. of Med.,* Sept. 1850.) The best antidote, according to Alfred Smee, is ammonia, given largely diluted and mixed with sweet oil.

Bromine is extensively used in the manufacture of bromides, in photography, and in the manufacture of coal tar colors.

BUCHU. U. S. (Br.)

BUCHU

(bū′ɕhū)

"The dried leaves of *Barosma betulina* (Thunberg) Bartling and Wendland (Fam. *Rutaceæ*)." *U. S.* "The dried leaves of Barosma betulina, *Bart. and Wendl.*" *Br.*

Buchu Folia, *Br.;* Folia Bucco, Folia Diosmæ, s. Barosmæ; Feuilles de Bucco (Booko, Buchu), *Fr.;* Buckublätter, Buccoblätter, *G.*

The leaves of the official and other Barosmas (so named from *βαρύς,* heavy, and *ὀσμή,* odor), and of some *Agathosmas,* are collected by the Hottentots, who value them on account of their odor, and, under the name of *bookoo* or *buchu,* rub them, in the state of powder, upon their greased bodies.

[1] *Iodine bromide* in aqueous solution is sometimes employed, which is made by rubbing 10 parts of iodine with 40 parts of distilled water, introducing into a flask, adding 20 parts of bromine, and shaking until the iodine is dissolved. 530 parts of distilled water are added, and the whole filtered. 20 parts contain 1 part of iodine tribromide. A solution containing 15 per cent. is sometimes found in commerce.

The United States and British Pharmacopœias are at present in accord in acknowledging as "buchu" the product of a single species; formerly several other species were also recognized as the source of Buchu, and *B. serratifolia* is still official in some of the European countries. The medicinal species are all erect, slender shrubs with opposite leaves, dotted with conspicuous pellucid oil glands, smooth, angular, purplish branches, often of a purplish color, white flowers, and a fruit of five erect carpels. They are chiefly distinguished by their leaves.

Barosma betulina.—The leaves are cuneate-obovate, apex recurved, with their margin sharply denticulate by spreading teeth. They are from one-half to three-fourths of an inch long, by three-tenths to five-tenths of an inch wide. The non-official species, which have been seen in European markets occasionally, are said to be used in South Africa as substitutes for the official buchu; they are:

Barosma crenulata (L), Hook. (*B. crenata,* Lindl.; *Diosma crenata,* De Cand.)—The leaves are opposite, ovate or obovate, acute, serrated and glandular at the edge, coriaceous, and full of small pellucid dots on the under surface. The flowers are white or of a reddish tint, and stand solitarily at the end of short, lateral leafy shoots.[1]

Barosma Eckloniana, Barth., a plant which has been considered to be only a variety of *B. crenulata,* has leaves which are rounded at the base, shorter and proportionately wider than those of *B. crenulata,* and also grow upon pubescent shoots.

B. serratifolia (Curt.), Willd.—The leaves are linear lanceolate, equally narrowed towards either end, three-nerved, with a truncate apex, which is always furnished with an oil-cell, and a sharply serrulate margin. Their length is from an inch to an inch and a half; their width one-fifth of an inch.

The leaves of *Barosma venusta,* which are said to have appeared in the London markets, are readily distinguished by their being very much smaller than those of *B. betulina,* which they otherwise resemble.

Under the name of *Karoo buchu,* in 1904 the leaves of the *Diosma succulenta,* L., var. *B. Bergiana,* H. and S., appeared in London; they are small and heath-like, thick, obtuse, and slightly recurved, and yielded to C. E. Sage (*C. D.,* 65, 506, 787) a semi-solid volatile oil having the odor of peppermint.

Properties.—Buchu leaves are officially described as "about 15 Mm. long, varying between oval and obovate, yellowish-green, apex obtuse, margin crenate or serrate with a gland at the base of each tooth, the base more or less wedge-shaped; coriaceous, both surfaces beset with numerous slight projections; odor strong and characteristic; taste somewhat mint-like, pungent and bitterish." *U. S.* "The transverse section exhibits an epidermis whose cells contain yellow sphero-crystals; the inner walls of these cells are thick and rich in mucilage. Odor and taste strong and characteristic." *Br.* The leaves of *B. crenulata* constitute the *short buchu* or *round buchu,* while those of *B. serratifolia* are the *long buchu* of commerce. The leaves of *B. crenulata* are at present comparatively infrequent in commerce, the parcels usually consisting of those of one of the other species almost unmixed. The species can be recognized by the characters already given. The leaves of the *Empleurum serrulatum* sometimes occur mixed with buchu leaves, occasionally constituting the bulk of the parcel. They are to be distinguished by their acrid taste and peculiar odor and by being longer and narrower than any buchu leaf, with a sharp-pointed apex, parallel sides, and coarse denticulation. Further, according to Holmes, when the leaf of a Barosma is held up to the light the lateral veins appear straighter, longer, and more strongly developed than in the leaves of the Empleurum. John C. Umney (*P. J.,* March, 1895) finds that the leaves of the latter contain 0.64 per cent. of a peculiar volatile oil. There is no reason to believe that they possess the therapeutical properties of buchu. Holmes enumerated a number of plants used in South Africa as substitutes (see *P. J.,* 1900, 70).

Flückiger obtained from *B. betulina* 1.56 per cent. of volatile oil, which had the odor of peppermint rather than of buchu, and deviated the plane of polarization considerably to the left. On exposure to cold it furnished a camphor, which, after re-solution in alcohol, crystallized in needle shaped forms. After repeated purification in this manner, the crystals of *Barosma camphor,* or *diosphenol,* $C_{10}H_{16}O_2$, have a peppermint odor; they fuse at 85° C. and begin to sublime at 110° C. After fusion they again solidify only at 50° C. Barosma camphor is abundantly soluble in carbon disulphide. The crude oil from which the camphor had been separated had a boiling point of about 200° C., quickly rising to 210° C. or even higher. The oil which distilled between these temperatures, rectified over sodium, gave approximately the formula $C_{10}H_{16}O$. (*Pharmacographia,* 2d ed., p. 109.) Spica examined *B. crenulata* and found the volatile oil to differ from that obtained by Flückiger from *B. betulina;* the solid body was similar to diosphenol, but upon analysis gave the figures $C_{10}H_{16}O_2$, and hence is regarded by Spica as an oxycamphor. The liquid portion was a greenish-yellow oil, having a pleasant odor and a pungent, peppermint-like taste; by fractioning, it was separated into a portion isomeric with borneol, resembling thymol in odor and taste, to which the name of *dioscamphor* was given. A sub-

[1] C. J. S. Thompson has found that the leaves of *B. serratifolia* yield only 3.45 per cent. of resin and 1 per cent. of volatile oil, while those of *B. crenulata* yield 3.75 per cent. of resin and 1.6 per cent. of volatile oil, and those of *B. betulina* give 4.25 per cent. of resin and 1.45 per cent. of volatile oil; so that *B. serratifolia* would seem to be the least active of the species. (*P. J.,* xxi. 1890.)

stance extracted by alcohol from the residue after the removal of the oil Spica named *diosmin.* (*P. J.,* 1885, p. 106.) The results of Spica were confirmed by Shimoyama (*A. J. P.,* 1888, p. 624), who made several simple derivatives of diosphenol, and then prepared from it, by prolonged digestion with alcoholic potash, *diolic acid,* $C_{10}H_{18}O_3 + H_2O$, forming white crystalline needles, melting at 96° to 97° C., and a compound to which he gave the name *diol-alcohol.* Wayne's experiments (*A. J. P.,* 1876, p. 19) appear to indicate that the oil also contains a substance capable of being converted into salicylic acid. J. M. Maisch believed that buchu leaves do not contain salicylic acid, although the stearopten of the oil gives a blackish color with ferric chloride. (*A. J. P.,* July, 1881.) The yield of ash varies, according to the researches of H. W. Jones (*P. J.,* ix. 673), from 4.69 to 4.40 in *B. betulina,* 4.32 to 5.39 in *B. crenulata,* 5.03 to 5.22 in *B. serratifolia;* the ash itself was remarkable as containing a great deal of manganese. The short leaved buchu was found by P. W. Bedford to yield an average of 1.21 per cent. of volatile oil; while the long leaved, though more highly valued in the market, gave only 0.66 per cent., showing its great inferiority in strength. (*Proc. A. Ph. A.,* 1863, p. 211.)

Uses.—Buchu, originally employed by the Hottentots, has long since come into general use. Its activity depends upon the volatile oil, which is eliminated by the kidneys. Under its action there is no marked increase in the amount of the urine, hence the remedy is of no value in *dropsies,* but the oil affects very decidedly the mucous membrane of the genito-urinary tract. The remedy is very useful in *diseases of the urinary organs,* such as *gravel, chronic catarrh of the bladder, morbid irritation of the bladder and urethra, diseases of the prostate,* and *retention or incontinence of urine* from a loss of tone in the parts concerned in its evacuation. It should be given when the inflammation is not severe, but when it is in that condition of chronicity requiring oil of turpentine, tincture of cantharides, or other stimulant diuretics. An infusion (one ounce in a pint of boiling water) may be given in the dose of one to two fluidounces (30 to 60 Cc.), but the best preparation is the fluidextract.

Dose, one drachm (3.9 Gm.); of the fluidextract, a fluidrachm (3.75 Cc.), three or four times a day.

Off. Prep.—Fluidextractum Buchu, *U. S.;* Infusum Buchu, *Br.;* Tinctura Buchu, *Br.*

BUTYL-CHLORAL HYDRAS. Br.

BUTYL-CHLORAL HYDRATE

(bū′tȳl-ȼhlō′rạl hȳ′drăs)

$C_4H_5Cl_3O.H_2O = 191.94$

"Butyl-Chloral Hydrate, or trichlorbutylidene glycol, $CH_3.CHCl.CCl_2.CH(OH)_2$, is a crystalline hydrate obtained by the addition of water to the liquid butyl chloral produced by the action of chlorine gas on aldehyde." *Br.*

Butylchloralum Hydratum, Chloralhydratum Butyli; Trichlorbutylidene Glycol; Hydrous Butyl Chloral; Croton Chloral Hydrate (wrongly so called); Chloralum Butyli Hydratum; Butyl Chloralhydrate; Hydrate de Chloral Butylique, *Fr.;* Butylchloralhydrat, Trichlorbutylaldehydhydrat, *G.*

This substance was discovered by Krämer and Pinner of Berlin, during an examination of the accumulated by-products of the chloral factory of Schering. It was named croton-chloral hydrate because it was believed to bear a relationship to crotonic acid, the peculiar acid of croton oil; this was subsequently disproved by Pinner, who showed that it belonged to the butyl series. (*Ber. d. Chem. Ges.,* vii. 1321, 1561.) It is made by passing dry chlorine through aldehyde cooled to —10° C. (14° F.), in an apparatus similar to that used in making chloral. Fractional distillation is resorted to, and the product boiling between 163° C. (325.4° F.) and 165° C. (329° F.) is reserved; this is butyl-chloral, a colorless oily fluid. The necessary amount of water is added, and butyl-chloral hydrate is obtained.

Properties.—Butyl-chloral hydrate occurs in the form of crystalline, micaceous scales of a pungent odor, sparingly soluble in water, freely soluble in alcohol, hot water, and glycerin, but insoluble, or nearly so, in chloroform, a property which may be employed to separate it from ordinary hydrated chloral. When treated with caustic alkalies it is converted into formic acid, potassium chloride, and allylene dichloride, $C_3H_4Cl_2$. The British Pharmacopœia describes it as "in pearly white, trimetric laminæ, having a pungent but not acrid odor, and an acrid nauseous taste. It fuses at about 172° F. (77.8° C.) to a transparent liquid, which, in cooling, commences to solidify at about 160° F. (71.1° C.). Soluble in about 50 parts of *water,* and in its own weight of *glycerin* or of *alcohol* (90 per cent.); it slowly dissolves in 20 parts of *chloroform.* The aqueous solution is neutral or but slightly acid to *litmus.* It does not yield chloroform when heated with *solution of potassium hydroxide* or with *milk of lime* (absence of chloral hydrate)." *Br.*

Uses.—Butyl-chloral hydrate was proposed by Liebreich, in 1870, as a remedy in the treatment of *trigeminal neuralgia.* He states that a drachm (3.9 Gm.) of it causes deep sleep, accompanied by anæsthesia of the head, with complete loss of irritability of the eyeball and of the trigeminal nerve. The circulation is kept up with great tenacity, and, if the dose has been large enough, death results from the arrest of respiration. These statements of Liebreich were contradicted by the research of J. von Mering and of H. W. Schmidt, who found that no anæsthesia was produced unless sufficient doses were given to cause complete narcosis, and that the general course of the symptoms caused by the butyl-chloral hydrate was exactly parallel to that of those produced by hy-

drated chloral. But a number of observers have used butyl-chloral hydrate with asserted good results in *tic-douloureux*. The relief obtained is, unfortunately, only temporary and palliative. The drug has been commonly administered in doses of from 5 to 20 grains (0.32 to 1.3 Gm.) in syrup. The safer plan is to give 5 grains (0.32 Gm.) every half hour until 30 grains (2.0 Gm.) have been taken or relief afforded. The original formula of Liebreich was—butyl-chloral hydrate 5 to 10 parts; glycerin 20 parts; distilled water 130 parts. Dose, half a fluidounce, followed in five minutes by a second dose, ten minutes later by a third dose, unless relief is afforded. That such medication is safe is not certain. For experiments in making and dispensing solutions of butyl-chloral hydrate, see *Proc. A. Ph. A.*, 1894, 578.

Dose, of British Pharmacopœia, from five to twenty grains (0.32 to 1.3 Gm.).

CAFFEINA. U. S., Br.

CAFFEINE [Theine]

(căf-fe-ĭ'nạ)

$C_8H_{10}N_4O_2 + H_2O = 210.64$

"A feebly basic substance [$C_5H(CH_3)_3N_4O_2 + H_2O$] obtained from the dried leaves of *Thea sinensis* Linné (Fam. *Ternstræmiaceæ*), or from the dried seeds of *Coffea arabica* Linné (Fam. *Rubiaceæ*); found also in other plants."[1] *U. S.* "An alkaloid, $C_8H_{10}N_4O_2,H_2O$, usually obtained from the dried leaves of Camellia Thea, *Link*, or the dried seeds of Coffea arabica, *Linn.* Crystallized from aqueous solution, it contains one molecule of water." *Br.*

Trimethyl-xanthine, Methyl-theobromine; Caffeia, Theina, Guaranina, Caféine, *Fr. Cod.;* Coffeïnum, *P. G.;* Koffeïn, Kaffeïn, Theïn, *G.;* Caffeina, *It.;* Cafeina, *Sp.*

Caffeine (*Caffeia*) was first discovered by Runge, and afterwards by Pelletier, Caventou and Robiquet. Strecker first proved it to be methyl-theobromine by making it from theobromine synthetically.[2] (*Ann. Ch. Ph.*, 118, 170.) It is now recognized as an immediate derivative of xanthine, $C_5H_4N_4O_2$ being the trimethyl-derivative of the same, and it belongs to the purine group, of which xanthine is the dioxy-derivative. Emil Fischer has accomplished the conversion of uric acid, $C_5H_4N_4O_3$, into xanthine, and this into caffeine.

Caffeine may be made as follows: Exhaust bruised coffee by two successive portions of boiling water, unite the infusions, add lead acetate in order to precipitate various principles accompanying the caffeine, filter, decompose the excess of lead acetate in the filtered liquor by hydrogen sulphide, concentrate by evaporation, and neutralize with ammonia. The caffeine is deposited in crystals upon cooling, and may be purified by redissolving in water, treating with animal charcoal, and evaporating. H. Leuchsenring obtains caffeine by availing himself of its property of subliming unchanged by heat. He precipitates a concentrated decoction of coffee by a weak solution of lead acetate, filters, evaporates to dryness, mixes the residue with sand, and sublimes as in Mohr's process for procuring benzoic acid. (*A. J. P.*, xxxii. 25.) Still another method, proposed by Vogel, is to treat coffee, ground to powder, with petroleum benzin, which dissolves the caffeine and an oily substance, separate the petroleum benzin by distillation and treat the residue with boiling water, which dissolves the caffeine, and deposits it in a crystalline form, after filtration and concentration. (*J. P. C.*, 3e sér., xxxv. 436.) Paul and Cownley's process for estimating the caffeine in coffee is to mix finely powdered coffee with moist lime, and exhaust with alcohol by hot repercolation. The alcohol is evaporated off, and the residue mixed with water and a few drops of diluted sulphuric acid; the mixture is filtered, and the filtrate and washings, when cool, treated with chloroform to wash out the alkaloid; the chloroformic solution is evaporated in a tared dish, and the residue weighed as caffeine. (*P. J.*, 1887, p. 565.) Petit and Terrat subsequently found that the presence of lime or magnesia retards the extraction of the caffeine, they recommend direct extraction by chloroform containing a trace of water (*J. P. C.*, 1896, 529). For another method, by E. D.

[1] The United States Pharmacopœia allows caffeine to be prepared from either one of the ordinary commercial sources, but because tea leaves contain a much larger percentage of the alkaloid than does the coffee berry, and are frequently thrown into commerce in a damaged condition, unfit for use as a beverage, commercial caffeine is almost always prepared from them. If the assertion of Thomas J. Mays, that theine, though chemically identical with caffeine, is physiologically different, be confirmed, it will become necessary to recognize theine as an official alkaloid, and direct that caffeine be prepared from coffee. The argument that tea and coffee differ in their gross effects on the human body, and that therefore the alkaloids cannot be identical, has no force, because coffee contains an active empyreumatic oil, developed during the process of roasting. How far the conclusions arrived at by Mays by experiments upon frogs must be accepted still remains a matter of opinion. We think, however, that further physiological studies of the three alkaloids theine, caffeine, and guaranine are necessary before their physiological diversity can be considered established. Dunstan and Shepheard (*J. Chem. S.*, 1893, 195) reviewed the question of the identity of caffeine and theine with great care, and established the complete chemical identity of the two by a study of a number of derivatives. The clinical results obtained by Mays (*Med. News*, vol. xlviii.) are sufficient to warrant the trial of theine as a local anæsthetic injected in a dose of a third of a grain over painful nerves.

[2] In an examination of 25 varieties of coffee, Dragendorff found a variation in the amount of caffeine of from 0.6 to 2.2 per cent. The most important varieties were as follows:

Brown Penang	0.71	per cent.
Finest Mocha	0.64	"
Yellow Menado	1.22	"
Finest plantation Jamaica	1.43	"
First Surinam	1.78	"
Pearl plantation Ceylon	0.78	"
Yellow Java	0.88	"
Gray Java	2.21	"
First native Ceylon	0.87	"
Second " "	1.54	"
Third " "	1.59	"
Costa Rica	1.18	"
West Indian	1.22	"
Rio	1.14	"
Jamaica	0.67	"
Santos	1.46	"

Smith, see *Ph. Era*, 1887, 17; see also *A. J. P.*, 1892, 468, and 1893, 338; *J. P. C.*, 1893, 545; *Ap. Ztg.*, 1893, 132; *C. D.*, 1893, 210; *Ph. Era*, 1897, 391.

Caffeine is prepared on a considerable scale from damaged tea. The tea is exhausted with boiling water, the decoction boiled with litharge or lead acetate, and the filtered solution evaporated till the alkaloid crystallizes out on cooling. The product can be purified by resublimation or by crystallization from hot water. (Allen, *Com. Org. Anal.*, 2d ed., vol. iii., part ii., 474.)

Properties.—Caffeine is a feeble base, capable of forming definite compounds with mineral acids but not with organic acids; the latter, however, increase its solubility in water and other liquids. (See *Caffeina Citrata.*) Caffeine is in "white, flexible, silky, glistening needles, usually matted together in fleecy masses, permanent in the air; odorless, and having a bitter taste. If crystallized from water, it contains one molecule of water of crystallization, but if crystallized from alcohol, chloroform, or ether, it contains none. Soluble in 45.6 parts of water, 53.2 parts of alcohol, 375 parts of ether, and 8 parts of chloroform at 25° C. (77° F.); soluble in 5.2 parts of water at 80° C. (176° F.), and in 17.1 parts of alcohol at 60° C. (140° F.). Its solubility in water is increased by the presence of certain salts,—*e.g.*, potassium bromide, sodium benzoate, sodium salicylate, and others. Caffeine sublimes at about 178° C. (352.4° F.), and should leave no residue. Its melting point is 236.8° C. (458.3° F.). An aqueous solution of Caffeine is neutral to litmus paper. If a small quantity of Caffeine be dissolved in about 1 Cc. of hydrochloric acid in a porcelain dish, a little potassium chlorate added, the whole evaporated to dryness on a water-bath, and the dish then inverted over a vessel containing a few drops of ammonia water, the residue will acquire a rich purple color, which is destroyed by fixed alkalies. If a fragment of Caffeine be dissolved in sulphuric acid and a minute fragment of potassium dichromate be added to the liquid, a yellowish-green color, which gradually becomes green, will be produced. Caffeine should dissolve in sulphuric acid or in nitric acid without producing a color (absence of *organic impurities*). Its aqueous solution should not be precipitated by mercuric potassium iodide T.S. (absence of *alkaloids*)." *U. S.* The British Pharmacopœia describes it as "soluble in 80 parts of cold *water*, the solution having a faintly bitter taste and being neutral to *litmus*. Easily soluble in boiling *water, alcohol* (90 per cent.), or *chloroform;* sparingly soluble in *ether*. It dissolves without color in *sulphuric* and *nitric acids*. At 212° F. (100° C.) the crystals lose 8.49 per cent. of their weight, and at a higher temperature melt and volatilize without decomposition. Treated with a crystal of *potassium chlorate* and a few drops of *hydrochloric acid*, and the mixture evaporated to dryness in a porcelain dish, a reddish residue results, which becomes purple when moistened with *solution of ammonia*. In an aqueous solution of the alkaloid, *tannic acid* gives a white precipitate soluble in excess of the reagent, but no precipitate is caused by *solution of potassium iodide* containing mercuric iodide (distinction from other official alkaloids)." *Br.*

When the solution, made by saturating potassium iodide with mercuric oxide, is added to a solution of caffeine, a precipitate is produced, which soon takes the form of white, shining, acicular crystals. This reaction was proposed as a test of caffeine by Dellfs; for though the same solution will precipitate the other alkaloids, the product is always amorphous. (*Chem. Gaz.*, Feb. 45, 1855.) Tanret proposes to increase the solubility of caffeine by adding definite proportions of sodium benzoate, cinnamate or salicylate, which form with it compounds rich in alkaloid (45.8, 58.9, and 61 per cent. respectively). These are well adapted for hypodermic administration, as they are all freely soluble in water. The proportions recommended are as follows: *caffeine-sodium benzoate* (caffeine, 244, sodium benzoate, 288); *caffeine-sodium cinnamate* (caffeine, 244, sodium cinnamate, 170); *caffeine-sodium salicylate* (caffeine, 244, sodium salicylate, 160). (*L'Union Pharm.*, xxxvii, 394.) Caffeine is remarkable for containing a larger proportion of nitrogen than does almost any other proximate vegetable principle, in this respect equalling some of the highly animalized products.

Uses.—There have been a few cases of poisoning by caffeine; a drachm of citrated caffeine swallowed by an adult was followed by burning in the throat, giddiness, faintness, nausea, tremor of the extremities, abdominal pain, mental distress, great cardiac oppression and finally collapse. Consciousness was not impaired and there was no headache until the patient began to recover. A decoction of 8 ounces of freshly roasted coffee, taken for the purpose of producing abortion, caused pronounced choreic tremors, great restlessness, quickened respiration, and rapid pulse, with very strong, even violent, heart beats. In doses of 3 to 5 grains caffeine produces in the healthy individual a peculiar wakefulness, with stimulation of the cerebrum, and some increase of the urinary secretion and force of the pulse. There is usually marked increase of the mental activity and of the capability for sustaining mental work. About two hours after the ingestion of 12 grains by Pratt, there were intense physical restlessness and mental anxiety, with obstinate sleeplessness, active and persistent thinking, general muscular tremulousness, and frequent urination.

Given in large dose to the lower animals, caffeine produces hurried respiration, restlessness, slightly lowered, followed by markedly elevated, temperature, tetanic and clonic convulsions, progressive paralysis, and finally death from paralytic arrest of respiration. The cause of the convulsions in mammals is not determined, but in the frog they are of spinal origin, for

both Pratt and Le Blond have found that cutting of the cord does not arrest them below the point of section, while destruction of the cord (Pratt and Leven) prevents their development. It would appear, therefore, that caffeine acts upon the frog as a stimulant to the motor side of the spinal cord, and it is probable that the physical restlessness and tremulousness produced in man are largely of spinal origin. Upon the motor nerves caffeine has no effect, but there is some reason for suspecting that it exerts a very feeble influence upon the sensory nerves. Upon the muscles caffeine acts as a powerful poison; when an isolated piece of the gastrocnemius of the frog is thrown into a one per cent., or even weaker, solution of the citrate of caffeine, it becomes contracted and stiff, and unable to respond to the galvanic current in from two to three minutes. It has been abundantly proved that it is the muscle fibre which is affected, and it seems to be established that the paralysis is preceded by a period of excitement, during which the contractility of the muscle is increased both in its sensitiveness to stimuli and in its power. The action of caffeine upon the circulation is distinct, as has been shown by Leven, Binz, and other observers. The alkaloid produces in the mammal, elevation of the arterial pressure, which is at least in part due to a direct action upon the heart; caffeine in small dose reinforces the isolated frog's heart, and gives to its contractions more amplitude and more energy. Reichert found that even after destruction of the vasomotor centres in the medulla oblongata, caffeine still elevates the arterial pressure. He believes that this rise of the arterial pressure, which must be independent of the vasomotor centres, is due to a direct action of the caffeine upon the muscle fibres in the vessel walls. Direct proof of this, however, seems to be wanting, and it remains uncertain whether the rise of pressure is due entirely or only in part to the cardiac stimulation. In advanced stages of caffeine poisoning the arterial pressure falls, both the heart and the vasomotor system being depressed or paralyzed. The pulse rate is usually but not always increased by caffeine, probably due to a stimulation of the cardio-accelerator mechanism.

One of the most constant symptoms produced in man by overdoses of caffeine is excessive diuresis, and experiments made upon the lower animals show that caffeine acts as a diuretic not only by influencing the circulation, but also by directly affecting the secreting cells of the kidney or the nerves which dominate those cells, the probabilities being in favor of the first of these theories of action. According to Schroeder, not only the water but also the solids of the urine are increased.

The question whether caffeine has an influence upon tissue changes and the consequent nitrogenous elimination cannot be considered as distinctly answered, though the most probable conclusion is that the action of caffeine upon urea elimination and upon general nutrition is not direct or pronounced. While the therapeutic dose of caffeine is broken up in the body with the formation of methyl-xanthine, which escapes with the urine, the toxic dose is at least in part eliminated by the kidney unchanged.

Caffeine is a valuable remedy in practical medicine as a cerebral and cardiac stimulant and as a diuretic. In undue *somnolence,* in *nervous headache,* in *narcotism,* also, at times, when the exigencies of life require excessively prolonged wakefulness, caffeine may be used as the most powerful agent known for producing wakefulness. In a series of experiments, J. Hughes Bennett found that within narrow limits there is a direct physiological antagonism between caffeine and morphine. Coffee and caffeine in narcotic poisoning are of value as a means of keeping the patient awake, and of stimulating the respiratory centres.

As a cardiac stimulant, caffeine may be used in any form of *heart failure;* the indications for its use are those which call for the employment of digitalis. It is superior to digitalis in never disagreeing with the stomach, in having no distinctive cumulative tendency, and in the promptness of its action. It is pronouncedly inferior to digitalis in the power and certainty of its action, and in the permanence of its influence once asserted. As a diuretic it is superior; it is very valuable in the treatment of *cardiac dropsies,* and is often useful in *chronic Bright's disease* when there is no irritation of the kidneys.

On account of its tendency to produce wakefulness, it is usually better to mass the doses early in the day, at least six hours being left between the last dose and the ordinary time for sleep. From eight to fifteen grains may be given in the course of a day in severe cases. If tried, it would probably prove a useful drug in cases of *sudden collapse* from various causes. The ordinary compounds of it are, however, not available for hypodermic use, because they are decomposed in the presence of water. The double benzoate of sodium and caffeine has been proposed as moderately stable and free from irritant properties: the following formula has also been commended by Tanret for hypodermic use: sodium salicylate, 31 gr.; caffeine, 40 gr.; distilled water, 60 gr. For internal administration the soluble preparation known as citrated caffeine is usually preferred.

Dose, one to five grains (0.065 to 0.32 Gm.).

Off. Prep.—Caffeina Citrata, *U. S.* (*Br.*); Pulvis Acetanilidi Compositus, *U. S.*

CAFFEINA CITRATA. U. S. (Br.)

CITRATED CAFFEINE [Caffeine Citrate]

(kăf-fe-ī'nă cĭ-trā'tă)

"An unstable compound, $C_8H_{10}N_4O_2,C_6H_8O_7$, prepared from Caffeine and Citric Acid." *Br.*

Caffeinæ Citras, *Br.;* Citrate de Caféine, *Fr.;* Koffeïncitrat, Citronensaures Koffeïn, *G.;* Citrato cafeico, *Sp.*

* "Caffeine, *fifty grammes* [or 1 ounce av., 334 grains]; Citric Acid, *fifty grammes* [or 1 ounce av., 334 grains]; Distilled Water, hot, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Dissolve the Citric Acid in the hot Distilled Water, add the Caffeine, and evaporate the resulting solution, on a water-bath, to dryness, constantly stirring toward the end of the operation. Reduce the product to a fine powder and transfer it to well-stoppered bottles." *U. S.* "Caffeine, 1 *ounce* (Imperial) or 20 grammes; Citric Acid, 1 *ounce* (Imp.) or 20 grammes; Distilled Water, 2 *fl. ounces* (Imp. meas.) or 40 cubic centimetres. Dissolve the Citric Acid in the Distilled Water; stir the Caffeine into the heated solution; evaporate to dryness on a water-bath, constantly stirring towards the end of the operation; reduce to a fine powder." *Br.*

In this preparation Merson (*P. J.*, 1904, 8) prefers to mix the caffeine with the citric acid without the aid of a liquid; he uses a sieve, water bath, and granulating tray, and asserts that the process yields a superior product. It is not regarded by chemists as a chemical salt, but as a mechanical mixture of the two substances composing it. The British Pharmacopœia gives the following as its chemical formula: $C_8H_{10}N_4O_2,C_6H_8O_7$.

It is described by the U. S. Pharm. as "a white powder, odorless, having a slightly bitter, acid taste and an acid reaction. One part of Citrated Caffeine forms a clear, syrupy solution, with about 4 parts of hot water. Upon dilution with 5 parts of water, a white, crystalline precipitate (caffeine) separates, which redissolves when about 25 parts of water have been added. It is also soluble in a mixture of equal volumes of chloroform and alcohol. If 0.25 Gm. of Citrated Caffeine be mixed with 5 Cc. of concentrated sulphuric acid in a porcelain dish, the mixture protected from dust and heated for fifteen minutes on a water-bath, a lemon-yellow color, and not a brown or black color, should develop (absence of *tartaric acid*)." *U. S.* The British Pharm. describes it as "a white inodorous powder with an acid and faintly bitter taste and an acid reaction on *litmus.* It is soluble in 32 parts of *water,* and also in a mixture of 2 parts of *chloroform* with one part of *alcohol* (90 per cent.). With 3 parts of *water* it forms a clear syrupy solution, but more *water* dissociates the salt and affords a white precipitate of caffeine which redissolves when excess of *water* is added. Heated in the air, the salt is charred and then burnt, leaving a mere trace of ash. It affords the reactions mentioned under 'Caffeina,' and also those characteristic of citrates." *Br.*

Uses.—Citrated caffeine is possessed of the physiological and therapeutic properties of caffeine.

Dose, from three to eight grains (0.2 to 0.5 Gm.).

Off. Prep.—Caffeina Citrata Effervescens, *U. S.* (*Br.*).

CAFFEINA CITRATA EFFERVESCENS. U. S. (Br.)

EFFERVESCENT CITRATED CAFFEINE

(căf-fẹ-ī′nạ cị-trā′tạ ĕf-fẹr-vĕs′cẹnṣ)

Caffeinæ Citras Effervescens, *Br.;* Effervescent Caffeine Citrate; Coffeïnum Citricum Effervescens; Brausendes Koffeïncitrat, *G.*

* "Citrated Caffeine, *forty grammes* [or 1 ounce av., 180 grains]; Sodium Bicarbonate, dried and powdered, *five hundred and seventy grammes* [20 ounces av., 46 grains]; Tartaric Acid, dried and powdered, *three hundred grammes* [or 10 ounces av., 255 grains]; Citric Acid, uneffloresced crystals, *one hundred and ninety-five grammes* [or 6 ounces av., 384 grains], to make about *one thousand grammes* [or 35 ounces av., 120 grains]. Powder the Citric Acid and mix it intimately with the Citrated Caffeine and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.). When the mixture has acquired a moist consistence by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles." *U. S.*

"Sodium Bicarbonate, in powder, 51 *ounces* (Imperial) or 510 grammes; Tartaric Acid, in powder, 27 *ounces* (Imp.) or 270 grammes; Citric Acid, in powder, 18 *ounces* (Imp.) or 180 grammes; Refined Sugar, in powder, 14 *ounces* (Imp.) or 140 grammes; Caffeine Citrate, 4 *ounces* (Imp.) or 40 grammes. Mix the Caffeine Citrate, Tartaric Acid, and Citric Acid; with this product thoroughly incorporate the mixed Sodium Bicarbonate and Refined Sugar; place in a dish or pan of suitable form heated to between 200° and 220° F. (93.3° and 104.4° C.). When the mixture, by aid of careful manipulation, has assumed a granular character, separate it into granules of uniform and convenient size by means of suitable sieves. Dry the granules at a temperature not exceeding 130° F. (54.4° C.). The product should weigh about 100 *ounces* (or 1000 grammes)." *Br.*

This compound contains about two per cent. of caffeine; the proportion was about one per cent. in the U. S. P. 1890. The old expensive process in which alcohol was used to make the mass, was abandoned, the amount of water of crystallization liberated from the citric acid on decomposition proving sufficient to moisten the mass; this effects a saving in the expense of manufacturing, while the use of heat with skilful manipulation has been found to produce equally good results. It differs from that of the British Pharmacopœia in containing no sugar. Samples of effervescent citrated caffeine have been found in the market very deficient in caffeine; the sweetening is some-

times effected by the use of saccharin instead of sugar. The powder affords an agreeable method of administering citrated caffeine.

Dose, one teaspoonful (3.9 Gm.) in water, to be taken during effervescence.

CALAMUS. U. S.

CALAMUS [Sweet Flag]

(căl'ą-mŭs)

"The unpeeled, dried rhizome of *Acorus Calamus* Linné (Fam. *Araceæ*)." *U. S.*

Radix Calami Aromatici, Radix Acori; Sweet Sedge (Cane, Rush, Root or Myrtle), Myrtle-flag (Grass or Sedge); Acore Vrai, *Fr. Cod.*; Acore Odorant, *Fr.*; Rhizoma Calami, *P. G.*; Kalmus, Kalmuswurzel, *G.*; Calamo aromatico, *It., Sp.*

Acorus Calamus, Willd., *Sp. Plant.* ii. 199; Barton, *Med. Bot.,* ii. 63; *B. & T.* 279.—The sweet flag, or calamus, has a perennial, horizontal, jointed, somewhat compressed root (rhizome), from half an inch to an inch thick, sometimes several feet in length, sending off numerous round and yellowish or whitish radicles from its base, and bunches of brown fibres resembling coarse hair from its joints, internally white and spongy, externally whitish with a tinge of green, variegated with triangular stains of light brown and rose color. The leaves are all radical, sheathing at the base, long, sword-shaped, smooth, green above, but, near their origin from the root, of a red color, variegated with green and white. The scape or flower stem resembles the leaves, but is longer, and from one side, near the middle of its length, sends out a cylindrical spadix, tapering at each end, about two inches in length, and crowded with greenish-yellow flowers. The fruit is an oblong capsule, divided into three cells, and containing numerous oval seeds.

This plant, which grows abundantly in the wet places throughout the United States, is very widespread in its world distribution, being found in Europe, Western and Southern Asia, including India and Japan, so that the dried rhizomes of commerce are produced in the three continents. The leaves as well as the root have an aromatic odor; but the root only is employed. It should be collected late in the autumn, or in the spring. After removal from the ground, the rhizomes are washed, freed from their fibres, and dried with a moderate heat. By drying they lose nearly one-half their diameter, but are improved in odor and taste.[1]

Properties.—Calamus is officially described as follows: "Rhizome 1 to 2 Cm. thick, usually in longitudinally split pieces of various lengths; when entire, cylindraceous and somewhat vertically flattened, externally reddish-brown, somewhat annulate from remnants of leaf-sheaths; upper surface with triangular leaf-scars, the lower surface with circular pitted scars of roots; fracture short, showing numerous oil-cells and scattered fibrovascular bundles, the latter crowded within the endodermis; odor aromatic; taste pungent and bitter." *U. S.* Their texture is light and spongy, their color internally whitish or yellowish white, and their fracture short and rough. A German variety imported consists solely of the interior of the root. The pieces are usually long, slender, irregularly quadrangular, and of grayish-white color.

The odor of calamus is strong and fragrant; its taste warm, bitterish, pungent, and aromatic. Its active principles are taken up by boiling water. From 100 parts of the fresh root of the European plant, Trommsdorf obtained 0.1 of volatile oil, 2.3 of soft resin, 3.3 of extractive with a little potassium chloride, 5.5 of gum with some potassium phosphate, 1.6 of starch analogous to inulin, 21.5 of lignin, and 65.7 of water.[2] Sixteen ounces of the dried root afforded to Neumann about two scruples of volatile oil. The oil is at first yellow, but ultimately becomes red, and has the odor and taste of calamus. Kurbatow (*Ann. Ch. Ph.,* vol. 173, p. 4) examined oil of calamus, and found that the portion boiling below 170° C. (338° F.) yielded after treatment with sodium a terpene, $C_{10}H_{16}$, having a sp. gr. .8793 at 0° C. (32° F.), and having a boiling point of 158° C. (316.4° F.). According to *Schimmel's Report* (April, 1895), all oils of calamus having a lower rotary power than +10° and those which do not yield clear solutions with any proportion of 90 per cent. alcohol should be rejected. The extractive matter has an acrid and sweetish taste. H. Thomas obtained from calamus rhizomes a bitter principle, which he named *acorin,* in the form of a clear, thick, yellow liquid, having a neutral reaction, aromatic odor, and bitter, aromatic taste. It is a glucoside, having the formula $C_{36}H_{60}O_6$, splitting into oil of calamus and sugar; insoluble in water, but readily soluble in absolute alcohol, methylic alcohol and chloroform. By oxidation *acoretin,* a neutral resin is formed, and from the extract remaining after the acorin is removed Thomas obtained an alkaloid which he named *calamine;* this is crystalline, insoluble in water and ether, but soluble in alcohol, chloroform, and acetone. (*A. Pharm.,* 1886, 465; *P. J.,* 1886, 1085.) Calamus is sometimes attacked by worms, and deteriorates by keeping. The India variety is more slender than the European, and has a stronger and more pleasant flavor.

Uses.—Calamus is a feeble aromatic and as such is used, especially in domestic practice, in India and to some extent in other portions of the world. It is said to have been employed also by the Greeks under the name of ἄκορος,

[1] There has been a belief that calamus was known to the ancient Babylonians, this belief being founded on the translation of the word "qanû," occurring in the old Babylonian tablets, as "calamus." Albert G. Clay of the University of Pennsylvania, however, informs us that the word "qanû" means simply, so far as is at present known, "reeds," so that the passage usually translated "into their bowels I poured calamus, cedar, fragrant herbs" should be rendered "into their bowels I poured reeds, cedar, fragrant herbs."

[2] The volatile oil is contained in all portions of the plant, the leaves yielding to distillation, according to the analysis of Schimmel & Co. 0.2 per cent., the fresh root 1.5 to 3.5 per cent. the dried German root 0.8 and the Japan root as much as 5 per cent.

but not to be the *calamus aromaticus* of Dioscorides, which is affirmed by Royle to have been derived from Andropogon. The volatile oil is largely used in perfumery, and the powdered root itself is esteemed in Ceylon and India as a vermifuge and an insecticide.

Dose, in substance, 20 to 60 grains (1.3 to 3.9 Gm.); of infusion (an ounce to one pint of boiling water), one to two wineglassfuls (60 to 120 Cc.).

Off. Prep.—Fluidextractum Calami, *U. S.*

CALCII BROMIDUM. U. S.

CALCIUM BROMIDE

(kăl'cĭ-ī brō'mĭ-dŭm)

$CaBr_2 = 198.52$

"It should contain not less than 97 percent. of pure Calcium Bromide, and should be kept in well-stoppered bottles." *U. S.*

Calcium Bromatum, Bromure de Calcium, Bromure de Chaux, *Fr.;* Brom Kalk, Calciumbromid, *G.*

The process of Boedecker for its preparation consists in first forming a sulphur bromide, by the addition of 20 parts of the flowers of sulphur to 240 parts of bromine; this is added to a milk of lime containing 140 parts of fresh lime. Calcium bromide and sulphate are formed and are readily separated. (*J. P. C.,* 4e sér., viii. 463.) By the process of Jas. R. Mercein, five ounces of bromine and two and a half pints of water are put in a half-gallon specie jar, a stream of hydrogen sulphide passed through the bromine until it is all taken up, the liquid filtered, excess of hydrogen sulphide driven off by heat, and the solution of hydrobromic acid thus obtained distilled until four-fifths have passed over; the distillate is saturated with excess of precipitated calcium carbonate, filtered, and evaporated. (*A. J. P.,* xliv. 100.) Macdonald's method (*A. J. P.,* 1873), is as follows. Dissolve 4 ounces of ammonium bromide in a pint of water. Put into a flask and bring to the boiling point. Keep boiling, and add milk of lime (made from *pure* calcined lime) in small quantities, until ammoniacal vapors cease to be evolved. The operator can easily tell when this point has been reached, by the sense of smell. Filter the solution, evaporate to a syrupy consistency, remove from the fire, and stir until cold. Tasilly prepares *calcium oxybromide* by adding three parts of calcium oxide in small portions to a solution of one hundred parts of calcium bromide in seventy-five parts of hot water; acicular crystals of calcium oxybromide, $CaBr_23CaO,16H_2O$, are deposited on cooling the filtered solution.

Properties.—It is officially described as "a white, granular salt, odorless, of a sharp, saline taste, and very deliquescent. Soluble in 0.5 part of water, and in 1 part of alcohol at 25° C. (77° F.); more soluble at boiling temperatures. An aqueous solution of the salt is neutral to litmus paper. The aqueous solution of the salt (1 in 20) yields with ammonium oxalate T.S. a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid. Silver nitrate T.S. produces a light yellow precipitate, insoluble in nitric acid and in moderate excess of ammonia water." *U. S.*

Tests.—"If to 10 Cc. of the aqueous solution of the salt (1 in 20), 1 Cc. of chloroform be added, then chlorine water, which has been diluted with an equal volume of water, added cautiously, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color free from any violet tint (absence of *iodides*). If 1 Gm. of Calcium Bromide be added to 20 Cc. of water, it should form a clear, colorless solution, leaving no residue (absence of *insoluble impurities*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of Calcium Bromide and 1 Gm. of sodium acetate be dissolved in 5 Cc. of distilled water, and the solution made slightly acid through the addition of from 3 to 5 drops (or a sufficient quantity) of diluted acetic acid, after boiling and thoroughly cooling, the solution should not become cloudy within five minutes upon the addition, with agitation, of 5 drops of potassium dichromate T.S. (absence of *barium*). If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color (absence of *bromate*). To 5 Cc. of an aqueous solution of the salt (1 in 100), contained in a test-tube of about 40 Cc. capacity, add 5 Cc. of potassium hydroxide T.S. and about 0.2 Gm. of aluminum wire. In the upper portion of the test-tube, insert a plug of purified cotton or gauze, and over the mouth, a piece of moistened red litmus paper; place the tube in a bath of boiling water, and after fifteen minutes no blue coloration of the paper should be discernible (limit of *nitrates* and *ammonia*)." *U. S.*

Uses.—Calcium bromide was proposed by Hammond, in 1871, as a substitute for the corresponding salt of potassium. It has failed to gain much support from the medical profession, but is sometimes employed as an adjuvant in *epilepsy* and *hysteria.* Its action upon the lower animals has been partially investigated by Guttmann (*P. M. T.,* iv. 361), who finds that it is a sedative to the nerve centres, but lacks the depressant cardiac action of potassium bromide.

Dose, fifteen to thirty grains (1 to 2 Gm.).

CALCII CARBONAS PRÆCIPITATUS. U. S., Br.

PRECIPITATED CALCIUM CARBONATE
PRECIPITATED CHALK

(kăl'cĭ-ī cär'bŏ-năs præ-cĭp-ĭ-tā'tŭs)

$CaCO_3 = 99.35$

"It should contain not less than 99 percent. of pure Calcium Carbonate." *U. S.* "The

precipitate, $CaCO_3$, obtained by the interaction of calcium chloride and sodium carbonate." *Br.*

Carbonas Calcicus Præcipitatus, Creta Præcipitata, Calcaria Carbonica Præcipita; Precipitated Carbonate of Lime; Carbonate de Chaux Precipité, *Fr. Cod.;* Craie Precipitée, *Fr.;* Calcium carbonicum præcipitatum, *P. G.;* Calciumcarbonat; Präcipitirter kohlensaure Kalkerde, *G.;* Carbonato di calcio precipitato, *It.;* Carbonato de cal, *Sp.*

A formula for this salt is found in the Pharmacopœia of 1870. It is as follows: "Take of Solution of Chloride of Calcium *five pints and a half;* Carbonate of Sodium *seventy-two troy-ounces;* Distilled Water *a sufficient quantity.* Dissolve the Carbonate of Sodium in six pints of Distilled Water. Heat this solution and the Solution of Chloride of Calcium, separately, to the boiling point, and mix them. After the precipitate has subsided, separate it from the supernatant liquid by decantation, and wash it with boiling Distilled Water until the washings cease to be affected by a solution of nitrate of silver. Lastly, dry the precipitate on bibulous paper." *U. S.* 1870.

A mutual interchange of principles takes place, resulting in the production of sodium chloride which remains in solution, and calcium carbonate which is deposited,

$$CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl$$

Any peculiar advantage of the preparation must depend on the minute division of its particles. According to Bridges, this effect is best obtained by employing the solutions at the boiling temperature, a precaution which is observed in most processes. (*A. J. P.*, xvi. 163.) When properly made, it is "a fine, white powder, without odor or taste, and permanent in the air. Nearly insoluble in water; the solubility is increased by the presence of ammonium salts, and especially by carbon dioxide; alkali hydroxides diminish its solubility; insoluble in alcohol; in diluted acetic, hydrochloric, or nitric acid, it is completely soluble with effervescence. When heated to full redness, with access of air, the salt gradually loses carbon dioxide, and a residue of calcium oxide remains. For applying tests of identity and of purity, 5 Gm. of Calcium Carbonate are mixed with 100 Cc. of distilled water, followed by hydrochloric acid, added drop by drop, with agitation, until solution takes place. The resulting solution should, after boiling and cooling, be of acid reaction, and there should not remain more than traces of insoluble matter. In a portion of this acid solution, after neutralizing with ammonia water, ammonium oxalate T.S. produces a white precipitate of calcium oxalate, insoluble in acetic acid but soluble in hydrochloric acid. If to 20 Cc. of the acid solution, ammonia water be added until of alkaline reaction, no turbidity or precipitation should take place either before or after boiling (absence of *iron, aluminum, phosphates,* etc.). The acid solution should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of the salt be agitated with 50 Cc. of water, the filtrate should not show an alkaline reaction with litmus paper, and, on evaporation, should not leave a weighable residue (limit of *soluble impurities*)." *U. S.*

Uses.—For ordinary purposes, it probably has no such superiority over prepared chalk as to counterbalance its greater expensiveness, but it is preferred by some in the preparation of tooth powders.

Dose, from ten to forty grains (0.65 to 2.6 Gm.).

Off. Prep.—Pulvis Morphinæ Compositus, *U.S.;* Syrupus Calcii Lactophosphatis, *U. S., Br.;* Trochiscus Bismuthi Compositus, *Br.*

CALCII CHLORIDUM. U. S., Br.

CALCIUM CHLORIDE

(kăl'cĭ-ī ĉhlō'rĭ-dŭm)

$CaCl_2 = 110.16$

"Calcium Chloride, rendered anhydrous by fusion at the lowest possible temperature. It should contain not less than 99 percent. of pure Calcium Chloride, and should be kept in well-stoppered bottles." *U. S.* "The salt, $CaCl_2,2H_2O$, formed by neutralizing hydrochloric acid with calcium carbonate, carefully desiccated at a temperature not exceeding 392° F. (200° C.)." *Br.*

Calcium Chloratum; Calcaria Muriatica, Chloridum Calcicum; Muriate of Lime, Hydrochlorate of Lime; Chlorure de Calcium Fondu, Hydrochlorate de Chaux, *Fr.;* Chlorcalcium, Calciumchlorid, Salzsaures Kalk, *G.;* Cloruro di calcio, *It.;* Cloruro calcico, *Sp.*

Calcium chloride may be readily formed by saturating hydrochloric acid with chalk or marble, evaporating to dryness, and heating to redness. The hydrochloric acid, by reacting with the calcium carbonate, forms calcium chloride, carbon dioxide, and water, the latter of which is dissipated at a red heat,

$$CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$$

The Br. Ph. (1885), after neutralizing the acid with calcium carbonate, adds a little solution of chlorinated lime and slaked lime, filters, evaporates until the chloride becomes solid, and, instead of igniting the residue, dries it at about 204.4° C. (400° F.). Its composition, according to the British Pharmacopœia, is $CaCl_2, 2H_2O$.

Properties.—Calcium chloride is in "white, slightly translucent, hard fragments, odorless, having a sharp, saline taste. It is very deliquescent. Soluble in 1.3 parts of water, and in 8 parts of alcohol at 25° C. (77° F.); in 1.5 parts of boiling alcohol, and very freely soluble in boiling water, usually leaving a slight residue. Below a red heat the salt fuses, and, on cooling, solidifies without change in composition. When perfectly pure, Calcium Chloride dissolves in water without residue; the solution should be strictly neutral to litmus paper. When the salt has been overheated in fusing, the solution has an alkaline reaction, and a small residue of calcium oxide is left, which is soluble in hy-

drochloric acid. The aqueous solution (1 in 20) yields, with ammonium oxalate T.S., a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid. With silver nitrate T.S. it yields a white precipitate insoluble in nitric acid. If to the aqueous solution of the salt (1 in 20) ammonia water be added, until of alkaline reaction, no turbidity or precipitation should take place either before or after boiling (absence of *iron, aluminum, phosphates,* etc.). If from 10 Cc. of the solution the calcium be completely precipitated by ammonium oxalate T.S., the filtrate should, on evaporation and ignition, leave not more than a trace of fixed residue (limit of *magnesium* and *alkalies*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic* or *lead* (see PART III, Test No. 121)." *U. S.* "In dry, white, very deliquescent masses, soluble in an equal weight of *water* and in 3 parts of *alcohol* (90 per cent.). It affords the reactions characteristic of calcium and of chlorides. It should yield no characteristic reaction with the tests for iron, aluminium, or carbonates, and only the slightest reactions with the tests for magnesium. It evolves no chlorine or hypochlorous acid on the addition of *hydrochloric acid* (absence of hypochlorite)." *Br.* On account of its avidity for water, the fused salt is used for drying gases. The crystallized salt is also very deliquescent, and has the form of colorless, transparent, striated, six-sided prisms. The crystals, on exposure to heat, first dissolve in their water of crystallization, and, after this has evaporated, undergo igneous fusion. With ice or snow they form a powerful frigorific mixture. Calcium chloride exists in the water of the ocean and of many springs. It is usually associated with common salt and magnesium chloride, from which it is separated with difficulty. When crystallized it contains six molecules of water.

Uses.—Calcium chloride has the property of increasing the coagulability of the blood, and has been used to a considerable extent in *hæmophilia, hæmoptysis, menorrhagia,* and other forms of *internal bleeding.* Mayo Robson commends its administration for several days preceding surgical operations in which there is reason to expect severe hemorrhage. In severe cases of internal hemorrhage W. T. Silvestri reports excellent results from the intravenous injection of from three and one-half to five fluidounces (105 to 150 Cc.) of a recently sterilized one per cent. solution of the salt. The five per cent. solution has been frequently used in the form of an enema.

Dose, five grains (0.32 Gm.) three times a day, increased if necessary to twenty grains (1.3 Gm.), in dilute solution.[1]

[1] *Liquor Calcii Chloridi* was official in the U. S. P. 1870. A convenient method of making this preparation is to dissolve 228 grains of fused calcium chloride in 1 fluidounce of distilled water, and filter if necessary.

CALCII HYDRAS. Br.

CALCIUM HYDROXIDE SLAKED LIME

(kăl'cĭ-ī hȳ'drăs)

"Calcium hydroxide, $Ca(HO)_2$, recently prepared by the interaction of water and calcium oxide." *Br.*

Calcis Hydras; Hydrate of Lime; Chaux Eteinte, *Fr. Cod.;* Idrato di calcio, *It.*

The British Pharmacopœia no longer gives a detailed process for slaked lime. The process of the Br. Pharm. (1885) is as follows: "Take of Lime *two pounds* [avoirdupois]; Distilled Water *one pint* [Imperial measure]. Place the Lime in a metal pot, pour the water upon it, and when vapor ceases to be disengaged cover the pot with its lid and set it aside to cool. When the temperature has fallen to that of the atmosphere, put the slaked lime on an iron-wire sieve, and by gentle agitation cause the fine powder to pass through the sieve, rejecting what is left. Put the powder into a well-stoppered bottle, and keep it excluded as much as possible from the air. Slaked lime should be recently prepared." *Br.* 1885. Calcium hydroxide "affords the reactions characteristic of calcium. Strongly heated it loses nearly one fourth of its weight of water. It should yield only the slightest characteristic reactions with the tests for iron, aluminium, magnesium, sodium, potassium, carbonates, chlorides, phosphates, sulphates, or silica." *Br.*

For an account of the physical and medicinal properties of slaked lime, see *Calx.*

CALCII HYPOPHOSPHIS. U. S., Br.

CALCIUM HYPOPHOSPHITE

(kăl-cĭ-ī hȳ-pǫ-phŏs'phĭs)

$Ca(PH_2O_2)_2 = 168.86$

"It should contain not less than 98 percent. of pure Calcium Hypophosphite [$(PO.OH_2)_2Ca$], and should be kept in well-stoppered bottles; caution should be observed in dispensing Calcium Hypophosphite, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents." *U. S.* "Calcium Hypophosphite, $Ca(PH_2O_2)_2$, is obtained by the interaction of phosphorus, calcium hydroxide, and water." *Br.*

Calcis Hypophosphis; Calcium Hypophosphorosum, Hypophosphite of Lime; Calcaria Hypophosphorosa, Hypophosphis Calcicus; Hypophosphite de Chaux, *Fr. Cod.;* Unterphosphorigsaure Kalkerde, Calcium hypophosphit, *G.;* Hipofosfito calcico, *Sp.*

Attention has been called to the hypophosphites as a class of salts, in consequence of their recommendation by Churchill of Paris, in the treatment of *phthisis,* in which they were thought to be useful by furnishing phosphorus

to the tissues. One of the first papers on their mode of preparation and qualities was communicated by Wm. Procter. (See *A. J. P.*, xxx. 118.) Hypophosphorous acid consists of one atom of phosphorus, two of oxygen, and three of hydrogen, of which latter, however, only one atom is replaceable by metal. It is, therefore, a monobasic acid. It has a strong affinity for oxygen, and acts as a powerful deoxidizing or reducing agent, which property it is supposed to owe to the presence of the unreplaceable hydrogen atoms, sometimes termed "aldehydic" hydrogen. When heated, it is resolved into hydrogen phosphide and phosphoric acid. Its salts are generally soluble in water and deliquescent, and many of them are soluble in alcohol. They are converted into phosphates by heat, with the escape of hydrogen phosphide, and some of them are explosive.

Calcium hypophosphite has been most largely employed, and meets the views of those who wish to supply calcium phosphate to the system, as the hypophosphorous acid is converted into the phosphoric by its deoxidizing power. To prepare it Procter gave the following formula. Slake 4 pounds (avoirdupois) of lime with a gallon of water, add it, in a deep boiler, to 4 gallons of boiling water, and mix thoroughly. To the mixture add a pound (av.) of phosphorus, and continue the boiling, adding hot water from time to time to keep up the measure, until the combination is complete, and hydrogen phosphide is no longer evolved. It is necessary that provision should be made for the escape of the gas, which takes fire spontaneously in contact with the air. There are formed in the liquid calcium phosphate and hypophosphite, the phosphorus having become oxidized at the expense of the water, the hydrogen of which has escaped in combination with another portion of phosphorus, which is therefore lost. The liquid is filtered to separate the insoluble phosphate and residuary lime, then concentrated, and refiltered to separate the calcium carbonate formed by the action of the air on a little lime held in solution, and lastly evaporated until a pellicle appears; after which the salt may be allowed to crystallize by setting the liquid aside, or may be obtained in the granular form by continuing the heat, and stirring. The salt should be introduced into bottles. The former British Pharmacopœia practically adopted this process, but any uncombined lime remaining in the solution was separated by passing carbonic acid gas through it.

Properties.—Officially described as in "colorless, transparent, monoclinic prisms, or small, lustrous scales, or a white, crystalline powder, odorless, having a nauseous and bitter taste; permanent in the air. Soluble in 6.5 parts of water at 25° C. (77° F.), and in 6 parts of boiling water; insoluble in alcohol. When heated in a test-tube the salt decrepitates, and above 300° C. (572° F.) it begins to decompose, giving off water, and emitting inflammable gases (hydrogen and hydrogen phosphide), and leaving a residue of calcium pyrophosphate and metaphosphate, with some red phosphorus. The aqueous solution (1 in 20) is neutral or slightly acid to litmus paper, and yields, with ammonium oxalate T.S., a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid. The diluted aqueous solution, slightly acidulated with diluted nitric acid, yields with silver nitrate T.S. a precipitate, which is white at first but rapidly turns brown and black, due to the separation of metallic silver. With copper sulphate T.S., on gentle heating, a reddish-brown precipitate is formed. When the aqueous solution of Calcium Hypophosphite (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, with agitation, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. On further addition of the hypophosphite solution in excess, the precipitate becomes gray in color, due to its reduction to metallic mercury. If 1 Gm. of the salt be added to 20 Cc. of water and well shaken, not more than a trace of residue should remain (absence of *phosphate* and *sulphate*). If 5 Cc. of an aqueous solution of the salt (1 in 10) be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water, and evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). The aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121)." *U. S.* "Soluble in 8 parts of cold *water;* insoluble in cold *alcohol* (90 per cent.). Heated to redness the crystals ignite, evolving spontaneously inflammable hydrogen phosphide and hydrogen, and leave a reddish-colored residue. It affords the reactions characteristic of calcium. Its aqueous solution yields with *test-solution of mercuric chloride* a white precipitate turning gray. 0.25 gramme boiled for ten minutes with a solution of 0.6 gramme of *potassium permanganate* should yield, on filtration, a nearly colorless solution. The salt should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, magnesium, sodium, or potassium, and only the slightest reactions with the tests for chlorides or sulphates. It should afford little or no precipitate with *solution of lead acetate* (limit of phosphates and phosphites)." *Br.* The solubility of calcium hypophosphite is increased by the addition of hypophosphorous acid. For a method of purifying alkaline hypophosphites, see *J. P. A.*, 1879, 57; *N. R.*, 1879, 142.

As the soluble salts of mercury, copper, and silver are reduced by the hypophosphites, they are of course incompatible with it in prescriptions. With calcium hypophosphite all the soluble sulphates and carbonates produce precipitates. As the hypophosphites are insoluble in cod liver oil, they should be dissolved in syrup or water before being added to the oil. (See

Syrupus Hypophosphitum and *Emulsum Olei Morrhuæ cum Hypophosphitibus.*) W. A. H. Naylor considers the presence of sulphites in commercial hypophosphites to be the source of the disagreeable odor of hydrogen sulphide sometimes found in the compound syrup of hypophosphites. (*P. J.*, 1895, 144.)

Uses.—Calcium hypophosphite was at one time largely used in *chronic phthisis*, in various *scrofulous affections*, in *neurasthenia*, and other conditions of impaired nutrition of the nerve centres. It seems in none of these cases to be really efficient, but is harmless.

Dose, ten to thirty grains (0.65 to 2.0 Gm.), three times a day. (See *Syrupus Hypophosphitum* and *Syrupus Hypophosphitum Compositus.*)

Off. Prep.—Emulsum Olei Morrhuæ cum Hypophosphibitus, *U. S.;* Syrupus Hypophosphitum, *U. S.;* Syrupus Hypophosphitum Compositus, *U. S.*

CALCII PHOSPHAS PRÆCIPITATUS. U. S. (Br.)

PRECIPITATED CALCIUM PHOSPHATE

(kăl'cĭ-ī phŏs'phăs præ-cĭp-ĭ-tā'tŭs)

$Ca_3(PO_4)_2 = 307.98$

"It should contain not less than 99 percent. of pure Calcium Phosphate [$(PO.O_3)_2Ca_3$]." *U. S.* "Calcium Phosphate may be prepared by dissolving bone ash in dilute hydrochloric acid, adding the liquid to dilute solution of ammonia, washing the precipitate with cold water, and drying the washed precipitate at a temperature not exceeding 212° F. (100° C.); or by the interaction of calcium chloride and sodium phosphate." *Br.*

Calcii Phosphas, *Br.*, Calcis Phosphas (*Br.* 1885), Calcium Phosphate; Tricalcium Phosphate, Calcaria Phosphorica; Phosphas Calcicus Præcipitatus; Precipitated Phosphate of Lime; Phosphate of Calcium; Phosphate Tricalcique, *Fr. Cod.;* Phosphate de Chaux hydraté, *Fr.;* Phosphorsaure Kalkerde, Calciumphosphat, *G.;* Fosfato calcico, *Sp.*

A formula for this precipitate was given in the U. S. Pharmacopœia of 1870. It is as follows: "Take of Bone, calcined to whiteness, and in fine powder, *four troyounces;* Muriatic Acid *eight troyounces;* Water of Ammonia *twelve fluidounces*, or *a sufficient quantity;* Distilled Water *a sufficient quantity.* Macerate the Bone in the Acid, diluted with a pint of Distilled Water, until it is dissolved, and filter the solution. Add another pint of Distilled Water, and then, gradually, Water of Ammonia, until the liquid acquires an alkaline reaction. Mix the precipitate obtained, while yet in the state of magma, with twice its bulk of boiling Distilled Water, and pour the whole upon a strainer. Wash the precipitate with boiling Distilled Water until the washings cease to be affected by a solution of nitrate of silver, acidulated with nitric acid. Lastly, dry the precipitate with a gentle heat." *U. S.* 1870. For description of an apparatus for preparing calcium phosphate on a large scale, see *J. P. C.*, Sept. 1, 1875, 193. The salt has been very properly retained in the U. S. and Br. Pharmacopœias. There is, however, no necessity of retaining the word "præcipitatus" in the U. S. title, as it is never seen in commerce except as a precipitate. One of its uses has been to replace magnesium carbonate and absorbent cotton in the 1890 process for medicated waters; but it has now been superseded by purified talc.

The hydrochloric acid dissolves the calcium phosphate of the bones, and lets it fall, on the addition of ammonia, in a state of minute division. The ablution is intended to free it from adhering ammonium chloride. The salt thus obtained is, for the sake of distinction, called *bone calcium phosphate.*

Properties.—It is officially described as "a bulky, white, amorphous powder, odorless and tasteless; permanent in the air. Almost insoluble in cold water; partly decomposed by boiling water, which dissolves out the acid salt; almost insoluble in acetic acid, except when freshly precipitated; easily soluble in hydrochloric or nitric acid; insoluble in alcohol. At an intense white heat, the salt fuses without decomposition. When moistened with silver nitrate T.S., either before or after ignition, the salt acquires a yellow color (distinction from *acid calcium phosphate*, which, after ignition, when moistened with silver nitrate T.S., remains white). For applying tests of identity and of purity, shake 2 Gm. of Precipitated Calcium Phosphate with 20 Cc. of water, add nitric acid, drop by drop, until solution is effected, and then add sufficient water to make the liquid measure 40 Cc. While making this solution, no effervescence should occur on adding the acid (absence of *carbonate*). From a portion of this solution the salt is preciptated unchanged by a slight excess of ammonia water. From another portion ammonium molybdate T.S. precipitates yellow ammonium phosphomolybdate; the reaction is accelerated by a gentle heat, not exceeding 65° C. (149° F.). If to 5 Cc. of the solution, acidulated with nitric acid, 0.5 Cc. of silver nitrate T.S. be added, not more than a slight turbidity should result (limit of *chloride*). If to 5 Cc. of the solution, strongly acidulated with nitric acid, 1 Cc. of potassium sulphate T.S. be added, no turbidity should result upon standing (absence of *barium*). An aqueous solution of Calcium Phosphate (1 in 20), obtained by shaking the salt with water, adding hydrochloric acid, drop by drop, and heating until solution is effected, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Two Gm. of Calcium Phosphate should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "Soluble in *diluted hydrochloric acid* or *diluted nitric acid;* such a solution continues clear when a dilute solution of *sodium acetate* is added in excess (absence of calcium oxalate). It affords the reactions characteristic of calcium and of phosphates. Of the recently dried powder, 1 gramme dissolved in *diluted hydrochloric acid*

yields, when added to a very slight excess of *diluted solution of ammonia,* a white precipitate weighing when washed with cold *water* and dried at 212° F. (100° C.) not less than 0.95 gramme. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, magnesium, carbonates, or silica, and only the slightest reactions with those for chlorides." *Br.* Joly and Sorel record (*C. R. A. S.,* 1894, 738) the precipitation of tricalcium phosphate by adding crystals of hydrated bicalcium phosphate to boiling water; the acid liquid remaining contains monocalcium phosphate.

Uses.—In the form of burnt hartshorn, calcium phosphate formerly enjoyed a brief popularity in the treatment of *rickets* and *mollities ossium,* in which its use seemed to be indicated upon obvious chemical grounds. In 1851, Benecke suggested that, as it is essential in animals as well as plants to the formation of cells, it might be found useful in certain pathological states of the system characterized by defective nutrition, such as the *scrofulous affections,* and from that time its use has gradually become more frequent, and, in connection with other phosphates, as those of iron, sodium, and potassium, it has acquired no little reputation in different forms of *scrofula, mollities ossium, rickets,* and even *chronic phthisis.* It is also thought to have proved useful in hastening the *union of fractured bones;* and Alphonse Milne-Edwards is said to have shown, by experiments upon dogs and rabbits, that in these animals the callus in fractured bones forms more quickly under its use than without it. (*M. T. G.,* May, 1856, p. 489.) Though insoluble in water, it is probably in general dissolved by the gastric liquids, in consequence of the acid present in them; but it is best administered in acid solution, and is at present very extensively used dissolved in lactic acid and emulsified with cod liver oil.

Dose, ten to thirty grains (0.65 to 2.0 Gm.). (See *Syrupus Calcii Lactophosphatis;* also *Pulvis Antimonialis.*)

Off. Prep.—Extractum Euonymi Siccum, *Br.;* Pulvis Antimonialis, *Br.*

CALCII SULPHAS EXSICCATUS. U. S.

EXSICCATED CALCIUM SULPHATE

[Dried Calcium Sulphate]

(kăl'cī-ī sŭl'phăs ĕx-sĭc-cā'tŭs)

"A powder containing about 95 percent., by weight, of Calcium Sulphate [$CaSO_4 = 135.15$], and about 5 percent. of water; prepared from the purer varieties of native gypsum [$CaSO_4 + 2H_2O = 170.91$], by carefully heating until about three-fourths of the water has been expelled. Exsiccated Calcium Sulphate should be kept in well-closed vessels, carefully protected from moisture." *U. S.*

Calcii Sulphas, *Br.* 1885; Dried Gypsum; Plaster of Paris; Exsiccated Sulphate of Calcium; Calcis Sulphas; Sulphate of Lime; Gypsum; Calcium sulfuricum ustum, *P. G.;* Gebrannter Gyps, *G.*

The British Pharmacopœia (1898) dismissed calcium sulphate (dried), but inserted calcium sulphate in the articles employed in chemical testing in the Appendix. The native sulphate is best known as *gypsum,* and in its massive variety as *alabaster.* Gypsum is an abundant natural product, and the quantity mined in the United States has enormously increased in recent years. In 1903 it amounted to 1,041,704 tons, valued at $3,792,943; in 1904, 940,917 tons, valued at $2,784,325; and in 1905, 924,107 tons, valued at $3,105,000. It is officially described as "a fine, white powder, without odor or taste. From moist air it attracts water, becomes granular, and then loses the property of hardening with water. When mixed with half its weight of water, Exsiccated Calcium Sulphate forms a smooth, cohesive paste, which rapidly hardens. It is soluble in about 378 parts of water at 25° C. (77° F.), and in 451 parts at 100° C. (212° F.). In alcohol it is insoluble. It readily dissolves in diluted nitric or hydrochloric acid; also in saturated solutions of potassium nitrate, sodium thiosulphate, and of various ammonium salts. When heated above 204° C. (399.2° F.), Exsiccated Calcium Sulphate becomes anhydrous and loses the property of forming with water a paste which hardens rapidly. Its saturated solution in water is neutral to litmus paper, and forms white precipitates with barium chloride T.S., with ammonium oxalate T.S., and with alcohol. No effervescence should occur on the addition of diluted acids to Exsiccated Calcium Sulphate (absence of *carbonate*)." *U. S.*

Uses.—Gypsum is used by surgeons for mechanical purposes, but not at all in internal medicine. It is so slightly soluble in water that it may be considered for ordinary purposes insoluble. The solubility of the crystallized sulphate with 2 molecules of water (native gypsum) is, according to Curtman, at 15° C., 1 to 390; at 38° C., 1 to 368; and at 100° C., 1 to 451. The fact has been well established that its solubility varies with the temperature, but, like that of sodium sulphate, very unequally. Thus, according to Poggiale, it is greatest at 35° C. (95° F.), and above or below that temperature gradually diminishes, so that at 100° C. (212° F.), or the boiling point of water, it is very nearly the same as at 5° C. (41° F.), not far from the freezing point. (*J. P. C.,* 4e sér., v. 86.) The other point is that, when deprived of its water by heat, and reduced to the state of a white powder, it rapidly absorbs water added to it, and, from the state of semi-liquid paste into which it is brought with that fluid, hardens without great change of bulk. It is this property which fits plaster of Paris so well for all kinds of moulding; and to this also it owes its peculiar adaptability to the purpose of a splint. To prepare it for use, the gypsum must first be deprived of the greater part of its water by exposure to a heat of 100° C. (212° F.), or from that to 121.1° C. (250° F.). It loses both its molecules of

water of crystallization at a temperature of about 170° C. (338° F.), and is then known as *burnt gypsum.* If heated above 204° C. (399.2° F.) it becomes *dead-burnt,* and does not take up water readily and does not harden. When dehydrated, it is reduced to fine powder, and kept in air tight vessels for use. As thus prepared, if mixed with two parts of water, it forms a semi-liquid cream-like mass, which becomes solid and hard in fifteen or twenty minutes, the temperature rising during the process, as in the slaking of lime. The hydrated gypsum expands in solidifying, hence its advantages in preparing casts,—the expansion causes it to fill accurately all interstices. Cloëz (*Chem. News,* 1903, 58) states that the "setting" of plaster of Paris is due to the succession of three phenomena: 1. Hydration. 2. Partial solution. 3. Solidification of a supersaturated solution. According to T. E. Stark, a medical officer in the British army, flannel is the best material for bandages to be used with gypsum. It should be cut into strips an inch and a half broad and two or three yards long, which should first be spread on a table and rubbed well with the powdered gypsum on both sides, and always in the direction of the thread. The bandages should then be rolled up loosely, and kept for use in air tight cases. Thus prepared, the bandages, first thoroughly wetted, should be rolled round the limb, overlapping at the edges, so as to make a uniform covering. After application, it should be left to harden, which generally happens in fifteen or twenty minutes. A simpler method of using the gypsum for this purpose is, after the application of the bandages, to paint the whole thoroughly and carefully with the milk of gypsum, which will solidify, and enclose the part in a firm case.

Off. Prep.—Calx Sulphurata, *U. S.*

CALCIUM.

CALCIUM

(kăl′cĭ-ŭm)

Ca = 39.8

This is the metal characteristic of lime, and, consequently, of all calcareous substances. It was obtained by Matthiessen, in 1855, in masses of the size of a pea, by the electrolysis of calcium chloride with a Bunsen battery. It has been recently made on a much larger scale by electrolysis and has become better known. It is, when pure, a yellowish-white crystalline metal, ductile and malleable, with a specific gravity of 1.58 and melting at 760° C. It oxidizes slowly in dry air, more rapidly in moist air, and it must therefore be kept under petroleum.

Calcium is a very abundant element in nature, existing in the mineral kingdom chiefly as a carbonate, in the form of limestone, marble, chalk, and calcareous spar; and as a phosphate and carbonate in the bones and shells of animals, and as a sulphate in gypsum and selenite.

CALENDULA. U. S.

CALENDULA [Marigold]

(cą-lĕn′dŭ-lą)

"The dried ligulate florets of *Calendula officinalis* Linné (Fam. *Compositæ*)." *U. S.*

Mary-bud, Holigold; Fleurs de Tous les mois, Souci, *Fr.;* Ringelblume, Todtenblume, Warzenkraut, *G.;* Calendula, *Sp.*

Calendula officinalis, L.—The common marigold of the gardens is too well known to need description, other than that of the Pharmacopœia. Although the U. S. P. recognizes only the marigold florets, the whole plant, freshly gathered, is much used by the so-called eclectics and homœopathic practitioners, and was formerly official in the U. S. Pharmacopœia.

Properties.—"Florets, 15 to 25 Mm. long, yellow or orange-colored, one- to three-toothed, the short hairy tube occasionally enclosing the remnants of a filiform style and bifid stigma; odor slight and somewhat heavy; taste slightly bitter and faintly saline." *U. S.* The odor is much stronger in the fresh than in the dry herb, and on exposure to the sun the yellow color fades into whitish. Among its constituents are a bitter principle, and an amorphous substance called *calendulin* (discovered by Geiger most abundantly in the flowers), considered by Berzelius as analogous to bassorin, though soluble in alcohol. *French* or *African Marigold,* so called, is very frequently substituted for the official drug. It is the *Tagetes patula,* L., and *T. erecta,* Linn., both of Mexico. The flowers are readily distinguished by the scales of the involucre being united to form a tube, and by the slender, flattish achenes being crowned with a few chaffy or awned scales. The broadly strap-shaped ray-florets are toothed, and of a light or deep orange color sometimes striped with red. Latour and Magnier de la Source isolated from African marigold a yellow crystalline substance, *quercetagetin,* which Perkin examined and gave the composition $C_{15}H_{10}O_8$. (*P. J.,* 1902, 294.)

Uses.—In the days of therapeutic darkness calendula was thought to be antispasmodic, sudorific, deobstruent, and emmenagogue, and was given in low forms of *fever, scrofula, jaundice, amenorrhœa,* etc. Both the leaves and the flowers were used; but the latter were preferred, and were usually administered in the recent state in the form of tea. The tincture has been used to a considerable extent as an embrocation in sprains, bruises, etc., and probably is of as much value as simple alcohol.

Dose, from fifteen to sixty grains (1 to 3.9 Gm.).

Off. Prep.—Tinctura Calendulæ, *U. S.*

CALUMBA. U. S. (Br.)

CALUMBA [Columbo]

(cą-lŭm'bą)

"The dried root of *Jateorhiza palmatá* (Lamarck) Miers (Fam. *Menispermaceæ*)." *U. S.*
"The dried transversely cut slices of the root of Jateorhiza Columba, *Miers.*" *Br.*

Calumbæ Radix, *Br.;* Calumba Root; Radix Columbo; Colomba, *U. S.* 1850; Racine de Colombo, *Fr. Cod.;* Colombo, *Fr.;* Radix Colombo, *P. G.;* Kolombowurzel, *G.;* Colombo, *It.;* Colombo, Raiz de colombo, *Sp.;* Kalumbo, *Port.;* Calumb, *Mozambique.*

The calumba plant was long but imperfectly known. Flowering specimens of a plant gathered by Commerson, about the year 1770, in the garden of Poivre in the Isle of France, and sent to Europe with that botanist's collection, were examined by Lamarck, and described under the name of *Menispermum palmatum;* but its original locality was unknown, and it was only conjectured to be the source of calumba. In the year 1805, Forten, while engaged in purchasing the drug in Mozambique, obtained possession of a living offset of the root, which, being taken to Madras and planted in the garden of Anderson, produced a male plant, which was figured and described by Berry. From the drawing thus made, the plant was referred to the natural family of the Menispermaceæ; but, as the female flowers were wanting, some difficulty was experienced in fixing its precise botanical position. De Candolle, who probably had the opportunity of examining Commerson's specimens, gave its generic and specific character, but confessed that he was not acquainted with the structure of the female flower and fruit. This desideratum, however, was supplied by ample drawings sent to England by Telfair of Mauritius, made from plants which were propagated from roots obtained by Owen in 1825, while prosecuting his survey of the eastern coast of Africa. The plant was first placed in the genus Cocculus, which was separated by De Candolle from Menispermum. Subsequently, J. Miers established a new genus, which has been received by botanists, giving to it the name of Jateorhiza. Miers also separated his plant specifically from *C. palmatus* of De Candolle, describing it under the name of *Jateorhiza Columba.* This species is now recognized by the Br. Pharmacopœia, and was formerly also acknowledged by the U. S. Pharmacopœia, but the very careful researches of Hanbury (*Pharmacographia,* 2d ed., p. 23) led him to consider the specific differences as unimportant and inconstant, with which view the botanists of the U. S. 1890 revision coincided. The differences are that in *J. palmata* the lobes at the base of the leaf overlap, and the male inflorescence is nearly glabrous; while in *J. Columba* the basal lobes are rounded, but do not overlap, and the male inflorescence is setose-hispid. The plants are probably only varieties of one species, and it is almost certain that calumba is derived from each of them.

"The plants of the genus, natives of intertropical Africa, are all climbers, distinguished by a very peculiar habit, having very large deeply-lobed leaves, upon very long petioles, and clothed with long strigose hairs; their inflorescence is in long slender racemes; the fruit is a drupe containing a putamen covered with a dense hairy coating embedded in the fleshy mesoderm."

Jateorhiza palmata, Miers, *Annals and Mag. of Nat. Hist.,* Feb. 1864, p. 183. *B. & T.* 13. *Cocculus palmatus,* De Cand., *Syst. Veg.,* i. 523; Woodv., *Med. Bot.,* 3d ed., v. 21; Hooker, *Curtis's Bot. Mag.,* Nos. 2970, 2971.—This is a climbing plant, with a perennial root consisting of several fasciculated, fusiform, somewhat curved, and descending tubers, as thick as an infant's arm. The stems, of which one or two proceed from the same root, are twining, simple in the male plant, branched in the female, round, hairy, and about as thick as the little finger. The leaves, which stand on rounded, glandular, hairy footstalks, are alternate, distant, cordate, with three, five, or seven entire, acuminate, wavy, somewhat hairy lobes, and as many nerves, each running into one of the lobes. The flowers are small and inconspicuous, and arranged in solitary axillary racemes, which in the male plant are compound, in the female simple, and in both plants are shorter than the leaves.

Jateorhiza Columba, Miers, Br. Pharm.—*Cocculus palmatus,* Wallich, not De Cand.—*Menispermum Columba,* Roxb., *Flor. Ind.*—This species is characterized by "rounded, angularly striate, roughly pilose branches; broadly orbicular, sinuously lobed leaves, with rounded sinuses; the lobes being 5 in number, broadly ovate, acute, mucronately acuminate; the basal deeply divaricate and hence broadly cordate; 7 to 9 nerved, opaque above, on both sides furnished with short, adpressed, somewhat curved, reddish hairs, beneath pale, strongly reticulate with prominent nerves and veins; the petiole somewhat slender, striate, tortuous, and roughly glandular; the racemes axillary, solitary or many; the rachis greatly elongated, striate, bristly, with elongated, smooth, divaricate, almost capillary, subflexuous, few-flowered branches; the flowers sessile, and almost without bracts." (Miers.)

Both of these so-called species are natives of Mozambique, on the southeastern coast of Africa, where they grow wild in great abundance in the thick forests extending from the sea many miles into the interior. The root is dug up in March, when dry weather prevails. From the base of the root numerous fusiform offsets proceed, less fibrous and woody than the parent stock. These offsets are separated and cut into transverse slices, which are dried in the shade. The old root is rejected.

The plant is said to be cultivated both in Africa and the East Indies for the sake of its root, which under the name of *Calumb* is used in dyeing.

Calumba is sent from the Portuguese dominions in Southeastern Africa into India, from whence it goes into general commerce. At one time, when thought to be a product of Ceylon, it was supposed to have derived its name from Columbo, a city of that island, but a much more probable derivation is from the African name of the root above given. (See Lloyd's history of columbo root, *West. Drug.*, 1898, 8.)

Adulterations.—Formerly the high price of calumba led to its frequent adulteration, especially, it is said, with the roots of the *white bryony,* and of *Frasera carolinensis* or *American calumba,* and with the stem of *Coscinium fenestratum,* the *columbo wood* or *false columbo* of Ceylon. According to Stolze of Halle, the American calumba can be readily detected by the fact that while the tincture of true calumba is not affected by ferric sulphate or sesquichloride, and yields with tincture of galls a dirty precipitate, the tincture of Frasera becomes dark green with the former and is not affected by the latter reagent. *Coscinium fenestratum,* a bitter tonic used in Ceylon, is at once to be distinguished by its being a stem, not a root, and is said not to have appeared upon the market for many years. At present, owing to its great cheapness, calumba root seems to be very rarely adulterated. (See *P. J.*, 1901, 502, and Dec. 1904.)

Properties.—It is officially described in the U. S. Pharm. as "in transverse, circular or oval, biconcave sections, 2.5 to 5 Cm. in diameter and 2 to 12 Mm. thick; externally greenish-brown and roughly wrinkled; internally yellowish or grayish-yellow, with a few interrupted circles of fibrovascular bundles, distinctly radiate in the outer portion, with a dark cambium; fracture short, mealy; odor slight; taste slightly aromatic, very bitter." *U. S.* Along with the disks are sometimes a few cylindrical pieces an inch or two in length. The cortical portion is thick, of a bright yellow, slightly greenish color internally, but covered with a brownish, wrinkled epidermis. The interior or medullary portion, which is readily distinguishable from the cortical, is light, spongy, yellowish, usually more or less shrunk, so that the pieces are thinnest in the centre; and is often marked with concentric circles and radiating lines. Those pieces are to be preferred which have the brightest color, are most compact and uniform, and least worm eaten. According to the British Pharmacopœia "the cork is brownish and wrinkled, the cortex thick, marked with radiating lines, and separated by a dark line from the wood, in which the vessels are arranged in narrow radially elongated groups. The parenchymatous tissue is largely developed, and contains numerous starch grains, mostly simple with eccentric hilum." *Br.* The odor of calumba is slightly aromatic. The taste is very bitter, that of the cortical much more so than that of the central portion, which is somewhat mucilaginous. The root is easily pulverized. The powder is greenish, becoming browner with age, and deepening when moistened. As it attracts moisture from the air, and is apt to undergo decomposition, it should be prepared in small quantities.

Planche analyzed calumba in 1811, and found it to contain a nitrogenous substance, probably albumen, in large quantity, a bitter yellow substance not precipitated by metallic salts, and one-third of its weight of starch. He obtained also a small proportion of volatile oil, salts of calcium and potassium, ferric oxide, and silica. Wittstock of Berlin, afterwards isolated a principle, which he called *columbin.* This crystallizes in beautiful transparent quadrilateral prisms of the formula $C_{21}H_{22}O_7$, is without odor, and is extremely bitter. It is but very slightly soluble in water, more soluble in alcohol, ether, or chloroform, and imparts to these fluids a strongly bitter taste. It is more soluble in boiling alcohol, which deposits it upon cooling. The best solvent is diluted acetic acid. It is taken up by alkaline solutions, from which it is precipitated by acids. It is obtained by exhausting calumba by means of alcohol of the sp. gr. 0.835, distilling off three-quarters of the alcohol, allowing the residue to stand for some days until crystals are deposited, and lastly treating these crystals with alcohol and animal charcoal. The mother waters still contain a considerable quantity of columbin, which may be separated by evaporating with coarsely powdered glass to dryness, exhausting the residue with ether, distilling off the ether, treating the residue with boiling acetic acid, and evaporating the solution to crystallization.

From the researches of Bödecker it appears that another bitter principle exists in calumba, which corresponds in composition and chemical relations with *berberine,* the active principle of *Berberis vulgaris,* and is assumed to be identical with that substance. It was obtained by exhausting calumba with alcohol (sp. gr. 0.889), distilling off the alcohol, allowing the residual liquor to stand for three days so as to deposit the columbin, evaporating the supernatant liquid together with the aqueous washings of the columbin to dryness, exhausting the residue with boiling alcohol (sp. gr. 0.863), treating the solution thus obtained as the former one, submitting the residue to the action of the boiling water, filtering, and adding hydrochloric acid, collecting the precipitate thus formed on a filter, drying it with bibulous paper, and finally, in order to separate adhering acid, dissolving it in alcohol, and precipitating with ether. The result was an imperfectly crystalline, bright yellow powder, of a disagreeable, bitter taste, supposed to be *berberine hydrochloride.* It is stated that berberine is present in calumba in much larger proportion than columbin, and, being freely soluble in hot water and alcohol, while columbin is but slightly so, is probably more largely extracted in the ordinary liquid preparations of the root. (*A. J. P.*, xx. 322.) A third constituent, *columbic acid,* was also discovered by Bödecker. It is yellow, amorphous,

nearly insoluble in cold water, but dissolving in alcohol and in alkaline solutions. It tastes somewhat less bitter than *columbin.*

P. E. Alessandri isolated *calumbine* (which he considers an alkaloid) by the following process. An infusion of calumba is made with a 3 per cent. solution of oxalic acid; the yellow bitter liquid is neutralized with ammonia and evaporated to one-third its bulk; it is, when cooled, treated with ether, separated, and the ethereal solution on evaporation yields pure white calumbine. (*L'Orosi,* v. 1; *P. J.,* 1882, p. 995.) Alessandri obtains *berberine* from calumba by neutralizing a cold infusion, made with diluted oxalic acid (3 per cent.), with baryta; the precipitate which is produced is separated. The liquid is heated, allowed to stand for twenty-four hours to allow the barium oxalate to deposit, filtered, and then a current of carbonic acid is passed through to remove baryta. It is then treated by shaking the ammoniacal liquid with ether as in Alessandri's process for calumbine (see above), and, after the ethereal layer is separated, the aqueous liquid is evaporated to dryness. Berberine is obtained from the extract by treating the latter with alcohol, the berberine being purified by washing with ether. *Columbic acid* may be obtained from the precipitate produced by the addition of barium oxide to the oxalic acid infusion. (*L'Orosi,* v. 1; *P. J.,* 1882, p. 995.) Bocchiola (*Y. B. P.,* 1891, p. 162) states that the older roots contain more of the active principles than the younger ones. He found that the inner and the outer portions of calumba also vary in their constituents; thus in the woody or inner part he found the following percentages: calumbine 1.90, berberine 0.72, ether extract 0.80, alcoholic extract 3.86, diluted alcoholic extract 17.80, ash 6. In the cortical or outer part he found calumbine 1.42, berberine 1.43, ether extract 0.70, alcoholic extract 3.89, diluted alcoholic extract 17.96, ash 5. Hilger obtained from calumba: columbin, columbic acid, and berberine in a pure condition. He assigns to columbin the formula $C_{21}H_{24}O_7$, and to columbic acid $C_{21}H_{22}O_6$. (*Zeit. Oest. Apoth. Ver.,* 1896, No. 1, 8–14.) Haensel (*P. J.,* 1904, 216) obtained from calumba a volatile oil which exists in very small quantities (0.00568 per cent.). It has a peculiar odor and bitter taste.

There can be little doubt that both columbin and berberine contribute to the remedial effects of calumba. The virtues of the root are extracted by boiling water and by alcohol. Precipitates are produced with the infusion and tincture by infusion of galls, and by solutions of lead acetate and subacetate, but the bitterness is not affected.

Uses.—Calumba is a mild bitter tonic, free from astringency. It is very useful in functional atonic conditions of the digestive organs. It is frequently administered in combination with other tonics, aromatics, mild cathartics, and antacids. A favorite remedy of Geo. B. Wood for the permanent cure of a disposition to the accumulation of *flatus* in the bowels was an infusion made with half an ounce of calumba, half an ounce of ginger, a drachm of senna, and a pint of boiling water, and given in the dose of a wineglassful three times a day. Calumba is much used by the natives of Mozambique in *dysentery* and other diseases. (Berry.) It was first introduced to the notice of the profession in Europe by François Redi, in the year 1685. (See *Infusum Calumbæ;* also *Fluidextractum Calumbæ,* and *Tinctura Calumbæ.*)

Dose, of the powder, from ten to thirty grains (0.65 to 2.0 Gm.), which may be repeated three or four times a day.

Off. Prep.—Fluidextractum Calumbæ, *U. S.;* Infusum Calumbæ, *Br.;* Liquor Calumbæ Concentratus, *Br.;* Tinctura Calumbæ, *U. S., Br.*

CALX. U. S., Br.

LIME CALCIUM OXIDE

(călx)

$CaO = 55.68$

"Prepared by calcining white marble, or the purest varieties of native calcium carbonate, and containing, when in the anhydrous state, not less than 90 percent. of pure Calcium Oxide. It should be kept in well-closed vessels, in a dry place." *U. S.* "Calcium Oxide, CaO; obtained by calcining chalk, limestone, or marble." *Br.*

Calcii Oxidum, Calcium Oxydatum; Calcaria Usta, Calx Viva, Calx Usta, Oxydum Calcicum; Burned Lime; Quicklime; Chaux Commune, *Fr. Cod.;* Chaux, Chaux vive, *Fr.;* Calcaria Usta, *P. G.;* Aetzkalk, Kalk, Gebrannter Kalk, *G.;* Ossido di calcio, Calce, *It.;* Cal viva, *Sp.*

Lime, which is ranked among the alkaline earths, is a very important pharmaceutical agent, and forms the principal ingredient in several standard preparations. It is a very abundant natural production. It is never found free, but mostly combined with acids, as with carbonic acid in chalk, marble, calcareous spar, limestone, and shells; with sulphuric acid in the different kinds of gypsum; with phosphoric acid in the bones of animals; and with silica in a great variety of minerals.

Preparation.—Lime is prepared by calcining, by a strong heat, some form of the native carbonate. The carbon dioxide is thus expelled, and the lime remains. When the lime is intended for delicate chemical operations, it may be obtained from pure white marble or oyster-shells. For the purpose of the arts it is procured from common limestone, by calcining it in kilns of peculiar construction. When obtained in this way it is generally impure, being of a grayish color, and containing alumina, silica, ferric oxide, and occasionally a little magnesia and manganese oxide.

The official lime of the United States and British Pharmacopœias is the lime of com-

merce, and not quite pure. It may be obtained purer by exposing pure white marble, broken into small fragments, in a covered crucible, to a full red heat for three hours, or until the residue, when slaked and suspended in water, no longer effervesces on the addition of hydrochloric acid.

Properties.—Lime is in "hard, white, or grayish-white masses, which, in contact with the air, gradually attract moisture and carbon dioxide, and fall to a white powder; odorless, and having a caustic taste. Soluble in about 760 parts of water at 25° C. (77° F.), and in about 1600 parts of boiling water; insoluble in alcohol. It forms readily soluble salts with diluted acetic, hydrochloric, or nitric acids. When sprinkled with about half its weight of water, Calcium Oxide becomes heated, and is gradually converted into a white powder (calcium hydroxide or slaked lime). When this is mixed with about 3 or 4 parts of water, it forms a smooth magma (milk of lime). Its aqueous solution has an alkaline reaction upon red litmus paper. If 1 Gm. of Calcium Oxide be slaked and then thoroughly mixed with 50 Cc. of water, and the greater portion of the milky liquid decanted, the addition of hydrochloric acid to this residue should not cause more than a slight effervescence (limit of *carbonate*). For applying tests of identity and of purity, 5 Gm. of Calcium Oxide, after slaking, are mixed with 100 Cc. of distilled water, followed by hydrochloric acid, added drop by drop, with agitation until solution takes place. The resulting solution should, after boiling and cooling, be of acid reaction and not deposit more than 0.025 Gm. of insoluble matter. With a portion of this solution, after neutralizing with ammonia water, ammonium oxalate T.S. produces a white precipitate of calcium oxalate, insoluble in acetic acid, but soluble in hydrochloric acid." *U. S.*

Lime is calcium oxide, and consists of one atom of calcium 39.80, and one of oxygen 15.88. Its sp. gr. is 3.08, while the hydroxide has the sp. gr. 2.078. (Filhol.) Its solubility in water is greatly increased by the addition of sugar or glycerin. (See *Syrupus Calcis.*) It is distinguished from the other alkaline earths by forming a very deliquescent salt (*calcium chloride*) by reaction with hydrochloric acid, and a sparingly soluble one with sulphuric acid. All acids, acidulous, ammoniacal, and metallic salts, borates, alkaline carbonates, and astringent vegetable infusions are incompatible with it.

Uses.—Lime acts externally as an escharotic, and was formerly applied to ill-conditioned *ulcers.* The *lime ointment* of Spender is made by incorporating four parts of washed slaked lime with one part of fresh lard and three parts of olive oil, previously warmed together. Mixed with potassium hydroxide, lime forms *Potassa cum Calce,* official in the U. S. P. 1890. As an internal remedy, it is converted into hydroxide and this is administered in solution. (See *Liquor Calcis;* also *Syrupus Calcis.*)

Off. Prep.—Extractum Ipecacuanhæ Liquidum, *Br.;* Liquor Calcis, *U. S., Br.;* Sulphur Præcipitatum, *U. S.;* Syrupus Calcis, *U. S.* (*Br.*)

CALX CHLORINATA. U. S., Br.

CHLORINATED LIME CHLORINATED CALCIUM OXIDE [Calx Chlorata, Pharm. 1890, Chloride of Lime]

(călx ȼhlọ-rī-nā'tą)

"A compound resulting from the action of chlorine upon calcium hydroxide, and containing not less than 30 percent. of available chlorine. It is often improperly called 'Chloride of Lime.' It should be kept in well-closed vessels, in a cool and dry place." *U. S.* "A product obtained by exposing slaked lime to the action of chlorine gas until absorption ceases." *Br.*

Hypochlorite of Lime or Calcium, Oxymuriate of Lime or Calcium, Chloris Calcicus, Chloruretum Calcis, Calcis Chloridum, Calcii Hypochloris, Calcium hypochlorite, Bleaching Powder; Chlorure de Chaux sec, *Fr. Cod.;* Poudre de Tennant ou de Knox, *Fr.;* Calcaria Chlorata, *P. G.;* Chlorkalk, Bleichkalk, *G.;* Cloruro di calcio, *It.;* Hipoclorito calcico clorurado, *Sp.*

This compound, originally prepared as a bleaching agent in 1798 by Tennant of Glasgow, is now enormously used both in the arts and in medicine.

The following is an outline of the process for making chlorinated lime on the large scale. A rectangular chamber is constructed, generally of silicious sandstone, the joints being secured by a cement of pitch, rosin, and dry gypsum. At one end it is furnished with an air tight door, and on each side with a glass window, to enable the operator to inspect the process during its progress. The slaked or hydrated lime is sifted, and placed on wooden trays eight or ten feet long, two feet broad, and one inch deep. These are piled within the chamber to a height of five or six feet on cross-bars, by which they are kept about an inch asunder in order to favor the circulation of the gas over the lime. The chlorine is generated in a leaden vessel nearly spherical, the lower portion of which is surrounded with an iron case, leaving an interstice two inches wide, intended to receive the steam for the purpose of producing the requisite heat. In the leaden vessel are five apertures. The first is in the centre of the top, and receives a tube which descends nearly to the bottom, and through which a vertical stirrer passes, intended to mix the materials, and furnished at the lower end with horizontal cross-bars of iron, or of wood sheathed with lead. The second is for the introduction of the sodium chloride and manganese. The third admits a siphon-shaped funnel, through which the sulphuric acid is introduced. The fourth is connected with a pipe to lead off the chlorine. The fifth, which is near the bottom, receives a discharge pipe passing through the iron case and

intended for drawing off the residue of the operation. The pipe which conducts the chlorine, terminates, under water, in a leaden chest or cylinder, where the gas is washed from hydrochloric acid. From this intermediate vessel the chlorine finally passes, by means of a rather large leaden pipe, through the ceiling to the chamber containing the lime. The process of impregnation generally lasts four days, this time being necessary to form a good bleaching powder. If it be hastened, heat will be generated, which will favor the production of calcium chloride, with a proportional diminution of chlorinated lime.

A more expeditious method of manufacture is now used, both in Germany (where it originated) and in this country, where bleaching powder is made from electrolytic chlorine. A series of horizontally placed drums or cylinders provided with revolving endless screws receive the dry calcium hydroxide, which, from its entering the top cylinder until discharged from the bottom one, meets a continuous stream of chlorine gas going in the opposite direction.

Several electrolytic processes for the decomposition of sodium and potassium chlorides have been introduced in recent years, whereby caustic alkali on the one hand and chlorine on the other hand are produced. The chlorine liberated is almost entirely utilized in the manufacture of bleaching powder. Large quantities are thus produced at present (1905) at Niagara Falls.

The importation of bleaching powder in 1900 amounted to 136,879,429 lbs., but in 1904 had diminished to 98,742,938 lbs. The domestic production has grown greatly in recent years (69,400,000 lbs. in 1902) and now exceeds the amount imported.

Properties.—Chlorinated lime is "a white, or grayish-white, granular powder, exhaling the odor of hypochlorous acid, having a repulsive, saline taste, and becoming moist and gradually decomposing on exposure to air. In water or in alcohol it is only partially soluble. An aqueous solution first colors red litmus paper blue, and then bleaches it. If Chlorinated Lime be dissolved in diluted acetic acid, an abundance of chlorine gas will be evolved, and only a trifling residue remain undissolved. From this solution ammonium oxalate T.S. throws down a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid." *U. S.* When perfectly saturated with chlorine it dissolves almost entirely in water. When exposed to heat, it gives off oxygen and some chlorine, and is converted into calcium chloride. It is incompatible with the mineral acids, carbon dioxide, and the alkaline carbonates. The acids evolve chlorine copiously, and the alkaline carbonates cause a precipitate of calcium carbonate. (See *Liquor Sodæ Chlorinatæ.*)[1]

Chlorinated lime is an oxidizing agent, the oxygen being derived from water, the hydrogen of which unites with the chlorine to form hydrochloric acid. It has a powerful action on organic matter, converting sugar, starch, cotton, linen, and similar substances into formic acid, which unites with the lime. (W. Bastick.) It also acts energetically on the volatile oils, including oil of turpentine, producing chloroform. (*J. P. C.*, Mars, 1855.)

Composition.—The composition of chlorinated lime is represented by the formula $CaOCl_2$, and it was formerly supposed to be a direct compound of lime with chlorine. This view, however, is not consistent with its reactions, for when distilled with diluted nitric acid it readily yields a distillate of aqueous hypochlorous acid, and when treated with water it is resolved into calcium chloride and hypochlorite, the latter of which may be separated in crystals by exposing the filtered solution to a freezing mixture, or by evaporating it in a vacuum over oil of vitriol and leaving the dense frozen mass to thaw upon a filter. A solution of calcium chloride mixed with hypochlorite then passes through, and feathery crystals remain on the filter, very unstable, but consisting, when recently prepared, of hydrated calcium hypochlorite, $Ca(OCl)_2.4H_2O$. This seems, at first sight, to show that the bleaching powder is a mixture of calcium chloride and hypochlorite, formed according to the equation

$$2CaO + Cl_4 = CaCl_2 + Ca(ClO)_2$$

but if this were its true constitution, the powder when digested with alcohol ought to yield a solution of calcium chloride containing half the chlorine of the original compound, which is not the case. Its constitution is, therefore, better represented by the formula $Ca\begin{cases} Cl \\ OCl \end{cases}$ suggested by Odling, this molecule being decomposed by water into chloride and hypochlorite in the manner just explained, and yielding with diluted nitric acid or sulphuric acid a distillate containing hydrochloric and hypochlorous acids,

$$CaCl(OCl) + 2HNO_3 = Ca(NO_3)_2 + HCl + HClO$$

(Lunge[2] and Schaeppi, *A. J. P.*, 1881; Lunge and Naef, *Ber. d. Chem. Ges.*, 1883.) Lunge

[1] Chlorinated lime constantly becomes weaker on exposure to air, giving off chlorine or hypochlorous acid, probably through the influence of the atmospheric carbon dioxide, which sets them free by combining with the lime. But it would seem that, even when closely confined, it sometimes at least gives off gaseous matter, as we have an account of a well-stoppered bottle containing it having been broken by a violent explosion, without any peculiar exposure to heat. (See *A. J. P.*, 1861, p. 72.) Barreswil has found that the subjection of chlorinated lime to strong pressure greatly diminishes the tendency to decomposition. It is rendered in this way as hard as a stone, and may be kept long without undergoing change. (*Chem. News*, No. 58, p. 33.)

[2] According to Lunge's investigations, the best temperature for the absorption of chlorine by calcium hydroxide is 40° to 45° C.; from pure calcium hydroxide a bleaching powder of 43 per cent. active chlorine can be produced, in which case allowance for 4 per cent. of moisture in the hydroxide is made; strong mineral acids, when not used in excess, liberate only hypochlorous acid: dry carbon dioxide at normal temperature does not set free any chlorine, but at moderately elevated temperature drives off almost all the chlorine.

and Bachofen (*Zeit. angew. Chem.,* 1893, 326) have determined the specific gravities of chlorinated lime solutions at 15° C. (See *Proc. A. Ph. A.,* 1894, 579.)

Impurities and Tests.—Chlorinated lime may contain a great excess of lime, from imperfect impregnation with the gas. This defect will be shown by the large proportion insoluble in water. If it contain much calcium chloride, it will be quite moist, which is always a sign of inferior quality. When long and insecurely kept, it deteriorates from the gradual formation of calcium chloride and calcium carbonate. Several methods have been proposed for determining its bleaching power, which depends solely on the proportion of loosely combined chlorine. Walter proposed to add a solution of the bleaching powder to a standard solution of indigo sulphate, in order to ascertain its decolorizing power; but the objection to this test is that the indigo of commerce is very variable in its amount of coloring matter. The oxidation of an arsenous acid solution is largely used in practice. Lunge (*Ber. d. Chem. Ges.,* 1886, p. 869) has also proposed to use hydrogen dioxide (H_2O_2) solution for the valuation of bleaching powder. The two solutions liberate oxygen in exactly equal amount. This is measured in a nitrometer. According to Wittstein and Claude, the test of ferrous sulphate which was formerly official is not reliable. The U. S. P. volumetric method, which is based upon that of the British Pharmacopœia, is preferred. "Introduce into a stoppered weighing-bottle between 3 and 4 Gm. of Chlorinated Lime and weigh accurately; triturate this thoroughly with 50 Cc. of water, transfer the mixture to a graduated vessel, together with the rinsings, and add sufficient water to make 1000 Cc. After thoroughly shaking, add to 100 Cc. of the mixture 1 Gm. of potassium iodide, 5 Cc. of diluted hydrochloric acid, and sufficient tenth-normal sodium thiosulphate V.S. for complete decolorization. Multiply the number of Cc. of tenth-normal sodium thiosulphate V.S. consumed, by 0.3518, and divide this product by one-tenth of the weight of the Chlorinated Lime taken; the quotient represents the percentage of available chlorine present." *U. S.*

The following is the test given in the British Pharmacopœia: "0.5 gramme of Chlorinated Lime, mixed with 1.5 grammes of *potassium iodide* dissolved in 200 cubic centimetres of *water,* produces, when acidulated with 6 cubic centimetres of *hydrochloric acid,* a reddish solution, which requires for the discharge of its color at least 46.8 cubic centimetres of the *volumetric solution of sodium thiosulphate,* corresponding to 33 per cent. of available chlorine." *Br.* In this process iodine is separated by the chlorine in equivalent quantity, and imparts color to the liquid, which is removed by the sodium thiosulphate, by forming colorless compounds with the iodine, and the quantity required for this purpose measures the quantity of iodine, and consequently that of the chlorine, present in the chlorinated solution. (See *Sodii Thiosulphas.*)

Uses.—Chlorinated lime, externally applied, is a desiccant and disinfectant, and has been used with advantage in solution, as an application to ill-conditioned *ulcers, burns, chilblains,* and *cutaneous eruptions,* especially *itch;* as a gargle in *putrid sore throat;* and as a wash for the mouth to disinfect the breath, and for *ulcerated gums.* Internally, it is stimulant and alterative. It has been used occasionally internally, in *adynamic dysentery, typhus fever,* and various other *low diseases;* it may be considered as therapeutically equivalent to chlorine. The dose internally is from three to six grains (0.2 to 0.4 Gm.), dissolved in one or two fluidounces (30 to 60 Cc.) of water, filtered and sweetened with syrup. It should never be given in pills. As it occurs of variable quality, and must be used in solution more or less dilute, according to the particular purpose to which it is to be applied, it is impossible to give any very precise directions for its strength as an external remedy. From one to four drachms of the powder added to a pint of water, and the solution filtered, will form a liquid within the limits of strength ordinarily required. For the cure of *itch,* Derheims has recommended a much stronger solution—three ounces of the chloride to a pint of water, the solution being filtered, and applied several times a day as a lotion, or constantly by wet cloths. When applied to *ulcers,* their surface may be covered with lint dipped in the solution. When used as an ointment to be rubbed upon *scrofulous enlargements* of the lymphatic glands, this may be made of a drachm of the chloride to an ounce of lard. Chlorinated lime is less eligible for some purposes than the solution of chlorinated soda. (See *Liquor Sodæ Chlorinatæ.*)

Chlorine gas is a very active germicide, and, as chlorinated lime affords the best practical method of using it for ordinary disinfecting purposes, it seems proper to discuss the subject at this place. It has been proved by the concurrent results of numerous experimenters that chlorine, if present in the proportion of one part in one hundred in the atmosphere of a room, is able to destroy *disease germs,* provided that the air and the objects are moist, and that the exposure continues for upwards of one hour. In the case of any infected room or confined space, as the hold of a ship, it seems to us, however, that the endeavor should be to have a larger proportion of the chlorine gas present for several hours, and, if it can be readily accomplished, steam should also be allowed to enter with the gas, so as to make sure that all parts shall be thoroughly moistened. The importance of this is shown by the experiments of Fischer and Proskauer, who found that dry anthrax spores maintained their integrity for one hour when exposed to the action of a dry chlorine atmosphere containing about forty-five per cent. of chlorine, whereas

moistened spores were killed by an hour's exposure to a moist atmosphere containing four per cent. of chlorine. Sternberg found that six hours' exposure of vaccine lymph upon ivory points to a moist atmosphere containing one part of chlorine in one hundred was sufficient to destroy the infective power of the lymph. Chlorine is not only germicidal, but it also has the power of decomposing hydrogen sulphide compounds, and is thereby a deodorant. In all these employments of chlorine it must be remembered that it is not possible for human beings to breathe a chlorinated air, and that the apartment must be, therefore, empty, and also as hermetically sealed as possible to prevent the escape of gas. The experiments of Duggan show that the hypochlorites as derived from chlorinated lime are very active germicides, one part to four hundred being capable of destroying moist germs in two minutes, and six parts to ten thousand killing the spores of the anthrax-bacillus in six hours. A half of one per cent. of the hypochlorites in solution is said to be sufficient to destroy spores almost instantly.

Ordinary bleaching powder contains from twenty-five to forty per cent. of available chlorine; one part of the powder to one hundred of water is strong enough for ordinary purposes. The odor and taste of this solution are such that it can scarcely be considered a dangerous poison, and it has been affirmed, although with doubtful correctness, that such solution will not injure clothing, bedding, etc. The cost of bleaching powder for use in small quantities is so slight that even a saturated solution may be prepared for use in the sickroom at a nominal cost. *For the destruction of disease germs in urine, fecal discharges, sputa, etc., a saturated solution of bleaching powder appears to be in all respects the best disinfectant known.* As it is important to destroy the germs as soon as possible, this solution should be put into the receptacle to be used by the patient *before* the discharges are ejected into them. As the chlorinated solution attacks metals, the spit cups, etc., should be of china or glass.

In consequence of its powers as a disinfectant, chlorinated lime is a very important compound in its application to medical police. It may be used with advantage for preserving bodies from exhaling an unpleasant odor, before interment, in the summer season. In juridical exhumations its use is indispensable, as it effectually removes the disgusting and insupportable fetor of the corpse. The mode in which it is applied, in these cases, is to envelop the body with a sheet completely wet with a solution made by adding about a pound of the powder to a bucketful of water. This solution may also be employed for disinfecting dissecting rooms, privies, common sewers, docks, and other places with offensive effluvia.

Chlorinated lime acts exclusively by its chlorine, which, being loosely combined, is disengaged by the slightest affinities. It should, therefore, be carefully kept from contact with the air and organic substances, which cause rapid loss of chlorine, and the modern method of putting it up for ordinary use in hermetically sealed pasteboard or zinc boxes is a great convenience. R. C. Bicknell examined commercial chlorinated lime put up in boxes for available chlorine; he found the top layers usually deficient in strength, but in the interior from 30 to 35 per cent. of chlorine. Some of the packages assaying 30 per cent. of chlorine were more than a year old. (*A. J. P.*, 1886, p. 593.) Investigations made more recently show that variations in the percentage of chlorine are found in the chlorinated lime put up in packages. See Puckner, Stephens, Harding (*Proc. A. Ph. A.*, 1898, 905). All acids, even carbonic, disengage it, and, as this acid is a product of animal and vegetable decomposition, noxious effluvia furnish the means, to a certain extent, of their own disinfection; but the stronger acids disengage the chlorine far more readily, and among these sulphuric acid is the most convenient. Accordingly, the powder may be dissolved in a very dilute solution of this acid; or a small quantity of the acid may be added to an aqueous solution ready formed, if a more copious evolution of chlorine be desired than that which takes place from the mere action of the carbon dioxide of the atmosphere.

Chlorinated lime may be advantageously applied to the purpose of purifying offensive water, a property which makes it invaluable on long voyages. When used for this purpose, from one to two ounces of the chloride may be mixed with about sixty-five gallons of the water. The water must afterwards be exposed for some time to the air, and allowed to settle, before it is fit to drink. Chlorinated lime is rarely used internally.

Dose, official, four grains (0.26 Gm.).

Off. Prep.—Liquor Calcis Chlorinatæ, *Br.;* Liquor Sodæ Chlorinatæ, *U. S., Br.*

CALX SULPHURATA. U. S., Br.

SULPHURATED LIME [Crude Calcium Sulphide]

(călx sŭl-phū-rā'tą)

"A mixture containing at least 60 percent. of calcium sulphide [CaS = 71.63], together with unchanged calcium sulphate [$CaSO_4$ = 135.15], and carbon, in varying proportions." *U. S.*

"A mixture containing not much less than 50 per cent. of calcium sulphide, CaS, with calcium sulphate and carbon. It may be prepared by reducing native calcium sulphate by means of carbon." *Br.*

Calcium Sulphuratum, Calcii Sulphidum; Calcaria Sulfurata, Hepar Sulphuris Calcareum, Hepar Calcis; Sulphide of Calcium; Sulfure de Chaux, *Fr.;* Kalkschwefelleber, *G.*

* "Exsiccated Calcium Sulphate, in fine powder, *seventy grammes* [or 2 oz. av., 205 grains];

Charcoal, in fine powder, *ten grammes* [or 154 grains]; Starch, *two grammes* [or 31 grains]. Mix the powder thoroughly, pack the mixture lightly into a crucible, cover this loosely, and heat it to bright redness, until the contents have lost their black color. Allow the crucible to cool, reduce the product to powder, and at once transfer it to small, glass-stoppered vials." *U. S.*

The U. S. Pharmacopœia of 1890 abandoned the former process of preparing this substance, and adopted the British process (1885) with some modifications; this was retained in the U. S. P. (8th Rev.). The present British Pharm. (1898) does not give a detailed process.

By subjecting a mixture of seven parts of calcium sulphate and one part of charcoal to a red heat, in a covered crucible, carbonic oxide is formed, and calcium sulphide is produced,

$$CaSO_4 + 2C = CaS + 2CO_2$$

A less convenient method is to pass hydrogen sulphide over red-hot lime, but if the lime be pure a better product is insured. This preparation, which was introduced into both Pharmacopœias, is of doubtful utility, particularly in the form in which it is produced. The amount of calcium sulphide present must vary considerably according to circumstances. The medicinal activity is measured alone by the quantity of sulphide in the finished preparation, calcium sulphate, the other constituent, being inert. It is to be regretted that a method of purification was not appended.

Properties.—Sulphurated lime is officially described as "a pale gray powder, exhaling a faint odor of hydrogen sulphide, having a nauseous and alkaline taste; gradually decomposing by exposure to moist air. Very slightly soluble in cold water, more readily in boiling water, which partially decomposes it; insoluble in alcohol. When Sulphurated Lime is decomposed by diluted acetic acid, calcium acetate is formed, hydrogen sulphide gas is evolved, and a residue of calcium sulphate and carbon remains. The filtrate from this yields with ammonium oxalate T.S. a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid." *U. S.*

Tests.—"If 1 Gm. of Sulphurated Lime be added to a cold solution of 2.08 Gm. of cupric sulphate in 50 Cc. of water, followed by 10 Cc. of diluted hydrochloric acid, added in small portions, with constant stirring, and the mixture digested on a water-bath for 15 minutes and filtered, the addition of an excess of ammonia water should impart no color to the filtrate (presence of at least 60 percent. of pure Calcium Sulphide)." *U. S.* The British Pharmacopœia describes it as "a grayish-white powder with a smell of hydrogen sulphide. If 0.8 gramme be mixed with a cold solution of 1.4 grammes of *copper sulphate* in 50 cubic centimetres of *water*, and, after the addition of a little *hydrochloric acid*, the mixture be well stirred and heated to a temperature approaching that of ebullition until all action has ceased, and then filtered, the filtrate should give no red color with *solution of potassium ferrocyanide* (presence of a due proportion of sulphide)." *Br.*

Calcium sulphydrate, or *calcium hydrosulphide,* $Ca(SH)_2$, is formed when hydrogen sulphide is passed into milk of lime as long as it is absorbed. It is in the form of a paste of a greenish-gray color, and exhales a strong odor of hydrogen sulphide.

Uses.—It is used as a *depilatory,* and is applied in a layer on the part which is to be deprived of hair. At the end of fifteen minutes it is removed with a wet sponge, which at the same time detaches the hairs. On account of this preparation giving out hydrogen sulphide, it should not be applied near the mouth or nose. An impure aqueous solution of calcium sulphide, necessarily containing calcium thiosulphate from the manner of its preparation, is used with great success, in Belgium, in *itch,* the cure of which it effects in a few hours. It is made by boiling together one part of sublimed sulphur, two of lime, and ten of water. The liquid is allowed to cool, and the clear part poured off and kept in well-stoppered bottles. For an explanation of the reaction which takes place, see *Sulphur Præcipitatum.* The patient, after having been well washed with soap and tepid water in a bath, is rubbed over with the liquid, which is allowed to dry on the skin for a quarter of an hour. A second bath is then taken, which completes the cure. The preparation, when it dries, leaves on the skin a thin layer of the sulphur compound, which destroys the itch insect and its eggs.

Sulphurated lime has been strongly recommended by Ringer, Duhring, and other authorities as a remedy for *furuncular eruptions,* and it has also been used successfully in *acne.*

Dose, one-tenth to one-half grain (0.006 to 0.032 Gm.).

CAMBOGIA. U. S., Br.

GAMBOGE

(căm-bō′gĭạ)

"A gum-resin obtained from *Garcinia Hanburii* Hooker filius (Fam. *Guttiferæ.*)" *U. S.* "A gum-resin obtained from Garcinia Hanburii, *Hook. f.*" *Br.*

Gambogia, *U. S. Pharm.* 1870; Gummi-resina guttæ (s. gutti), Gutta Gamba, Cambodia; Gomme-gutte, *Fr. Cod.;* Gutte, *Fr.;* Gutti, *P. G.;* Gummigutt, *G.;* Gumma gotta, *It.;* Gutagamba, Goma gutta, *Sp.*

Under the name of *Cambogia Indica, Indian Gamboge,* the British Addendum recognizes a gum-resin obtained from the *Garcinia Morella,* Desrouss. Several plants belonging to the natural family of Guttiferæ, growing in the equatorial regions, yield on incision a yellow opaque juice, which hardens on exposure and bears a close resemblance to gamboge; but it is only from a particular tree, growing in Siam, that the official gum-resin is procured. According

to observations of Baildon and Jamie, gamboge is obtained exclusively from the province of Cambodia, the plant not being found in any other part of Siam nor in Cochin-China. (*J. P. C.*, Juillet, 1874.) Formerly the United States and all the British Pharmacopœias ascribed it to *Stalagmitis cambogioides*. Both the genus and the species were established by Murray of Göttingen, in 1788, from dried specimens belonging to König, procured in Ceylon; and, from information derived from the same source, it was conjectured by Murray that the tree yielded not only the gamboge of Ceylon, but also that collected in Siam. On this authority the British Colleges made the references alluded to. But it was ascertained by Graham of Edinburgh, that there is no such plant as *Stalagmitis cambogioides;* the description of Murray having been drawn up from accidentally conjoined specimens of two trees belonging to different genera, one being the *Xanthochymus ovalifolius* of Roxburgh, and the other the *Hebradendron cambogioides* of Graham. By several botanists the gum-resin has been ascribed to *Garcinia Cambogia*, also a tree of Ceylon belonging to the Guttiferæ and yielding a yellowish concrete juice; but a specimen of this juice, sent to Edinburgh, was found by Christison to differ from gamboge both in composition and appearance, being of a pale lemon-yellow color. Thus it appears that neither of these references is correct; and, besides, the fact seems to have been overlooked that commercial gamboge is never obtained from Ceylon, but exclusively from Siam and Cochin-China. A gum-resin from Ceylon having been found similar in composition to the gamboge of commerce, and the tree which produced it having been referred by Graham to a new genus and named by him *Hebradendron cambogioides*, the Edinburgh College, in the last edition of its Pharmacopœia, was induced to adopt this Ceylon gamboge as official, and to recognize the name proposed by Graham for the tree producing it. But, as this variety is never found in Western commerce, and exists only in cabinets, or in the bazaars of India, it scarcely merited a place in an official catalogue; moreover, the genus Hebradendron is not acknowledged by botanists. The *H. cambogioides* is the *Garcinia pictoria* of Roxburgh (*Flor. Ind.*, ii. 627), which Sir Joseph Hooker considers to be a variety of the *G. Morella*, Desrouss., though Beddome keeps it distinct on account of its having the fertile flower bearing "the staminodes in bundles and the stigma very small and 4-lobed." Several years since, Christison received from Singapore specimens of the gamboge plant cultivated in that island, and derived from Siam, which proved to be a Garcinia, differing from the *G. elliptica* of Wallich chiefly in having its male flowers upon pedicels. Subsequently Hanbury obtained from the same source numerous specimens of the same plant, and was enabled to confirm the statement of Christison; but he also found that the plant approached very near to the *Garcinia Morella* of Desrousseaux, from which it could be distinguished only by its pedicellate flowers. These specimens were afterwards submitted to the inspection of Thwaites in Ceylon, who is perfectly familiar with the Garcinias of that island, and were pronounced by him to belong to a variety of *G. Morella*, scarcely differing from the Ceylon plant, except in having pedicelled instead of sessile flowers; for these two varieties the names of *G. Morella*, var. *sessile*, and *G. Morella*, var. *pedicellata*, were proposed. Sir Joseph Hooker, however, determined (*Journ. Linn. Soc.*, xiv. 485) that the var. *pedicellata* is a distinct species, differing from *G. Morella* in having not only its flowers pedicellate, but also its leaves more ovate and much larger, and its fruit larger; he very properly gave it the specific name of *Hanburii* to commemorate the contributions of the late Mr. Hanbury to pharmaceutical science, and his connection with the history of the present plant. According to the researches of Beckett, *G. Hanburii* is confined to the islands and sea coast of the Gulf of Siam, where it is known as "*Ton Rong*," and where it grows to the height of fifty feet, with a diameter of twelve inches. *Ceylon gamboge*, derived from the *Hebradendron cambogioides* of Graham (*Cambogia Gutta*, L., *Garcinia Morella*, De Cand., *G. pictoria*, Roxb.), is procured by incisions, or by cutting away a portion of the bark, and scraping off the juice which exudes. The specimens sent to Christison were in flattish or round masses, eight or nine inches in diameter, apparently composed of aggregated irregular tears, with cavities which are lined with a grayish and brownish powdery incrustation. It resembled coarse gamboge, and was identical in composition. In Ceylon it is used as a pigment and purgative. (Christison.) *New Caledonian Gamboge*, derived from *Garcinia Collina*, Vieil, is described by Heckel and Schlagdenhauffen as very similar in its appearance and reactions to ordinary gamboge; its color is, however, deep orange. A white crystalline compound, which when heated beyond 235° C. produced pyrocatechin, was found in it, and marked the point of difference between it and other varieties of gamboge. (*Rép. de Pharm.*, 1893, 193.)

Gamboge is said to be procured in Siam by breaking off the leaves and shoots of the tree; the juice, which is contained in ducts or latex vessels in the bark, issues in drops, and, being received in suitable vessels, gradually thickens, and at length becomes solid. Jamie of Singapore, states that incising the trunk and larger branches is often practised. The juice is frequently received into the hollow joints of the bamboo, and the water expelled by mild continuous heat. In this way the so-called pipe gamboge is formed, the contraction during drying causing the cylinders to be hollow. According to Beckett, Siam gamboge is obtained only from trees of not less than ten years of age and during the rainy months, from June to

October, by cutting long, spiral grooves into the bark and collecting in hollow bamboos the sap which trickles down in a viscous stream. (*Kew Bulletin,* 1895.)

The name *gummi gutta,* by which gamboge is generally known on the continent of Europe, probably originated from the circumstance that the juice escapes from the plant by drops. The official title was undoubtedly derived from the province of Cambodia, in which the gum-resin is collected. Gamboge was first brought to Europe by the Dutch, about the middle of the seventeenth century. We import it from Canton and Calcutta, whither it is carried by the native or resident merchants. There is no difference in the appearance or character of the drug as brought from these two ports,—an evidence that it is originally derived from the same place.

Varieties.—The best gamboge is in cylindrical rolls, from one to three inches in diameter, sometimes hollow in the centre, sometimes flattened, often folded double, or agglutinated in masses so that the original form is not always easily distinguishable. The pieces sometimes appear as if rolled, but are in general striated longitudinally from the impression made by the inner surface of the bamboo. They are externally of a dull orange color, which is occasionally displaced by greenish stains, or concealed by the bright yellow powder of the drug, slightly adhering to the surface. In this form the drug is sometimes called *pipe gamboge.* Another variety is imported under the name of *cake* or *lump gamboge.* It is in irregular masses of two or three pounds or more, often mixed with sticks and other impurities, containing many air-cells, less dense, less uniform in texture, and less brittle than the former variety, and breaking with a dull and splintery instead of a shining and conchoidal fracture. The worst specimens of this variety, as well as of the cylindrical, are sometimes called by the druggists *coarse gamboge.* They differ, however, from the preceding only in containing a greater amount of impurities. Indeed, it would appear from the experiments of Christison that all the commercial varieties of this drug have a common origin, and that cake or lump gamboge differs from the cylindrical only in the circumstance that the latter is the pure concrete juice, while to the former, farinaceous matter and other impurities have been added for the purpose of adulteration. The inferior kinds of gamboge may be known by their greater hardness and coarser fracture; by the brownish or grayish color of their broken surface, which is often marked with black spots; by their obvious impurities, and by the green color which their decoction, after cooling, gives with tincture of iodine (starch). When pure, the gum-resin is completely dissolved by the successive action of ether and water, so that the amount of residue left by any specimen treated in the manner just spoken of indicates approximately the measure of the adulteration.

Properties.—The official description is as follows: "In cylindrical pieces, usually hollow in the centre, of variable length, 2 to 5 Cm. in diameter, externally grayish orange-brown, longitudinally striate; fracture conchoidal, orange-red, waxy, and somewhat porous; inodorous; taste very acrid. Powder bright yellow, sternutatory, containing few or no starch grains. Not more than 25 percent. should be insoluble in alcohol; ash not more than 3 percent." *U. S.*

From the brilliancy of its color, gamboge is highly esteemed as a pigment. It has no odor, and little taste, but, after remaining a short time in the mouth, produces an acrid sensation in the fauces. Its sp. gr. is 1.221. "When *solution of iodine* is added to a cooled aqueous decoction, the color should not become distinctly green (absence of more than a trace of starch). When incinerated it should not yield more than 3 per cent. of ash." *Br.* It is a gum-resin, without volatile oil. Christison has shown that the proportion of gum and resin varies in different specimens even of the purest drug. In one experiment, out of 100.8 parts he obtained 74.2 of resin, 21.8 of gum, and 4.8 of water. The gum is quite soluble in water, and of the variety denominated arabin. Flückiger, however, says that the gum is not identical with gum arabic, as its solution does not redden litmus, and is not precipitated by neutral lead acetate, nor by ferric chloride, nor by sodium silicate or biborate. By fusing purified gamboge resin with potassium hydroxide, Hlasiwetz and Barth (*Ann. Ch. Ph.,* 138, 61) obtained acetic and other acids of the same series, together with *phloroglucin,* $C_6H_3(OH)_3$, *pyrotartaric acid,* $C_5H_8O_4$, and *isouvitinic acid,* $COOH.C_6H_4.CH_2COOH$. Sassarini found gamboge to contain the following constituents: 1. Gum analogous to arabin. 2. Volatile oil, consisting of terpene and a camphor. 3. Isouvitinic and acetic acids. 4. A phenol ester. 5. Resin. 6. Methyl alcohol and some higher homologues. 7. A liquid having a fruity odor resembling aldehyde or acetone. He believes phloroglucin found by others to be a decomposition product. (*Ann. di Chim. Farm.,* 1897.) Gamboge is readily and entirely diffusible in water, forming a yellow opaque emulsion, from which the resin is very slowly deposited. It yields its resinous ingredient to alcohol, forming a golden-yellow tincture, which is rendered opaque and bright yellow by the addition of water. Its solution in ammoniated alcohol is not disturbed by water. Ether dissolves about four-fifths of it, taking up only the resin. It is wholly taken up by alkaline solutions, from which it is partially precipitated by the acids. The strong acids dissolve it; the solution when diluted deposits a yellow sediment. The color, acrimony, and medicinal power of gamboge are thought to reside in the resin. Hirschsohn gives a method for detecting gamboge in mixtures in *Ph. Z. R.,* xxiv. (*A. J. P.,* 1885.)

Uses.—Gamboge is a powerful, drastic, hydragogue cathartic, so very apt to produce

nausea and vomiting and much griping when given in the full dose that it is almost never employed except in combination with other cathartics. In large quantities it is capable of causing fatal effects, and death has resulted from a drachm. The full dose is from two to six grains (0.13 to 0.4 Gm.), which in cases of *tænia* has been raised to ten or fifteen grains (0.65 to 1.0 Gm.). It may be given in pill or emulsion, or dissolved in an alkaline solution. In the dose of five grains (0.32 Gm.) the resin is said to produce copious watery stools, with little or no uneasiness. If this be the case, it is probable that, as it exists in the gum-resin, its purgative property is somewhat modified by the other ingredients.

Dose, two grains (0.13 Gm.).

Off. Prep.—Pilulæ Catharticæ Compositæ, *U. S.;* Pilula Cambogiæ Composita, *Br.*

CAMPHORA. U. S., Br.

CAMPHOR

(căm'phọ-rạ)

$C_{10}H_{16}O = 150.98$

"The dextrogyrate modification of the saturated ketone [$C_9H_{16}CO$], obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*), and purified by sublimation. Camphor should be kept in well-closed vessels, in a cool place." *U. S.* "A white crystalline substance obtained from Cinnamomum Camphora, *Nees and Eberm.*, purified by sublimation." *Br.*

Camphre du Japon, *Fr. Cod.;* Camphre, *Fr.;* Camphora, *P. G.;* Kampher, Kampfer, Campher, *G.;* Canfora, *It.;* Alcanfor, *Sp.*

The name of camphor has been applied to various concrete, white, odorous, volatile products, found in different aromatic plants, and resulting probably from chemical change in their volatile oil. But commercial camphor is derived exclusively from two plants, the *Camphora Officinarum* of Nees or *Laurus Camphora* of Linnæus, and the *Dryobalanops aromatica;* the former of which yields our official camphor, the latter, the Borneo or Baras camphor, a product much valued in the East, but unknown in the commerce of this country and of Europe.

Cinnamomum Camphora, B. & T. 222—*Camphora Officinarum,* Nees, *Laurin.* 88; Carson, *Illust. of Med. Bot.,* ii. 29, pl. xxiv.—*Laurus Camphora,* L. Willd., *Sp. Plant.* ii. 478. The camphor tree is an evergreen which sometimes attains great size,[1] having the aspect of the linden, with a trunk straight below, but divided above into many branches, which are covered with a smooth, greenish bark. Its leaves, which stand alternately upon long footstalks, are ovate-lanceolate, entire, smooth and shining, ribbed, of a bright yellowish-green color on their upper surface, paler on the under, and two or three inches in length. The flowers are small, white, pedicelled, and collected in clusters, which are supported by long axillary peduncles. The fruit is a red berry, resembling that of the cinnamon. The camphor tree is a native of China, Japan, and adjacent portions of Eastern Asia, but is capable of cultivation in most sub-tropical countries, where the minimum winter temperature is not below 20° F., and the summers are warm. It thrives in Formosa, Madagascar, Argentina, Egypt, Canary Islands, Southern Europe, Southern Florida, Southern California, and is being cultivated in India and Ceylon. The chief obstacle to its cultivation seems to be the extreme slowness of growth of the tree, and the corresponding slowness of returns from the investment. For an account of cultivation in Florida see *D. C.*, Sept. 1902.

Although the leaves of the camphor tree when bruised have the odor of camphor the drug is obtained solely from the root, trunk, and branches by the process of sublimation. Only the older trees are employed; indeed it is said that a tree must be fifty years old before it should be considered available. The trees are marked in the forest after investigation by an expert, the lower part of the trunk, with roots, chopped up in small fragments, and some form of heat applied. In Japan, the chips are said to be placed with a little water in iron vessels, surmounted by earthenware capitals furnished with a lining of rice straw. A moderate heat is then applied, and the camphor, volatilized by the steam, rises into the capital, where it is condensed upon the straw. In China the comminuted plant is said to be first boiled with water until the camphor adheres to the stick used in stirring, when the strained liquor is allowed to cool, and the camphor which concretes, being alternated with layers of earth, is submitted to sublimation. In the island of Formosa, where the camphor tree abounds, the chips are heated in a rough still. This is usually composed of a furnace surmounted with a trough or similar rude vessel, which is protected by clay. In this reservoir the chips are placed, with water upon them, and a perforated board luted upon the top; on this are set earthenware pots. A fire having been lighted, steam rises through the chips and carries the camphor with it to deposit it in the pots. The crude camphor is taken to the towns in baskets and then put into large vats, with holes in the bottom, through which an oil escapes called *camphor oil,*[2] much used by the

[1] A tree seen by Kämpfer, in Japan, in 1691, with a trunk 36 feet in circumference, was in the year 1826 described by Siebold as having a circumference of 50 feet.

[2] OIL OF CAMPHOR.—Two substances occur in commerce under the name of oil of camphor: the one derived from the *Cinnamomum Camphora,* known as the *Formosa* or *Japanese Oil of Camphor,* and formerly official under the name of *Oleum Camphoræ* in the U. S. P.; the other the product of *Dryobalanops aromatica,* the *East India oil of comphor,* not occurring in American and European commerce. The com-

Chinese for medicinal purposes. It is said that of recent years hydraulic pressure is largely substituted for drainage.

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mercial oil of camphor, as found in our markets, is a colorless fluid or of a light yellowish-brown color, having a strong odor precisely like that of camphor, a bitterish camphorous taste, and a specific gravity, according to Wm. Procter, of 0.940. As described by Lallemand, the oil of the *Cinnamomum Camphora* is very fluid, scarcely colored, and of a strong odor of camphor. It acts strongly on polarized light, and is dextrogyrate. It has been considered to be simply a mixture of camphor, $C_{10}H_{16}O$, and a hydrocarbon, $C_{10}H_{16}$, but is in reality much more complex. Yoshida (*A. J. P.*, 1886, p. 99) separated it into five portions, as follows: 0.2 per cent. boiling below 145° C.; 7 per cent. of a hydrocarbon boiling at 156° C.; 20 per cent. of a hydrocarbon boiling at 172° to 173° C.; 22.8 per cent. of camphor, boiling point 205° C.; 50 per cent. of an oxygenated oil boiling at 212° to 213° C. The hydrocarbon boiling at 156° C., Yoshida determined to be *terebinthene*, $C_{10}H_{16}$, which differs in physical respects, however, from the terebinthene of oil of turpentine. The hydrocarbon boiling at 172° to 173° C. he found to have a pleasant lemon odor, and, he thinks, is identical with the *citrene* of lemon oil. To the oxygenated oil, which constitutes half of the crude oil, he gives the formula $C_{10}H_{16}O,H_2O$, and calls it *camphorogenol*. Schimmel & Co. of Leipsic, have, since 1885, extracted *safrol* commercially from the Japanese oil of camphor, and they give a different account of its composition. They state (*Schim. Rep.*, 1888) that it contains *camphor, safrol, eugenol,* a *sesquiterpene*, $C_{15}H_{24}$, and possibly *terpinol*. They do not consider Yoshida's camphorogenol to be a distinct substance.

Within the last few years there has appeared in the American and English markets in considerable quantity an oil of camphor produced in Japan. It is imported in tin cans, and varies in tint from the colorless transparency of water, through pale straw and yellow, to deep black. The specific gravity varies from 0.898 in the colorless oil to 0.990 in the very dark. The oil seems to vary greatly in the amount of camphor it contains, much of it having nearly all the solid principle removed before exportation. The odor is distinctly camphoraceous, with a peculiarity that suggests the odor of sassafras. It is said by Peter MacEwan to differ from the Formosa oil in its behavior towards nitric acid. If half a drachm of the acid be allowed to act upon half a drachm of Japanese oil, and then diluted with half a drachm of water, a crimson color will be produced. The Formosa oil so treated yields a milky color with a scarcely perceptible green shade; hydrochloric acid gives with each oil a salmon color, more marked, however, with the Japanese oil. For further details, see *P. J.*, vols. xv., xvi., and *J. C. S.*, Oct. 1885. The oil is said to be used in Japan for the preparation of Chinese ink and varnishes, and for burning. As a diluent for artists' colors it is useful because its capacity for dissolving resins is greater than that of oil of turpentine and similar liquids.

The Formosa camphor oil industry, owing to onerous trade restrictions, has decreased greatly (*Journ. Soc. Chem. Ind.*, 1887, 391), while that of Japan has increased enormously. In 1885 the exportation from Japan was 225,200 kilos, in 1886, 537,700 kilos, and in 1887 much more; but on account of the failure of price the Japanese have consumed most of the oil they produce, the importation into the United States in 1892 having decreased to but a little more than one-fourth of what it formerly was.

The oil of camphor has properties similar to those of camphor, but more stimulant, and is especially applicable to affections of the stomach and bowels in which an anodyne and stimulant impression is indicated, as *flatulent colic* and *spasmodic cholera*. It may also be used externally, as a rubefacient and anodyne liniment, diluted with soap liniment, or olive oil, in *local rheumatism* and *neuralgic pains, bruises, sprains*, etc. The dose is two or three minims (0.12 to 0.2 Cc.).

The *Dryobalanops oil of camphor* is said to be found in trees too young to produce camphor, and is supposed to constitute the first stage in the development of this substance, as it occupies the cavities in the trunk which are afterwards filled with the camphor. The chief constituent of it is a peculiar volatile oil, which is termed *borneene;* it is isomeric with oil of turpentine, $C_{10}H_{16}$, and holds in solution borneol and resin. By fractional distillation this oil may be separated into two portions, the one more volatile than the other, but not differing in composition.

Commercial History.—The commerce of the world is supplied with camphor from China, Japan, and Formosa, the great bulk of the product coming from the latter island. After the annexation of Formosa by the Japanese, that Government, led by the unnecessary destruction of the camphor trees of the island, the inferiority of the camphor obtained, and the waste of the processes employed, and especially by the desire for revenue, made a governmental monopoly of the camphor trade which went into operation in 1900. The product obtained by the camphor gatherers is said to be taken by the government at a fixed price, about $15.00 a picul (133 lbs.). From the first it was found necessary to afford military protection to the gatherers, from the abounding savage tribes, and during the Russo-Japanese war irregularities in this regard are said to have greatly diminished the product and to be the chief cause of the present high price of camphor. The camphor is sold by the Japanese government through a single London firm or company, Samuel Samuels, with sub-agencies at Hamburg, New York, and perhaps other cities. From these agencies refiners in different parts of the world buy it by contract for a year at a time. The statement freely made that camphor is sold at a fixed price by the Japanese government, is incorrect, and the extraordinary rise of camphor in price is shown by the fact that in Nov., 1895, the average wholesale price of refined camphor was 58 cents per pound; in Nov., 1900, 62.5 cents per pound; in Nov., 1905, 83 cents per pound. The importations of crude camphor were in 1902, 1,831,058 lbs., valued at $576,405; in 1903, 2,508,420 lbs., valued at $764,403; and in 1904, 2,819,883 lbs., valued at $874,709.

There are two very distinct varieties of the crude camphor, namely—the Chinese and the Japanese,[2] the Japanese camphor being divided

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[2] *Sumatra Camphor. Borneo Camphor. Dryobalanops Camphor. Bhimsaim Camphor. Baros Camphor. Borneol.*—This camphor is produced in the islands of Sumatra and Borneo, by *Dryobalanops aromatica*, Gaertn. (*D. Camphora*, Coleb.) This tree is very large, often exceeding one hundred feet in height, with a trunk six or seven feet in diameter, and ranks among the tallest and largest trees in India. (*A. J. P.*, xxiv. 329.) It is found in Sumatra and Borneo, and is abundant on the northwest coast of the former island. The camphor exists in concrete masses, which occupy longitudinal cavities or fissures in the heart of the tree, from a foot to a foot and a half long, at certain distances apart. The younger trees are generally less productive than the old. The only method of ascertaining whether a tree contains camphor is by incision. A party proceed through the forest, wounding the trees, till they find one which will answer their purpose; and hundreds may be examined before this object is attained. When discovered, the tree is felled and cut into logs, which are then split, and the camphor removed by means of sharp-pointed instruments. It is stated that the masses are sometimes as thick as a man's arm, and that the product of a medium-sized tree is nearly eleven pounds; of a large one, double that quantity. The trees which have been wounded and left standing often produce camphor seven or eight years afterwards. Ida Pfeiffer states, in her *Second Journey Round the World* (Am. ed., p. 183), that the camphor is also found in a concrete state under the bark and is swept down with long brooms. The whole tree is pervaded more or less by the cam-

into the Japanese camphor proper and the Formosa camphor. Of the two commercial varieties the Chinese comes in chests lined with lead, each containing about 130 pounds. It occurs in small grains or granular masses, of a dirty white color, frequently mixed with impurities. Japanese camphor (formerly known as *Dutch camphor* or *"tub camphor"* because it was exported through Batavia) is sent into market in tubs, covered with a peculiar matting, and in its general aspect resembles Chinese camphor. The value and purity of both Chinese and Japanese camphor vary greatly in different specimens, but recently much of the Chinese crude camphor has been whiter and cleaner than the Japanese. It is always small grained and yields on sublimation crystals much smaller than are obtained from Japanese camphor, and is therefore less esteemed. A dark inferior grade of camphor is also obtained in the United States from commercial oil of camphor.

Artificial Camphor.—Camphor can also be made artificially by the oxidation of *camphene*, $C_{10}H_{16}$, with chromium trioxide mixture. Camphene is obtained from either pinenehydrochloride (so-called artificial camphor) or from bornyl chloride by treatment with alcoholic potash, and is a solid crystalline mass, fusing at 49° C. In the patented process of Nathan Thurlow, camphor is made by submitting oil of turpentine to the action of anhydrous oxalic acid in steam-jacketed reaction tanks. The liquid mass, containing *pinyl oxalate* and *pinyl formate*, is then distilled in the presence of an alkali with live steam, the resultant products being camphor, Borneol camphor, and certain oily products, which are separated from one another and purified by a somewhat complicated process. It is stated that turpentine yields in this process from 25 to 35 per cent. of its weight, and that oil of lemon and other essential oils, and terpenes are obtained as secondary products. This artificial camphor is either optically inactive or has a very slight dextrorotation, but in general physical properties exactly resembles natural camphor. So far, however, it seems to be difficult to work the process upon a large scale and the artificial product has had no effect upon the general camphor market. Camphor can also be produced from isoborneol, by the action of oxidizing mixtures. The method patented in France, which is said to yield from 95 to 100 per cent. of camphor, consists in suspending ten kilogrammes of isoborneol in ten kilogrammes of benzol, and adding ten kilogrammes of potassium permanganate dissolved in one thousand liters of water, until the color of the permanganate is discharged. The camphor produced is separated by distillation and crystallized from petroleum benzin. (*Chem. Ztg.*, 28).

Refined Camphor.—The process for refining camphor was first practised in Europe by the Venetians, who probably derived it from the Chinese. It was afterwards transferred to the Dutch, who long enjoyed a monopoly of this business; and it is only within recent years that the process has been generally known. It is now practised largely in this country, and the camphor refined in our domestic establishments is equal to any formerly imported. Crude camphor is mixed with about one-fiftieth of quick-lime, and exposed, in an iron vessel placed in a sand bath, to a gradually increasing heat, by which it is melted and ultimately converted into vapor, which condenses in a suitable receiver. Refined in this manner, it is usually in the form of large circular cakes, one or two inches thick, slightly convex on one side and concave on the other, and perforated in the centre. Much refined camphor comes into the market in the form of compressed blocks, this being especially true of camphor refined in Philadelphia and Japan. It is stated that in Japan the refining of camphor is done by the Government and also by individuals, the process being probably that employed in the Philadelphia laboratories, as the first refining of camphor was done in Japan by a man who had been thoroughly educated in these laboratories. Japanese refined camphor

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phor or the oil. The wood retains a fragrant odor, and, being, on this account less liable to the attacks of insects, is highly esteemed for carpenter work.

Borneo camphor resembles in appearance ordinary camphor, but has, according to Christison, a specific gravity of 1.009, and sinks in water. Its odor is also distinctly different from that of camphor. It usually pulverizes without the addition of alcohol, is less volatile than ordinary camphor, and does not crystallize in the interior of the bottles in which it is kept. It fuses at 206° C. and boils at 212° C.; is dextrogyrate; has a formula of $C_{10}H_{17}(OH)$; and by the action of boiling nitric acid is converted into common camphor. It does not reach European commerce, being largely consumed in the Batta provinces, especially in funeral rites; and any that is exported is bought up at enormous prices for China, where it is preferred for embalming purposes on account of its being less volatile than the ordinary drug.

Borneo camphor is also produced in Johore, a province of the Malay peninsula, where it is sold in four qualities. The first is composed of transparent crystals, generally a quarter of an inch and upwards in length; the second of brown crystals, inferior in size; the third of powdery coherent and slightly colored grayish crystals, which resemble Japanese camphor; the fourth quality is brownish, pulverulent, and looks like sea shore sand. (See *P. J.*, xvii.)

Ngai camphor is yielded by the *Blumea balsamifera*, which occurs in India, China, Formosa, etc. The crude drug is known to the Chinese *as ngai-fêu*, and when refined in Canton as *ngai-p'ien*. About ten thousand pounds annually are exported from Canton. The refined camphor in appearance, odor, hardness, specific gravity, and volatility agrees almost precisely with Borneo camphor. According to Plowman, it has the chemical composition of Borneo camphor, but differs from it in its alcoholic solution being lævogyrate, and in being converted by boiling nitric acid into a substance thought to be identical with the stearoptene of *Chrysanthemum Parthenium*, Pers.

The physiological action of *Borneo* and *Ngai camphor* and of artificial *borneol* has been studied by R. Stockman (*J. P.*, 1888), who finds that the action of the three substances is practically identical and closely resembles that of true camphor. He finds that these substances act as stimulants to the heart, but that when the dose is sufficiently large there occurs a fall of blood pressure, apparently due to dilatation of the vessels; that in poisoning the respiration is always very much slowed, apparently by a centric action; that the convulsions which the drug produces are due to an influence upon the cerebral cortex; and that there is a lessening of the functional activity of the spinal cord and of the motor nerves. The results obtained by A. Lapin (*Med. Age*, 1894, xii.) with borneol, seem not to be discordant with those of Stockman, and show that in its proper dose the drug increases the energy of the heart, and that in frogs it is an especial motor nerve paralyzant.

occurs in rather thin, oblong cakes, enclosed in small tin boxes which have been hermetically sealed by paper pasted over their edges. Camphor is refined in Philadelphia as follows: The vessels in which the camphor is put are of cast iron, circular, from 12 to 15 inches or more in diameter, and 4 inches deep, with perpendicular sides, and a ledge at top, on which the cover rests. This consists of sheet iron, with a hole through the centre about an inch in diameter, over which a small hollow cone of sheet iron is placed loosely. The crude camphor mixed with the lime, the object of which is said to be to combine with the moisture present, which interferes with the due solidification of the camphor vapor, is placed in the iron vessels described, of which from 20 to 50 are arranged in a long sand bath. Heat is then applied until the camphor melts, after which the temperature is kept as nearly uniform as possible, so that the vaporization may take place regularly, without violent ebullition. The vapor condenses on the lower surface of the lid, and care is taken, by the occasional removal of the iron cone, and clearing of the opening by means of a knife, to allow the escape of any accidental excess of the vapor.

Properties.—"White, translucent masses, of a tough consistence and a crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform; having a penetrating, characteristic odor, and a pungent, aromatic taste. Specific gravity: 0.990 at 25° C. (77° F.). It is optically active, being dextrogyrate. Very sparingly soluble in water, but readily soluble in alcohol, ether, chloroform, carbon disulphide, petroleum benzin, and in fixed and volatile oils. When Camphor is triturated, in about molecular proportions, with menthol, thymol, phenol, or hydrated chloral, liquefaction ensues. It melts at 175° C. (347° F.), boils at 204° C. (399.2° F.), and is inflammable, burning with a luminous, smoky flame. On exposure to the air, it evaporates more or less rapidly at ordinary temperatures, and, when moderately heated, it sublimes without leaving a residue. If a small piece of Camphor be dropped into a small porcelain dish, the latter placed in a larger dish, and a clean beaker moistened on the inner surface with distilled water be inverted over the smaller dish immediately after igniting the Camphor, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water, and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S. (absence of *chlorinated products*)." *U. S.* Camphor has a peculiar, strong, penetrating, fragrant odor, and a bitter, pungent taste, with a slight sense of coolness. It is beautifully white and pellucid, somewhat unctuous to the touch, brittle, and yet possessed of a tenacity which renders its reduction to a fine powder very difficult, unless its cohesion be overcome by the addition of a minute proportion of alcohol, ether, chloroform, glycerin, essential or fatty oils, or other volatile liquid for which it has an affinity. It may be obtained in powder by pulverizing with an equal weight of sugar, by precipitating the tincture with water, or by grating and afterwards sifting it, or, by sublimation. A still better plan is to dissolve camphor in one and a half parts of alcohol, and pour this solution with stirring into four parts of water. Collect the precipitate, wash with water, and dry. By noting the quantity of camphor used, the amount left dissolved in the diluted alcohol can be calculated, and this solution used in making tincture. The fracture of camphor is shining, and its texture crystalline. Its sp. gr. varies from 0.9857 to 0.996. When thrown in small fragments upon water, it assumes singular circulatory movements, which cease upon the addition of a drop of oil; and this property has been applied to the detection of grease in liquids, a very small proportion of which is sufficient to prevent the movements. Its volatility is so great that, even at ordinary temperatures, it is wholly dissipated if left exposed to the air. When it is confined in bottles, the vapor condenses on the inner surface, and, in large bottles partially filled, sometimes forms, after long standing, large and beautiful crystals. It melts at 175° C. (347° F.), boils at 204° C. (399.2° F.), and, in closed vessels, sublimes unchanged.

When allowed to concrete slowly from the state of vapor, it assumes the form of hexagonal plates. It is not altered by air and light. It readily takes fire, burning with a brilliant flame, with much smoke, and without residue. Water triturated with camphor dissolves, according to Berzelius, not more than a 1000th part; which, however, is sufficient to impart a decided odor and taste to the solvent. By the intervention of sugar or magnesia a much larger proportion is dissolved. (See *Aqua Camphoræ.*) Carbon dioxide increases the solvent power of water, as also does the spirit of nitrous ether. Ordinary alcohol will take up 75 per cent. of its weight of camphor, which is precipitated upon the addition of water. Berzelius states that 100 parts of alcohol, of the sp. gr. 0.806, dissolve 120 parts at 10° C. (50° F.). It is soluble without change in ether, the volatile and fixed oils, strong acetic acid, and diluted mineral acids, and is extremely soluble in chloroform. "It is soluble in about 700 parts of *water,* in about 1 part of *alcohol* (90 per cent.), in one quarter part of *chloroform,* and in 4 parts of *olive oil;* very soluble in *ether.*" *Br.* Nitric acid on prolonged boiling with camphor oxidizes it into *camphoric acid,* $C_{10}H_{16}O_4$ (see page 25), and *camphoronic acid,* $C_9H_{14}O_6$. Schwanert's *camphresinic acid,* $C_{10}H_{14}O_{12}$, is, according to Kachler, a mixture of these two. Sulphuric acid in the proportion of ten parts to one gives, when heated with camphor, an oil isomeric with camphor, boiling at 200° C. (392° F.), and yielding a solid camphor when distilled repeatedly over potassium hydroxide.

Sulphuric acid in the proportion of four to one with camphor, gives, according to Chautard, a volatile product which he calls *camphrene,* and to which Schwanert gives the formula $C_9H_{14}O$. Kachler (*Ann. Ch. Ph.,* 164, p. 90) considers, however, that camphrene is only *phorone* (a condensation product of acetone) with slight impurities. Alcoholic potassium hydroxide solution heated with camphor gives a derivative called *campholic acid,* $C_{10}H_{18}O_2$, a white solid, fusing at 95° C. (203° F.), and boiling at 250° C. (482° F.). Resins unite with camphor, forming a soft tenacious mass, in which the odor of the camphor is sometimes almost extinguished, and frequently diminished; and a similar softening effect results when it is triturated with the concrete oils. Exposed to a strong heat, in close vessels, camphor is resolved into carbonic acid gas and hydrocarbons, among which cymol is especially to be recognized.

Camphor, $C_{10}H_{16}O$, and borneol, $C_{10}H_{18}O$, are classified together as belonging to the group called in general *camphors,* which occur with the *terpenes* or essential oils, $C_{10}H_{16}$, and are to be considered as oxidation products of these latter.

Borneol is an alcohol, yielding esters when heated to about 200° C. (392° F.) with organic acids. It is a secondary alcohol, and therefore contains the group CH.OH linked to a more complex group. Secondary alcohols by oxidation yield *ketones,* by the change of the CH.OH group to CO. Common camphor bears this relation to borneol, and is therefore considered as a ketone, and can be formed from borneol by the action of mild oxidizing agents. The action of metallic sodium, on the other hand, upon common camphor, $C_{10}H_{16}O$, yields borneol, $C_{10}H_{18}O$.

Genuine camphor is said to be sometimes adulterated with the artificial, which may be detected by the action of ammonia upon its alcoholic solution, causing a flocculent precipitate, which does not redissolve, and the quantity of which is proportionate to that of the artificial product in any mixture of the two. (*A. J. P.,* xxxiv. 189.) As a means of distinguishing camphor from the artificial camphor resulting from the reaction between the oil of turpentine and hydrochloric acid, J. W. Bailey recommends that a drop of alcohol, holding in solution a little of the camphor to be tested be allowed to evaporate on the slide of a microscope. The crystals then formed produce with polarized light, beautiful colors, if of natural camphor, but not, if of the artificial. (*Neues Repertorium,* xvi. 763, 1867.)

Uses.—Camphor does not seem to have been known to the ancient Greeks and Romans. Europe probably derived it from the Arabians, by whom it was employed as a refrigerant. The local action of camphor is that of an irritant, with probably a benumbing influence upon the peripheral nerves of the mucous membrane. It is readily absorbed, and is finally eliminated from the kidneys, chiefly in the form of campho-glycuronic acid. When taken in moderate dose it produces in health a feeling of warmth in the stomach, some increase in the frequency, the force, and the fulness of the pulse, and a slight mental exhilaration. After larger doses there are lassitude, decrease in the frequency of the pulse, and giddiness, preceded, it may be, by a short period of excitement. The symptoms produced by poisonous doses are: faintness, headache, vertigo, confusion of ideas, burning pain in the stomach, delirium, violent convulsions, insensibility, general paralysis; a pulse generally small, but sometimes accelerated and sometimes lowered in number; a skin cool, pale, or livid, generally bedewed with sweat. Sudden unconsciousness, with or without convulsions, has been in some instances the first manifestation of the action of the poison, and of course in any individual case many of the symptoms detailed above may be wanting. Camphor has an action upon the cerebral cortex by virtue of which when in moderate dose it has some calmative influence, and when in toxic dose is capable of causing coma and convulsions. The therapeutic dose has no perceptible influence upon the spinal cord, although there is some physiological reason to believe that in certain doses the drug does stimulate the motor cells; in toxic doses there is depression of the motor cord. The drug acts as a stimulant of moderate power upon the respiratory centres, and also upon the cardiac muscle, but does not distinctly and consistently elevate the blood pressure because of the dilatation of the blood vessels which it produces, by both centric and peripheral action. It is used in practical medicine as an antispasmodic in various hysterical conditions, in nervous *headaches, dyspnœa,* etc. At one time it was supposed to have a distinct influence upon the sexual organs, and was used both as an aphrodisiac and as an anaphrodisiac, but is at present rarely employed in sexual conditions. As a cardiac stimulant it has been largely used, especially in Germany, in sudden *heart failure* and in the profound adynamia of *acute endocarditis, typhoid fever, pneumonia,* etc., frequently with happy effect. For this purpose it must be employed hypodermically, preferably dissolved in olive oil. For hypodermic use the German Pharmacopœia recognizes *Oleum camphoratum* (which should not be confounded with *Linimentum Camphoræ* of the U. S. Pharmacopœia), the oil is made by dissolving one part of camphor in nine parts of olive oil. According to Schilling, as much as thirty grains a day of the camphor may be thus administered without disagreeable results. As a local remedy, camphor is of value in all forms of *serous diarrhœa,* allaying intestinal pain and checking intestinal secretions. It is largely employed as a local application which is at once stimulant and calmative in *rheumatic affections,* in *sprains, bruises,* and like injuries; camphor is largely used in liniments. It may be administered in pill but pre-

ferably in capsule, but when very large doses are given it is best administered in emulsion, as in this form it produces as mild gastric irritation as possible.

Camphor water of the U. S. Pharmacopœia is an excellent but feeble preparation. The spirit of camphor may be given in milk or even in water, although under the latter circumstances it is apt to adhere to the sides of the vessel or of the spoon. An excellent method of administration is afforded by an emulsion made by rubbing up the camphor with mucilage of acacia and water. As camphor is freely soluble in chloroform, when it is desired to give the two remedies together the camphor may be dissolved in the chloroform. There is no known antidote to camphor, and in poisoning by it, after evacuation of the stomach and bowels, the symptoms must be met as they arise.

Dose, two to five grains (0.13 to 0.32 Gm.).

Off. Prep.—Aqua Camphoræ, *U. S.*, *Br.;* Ceratum Camphoræ, *U. S.* (from camphor liniment); Ceratum Plumbi Subacetatis, *U. S.;* Linimentum Aconiti, *Br.;* Linimentum Belladonnæ, *U. S.*, *Br.;* Linimentum Camphoræ, *U. S.*, *Br.;* Linimentum Camphoræ Ammoniatum, *Br.;* Linimentum Hydrargyri, *Br.* (from camphor liniment); Linimentum Saponis, *U. S.*, *Br.;* Linimentum Sinapis, *Br.;* Linimentum Terebinthinæ, *Br.;* Linimentum Terebinthinæ Aceticum, *Br.* (from camphor liniment); Pulvis Morphinæ Compositus, *U. S.;* Spiritus Camphoræ, *U. S.*, *Br.;* Tinctura Camphoræ Composita, *Br.;* Tinctura Opii Camphorata, *U. S.* (*Br.*); Unguentum Hydrargyri Compositum, *Br.*

CAMPHORA MONOBROMATA. U. S.

MONOBROMATED CAMPHOR

(kăm′phọ-rạ mŏn-ọ-brō-mā′tạ)

$C_{10}H_{15}BrO = 229.34$

"A substitution product of camphor [$C_9H_{15}Br.CO$]." *U. S.*

Bromated Camphor, Brominated Camphor, Bromcamphor, Bromo-camphor; Camphre Monobromé, *Fr. Cod.;* Monobrom Camphor, Bromkampher Kampfermonobromid, *G.;* Camfora monobromata, *It.;* Alcanfor monobromado, Bromuro de alcanfor, *Sp.*

This substance was discovered in 1861 by Th. Swarts, who prepared it by heating dibromide of camphor in a sealed tube to 100° C. It may also be made by heating bromine and camphor in the proper chemical proportions for three hours in a sealed tube, on a water bath. The crystalline mass is washed with water, recrystallized from alcohol after treatment with animal charcoal, washed with an alcoholic solution of potassium hydroxide, then with much water, and finally recrystallized from a mixture of alcohol and ether. It is very easy to prepare the monobromide on a small scale in this way. There is, however, at all times a very great pressure upon the inside of the tube, and the attempt to practise the method upon a large scale is very likely to result in shattering the tubes. This has led to numerous experiments as to the best method of preparing it. For methods of preparing bromocamphor and allied products, see *Chem. News,* 1896, 208. Maisch's method is as follows: Introduce 4 oz. of bromine gradually into a retort in which 13 oz. of camphor have been previously placed. In 15 or 20 minutes a brisk reaction will commence. When this subsides, 8 or 9 oz. more of bromine are to be poured in, in four portions waiting after each addition until the reaction ceases. The liquid in the retort is now to be heated to about 132° C. (270° F.), then cooled, and sufficient petroleum benzin added to dissolve the crystalline mass. The crystals which are formed on cooling may be purified by recrystallization from benzin or hot alcohol. (*A. J. P.,* 1872, 339.) Various modifications of this process have been proposed. J. U. Lloyd (*A. J. P.,* April, 1875) directs the addition of water to the camphor and bromine in the retort, and boils the mixture for two hours, or until all the water is evaporated. Then the contents are poured into a dish and treated with warm alcohol, and allowed to crystallize, the mother liquor being drained off and the product recrystallized from hot alcohol. C. C. Keller (*S. W. P.,* 1880, p. 50) uses chloroform (instead of water, as proposed by Lloyd) with the camphor and bromine, and washes the crystals with absolute alcohol, crystallizing them finally from an ethereal solution. 300 parts of camphor yield 340 parts of monobromated camphor, the theoretical yield being about 456 parts.

Properties.—"Colorless, prismatic needles or scales, having a mild but characteristic camphoraceous odor and taste, permanent in the air, unaffected by light, and neutral to litmus paper. Almost insoluble in water; freely soluble in alcohol, ether, chloroform, hot petroleum benzin, and fixed and volatile oils; slightly soluble in glycerin; it is also soluble, without decomposition, in cold, concentrated sulphuric acid, from which it separates again unaltered, when the solution is poured into water. It melts at 76° C. (168.8° F.), and sublimes at a slightly higher temperature. At 274° C. (525.2° F.) it boils without decomposition, and is finally volatilized without leaving a residue. If a few crystals of Monobromated Camphor be fused in a dry test-tube with metallic sodium, the residue dissolved in water and the solution acidulated with nitric acid, a copious, faintly yellowish precipitate should be produced upon the addition of silver nitrate T.S." *U. S.*

Uses.—Monobromated camphor was first proposed as a medicine by Deneffe, and has been used as a nerve sedative in *delirium tremens, hysteria, convulsive irritation* of teething, *sleeplessness,* etc. According to the experiments of Bourneville (*Prog. Med.,* 1874) and of Lawson, it produces in mammals muscular weakness, passing into paralysis, very decided progressive reduction of temperature, decrease in the respiration rate, sleep passing into stupor, and finally death. Bourneville states

that the vessels of the ear and eyelids in the rabbit are contracted. Its therapeutic action resembles, but is not identical with, that of other bromides; in the experience of H. C. Wood, it has seemed to be of value in *spermatorrhœa.* It is not safe to give it too freely, as in some cases its ingestion has been followed by epileptiform convulsions. The emulsion may be made by dissolving it in six times its weight of expressed oil of almonds, and then forming an emulsion with gum and water in the usual manner.[1]

Dose, two to five grains (0.13 to 0.32 Gm.) repeated as required.

CANNABIS INDICA. U. S., Br.

INDIAN CANNABIS [Indian Hemp]

(căn'nȧ-bĭs ĭn'dĭ-cȧ)

"The dried flowering tops of the pistillate plants of *Cannabis sativa* Linné (Fam. *Moraceæ*), grown in the East Indies and gathered while the fruits are yet undeveloped, and carrying the whole of their natural resin." *U. S.* "The dried flowering or fruiting tops of the female plant of Cannabis sativa, *Linn.,* grown in India; from which the resin has not been removed." *Br.*

Hemp, Indian Hemp; Herba Cannabis Indicæ; Chanvre, *Fr. Cod.;* Chanvre de l'Inde, *Fr.;* Indischer Hanf, *G.;* Cañamo, *Sp.*

Cannabis sativa, Linn., *Sp. Plant.* 1457; Griffith, *Med. Bot.,* p. 572; *B. & T.* 231.—Hemp is an annual plant, from four to eight feet or more in height, with an erect, branching, angular stem. The leaves are alternate or opposite, on long, lax footstalks, roughish, and digitate, with linear-lanceolate, serrated segments. The stipules are subulate. The flowers are axillary; the male in long, branched, drooping racemes; the female in erect, simple spikes. The stamens are five, with long pendulous anthers; the pistils two, with long, filiform, glandular stigmas. The fruit is ovate and one-seeded. The whole plant is covered with a fine pubescence, scarcely visible to the naked eye, and somewhat viscid to the touch. The hemp plant of India, from which the drug is derived, has been considered by some as a distinct species, and named *Cannabis indica;* but the most observant botanists, upon comparing it with our cultivated plant, have been unable to discover any specific difference. It is now, therefore, regarded merely as a variety, and is distinguished by the epithet *indica.* Pereira states that in the female plant the flowers are somewhat more crowded than in the common hemp, but that the male plants in the two varieties are in all respects the same.

C. sativa is a native of the Caucasus, Persia, and the hilly regions in Northern India. It is cultivated in many parts of Europe and Asia, and largely in our Western States. It is from the Indian variety exclusively that the medicine was formerly obtained, the heat of the climate in Hindostan apparently favoring the development of its active principle.[2] H. C. Wood, having obtained a parcel of the male plant of *C. americana* (*C. sativa*) from Kentucky, made an alcoholic extract of the leaves and tops, and, upon trying it on the system, found it effective in less than a grain, and, having inadvertently taken too large a dose, experienced effects which left no doubt of the powers of the medicine, and of the identity of its influence with that of the Indian plant. How far the female tops might have the same effect is left uncertain; but if we are to judge from analogy with the Indian plant, they would be preferable to the male. (*Proc. Am. Philos. Soc.,* vol. xi. p. 226.) The results obtained by H. C. Wood were so decisive that at the 1880 revision of our Pharmacopœia the American plant was recognized; but in 1890 it was dropped as *C. americana.*

Cannabis indica from the North of France, also from Uganda, Africa, has appeared in London. According to W. E. Dixon, neither of the above varieties is nearly so active as is the Indian drug. (*P. J.,* April, 1905.)

The seeds, though not now official, have been used in medicine. They are about the eighth of an inch long, roundish-ovate, somewhat compressed, of a shining ash-gray color, and of a disagreeable, oily, sweetish taste. They yield by expression about 20 per cent. of a fixed oil, which has the drying property, and is used in the arts. They contain also uncrystallizable sugar and albumen, and when rubbed with water form an emulsion, which may be used advantageously in inflammations of the mucous membrane, though without narcotic properties. The seeds are much used as food for birds, as they are fond of them. They are generally believed to be in no degree poisonous; but Michaud relates the case of a child in whom

[1] *Elixir of Monobromated Camphor* is proposed by Munday (*P. J.,* March 3, 1877). Monobromated camphor 3 parts, alcohol (90 per cent.) 120 parts, orange-flower water 80 parts, glycerin 100 parts. Mix the alcohol and glycerin; dissolve the monobromated camphor by the use of a gentle heat, and add the orange-flower water. It contains 1 per cent. of monobromated camphor.

[2] On a visit to the botanical garden of Edinburgh, in the autumn of 1860, George B. Wood saw a full grown specimen of *Cannabis sativa,* and was surprised to find that it was only about four feet high, had little or no odor, and was scarcely adhesive when handled. If this is the general character of the hemp plant in the north of Europe, it is not surprising that it should be destitute of the medicinal properties of the Indian plant. In Philadelphia the plant attains a height usually of six or eight feet, has a decided narcotic odor, and exudes so much of its peculiar resin as to be very adhesive to the fingers. On this occasion Christison informed George B. Wood, from information he had received from India, that the plant there cultivated in the hot plains does not yield hashish satisfactorily, but that this product is chiefly if not exclusively obtained from it in the hilly regions. He said, moreover, that the story of the natives running through the hemp fields and collecting the resin on their clothing, from which it is afterwards scraped, is, if not quite untrue, at least apocryphal. He had been informed that the real mode of gathering it is to rub the hemp tops between the hands and, when the palms and fingers are sufficiently loaded with the resin, to scrape it off. It is possible, however, that different methods may be followed in different localities.

serious symptoms of narcotic poisoning occurred after taking a certain quantity of them. It is probable that some of the fruit eaten by the child was unripe, as in this state it would be more likely to partake of the peculiar qualities of the plant. (*Ann. Thér.*, 1860.)

In Hindostan, Persia, and other parts of the East, hemp has long been habitually employed as an intoxicating agent. The parts are the tops of the plant, and a resinous product obtained from it. *Bhang,* is the selected, dried and powdered leaves. *Ganjah* or *gunjah* is the tops of cultivated female plants, cut directly after flowering, and formed into round or flat bundles from two to four feet long by three inches in diameter.[1] It is stated that in the province of Bengal great care is taken to eradicate the male plants from the fields before fertilization of the female, and that thereby the yield and quality of the resin is greatly increased. In Bombay this matter is commonly neglected, so that Bengal ganjah is much superior to Bombay ganjah. It is recognized in India that ganjah rapidly deteriorates on keeping, that which is one year old being not more than one-quarter as potent as the fresh drug, while two year old ganjah is practically inert and is required by the Indian government to be burned in the presence of excise officers. It is probable, however, that much old ganjah finds its way into the markets of the world. All importations of ganjah or hemp from India should be made directly after the harvesting of the new crop in April or May, and the extract should be prepared at once and kept in hermetically sealed jars. There is on the surface of the plant a resinous exudation to which it owes its stickiness. Men clothed in leather or rawhides are said to run through the hemp fields, brushing forcibly against the plants, thus separating the resin, which is subsequently scraped from their dress and formed into balls. These balls, and also masses formed out of resin mechanically separated from gunjah bundles are called *churrus.* This is the *hashish* or *hasheesh* of the Arabs.

Hashish is also produced in considerable quantities in Persia by rolling and rubbing the flowers, stalks and leaves of hemp on rough woolen carpets and subsequently scraping off with a knife and making into balls or sticks the adherent resinous substance. The carpets are afterwards washed with water and the extract obtained by evaporation sold at a low price. The dose for smoking of the best hashish is said to be one-fourth to one grain (0.016 to 0.065 Gm.). The fanatics are affirmed to be generally hashish devotees.

The dealing in hashish in India is said to be a Government monopoly, and a very heavy license is required for the right to even purchase it in quantity. The importation of it into Egypt is so strongly interdicted that the mere possession of it is a penal offence; we found it, however, readily procurable. It is said to be brought into the country in pigs' bladders, in the Indo-European steamers, and thrown out at night during the passage into the Suez canal, to be picked up by the boats of confederates. Notwithstanding the Governmental interdiction, it is largely used by smoking in Egypt, as an intoxicant. The statement of W. E. Dixon (*B. M. J.*, Nov. 1899) that the inhalations of hemp smoke produces great exhilaration and causes muscular fatigue to disappear for the time being is undoubtedly correct, but his further belief that the habit is not apt to grow upon the hemp votary is more doubtful.

Momea or *mimea* is a hemp preparation said to be made in Thibet with human fat. From gunjah the Messrs. Smith of Edinburgh, obtained a purer resin by the following process. Bruised gunjah is digested, first in successive portions of warm water, until the expressed liquid comes away colorless; and afterwards for two days, with a moderate heat, in a solution of sodium carbonate, containing one part of the salt for two of the dried herb. It is then expressed, washed, dried, and exhausted by percolation with alcohol. The tincture, after being agitated with milk of lime containing one part of the earth for twelve of the gunjah used, is filtered; the lime is precipitated by sulphuric acid; the filtered liquor is agitated with animal charcoal, and again filtered; most of the alcohol is distilled off, and to the residue twice its weight of water is added; the liquor is then allowed to evaporate gradually; and, finally, the resin is washed with fresh water until it ceases to impart a sour or bitter taste to the liquid, and is then dried in thin layers. Thus obtained, it retains the odor and taste of the gunjah, which yields from 6 to 7 per cent. of it.

Properties.—Fresh hemp has a peculiar narcotic odor, which is said to be capable of producing vertigo, headache, and a species of intoxication. It is much less in the dried tops, which have a feeble bitterish taste. According to Royle, *churrus* is, when pure, of a blackish-gray, blackish-green, or dirty olive color, of a fragrant and narcotic odor, and a slightly warm, bitterish, and acrid taste. The Indian hemp is officially described as "in dark green or more or less brownish compressed masses, consisting of the densely paniculate branchlets, about 5 Cm. or more in length, and the inflorescence more or less agglutinated with a resinous exudation; commonly with a few undeveloped digitate leaves of one or more linear-lanceolate leaflets; clothed with numerous sheathing, pointed bracts, each containing two small mature but unfertilized pistillate flowers; odor agreeably narcotic; taste characteristic. In the powder few or no pollen grains or stone-cells should be present." *U. S.* "The fruit is one-seeded and supported by an ovate-lanceolate bract. Both leaves and bracts bear external oleo-resin glands and one-celled curved hairs, the bases of which are enlarged and contain

[1] For detailed description see *P. J.*, lxix. 1902, p. 129.

cystoliths." *Br.* For a histological description of the leaf by A. R. L. Dohme, see *Proc. A. Ph. A.*, 1897, 569.

Indian churrus or hasheesh is a hard resinous mass of a greenish-gray color, containing much gritty earth, and, as it occurs in Egypt, of a feeble, hemp-like odor and taste. Schlesinger found in the leaves a bitter substance, chlorophyll, green resinous extractive, coloring matter, gummy extract, extractive, albumen, lignin, and salts. The plant also contains volatile oil in very small proportion, which probably has narcotic properties. The resin obtained by T. & H. Smith of Edinburgh, in 1846, has been thought to be the active principle, and received the name of *cannabin*. By repeated distillation of the same portion of water from relatively large quantities of hemp renewed at each distillation, M. J. Personne obtained a volatile oil, of a stupefying odor, and an action on the system such as to dispose him to think that it was the active principle of the plant. As the water distilled was strongly alkaline, he supposed that his volatile principle might be a new alkaloid; but the alkaline reaction was found to depend on ammonia; and the liquid obtained proved to be a volatile oil, lighter than water, of a deep amber color, a strong odor of hemp, and composed of two distinct oils, one colorless, with the formula $C_{18}H_{20}$, the other a hydride of the first, $C_{18}H_{22}$, which was solid, and separates from alcohol in plate-like crystals. For the former Personne proposes the name of *cannabene*. It is affirmed that when this is inhaled, or taken into the stomach, a singular excitement is felt throughout the system, followed by a depression, sometimes amounting to syncope, with hallucinations which are generally disagreeable, but an action on the whole slighter and more fugitive than that of the resin. The various substances of alkaloidal nature that have been described by different investigators as found in Indian hemp are now recognized as due to decomposition products of *choline*, which was identified as present by Jahns (*P. J.* (3), 17, 1049). *Cannabindon*, $C_8H_{12}O$, is a dark red syrupy liquid obtained by Kobert (*Chem. Ztg.*, 1894, 741) from Cannabis Indica; it is soluble in alcohol, ether and oils; it is affirmed to be narcotic in doses of from half a grain to two grains (0.032 to 0.13 Gm.). As a result of a reinvestigation of charras (churrus) from Indian hemp, Wood, Spivey, and Easterfield (*J. Chem. S.*, vol. lxix. 539) have found the following principles: 1, a *terpene*, boiling between 150° and 180° C.; 2, a *sesquiterpene*, boiling at 258° to 259° C.; 3, a *crystalline paraffin* of probable formula $C_{29}H_{60}$, melting at 63.5° C.; and 4, a *red oil*, boiling at 265° to 270° C. under a pressure of 20 Mm., to which they give the name *cannabinol*, and the formula $C_{18}H_{24}O_2$. This latter constituent they consider the only active ingredient. It is probably the same substance as the dark red syrup of Kobert, mentioned above under the name cannabindon. The authors found that cannabinol readily underwent superficial oxidation, at the same time losing its toxic activity. Famuleuer and Lyons (*A. Pharm.*, 1904) believe that the only reliable preparation of Cannabis is a fluidextract made from the *fresh* drug. I. Roux (*A. Pharm.*, 1887), has experimented upon extracts made by treating purified extract of hemp with petroleum benzin and ether. The ether extract produced insignificant results. The petroleum extract was excitant and convulsivant. The alcoholic extract was a feeble narcotic. At the present time (1905) no characteristic alkaloid is believed to be present; the volatile oil, found in small quantity, is not the active principle. The resin "cannabin" of which *cannabinol* is the chief constituent, appears to be active. Fränkel (*A. E. P. P.*, 1903, p. 266) claims to have isolated the active principle of hashish as a pure and chemically well defined body. It has the formula $C_{21}H_{30}O_2$, and is a phenol-aldehyde. It is of a pale yellow color and of a thick consistency. When heated it becomes quite fluid and distils at 215° C. under a pressure of 0.5 Mm. It oxidizes in the air, acquiring a brown tint. It responds to Millon's reaction, and can be acetylized, showing thus its phenol character. Fränkel proposes that the name *cannabinol* be given to it and that the term *pseudo-cannabinol* be given to the inactive substance of Wood, Spivey and Easterfield.

Uses.—Extract of hemp is a powerful narcotic, causing exhilaration, intoxication, delirious hallucinations, and, in its subsequent action, drowsiness and stupor, with little effect upon the circulation. It is asserted also to act as a decided aphrodisiac, to increase the appetite, and occasionally to induce the cataleptic state. In overdoses it may produce poisonous effects. In morbid states of the system it has been found to cause sleep, to allay spasm, to compose nervous disquietude, and to relieve pain. In these respects it resembles opium; but it differs from that narcotic in not diminishing the appetite, checking the secretions, or constipating the bowels. It is much less certain in its effects, but may sometimes be preferably employed, when opium is contra-indicated by its nauseating or constipating effects, or its disposition to produce headache, and to check the bronchial secretion. The complaints in which it has been specially recommended are *neuralgia, gout, rheumatism, tetanus, hydrophobia, epidemic cholera, convulsions, chorea, hysteria, mental depression, delirium tremens, insanity,* and *uterine hemorrhage*. Alexander Christison of Edinburgh, affirms that it has the property of hastening and increasing the contractions of the uterus in delivery, and has employed it with advantage for this purpose. It acts very quickly, and without anæsthetic effect. It appears, however, to exert this influence only in a certain proportion of cases. (*Ed. Month. Journ. of Med. Sci.*, xiii. 117; xv. 124.) According to C. R. Marshall (*L. L.*, i., 1897; also *J. A. M. A.*,

Oct. 1898), cannabinol acts as a powerful hypnotic upon dogs and cats, producing also ataxia and other evidences of action upon the nerve centres. Its influence upon the circulation was found to be very feeble, though excessive doses reduced the pulse rate. In man, doses of from one and a half to two grains of cannabinol produced very active intoxication, with symptoms similar to those caused by cannabis indica. The strength of the extract varies much as found in commerce, and therefore no definite dose can be fixed. When it is of good quality, half a grain or a grain (0.032 to 0.065 Gm.), will affect the system, while some apparently good extracts are practically inert. The proper plan is to begin with one-quarter grain (0.016 Gm.), repeated at intervals of two, three, or four hours, and gradually increased until its influence is felt, and the strength of the parcel employed is thus ascertained. Afterwards the dose should be regulated by the ascertained strength; but, should a new parcel be employed, the same caution must be observed as to the commencing dose. The Br. tincture is prepared by dissolving an ounce of the extract in a pint (Imp. meas.) of alcohol. A dose of this, equivalent to a grain of the extract, is about twenty minims (1.3 Cc.), or forty drops. The inertness of much of the commercial extract Marshall believes to be due to the proneness of cannabinol to undergo oxidation. Of the terpenes of cannabis indica, Marshall took as high as eight minims (0.5 Cc.) without effect.

Dose, of Indian cannabis, one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Extractum Cannabis Indicæ, *U. S., Br.;* Fluidextractum Cannabis Indicæ, *U. S.;* Tinctura Cannabis Indicæ, *U. S., Br.* (from extract).

CANTHARIS. U. S., Br.

CANTHARIDES [Blistering Flies, Spanish Flies]

(căn'tha-rīs)

"The beetle, *Cantharis vesicatoria* (Linné) De Geer, thoroughly dried at a temperature not exceeding 40° C. (104° F.)." *U. S.* "The dried beetle, Cantharis vesicatoria, *Latr.*" *Br.*

Muscæ Hispanicæ; Cantharide, *Fr. Cod.;* Cantharides, *P. G.;* Spanische Fliegen, Kantharide, Canthariden, *G.;* Cantaride, Cantarella, Mosca di Spagna, *It.;* Cantaridina, *Sp.*

The Br. Add. under the name of *Mylabris* recognizes not only the dried beetle *Mylabris phalerata,* Pallas, but also allows the use in the Colonies of other species of the genus, provided that they yield a similar proportion of canthardin.[1]

The term *Cantharis* was employed by the ancient Greek writers to designate many coleopterous insects or beetles. Linnæus gave the title to a genus not including the official blistering insect, and placed this in the genus *Meloë,* which, however, has been since divided into several genera. Geoffrey made the Spanish fly (beetle) the prototype of a new genus, *Cantharis,* substituting *Cicindela* as the title of the Linnæan genus. Fabricius altered the arrangement of Geoffrey, and substituted *Lytta* for *Cantharis* as the generic name. The former was adopted by the London College, and at one time was in extensive use; but, the latter, having been restored by Latreille, is now recognized in the British and U. S. Pharmacopœias, and is universally employed. By this naturalist the vesicating insects were grouped in a small tribe, corresponding very nearly with the Linnæan genus Meloë, and distinguished by the title *Cantharidæ.* This tribe he divided into eleven genera, among which is Cantharis. Two others of these genera, *Meloë* properly so called, and *Mylabris,* have been employed as vesicatories. *Mylabris cichorii* is thought to be one of the insects described by Pliny and Dioscorides under the name of cantharides, and is to this day employed in Italy, Greece, the Levant, and Egypt; and another species, *M. pustulata,* is used for the same purpose in China. W. R. Warner has found 500 parts of *M. cichorii* to yield 2.13 parts of cantharidin, which somewhat exceeds the yield of Spanish flies (*A. J. P.,* xxviii. 195); and R. Wolff has obtained by ethereal extraction more than 4 parts of cantharidin in 500 of the *Lytta aspersa* of Buenos Ayres. The *M. cichorii* has been recently imported to some extent under the name of *Chinese blistering fly.* It is black, with the powder blackish gray and free from shining particles; it yielded to Maisch (*Proc. A. Ph. A.,* 1872) 1.016 per cent., and to L. Fahnestock 1.25 per cent., of cantharidin (*A. J. P.,* 1879). For further account of non-official blistering beetles, the reader is referred to the footnote, page 284.

Cantharis vesicatoria (L.), De Geer, Latr., *Gen. Crust. et Insect.,* ii. p. 220.—This beetle is from six to ten lines in length, by two or three in breadth, and of a shining, golden-green color. The head is large and heart-shaped, bearing two thread-like, black, jointed feelers; the thorax short and quadrilateral; the wing-sheaths long and flexible, covering brownish membranous wings. When alive, the Spanish flies have a strong, penetrating, fetid odor, compared to that of mice, by which swarms of them may be detected at a considerable dis-

[1] *Mylabris* of the *Br. Add.* is characterized as "usually an inch (twenty-five millimetres) or rather more long, and three-eighths of an inch (nine millimetres) broad; with two long elytra, each three times as long as broad, black with two broad wavy transverse orange-colored bands and a large orange-colored spot at the base of each; one pair of brown membranous wings." Of Mylabris there have been used a *Vinegar,* (*Acetum Mylabridis, Br. Add.* two ounces to one pint); a *Warming Plaster* (*Emplastrum Calefaciens, Br. Add.*); a *Plaster* (*Emplastrum Mylabridis, Br. Add.*); and a *Blistering Liquid* (*Liquor Epispasticus Mylabridis, Br. Add.* ten ounces to one pint), and an Ointment (*Unguentum Mylabridis, Br. Add.* one ounce to ten ounces); evidently substituted for the corresponding preparations of cantharides.

tance. They attach themselves preferably to certain trees and shrubs, such as the white poplar, privet, ash, elder, and lilac, upon the leaves of which they feed. They are most abundant in Spain, Italy, and Southern France, but are found also in all the temperate parts of Europe, and in Western Asia. According to the researches of Lichtenstein, the eggs are laid by the female in the latter part of June in small cylindrical holes made in the ground. A week later the larvæ hatch out. They are a millimeter long, with two long caudal threads, and of a brown color. After many efforts, Lichtenstein succeeded in getting them to feed on the honey contained in the stomach of bees. In a few days they changed into milk-white larvæ, and about a month after this buried themselves in the ground, to assume the chrysalis stage and to hatch out the following spring as perfected beetles. In the wild state the larvæ are said to crawl up flowers and attach themselves to bees or other hymenopterous insects; carried by the bee to the hive, the larvæ feed upon the young bees and the honey and bee-bread stored up for use. The beetles usually make their appearance in swarms upon the trees in May and June, when they are collected.

The time preferred for this purpose is in the morning, at sunrise, when they are torpid from the cold of the night, and easily let go their hold. Persons with their faces protected by masks, and their hands with gloves, shake the trees, or beat them with poles; and the insects are received as they fall upon linen cloths spread underneath. They are then plunged into vinegar diluted with water, or exposed in sieves to the vapor of boiling vinegar, and, having been thus deprived of life, are dried either in the sun, or in apartments heated by stoves. This mode of killing the flies by the steam of vinegar is as ancient as the times of Dioscorides and Pliny. In some places they are gathered by smoking the trees with burning brimstone. It has been proposed by Lutrand to destroy them by the vapor of chloroform. When perfectly dry, they are introduced into casks or boxes lined with paper and carefully closed, so as to exclude as much as possible the atmospheric moisture. According to Neutwich, the young fly has no vesicating power (*P. J.*, Nov. and Dec., 1870, p. 355); but this is denied by H. Beauregard. (*Ibid.*, xv. 873.)

Cantharides come chiefly from Spain, Italy, Sicily, and other parts of the Mediterranean. Considerable quantities are also brought from St. Petersburg, derived originally, in all probability, from the southern provinces of Russia, where the insect is very abundant. The Russian flies are most esteemed. They may be distinguished by their greater size, and their color approaching to that of copper.

In the United States are several species of Cantharis, which have been employed as substitutes for *C. vesicatoria* and found equally efficient; but none of them are now recognized by the U. S. Pharmacopœia, even *C. vittata*, which was at one time official, having been discarded.[1]

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[1] *Blistering Beetles not official.* 1. *Cantharis vittata.* Latreille, *Gen. Crust. et Insect.;* Durand, *A. J. P.*, ii. 274, fig. 4.—The "*potato fly*" is rather smaller than *C. vesicatoria*, which it resembles in shape. Its length is about six lines. The head is light red, with dark spots upon the top; the feelers are black; the elytra or wing-cases are black, with a yellow longitudinal stripe in the centre, and with a yellow margin; the thorax is also black, with three yellow lines; and the abdomen and legs, which have the same color, are covered with a cinereous down. It inhabits chiefly the potato vine, and appears about the end of July or beginning of August, in some seasons very abundantly. It is found on the plant in the morning and evening, but during the heat of the day descends into the soil. The insects are collected by shaking them from the plant into hot water, and are afterwards carefully dried in the sun. They are natives of the Middle and Southern States. This species of Cantharis was first described by Fabricius in the year 1781, and was introduced to the notice of the profession by Isaac Chapman of Bucks County, Pennsylvania, who found it equal if not superior to the Spanish fly as a vesicatory. The testimony of Chapman has been corroborated by that of many other practitioners. It may be applied to the same purposes treated in the same manner, and given in the same dose as the foreign insect. W. R. Warner obtained 1.99 parts of cantharidin from 500 parts of this beetle, but by improved methods Fahnestock procured 1⅛ per cent. of the active principle. (*A. J. P.*, xxviii. 195; ii. 298.) According to the researches of Jos. Leidy, the vesicating principle resides in the blood, the eggs, and a peculiar fatty matter of certain accessory glands of the generative apparatus (*A. J. M. S.*, Jan. 1869, p. 60); while H. Beauregard (*P. J.*, xv. 873) found that the blood, the seminal vesicles of the male, the eggs, and all parts of the generative organs of the female are active. This insect must not be confounded with the "potato bug" the *Colorado potato beetle* (*Doryphora decemlineata*) which has proved so destructive to potato plants, and which according to the researches of L. Dembinski (*A. J. P.*, 177, p. 550) contains no cantharidin.

2. *Cantharis cinerea.* Latreille, *Gen. Crust. et Insect.;* Durand, *A. J. P.*, ii. 274, fig. 5.—The *ash-colored cantharis* closely resembles the preceding species in figure and size, but differs from it in color. The elytra and body are black without the yellow stripes that characterizes *C. vittata*, and are entirely covered with a short and dense ash-colored down, which conceals the proper color of the insect. The feelers are black, and the first and second joints are very large in the male. This species also inhabits the potato plant, and is occasionally found on other plants, as the English bean and wild indigo. It is a native of the Northern and Middle States. Illiger in 1801 discovered its vesicating properties; but Gorham was first to call public attention particularly to the subject, and to the fact of its equality in all respects with the potato fly, in a communication addressed, in the year 1808, to the Medical Society of Massachusetts.

3. *Cantharis marginata.* Latreille, *Gen. Crust. et Insect.;* Durand, *A. J. P.*, ii. 274, fig. 6.—This is somewhat larger than *C. vittata*, and of a different shape. The elytra are black, with the suture and margin ash-colored. The head, thorax, and abdomen are black, but nearly covered with an ash-colored down; and on the upper part of the abdomen, under the wings, are two longitudinal lines of a bright clay color. The insect is usually found, in the latter part of summer, upon different species of Clematis, and frequents especially the lower branches which trail along the ground. Woodhouse of Philadelphia, first ascertained its vesicating properties; but it had previously been described by Fabricius as a native of the Cape of Good Hope. Harris of Massachusetts, found it as efficient as any other species.

4. *Cantharis atrata.* Latreille, *Gen. Crust. et Insect.;* Durand, *A. J. P.*, ii. 274, fig. 7.—The *black cantharis* is smaller than the indigenous species already described, but resembles *C. marginata* in figure. Its length is only four or five lines. It is distinguished by its size, and its uniform black color. It frequents more especially the different species of Aster and Solidago, though it is found also on *Prunella vulgaris*, *Ambrosia trifida*, and some other plants. Durand met with considerable numbers of this insect near Philadelphia, in the month of September; and they continued to appear till the middle of October. They are common in the Northern and

Properties.—"From 18 to 25 Mm. long, about 6 Mm. broad; flattish-cylindrical, with filiform antennæ; black in the upper part, with two long wing-sheaths, and ample membranous, transparent, brownish wings; elsewhere of a shining coppery-green color; odor strong and disagreeable; taste slight, afterwards acrid. The powder is grayish-brown, with shining green particles, and contains few or no hairs; ash not more than 8 percent." *U. S.* Dried Spanish flies preserve the form and color, and, to a certain extent, the disagreeable odor, of the living insect. They have an acrid, burning, and urinous taste. Their powder is of a grayish-brown color, interspersed with shining green particles, which are the fragments of the feet, head, and wing-cases. If kept perfectly dry, in well-stoppered glass bottles, they retain their activity for a great length of time. A portion which had been preserved by Van Swieten for thirty years, in a glass vessel, was found still to possess vesicating properties. But exposed to a damp air they quickly undergo putrefaction, and this change takes place more speedily in the powder. Hence the insects should either be kept whole, and powdered as they are wanted for use, or, if kept in powder, should be well dried immediately after pulverization, and preserved in air tight vessels. They should never be purchased in powder, as, independently of the consideration just mentioned, they may in this state be more easily adulterated. But, however carefully managed, cantharides are apt to be attacked by mites, which feed on the interior soft parts of the body, reducing them to powder, while the hard exterior parts are not affected. An idea was at one time prevalent that the vesicating property of the insect was not injured by the worm, which was supposed to devour only the inactive portion. But this has been proved to be a mistake. Farines, an apothecary of Perpignan, has satisfactorily shown that, though the hard parts left by these mites possess some vesicating power, and the powder produced by them still more, yet the sound flies are much stronger than either. Camphor, which has been recommended as a preservative, does not prevent the destructive agency of the worm. It appears from the experiments of Nivet that, though camphor does not preserve the entire fly from the attacks of the larvæ of the *Anthrenus*, it actually destroys the mites of the Cantharis so often found in the powder, and may, therefore, be introduced with advantage, in small lumps, into bottles containing powdered cantharides. (*J. P. C.*, xix. 604.) Ammonium carbonate has also been recommended as a preservative. Pereira has found that a few drops of strong acetic acid, added to the flies, are very effectual. Among the best means of preserving them, whether whole or in powder, is the application of the process of Apert, which consists in exposing them for half an hour, confined in glass bottles, to the heat of boiling water, which destroys the eggs of the insect, without impairing the virtues of the flies. (*Ibid.*, xxii. 246.) Of course the access of water to the flies should be carefully avoided. Lutrand recommends chloroform as the best preservative that he has tried. (*J. P. C.*, xviii. 214.) We have little doubt that exposure, in a confined vessel, to the vapor of phenol, would be a perfect protection against all forms of insect life. It is stated by Farines that when the flies are destroyed by the vapor of pyroligneous acid, instead of common vinegar, they acquire an odor which contributes to their preservation. Cantharides will bear a very considerable heat without losing the brilliant color of their elytra; nor is this color extracted by water, alcohol, ether, or the oils, so that the powder might be deprived of all its active principle and yet retain the exterior characters unaltered. The wing cases resist putrefaction for a long time, and the shining particles have been detected in the human stomach months after interment.

So early as 1778, Thouvenel attempted to analyze cantharides, and the attempt was repeated by Beaupoil in 1803; but no very interesting or valuable result was obtained until 1810, when Robiquet discovered in them a crystalline substance, which proved to be the

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Middle States, but are not confined exclusively to this country, being found also in Barbary. Oswood and Harris of New England, satisfactorily ascertained their vesicating powers. They are probably identical with the insect noticed as vesicatory by Woodhouse, under the name of *Meloë niger*.

5. *Cantharis vulnerata.* Harrison Allen, *Medical Zoology*, 1st ed., p. 150.—Geo. H. Horn states that this is so abundant upon the Pacific coast that he has often seen bushels of the insects covering the ground. It has a black body, an orange-colored head, sometimes with a broad black stripe down the middle, and black wing-cases. Horn found it medicinally very active, as was also the less plentiful *C. melæna.*

Several other species have been discovered in the Unites States, but not yet practically employed. Among these are *C. æneas*, a native of Pennsylvania, discovered by Say; *C. politus* and *C. aszelianus*, inhabiting the Southern States; *C. nuttalli*, a large and beautiful insect of Missouri, first noticed by Nuttall, and said to surpass the Spanish fly in magnitude and splendor; and *C. albida*, another large species, found by Say near the Rocky Mountains. Of these, *C. nuttalli* (*Lytta nuttalli*, Say, *Am. Entomol.*, i. 9) bids fair, at some future period, to be an object of importance in the western section of the country. The head is of a deep greenish color, with a red spot in front; the thorax is of a golden green; the elytra red or golden purple and somewhat rugose on their outer surface, green and polished beneath; the feet black; the thighs blue or purplish. The exploring party under Colonel Long ascertained the vesicating powers of this insect. It was found on the plains of the Missouri, feeding on a scanty grass. In one spot it was so numerous as to be swept away by bushels, in order that a place might be cleared for encamping. There are also a number of beetles found in the United States which are plentiful enough to be capable of affording a commercial article, and which are so closely allied to the genus Cantharis as to render it probable that they possess blistering properties. For an account of the more important, see *Proc. A. Ph. A.*, 1876, p. 506.

Mylabris bifasciata and *M. lunata*, said to be common South African beetles used by the natives for producing vesication, have appeared in the London market. They yielded to J. Oldham Braithwaite from 1.09 to 1.02 per cent. of cantharidin. *Meloë proscarabæus* and *M. majalis* have been occasionally substituted for cantharides in Europe, and *M. trianthemæ* is used in the upper provinces of Hindostan. J. O. Braithwaite found the *Mylabris bifasciata* of the Cape of Good Hope extremely rich in cantharidin, while its co-dweller, *M. lineata*, contained but little. (*P. J.*, xviii. 246.) *Heuchys sanguinea*, or "*Chinese cantharides*" of the London market, does not contain cantharidin. (J. Moss, *P. J.*, xvii. 845.) *Epicauta gorhami* is said to be used in Japan as a cantharidal beetle. *Ph. Ztg.*, March, 1891.

vesicating principle of the insect and received the name of *cantharidin*. The constituents, according to Robiquet, are— 1, a green oil, insoluble in water, soluble in alcohol, and inert as a vesicatory; 2, a black matter, soluble in water, insoluble in alcohol, and inert; 3, a yellow viscid matter, soluble in water and alcohol, and without vesicating powers; 4, cantharidin; 5, a fatty matter, insoluble in alcohol; 6, calcium and magnesium phosphates, acetic acid, and, in the fresh insect, a small quantity of uric acid. Orfila afterwards discovered a volatile principle, upon which the fetid odor of the fly depends. It is separable by distillation with water. Dragendorff has found a volatile principle which acts on the system in the same manner as cantharidin. When powdered flies are moistened with water and distilled, the part which passes over, at or below 100° C. (212° F.), contains this principle. (*Chem. News*, May 31, 1867.) That the green coloring matter is chlorophyll seems to be shown by the experiments of Pocklington, who (*P. J.*, [3], iii. p. 681) found that when cantharides was treated with alcohol, ether, and carbon disulphide, the solutions yielded absorption spectra agreeing with that of chlorophyll. Cantharidin exists in commercial cantharides to the extent of from 0.6 to 0.9 per cent. (See also *Ph. Centralh.*, 1901, 674.) E. Dieterich prepares cantharidin by macerating 1000 parts of coarsely powdered cantharides in 1500 parts of acetic ether mixed with 20 parts of sulphuric acid; after adding 40 parts of barium carbonate to neutralize the excess of sulphuric acid, the mixture is exhausted with acetic ether in an extraction apparatus, the liquid is distilled, and the residue, consisting of cantharidin, resin, fat, etc., is set aside for eight days to allow the cantharidin to crystallize; 200 parts of petroleum benzin (sp. gr. 0.740) are then added, gently heated in order to dissolve the fatty matter, the liquid filtered, and the cantharidin washed with petroleum benzin and recrystallized from its solution in 90 per cent. alcohol. If perfectly pure cantharidin is needed, the cantharidin may be dissolved in acetic ether or chloroform and the solution passed through animal charcoal, filtered, and allowed to crystallize. (*J. P. C.*, 1893, 375.) For assay of cantharides for cantharidin see *P. J.*, 1903, 558 and 783.

Cantharidin is in the form of white crystalline scales, of a shining micaceous appearance, inodorous, tasteless, almost insoluble in water and in cold alcohol, but soluble in ether, chloroform, benzene, the oils, and in hot alcohol and acetic acid, which deposit it upon cooling. According to Procter it is insoluble in water. Cold alcohol dissolves it slightly, hot alcohol freely. It is more soluble in ether, which also dissolves it more freely hot than cold. Chloroform, cold or hot, is its best solvent; and acetone ranks next to it in this respect. Olive oil, at 250° F., dissolves one-twentieth of its weight, and oil of turpentine, boiling hot, one-seventieth; and both deposit the greater portion on cooling. The olive oil solution after deposition vesicates, the terebinthinate does not. Strong acetic, sulphuric, and nitric acids dissolve it, with the aid of heat, and deposit it unchanged on cooling. It is also dissolved by solutions of potassium or sodium hydroxide, and to a small extent by a strong solution of ammonia. (*A. J. P.*, xxiv. 296.) Formic acid is said to be the best solvent. Somewhat different results in relation to the solubility of cantharidin have been obtained by M. E. Rowan. Careful experimentation with distilled water showed that, when agitated for eight days at ordinary temperatures with pure cantharidin, it was capable of dissolving 0.0266 per cent. of that principle; boiling water dissolves 0.297 per cent.; boiling alcohol (99° Tralles) 2.168 per cent. (*J. P. C.*, Mai, 1873, 409.) It fuses at 210° C. (410° F.), is volatilizable by heat without decomposition, and its vapor condenses in acicular crystals. As determined by the experiments of Wm. A. Guy, the subliming heat of isolated cantharidin is 100° C. (212° F.), or the temperature of boiling water. (*P. J.*, Feb. 1868, 373.)

According to Masing and Dragendorff, cantharidin, $C_{10}H_{12}O_4$, is capable of combining with water, and thus becomes cantharidic acid, $C_{10}H_{14}O_5$, and in this state forms definite compounds with bases, such as $K_2C_{10}H_{12}O_5$ and $Na_2C_{10}H_{12}O_5$, which are crystallizable. These may be obtained by heating cantharidin with an alkaline hydroxide solution. (*J. P. C.*, Janv. 1868, 79.) Cantharidin itself has been found to combine like an acid with the salifiable and earthy bases, forming soluble compounds with potassium, sodium, and lithium hydroxides, salts of very sparing solubility with baryta, strontia, and lime, and with magnesia a salt which, though feebly soluble in water (100 parts of water dissolving only 0.24 of the salt) (see *P. J.*, March 13, 1880), is much more largely dissolved in cold than in hot water, and in cold than in hot alcohol. Cantharidin is therefore recognized as the lactone or inner anhydride of cantharidic acid. The potassium salt crystallizes with 3 molecules of water, and is soluble in 25 parts of water. On the addition of strong acids to this solution, cantharidic acid is not precipitated, as might be expected, but the lactone cantharidin. This potassium salt has been recommended by Liebreich for use in subcutaneous injections in cases of *phthisis*, but is of very doubtful value. The most satisfactory test of cantharidin is its vesicating property. Notwithstanding the insolubility of this principle in water and cold alcohol, the decoction and tincture of cantharides have the medicinal properties of the insect; and Lewis ascertained that both the aqueous and alcoholic extracts act as effectually in exciting vesication as do the flies themselves, while the residue is in each case inert. Cantharidin consequently exists in the insect so combined with the yellow matter as to be rendered soluble in water and cold alcohol. If, as stated by E. Dieterich (1883), formic acid is present in the

Spanish fly, it is probable that the solution of the cantharidin is due to its presence. He also showed that cantharidin was not volatilized with the vapor of benzin, a fact which may prove useful in preparing blistering plasters coated with a benzin solution of cantharidin. (*Ph. Centralh.*, 1901, 464.) H. G. Greenish calls attention to the fact that much loss of cantharidin takes place in making the various pharmaceutical preparations, through insufficient exhaustion by the use of the ordinary solvents. He obtained 0.822 per cent. of cantharidin from exhausted residues. Homolka records (*Ber. d. Chem. Ges.*, xix. 1082), the results of an investigation of the chemical decompositions of cantharidin.

Adulterations.—These are not common. Occasionally other insects, or even beads, are added, purposely, or through carelessness. These may be readily distinguished by their appearance. Flies exhausted of their cantharidin are sometimes substituted for the genuine drug. They are worthless, and are to be distinguished by their lack of substance and their yielding a nearly colorless ethereal tincture. Pereira states that powdered flies are sometimes adulterated with euphorbium. According to the researches of Fahnestock (*A. J. P.*, 1879, p. 298), age destroys the activity of the drug without of necessity impairing its physical appearance.

The percentage of cantharidin found in cantharides furnishes the best test of their virtues. Wm. Procter succeeded, by means of chloroform, in isolating cantharidin with great facility. He treated the flies with chloroform by percolation, displacing the last portion by means of alcohol, and allowing the resulting solution to evaporate spontaneously. Cantharidin is thus obtained in crystals mixed with the green oil, the greater portion of which may be removed by bibulous paper. The residuary crystals are dissolved in a mixture of ether and alcohol, which, by the spontaneous evaporation of the ether, yields the cantharidin nearly pure. Mortreux, having ascertained that the cantharidin is insoluble in carbon disulphide, proposed to use this fluid for removing the fatty matter associated with the cantharidin crystals obtained by the use of chloroform. He employed the same liquid in estimating the proportion of cantharidin, which he found to be about 20 centigrammes for 40 grammes of the flies, or half of one per cent. (*J. P. C.*, 3e sér., xlvi. 33, 1864.) Wittstein obtains it by digesting coarsely powdered flies repeatedly with water, straining through linen and expressing, allowing the liquid to settle for a day, separating the supernatant oil, adding a little wood charcoal, evaporating to dryness, treating the residue with ether so long as the solution affords a laminated substance on evaporation, evaporating the ethereal solution, treating the residue with cold alcohol of 80 per cent. for one day with frequent shaking, and finally drying the scales. (See *A. J. P.*, xxviii.) Williams has obtained it by means of benzene. (*Ibid.*, xxvi.) For a method of assaying cantharides and its official preparations by H. G. Greenish and Harold Wilson, see *P. J.*, 1898, 255, or *Am. Drug.*, 1898, 224.

Uses.—Internally administered, cantharides is a powerful irritant, with a peculiar direction to the urinary and genital organs. Genito-urinary irritation is ordinarily the first symptom produced by small doses of cantharides, and, if the dose has been large enough, it may amount to violent strangury, attended with excruciating pain, and the discharge of bloody urine. Toxic doses of Spanish fly produce obstinate and painful priapism, vomiting, bloody stools, severe pains in the whole abdominal region, excessive salivation with a fetid breath, hurried respiration, a hard and frequent pulse, burning thirst, exceeding difficulty of deglutition, sometimes a dread of liquids, frightful convulsions, tetanus, delirium, and death. Orfila has known twenty-four grains of the powder to prove fatal. Dissection reveals inflammation and ulceration of the mucous coat of the whole intestinal canal. According to Poumet, if the intestines be inflated, dried, cut into pieces, and examined in the sun between two pieces of glass, they will exhibit small shining yellow or green points, strongly contrasting with the matter around them. (*J. P. C.*, 3e sér., iii. 167.)[1]

The poisonous effects are to be counteracted by the use of emetics, cathartics, and opiates by the stomach and rectum. From the experiments of Schroff it seems that oils somewhat accelerate the poisonous action, probably by dissolving the cantharidin. (See *A. J. P.*, xxviii. 365.) By experiments upon dogs, Thouery, a French apothecary, has satisfied himself that animal charcoal possesses a real antidotal power. (*J. P. C.*, 1858, p. 65.) Cantharides have been long and beneficially used in medicine. Either these or other vesicating insects appear to have been given by Hippocrates in *dropsy* and *amenorrhœa*, in the latter of which complaints, when properly prescribed, they are a highly valuable remedy. They are also useful in obstinate *gleet, leucorrhœa,* and *seminal weakness,* and in *paralytic incontinence of urine.* They are used also in certain cutaneous eruptions, especially those of a scaly character, and in chronic *eczema.* Their unpleasant effects upon the urinary passages are best obviated by the free use of diluent drinks, or when severe, by opiate enemata. The dose of cantharides is one or two grains (0.065 to 0.13 Gm.) of the powder, which may be given twice a day, in the form of pill. The tincture, however, is more frequently employed.

Externally applied, cantharides excites inflammation in the skin, which terminates in a copious secretion of serum under the cuticle.

[1] Cantharidin may be detected in the body after death from poisoning. Dragendorff states that he has succeeded in finding it in the dead body of a cat three months after it had been taken, and is convinced that it might be discovered in the human corpse six months after burial. (*J. P. C.*, 1873, p. 443.)

It may be employed either as a rubefacient, or to blister. In the former capacity it is seldom used, but as an epispastic it is preferred to all other substances. When blisters are allowed to stay on only long enough to irritate the skin, but not to blister, they are known as *flying blisters*. Used in this way, they are sometimes of service in *neuralgias*, applied directly over the seat of pain. Their chief value is, however, found in cases of severe internal irritation. It is of great importance that the practitioner should clearly comprehend the distinct uses of the rubefacient and the blister. The rubefacient is to be employed as a revulsive when the internal irritation is severe but is not connected with pronounced organic change. The immediate impression of a rubefacient, acting as it does upon a much larger surface than does the blister, is greater than that of the blister, but the permanent revulsive action is much less. The blister is, therefore, to be used when the internal disease is connected with inflammatory structural change. Thus, in a case of *gastrodynia*, a rubefacient is of much more service than a blister, while the blister is decidedly more effective in *peritonitis*. In a general wide-spread *congestion of the lung* the rubefacient is to be preferred to the blister, but in *pneumonia* the blister to the rubefacient. As, however, congestion of neighboring parts usually accompanies a localized inflammation, a rubefacient is sometimes to be employed as a temporary substitute for or adjuvant to a blister. The amount of serous discharge produced by blisters appears to be sometimes of service in almost directly evacuating local serous exudations. Thus, not rarely repeated blistering affords the best treatment of a *serous pleurisy*. Possibly, however, even in these cases, the blister acts purely as a counter-irritant, as it certainly does in *chronic rheumatism* and other *diseases of the joints*. In all *chronic joint inflammations* the best results may often be obtained by a reblistering, extending, if necessary, over weeks and months. In some cases of *skin disease* blisters are capable of substituting their own action for the original morbid disease, and they are still occasionally used for this purpose in *tinea capitis*, obstinate *herpes*, and other affections. The length of time that a blister should be applied varies with the individual and with the position of the disease. In some constitutions they produce a poisonous impression, attended with frequent pulse, dryness of the mouth, subsultus tendinum, and even convulsion. Such symptoms are probably the results of an intense peripheral nervous irritation acting upon very susceptible centres. Such is not, however, the case with the strangury which may follow absorption of the cantharidin, and which is always the result of the direct action of the cantharidin upon the genito-urinary tract. In order to avoid such genito-urinary irritation, and also as much as possible the pain at the seat of application, the blister should be left on only until it distinctly reddens the skin, when a flaxseed poultice may be applied, and in the course of two or three hours the blister is formed. The time necessary for such reddening of the skin is usually from four to six hours, if the cantharidin be active. (See *Ceratum Cantharidis*.)

Liebreich strongly recommends hypodermic injections of cantharidin in the treatment of *phthisis*, but general clinical experience has not confirmed the value of the remedy. *Liebreich's cantharidal solution* was made by heating 20 Cc. of water with 0.2 Gm. of cantharidin and 0.4 Gm. of potassium hydroxide until solution was obtained, then adding enough water to make 1000 Cc. The dose of the cantharidate was 0.0001 Gm. increased to 0.0002 Gm., or even beyond.

Dose (official), of cantharides, one-half grain (0.032 Gm.), but it is rarely used internally.

Off. Prep.—Acetum Cantharidis, *Br.;* Ceratum Cantharidis, *U. S.;* Collodium Cantharidatum, *U. S.* (*Br.*) (from liquor); Emplastrum Calefaciens, *Br.;* Emplastrum Cantharidis, *Br.;* Liquor Epispasticus, *Br.;* Tinctura Cantharidis, *U. S.*, *Br.;* Unguentum Cantharidis, *Br.*

CAPSICUM. U. S. (Br.)

CAPSICUM [Cayenne Pepper]

(kăp'sĭ-kŭm)

"The dried, ripe fruit of *Capsicum fastigiatum* Blume (Fam. *Solanaceæ*), deprived of its calyx." *U. S.* "The dried, ripe fruit of Capsicum minimum, *Roxb.*" *Br.*

Capsici Fructus, *Br.;* Piper Hispanicum; Capsicum Fruit, African or Pod Pepper, Red pepper, Chillies, Bird Pepper, Spur Pepper, Paprika; Fructus Capsici, *P. G.;* Spanischer Pfeffer, Schlotenpfeffer, *G.;* Piment de Cayenne, Piment des jardins, Poivre d' Espagne, Poivre de Guinée, Poivre d'Inde, Poivre de Cayenne, Piment rouge, Capcique, *Fr.;* Peperone, *It.;* Pimiento, Chile, Aji, *Sp.*

Owing probably to its wide-spread cultivation, the genus Capsicum contains a large number of plant forms whose specific relations afford a very difficult problem to the systematic botanist. The probability is that the entire genus was originally confined to the American tropics, although it has been cultivated since the time of Columbus in the temperate and tropical zones of almost the whole world. Its first appearance in literature seems to be in an epistle by Peter Martyn, dated September, 1493, speaking of its having been brought by Columbus. Neither in ancient Sanscrit, Chinese, Greek, Latin, or Hebrew is there a name for it. In 1887 Asa Gray expressed his belief that there are only two species in the genus, although in the last previous revision of the genus, in 1852, Dunal had recorded fifty species. After a very thorough and careful study of the subject, including the cultivation of every procurable variety and species for four years in the Missouri Botanical Garden, H. C. Irish has reached the conclusion that the dictum of Gray

was correct, and that there are really only two species of the genus, one of which is herbaceous and annual or biennial, the other shrubby and perennial, a conclusion which seems to be accepted.

The first of these species is the one most extensively cultivated in Europe and in this country; it is the *C. annuum,* L. The second is in its varieties very largely grown in the tropical and subtropical latitudes, its fruit not ripening at all or only to a slight degree in the temperate zone. It is the species which was described under the name of *C. frutescens,* by Linnæus, in 1737. By Irish it is divided into two varieties,—*C. frutescens* proper, which is characterized by its fruit being oblong, acuminate, and usually embraced by the calyx, and *C. frutescens baccatum,* which is characterized by its ovate or subround fruit, usually seated on the calyx. This variety is the *C. baccatum* of Linnæus, 1767. In the first of these varieties are comprised the *C. fastigiatum* of Blume and the *C. minimum* of Miller and of Roxburgh, which yield most of the Cayenne pepper produced in the tropics, although, especially in the West Indies and South America, *C. baccatum* is largely cultivated. It is even doubtful whether *C. annuum* should be considered as a distinct species from *C. frutescens,* as in tropical climates varieties have been produced which are perennial and somewhat woody.

The British Pharmacopœia seems to be in error in ascribing the original description of the *Capsicum minimum* to Roxburgh, since his *Flora Indica* did not appear until 1832, whereas the species was described by Miller, in the *Garden Dictionary,* in 1771.

Capsicum annuum, Willd., *Sp. Plant.* i. 1052; *B. & T.* 189.—The stem of the annual capsicum is thick, roundish, smooth, and branching; rises two or three feet in height, and supports ovate, pointed, smooth, entire leaves, which are placed without regular order on long footstalks. The flowers are solitary, white, and stand on long peduncles at the axils of the leaves. The calyx is persistent, tubular, and five-cleft; the corolla, monopetalous and wheel-shaped, with the limb divided into five spreading, pointed, and plaited segments; the filaments, short, tapering, and furnished with oblong anthers; the germen, ovate, supporting a slender style which is longer than the filaments and terminates in a blunt stigma. The fruit is a pendulous, pod-like berry, of varying shape and size, light, smooth, and shining, of a bright scarlet, orange, or sometimes yellow color, with two or three cells, containing a dry, loose pulp, and numerous flat, kidney-shaped, whitish seeds.

The following are the characteristics of the two varieties of the shrubby or perennial capsicum, as given by Irish:

C. frutescens, Linn.—"Plants shrubby, perennial, two and a half to six feet high. Branches angular, often channelled, puberulent or pubescent, especially on the younger portions; usually greatly enlarged at the nodes, green or sometimes purplish striate, slightly purple at the nodes. Leaves broadly ovate, acuminate, three to six inches long, two to three and one-half inches wide, usually puffed or wrinkled, more or less pubescent, especially around the veins. Petioles medium, usually subciliate; peduncles slender, one to two inches long, often in pairs, usually longer than the fruit. Calyx usually cup-shaped, embracing base of the fruit; teeth short, corolla white or greenish white, spreading three-eighths to three-quarters inch, often with ocherous markings in the throat. Fruit red, ovate, obtuse or oblong acuminate, three-quarters to one and one-quarter inches long, one-quarter to three-quarters inch diameter."

C. frutescens baccatum, Linn.—"Plants one to three feet high, under cultivation often six feet. Branches numerous, slender, fastigiate flexuose, usually quite densely purple, striate, scabrous, pubescent. Leaves ovate, acuminate, rather abruptly narrowing into the petioles, solitary or in twos, more or less pubescent along the veins and sometimes on the surface. Petioles short, usually hairy, broadened at base. Peduncles solitary or in twos, extreme axillary vertical (giving a peculiar character to the fruit), slender; one to one and one-quarter inches long, smooth, or in young specimens subhairy. Calyx short, cyathiform, subhairy, subciliate. Corolla small, spreading about one-half inch, greenish white. Fruit ovate or subround, about one-quarter inch diameter. Unripe fruit sometimes changing from green to blackish spotted, finally ripening into a red or yellow."

Capsicum annuum is largely cultivated both in the United States and in Europe, flowering in the early or middle summer, and ripening its fruit in the early autumn. There are numerous varieties of it differing in the shape of their fruit. That which is chiefly cultivated in the United States for market, to be used in the green state in pickling, or cooked for the table, is a large irregularly ovate or conical berry, depressed or horned at the extremity, and when ripe varying in color from yellowish to scarlet. A variety with a long, conical, pointed and recurved fruit, which is usually not thicker than the finger, is said to be especially used in the making of red pepper. In another variety the berries are not more than an inch in diameter, spherical and slightly compressed.

When ground into powder the fruit of the *Capsicum annuum* constitutes *paprika,* or as it is sometimes called, *sweet pepper;* it is very little used by itself but is largely employed for the mixing with the powder of chillies or true cayenne pepper; it has scarcely more than one-sixth the pungency of real cayenne pepper, so that the addition of it to powdered chillies may almost be considered an adulteration.

Paprika is to be distinguished, when pure, by its light yellowish color, and by its comparatively feeble taste. The cayenne pepper of the

grocery stores is very largely a mixture of paprika and true pepper. The microscopic characteristics in the fruits of the two species are not sufficiently pronounced to be of avail in detecting the presence of the feebler substance in the powdered pepper, although, according to T. Edward Wallis, the outer portions of the pericarp of *Capsicum annuum* are cuticularized or suberized, while in *Capsicum fastigiatum* all the cells are composed purely of cellulose. True cayenne pepper, *Chillies* or *Bird pepper,* is produced in almost all tropical and sub-tropical countries, but is said to come in very large proportion from Zanzibar. The pod is at once distinguished by the peculiar thinness and tendency to wrinkle of its outer coating.

The varieties of cayenne pepper are numerous as they occur in the American market—the pods of the *East African pepper* are half an inch in length, flattened, almost cylindrical, although showing distinctly the conical form; the pods of the *Madagascar peppers* reach the length of two and a half to three inches and a breadth of three-fourths of an inch; those of the *Bombay* or *cherry pepper* are very dark in color, one and a half to two inches in length, and half an inch or more in breadth at the base. They are strictly conical and less likely to be flat than those of the other varieties. *Zanzibar pepper* is smaller than the *East African pepper* but otherwise similar to it. *Japanese capsicum,* whose botanical source is not positively known, occurs in the market in two forms, one in which the pods are large, reaching the length of two and a half inches; the other in which the small pods are not over an inch in length. The larger pods are scarcely to be distinguished from *Madras Chillies;* the smaller resemble, but are nearly twice the size of, the East African pepper. The color of the pods varies from light yellowish brown to deep red.[1]

The U. S. Pharm. describes the fruit of *C. fastigiatum* as follows: "Oblong-conical, from 10 to 20 Mm. long, with a red, shining, membranous and translucent pericarp; two-celled, and containing 10 to 20 flat, reniform, yellowish seeds attached to a thick, central placenta; odor distinct; taste intensely pungent. Few or no starch grains or sclerenchymatous fibres should be present in the powder." *U. S.* The Br. Pharm. gives the characteristics of the fruit of *C. minimum* as "Dull orange-red, oblong-conical, obtuse, two-celled fruits, from about one-half to three-fourths of an inch (twelve to twenty millimetres) in length and a quarter of an inch (six millimetres) in diameter; sometimes attached to a five-toothed inferior calyx, and a long, straight, slender peduncle. The pericarp is somewhat shrivelled, glabrous, translucent, and leathery, and contains from ten to twenty small flat seeds, either loose or attached to a thin reddish dissepiment." *Br.*

The difficulty of distinguishing the source of powdered capsicum is increased by the fact that the red color fades upon exposure to light, and that the powdered African pepper, though very powerful, is a light brownish-yellow. The value of any specimen may be, however, fairly estimated by the intensity of its odor, which is peculiar, somewhat aromatic, and extremely irritant, and by its acrid, burning taste. The pungency appears to depend on a peculiar principle, which was obtained, though not in a perfectly isolated state, by Braconnot, and named *capsicin.* It is obtained as a thick yellowish-red liquid, but slightly soluble in water. When gently heated it becomes very fluid, and at a higher temperature is dissipated in fumes which are extremely irritating if inhaled. Capsicin is a mixed substance, consisting of resinous and fatty matters. In 1876, Thresh isolated a well defined active principle, *capsaicin,* from the extract which he obtained by exhausting Cayenne pepper with petroleum. From the red liquor dilute caustic alkali removes capsaicin, which is to be precipitated in minute crystals by passing carbon dioxide through the alkaline solution. The crystals may be purified by recrystallizing them from either alcohol, ether, petroleum benzin, glacial acetic acid, or hot carbon disulphide; in petroleum, capsaicin is but sparingly soluble, yet it is dissolved abundantly on the addition of fatty oil. The crystals of capsaicin are colorless, and answer to the formula $C_9H_{14}O_2$; they melt at 59° C. (138.2° F.), and begin to volatilize at 115° C. (239° F.), but decomposition can be avoided only with great care. The vapors

[1] T. Edward Wallis believes that the different cayenne peppers can be distinguished from one another when powdered by the character of their epidermis and the tissue immediately below it, and gives the following tabulated summary of the differences. (*P. J.*, July, 1902.)

	C. minimum.	*C. annuum.*	*Japanese Chillies.*
Epidermis.	Thick and straight-walled rectangular cells with few pits; often arranged in groups of five to seven in a row and with a uniformly striated cuticle. Size of cells, 25 mkm. to 60 mkm. in either direction.	Irregular polygonal cells with evenly thickened walls, traversed by numerous well-marked, simple pits. The cuticle shows striated ridges. Size of cells, 60 mkm. to 100 mkm. long, and 25 mkm. to 50 mkm. wide.	Cells with strongly thickened walls and a radiated lumen. The pits only rarely penetrate the whole thickness of the wall. No visible striation. Size of cells, 30 mkm. to 80 mkm. long, and 15 mkm. to 45 mkm. wide.
Hypoderma.	Delicate thin-walled cellulose cells.	Several layers of cuticularized collenchymatous cells, having a rounded outline and very few pits.	A single layer of regular polygonal cells with cuticularized, fairly thick walls, traversed with numerous pits, which give them a beaded appearance.

of capsaicin are of the most dreadful acridity, and even the ordinary manipulation of that substance requires much precaution. Felletar (*J. P. C.*, Avril, 1870, p. 347) first obtained from capsicum fruits a volatile alkaloid, which resembles coniine in odor, but is distinguished by the different shape of its hydrochloride crystals. H. Pabst (1892) made a thorough investigation of the fruit of *C. annuum*. He does not think that an alkaloid exists originally in the fruit, but believes that the alkaloidal reactions are due to a decomposition product. He finds, besides capsaicin, a red coloring matter, and oleic, palmitic, and stearic acids. The red coloring matter, by saponification, was shown to be a cholesterin ester of the fatty acids. (*A. J. P.*, 1892, 370.) Moerbitz (1898) isolated a pungent principle having a bitter taste, which he states is neither capsicin nor capsicol, and names *capsicutin*. He gives it the formula $C_{35}H_{54}N_3O_4$, and states that it is neither an alkaloid nor glucoside; it does not have acid properties. Red lead oxide is sometimes added to the powdered capsicum sold in Europe; it may be detected by digestion in diluted nitric acid, and precipitating the lead by sodium sulphate. Capsicum is said to be sometimes adulterated with colored sawdust, which may be recognized by the microscope. It is often adulterated with inert vegetable substances. The British Pharmacopœia requires that capsicum should yield on incineration not more than 6 per cent. of ash; this test would detect the presence of most adulterants. It is occasionally attacked by insects.

Uses.—Capsicum is a very powerful local stimulant, producing, when swallowed, a sense of heat in the stomach, and a general glow over the body without any narcotic effect. It is much employed as a condiment, especially in hot climates, and is useful in cases of atony of the stomach or intestines. It is strongly contraindicated by the existence of gastric catarrh of the ordinary type, but in the chronically inflamed stomachs of persons of intemperate habits it frequently appears to do good, probably by lessening the size of the dilated blood vessels and thereby relieving chronic congestion. It is often added with advantage to tonic prescriptions in cases of *neurasthenia*.

Applied externally, Cayenne pepper is a powerful rubefacient, which has the advantage of acting speedily without danger of producing vesication. It may be applied in the form of cataplasm, or more conveniently and efficiently as a lotion, mixed with heated spirit. The powder or tincture brought into contact with a *relaxed uvula* often acts very beneficially. The tincture has also been used advantageously in *chilblain*. The fluidextract and the oleoresin (*Oleoresina Capsici, U. S.*) are powerfully rubefacient. A gargle may be prepared by infusing half a drachm of the powder in a pint of boiling water, or by adding half a fluidounce of the tincture to eight fluidounces of rose water.

Dose, of the powder, from one to ten grains (0.065 to 0.65 Gm.), which is most conveniently given in the form of pill. Of an infusion prepared by adding two drachms to half a pint of boiling water, the dose is half a fluidounce (15 Cc.).

Off. Prep.—Fluidextractum Capsici, *U. S.;* Oleoresina Capsici, *U. S.;* Pilulæ Podophylli, Belladonnæ et Capsici, *U. S.;* Tinctura Capsici, *U. S., Br.;* Unguentum Capsici, *Br.*

CARBO.

CARBON

(cär-bō)

C = 11.91

Carbone, *Fr.;* Kohlenstoff, *G.;* Carbone, *It.;* Carbon, *Sp.*

Carbon is an element of great importance, and very extensively diffused in nature. It exists in large quantity in the mineral kingdom, and is the most abundant constituent of animal and vegetable matter. In the crystallized state it constitutes the diamond; and, more or less pure, it forms the substances called graphite (or black lead and plumbago), anthracite and bituminous coal, coke, animal charcoal, and vegetable charcoal. Combined with oxygen it forms *carbon dioxide*, or *carbonic acid gas*, which is a constituent of the atmosphere, and present in many natural waters, especially those which have an effervescing quality. United with oxygen and a base it forms the carbonates, among others *calcium carbonate*, which is one of the most abundant minerals. There are three allotropic conditions of carbon, represented respectively by the diamond, graphite, and charcoal.

The diamond has been found in quantity in India, in Brazil, and in South Africa, but at the present time is obtained almost exclusively from the last named locality. Several diamonds have been found in the gold regions of Georgia and North Carolina. This gem is perfectly transparent, and the hardest and most brilliant substance in nature. Its sp. gr. is about 3.5. It is fixed and unalterable in the fire, provided air be excluded, but is combustible in air or oxygen, the product being the same as when charcoal is burned, namely, carbon dioxide. It has been made artificially at the temperature of the electric arc (2500° to 3000° C.) by Moissan.

Next to diamond, graphite or plumbago is the purest natural form of carbon. Graphite is the substance of which black-lead crucibles and pencils are made. It is found in greatest purity in the mine of Borrowdale, in England, and in Ceylon, from which latter place most of the graphite of commerce is now obtained, but it also occurs very pure in this country, and in extensive deposits at Ticonderoga, N. Y., at Stourbridge, Mass., and in Canada. In physical characters it is utterly different

from the diamond; it crystallizes in hexagonal plates, is very soft and unctuous, of 2 to 2.5 sp. gr., and generally contains a little ash. In connection with the production of silicon carbide (carborundum) in the electric furnace, Acheson has produced a very pure artificial graphite by simply increasing the heat until the silicon was volatilized. This artificial graphite has a specific gravity of 2.5, is soft and of high metallic lustre. It is extensively used for electrodes in the electrolysis of brine and similar operations, and for graphite paint. *Anthracite*, the purest variety of natural coal, occurs in different parts of the world, but particularly in the State of Pennsylvania. It contains from 90 to 95 per cent. of carbon, and several per cent. of ash. *Bituminous coal* is another variety, containing, besides the fixed or free carbon, some 10 to 15 per cent. of volatile hydrocarbons or gas-making material. When this is driven off by the process of charring, as in the manufacture of coal-gas, a kind of mineral charcoal, called *coke*, is obtained, very useful in the arts as a fuel. When peat is charred, it is converted into *peat charcoal*, which forms a cheap disinfectant and deodorizer, applicable to the purification of hospitals, dissecting-rooms, factories, privies, etc.

Carbon may be obtained in a state approaching to purity by several processes. One method is to expose lamp-black to a full red heat in a close vessel. It may also be obtained, in a very pure state, by passing the vapor of volatile oils through an ignited porcelain tube, whereby the hydrogen and oxygen of the oil will be dissipated, and the charcoal left in the tube. The purest lamp-black is now made from natural gas in Western Pennsylvania and in Ohio. This lamp-black is miscible with water, does not color ether, and is free from oily matter.

Properties.—Carbon, in its uncrystallized state, is an insoluble, infusible solid, generally of a black color, and without taste or odor. It burns when sufficiently heated, uniting with the oxygen of the air, and generating carbon dioxide. Its sp. gr. in the solid state, apart from its pores when in mass, is 3.5; but with the air of the pores included, it is only 0.44. It is an almost unalterable and indestructible substance, and has great power in resisting and correcting putrefaction in other bodies. When properly prepared, it possesses the property of absorbing the coloring and odorous principles of most liquids. (See *Carbo Animalis.*) Its other physical properties differ according to its source and peculiar state of aggregation. As a chemical element it enjoys a very extensive range of combination. It forms two compounds with oxygen, *carbon dioxide* (carbonic acid gas) and *carbon monoxide* (carbonous oxide). With hydrogen it forms a number of compounds, called *hydrocarbons*, of which the most interesting are light carburetted hydrogen or marsh-gas, olefiant gas, acetylene, the hydrocarbons constituting petroleum, and the various essential oils. With nitrogen, carbon constitutes cyanogen, the compound radical of hydrocyanic or prussic acid, and when united in minute proportion with iron as carbide it is present in cast iron and steel.

CARBO ANIMALIS. U. S.

ANIMAL CHARCOAL

(cär'bō ăn-ĭ-mā'lĭs)

"Charcoal prepared from bone." *U. S.*

Spodium, Ebur Ustum; Bone Black, Ivory Black; Charbon Animal Ordinaire, *Fr. Cod.;* Noir Animal Pulvérisé, Noir d'os, *Fr.;* Thierische Kohle, Knochenkohle, Beinschwarz, Thierkohle, *G.;* Nero di ossa, Carbone animale, *It.;* Carbon animal, Carbon de hueso, *Sp.*

Animal charcoal was not retained in the British Pharmacopœia (1898).

The animal charcoal employed in pharmacy and the arts is usually obtained from bones, by subjecting them to a red heat in close vessels. The residue of the ignition is a black matter, which when reduced to powder forms *bone black*, sometimes incorrectly called *ivory black*. Ivory by carbonization will furnish a black which, on account of its fineness and intensely black color, is more esteemed than the ordinary bone black, but is much more expensive.

In manufacturing bone black, the bones, first treated with steam to separate the fat, are subjected to destructive distillation in iron cylinders connected with vessels which receive the ammoniacal liquor, called *bone spirit*, together with a dark tarry liquid (*bone oil*), this being a secondary product of the operation. When the distillate ceases to come over, the residue is charred bone, or bone black. Bone consists of animal matter with calcium phosphate and carbonate. In consequence of the decomposition of the animal matter involved in this destructive distillation, the nitrogen and hydrogen, united as ammonia, and a part of the charcoal, in the form of carbon dioxide, distil over, while the remainder of the charcoal is left in the cylinder, intermingled with the calcareous salts. Diess of Paris, proposes carbon disulphide as a solvent for the fat of bones, as it furnishes a larger and better product of fat, and renders the bones fitter for producing a good bone black. This form of animal charcoal necessarily contains calcium phosphate and carbonate.

Properties.—"Dull black, granular fragments, or a dull black powder, odorless, nearly tasteless, and insoluble in water or alcohol. When ignited, it leaves a grayish or yellowish-white ash, amounting to about 85 percent. of the original weight of the portion taken, which should have been previously dried at 120° to 125° C. (248° to 257° F.) to a constant weight. The ash should be soluble in hydrochloric acid with the aid of heat, leaving not more than a trifling residue. If 1 Gm. of Animal Charcoal be boiled for several minutes with a mixture of 3 Cc. of potassium hydroxide T.S. and 5 Cc. of

water the filtrate should be colorless or nearly so (evidence of *complete carbonization*)." *U. S.* It is more dense and less combustible than vegetable charcoal; from which, moreover, it may be distinguished by burning a small portion of it on a red hot iron, when it will leave a residue imperfectly acted on by sulphuric acid, whereas the ashes from vegetable charcoal readily dissolve in this acid, forming a bitterish solution.

Animal charcoal by no means invariably possesses the decolorizing property, as this depends upon its peculiar state of aggregation. If pure animal matter (soft tissues) is carbonized, it usually enters into fusion, and, from the gaseous matter which is extricated, becomes porous and cellular. The charcoal formed has generally a metallic lustre, and a color resembling that of black lead. It has, however, little or no decolorizing power, even though finely pulverized.

The decolorizing power of vegetable charcoal was first noticed by Lowitz of St. Petersburg; and that of animal charcoal by Figuier of Montpellier, in 1811. In 1822 the subject was ably investigated by Bussy, Payen, and Desfosses. The power is generally communicated to charcoal by igniting it in close vessels, but not always. The kind of charcoal, for example, obtained from substances which undergo fusion during carbonization scarcely possesses the property, even though it may be afterwards finely pulverized. The property in question is possessed to a certain extent by wood charcoal, but is developed in it in a much greater degree by burning it with some chemical substance, which may have the effect of reducing it to an extreme degree of fineness. The most powerful of all the charcoals for discharging colors are those obtained from certain animal matters, such as dried blood, hair, etc., by first carbonizing them in connection with potassium carbonate, and then washing the product with water. Charcoal thus prepared seems to be reduced to a state of extremely minute division, and is, therefore, very porous. The next most powerful decolorizing charcoal is *bone black*, in which the separation of the carbonaceous particles is effected by the calcium phosphate present in the bone. Vegetable substances also may be made to yield a good charcoal for destroying color, provided, before carbonization, they be well comminuted, and mixed with pumice stone, chalk, flint, or other similar substance in a pulverized state.

In the manufacture of yellow prussiate of potash there is obtained a fine black sediment, which has a powerful decolorizing action; this is sometimes attributed to the organic nitrogenous character of the material from which it is made.

The table below, abridged from one drawn up by Bussy, denotes the relative decolorizing power of different charcoals.

In order to determine the commercial value of animal charcoal, Corenwinder has proposed to ascertain its power of absorbing lime from a solution of calcium saccharate of determinate strength. The value is in proportion to the absorbing power of the charcoal. A given weight of the charcoal to be tested is left in contact, for an hour, with a given volume of the solution of the saccharate, taken in excess. The liquid is then filtered, and a small measure of it saturated with diluted sulphuric acid of known strength. The less the acid necessary for this purpose, the greater the amount of lime absorbed, and the better the animal charcoal. (*Chem. Gaz.*, 1854; *Scientific American*, April 22, 1876; *A. Pharm.*, 1887; *Proc. A. Ph. A.*, 1887.) See also Laval's investigations, *P. J.*, 1900, 214. Dupuy found that the addition of a few grains of animal charcoal to a few cubic centimeters of cold fresh tincture of guaiacum immediately causes the development of a blue color, while wood charcoal does not give this reaction (*P. J.*, 1897, 190).

Spent animal charcoal, which has been used by the sugar refiners, may have its decolorizing power restored by calcination, which destroys the organic matters that have become fixed in it, and it is stated that it may be submitted to this process twenty times before becoming unfit for use, although this depends upon the amount of calcium salts it takes up from the raw sugars, beet sugars using up the black faster than sugars from the cane. According to Pelouze, the same object may be accomplished by subjecting it to a weak solution of potassium or sodium carbonate. In removing the coloring matter, the alkaline solution becomes yellow. After its action the animal charcoal must be carefully washed, first with boiling water, and afterwards with acidulated water. A process devised by

KINDS OF CHARCOAL.	Decolorizing power on syrup.	Decolorizing power on indigo.
Bone black	1	1
Bone charcoal treated with an acid	1.6	1.8
Lamp-black, not ignited	3.3	4
Charcoal, from potassium acetate	4.4	5.6
Blood ignited with calcium phosphate	10	12
Lamp-black ignited with potassium carbonate	10.6	12.2
Blood ignited with chalk	11	18
White of egg ignited with potassium carbonate	15.5	34
Glue ignited with potassium carbonate	15.5	36
Bone charcoal, formed from bone deprived of calcium phosphate by an acid, and subsequently ignited with potassium carbonate	20	45
Blood ignited with potassium carbonate	20	50

Leplay and Cuisinier is probably more effectual. The charcoal, without being removed from the cylinders, is thoroughly washed, treated by steam to remove viscous substances, and then percolated successively, 1, by a weak alkaline solution, which removes salts and some coloring matter; 2, by weak hydrochloric acid, which, in removing a certain amount of salts of lime, liberates coloring matter; 3, again with a weak alkaline solution, to carry off the remaining coloring matter; and 4, lastly by a solution of calcium biphosphate, by which the decolorizing power of the charcoal is restored.

Animal charcoal is capable of taking the bitter principles from infusions and tinctures, and iodine from liquids which contain it in solution. Its power, however, of acting on solutions and chemical compounds is stated by Warington and Weppen to be more decided in its purified condition. (See *Carbo Animalis Purificatus;* see also *Ephem.,* 1885, p. 721.) On the other hand, Carswell (*P. J.,* 1893, 615) believes that the purification of animal charcoal is based on erroneous conclusions as charcoal possesses no inherent powers of decolorization but the latter depends partly on the aggregation of cellular spaces and chiefly on the mineral constituents.

Bone black consists of about 90 per cent. of calcium phosphate and carbonate, and 10 per cent. of charcoal.

Uses.—Animal charcoal is used in pharmacy for decolorizing vegetable principles, such as gallic acid, quinine, morphine, veratrine, etc., and in the arts, principally for clarifying syrups in sugar refining, for depriving spirits distilled from grain of the penetrating impurity, called *fusel oil,* which imparts to them an unpleasant odor and taste, as first distilled, and for the filtration of petroleum residues in the manufacture of petrolatum and petroleum jellies. (See *Petrolatum.*) The manner in which it is used as a decolorizer is to mix it with the substance to be decolorized, and to allow the mixture to stand for some time. The charcoal unites with the coloring matter, and the solution by filtration is obtained white and transparent. Its use, however, in decolorizing the alkaloids and other vegetable principles, no doubt causes a loss by absorption, since it has been shown by the experiments of Lebourdais, mentioned under the head of purified animal charcoal, that several of these principles may be obtained by the sole action of charcoal. For most pharmaceutical operations, and for use as an antidote, animal charcoal must be purified by hydrochloric acid from calcium phosphate and carbonate. (See *Carbo Animalis Purificatus.*) According to Guthe, a German chemist, bone charcoal, without purification, is to be preferred as a decolorizer in all cases in which the calcareous salts exert no injurious effect. Voilé uses animal charcoal as an absorbent in a pill excipient for making creosote and croton oil pills.

Off. Prep.—Carbo Animalis Purificatus, *U. S.*

CARBO ANIMALIS PURIFICATUS. U. S.

PURIFIED ANIMAL CHARCOAL

(cär′bō ăn-ĭ-mā′lĭs pū-rĭ-fĭ-cā′tŭs)

Charbon animal purifié, *Fr. Cod.;* Gereinigte Knochenkohle, *G.;* Carbone di ossa depurato, *It.*

* "Animal Charcoal, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Hydrochloric Acid, *three hundred grammes* [or 10 ounces av., 255 grains]; Boiling Water, *a sufficient quantity.* Introduce the Animal Charcoal into a capacious vessel, add *two hundred grammes* [or 7 ounces av., 24 grains] of Hydrochloric Acid, and *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Boiling Water. By means of a sand-bath keep the mixture gently boiling during eight hours, adding water occasionally to maintain the original volume. Then add *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Boiling Water, transfer the mixture to a muslin strainer, and, when the liquid has run off, return the Charcoal to the vessel. Add to it *one hundred grammes* [or 3 ounces av., 231 grains] of Hydrochloric Acid and *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Boiling Water, boil for two hours, again add *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Boiling Water, transfer the whole to a plain filter, and when the liquid has passed through, wash the residue with Boiling Water until the washings produce only a faint cloudiness with silver nitrate T.S. Dry the powder in a drying oven, and immediately transfer it to well-stoppered vials." *U. S.*

"Take of Bone Black, in powder, *sixteen ounces* [avoirdupois]; Hydrochloric Acid *ten fluidounces;* Distilled Water *a sufficiency.* Mix the Hydrochloric Acid with a pint of the Water, and add the Bone Black, stirring occasionally. Digest at a moderate temperature for two days, agitating from time to time; collect the undissolved charcoal on a calico filter, and wash with Distilled Water until what passes through gives scarcely any precipitate with nitrate of silver. Dry the charcoal, and then heat it to redness in a closely-covered crucible." *Br.* 1885.

Animal charcoal, as it is made by charring bones, necessarily contains bone phosphate and calcium carbonate, the presence of which does no harm in some decolorizing operations; but in delicate chemical processes these salts may be dissolved or decomposed, and thus become a source of impurity. It is on this account that animal charcoal requires to be purified from its calcareous salts; and this is accomplished by diluted hydrochloric acid, which dissolves the phosphate and decomposes the carbonate. According to Stenhouse, aluminized vegetable charcoal is equally efficacious with purified animal charcoal as a decolorizer. (See page 296.)

Properties.—Purified animal charcoal is "a dull black powder, odorless, tasteless, and insoluble in water, alcohol, or other solvents. If 2 Gm. of the powder be ignited at a red heat with

free access of air in a broad, shallow porcelain or platinum dish, it should not leave a residue weighing more than 0.08 Gm., or 4 per cent. of the original weight (limit of *silicates* and *other fixed inorganic matter*). If 1 Gm. of the powder be boiled with a mixture of 3 Cc. of potassium hydroxide T.S. and 5 Cc. of water during three minutes, the filtrate should be colorless (evidence of *complete carbonization*)." *U. S.*

It has been shown by Robert Warington that bitter vegetable substances, including the organic alkalies, are removed from solution by passing through purified animal charcoal, especially when the action is assisted by heat. Weppen finds that a similar effect is produced by it in removing resins from tinctures, tannic acid and bitter principles from astringent and bitter infusions, and certain metallic salts from their solutions. Purified animal charcoal, thus employed, has been resorted to by Lebourdais as an agent for obtaining the active principles of plants. A decoction or infusion of the plant is either boiled with or filtered through the charcoal, which takes up, more or less completely, the bitter and coloring principles. The charcoal, after having been washed and dried, is treated with boiling alcohol, which dissolves the principles taken up. Finally, the alcohol is distilled off, and the principles are obtained in a separate state. In this way digitalin, ilicin, scillitin, columbin, colocynthin, arnicine, strychnine, quinine, and other principles have been obtained by Lebourdais. (*Chem. Gaz.*, Nov. 15, 1848.) (In relation to the method of Lebourdais, see a paper by J. S. Cobb, in *A. J. P.*, 1851.) A. B. Garrod proposed purified animal charcoal as an antidote to vegetable and animal poisons, with which it appears to combine. According to his experiments, common bone black has not one-fifth of the power possessed by the purified substance, and vegetable charcoal and lamp-black are nearly or quite useless. The amount of the antidote proposed by Garrod is half an ounce for each grain of a vegetable alkaloid. Alfred Taylor deemed the results of Garrod inconclusive. B. H. Rand made some interesting observations in relation to the antidotal powers of purified animal charcoal, and proved that poisonous doses of the strongest vegetable poisons may be swallowed with impunity if mixed with that substance. (*Med. Exam.*, Sept. 1848.) As an antidote for phosphorus (see *N. Y. M. R.*, 1874, p. 68) its value is very doubtful.

In using animal charcoal for decolorizing active vegetable principles much loss is often incurred by the absorption of those principles by the charcoal.

CARBO LIGNI. U. S., Br.

CHARCOAL

(cär'bō lig'nī)

"Charcoal prepared from soft wood, and very finely powdered. It should be kept in well-closed vessels." *U. S.* "The carbonaceous residue of wood charred by exposure to a red heat without access of air." *Br.*

Carbo Præparatus, Carbo e Ligno, Carbo Vegetabilis; Wood Charcoal, Vegetable Charcoal; Charbon Végétal, Charbon de bois, *Fr.*; Carbo Ligni Pulveratus, *P. G.*; Gepulverte Holzkohle, Holzkohle, Präparirte Kohle, *G.*; Carbone Vegetale, Carbone di legno, *It.*; Carbon vegetal medicinal, Carbon de lena, *Sp.*

Preparation on the Large Scale.—Billets of wood are piled in a conical form, and covered with earth and sod to prevent the free access of air, several holes being left at the bottom and one at the top of the pile, in order to produce a draught to commence the combustion. The wood is then kindled from the bottom. In a little while the hole at the top is closed, and, after the ignition is found to have pervaded the whole pile, those at the bottom are stopped also. The combustion taking place with a smothered flame, the volatile portions of the wood, consisting of hydrogen and oxygen, are dissipated, while the carbon is left, a portion of it, however, being lost by combustion. Wood, thus carbonized, yields not more than 17 or 18 per cent. of charcoal. A better method is to char the wood in iron cylinders, when it yields from 22 to 23 parts in 100 of excellent charcoal; and, at the same time, the means are afforded for collecting the volatile products, consisting of pyroligneous acid, empyreumatic oil, and tar. This process for obtaining charcoal has been described under another head. (See *Acidum Aceticum.*) A method of preparing charcoal by subjecting wood to superheated steam has been invented by Violette. When the temperature of steam is 300° C. (572° F.), the wood is converted into a peculiar charcoal, called *red charcoal*, which is intermediate in its qualities between wood and ordinary charcoal. When the temperature is lower, the carbonization is incomplete; when higher, the product is black charcoal. The steam process yields a uniform charcoal for a given temperature, which may be easily regulated, and a product about double that obtained in closed cylinders. Charcoal contains *carbon*, approximately in proportion to the temperature at which it is formed; varying from 65 per cent. when made at 250° C. (482° F.) to 80 per cent. when made at 400° C. (752° F.). The gaseous matter present, on the other hand, decreases with the temperature of carbonization. Thus, for charcoal made at 300° C. (572° F.), it is one-third of its weight; at 350° C. (662° F.), one-fourth.

E. C. C. Stanford has called attention to a variety of vegetable charcoal, obtained by charring a species of sea weed, *Laminaria digitata*, gathered on the shores of the Hebrides, which, on account of the large proportion of calcium carbonate contained in it (20 per cent.), is unfit for use in refining sugar; it, however, possesses more of the deodorizing and decolorizing power than animal charcoal itself,

which, with the exception referred to, it closely resembles in chemical composition. (*P. J.*, 1867, 186.)

Preparation for Medicinal Use.—Belloc recommends charcoal for this purpose to be obtained from poplar shoots, cut at the time the sap rises, and deprived of their bark. The carbonization should be performed in cast iron vessels at a red-white heat. The product is a light and brilliant charcoal, which must be purified by being macerated for three or four days in water, frequently renewed. It is then dried, powdered, and placed in bottles, which should be well-stoppered. The charcoal most esteemed in Philadelphia for medicinal purposes is that prepared by Dupont, near Wilmington, Delaware, for the manufacture of gunpowder. It is made from young willow shoots of two or three years' growth.

Properties.—Charcoal is a black, shining, brittle, porous substance, tasteless and inodorous, and insoluble in water. It is a good conductor of electricity, but a bad one of heat. It possesses the remarkable property of absorbing many times its own bulk of certain gases. "A black, odorless, and tasteless powder, free from gritty matter. If 1 Gm. of Charcoal be boiled with a mixture of 3 Cc. of potassium hydroxide T.S. and 5 Cc. of water for several minutes, the filtrate should be colorless or nearly so (evidence of *complete carbonization*)." *U. S.* The British Pharmacopœia describes it as "a black powder without taste or odor, free from gritty matter. When burned at a high temperature with free access of air, it should not leave more than 7½ per cent. of ash." When exposed to the air after ignition, charcoal increases rapidly in weight, absorbing from 12 to 14 per cent. of moisture. As ordinarily prepared, it contains the incombustible part of the wood, amounting to 1 or 2 per cent., which is left as ashes when the charcoal is burned. This inorganic material may be removed by digesting the charcoal in diluted hydrochloric acid, and afterwards washing it thoroughly with boiling water.

Uses.—Powdered charcoal is an active absorbent, but otherwise is practically free from medicinal properties. In the past it has been much used in *dyspepsia* with fetid breath, *pyrosis, diarrhœa,* and even *constipation.* Its influence upon the bowels, if it has any other than its mechanical action, really tends towards the production of constipation. At one time it was much used as a dressing for ulcers but is at present rarely employed, though the *Cataplasma Carbonis* or charcoal poultice is still occasionally prescribed in Great Britain. Several of its varieties are used as tooth powder. Those generally preferred are the charcoals of the cocoa-nut shell and of bread. It is said that charcoal proves useful in preserving the teeth by absorbing the acid sometimes morbidly present in the mucus of the mouth. The dose of charcoal varies from one to four teaspoonfuls (3.9 to 15.5 Gm.) or more. Daniel gave it in his case of constipation in doses of a teaspoonful (3.9 Gm.), repeated every half hour. *Charcoal biscuits* have been prepared, containing 15 or 20 per cent. of charcoal in fine powder, while *charcoal lozenges,* either of charcoal alone or associated with bismuth, have been employed with asserted good results in certain forms of gastric disturbances.

For internal use charcoal is preferred by some in the *granular form.* W. Lascelles Scott employs the following method of preparing it. He prefers the wood of the box, willow, or linden, which, after being charred, should be allowed to cool out of contact with air, then boiled for some time in diluted hydrochloric acid, and afterwards, having been thoroughly washed with pure water, in a little weak ammonia. The fragments are again ignited, and then quickly powdered, and passed through a sieve of 80 or 100 apertures to the inch. Nine pounds of this powder are mixed with one pound of pure sugar passed through a 30 sieve, and 4 ounces of gum arabic in impalpable powder. The whole is then moistened with a few ounces of warm distilled water, to which have been added an ounce and a quarter of tincture of benzoin, and a little mucilage. The mass is now granulated on flat steam pans, in the usual manner, at a temperature of 101.6° to 107.2° C. (215° to 225° F.). When perfectly dry it is sifted, and secured in well-stoppered bottles. (*Chem. News,* 1867, p. 204.)

Stenhouse has devised a process for combining alumina with common vegetable charcoal, forming what he calls *aluminized charcoal,* which is an economical substitute for purified animal charcoal, and equally efficacious as a decolorizer. It is prepared by digesting finely powdered charcoal with sufficient of the solution of aluminum sulphate to give an impregnation of 7.5 per cent. of alumina. The whole is evaporated to dryness, and ignited in a covered Hessian crucible, until the water and acid have been dissipated. Aluminized charcoal is perfectly black, though thoroughly impregnated with anhydrous alumina, and only requires to be carefully pulverized to be ready for use. On similar principles, Stenhouse prepares his *artificial bone black,* by impregnating powdered wood charcoal with 7.5 per cent. of calcium phosphate, by digesting it in a solution of this salt in hydrochloric acid, evaporating to dryness, and igniting in covered vessels. This charcoal decolorizes well, but can be used only for neutral solutions.

Charcoal may act either as an oxidizer or as a deoxidizer, these contrary powers depending upon the temperature of the experiment; at the ordinary temperature, by its porosity, it facilitates atmospheric oxidation of animal matter with which it is placed in contact, while, on the other hand, at a low red heat it deoxidizes or reduces many metallic oxides with the formation of carbon monoxide. The bodies of two dogs having been laid in an open box on a bed of charcoal a few inches deep, and

covered by the same material, were kept by John Turnbull of Glasgow, for six months in his laboratory, without emitting any perceptible effluvium; and when they were examined at the end of this time, scarcely anything remained but the bones. Stenhouse, who relates this experiment, has confirmed it by observations of his own, and believes that the animal matter thus treated undergoes putrefaction, though the products, by their rapid oxidation and absorption, are prevented from contaminating the air. He therefore considers charcoal not to be antiseptic, but the very opposite. It is said that water may be kept sweet at sea by the addition of a little powdered charcoal to each cask.

Dose, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Acidum Sulphurosum, *U. S.;* Calx Sulphurata, *U. S.*

CARBONEI DISULPHIDUM. U. S. (Br.)

CARBON DISULPHIDE [Carbon Bisulphide]

(cär-bō′nę-ī dī-sŭl′phį-dŭm)

$CS_2 = 75.57$

"Carbon Disulphide should be kept in partially filled, well-stoppered bottles, or in tin cans, in a cool place, remote from lights or fire." *U. S.* "Carbon Bisulphide, CS_2, may be prepared by the combination of carbon and sulphur at a high temperature, the product being subsequently condensed and purified." *Br.*

Carbonis Bisulphidum, *Br.,* Carbonii Bisulphidum; Carbon Bisulphide; Carbon Sulphide; Sulfure de Carbone, *Fr. Cod.;* Carboneum Sulfuratum, Alcohol Sulfuris, Schwefelkohlenstoff, Kohlensulfid, Schwefelalkohol, *G.;* Solfuro di carbonio, *It.;* Sulfuro de carbono, *Sp.*

This compound, corresponding to carbon dioxide (carbonic acid gas), CO_2, is prepared by the direct combination of carbon and sulphur at a moderate red heat. To effect this, charcoal is heated to redness in a vertical cylinder, while sulphur is admitted through a lateral tubulure near the bottom. As the sulphur melts and vaporizes, it combines with the carbon, and the carbon disulphide formed distils over through a series of condensing tubes, which, while they serve to collect the crude carbon disulphide, allow of the escape of the hydrogen sulphide formed at the same time. The crude product is then rectified, first over a solution of chlorinated lime to break up any hydrogen sulphide gas remaining, and then repeatedly either over mercury, mercuric chloride, anhydrous cupric sulphate, or over a pure fatty oil, which withdraws from it all free sulphur and bad smelling sulphur compounds. The manufacture of carbon disulphide has assumed large proportions. In the works of Deiss at Pantin, near Marseilles, France, 5000 kilogrammes were turned out daily, and their annual production exceeds 1,200,000 kilogrammes.

The most decided improvement in the manufacture of carbon disulphide was made by E. R. Taylor of Penn Yan, New York, who introduced a patented electrothermal process which can be worked continuously. In large furnaces 41 feet high by 16 feet in diameter an alternating current is applied through carbon electrodes. The metallic sulphur passing over the electrodes is vaporized and rises through the glowing carbon, the carbon disulphide being taken off as vapor through a side connection near the top of the furnace. The impure carbon disulphide is purified by forcing lime water in a fine spray through the disulphide liquor until the water runs out of the tank colorless. The carbon disulphide is finally rectified by steam heat. It is used in the arts for the extraction of oils from different oil seeds, for the extraction of sulphur from some varieties of sulphur ores, for the cleansing of wool and recovering the fat, as a solvent for caoutchouc in the manufacture of india rubber goods, for the extraction of perfumes, and on an enormous scale in France as a remedy against the *phylloxera.* Von Lengyel describes a carbon sulphide having the composition C_3S_2. (*Proc. A. Ph. A.,* 1893, 1021.)

Properties.—"A clear, colorless, highly refractive liquid, very diffusive, having a strong, characteristic but not fetid odor, and a sharp, aromatic taste. Specific gravity: 1.256 to 1.257 at 25° C. (77° F.). Soluble in 526 parts of water at 25° C. (77° F.); very soluble in alcohol, ether, chloroform, fixed and volatile oils. Carbon Disulphide vaporizes rapidly at the ordinary temperature, is highly inflammable, boils at 46° to 47° C. (114.8° to 116.6° F.), and when ignited, burns with a bluish-white flame, producing carbon dioxide and sulphur dioxide. It should not affect the color of blue litmus paper moistened with water (absence of *sulphur dioxide*). A portion evaporated spontaneously in a glass vessel should leave no residue (absence of *dissolved sulphur*). Lead acetate T.S. agitated with it should not be blackened (absence of *hydrogen sulphide*)." *U. S.*

Uses.—Carbon disulphide is a powerful poison, but is not used as an internal remedy. According to Delpech, the workmen exposed to the fumes of the disulphide are affected with headache, vertigo, and over-excitement of the nervous system, as evinced by voluble talking, incoherent singing, or immoderate laughter, or sometimes by weeping; and a continuance of the exposure is apt to finally cause a state of cachexia, characterized by general weakness, loss of sexual appetite, dulness of sight and hearing, and impairment of memory. Later writers assert that these phenomena are hysterical, and that what the carbon disulphide does is to produce an hysterical neurosis. (See *Annales de Hygiène,* 1895, xxxiii.) The swallowing by a man of half an ounce of carbon disulphide was followed in half an hour by absolute unconsciousness, very rapid, feeble pulse, slow and stertorous respiration, cold and clammy surface of body, and insensitive con-

junctiva, with mobile pupils. Two hours later, death occurred. The blood was found fluid, but there were no marked lesions of irritation in the gastro-intestinal mucous membrane. (*L. L.*, July 17, 1886.) India rubber workers, by whom the disulphide is largely used, are said to suffer frequently from paralytic symptoms. (*L. L.*, Jan. 1886.)

Externally, the disulphide has been used as a counter-irritant and local anæsthetic. In *enlarged lymphatic glands*, Turnbull has employed it with asserted good success. He applies it by means of a bottle with a proper sized mouth, containing a fluidrachm of the disulphide, imbibed by a piece of sponge. The skin over the gland is first well moistened with water. He employed the vapor also with benefit in deafness, when dependent on want of nervous energy and a deficiency of wax. For this purpose, the bottle containing the disulphide is made with a neck to fit the meatus, and, being applied to the ear, is held there until considerable warmth is produced. The remedy has been used often with very good results, in a similar manner, in *facial* and other *neuralgias* aud various local *pains*. It causes a good deal of smarting, but its disagreeable odor is the chief objection to it. Chiandi Bey finds that a solution of carbon disulphide (three parts per thousand) is a most energetic antiseptic, killing microbes and arresting all fermentation; he proposes its use in *zymotic diseases* internally. (*C. R. A. S.*, xcix.) In France the disulphide has been used in *diarrhœa* in 3.5 per cent. solution, of which the dose is two tablespoonfuls (30 Cc.) four or five times a day.

Off. Prep.—Used as a solvent in Charta Sinapis, *U. S.;* Liquor Caoutchouc, *Br.;* Pilula Phosphori, *Br.*

CARDAMOMUM. U. S. (Br.)

CARDAMOM

(cär-da-mō'mŭm)

"The dried nearly ripe fruit of *Elettaria repens* (Sonnerat) Baillon (Fam. *Zingiberaceæ*)." *U. S.* "The dried ripe seeds of Elettaria Cardamomum, *Maton.* The seeds should be kept in their pericarps and separated when required for use." *Br.*

Cardamomi Semina, *Br.;* Cardamomum Minus, Cardamomum Malabaricum; Malabar Cardamoms, Cardamoms; Cardamome du Malabar. *Fr. Cod.;* Petit Cardamome. *Fr.;* Fructus Cardamomi, *P. G.;* Malabar Kardamomen, Cardamomen, Kleine Kardamomen, *G.;* Cardamomo minore, *It.;* Cardamomo, Cardamomo menor, *Sp.;* Ebil, *Arab.;* Kakelah seghar, *Pers.;* Capalaga, *Malay;* Gujaratil elachi, *Hindost.*

The subject of Cardamom has been involved in some confusion and uncertainty, both in its commercial and botanical relations. The name has been applied to the aromatic capsules of various Indian plants belonging to the family of Zingiberaceæ. Three varieties have long been designated by the several titles of the *lesser, middle,* and *larger,—cardamomum minus, medium,* and *majus;* but these terms have been used differently by different writers, so that their precise signification remains doubtful. To Pereira we are mainly indebted for the clearing up of this confusion. It is well known that the *lesser cardamom* of most writers is the variety recognized by the Pharmacopœias and generally kept in the shops. The other varieties, though circulating to a greater or less extent in European and Indian commerce, are little known in this country.[1]

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[1] *Ceylon Cardamom.*—This has been denominated variously *cardamomum medium, cardamomum majus,* and *cardamomum longum,* and is sometimes termed in English commerce *wild cardamom.* It is the *large cardamom* of Guibourt. In the East it is sometimes called *grains of Paradise;* but it is not the product known with us by that name. (See below.) It is derived from a plant cultivated in Candy, in the island of Ceylon, and also growing wild in the forests of the interior, which was designated by Sir James Edward Smith *Elettaria major,* but is now generally acknowledged to be only a variety of the official plant. This plant was described by Pereira in *P. J.*, ii. 388. It is affirmed that the annual product reaches nearly 750,000 pounds. The fruit is a lanceolate-oblong, acutely triangular capsule, somewhat curved, about an inch and a half long and four lines broad, with flat and ribbed sides, tough and coriaceous, brownish or yellow ash-colored, having frequently at one end the long, cylindrical, three-lobed calyx, and at the other the fruit-stalk. It is three-celled, and contains angular, rugged, yellowish-red seeds, of a peculiar fragrant odor and spicy taste. Its effects are analogous to those of the official cardamom.

2. *Round Cardamom.*—This is probably the Ἄμωμον of Dioscorides and the *Amomi ura* of Pliny, and is believed to be the fruit of *Amomum cardamomum,* Willd., growing in Sumatra, Java, and other East India islands. The capsules are usually smaller than a cherry, roundish or somewhat ovate, with three convex sides, more or less striated longitudinally, yellowish or brownish white, and sometimes reddish, with brown, angular, cuneiform, shrivelled seeds, which have a spicy camphorous flavor. They are sometimes, though rarely, met with connected in their native clusters, constituting the *amomum racemosum,* or *amome en grappe,* of the French. They are similar in medicinal properties to the official, but are seldom used except in the southern parts of Europe.

3. *Java Cardamom.*—The plant producing this variety is supposed to be the *Amomum maximum* of Roxburgh, growing in Java and other Malay islands in the East. The capsules are oval, or oval-oblong, often somewhat ovate, from eight to fifteen lines long, and from four to eight broad, usually flattened on one side and convex on the other, sometimes curved, three-valved, and occasionally imperfectly three-lobed, of a dirty grayish-brown color, and coarse fibrous appearance. When soaked in water, they exhibit as their distinguishing character from nine to thirteen ragged membranous wings along their whole length. The seeds have a feebly aromatic taste and odor. This variety of cardamom affords but a very small proportion of volatile oil, is altogether of inferior quality, and, when imported into London, is usually sent to the continent.

4. *Madagascar Cardamom.*—This is the *Cardamomum majus* of Geiger and some others, and is thought to be the fruit of *Amomum angustifolium* of Sonnerat, growing in marshy grounds in Madagascar. The capsule is ovate, pointed, flattened on one side, striated, with a broad circular scar at the bottom, surrounded by an elevated, notched, corrugated margin. The seeds have an aromatic flavor analogous to that of official cardamom.

5. *Bengal Cardamom.*—The fruit of *Amomum subulatum,* Roxb., sometimes known by the name of Winged Bengal Cardamom. *Morung elachi,* or *Buro elachi,* is about an inch in length, obscurely three-sided, ovoid or somewhat obconic, with nine narrow, jagged ridges or wings (best seen after soaking in water) upon its distal end, which terminates in a truncate bristly nipple. The pericarp is coarsely striated, of a deep brown, splitting into three valves, disclosing a three-lobed mass of seeds, 60 to 80 in number.

The official cardamoms are produced solely in India, chiefly in Malabar, Mysore, and adjacent regions. Malabar cardamoms are rather smaller than Mysore cardamoms.

Linnæus confounded, under the name of *Amomum Cardamomum,* two different plants —the genuine, that of Malabar, and another growing in Java. These were separated by Willdenow, who conferred on the former, Sonnerat's title of *Amomum repens,* while he retained the original name for the latter, though not the true cardamom plant. In the tenth volume of the *Linnæan Transactions,* 1811, White, a British army surgeon in India, published a very minute description of the Malabar plant, which he had enjoyed frequent opportunities of examining in its native state. From this description Maton inferred that the plant, according to Roscoe's arrangement of the Scitaminaceæ, could not be considered an *Amomum;* and as he was unable to attach it to any other known genus, he proposed to construct a new one, with the name of *Elettaria,* derived from *elettari* or *elatari,* the Malabar name of this drug. Sir James Smith afterwards suggested the propriety of naming the new genus *Matonia,* in honor of Maton; and the latter title, having been adopted by Roscoe, obtained a place in former editions of the London and U. S. Pharmacopœias. The celebrated Roxburgh described the Malabar cardamom plant as an *Alpinia,* with the specific name *Cardamomum.* As doubts were entertained of the necessity for the new genus proposed by Maton, Roxburgh was followed in the London and U. S. Pharmacopœias, and the fruit was referred to *Alpinia Cardamomum.* This decision, however, was revised in the later editions of the U. S. and British Pharmacopœias. Roscoe arranged it with the abandoned genus *Renealmia* of Linnæus, which he restored.

Ellettaria repens (Sonnerat), Baillon; *E. Cardamomum,* Maton; *B. & T.* 267.—*Alpinia Cardamomum,* Roxburgh.—*Amomum repens,* Sonnerat; Willd., *Sp. Plant.* i. 9.—*Renealmia Cardamomum,* Roscoe.—*Matonia Cardamomum,* Smith. Figured in *Linn. Trans.,* x. 248, and Carson's *Illust. of Med. Bot.,* ii. 55.—The cardamom plant has a tuberous horizontal root or rhizome, furnished with numerous fibres, and sending up from eight to twenty erect, simple, smooth, green and shining, perennial stems, which rise from six to twelve feet in height, and bear alternate sheathing leaves. These are from nine inches to two feet long, from one to five inches broad, elliptical-lanceolate, pointed, entire, smooth and dark green on the upper surface, glossy and pale sea-green beneath, with strong midribs, and short footstalks. The flower-stalk proceeds from the base of the stem, and lies upon the ground, with the flowers arranged in a panicle. The calyx is monophyllous, tubular, and toothed at the margin; the corolla monophyllous and funnel-shaped, with the inferior border unilabiate, three-lobed, and spurred at the base. The fruit is a three-celled capsule, containing many seeds; during drying it is said to lose three-fourths of its weight.

This valuable plant is a native of the mountains of Malabar, where it springs up spontaneously in the forests after the removal of the undergrowth, and is very extensively cultivated by the natives. For a detailed account of culture, see *A. J. P.,* 1877, 605; also *P. J.,* 1888. Cardamoms have also been cultivated to some extent in tropical America. The plant begins to yield fruit at the end of the fourth year, and continues to bear for several years afterwards. The capsules when ripe are picked from the fruit-stems, dried over a gentle fire or by sun-heat, and separated by rubbing with the hands from the footstalks and adhering calyces. J. W. Mollison describes

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6.—*Nepaul Cardamom* is produced by an Amomum of undetermined species, and resembles the Bengal cardamom, except in having a long tubular calyx on its summit, and in being usually attached to a stalk.

7. *Grains of Paradise. Grana Paradisi.*—Under this name and that of *Guinea grains,* and *Melegueta* or *Mallaguetta pepper,* are found in commerce small seeds of a round or ovate form, often angular, and somewhat cuneiform, minutely rough, brown externally, white within, of a feebly aromatic odor when rubbed between the fingers, and of a strongly hot and peppery taste. Two kinds of them are known in the English market, one larger, plumper, and more warty, with a short conical projecting tuft of pale fibres on the umbilicus; the other smaller and smoother, and without the fibrous tuft. The latter are the more common. It is probable that one of the varieties is produced by *Amomum Grana Paradisi* of Sir J. E. Smith, and the other by Roscoe's *Amomum Melegueta.* (Pereira's *Mat. Med.,* 3d ed., p. 1134.) W. F. Daniell, who has published (*P. J.,* xiv. 312 and 356) an elaborate paper on the Amoma of Western Africa, states that the true Mallaguetta pepper is obtained exclusively from varieties of the same species to which belong the *Amomum Granum Paradisi* of Afzelius and the *A. Melegueta* of Roscoe; while the *A. Grana Paradisi* of Sir J. E. Smith is a different plant, and yields a different product. These grains are imported from Guinea, and other parts of the western coast of Africa. Similar grains are taken to England from Demerara, where they are obtained from a plant cultivated by the negroes, supposed to have been brought from Africa, and believed by Pereira to be the *Amomum Melegueta* of Roscoe. (*Ibid.,* vi. 412.) At the international exhibition of 1862, at London, Geo. B. Wood noticed a specimen of similar grains, under the name of grains of Paradise, sent from the island of Trinidad. Their effects on the system are analogous to those of pepper; but they are seldom used except in veterinary practice, and to give artificial strength to spirits, wine, beer, and vinegar. In the same journal (ii. 443), Pereira points out seven distinct scitamineous fruits to which the name of grains of Paradise has been applied by different authors. J. C. Thresh made a proximate analysis of the seeds, and found volatile oil, resin, tannin, starch, albuminoids, and an active principle in the form of a straw-colored, viscid, odorless fluid, pungent, but not so hot as capsaicin. (*P. J.,* 1884, p. 297.) Fredk. Schwartz found in the seeds a reddish-brown acrid resin, and an oil having a burning aromatic taste, upon which the virtues probably depend. (*A. J. P.,* 1886, 118; consult also Hanausek's researches on grains of Paradise in *Chem. Ztg.,* 1893, 1765.)

Bastard Cardamom, the seeds of *Amomum Xanthoides,* Wall., resembles true cardamom in appearance, but is of a dirty green color, and has a very biting camphor-like taste. B. Niederstadt gives the following as the results of analysis of the true (hulled) seed and of the bastard cardamom:

	True.	Bastard.
Water	15.25	15.50
Ether soluble extract	5.10	4.04
Ash	6.55	7.50
Starch and sugar	28.84	24.00
Cellular tissue, nitrogenous matters and extractive	44.26	48.96

A cardamom from East Africa, with a flavor resembling that of official cardamom and of the Korarima cardamom, is said to have been seen in the London market, but apparently has not been identified.

the method of washing and curing cardamoms employed in the Bombay Presidency, India. The washing and manipulation is performed by women, and water from special wells is employed. The cardamoms are first washed in earthenware vessels containing a mixture of the well water and pounded soap nut and a species of acacia, in the proportion of two pounds of the former to a quarter pound of the latter. About ten pounds of cardamoms are treated at one time. Two women stir them vigorously in the mixture for about one minute and then allow them to rest about an equal length of time, and again stir for another minute. A thick lather results. This completes the first washing, after which the cardamoms are baled out by hand into a basket where they are allowed to drain for a few seconds, and then subjected to a second washing similar to the first except that the mixture contains less of the soap nut preparation and an additional quantity of soap solution. They are then thrown upon a mat and sprinkled with water from the special well at intervals of a half hour, until the next morning, when they are spread upon the roof of a house and allowed to dry for four or five hours. After nipping off the short stalk, an operation performed with a large pair of shears by women who are often very expert, the cardamoms are sorted, only the most plump fruits being prepared for the foreign market. Besides bleaching by this process, cardamoms are also subjected to starching in India. The starched product has a whiter appearance than the bleached cardamoms. The starch is prepared by pounding together rice, wheat, country soap and buttermilk. The paste is diluted with water and sprinkled over the cardamoms as they are rubbed by hand. (*B. C. D.*, 1904, see also *Ph. Era*, 1904, 137.)

Thus prepared, they are ovate-oblong, from three to ten lines long, from two to four thick, three-sided with rounded angles, obtusely pointed at both ends, longitudinally wrinkled, and of a yellowish-white color. The seeds which they contain are small, angular, irregular, rough as if embossed upon their surface, of a brown color, easily reduced to powder, and thus separable from the capsular covering, which, though slightly aromatic, is much less so than the seeds, and should be rejected when the medicine is administered. The seeds constitute about 74 parts per cent. by weight. According to Pereira, three varieties are distinguished in commerce: 1, the *shorts*, from three to six lines long, from two or three broad, browner and more coarsely ribbed and more highly esteemed than the others; 2, the *long-longs*, from seven lines to an inch in length by two or three lines in breadth, elongated, and somewhat acuminate; and 3, the *short-longs*, which are somewhat shorter and less pointed than the second variety. The odor of cardamom is fragrant, the taste warm, slightly pungent, and highly aromatic. "Oblong-ovoid, obtusely triangular in transverse section, from 10 to 20 Mm. long, slightly beaked at the apex, rounded to truncate at the base; three-celled and with central placentæ; pericarp thin, leathery, nearly tasteless, and of a pale yellow color; seeds 15 to 18 in number, about 4 Mm. long, oblong-ovoid and irregularly angular, reddish-brown, enclosed in a thin, membranous aril; odor and taste strongly and agreeably aromatic. Ash not more than 4 per cent. The seeds alone contain active and valuable constituents." *U. S.* "Incinerated they should not yield more than 4 per cent. of ash." *Br.* Cardamom yields its virtues to water and alcohol, but more readily to the latter. The seeds contain 4.6 per cent. of volatile oil, 10.4 of fixed oil, 2.5 of a salt of potassium mixed with a coloring principle, 3.0 of starch, 1.8 of nitrogenous mucilage, 0.4 of yellow coloring matter, and 77.3 of ligneous fibre. (Trommsdorff.) The volatile oil is colorless, of an agreeable and very penetrating odor, and of a strong aromatic, burning, camphorous, and bitterish taste. It is dextrogyrate, and consists essentially of a terpene, $C_{10}H_{16}$, with small quantities of formic and acetic acids. From old specimens of oil Dumas and Peligot claim to have separated crystals of *terpene hydrate*, $C_{10}H_{20}O_2 + H_2O$, while Flückiger has obtained a crystalline deposit from Ceylon oil which he considers identical with common camphor. Weber (*Ann. Ch. Ph.*, 238, 98) speaks of finding a small amount of a crystalline non-volatile compound which fuses at 60° to 61° C. Schimmel & Co. published in their semi-annual reports for April and October, 1897, some results of investigation of several varieties of cardamom oil. The terpenes of Ceylon oil they state to be *terpinene* and *dipentene;* both Ceylon and Bengal cardamom contain *cineol*, $C_{10}H_{18}O$; Malabar cardamom yields *terpineol* as well as cineol, while Siam cardamom yields a crystalline sediment composed of borneol and camphor in approximately equal proportions. The sp. gr. of the oil is between 0.92 and 0.94. It cannot be kept long without undergoing change, and finally, even though excluded from the air, loses its peculiar odor and taste. If ether be made to percolate through the powdered seeds, and the liquor obtained be deprived of the ether, a light greenish-brown fluid remains, consisting almost exclusively of the volatile and fixed oils. It has the odor of cardamom, and keeps better than the oil obtained by distillation. (*A. J. P.*, xxi. 116.) The oil of cardamom of commerce is often factitious, being composed of several cheap volatile oils, oils of cajuput, nutmeg, and others being used. Schimmel & Co. announced in 1901 that they no longer distilled the oil from the fruit of Elettaria Cardamomum, but from the seeds of another species; this oil makes a clear solution with three parts by volume of 70 per cent. alcohol. (*Schim. Rep.*, 1901, 14.) The seeds should be powdered only when wanted for use, as they retain their aromatic properties best while in the capsule.

Cardamoms are sometimes adulterated; G. W. Kennedy reported nearly 4 per cent. of orange

seeds and unroasted grains of coffee mixed with the cardamoms. (*A. J. P.*, 1872.) Solstein (1892) found that pure powdered cardamom yields 8.36 per cent. of ash; three commercial samples of powdered cardamom that he examined contained sodium carbonate.

Uses.—Cardamom is a grateful aromatic, not strongly heating and stimulating, and useful chiefly as an adjuvant. Throughout the East Indies it is largely consumed as a condiment. It was known to the ancients, and derived its name from the Greek language. In this country it is employed chiefly as an ingredient in compound preparations.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Extractum Colocynthidis Compositum, *U. S., Br.;* Pulvis Aromaticus, *U. S.* (*Br.*); Pulvis Cretæ Aromaticus, *Br.;* Tinctura Cardamomi, *U. S.;* Tinctura Cardamomi Composita, *U. S., Br.;* Tinctura Gentianæ Composita, *U. S., Br.;* Tinctura Rhei, *U. S.* (*Br.*).

CARUM. U. S. (Br.)

CARAWAY

(cā′rŭm)

"The dried fruit of *Carum Carvi* Linné (Fam. *Umbelliferæ*)." *U. S.* "The dried fruit of Carum Carvi, *Linn.*" *Br.*

Carui Fructus, *Br.,* Caraway Fruit; Carvies, Cumin des Prés, Carvi, *Fr. Cod.;* Fructus Carvi, *P. G.;* Gemeiner Kümmel, Kümmel, Garbe, *G.*

Carum Carvi, Willd., *Sp. Plant.,* i. 1470; *B. & T.* 121.—This plant is biennial and umbelliferous, with a spindle-shaped, fleshy, whitish root, and an erect stem, about two feet in height, branching above, and furnished with doubly pinnate, deeply incised leaves, the segments of which are linear and pointed. The flowers are small and white, and in erect terminal umbels, with an involucre, consisting sometimes of three or four bracts, sometimes of one only, and are destitute of partial involucre.

The caraway plant is a native of Europe, growing wild in meadows and pastures, and cultivated in many places. It has been introduced into this country. The flowers appear in May and June, and the seeds, which are not perfected until the second year, ripen in August. The root, when improved by culture, resembles the parsnip, and is used as food in Northern Europe. The seeds are the part used in medicine. They are collected by cutting down the plant, and threshing it on a cloth. Our markets are supplied partly from Europe, partly from our own gardens. The American seeds are usually rather smaller than the German. Under the name of *Ajowan,* the fruits of the *Carum Ajowan,* Bentham & Hooker (*Ammi copticum,* L.), are largely used in India. They are $\frac{1}{16}$ to $\frac{1}{15}$ of an inch long, and resemble the fruits of common parsley, but are distinguished by their odor, and by their surface being very rough from numerous very minute tubercles. They contain about 4 per cent. of a volatile oil, which has the odor of the oil of thyme, and contains thymol; it may be used as an aromatic carminative. (See *B. M. J.,* June 6, 1885.) For a description of the *oil of ajowan* see *Schim. Rep.,* 1903, 78.

Caraway seeds (half-fruits) are about two lines in length, slightly curved, with five longitudinal ridges, which are of a light yellowish color, while the intervening spaces are dark brown. "About 4 or 5 Mm. long, oblong, laterally compressed, usually separated into the two mericarps, which are curved, tapering toward each end, dark brown, with five yellowish, filiform ribs, and with six oil-tubes; seed plane upon the face, nearly equilaterally pentagonal in transverse section; odor and taste agreeably aromatic; ash not more than 8 percent." *U. S.* "When incinerated the Fruit should not yield more than 8 per cent. of ash." *Br.* They have an agreeable aromatic odor, and a sweetish, warm, spicy taste. These properties depend on an essential oil, which they afford largely by distillation. (See *Oleum Cari.*) The residue is insipid. They yield their virtues readily to alcohol and more slowly to water.

"Drawn caraway seeds," a term applied to such as have been recovered from the still residue after obtaining the volatile oil, are used to adulterate caraway; the exhausted "seeds" are much darker in color than are the genuine. (*P. J.,* 1896, 150.)

Uses.—Caraway is a pleasant stomachic and carminative, occasionally used in *flatulent colic,* and as an adjuvant or corrective of other medicines. The dose in substance is from 15 to 30 grains (1 to 2 Gm.). An infusion may be prepared by adding two drachms of the seeds to a pint of boiling water. The volatile oil, however, is most employed. (See *Oleum Cari.*) Three and a half ounces of the oil of caraway caused violent vomiting and abdominal pain, with loss of consciousness, ending, however, in recovery. The urine contained both acetone and albumin. (*Cb. I. M.,* xxii. 1902.) In culinary operations the seeds are added to cakes, to which they communicate an agreeable flavor, while they stimulate the digestive organs.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Aqua Carui, *Br.;* Confectio Piperis, *Br.;* Pulvis Opii Compositus, *Br.;* Tinctura Cardamomi Composita, *U. S., Br.;* Tinctura Sennæ Composita, *Br.*

CARYOPHYLLUS. U. S. (Br.)

CLOVES

(căr-ĭ-o-phĭl′lŭs)

"The dried flower buds of *Eugenia aromatica* (Linné) O. Kuntze (Fam. *Myrtaceæ*)." *U. S.* "The dried flower-buds of Eugenia caryophyllata, *Thunb.*" *Br.*

Caryophyllum, *Br.;* Caryophylli Aromatici; Girofle, *Fr. Cod.;* Gérofle, Clous Aromatiques, Clous de Girofle, *Fr.;* Caryophylli, *P. G.;* Gewürznelken, Nägelein, *G.;* Garofani, *It.;* Clavo de especia, *Sp.;* Cravo da India, *Portug.;* Kruidnagel, *Dutch;* Kerunfel, *Arab.*

Eugenia aromatica (L.), O. Kuntze; *E. caryophyllata*, Willd., *Sp. Plant.* ii. 965; *B. & T.* 112.—*Caryophyllus aromaticus*, L., *Sp. Plant.*, 735; De Cand., *Prodrom.*, iii. 262; Carson, *Illust. of Med. Bot.*, i. 43, pl. 37.—This small tree is one of the most elegant of those inhabiting the islands of India. It has a pyramidal form, is always green, and is adorned throughout the year with a succession of beautiful rosy flowers. The stem is of hard wood, and covered with a smooth, grayish bark. The leaves are about four inches in length by two in breadth, obovate-oblong, acuminate at both ends, entire, sinuated, with many parallel veins on each side of the midrib, supported on long footstalks, and opposite. They have a firm consistence and a shining green color, and when bruised are highly fragrant. The flowers are disposed in terminal corymbose panicles, and exhale a strong, penetrating, and grateful odor.

The natural geographical range of the clove is extremely limited, being confined to the Molucca or, as they were one time called, Clove Islands. According to Flückiger, cloves were known in Western Europe as early as the sixth century, long before the discovery of the Moluccas by the Portuguese. After the conquest of the Molucca Islands by the Dutch, the monopolizing policy of that commercial people led them to extirpate the trees in nearly all the islands except Amboyna and Ternate, which were under their immediate inspection. Notwithstanding their jealous vigilance, a French governor of the Isles of France and Bourbon, named Poivre, succeeded, in the year 1770, in obtaining plants from the Moluccas and introducing them into the colonies under his control. Five years afterwards the clove-tree was introduced into Cayenne and the West Indies, in 1803 into Sumatra, and in 1818 into Zanzibar. At present the spice is cultivated both in the West and East Indies, in tropical Africa, and in Brazil.

The unexpanded flower buds are the part of the plant employed under the ordinary name of cloves.[1] They are first gathered when the tree is about six years old. The fruit has similar aromatic properties, but much weaker. The buds are at first white, then become green, and then bright red, when they must be at once collected, which is done by hand picking, or by beating the trees with bamboos and catching the falling buds. In the Moluccas they are said to be sometimes immersed in boiling water and afterwards exposed to smoke and artificial heat before being spread out in the sun. In Zanzibar, Cayenne, and the West Indies they are dried simply by solar heat.

Although it is stated that as early as 266 B. C., during the reign of the Han dynasty, the Chinese court officers were accustomed to hold cloves in their mouths before addressing the sovereign, that their breath might have an agreeable odor, the spice seems to have been first introduced into Europe in the fourth century, and became a great source of wealth to the enterprising merchants of mediæval Venice, who obtained it from the Arabians. After the discovery of the southern passage to India, the trade in this spice passed into the hands of the Portuguese, but was subsequently wrested from them by the Dutch, by whom it was long monopolized. The United States derive much of their supply from the West Indies and Guiana; but the great sources of cloves have been recently the islands of Zanzibar and Pemba, on the east coast of Africa. In 1872 the clove orchards in Zanzibar were nearly destroyed by a hurricane, but they have been replanted.[2] In commerce the varieties of cloves are known by the names of the localities of their growth, and so closely resemble one another as to be distinguished only by experts. The *Penang cloves* have been especially esteemed. The *Bencoolen cloves* from Sumatra are by many druggists deemed equal to them. The Amboyna and Molucca cloves are stated to be thicker, darker, heavier, more oily, and more highly aromatic than those cultivated elsewhere. Formerly cloves were frequently adulterated, but the comparatively low price of later times has discouraged this fraud. (See Kraemer, *Proc. A. Ph. A.*, 1894, 159.)

Properties.—Cloves resemble in shape a nail with a round head with four spreading points beneath it. "About 15 Mm. long, brownish-black, consisting of a stem-like, solid calyx-tube, obscurely four-angled and granular roughened, terminated by four teeth, and surmounted by a globular head, consisting of four petals, which cover numerous curved stamens and one style; odor strongly aromatic; taste pungent and aromatic, followed by slight numbness. Cloves should not float in a horizontal position on water. The powder contains few or no starch grains or stone cells. Ash not more than 8 percent." *U. S.* "Incinerated they should not yield more than 7 per cent. of ash." *Br.* Their color is externally deep brown, internally reddish; their odor strong and fragrant; their taste hot, pungent, aromatic, and very permanent. The best cloves are large, heavy, brittle, and exude a small quantity of oil on being pressed or scraped with the nail. When light, soft, wrinkled, pale, and of feeble taste and odor, they are inferior. Those from which the essential oil has been distilled are sometimes fraudulently mixed with the genuine. In powdered cloves this fraud appears to be extensively practised, and its detection is almost impossible.

Trommsdorf obtained from 1000 parts of cloves 180 of volatile oil, 170 of a peculiar tannin, 130 of gum, 60 of resin, 280 of vegetable

[1] The stems of the flowers also enter commerce. They possess the odor and taste of the cloves, and, as they are worth only about one-fifth the price of the cloves and are said nearly to equal them in strength, they are largely used in the manufacture of ground cloves as well as of oil of cloves. In France they are generally known by the name of *griffes de girofle*.

[2] For detailed information as to method of growth, see *P. J.*, June, 1890.

fibre, and 180 of water. Wm. L. Peabody (1895) found the percentage of tannin in cloves to range from 10 to 13 per cent., and that it has the same chemical composition as gallotannic acid. Lodibert afterwards discovered a fixed oil, aromatic and of a green color, and a white resinous substance which crystallizes in fasciculi composed of very fine diverging silky needles, without taste or odor, soluble in ether and boiling alcohol, and exhibiting neither alkaline nor acid reaction. This substance, called by Bonastre *caryophyllin,* was found in the cloves of the Moluccas, of Bourbon, and of Barbados, but not in those of Cayenne, from which, however, it has since been procured. To obtain it, the ethereal extract of cloves is treated with water, and the white substance thrown down is separated by filtration, and treated repeatedly with ammonia to deprive it of impurities. The most recent determination of its formula by Mylius (*Ber. d. Chem. Ges.,* 1873, p. 1053) makes it $C_{20}H_{32}O_2$. Theod. Martius obtains it cheaply by exposing cloves, previously deprived as far as possible of oil by distillation with water, to distillation at a higher temperature, redistilling the brown liquid obtained until the distillate nearly ceases to have the taste or odor of cloves, and then purifying the residue by washing with water, and treating it with boiling alcohol and animal charcoal repeatedly, until the caryophyllin, which is deposited by the alcohol on cooling, is perfectly white. (See *A. J. P.,* xxxii. 65.) Dumas has discovered another crystalline principle, which forms in the water distilled from cloves, and is gradually deposited. Like caryophyllin, it is soluble in alcohol and ether, but differs from that substance in becoming red when touched with nitric acid. Bonastre proposed for it the name of *eugenin.* (*J. P. C.,* xx. 565.) It has the formula $C_{10}H_{12}O_2$, and is isomeric with eugenol or eugenic acid, a constituent of oil of cloves. Water extracts the odor of cloves with comparatively little of their taste. All their sensible properties are imparted to alcohol; and the tincture when evaporated leaves an excessively fiery extract, which becomes insipid if deprived of the oil by distillation with water, while the oil which comes over is mild. Hence it has been inferred that the pungency of this aromatic depends on a union of the essential oil with the resin. *Caryophyllic acid,* $C_{20}H_{32}O_6$, is obtained by gradually adding caryophyllin to fuming nitric acid, kept cool by immersing the vessel in water until crystals begin to separate; these are purified by dissolving them in ammonia, precipitating with hydrochloric acid, and redissolving in alcohol and crystallizing. For an account of the oil, see *Oleum Caryophylli.* The infusion and oil of cloves are reddened by nitric acid, and rendered blue by tincture of ferric chloride, facts of some interest, as morphine gives the same reactions.

Uses.—Cloves are among the most stimulant of the aromatics, but, like others of this class, act less upon the system at large than on the part to which they are immediately applied. They are sometimes administered in substance or infusion to relieve *nausea* and *vomiting,* correct *flatulence,* and excite *languid digestion;* but their chief use is to assist or modify the action of other medicines. They enter into several official preparations.

The French Codex directs a *tincture of cloves* to be prepared by digesting for ten days, and afterwards filtering, a mixture of three ounces of powdered cloves and sixteen of 80 per cent. alcohol.

Dose, in substance, from five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Infusum Aurantii Compositum, *Br.;* Infusum Caryophylli, *Br.;* Pulvis Cretæ Aromaticus, *Br.;* Tinctura Lavandulæ Composita, *U. S.;* Tinctura Rhei Aromatica, *U. S.;* Vinum Opii, *U. S.*

CASCARILLA. Br.

CASCARILLA

(kăs-ca-rĭl'la)

"The dried bark of Croton Eluteria, *J. J. Bennett.*" *Br.*

Cascarillæ Cortex, Br. (1885), Cascarilla Bark, Sweetwood Bark; Cascarille officinale, *Fr. Cod.;* Cortex Eluteriæ, Cortex Thuris; Chacrille, Ecorce éleuthérienne, Cascarille, *Fr.;* Cortex Cascarillæ, *P. G.;* Cascarillrinde, Cascarilla, Kaskarillrinde, *G.;* Cascarilla, Cascarigila, *It.;* Chacarilla, Quina aromatica, *Sp.*

There has been much confusion in relation to the different species of Croton growing in the West Indies, and as to which of them the Cascarilla of commerce is to be ascribed. At present, however, it is generally admitted that this bark,[1] which is brought exclusively from the Bahama Islands, is the product of *Croton Eluteria;* and, though it is probable that the proper *C. Cascarilla* may at one time have yielded a portion of its bark to commerce, at present little or none is derived from that species. The London College committed the error, which it afterwards corrected, of recognizing *C. Cascarilla* of Don as the source of it. This botanist mistook the *Copalchi bark* of Mexico, which is produced by *Croton Pseudochina* of Schiede, and somewhat resembles cascarilla, for the genuine bark, and hence proposed to transfer the specific name of Cascarilla to the Mexican plant.[2]

[1] Under the name of "cascarilla," also "*Quina morada,*" the bark of the *Pogonopus febrifugus* is said to be used in the Argentine Republic as a substitute for the true cinchona bark. There has been separated from it a blue fluorescent substance, *moradin,* and an alkaloid, *moradeine.* (*P. J.,* xx. 854.)

[2] *Copalchi bark* has been mistaken not only for cascarilla, but also for a variety of cinchona. Portions of it, having been taken to Europe, attracted the attention both of pharmacologists and physicians. Two kinds were noticed: one, in small slender quills, of an ash color, bearing some resemblance to a variety of pale cinchona, but having the flavor of cascarilla, and burning with a similar odor; the other in larger

Croton Eluteria, Bennett, *Journ. of the Linn. Soc.,* iv. 29; Daniell, *P. J.,* 2d ser., iv. 145, figured at p. 150; *B. & T.* 238.—*Clutia Eluteria,* Woodv., *Med. Bot.,* 3d ed., iv. 633, t. 223. As described by W. F. Daniell, who resided in the Bahama Islands, this, though commonly a shrub from three to five feet high, sometimes appears in the form of a small tree with a stem from four to eight inches in diameter.[2] The stem is straight, and marked at intervals with white or grayish stains. The leaves are petiolate, from two to three inches in length by an inch or more in breadth, often somewhat cordate at the base, obtusely acuminate, pale or grayish green above, and densely covered beneath with shining silvery scales, appearing white at a distance. They are smaller and narrower in the plants of arborescent growth. The flowers, which have a delicious odor, are monœcious, small, white, petiolate, and closely set in simple terminal or axillary spikes. The shrub is a native of the Bahamas, scarce at present in the island of New Providence, but still abundant in Andros, Long, and Eleutheria islands, from the latter of which is derived its botanical title. Daniell calls the plant *sweet-wood.* The name of *sea-side balsam* belongs to another species, *C. balsamiferum* of Linnæus, which grows in the Bahamas and other West India islands, and owes its name to the exudation of a balsamic juice from its young branches when wounded.

Croton Cascarilla, Bennett, *Journ. of the Linn. Soc.,* iv. 30—*Clutia Cascarilla,* Linn., *Sp. Plant.,* ed. 1, 1042.—*Ricinoides elæagnifolia,* Catesby, *Hist. Carolin.,* ii. t. 46.—As described by Daniell, this is a shrub of from four to six feet, much branched, with a pale grayish-green stem, without the white stains of the former species. The leaves are petiolate, long, narrow, lanceolate, tapering towards each end, pointed, with flat or somewhat undular margins, above smooth and green, beneath pale and very hairy. The flowers are monœcious, in simple terminal spikes, with small white petals tinged with yellow. They are very fragrant. The plant is a native of the Bahamas, and is said also to grow in Hayti. In the Bahamas it is much scarcer than formerly, and is said by Daniell to yield at present none of the cascarilla of commerce, although much was formerly derived from it. This species seems to have been confounded by some with *Croton lineare* of Jacquin, which grows in the Bahamas and most of the West India islands, where it is known by the name of *wild rosemary,* owing probably in part to its fragrant odor, but still more to its narrow linear leaves with reflected margins.

Cascarilla is brought to this market from the West Indies, and chiefly, as we have been informed, from the Bahamas. It comes in bags or casks. We have observed it in commerce in two forms, so distinct as to merit the titles of varieties. In one, the bark is in rolled pieces of every size, from three or four inches in length and half an inch in diameter to the smallest fragments, covered externally with a dull whitish or grayish-white epidermis, which in many portions is partially, sometimes wholly removed, leaving a dark brown surface, while the inner surface has a chocolate color, and the fracture is a reddish brown. The small pieces are sometimes curled, but have a distinct abrupt edge as if broken from the branches. The second variety consists entirely of very small pieces, not more than an inch or two in length, very thin, without the white epidermis, not regularly quilled, but curved more or less in the direction of their length, often having a small portion of woody fibre attached to their inner surface, and appearing precisely as if shaved by a knife from the stem or branches. Whether these two varieties are derived from distinct species, or differ only because of the mode of collection, it is difficult to determine. A. W. Southall describes a bark (believed to belong to the genus Croton, and obtained from Colombia) in *P. J.,* 1894, 574. "In quills or curved pieces about 2 Mm. thick, having a grayish, somewhat fissured, easily detached, corky layer, more or less coated with a white lichen, the uncoated surface being dull brown, and the inner surface smooth. It breaks with a short fracture, having a resinous and radially striate appearance. When burned, it emits a strong, aromatic, somewhat musk-like odor; its taste is warm and very bitter." *U. S.* 1890. "Fracture short, and resinous; the transverse section exhibits under a lens dark reddish-brown bast traversed by thin whitish medullary rays, but no groups of sclerenchymatous cells." *Br.*

Properties.—Cascarilla has an aromatic odor, rendered much more distinct by friction, and a warm, spicy, bitter taste. It is brittle, break-

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quills, with a thick cork-like epidermis, very bitter, and yielding an aromatic odor when burnt. The former is the product of *Croton Pseudochina,* Schlechtendal, *C. niveus,* Jacquin; the latter is of unknown origin, but conjecturally referred to *C. suberosus.* J. E. Howard states that the quilled copalchi bark contains a bitter alkaloid, soluble in ether, and precipitable as a white hydroxide from its acid solution. (*P. J.,* xiv. 319.) Copalchi bark is an aromatic tonic, employed in Mexico in intermittents, and capable of useful application in all cases requiring a mild aromatic bitter. Stark has employed it advantageously in feeble states of digestion with irritable bowels, and found it in one or two cases, to exhibit antiperiodic properties. It may be given in infusion, made with half an ounce of the bark to a pint of water, in the dose of one or two fluidounces three times a day. (*Ed. Med. and Surg. Journ.,* April, 1849, p. 410; see also *P. J.,* 1886, p. 917.)

[2] The plant referred to in very early editions of this work as having been seen by Wright in Jamaica, and called by him *C. Eluteria,* is, according to Bennett, a distinct species, *C. Sloanei,* which was confounded by Linnæus with the genuine cascarilla plant, under the name of *Clutia Eluteria.* The genuine plant was first described by him in his *Hortus Cliffortianus* (pp. 486-7), from a specimen in Clifford's herbarium in the British Museum, and afterwards apparently confused with a Jamaica specimen sent to him by Patrick Brown, from the latter of which the description of his *Clutia Eluteria* was drawn up, which is quite inapplicable to the original plant. It is the *C. Sloanei* also that was described by Schwartz in his *Flora Indiæ Occidentalis* (p. 1183), under the name of *Croton Eluteria,* and probably the same that was figured by Carson in his *Illust. of Med. Bot.,* ii. 34, pl. 78. (See *P. J.,* 1859, pp. 132-3.)

ing with a short fracture. When burned it emits a pleasant odor, closely resembling that of musk, but weaker and more agreeable. This property serves to distinguish it from other barks. It was analyzed by Trommsdorff, and more recently by Duval of Lisieux, in France. The constituents found by the latter were albumen, a peculiar kind of tannin, a bitter crystallizable principle called *cascarillin,* a red coloring matter, fatty matter of a nauseous odor, wax, gum, volatile oil, resin, starch, pectic acid, potassium chloride, a salt of calcium, and lignin. The oil, according to Trommsdorff, constitutes 1.6 per cent., is of a greenish-yellow color, has a penetrating odor analogous to that of the bark, and is of the sp. gr. 0.938. G. Feudler (*A. Pharm.,* 1900, p. 671) finds the oil to contain about 2 per cent. of free acid, which consists of a liquid acid, $C_{11}H_{20}O_2$, to which the name of *cascarillic acid* was given, and a solid portion made up of a mixture of palmitic and stearic acids. The oil contains 0.3 per cent. of *eugenol,* a terpene differing from pinene, *cymene,* possibly some *l-limonene,* two sesquiterpenes and an alcohol, $C_{15}H_{23}OH$. To obtain cascarillin, Duval treated the powdered bark with water, added lead acetate to the solution, separated the lead by hydrogen sulphide, filtered, evaporated with the addition of animal charcoal, filtered again, evaporated at a low temperature to a syrupy consistence, and, having allowed the semi-liquid substance thus obtained to harden by cooling, purified it by twice successively treating it, first with a little cool alcohol, to separate the coloring and fatty matters, and afterwards with boiling alcohol and animal charcoal. The last alcoholic solution was allowed to evaporate spontaneously. Thus obtained, cascarillin is white, crystalline, inodorous, bitter, very slightly soluble in water, soluble in alcohol and ether. (*J. P. C.,* 3e sér., vii. 96.) It melts at 205° C. (401° F.), is not volatile nor a glucoside. Its composition answers to the formula $C_{12}H_{18}O_4$. P. E. Alessandri regards *cascarilline* as an alkaloid, and obtains it economically by mixing powdered cascarilla with sufficient 3 per cent. aqueous solution of oxalic acid to cover it, shaking the mixture, and heating it to 140° F., then allowing it to cool, expressing the mixture and saturating the filtered liquor with ammonia, then evaporating at a low temperature to two-thirds of its bulk, allowing it to cool, and separating any deposit. The clear liquid is then shaken with ether; this takes up the cascarilline, which may be obtained through evaporation of the ethereal liquid. (*L'Orosi,* v. 1; *P. J.,* 1882, 993.) R. A. Cripps was unable to obtain the alkaloid by Alessandri's method, and suggests that the bitterness of the so-called cascarilline might be due to adherent resin. (*P. J.,* 1886, 1103.) Either alcohol or water will partially extract the active matters of cascarilla; but diluted alcohol is the proper menstruum. Naylor and Littlefield have reviewed the processes of Duval and Alessandri for preparing cascarilline, and find that Duval's method gives the purer product. They find its melting point to be 203.5° C., and give it the formula $C_{16}H_{24}O_5$. (*Y. B. P.,* 1896, 301.) W. A. H. Naylor subsequently found *betaine* in cascarilla. (*P. J.,* 1898, 279.)

Uses.—This bark is aromatic and tonic. It was known in Germany so early as the year 1690, and was much used as a substitute for Peruvian bark by those who were prejudiced against that febrifuge in the treatment of *remittent* and *intermittent fevers.* It has, however, lost its reputation, and is now employed only where a pleasant and gently stimulant tonic is desirable, as in *atonic dyspepsia,* and other cases of debility of the stomach or bowels, especially in combination with the more powerful bitters. It may be given in powder or in infusion. Procter published a formula for a fluidextract which contains the virtues of a troyounce of the bark in a fluidounce. (*A. J. P.,* 1863, p. 113.) In consequence of its pleasant odor when burned, some smokers mix it in a small quantity with their tobacco; but it is said to occasion vertigo and intoxication.

Dose, twenty to thirty grains (1.3 to 2.0 Gm.).

Off. Prep.—Infusum Cascarillæ, *Br.;* Tinctura Cascarillæ, *Br.*

CASSIA FISTULA. U. S. (Br.)

CASSIA FISTULA [Purging Cassia]

(cās'sī-ą fīs'tū-lą)

"The dried fruit of *Cassia Fistula* Linné (Fam. *Leguminosæ*)." *U. S.* "The pulp obtained from the pods of Cassia Fistula, *Linn.*" *Br.*

Cassiæ Pulpa, *Br.;* Cassia Pulp, Pudding-stick (or pipe); Fructus Cassiæ Fistulæ; Casse Officinale, *Fr. Cod.;* Casse en bâtons, Pulpe de Casse, Casse Mondée, Casse, *Fr.;* Röhrenkassie, Purgircassie, Fistelkassie, *G.;* Cassia, *It.;* Cana fistula, *Sp.*

The tree which yields the purging cassia is ranked by some botanists as a distinct genus, separated from the Cassia, and denominated *Cathartocarpus.* (See *Lindley's Flor. Med.,* 262.)

Cassia Fistula, Willd., *Sp. Plant.* ii. 518; Carson, *Illust. of Med. Bot.* i. 24, pl. 26; *B. & T.* 87.—*Cathartocarpus Fistula,* Persoon, *Synops.* i. 459.—This is a large tree, rising to the height of forty or fifty feet, with a trunk of hard, heavy wood, dividing towards the top into numerous spreading branches, and covered with a smooth ash-colored bark. The leaves are commonly composed of five or six pairs of opposite leaflets, which are ovate, pointed, undulated, smooth, of a pale green color, from three to five inches long, and supported upon short petioles. The flowers are large, of a golden yellow color, and arranged in long, pendent, axillary racemes. The fruit consists of long, cylindrical, woody, dark-brown, pendulous pods, which when agitated by the wind strike against each other and produce a

sound that may be heard at a distance. This species of Cassia is a native of Upper Egypt and India, whence it is generally supposed to have been transplanted to other parts of the world. It is at present very extensively diffused through the tropical regions of the old and new continents, being found in Insular and Continental India, Cochin-China, Egypt, Nubia, the West Indies, and the warmer parts of the continent of America. Under the name of *Golden Shower* it is known as an ornamental shade tree in all tropical countries. The fruit is the official part of the plant. It is imported from the East and West Indies, chiefly the latter, and from South America.

Properties.—Cassia pods are a foot or more in length, straight, or but slightly curved, cylindrical, less than an inch in diameter, with a woody shell, externally of a dark-brown color, and marked with three longitudinal shining bands, extending from one end to the other, two of which are in close proximity, appearing to constitute a single band, and the third is on the opposite side of the pod. These bands mark the place of junction of the valves of the legume, and are represented as sometimes excavated in the form of furrows. There are also circular depressions at unequal distances. The official description is as follows. "Cylindrical, 25 to 50 Cm. long, about 20 Mm. in diameter, chestnut-brown in color, on one side a longitudinal groove and on the other a smooth line or slight ridge, indicating the two sutures; indehiscent, the cavity divided transversely into numerous compartments, each containing a reddish-brown, glossy, flattish-ovoid seed embedded in a blackish-brown pulp; with an odor resembling that of prunes, and a mawkish sweet taste." *U. S.* The pods brought from the East Indies are smaller, smoother, have a blacker pulp, and are more esteemed than those from the West Indies. We have seen pods in the American market sold as cassia pods, which were an inch and a half in diameter, flattened on the sides, exceedingly rough on the outer surface, and marked by three longitudinal very elevated ridges, corresponding to the bands or furrows of the common cassia. The pulp was rather nauseous, but in other respects seemed to have the properties of the official purging cassia. They corresponded exactly with a specimen of the fruit of *Cassia brasiliana*, Lam., brought from the West Indies, and were probably derived from that plant.

The heaviest pods, and those which do not make a rattling noise when shaken, are to be preferred, as they contain a larger portion of the pulp, which is the part employed. This should be black and shining and have a sweet taste. It is apt to become sour if long exposed to the air, or mouldy if kept in a damp place. The pulp is extracted from the pods by first bruising them, then boiling them in water, and afterwards evaporating the decoction; or, when the pods are fresh, by opening them at the sutures and removing the pulp with a spatula.

Cassia pulp has a slight odor, and a sweet mucilaginous taste. According to Henry it contains sugar, gum, coloring matter, and a tannin-like substance; while Haensel obtained from it by steam distillation a dark yellow volatile oil, also butyric acid. (*Ph. Cb.*, 41.)

Uses.—Cassia pulp is laxative, and may be advantageously given in small doses in cases of *habitual costiveness*. In quantities sufficient to purge, it occasions nausea, flatulence, and griping. In this country it is rarely prescribed, except as an ingredient in the official confection of senna, which is a pleasant and useful laxative preparation.

Dose, of the pulp as a laxative, one or two drachms (3.9 or 7.7 Gm.), as a purge one or two ounces (31 or 62 Gm.).

Off. Prep.—Confectio Sennæ, *U. S.*, *Br.*

CATAPLASMA KAOLINI. U. S.

CATAPLASM OF KAOLIN

(căt-ą-plăs'mą kā-ǫ-lī'nī)

Cataplasme de terre à porcelaine, *Fr.*; Porzellanthonumschlag, *G.*

℞ "Kaolin, in very fine powder, *five hundred and seventy-seven grammes* [or 20 ounces av., 154 grains]; Boric Acid, in very fine powder, *forty-five gramme* [or 1 ounce av., 257 grains]; Thymol, *one-half gramme* [or 8 grains]; Methyl Salicylate, *two grammes* [or 31 grains]; Oil of Peppermint, *one-half gramme* [or 8 grains]; Glycerin, *three hundred and seventy-five grammes* [or 13 ounces av., 99 grains]; to make about *one thousand grammes* [or 35 ounces av., 120 grains].

Heat the Kaolin in a suitable vessel at 100° C. (212° F.), with occasional stirring for one hour; mix it intimately with the Boric Acid, and then incorporate the mixture thoroughly with the Glycerin; finally add the Thymol, which has been dissolved in the Methyl Salicylate and the Oil of Peppermint, and make a homogeneous mass. It should be kept in an air-tight container." *U. S.* This cataplasm was introduced into the U. S. Pharmacopœia (8th Rev.), to supply the demand for an antiseptic poultice; the kaolin should be carefully sifted before using and the usefulness of the preparation will largely depend upon the thoroughness with which the ingredients are mixed. Kaolin varies somewhat in its absorptive properties and the quantity of glycerin, directed in the official formula, will be found slightly insufficient for some kinds of kaolin found in commerce. Cataplasm of kaolin is a grayish paste of soft consistence having the aromatic odor of the antiseptic used in the process. It is very important to keep it closely covered at all times, as the glycerin which is present has the tendency to absorb moisture from the atmosphere and impair the usefulness of the cataplasm.

Uses.—Cataplasm of kaolin may be applied warm in local inflammations in which a poultice is useful. It has been highly lauded in *pneumonia,* but it is doubtful if it has any advantage, aside from ease of application, over the flaxseed poultice.

CERA ALBA. U. S., Br.

WHITE WAX

(cē′rạ ăl′bạ)

"Yellow Wax, bleached." *U. S.* "Yellow Beeswax which has been bleached by exposure to moisture, air and light." *Br.*

White Beeswax; Cire Blanche, *Fr. Cod.;* Cera alba, *P. G.;* Weisses Wachs, *G.;* Cera bianca, *It.;* Cera blanca, *Sp.*

CERA FLAVA. U. S., Br.

YELLOW WAX

(cē′rạ flā′vạ)

"A solid substance prepared from the honeycomb of the bee, *Apis mellifera* Linné." *U. S.* "Prepared from the honeycomb of the Hive Bee, Apis mellifica, *Linn.*" *Br.*

Cera Citrina; Beeswax; Cire Jaune, Cire d'Abeilles, *Fr.;* Cera Flava, *P. G.;* Gelbes Wachs, *G.;* Cera gialla, Cera vergine, *It.;* Cera amarilla, *Sp.*

The name Apis mellifera was given to the honey-bee by Linnæus in 1758, *Systema Naturæ,* 10th edition; subsequently (*Ibid.,* 12th edition, 1767), Linnæus changed the name to mellifica, but according to the established rules of scientific nomenclature the first name must hold, and the revisers of the United States Pharmacopœia were therefore correct in adopting it. It was at one time doubtful whether the wax which constitutes the walls of the honeycomb is elaborated or merely gathered by the insect. Huber, however, by feeding bees exclusively on honey and water, determined that under these circumstances wax is produced in the form of scales under the rings of the abdomen. But wax also exists in plants, bearing in this, as in other respects, a close analogy to the fixed oils.[1]

1. Cera Flava, or *Yellow Wax.*—This is obtained by slicing the comb taken from the hive, draining and afterwards expressing the honey, and melting the residue in boiling water, which is kept hot for some time in order to allow the impurities to separate and either subside or be dissolved by the water. When the liquid cools the wax concretes, and, having been removed and again melted in boiling water, is strained and poured into pans or other suitable vessels. The labor saving device is sometimes adopted of stretching a strainer of cheese cloth upon a hoop and wedging the latter down into the hot mixture below the level of the water; as this cools, the melted wax slowly rises through the cloth, and thus a perfectly clean cake of wax is formed on top on cooling. It is usually brought to market in round flat cakes of considerable thickness. The druggists of Philadelphia are supplied chiefly from the Western States and North Carolina, especially the latter, and from Cuba and California.

Properties.—Yellow wax is "a yellowish to brownish-yellow solid, having an agreeable, honey-like odor, and a faint balsamic taste. Specific gravity: 0.951 to 0.960 at 25° C. (77° F.).[2] Melting point: 62° to 64° C.

[1] Besides the official species other bees are used as honey makers. The extremely vicious, blackish-brown *Apis fasciata* was kept by the ancient Egyptians on floating apiaries, which as the season progressed slowly drifted down the Nile, following the successive opening of the flowers. In Senegal, *Apis adansonii,* and in Southern Africa *Apis caffra* and *Apis scutellata* produce honey; while the *Apis unicolor* of Madagascar has been domesticated in that island and introduced into other parts of the world. In India honey is made in large quantities by *Apis dorsata* (the largest of known bees) (*Apis indica, Apis florea*). *India Wax* differs from official wax chiefly in its lower acid value. A wax is also produced in India by the so-called *Kota bees,* belonging to the genus Melipona; they are minute stingless insects, which furnish a sticky, dark-colored wax, resembling in physical and chemical characteristics the propolis of the honey bee rather than the true wax.

China wax, called *pe-la* by the *Chinese,* resembles spermaceti in whiteness and crystalline appearance, but is distinguished by greater hardness and friability and a somewhat fibrous fracture. It melts at about 83° C. (181° F.), is very slightly soluble in alcohol or ether, is insoluble in cold oil of turpentine and rectified petroleum, but is dissolved with the aid of heat, and is very soluble in benzene. These solubilities distinguish it from spermaceti. (*P. J.,* xiv. 9.) It was formerly supposed to be of vegetable origin, but has been ascertained to be the product of an insect *Coccus cerifcrus* deposited on the twigs of the Chinese Ash, *Fraxinus Chinensis* (Roxburgh), and, investing them closely, becomes embedded in a waxy material, which is scraped off with the insects, and constitutes the crude wax. It is purified by melting and straining. (Hanbury, *P. J.,* xii. 476.) T. T. Cooper, in his "Travels of a Pioneer" in China, gives some interesting statements as to the production of this wax, which are the result of his own personal observations. It is chiefly the province of S'zchuan which is the seat of this industry, the cultivation of the China wax being a source of great wealth to this province, second only in importance to the silk culture. The "wax trees" are all cut down at the height of 8 feet, leaving no branches, the trunks being about as thick as a man's thigh, and sending forth shoots in the spring. The insects are cultivated in a different province, that of Yunnan, whence vast quantities of the eggs are sent annually to S'zchaun, where they are received in little balls of the size of a pea. These are suspended, enclosed in young leaves, to the shoots of the tree in March. In about two months the larvæ appear, and, feeding on the leaves, soon attain the size of small butterflies, and spread themselves in immense numbers over the branches, which are whitened by them so as to seem covered with feathery snow. The grub, as it advances to the chrysalis form, buries itself in a white secretion by which all the branches are coated an inch in thickness. These are then cut off near the stem and divided into small pieces, which are tied in bundles and put into large caldrons, where they are boiled in water till all the wax melts and rises to the surface. It is then skimmed off and run into moulds, where it hardens. In this form it is sold over the Empire, where it is used for candles and as medicine. (*P. J.,* 1872; also vol. xv., 1885.)

[2] Dieterich has modified Hager's method of taking the specific gravity of wax, as follows: A piece of wax is heated on the edge of a colorless flame, so that drops of melted wax may fall into alcohol placed in a saucer. Having thus obtained about a dozen wax-

(143.6° to 147.2° F.). It is somewhat brittle when cold, and when broken presents a dull, granular, not crystalline fracture. By the heat of the hand it becomes plastic. Yellow Wax is insoluble in water, sparingly soluble in cold alcohol; boiling alcohol dissolves the cerotic acid and a portion of the myricin. It is completely soluble in ether, chloroform, and in fixed and volatile oils; partially soluble in cold benzene or carbon disulphide, and completely soluble in these liquids at a temperature of 25° to 30° C. (77° to 86° F.). If 1 Gm. of Yellow Wax be boiled for half an hour with 35 Cc. of an aqueous solution of sodium hydroxide (1 in 7), the volume being preserved by the occasional addition of water, the Wax should separate on cooling without rendering the liquid opaque, and no precipitate should be produced in the liquid, after filtration through glass-wool or asbestos, on the addition of hydrochloric acid (absence of *fats* or *fatty acids, Japan wax,* or *rosin*). Hydrochloric acid should produce no precipitate in water which has been boiled with a portion of the Wax (absence of *soap*). If 5 Gm. of Yellow Wax be heated in a flask to 160° C. (320° F.), for fifteen minutes, with 25 Cc. of sulphuric acid, and the mixture then poured into a large excess of water, no notable amount of solid substance which cannot be decomposed by sulphuric acid on further treatment, should separate (absence of *paraffin* or *ceresin*). Yellow Wax saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 90 to 96 (see PART III, Test No. 99)." *U. S.* The British Pharm. states that yellow wax should be "firm, breaking with a granular fracture, yellowish, having an agreeable honey-like odor. Not unctuous to the touch. It should be readily and entirely soluble in hot *oil of turpentine.* It should not yield more than 3 per cent. to cold *alcohol* (90 per cent.), nor more than 50 per cent. to cold *ether,* and nothing to *water* or to boiling *solution of sodium hydroxide,* the two latter liquids after filtration neither being turbid nor yielding a precipitate on the addition of *hydrochloric acid* (absence of fatty acids, resin, and Japan wax). Specific gravity 0.960 to 0.970. Melts at 144.5° to 147° F. (62.5° to 63.9° C.) when tested in the following manner. Liquefy a small piece, and draw a little of the liquid Beeswax up into a capillary tube of not more than one millimetre in internal diameter; after it has been allowed to cool for three hours, fix a piece of the filled capillary tube to the bulb of a thermometer by a thread; immerse the bulb and tube in a beaker of water, and heat the latter gradually on a water-bath; at the moment the opaque rod of Beeswax becomes transparent, note the temperature. The solidifying point is two to three degrees lower than the melting point. 5 grammes of the Beeswax, melted in and mixed with boiling *alcohol* (90 per cent.), should require for neutralization not less than 1.6 cubic centimetres of *normal alcoholic volumetric solution of potassium hydroxide,* using *phenol-phthalein* as an indicator. Upon the further addition of 20 cubic centimetres of the volumetric solution, and well boiling for one hour under a reflux condenser, not less than 6.2 nor more than 6.8 cubic centimetres should be found to have combined with the Beeswax, as shown by the titration of the uncombined alkali with *volumetric solution of sulphuric acid.* If 5 grammes of Beeswax are heated for fifteen minutes with 25 grammes of *sulphuric acid* to 320° F. (160° C.) and the mixture diluted with *water,* no solid wax-like body should separate (absence of paraffin). Beeswax should not yield any characteristic reaction with the tests for starch." *Br.*

Various adulterations have been practised, most of which may be readily detected. Meal, earth, and other insoluble substances are at the same time discovered and separated by melting and straining the wax. When the fracture is smooth and shining instead of being granular, the presence of rosin may be suspected. This is dissolved by cold alcohol, while the wax is left untouched. Yellow wax is frequently adulterated with a mixture of paraffin and rosin; such wax is usually translucent on the edges. For other adulterating substances used, and the modes of detecting them, see the remarks which follow on white wax.

Yellow wax is used chiefly as an ingredient of plasters and cerates.

2. CERA ALBA, *Bleached Yellow Wax,* or *White Wax.*—The color of yellow wax is discharged by exposing it, with an extended surface, to the combined influence of air, light and moisture. The process of bleaching is carried on to a considerable extent in this country. The wax, previously melted, is made to fall in streams upon a revolving cylinder, kept constantly wet, upon which it concretes, forming thin ribbon-like layers. These, having been removed, are spread upon linen cloths stretched on frames and exposed to the air and light, care being taken to water and occasionally turn them. In a few days they are partially bleached; but, to deprive the wax completely of color, it is necessary to repeat the whole

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pearls, they are allowed to dry thoroughly by letting them remain on blotting paper for 24 hours. Eight portions of diluted alcohol are prepared, of the following specific gravities respectively: 0.960, 0.961, 0.962, 0.963, 0.964, 0.965, 0.966, 0.967, and the pearl is dropped into these liquids in turn. The specific gravity of the wax is of course the same as the specific gravity of that liquid in which the pearl remains floating indifferently in any part of the vessel. (See Remington's *Practice of Pharmacy,* page 78, *Lovi's beads.*) Dieterich examined hundreds of specimens annually, and found the wax to vary in sp. gr. from 0.963 to 0.966. He also determined the specific gravities of the following substances some of which are used to adulterate wax: white wax, 0.973; cera japonica, Japan wax, 0.975; ceresin, half white, 0.920; ozokerite, crude, 0.952; rosin, common, 1.108; cacao butter, 0.980 to 0.981; pure rosin, 1.045; beef suet, 0.952 to 0.953; yellow wax, 0.963 to 0.964; ceresin, white, 0.918; ceresin, yellow, 0.922; spermaceti, 0.960; French rosin, 1.104 to 1.105; paraffin, med. hard, 0.913 to 0.914; stearin. A No. 1, 0.971 to 0.972; mutton suet, 0.961. (*A. Pharm.,* 1882, p. 55.)

process once, if not oftener. When sufficiently white, it is melted and cast into small circular cakes.[1] Yellow wax may also be decolorized by treatment with animal charcoal or with potassium permanganate, potassium dichromate and sulphuric acid, and hydrogen peroxide. White wax sometimes contains one or more free fatty acids, consequent probably upon the employment of alkalies in bleaching it, which render it an unfit ingredient in the unctuous preparations of certain salts. It may be deprived of these acids by means of alcohol.

Perfectly pure wax is white, shining, diaphanous in thin layers, inodorous, insipid, harder and less unctuous to the touch than the yellow, soft and ductile at 35° C. (95° F.) and fusible at 65° C. (149° F.), retaining its fluidity at a lower temperature. The U. S. Pharmacopœia describes it as "a yellowish-white solid, somewhat translucent in thin layers, having a faint, characteristic odor, and nearly tasteless. Specific gravity: 0.950 to 0.960 at 25° C. (77° F.). Melting point: 64° to 65° C. (147.2° to 149° F.). In other respects White Wax has the characteristics of, and should respond to the reactions and tests given under, *Cera Flava.*" *U. S.*

By a great heat it is partly volatilized, partly decomposed; and, when flame is applied to its vapor, it takes fire and burns with a clear bright light. It is insoluble in water, and in cold alcohol or ether, but is slightly soluble in boiling alcohol and ether, which deposit it in a great measure upon cooling. The volatile and fixed oils dissolve it with facility, rosin readily unites with it by fusion, and soaps are formed by the action of sodium and potassium hydroxides. It is not affected by the acids at ordinary temperatures, but is converted into a black mass when boiled with concentrated sulphuric acid. Bleached wax contains, according to Lewy's analysis, 80.2 per cent. of carbon, 13.4 of hydrogen, and 6.4 of oxygen. It is a mixture of three different substances, which may be separated from one another by alcohol,—viz.: 1, *myricin,* insoluble in boiling alcohol, and consisting chiefly of myricyl palmitate ($C_{16}H_{31}O.OC_{30}H_{61}$),—that is, a compound of *palmitic acid,* $C_{16}H_{31}O.OH$, and *myricyl alcohol,* $C_{30}H_{61}OH$; 2, *cerotic acid,* $C_{27}H_{54}O_2$ (formerly called *cerin* when obtained only in an impure state), which is dissolved by boiling alcohol, but crystallizes out on cooling; 3, *cerolein,* which remains dissolved in the cold alcoholic liquid. This latter is probably a mixture of fatty acids, as indicated by its acid reaction. Schwalb (*Ann. Chem.,* 224, 225) found melissic acid and some unsaturated acids of the oleic series; also higher solid hydrocarbons of the saturated series, such as $C_{27}H_{56}$ and $C_{31}H_{64}$. Kebler states that the hydrocarbons in beeswax amount to from 12.72 to 13.78 per cent. (*A. J. P.,* 1893, 587.) T. Marie believes that cerotic acid, as ordinarily obtained, is a mixture of two distinct acids. He gives $C_{30}H_{60}O_2$ as the formula for melissic acid and $C_{25}H_{50}O_2$ for pure cerotic acid.

Wax has been variously adulterated. Heavy substances sink to the bottom of the vessel when the wax is melted. *Starch, meal,* and other *insoluble substances* remain behind when the wax is dissolved in oil of turpentine or petroleum benzin. *Water,* which is said to be sometimes fraudulently incorporated with it, by agitation when partially melted, is driven off by heat. *Fatty substances* render lime water turbid when agitated with it and allowed to stand. For the detection of stearin and stearic acid, Lebel dissolves the suspected wax in two parts of oil, beats the cerate thus formed with its weight of pure water, and then adds a few drops of solution of lead subacetate. If stearin be present, there will be an immediate decomposition, and the mixture will acquire an extraordinary solidity from the formation of lead stearate. (*J. P. C.,* 3e sér., xv.) Vogel proposes chloroform as a means of detecting the adulteration with fatty matters. That liquid dissolves only 25 per cent. of wax, but stearin and stearic acid completely. If, therefore, wax treated with 6 to 8 parts of chloroform loses more than one-quarter of its weight, it may be considered as impure. (*Ibid.,* xvii.) Overbeck detects stearic acid by the abundant effervescence produced from the escape of carbon dioxide when a small portion of the suspected wax is boiled in a solution composed of one part of sodium carbonate and fifty of distilled water. (*P. J.,* xi. 128.) The best test for fats, fatty acids or rosin is the pharmacopœial test of boiling with sodium hydroxide solution and testing the filtrate obtained after cooling. For the detection of rosin, cold alcohol is sufficient. It dissolves the rosin, and yields it on evaporation, attended with a very small portion of pure wax, which yields 2.4 per cent. to cold alcohol. (Ed. Davies, *A. J. P.,* 1870, p. 537.) F. Jean states that a few drops of sulphuric acid added to the melted wax adulterated with rosin, cause a red color, or, if only 1 per cent. be present, a green tint. (*A. J. P.,* 1881, p. 307.) White wax should not melt below 65° C. (149° F.); yellow not below 62.5° C. (144.5° F.). (*Br.*) *Japan wax* is said also to be largely employed for adulterating beeswax; so that sometimes but little of the product of the bee is to be found in the mixture. To detect Japan wax, Dullo boils together for a minute 10 Gm. of wax, 120

[1] The following process for purifying wax by steam has been patented by Cassgrand, in France, and is said to have been employed advantageously. Wax melted by steam is passed along with the steam through a coiled tube or worm, is received into a jacketed kettle heated by steam, where it is washed with water, and is then raised by a pump into another pan, also heated by steam, where it is again washed with water; the whole operation is repeated three or four times, the wax being allowed to rest for about four or five minutes in the upper pan after each operation, and, after the last one, an hour or two for the subsidence of impurities. The wax is then granulated by means of cold water, allowed to dry for two or three days, and then exposed to light and air. The whole process is completed in a few days. (See *A. J. P.,* xxvi. 525.)

Gm. of water, and 1 Gm. of sodium hydroxide; if Japan wax be present, a soap will immediately form, which will slowly solidify on cooling. Beeswax does not saponify under these circumstances. (*Ibid.*, 4e sér., i. 448.) Ceresin, a principle obtained from ozokerite (see PART II), is also employed as an adulterant, and is manufactured largely for that purpose in Vienna. It is only native paraffin, and of course answers to the tests for that substance. There are other less precise methods of detecting adulterations. Thus, spermaceti and lard render wax softer and less cohesive, of a smoother and less granular fracture, and of a different odor when heated. The melting point and specific gravity are lowered by tallow, suet, lard, and especially by paraffin. *Legrip's cereometer* is based upon the altered specific gravity of wax when adulterated. Anyone may apply this principle by making such a mixture of alcohol and water that pure wax will neither sink nor rise in it, but remain wherever placed. (See page 308.) Adulterated wax would either float or sink in this liquid. The most valuable information, however, is obtained by the determination, according to Hübl's process, of the three chemical constants,—viz., acid value, 20; ester value, 75; and saponification value, 95. In yellow wax the iodine value, 7.9 to 8.9, is also of use; in white wax the bleaching process has altered the bodies which absorb the iodine. (See also *Chem. Ztg.*, 1893, 918; *Proc. A. Ph. A.*, 1894, 957; *D. C.*, 1898, 33; *Am. Drug.*, 1898, 97, and 1904, 103, 105.)

Uses.—Wax has little effect upon the system. Under the impression that it sheathed the inflamed mucous membrane of the bowels, it was formerly prescribed in *diarrhœa* and *dysentery;* and it is mentioned by Dioscorides as a remedy in the latter complaint; but at the present time, we suppose, no one would think of employing wax for such purposes. Its sole use in modern medicine is in the formation of ointments, cerates, plasters, suppositories, and surgical dressings, etc.; in which it acts mechanically, either giving stiffness or serving to protect from water. It is an ingredient in almost all the official cerates, which owe to it their general title.

3. VEGETABLE WAX.—Many vegetable products contain wax. It exists in the pollen of numerous plants, and forms the bloom or glaucous powder which covers certain fruits, and the coating of varnish with which leaves are sometimes supplied. In some plants it is so abundant as to be profitably extracted for use. Such is the *Ceroxylon andicolum*, Humb., a lofty palm growing in the South American Andes. Upon the trunk of this tree, in the rings left by the fall of the leaves, is a coating of wax-like matter, about one-sixth of an inch thick, which is removed by the natives and employed in the manufacture of tapers. It contains, according to Vauquelin, two-thirds of a resinous substance and one-third of pure wax. Two kinds of wax are collected in Brazil, one called *carnauba*,[1] from the leaves of the *Copernicia cerifera*, a palm, which forms large forests in the provinces

[1] *Carnauba Wax* is collected by cutting out the leaf buds, drying and beating them, and melting the powder thus detached, in water. H. Stürke has stated as the result of an investigation that carnauba wax contains: a hydrocarbon, melting at 59° C.; an alcohol, $C_{27}H_{55}.OH$, melting at 76° C.; myricyl alcohol, $C_{30}H_{61}.OH$, melting at 85.5° C.; a diatomic alcohol, $C_{25}H_{50}.(OH)_2$, melting at 103.5° to 103.8° C.; an acid, $C_{24}H_{48}O_2$, isomeric with lignocerotic acid, melting at 72.5° C.; an acid, $C_{27}H_{54}O_2$, isomeric with cerotic acid, melting at 79° C.; and an acid, or rather the lactone (anhydride) of an acid, $C_{19}H_{38}\begin{cases}CH_2OH\\COOH\end{cases}$, melting at 103.5° C., from which an acid, $C_{19}H_{38}(COOH)_2$, melting at 90° C. has been prepared. (Schaedler, *Technol. der Fette und Oele*, 2te Auf., p. 884.) It is hard, brittle, and buff-colored, yellow, or greenish, resembling the resins more than wax, and melts at 84° C. (183.2° F.) which is much higher than the fusing point of other kinds of vegetable wax. "It takes a fine polish when rubbed with any soft material" does not receive impressions from the finger at the natural temperature of the hand, and is adapted for polishing furniture, either alone or mixed with wax. 2,000,000 pounds of it are said to be annually produced in Brazil, where it is largely used, mixed with tallow, in making candles, etc. (See also *P. J.*, 1904, 246.)

Under the name of *Ocotilla wax*, Helen Abbott Michael described (*A. J. P.*, Feb. 1885) a vegetable wax which she obtained from the bark of *Fouquiera splendens*, and believed to be a new variety. A wax which is said to be used, under the name of *Arbol de la Cera*, in Mexico not only for domestic purposes, but also as a remedy in diarrhœa and jaundice, is that obtained by boiling the fruit of the *Myrica jalapensis* in water. It is greenish or yellow, more brittle and unctuous than beeswax, has a feeble odor, a slightly bitter taste, and a density nearly equal to that of water, and melts at 43° C.; but on exposure the fusing point rises to 47.5° C. It is wholly soluble in boiling ether, insoluble in water, sparingly soluble in cold alcohol, and dissolves in twenty parts of boiling alcohol, depositing the greater part on cooling; alkalies saponify it readily. (*A. J. P.*, xv. 339, 1885.)

Pisang Wax from *Ficus cerifera*, according to Greshoff and Sack, occurs in white crystalline cakes, having the sp. gr. 0.963 to 0.970 at 15° C., and melting at 79° to 81° C. It is very sparingly soluble in ethyl alcohol, even when boiling, but readily soluble in boiling oil of turpentine, amyl alcohol, and carbon disulphide. Its acid number is 2 to 3, its saponification number 109. *Pisang-cerylic acid*, obtained by saponification, melts at 71° C., and has the composition $C_{24}H_{48}O_2$; while *pisang-cerylic alcohol*, which was also isolated, melts at 78° C., and has the formula $C_{13}H_{18}O$.

Gondang Wax occurs in brown pieces which are yellowish internally and have a sp. gr. of 1.015. In distinction from pisang wax, gondang wax is soluble in all the usual solvents at a boiling temperature, and it may be almost completely dissolved by prolonged boiling with ethyl alcohol, being however again deposited on cooling. Gondang wax purified in this way melted at 61° C., and yielded *fico-cerylic acid* on saponification, which has the formula $C_{13}H_{26}O_2$, and melts at 57° C., while *fico-cerylic alcohol* has the formula $C_{17}H_{28}O$, and melts at about 198° C. In its general character gondang wax is intermediate between wax and caoutchouc.— *Ph. Ztg.*, 1901, 563.

Japanese Wax has been imported into Europe in considerable quantities, either directly from Japan, or through the Chinese ports. It is obtained from the berries of the *Rhus succedaneum* of Linnæus, and in small amount from the *R. sylvestris* and *R. vernicifera*, or lacquer plant. The partially dried berries are crushed, winnowed, steamed, placed in hemp cloth bags, steamed again, and pressed in a wooden wedge press. They yield about 15 per cent. of a coarse greenish tallowy mass. It has come in two forms, the one, as originally distinguished by Hanbury, of circular cakes, about four inches in diameter, and an inch thick, flat on one side and somewhat convex on the other; the second, as brought directly from Japan, of large rectangular blocks weighing, it may be, as much as 1 picul (133⅓ lbs.) which are packed in chests. It bears a considerable resemblance to purified beeswax, but is not quite so white, having a slightly yellowish tint, is softer, more friable, and has a somewhat rancid odor and taste. Its melting point is below that of wax, varying from 42° C. (107° F.) to 55° C. (131° F.). It is much more soluble in alcohol than is beeswax, is sa-

of Ceara, the other *ocuba*, from the fruit of a shrub of the province of Para (*J. P. C.*, 3e sér., v. 154). A form of vegetable wax sometimes seen in this country is that derived from *Myrica cerifera*, L., and commonly called *myrtle wax*. The *wax myrtle* is an aromatic shrub, from one to twelve feet high, growing in the United States, from New England to Louisiana, and flourishing especially on the sea coast. The fruit, which grows in clusters closely attached to the stems and branches, is small, globular, and covered with a whitish coat of wax, which may be separated for use. Other parts of the plant are said to possess medicinal virtues. The bark of the root is acrid and astringent, and in large doses emetic, and has been popularly employed in jaundice. The process for collecting the wax is simple. The berries are boiled in water, and the wax, melting and floating on the surface, is either skimmed off and strained, or allowed to concrete as the liquor cools, and then removed. To render it pure, it is again melted and strained, and cast into large cakes. It is collected in New Jersey, North Carolina, and New England, and particularly in Rhode Island.

Myrtle wax is of a pale grayish-green color, somewhat diaphanous, more brittle and unctuous to the touch than beeswax, of a feeble odor, and a slightly bitterish taste. It is about as heavy as water, and melts, according to G. E. Moore, at from 46.6° C to 48.8° C. (116° F. to 120° F.). It is insoluble in water, scarcely soluble in cold alcohol, soluble, excepting about 13 per cent., in twenty parts of boiling alcohol, which deposits the greater portion on cooling, soluble also in boiling ether, and slightly so in oil of turpentine. It is readily saponifiable with the alkalies. Myrtle wax is a mixture of glycerides and not a true wax. This variety of wax has been popularly employed in the United States as a remedy for *dysentery;* in which disease Fahnestock gave the powdered wax in doses of a teaspoonful frequently repeated, with alleged great advantage. (*Am. J. M. S.*, ii. 313.) It is occasionally substituted by apothecaries for beeswax in the formation of plasters, and is used in the preparation of tapers and candles. It is somewhat fragrant when burning, but emits a less brilliant light than common lamp oil.

Off. Prep.—*White wax.*—Ceratum, *U. S.;* Ceratum Camphoræ, *U. S.;* Pilula Phosphori, *Br.;* Suppositoria Acidi Carbolici, *Br.;* Unguentum, *U. S.;* Unguentum Aquæ Rosæ, *U. S., Br.;* Unguentum Cetacei, *Br.*

Yellow wax.—Ceratum Cantharidis, *U. S.* (*Br.*); Ceratum Resinæ, *U. S.* (*Br.*); Ceratum Resinæ Compositum, *U. S.;* Emplastrum Calefaciens, *Br.;* Emplastrum Menthol, *Br.;* Emplastrum Picis, *Br.;* Unguentum Hydrargyri Compositum, *Br.;* Unguentum Picis Liquidæ, *U. S., Br.;* Unguentum Staphisagriæ, *Br.*

ponifiable with the alkalies, and is in the main a glyceride of palmitic acid with smaller amounts of the glycerides of stearic and arachidic acids. It has been employed in the preparation of candles, which yield as brilliant light as those made of common wax. It has been found useful in the preparation of cerates, etc. From Roucher's experiments it appears that there are two melting points of this wax, one corresponding closely with Procter's results, while the same wax rapidly heated to a point above that of fusion and then allowed to cool, if plunged into water at 42° C., melts into a transparent liquid; consequently melting at a point 12° C. below its freezing point in its ordinary state, which was 54° C.; the two temperatures being about equivalent in Fahrenheit's scale to 107° and 129°. (*P. J.*, Aug. 1872.)

CERATA.

CERATES

(cę-rā'tą)

Cérats, Céréolés, Elæocéréolés, *Fr.;* Cerate, Wachssalben, *G.*

These are unctuous substances consisting of oil or lard, mixed with wax, spermaceti, or rosin, to which various medicaments are frequently added. Their consistence, which is intermediate between that of ointments and that of plasters, is such that they may be spread at ordinary temperatures upon linen or leather, by means of a spatula, and do not melt or run when applied to the skin. In preparing them, care should always be taken to select the oil or lard perfectly free from rancidity. In reference to the wax, too, there would seem to be a choice, as experience has shown that cerates made with yellow wax keep longer unchanged than those made with white or bleached wax, probably because there is in yellow wax some principle which corrects the tendency of fatty matters to become rancid. (F. Bringhurst, *A. J. P.*, 1869, 59.) The liquefaction should be effected by a very gentle heat, which may be applied by means of a water bath, and during the refrigeration the mixture should be well stirred, and the portions which solidify on the sides of the vessel should be made to mix again with the liquid portion, until the whole assumes the proper consistence, or, as some prefer, the melted cerate is allowed to cool quickly without stirring. When a large quantity is prepared, the mortar or other vessel into which the mixture may be poured for cooling should be previously heated by means of boiling water. It has been proposed to substitute paraffin for wax in the preparation of the cerates, but the great tendency to produce granulation in the finished cerate has largely prevented its use.

It is, we think, unfortunate that this class of preparations has been abandoned in the British Pharmacopœia, the several cerates having been rejected, or transferred to the class of ointments. Independently of the connection between the name and one of the characteristic constituents of the cerates, there is ground for difference between them and the ointments in their consistence, that of the cerates being such as to render them especially suitable for spreading on linen, while that of ointments

is peculiarly adapted to inunction. W. H. Mielcke (*Ph. Cb.*, 1881, Nos. 20, 21) proposes a class of preparations, to which he has given the name "*Steatins*," "*Steatinum*." These are of about the consistence of cerates, of varied composition, and contain usually a considerable portion of tallow. The *Steatinum Iodoformi* offers a fair specimen of the class. "Take of mutton tallow 18 parts, expressed oil of nutmeg 2 parts, iodoform, in fine powder, 1 part. Melt the tallow and add the other ingredients." For other formulas, see *A. J. P.*, 1881, p. 404.

CERATUM. U. S.

CERATE [Simple Cerate]

(cę-rā′tŭm)

Ceratum Adipis, *U. S.* 1860; Ceratum Simplex, *U. S.* 1850; Cérat Simple, *Fr. Cod.*; Unguentum cereum, *P. G.*; Einfaches Cerat, Wachssalbe, *G.*; Cerato simple, *Sp.*

* "White Wax, *three hundred grammes* [or 10 ounces av., 255 grains]; White Petrolatum, *two hundred grammes* [or 7 ounces av., 24 grains]; Benzoinated Lard, *five hundred grammes* [or 17 ounces av., 279 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the white Wax, add the White Petrolatum, then the Benzoinated Lard, continuing the heat until the mixture is liquefied, and stir it constantly until it congeals. For use in southern latitudes, and during the heated season in other localities, *fifty grammes* [or 1 ounce av., 334 grains] of Benzoinated Lard may be replaced by an equal quantity of White Wax." *U. S.*

In the U. S. Pharmacopœia (8th Rev.) 20 per cent. of white petrolatum, and 50 per cent. of benzoinated lard are directed in place of the 70 per cent. of lard used in the U. S. P. 1890 process. The present official cerate will for these reasons remain free from rancidity a much longer time. In the preparation of this cerate, peculiar care should be taken that the oleaginous ingredient be entirely free from rancidity, and that the heat employed be not sufficient to produce the slightest decomposition, for the value of the preparation depends on its perfect blandness. To avoid change, it should be put up in small jars, and covered closely with tin foil so as to exclude the air. It is used for dressing *blisters, wounds,* etc., in all cases in which the object is to prevent the contact of air and preserve the moisture of the part and at the same time to avoid all irritation. It is sometimes improperly employed as the vehicle of substances to be applied by inunction. For this purpose benzoinated lard should be used in winter, and simple ointment in summer, the cerate having too firm a consistence. George W. Sloan recommended the use of simple cerate as a pill excipient for certain oxidizable substances and special uses. (*Proc. A. Ph. A.*, 1884.)

CERATUM CAMPHORÆ. U. S.

CAMPHOR CERATE

(cę-rā′tŭm căm′phọ-ræ)

Pommade Camphrée, *Fr. Cod.*; Pomatum Camphoratum, *Fr.*; Kamphersalbe, *G.*; Pomada alcanforada, Pomatum camphoratum, *Sp.*

* "Camphor Liniment, *one hundred grammes* [or 3 ounces av., 231 grains]; White Wax, *three hundred and fifty grammes* [or 12 ounces av., 151 grains]; White Petrolatum, *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; Benzoinated Lard, *four hundred grammes* [or 14 ounces av., 48 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the White Wax, add the White Petrolatum, then the Benzoinated Lard, and continue the heat until the mixture is liquefied. While the mixture is cooling, add the Camphor Liniment, and incorporate thoroughly by stirring until it congeals." *U. S.*

Camphor cerate now contains 2 per cent. of camphor; that of the U. S. P. 1880 contained only three-fifths of 1 per cent. This preparation was introduced in the U. S. P. 1880 primarily for use in making cerate of subacetate of lead by the extemporaneous process. It was subsequently found useful as a slightly stimulating dressing; hence the proportion of camphor was increased.

CERATUM CANTHARIDIS. U. S. (Br.)

CANTHARIDES CERATE

(cę-rā′tŭm cạn-thăr′|-dīs)

Emplastrum Cantharidis, *Br.*; Cantharides Plaster; Emplastrum Epispasticum, s. Vesicatorium, s. Vesicans, Emplastrum Lyttæ; Blistering Cerate or Plaster; Emplâtre Vesicatoire, *Fr. Cod.*; Pommade Épispastique, Emplâtre de Cantharides, *Fr.*; Emplastrum Cantharidum Ordinarium, *P. G.*; Spanischfliegen Pflaster, Blasenpflaster, *G.*; Pomata di cantaridi, *It.*; Unguento de cantaridas, *Sp.*

* "Cantharides, in No. 60 powder, *three hundred and twenty grammes* [or 11 ounces av., 126 grains]; Liquid Petrolatum, *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; Yellow Wax, *one hundred and eighty grammes* [or 6 ounces av., 153 grains]; Rosin, *one hundred and eighty grammes* [or 6 ounces av., 153 grains]; Lard, *one hundred and seventy grammes* [or 5 ounces av., 436 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Cantharides with the Liquid Petrolatum, and set the mixture aside, well covered, in a warm place, for forty-eight hours. Then add it to the Rosin, Yellow Wax, and Lard, previously melted and strained through muslin, and keep the mixture in a liquid condition by means of a water-bath, stirring occasionally, for one hour. Finally, remove it from the bath, and stir the mixture until it begins to congeal." *U. S.*

The British Pharmacopœia directs: Cantharides, in powder, 3½ *ounces* (Imperial) or thirty-five grammes; Yellow Beeswax, Lard, and

Resin, each, 2 *ounces* (Imp.) or twenty grammes; and Soap Plaster, ½ *ounce* (Imp.) or five grammes; melts the Resin, Soap Plaster, Wax, and Lard together; then introduces the Cantharides, mixes the whole thoroughly, and continues to stir the mixture while cooling. (See *Emplastrum Cantharidis.*)

This is the common well known *blistering plaster.* As it can be readily spread without the aid of heat, it is properly a cerate, and is, therefore, correctly named in the U. S. Pharmacopœia. The process now official differs from that of previous Pharmacopœias in the substitution of liquid petrolatum for oil of turpentine; the previous maceration of the cantharides with this solvent has for its object the softening and extraction of the cantharidin; the present cerate is somewhat firmer in consistence than that made by the U. S. P. 1890.

There can be no question of the advantage of retaining the cantharides in contact with hot liquefied fatty bodies to facilitate the extraction of the cantharidin. The cerate is essentially the same as prepared by the two processes, though the U. S. formula has a decided advantage over the British, in keeping the mixture of the flies and the other ingredients for some time at an elevated temperature, while in the latter they are allowed to cool after being mixed with the fatty substances. Care was formerly considered requisite, in making the cerate, not to injure the flies by heat; it was therefore recommended that they should not be added to the other ingredients until immediately before these begin to stiffen, after having been removed from the fire; and, though this direction has been omitted, no provision is made for the continued application of heat.

From the experiments of Donovan, and those of Procter (*A. J. P.,* xiii. 302 and xxiv. 296), it may be inferred that the vesicating principle of Spanish flies is not injured or dissipated by a heat under 148.8° C. (300° F.), and that a limited elevated temperature, instead of being hurtful, is positively advantageous in the preparation of the cerate. The cantharidin is thus more thoroughly dissolved by the oleaginous matter, and consequently brought more efficiently into contact with the skin, than when retained in the interior of the tissue of the fly. Another advantage, stated by Donovan, is that the moisture usually existing to a certain extent in all the ingredients of the cerate is thus dissipated, and the preparation is less apt to become mouldy, or otherwise to undergo decomposition. Instead, therefore, of waiting until the melted wax, resin, and lard begin to stiffen, it is better to add the powder before the vessel is removed from the fire. Donovan recommends that, as soon as the other ingredients are melted, the powdered flies should be added, and the mixture stirred until the heat is shown by a thermometer to have risen to 121.1° C. (250° F.), when the vessel is to be removed from the fire, and the mixture stirred constantly until cool. At the heat mentioned, ebullition takes place in consequence of the escape of the moisture contained in the materials. In the cerate thus prepared, the active matter has been dissolved by the lard, and the powder may be separated, if deemed advisable, by straining the mixture before it solidifies. Care should be taken that the temperature be not so high as to decompose the ingredients; and it would be better to keep it within 100° C. (212° F.), by means of a water bath, as in the U. S. process, than to incur any risk from its excess. Violent irritation and even vesication of the face of the operator are stated to have resulted from exposure to the vapors of the liquid, at a temperature of 121.1° C. (250° F.). (*P. J.,* ii. 391.) From an experiment, however, of Procter, it appears that, though cantharidin begins to volatilize slightly at 121.1° C. (250° F.), and rapidly rises in vapor and sublimes at from 205.5° C. to 211.1° C. (402° F. to 412° F.), yet it is not decomposed unless by increasing the heat considerably above the last-mentioned point. (*A. J. P.,* xxiv. 296 and 298.) Dieterich states that the activity is greatly increased by the use of acid in the manufacture. Thus, for every 250 Gm. of powdered flies used he adds to the melted mass 1 Gm. sulphuric acid and 10 Gm. alcohol (90 per cent.), keeps the mass for two hours at 70° C., and finally adds 2 Gm. barium carbonate rubbed up with 6 Gm. alcohol. (*Ph. Centralh.,* 1892, 425.) It is desirable that the flies should be very finely pulverized. Coarsely powdered cantharides should not be used, because of the imperfect and unequal distribution of the vesicating agent. Powdered euphorbium is said to be sometimes fraudulently added.

Uses.—The cerate will raise a blister in ordinary conditions of the system, if the flies are good, and not injured in the preparation. It should be spread on soft leather, though linen or even paper will answer the purpose when leather is not to be had. An excellent mode of preparing it for use is to spread a piece of leather, of a proper size, first with adhesive plaster, and afterwards with the cerate, leaving a margin of the former uncovered, in order that it may adhere to the skin. Heat is not requisite, and should not be employed in spreading the cerate. Some sprinkle powdered flies upon the surface of the plaster, press them lightly with a roller, and then shake off the portion which has not adhered; but, if the flies originally employed were good, this addition is superfluous. The practice of applying over the surface with a brush an ethereal tincture of cantharides, which leaves a thin coating of extract, renders the preparation more certain.

Previous to the application of the plaster, the skin should be moistened with warm vinegar or other liquid. In adults, when the full action of the flies is desired, and the object is to produce a permanent effect, the application should be continued for eight hours, and on the scalp for twelve hours. In very delicate persons, however, or those subject to strangury, or upon

parts of a loose texture, or when the object is merely to produce a blister to be healed as quickly as possible, the plaster should remain no longer than is necessary for the production of full redness of the skin, which generally occurs in five or six hours, or even in a shorter time. It should then be removed, and followed by a flaxseed poultice, or some other emollient dressing, under which the cuticle rises, and a full blister is usually produced. By this management the patient will generally escape strangury, and the blister will very quickly heal after the discharge of the serum. In young children, cantharides sometimes produce alarming and even fatal ulceration, if too long applied, and from two to four hours are usually sufficient for any desirable purpose. When the head, or other hairy part, is to be blistered, an interval of ten or twelve hours should, if possible, be allowed between the shaving of the part and the application of the plaster, so that the abrasions may heal, and some impediment be offered to the absorption of the cantharidin. After the blister has been formed, it should be opened at the most depending parts, and, the cuticle being allowed to remain, should be dressed with simple cerate; but, if it be desirable to maintain the discharge for a short time, rosin cerate should be used, and the cuticle removed if it can be done without inconvenience. When it is wished that the blistered surface should heal as soon as possible, Goulard's cerate should be freely applied. The effects of an issue may be obtained by employing savin ointment, or the ointment of Spanish flies, as a dressing. If much inflammation takes place in the blistered surface, it may be relieved by emollient poultices, weak lead water, or Goulard's cerate. When there is an obstinate indisposition to heal, we have found nothing so effectual as zinc ointment with two to four grains of phenol to the ounce.

Various preparations of cantharides have been proposed and employed as substitutes for the cerate. They consist for the most part of cantharidin, more or less pure, either dissolved in olive oil, and applied to the skin by means of a piece of paper saturated with it, or incorporated with wax and spread in a very thin layer upon fine waxed cloth, silk, or paper, constituting *blistering cloth, blistering paper, vesicating taffeta*, etc. The advantages of these preparations are that they occupy less space, are more portable, and, being very pliable, are more easily adapted to irregularities of the surface. Absolutely pure cantharidin is expensive and not requisite,[1] as extracts of cantharides, made with ether, alcohol, or boiling water, will answer every purpose. Henry and Guibourt give the following formula. Digest powdered cantharides in ether, distil off the ether, evaporate the residue by means of a salt water bath, until ebullition ceases, melt the mass which remains, with twice its weight of wax, and spread the mixture upon waxed cloth. The *waxed cloth* may be prepared by spreading upon linen or muslin a mixture composed of 8 parts of white wax, 4 of olive oil, and 1 of turpentine, melted together. An extract of cantharides of a buttery consistence, said to act very efficiently when applied by means of paper greased with it, is prepared by digesting 4 parts of flies with one part of strong acetic acid and 16 of alcohol, straining, filtering, and evaporating at a moderate heat. *A cerate of the extract of cantharides* was formerly official (see U. S. D., 18th ed., p. 358.)

A preparation which received the favorable report of a committee of the Society of Pharmacy, at Paris, is the following, proposed by Dubuisson. Four parts of a hydro-alcoholic extract of the flies, made by maceration, are mixed with an aqueous solution of one part of pure gelatin, so as to obtain a solution of suitable consistence, which is then applied upon a piece of stretched waxed cloth, care being taken that the strokes of the brush should always have the same direction. When the first layer has dried, a second and a third are to be applied in the same manner. The gelatin renders the plaster more adhesive and gives consistence. The hydro-alcoholic extract is preferred to the alcoholic, because it contains less of the green oil, which does not readily mix with the other ingredients. The committee, however, preferred the aqueous extract, as cheaper and more active. This taffeta has been tried, and found to raise blisters in four hours. (*J. P. C.*, 3e sér., viii. 67.) For very speedy vesication, an infusion of the flies in strong acetic acid is sometimes employed. None of these preparations are likely to supersede the cerate, but the demand for them was met by introducing into the Pharmacopœia of 1880 *Charta Cantharidis* and *Collodium Cantharidatum* in subsequent pharmacopœias.

CERATUM PLUMBI SUBACETATIS.
U. S. (Br.)

CERATE OF LEAD SUBACETATE [Goulard's Cerate]

(cẹ-rā'tŭm plŭm'bī sŭb-ăç-ẹ-tā'tīs)

Unguentum Glycerini Plumbi Subacetatis, *Br.;* Unguentum Plumbi Subacetatis Compositum; Compound Ointment of Subacetate of Lead, Ointment of Glycerin of Lead Subacetate; Ceratum cum Subacetate Plumbico; Cérat Saturné, *Fr. Cod.;* Cérat de Goulard, *Fr.;* Unguentum Plumbi, *P. G.;* Bleisalbe, Bleicerat, *G.;* Pomato con acetato basico di piombo, Unguento saturnino, *It.;* Cerato de saturno, *Sp.*

* "Solution of Lead Subacetate, *twenty grammes* [or 309 grains]; Wool-Fat, *twenty grammes* [or 309 grains]; Paraffin, *twenty grammes* [or 309 grains]; White Petrolatum, *thirty-eight*

[1] Dragendorff (*A. J. P.*, 1872, p. 273) recommends *sodium cantharidate*. M. E. Delpech (*A. J. P.*, xlii. 240) proposes the use of *potassium cantharidate* in substance or solution. He prepares it by dissolving two parts of cantharidin in 150 parts of alcohol, and adding 1.6 parts of potassium hydroxide dissolved in a very little water. The whole becomes a crystalline mass, from which the alcohol may be separated by pressure. See also R. Rother, *Ch. Ph.*, Nov. 1872.

grammes [or 1 ounce av., 150 grains]; Camphor, *two grammes* [or 31 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. To the melted Wool-Fat in a warm mortar gradually add the Solution of Lead Subacetate, and incorporate it by slow trituration. To the mixture add the White Petrolatum and Paraffin, previously melted, and in which the Camphor has been dissolved; mix thoroughly until homogeneous." *U. S.*

The British Pharmacopœia makes an ointment by mixing glycerin of subacetate of lead with soft and hard paraffin together. (See *Unguentum Glycerini Plumbi Subacetatis;* also *Glycerinum Plumbi Subacetatis.*)

The process for this cerate has been greatly improved in the U. S. P. (8th Rev.) by eliminating the fatty ingredients (lard and cotton seed oil) used in making the camphor cerate of the previous pharmacopœia; white petrolatum, wool-fat and paraffin are now used, and this change removes the great objection to the former official cerate, of proneness to rancidity, and discoloration. F. A. Haussmann (*A. J. P.,* 1897, 575) suggested the use of hydrated wool-fat in place of the camphor cerate; the new official process requires anhydrous wool-fat. This cerate received the name by which it is commonly known from Goulard, by whom it was employed and recommended.

Uses.—It is used chiefly in *excoriations, burns, scalds,* and *chilblains,* and in *cutaneous eruptions.* Wherever there is an acute active inflammation of the skin it is a most efficient remedy.

CERATUM RESINÆ. U. S. (Br.)

ROSIN CERATE [Basilicon Ointment]

(cẹ-rā'tŭm rẹ-sĭ'næ)

Unguentum Resinæ, *Br.;* Ointment of Resin, Unguentum Basilicum; Unguentum Tetrapharmacum; Resin Ointment, Resin Cerate; Onguent Basilicum, *Fr. Cod.;* Cérat de Résine Anglais, *Fr.;* Harzcerat, Harzsalbe, Königsalbe, Zugsalbe, *G.*

* "Rosin, *three hundred and fifty grammes* [or 12 ounces av., 151 grains]; Yellow Wax, *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; Lard, *five hundred grammes* [or 17 ounces av., 279 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Rosin, add the Yellow Wax and the Lard, and continue the heat until liquefied, then strain the liquid through muslin, and allow it to congeal with occasional stirring. In cold weather *five hundred and thirty grammes* [or 18 ounces av., 304 grains] of Lard, and *one hundred and twenty grammes* [or 4 ounces av., 102 grains] of Yellow Wax may be used." *U. S.*

"Take of Resin, Yellow Beeswax, and Olive Oil, each 8 *ounces* (Imperial) or 200 grammes; Lard, 6 *ounces* (Imp.) or 150 grammes. Add the Lard and Olive Oil to the previously melted Resin and Beeswax; strain; stir until cold." *Br.*

The U. S. preparation does not differ greatly from that formerly official except that occasional stirring while congealing is directed; the U. S. P. 1890 process forbade stirring. The British process (1898) discards the simple ointment and almond oil previously used (1885), and substitutes lard and olive oil. Rosin cerate, commonly called *basilicon ointment,* is much used as a gently stimulating application to *blistered surfaces, indolent ulcers, burns, scalds,* and *chilblains.* We have found no application more effectual in disposing the *ulcers* which follow *burns* to heal.

Off. Prep.—Linimentum Terebinthinæ, *U. S.*

CERATUM RESINÆ COMPOSITUM. U. S.

COMPOUND ROSIN CERATE [Deshler's Salve]

(cẹ-rā'tŭm rẹ-sĭ'næ cọm-pŏs'ĭ-tŭm)

Cérat de Résine Composé, *Fr.;* Zusammengesetzte Harzsalbe, *G.*

* "Rosin, *two hundred and twenty-five grammes* [or 7 ounces av., 410 grains]; Yellow Wax, *two hundred and twenty-five grammes* [or 7 ounces av., 410 grains]; Prepared Suet, *three hundred grammes* [or 10 ounces av., 255 grains]; Turpentine, *one hundred and fifteen grammes* [or 4 ounces av., 25 grains]; Linseed Oil, *one hundred and thirty-five grammes* [or 4 ounces av., 333 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Rosin, Yellow Wax, Turpentine, and Prepared Suet; to this add the Linseed Oil, and continue the heat until the mixture is liquefied; then strain it through coarse muslin, and stir it until it begins to congeal." *U. S.*

Compound rosin cerate was introduced into the U. S. P. (8th Rev.) because of its continued use in some parts of the country; it was official in the U. S. P. 1870. Owing to the presence of linseed oil it has a tendency to become tough in consistence on keeping; but the peculiar consistence has been urged as one of its advantages. It is used for the same purposes as rosin cerate; see *Ceratum Resinæ.*

CERII OXALAS. U. S., Br.

CERIUM OXALATE [Cerous Oxalate]

(cē'rĭ-ī ŏx'ạ-lăs)

$Ce_2(C_2O_4)_3 \cdot 10H_2O = 719.22$

"Cerium Oxalate consists chiefly of a mixture of the oxalates of cerium, didymium, and lanthanum, and of other rare earths of this group." *U. S.* "Cerium Oxalate, $Ce_2(C_2O_4)_3,9H_2O$, may be obtained by interaction of a soluble cerium salt and a soluble oxalate. It usually contains some lanthanum oxalate and didymium oxalate." *Br.*

Oxalate of Cerium; Cerium Oxalicum, Oxalas Cericus; Oxalate de Cérium, *Fr.;* Oxalsaures Ceroxydul, Cerium Oxalat, Ceroxalat, *G.*

Cerium is a metal, which was discovered in 1803 by Berzelius and Hisinger, and about the same time by Klaproth, who, however, described it as an earth. By the two former chemists it was recognized as a metal, and named cerium in honor of the goddess Ceres. It was obtained from a Swedish mineral, formerly from its great weight called *heavy stone of Bastnas* (*Bastnas Schwerstein*), but now named *cerite,* after the metal extracted from it. Besides cerite, it has been found in several other minerals, as *gadolinite, orthite,* and *monazite,* etc. It is not easy to obtain it pure in the metallic state, as its oxides and salts are difficult of reduction. Berzelius describes it as in the form of pulverulent masses, of a deep chocolate-brown, which exhibit, however, under the burnisher a metallic appearance and a dark gray color. Hildebrand and Norton have since prepared it in large quantity by the electrolysis of its chloride. It is a bad conductor of electricity. Heated in the air it takes fire before the point of ignition, and burns vividly, passing to the state of peroxide. At ordinary temperatures it is oxidized in a moist atmosphere, giving out a strong and disagreeable odor. In water, especially when moderately heated, it rapidly oxidizes, with the evolution of hydrogen and the water does not become alkaline. There are two cerium oxides formerly considered as the protoxide and sesquioxide. (According to more recent investigators, cerium forms a sesquioxide and a dioxide only, so that cerous oxalate, which is the official salt, is an oxalate of the sesquioxide, a fact recognized in the Pharmacopœia of 1880.) Sulphur and phosphorus combine with it. Of its compounds two only have been introduced into medicine, the nitrate and the oxalate.

Cerium oxalate may be obtained from cerite, and F. F. Mayer gave a process for the purpose, of which the following is an outline. The mineral consists of cerium, lanthanum, and didymium silicates, with numerous other substances in smaller proportion, the cerium oxide constituting about 39 per cent. of the whole. The powdered mineral is made into a paste with sulphuric acid, and then heated over a lamp until the mass ceases to swell and no longer absorbs sulphuric acid very cautiously added. Upon the cooling of the mass, it is powdered, and exposed in a crucible to the heat of an anthracite fire until it assumes a pale brownish-red color. It is now lixiviated first with hot water and then with nitric acid, and the solution treated with hydrogen sulphide in order to get rid of various metals by precipitation. To the clear liquid some hydrochloric acid is first added, and then a solution of oxalic acid, the former of which holds in solution the calcium oxalate produced, the latter throws down cerium oxalates and oxalates of other metals. The precipitate, having been washed with warm water, is formed into a paste with a quantity of magnesium carbonate equal to half that of the mineral employed; and the paste is dried on porous fire brick, finely powdered, and calcined until it becomes of a cinnamon color. It now contains all of the cerium in the form of ceroso-ceric oxide. To separate this the mass is treated with an excess of nitric acid, the solution evaporated to get rid of the excess of acid, then diluted with warm water, and lastly poured into a vessel containing boiling water acidulated with a little more than half of one per cent. of sulphuric acid. A yellow precipitate of basic cerium sulphate is formed, while a little of the neutral sulphate, and all the lanthanum and didymium, remain dissolved. The precipitate is now dissolved in stronger sulphuric acid, the solution digested with a few crystals of sodium thiosulphate, in order to reduce the ceroso-ceric oxide to cerous oxide, and the liquid, having been filtered, is treated with solution of oxalic acid, which causes a precipitate of cerium oxalate. This is washed with warm water, and dried. (*A. J. P.*, 1860, p. 4.)

The cerium compounds were formerly obtained chiefly from cerite, which occurs in considerable amounts in Sweden, and affords at least 50 per cent. of *cerium oxide.* The thorium salts were obtained from the mineral *thorite,* which is found in Norway, and contains about 60 to 70 per cent. of its peculiar earth. According to O. N. Witt, it was soon found that the supplies of thorite were not sufficient to even approximately meet the demand for thorium salts required for the incandescent gas mantle industry. A new source of supply was therefore sought for, and this has been found in the mineral monazite, which occurs in considerable quantities in North Carolina and in the Province of Bahia, in Brazil. It is from the latter source that the German industries now chiefly draw their supplies. Monazite is a cerous phosphate, in which a portion of the cerium is replaced by the other cerite earths. The thorium earth is not an integral constituent of the mineral, and, although quite regularly admixed with it, its amount varies within very broad limits. It is further stated by Witt that the monazite from Bahia contains at the most from 5 to 6 per cent. of thorium earth, while the earths of the cerite group amount to from 50 to 60 per cent. or more, of which about one-half is cerium itself. The occurrence of these two earths in nature is therefore in inverse proportion to the requirements for industrial purposes. As enormous quantities of monazite have to be worked up in order to obtain the necessary supplies of thorium salts, and as only a very small proportion of the cerite earths which are obtained at the same time can be utilized in the form of cerium nitrate, it is evident that these must accumulate in considerable amounts. It has thus become an important problem, upon which technical chemists have been engaged for some time, to devise a

practical method for the separation of the cerite earths, with the hope that they might then find some industrial applications for which the complex mixtures now available are not adapted. From the existing conditions of this industry, as briefly outlined, it may be inferred that the cerium oxalate of commerce, which, although used medicinally, likewise consists of such a complex mixture of the oxalates of cerium, lanthanum, and didymium, is at present more or less a by-product in the manufacture of thorium salts. See Power and Shedden, on the Composition and Determination of Cerium Oxalate (*J. Soc. Chem. Ind.*, xix. No. 7; also *Ph. Ztg.*, 1902, 297).

Properties.—It is officially described as "a fine, white powder, without odor or taste, and permanent in the air. Insoluble in water, alcohol, ether, or in solutions of potassium or sodium hydroxide; insoluble in cold, but soluble in hot, diluted sulphuric or hydrochloric acid. When heated to redness it is decomposed, leaving a residue of reddish-brown ceric and other rare-earth oxides, constituting not less than 47 per cent. of the salt. On boiling the salt with potassium hydroxide T.S., an insoluble residue of white hydroxides is produced; if the filtrate from this residue be supersaturated with acetic acid, the addition of calcium chloride T.S. will produce a white precipitate, insoluble in acetic acid but soluble in hydrochloric acid. If the residue left after heating Cerium Oxalate be dissolved in concentrated sulphuric acid, and a small crystal of strychnine added, a deep blue color will appear, which will rapidly change to purple and then to red. From the solution in diluted hydrochloric or sulphuric acid, potassium hydroxide T.S. precipitates white hydroxides, which do not redissolve in an excess of the reagent, and gradually turn yellow in contact with air. Ammonium carbonate T.S. precipitates from the same solution white cerous and other rare-earth carbonates, which are somewhat soluble in an excess of the reagent. If 0.1 Gm. of Cerium Oxalate be dissolved in 1 Cc. of sulphuric acid, and 2 Cc. of potassium sulphate T.S. be added, small, colorless crystals of cerium and other rare-earth potassium sulphates will, after some time, be deposited. No effervescence should occur when the salt is dissolved in diluted hydrochloric acid (absence of *carbonates*). The solution of the salt (1 in 20) in diluted hydrochloric acid should not respond to the Time-Limit Test for *heavy metals*, omitting the addition of the ammonia water (see PART III, Test No. 121). Five Cc. of the solution of the salt (1 in 10) in diluted hydrochloric acid should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). On boiling the salt with potassium hydroxide T.S. and filtering, no precipitate should be produced in the filtrate by the addition of either ammonium chloride T.S. (absence of *aluminum*) or ammonium sulphide T.S. (absence of *zinc*)." *U. S.* As usually seen in commerce it has a pinkish tinge, due to the presence of a trace of a compound of didymium. The British Pharmacopœia states that it is "an almost white granular powder, insoluble in *water*, decomposed at a dull red heat, yielding a reddish-brown powder which dissolves completely and without effervescence in boiling *hydrochloric acid;* the resulting solution gives with a saturated solution of *potassium sulphate* a white crystalline precipitate. When incinerated it loses 53 per cent. in weight. It should yield no characteristic reaction with the tests for arsenium, iron, aluminium, zinc, calcium, carbonates, or phosphates."

Uses.—Cerium oxalate is supposed to act in a manner very similar to bismuth subnitrate. It was originally brought forward by Sir James Y. Simpson as a remedy in the *vomiting of pregnancy*, and has been extensively used in this affection, and also in gastric disturbances of various diseases, such as *phthisis, uterine disorder, hysteria, dyspepsia, pyrosis*, etc. To a less extent it has been used in intestinal inflammatory diseases. Simpson also considered it to be a good nervine tonic, and used it with asserted great advantage in *chorea*.

Cerium nitrate has also been employed, though not official. Simpson believed it to be a nervine tonic, and also useful in *irritable dyspepsia* and *chronic vomiting*. The dose is the same as that of the oxalate, though it would be prudent to begin with a smaller quantity, as, being a soluble salt, it might be more disposed to irritate in overdoses.

Dose, of either the oxalate or nitrate, one grain (0.065 Gm.), doubled if necessary, and repeated three times a day, or more frequently if a return of the vomiting should seem to require it. It may be given in pill or suspended in water.

CETACEUM. U. S., Br.

SPERMACETI

(cę-tā'cę-ŭm)

"A peculiar, concrete, fatty substance, obtained from the head of the sperm whale, *Physeter macrocephalus* Linné." *U. S.* "A concrete fatty substance, obtained, mixed with oil, from the head of the Sperm Whale, Physeter macrocephalus, *Linn.* It is separated from the oil by filtration and pressure, and is afterwards purified." *Br.*

Blanc de Baleine ou Cétine, *Fr. Cod.;* Spermacéti, Cétine, Ambre Blanc, *Fr.;* Cetaceum, *P. G.;* Walrat, Wallrath, Spermaceti, *G.:* Cetina, Spermaceti, *It.;* Esperma de ballena, Sperma ceti, *Sp.*

The spermaceti whale is from sixty to eighty feet long, with an enormous head, not less in its largest part than thirty feet in circumference, and constituting one-third of the whole length of the body. The upper part of the head is occupied by large cavities, separated by cartilaginous partitions, and containing an

oily liquid, which, after the death of the animal, concretes into a white spongy mass consisting of spermaceti mixed with oil. This mass is removed, and the oil allowed to separate by draining. The crude spermaceti obtained from a whale of the ordinary size is more than sufficient to fill twelve large barrels. It still contains much oil and other impurities, from which it is freed by expression, washing with hot water, melting, straining, and repeated washing with a weak boiling potash lye. Common whale oil and the oil of other cetaceous animals contain small quantities of spermaceti, which they slowly deposit on standing.[1]

Properties.—Spermaceti is officially described as in "white, somewhat translucent, slightly unctuous masses of a scaly, crystalline fracture and a pearly lustre, with a very faint odor and a bland, mild taste. It becomes yellowish and rancid on prolonged exposure to air. Specific gravity: 0.938 to 0.944 at 25° C. (77° F.), 0.842 at 100° C. (212° F.). Melting point: 45° to 50° C. (113° to 122° F.). Insoluble in water and nearly so in cold alcohol; soluble in about 50 parts of boiling alcohol; also in ether, chloroform, carbon disulphide, fixed and volatile oils; only slightly soluble in cold petroleum benzin. An alcoholic solution of Spermaceti is neutral to litmus paper. If 1 Gm. of Spermaceti be boiled with 1 Gm. of anhydrous sodium carbonate and 50 Cc. of alcohol, and the mixture cooled and filtered, the filtrate, upon being supersaturated with acetic acid, may become turbid, but it should not afford a precipitate (absence of *stearic acid.*)" *U. S.* The British Pharmacopœia states that "it is reducible to powder by the aid of a little *alcohol* (90 per cent.). It is insoluble in *water,* and nearly insoluble in cold *alcohol* (90 per cent.), but soluble in *ether, chloroform,* boiling *alcohol* (90 per cent.), and in fixed and volatile oils. Melting point 114.8° to 122° F. (46° to 50° C.) when tested by the method described under 'Cera Flava.' 0.2 gramme dissolved, by the aid of a water-bath, in 20 cubic centimetres of *alcohol* (90 per cent.), two drops of *solution of phenol-phthalein* being added, should not require more than one drop of *volumetric solution of sodium hydroxide* to produce a permanent red color (limit of acidity). Boiled with *alcohol* (90 per cent.), and the mixture cooled and filtered, the filtrate should not afford a flocculent precipitate on the addition of *water* (absence of stearic acid)." *Br.* As found in commerce it is not chemically pure, containing a fixed oil, and often a peculiar coloring principle. From these it is separated by boiling in alcohol, which on cooling deposits it in crystalline scales. Thus purified, it does not melt under 49° C. (120° F.), is soluble in 40 parts of boiling alcohol of the sp. gr. 0.821 (Thénard), and is harder, more shining, and less unctuous than ordinary spermaceti. Spermaceti is a mixture of various fats. When recrystallized from alcohol as just described, the purified *cetin* is obtained, while the alcohol on evaporation deposits an oil (mechanically admixed sperm oil). The cetin which crystallizes out of the alcohol is essentially *cetyl palmitate,* $C_{16}H_{33}(C_{16}H_{31}O_2)$,—that is, a compound of *cetyl alcohol* (*ethal* of Chevreul), $C_{16}H_{33}.OH$, and *palmitic acid,* $C_{16}H_{32}O_2$. According to Heintz, however, there are small amounts of other fats with the cetin; fats containing the acids *stearic,* $C_{16}H_{36}O_2$, *myristic,* $C_{14}H_{28}O_2$, and *lauro-stearic,* $C_{12}H_{24}O_2$, and the alcohol radicals corresponding to these acids.

L. F. Kebler, after examining about twenty samples of spermaceti, found that commercial specimens have a melting point of from 42° to 47° C., a specific gravity ranging from 0.905 to 0.945 at 15° C., and saponification numbers from 125.8 to 134.6. (*A. J. P.,* 1896, 7, and 1897, 104.)

Uses.—Spermaceti has been given as a demulcent in irritations of the mucous membrane; but it has no remedial properties. It may be reduced to powder by the addition of a little alcohol or almond oil, or by melting it at a very low heat, pouring into a warm mortar, and agitating it until perfectly cold; an emulsion may be made by mixing spermaceti first with half its weight of olive oil, then with powdered gum arabic, and lastly with water. Spermaceti Cerate (*Ceratum Cetacei,* U. S. 1890) was made by melting together 10 parts of spermaceti and 35 parts of white wax and then adding 55 parts of warmed olive oil.

Off. Prep.—Unguentum Aquæ Rosæ, *U. S., Br.;* Unguentum Capsici, *Br.;* Unguentum Cetacei, *Br.*

CHARTA SINAPIS. U. S., Br.

MUSTARD PAPER

(chär'ta sĭ-nā'pĭs)

Sinapisme en feuille, *Fr. Cod.:* Papier Moutarde, Papier Sinapisé, *Fr.;* Charta sinapisata, *P. G.;* Senfpapier, *G.;* Carta senapata, *It.;* Papel sinapico, Charta sinapica, *Sp.*

* "Black Mustard, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Rubber, *ten grammes* [or 154 grains]; Petroleum Benzin, Carbon Disulphide, each, *a sufficient quantity.* Pack the Black Mustard in a conical percolator, and gradually pour Petroleum Benzin upon it until the percolate ceases to produce a permanent, greasy stain upon

[1] According to W. Gilmour, *sperm oil* should contain not less than 4 per cent. of cetin, and if much less be obtained by the following process, adulteration has been practised. Shake one part by weight of sulphuric acid (sp. gr. 1.84) with four parts of the oil; allow to stand 20 minutes, shaking twice; add 3 parts of distilled water; shake this thoroughly, and allow to stand from 16 to 20 hours; dilute with 3 or 4 times its volume of distilled water; agitate thoroughly. On standing, the cetin floats upon the top, and can readily be skimmed off, washed, dried, and weighed. (*P. J.,* vii. 328. See also *Chem. Ztg.,* 1893, 1458, and *Am. Drug.,* 1895, 105.)

blotting paper. Remove the powder from the percolator, and dry it by exposure to the air. Having meanwhile dissolved the Rubber in a mixture of *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], each, of Petroleum Benzin and Carbon Disulphide, mix the purified Mustard with a sufficient quantity of the solution to produce a semi-liquid magma, and apply this, by means of a suitable brush, to one side of a piece of rather thick, well-sized paper, so as to cover it completely, and then allow the surface to dry. A surface of sixty square centimeters should contain about 4 Gm. of Black Mustard deprived of oil. Before it is applied to the skin, Mustard Paper should be dipped in warm water for about fifteen seconds." *U. S.*

"Black and White Mustard Seeds, equal proportions by weight; Benzol, Solution of India-rubber, of each, a sufficient quantity. Bruise the Mustard Seeds and extract the fixed oil by percolation with the Benzol. Dry the residue by exposure to the air in a warm closet, and reduce to No. 60 powder. Mix seventy-five grains (or five grammes) of the purified mustard with five fluid drachms (or eighteen cubic centimetres) of Solution of India-rubber, and spread by means of a suitable brush over about 30 square inches (or about two square decimetres) of one side of a piece of cartridge paper. Allow it to dry by exposure to the air." *Br.*

The formula for this preparation was greatly improved by the U. S. P. in 1890 and Br. 1898. The British preparation (1885) was at fault in not providing for the extraction of the fixed oil by previously percolating with petroleum benzin or carbon disulphide; otherwise the paper will be greasy, giving to the plaster an untidy appearance and soiling the linen of the patient. Solution of gutta-percha is unsuited for use in this preparation, on account of want of adhesiveness, and the tendency of the mixture, when dry, to crack and peel off. We have used instead a solution of 1 part of pure rubber in 30 of equal parts of carbon disulphide and petroleum benzin. On the large scale, by means of a plaster spreading apparatus a uniform coat of this solution may be applied to paper. As the latter passes out from under the apparatus, a sieve containing the powdered mustard is shaken over it; this is fixed by the adhesive coat and firmly retained after the evaporation of the volatile liquids in a warm place. The application of the powdered mustard must be properly regulated according to the speed with which the machine delivers the coated paper. The paper is cut into pieces of convenient size, and needs only to be wetted with tepid water to be ready for use. Owing to the fact that the large manufacturers can put mustard paper upon the market at such low rates that it pays the apothecary better to buy than to prepare it, Charta Sinapis, so far as we can learn, is rarely made in the retail stores. Experience has shown that the ready-made mustard papers err rather from too much than from too little activity. Moreover, their action cannot be regulated with the same nicety as can that of the mustard poultice. Unless in the case of travellers, and of others who must wait upon themselves, the domestic application is preferable. The *mustard leaves* can rarely be borne for more than ten or fifteen minutes. For the medicinal uses of mustard paper see *Sinapis;* care should be observed to protect the leaves, as they are popularly called, from the action of moist air by keeping them in well closed tinned iron containers.

CHARTÆ.

PAPERS

(chär'tæ)

Papiers Sparadrapiques, *Fr.;* Medicamentirte Papiere, *G.*

This class of preparations, long official in the French Codex, was afterwards adopted into the British Pharmacopœia, but was not introduced into that of the United States until 1870.[1]

CHIMAPHILA. U. S.

CHIMAPHILA [Pipsissewa]

(ĉhi-mäph'i-la)

"The dried leaves of *Chimaphila umbellata* (Linné) Nuttall (Fam. *Ericaceæ*)." *U. S.*

Prince's Pine, Wintergreen; Bitter Wintergreen, King's Cure, Ground Holly, Love-in-winter, Rheumatism Weed; Herbe de Pyrole ombellée, *Fr.;* Doldenblüthiges Harnkraut, Wintergrün, *G.*

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[1] *Charta Cantharidis.*—A *blistering paper* was formerly recognized by the two Pharmacopœias, *Charta Cantharidis,* U. S., *Charta Epispastica,* Br.; but as these preparations were found inefficient, they have been very properly dropped from the official lists. The United States process (1880) is as follows: "White Wax, *eight parts* [or four ounces av.]; Spermaceti, *three parts* [or one and a half ounces av.]; Olive Oil, *four parts* [or two fluidounces]; Canada Turpentine, *one part* [or half an ounce av.]; Cantharides, in No. 40 powder, *one part* [or half an ounce av.]; Water, *ten parts* [or five fluidounces]. Mix all the substances in a tinned vessel, and boil gently for two hours, constantly stirring. Strain through a woolen strainer without expressing, and, by means of a water-bath, keep the mixture in a liquid state in a shallow, flat-bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces." *U. S.* 1880.

Charta Potassii Nitratis, U. S. 1890. (*Potassium Nitrate Paper*)—"Potassium Nitrate, *two hundred grammes* [or 7 ounces av., 24 grains]; Distilled Water, *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims]. Dissolve the Potassium Nitrate in the Distilled Water. Immerse strips of white, unsized paper in the solution, and dry them. Keep the paper in well-closed vessels." *U. S.* 1890. This preparation is identical with the *Charta Nitrata* of the German Pharmacopœia; it is sometimes called *asthma paper.* Care should be taken to dissolve thoroughly all the nitrate, so that it shall not be deposited upon the paper in large particles and interfere with slow and steady combustion. This paper is an excellent remedy, which in many cases of *asthma* affords much relief. It is used by burning in front of the patient, who inhales its fumes. Its efficacy is much increased by saturating it with fluidextract of belladonna and drying. Paper thus prepared must be used with some caution.

The genus *Chimaphila* was separated from *Pyrola* by Pursh. It embraces two American species, *C. umbellata* and *C. maculata,* known by the common title of *wintergreen.* The generic title is formed of two Greek words, χείμα, winter, and φίλος, a friend.

Chimaphila umbellata, Barton, *Med. Bot.,* i. 17; Carson, *Illust. of Med. Bot.,* i. 62, pl. 53.—*Pyrola umbellata,* Willd., *Sp. Plant.,* ii. 622; Bigelow, *Am. Med. Bot.,* ii. 15.—*Chimaphila corymbosa,* Pursh. *B. & T.* 165.—The pipsissewa is a small evergreen plant, with a perennial, creeping, yellowish root (rhizome), which gives rise to several simple, erect or semiprocumbent stems, from four to eight inches in height, and ligneous at their base. The leaves are wedge-shaped, somewhat lanceolate, serrate, coriaceous, smooth, of a shining, sap-green color on the upper surface, paler beneath, and supported upon short footstalks, in irregular whorls, of which there are usually two on the same stem. The flowers are disposed in a small terminal corymb, and stand upon nodding peduncles. The calyx is small and divided at its border into five teeth or segments. The corolla is composed of five roundish, concave, spreading petals, which are of a white color tinged with red, and exhale an agreeable odor. The stamens are ten, with filaments shorter than the petals, and with large, nodding, bifurcated, purple anthers. The ovary is globular and depressed, supporting a thick and apparently sessile stigma, the style being short and immersed in the ovary. The seeds are numerous, linear, chaffy, and enclosed in a roundish, depressed, five-celled, five-valved capsule, having the persistent calyx at the base. This humble but beautiful evergreen is a native of the northern latitudes of America, Europe, and Asia. It is found in all parts of the United States. It grows under the shade of woods, and prefers a loose sandy soil enriched by decaying leaves. The flowers appear in June and July. All parts of the plant are endowed with active properties. The leaves and stems are found in commerce. The leaves are officially described as "oblanceolate, 2.5 to 5 Cm. long, 8 to 18 Mm. broad, the upper portion coarsely and sharply serrate, acute or somewhat obtuse, the lower wedge-shaped and nearly entire; coriaceous, smooth, and uniformly dark green on the upper surface, paler beneath, the veins being very prominent; odor slight; taste astringent and bitter." *U. S.*

C. maculata (L.), Pursh (*Pyrola maculata,* L.), or *spotted wintergreen,* though not official, probably possesses similar virtues. The character of the leaves of the two plants will serve to distinguish them. Those of *C. maculata* are lanceolate, rounded at the base, where they are broader than near the summit, and of a deep olive green, veined with greenish white; the leaves of the official species are broadest near the summit, gradually narrowing to the base, and of a uniform shining green color.

Properties.—Pipsissewa, when fresh and bruised, exhales a peculiar odor. The leaves have been already described. Their taste is pleasantly bitter, astringent, and sweetish; that of the stems and root unites with these qualities a considerable degree of pungency. Boiling water extracts the active properties of the plant, which are also imparted to alcohol. The leaves have been examined by Samuel Fairbank, who found in them gum, starch, sugar, extractive, pectic acid, tannic acid, resin, fatty matter, chlorophyll, yellow coloring matter, lignin, a peculiar whitish substance which he calls *chimaphilin,* and various inorganic substances, as potassa, lime, magnesia, sodium chloride, and sulphuric, phosphoric, and silicic acids. The chimaphilin was obtained by agitating a tincture with chloroform, allowing the mixture to stand, removing the lighter liquid, and allowing the chloroformic solution to evaporate. A yellow crystalline substance was left, which, purified by solution in alcohol, filtration, and spontaneous evaporation, constituted the substance in question. It was also obtained by simply distilling the stems with water. It is in beautiful, golden-yellow, acicular crystals, inodorous, tasteless, fusible, volatilizable unchanged, insoluble or nearly so in water, soluble in alcohol, ether, chloroform, and the fixed and volatile oils, and possessed of neither acid nor alkaline properties. (*Journ. of the Maryland Coll. of Pharm.,* 1860.)

The active principle of pipsissewa leaves seems to have been isolated by E. S. Beshore (*A. J. P.,* 1887, p. 125) by treatment of the powdered leaves with petroleum spirit. He obtained white crystals, melting at 236° C., sparingly soluble in cold or boiling 90 per cent. alcohol, sparingly soluble in ether, benzin, chloroform, and cold glacial acetic acid; more soluble in hot glacial acetic acid. An ultimate analysis gave the formula $C_{10}H_{12}O$. He also obtained the golden-yellow crystalline principle of Fairbank both from the leaves and the stems. He considers it distinct from the one described above. Josiah C. Peacock (*A. J. P.,* 1892, p. 295) has made a careful analysis of both *C. umbellata* and *C. maculata.* He obtained in several ways the yellow crystalline principle *chimaphilin,* and studied its properties. It forms yellow acicular crystals, nearly odorless and tasteless, insoluble in water, soluble in alcohol, chloroform, ether, benzene, petroleum benzin, acetone, and glacial acetic acid. They may be sublimed by careful heating without change. Chimaphilin melts at 108° to 109° C., and has the composition $C_{24}H_{21}O_4$. Peacock also found three other crystalline principles, for which no formulas, however, are given. Ridenour (*A. J. P.,* 1895, 236) has also prepared chimaphilin, and by the analysis of the purified crystals and of two of its derivatives, confirms the formula, $C_{24}H_{21}O_4$, given by Peacock. He finds the melting point of the purified chimaphilin to be 114° C. He also prepared another crystalline

principle melting above 250° C., to which he gives the formula $C_{10}H_{19}O$, which agrees with Beshore's product. *Arbutin,* $C_{12}H_{16}O_7$, is also found in chimaphila.

Uses.—This plant is stated to have been used internally by the North American Indians in *scrofula* and *rheumatism,* and was subsequently a very popular remedy among the settlers of this country. It is now known, however, to be only slightly tonic, astringent, and diuretic. It is one of the mildest, and least effective of the so-called stimulating diuretics, being closely similar to, but less certain and effective than, uva ursi in its therapeutic influence and application. The best preparation is the official fluidextract, which may readily be made into a syrup.

Dose, thirty to ninety grains (2 to 6 Gm.).

Off. Prep.—Fluidextractum Chimaphilæ, *U. S.*

CHIRATA. U. S., Br.

CHIRATA

(ȼhị-rā'tạ)

"The dried plant of *Swertia Chirayita* (Roxburgh) Hamilton (Fam. *Gentianaceæ*)." *U. S.* "The dried plant, Swertia Chirata, *Ham.,* collected when in flower." *Br.*

East Indian Balmony; Chiretta; Chirette, *Fr.;* Chiretta, Ostindischer Enzian, *G.*

Swertia Chirayita (Roxb.), Hamilton. *Agathotes Chirayta,* Don, *Lond. Philos. Mag.,* 1836, p. 76.—*Gentiana Chirayta,* Fleming, *Asiat. Research.,* xi. 167.—*Ophelia Chirata,* Grisebach. *B. & T.* 183.—The *chirayta,* or *chirata,* is an annual plant, about three feet high, with a branching root, and an erect, smooth, round stem, branching into an elegant leafy panicle, and furnished with opposite, embracing, lanceolate, very acute, entire, smooth, three or five-nerved leaves. The flowers are numerous, peduncled, yellow, with a four-cleft calyx having linear acute divisions, the limb of the corolla spreading and four-parted, four stamens, a single style, and a two-lobed stigma. The capsules are shorter than the permanent calyx and corolla. The plant is a native of Nepaul and other parts of Northern India. The whole of it is gathered when the flowers begin to decay.[1]

The dried plant is imported into Europe in bundles, consisting mainly of the stems, with portions of the root attached. The stems contain a yellowish pith. The drug is officially described as "smooth; root simple, about 7 Mm. thick near the crown; stem about 1 M. long, externally yellowish or purplish-brown, cylindrical near the base, quadrangular and lightly winged above, with numerous opposite, ascending branches; wood yellowish, thin, enclosing usually a large yellowish easily separable pith; leaves opposite, sessile, ovate-lanceolate, entire, five-nerved, about 6 Cm. long; flowers numerous, panicled, small, with a four-lobed calyx and corolla; capsule ovoid, acute, one-celled, many-seeded; odor slight; taste intensely bitter." *U. S.* Its fruits are superior, bicarpellary, and unilocular. Its virtues are imparted to water and alcohol, and are retained in the extract. According to Lassaigne and Boissel, the stems contain resin, a yellow bitter substance, brown coloring matter, gum, and various salts. Flückiger and Höhn, who subsequently examined the stems and roots of chirata, extracted from them sugar, wax, chlorophyll, soft resin, tannin, an acid which they name *ophelic,* possessing the formula $C_{13}H_{20}O_{10}$, and a peculiar bitter substance, denominated *chiratin,* $C_{26}H_{48}O_{15}$. The acid is syrupy, deliquescent, yellowish brown, at first slightly sour, afterwards intensely bitter. It is soluble in water, with some turbidness, probably owing to resin mixed with it, and completely soluble in alcohol, or a mixture of this with ether. It decomposes certain salts, and forms amorphous compounds with acids. Chiratin is a yellow, hygroscopic powder, but feebly crystallizable, very bitter, sparingly soluble in cold water, more so in hot water, and readily dissolved by alcohol and ether. It is neutral to test paper, and yields a copious precipitate with tannic acid. By the action of acids, chiratin is separated into ophelic acid, and a yellowish-brown, amorphous substance, bitter, scarcely soluble in water, readily soluble in alcohol, and not reducing copper solutions, as the ophelic acid does. Höhn gives it the formula $C_{13}H_{24}O_3$, and names it *chiratogenin.* (*P. J.,* Aug. 1870, 106.)

Uses.—Chirata has long been used in India. It has been introduced into Europe, and appears to be highly esteemed, but has not been employed to any considerable extent in this country. Its properties are those of the pure bitters, and probably do not differ from those of the other members of the family of Gentianaceæ. (See *Gentiana.*) Like these, in overdoses it nauseates and oppresses the stomach. Some have supposed that, in addition to its tonic properties, it exerts a peculiar influence over the liver, promoting the secretion of bile

[1] In the Indian bazaars the name chirata is applied to various dried gentianaceous plants; the most important of these is the *Ophelia angustifolia.* It yields the *Paharee* or *Hill chirata,* which is distinguished by its inferior bitterness, and its rectangular, winged stems, whose section presents a thick woody ring and a centre nearly or entirely hollow, with only traces of pith. A false chirata, which has also found its way into the London markets, and resembles the official variety in having a well developed pith, but which is completely lacking in bitterness, is affirmed to be the product of *Ophelia alata.* (*P. J.,* xvii. 903.) Under the name of *Indian chirata,* the dried plant of the *Andrographis paniculata,* which is officially recognized by the Pharmacopœia of India, has appeared in the London market. It resembles much more closely recently dried broom tops than the true chirata. It is a little more than two feet long. The branching stems are from ⅛ to ¼ inch in thickness near the base, woody, quadrangular, furrowed, smooth, slightly knotted at the point from which the branches spring, the longitudinal furrows are continued through the roots, which have numerous fine radicles, the leaves are opposite decussate, branches erect or forming an acute angle with the stem, terminal shoots extremely slender.

and correcting it when deranged, and restoring healthy evacuations in cases of habitual costiveness. It has been used in *dyspepsia,* and in the *debility* of convalescence, and generally in cases in which corroborant measures are indicated. In India it has been successfully employed in *intermittents* and *remittents,* combined with the seeds of *Guilandina Bonducella,* L. It may be given in powder, infusion, tincture, or fluidextract.

Dose, twenty grains (1.3 Gm.).

Off. Prep.—Fluidextractum Chiratæ, *U. S.;* Infusum Chiratæ, *Br.;* Liquor Chiratæ Concentratus, *Br.;* Tinctura Chiratæ, *Br.*

CHLORALFORMAMIDUM. U. S.

CHLORALFORMAMIDE

(ȼhlō′rąl-för-mą-mī′dŭm)

$C_3H_4Cl_3NO_2 = 190.96$

"A crystalline solid [$CCl_3.CH(OH)NH.CO H$], made by the direct union of formamide with anhydrous chloral. It should be kept in amber-colored, well-stoppered vials." *U. S.*

Chloralamide; Chloralum formamidatum, *P. G.;* Chloralformamid, *G.*

Preparation.—It is made by mixing 45 Gm. of formamide with 147 Gm. of anhydrous chloral, when combination ensues; the crystalline mass is purified by recrystallization.

Properties.—Chloralformamide[1] is officially described as in "colorless, lustrous crystals, without odor, and having a somewhat bitter taste. Soluble in about 18.7 parts of water, and in 1.3 parts of alcohol at 25° C. (77° F.). It is readily soluble in ether, glycerin, acetone, and acetic ether. When heated with water to 60° C. (140° F.), it is hydrolized, hydrated chloral and formamide being produced. When heated to from 114° to 115° C. (237.2° to 239° F.), it melts, but at a higher temperature it is decomposed. It is not affected by diluted acids, but it is decomposed on warming with alkali hydroxides, the solution becoming at first turbid, and then clear, while chloroform separates. If 0.2 Gm. be heated carefully in an open dish, it should not give off inflammable vapors, and should volatilize without leaving a weighable residue (absence of *inorganic impurities* and distinction from *chloral alcoholate* and *ethyl carbamate*). One Gm. of Chloralformamide dissolved in 10 Cc. of alcohol should yield a solution which does not redden moistened blue litmus paper (absence of *formic, hydrochloric,* or *other free acids*). If 1 Gm. of Chloralformamide be dissolved in 10 Cc. of alcohol, the addition of a few drops of silver nitrate T.S. should not at once produce turbidity (absence of *decomposition products*)." *U. S.*

Uses.—Locally, chloralformamide is scarcely at all irritant, and when taken internally is quickly absorbed and is eliminated chiefly as urochloralic acid. When given to the lower animals, it produces lethargy, sleep, muscular relaxation, arrested respiration, followed by coma, failing respiration, and, if the dose has been sufficient, death by centric respiratory paralysis. As shown by the experiments of H. C. Wood and Cerna, subsequently confirmed by various observers, its influence upon the circulation and the spinal cord is extremely feeble, and it has no perceptible effect upon the nerve trunks and the muscles. It acts upon the cerebral cortex and therefore as an hypnotic resembles hydrated chloral, but its action is more slowly developed and is less positive. Confusion, giddiness and headache are the only unpleasant effects following its use, and they rarely occur. It is safer than hydrated chloral in the insomnia of cardiac weakness.

Dose, one-half to one drachm (2 to 3.9 Gm.), half an hour before the desired time of sleep.

CHLORALUM HYDRATUM. U. S. (Br.)

HYDRATED CHLORAL

[Chloral, Pharm. 1890, Chloral Hydrate]

(ȼhlō′rąl-ŭm hȳ-drā′tŭm)

$C_2HCl_3O + H_2O = 164.12$

"A crystalline solid, composed of trichloraldehyde or chloral [$CCl_3.COH$] with the elements of one molecule of water. It should be kept in glass-stoppered bottles, in a cool and dark place." *U. S.* "Chloral Hydrate, or trichlorethylidene glycol, $CCl_3.CH(OH)_2$, is obtained by the addition of water to the liquid chloral produced by the action of dry chlorine gas on ethylic alcohol." *Br.*

Chloral Hydras, *Br.;* Trichloraldehyd Hydrate, Trichlorethylidene Glycol; Hydrous Chloral; Chloral Hydraté *Fr. Cod.;* Hydrate de Chloral, *Fr.;* Chloralum Hydratum, *P. G.;* Chloral hydrat, *G.;* Clorallo idrato, *It.;* Hidrato de cloral, *Sp.*

Chloral was so uniformly used as a synonym for Hydrated Chloral that whenever the term chloral was used, the hydrated chloral was intended, and whenever the uncombined substance was referred to, it was designated *anhydrous chloral.* The U. S. P. (8th Rev.) now differentiates the official product by naming it hydrated chloral. Perhaps no medicine ever came so rapidly into extensive use as that now under consideration. Though discovered by Liebig in 1832, it was not until 1869 that its remedial properties were first made known by their discoverer, Otto Liebreich of Berlin; in 1878 the consumption of chloral was estimated at one ton daily in England and America alone; and, although not used now to this extent, it is still largely employed.

[1] *Chloralimide,* $CCl_3.CH{=}NH$, should not be confounded with chloralamide. Chloralimide is in colorless, inodorous, and insipid, long crystalline needles; melting at about 166° C. (330.8° F.); insoluble in water; readily soluble in alcohol, in ether, in chloroform, and in oils. Concerning its physiological action we have no certain knowledge; it is asserted to be hypnotic in doses of from fifteen to sixty grains (1 to 3.9 Gm.).

Anhydrous Chloral.—In preparing anhydrous chloral, the simple method originally employed by Liebig, of acting directly on alcohol by chlorine, is generally preferred, even, we believe, by the larger manufacturers. The following details of the manufacture of hydrated chloral as carried out on a commercial scale have been supplied by E. Schering of Berlin, who has been for years the largest manufacturer of it.

Absolute alcohol, in lots of 50 pounds each, is placed in large glass flasks and saturated with chlorine, which is passed in a continuous stream for 6 to 8 weeks. The chlorine is led into cold alcohol at first, and when no more is absorbed, the alcohol is heated at first gently and then to 60° C. (140° F.). When saturated, the mixture formed, in which the chloral now exists as chloral alcoholate, is agitated with sulphuric acid at a temperature of 60° C. (140° F.) for several hours, during which time most of the hydrochloric acid escapes. The separated chloral is then rectified over calcium carbonate. The pure chloral so obtained is then mixed in glass flasks with the necessary amount of water, and the resulting hydrated chloral either cast into cakes or purified by crystallization. As solvents for this purpose certain of the side products of the chloral manufacture, after being purified and rectified, are used, for instance, ethylene and ethylidene chlorides; or in their absence chloroform is used; petroleum benzin and carbon disulphide have also been recommended. The action of chlorine upon alcohol is said to be aided by the presence of "chlorine carriers," such as iodine, ferric chloride, thallium chloride, etc. The formula of anhydrous chloral is C_2Cl_3HO; in other words, aldehyde, C_2H_4O, in which 3 atoms of hydrogen has been replaced by 3 atoms of chlorine. The name of chloral was derived from the *chlor*ine and *al*cohol from which it is formed. The anhydrous chloral thus formed is a colorless liquid, of penetrating disagreeable odor, of little taste, of the sp. gr. 1.502, and boiling at 94° C. (201.2° F.). It is soluble in ether or chloroform without change. According to A. Trillat, in the formation of chloral from alcohol, the latter is first changed by the action of the chlorine into aldehyde; this unites with alcohol to form acetal, which is changed successively into mono-, di-, and trichloracetal; the action of hydrochloric acid decomposes this latter with the formation of chloral alcoholate and ethyl chloride; sulphuric acid decomposes the alcoholate, liberating chloral, which then is made to combine with water to form the crystalline hydrated chloral. (*Bulletin,* 1897, 17, 230.) As the union of hydrated chloral with water develops heat, it is supposed to be more than the formation of a hydrate, and the formula $CCl_3.CH{-}OH$ is assigned to the resulting compound. It does not show all the reactions of an aldehyde, as, for example, the red color of a magenta solution that has been decolorized with sulphurous acid, is not restored by it.

Meta-chloral.—By continued contact of anhydrous chloral and concentrated sulphuric acid, a change is effected in the chloral, by which it becomes a solid insoluble in water, which is designated as *insoluble chloral,* or *meta-chloral.* It is tasteless, of a white color resembling porcelain, and insoluble in alcohol and ether. Its formula is $C_6H_3Cl_9O_3$, being formed by the union of three molecules of chloral. It is stated that when perfectly pure, chloral does not become polymerised; the change is also said to be prevented by the addition of a little chloroform. When heated to 180° C., meta-chloral distils with reversion to liquid chloral. (Allen, *Com. Org. Anal.,* 2d ed., i. p. 171.)

Chloral Alcoholate.—A compound obtained by Roussin, which he announced as pure hydrated chloral, was found by Personne to contain no water, but to be in fact a compound of alcohol and chloral, and is now known by the name of *chloral alcoholate,* C_2HCl_3O,C_2H_6O. It results directly from the action of absolute alcohol on anhydrous chloral, and is now known to be formed as a stage in the manufacture of chloral from alcohol. As it is very likely to be confounded with hydrated chloral, the following points of difference should be noted. It forms white crystals melting at 46° C. (114.8° F.), and boils at 113.5° C. (236° F.), while hydrated chloral crystals melt at 58° C. (136.4° F.), and boiling at 97.5° C. (207° F.); chloral alcoholate melts without complete solution when warmed with two volumes of water, and, on cooling, congeals below the surface of the water, while hydrated chloral is soluble in one and one-half times its weight of water; chloral alcoholate, gently heated with nitric acid of 1.2 sp. gr., is violently attacked, while hydrated chloral is scarcely acted on; chloral alcoholate, when heated on platinum foil, inflames readily, while hydrated chloral scarcely burns. (Allen, *Com. Org. Anal.,* 2d ed., i. p. 172.)

The three related products, the *anhydrous chloral,* the polymeric *meta-chloral,* and the *alcoholate,* described above, have been more or less introduced into the European markets, and have required some notice to prevent them from being confounded with the hydrated chloral, which is alone official. The following observations will be confined to this last compound, and the reader will note that whether the simple term chloral, or the exact designation, hydrated chloral, is used, the same substance is intended.

Properties of Hydrated Chloral.—This is made by simply mixing anhydrous chloral with water. Acicular crystals soon form, which result from the union of a molecule each of the chloral and water, constituting hydrated chloral. As employed in the United States, this comes, we believe, exclusively from Europe, and chiefly from Germany. It was at one time

made in this country by E. R. Squibb of Brooklyn. It occurs in commerce mainly in two forms; in distinct crystals, which is the official form, or in crystalline plates, about three lines in thickness, broken into small, irregular pieces, so as to be readily introduced into broad-mouthed bottles. These pieces, while retaining their tabular form, are somewhat translucent, but usually covered with a white powder, which somewhat conceals that property. This is the more common form and the cheaper; but the crystals are to be preferred, as their purity may be relied on. Guerin adds his testimony to the necessity for dispensing only hydrated chloral which has been recrystallized and which is in the form of distinct crystals. He examined many samples, and found acidity in the cake variety, due, as he believes, to the formation of hydrochloric and formic acids, produced by the action of water retained in the cake during the manufacture, and this remaining in contact with the crystals excites decomposition. (*A. Pharm.*, 1886, p. 253.)

Hydrated chloral is white, possessing a peculiar pungent odor, and an acrid pungent taste, especially affecting the velum pendulum. The odor has been compared to that of an overripe melon. Exposed to the air it very slowly volatilizes, and, like camphor, when enclosed in a bottle, covers the interior surface with numerous minute crystals. The boiling point of the pure crystals is 97.5° C. (207° F.). If the boiling point be under 95° C., it indicates an under-hydrated preparation; if above 98° C., an over-hydrated one. (E. R. Squibb.) The pure hydrated chloral does not take fire when heated in a spoon, but evaporates without residue. With the aid of heat, its solution may be effected readily in chloroform; and the solution, on cooling, deposits it in beautiful crystals, which are generally needle-shaped, while those deposited from a solution in carbon disulphide are prisms. The aqueous solution is prone to decomposition, which is ultimately attended with the development of low organisms. Hydrated chloral should not, therefore, be kept long in this state. (E. Labbée, *A. G. M.*, Sept. 1870.) In its relation to acids and alkalies it is neutral or, according to E. Schering, slightly acid when perfectly pure. When equal parts of hydrated chloral in crystals and of camphor in small fragments are shaken together in a bottle, and allowed to stand, they liquefy, forming a clear solution. When hydrated chloral and sulphuric acid are mixed, the temperature is greatly reduced. A solution of hydrated chloral dissolves morphine, quinine, and most of the vegetable alkaloids. (R. F. Fairthorne, *A. J. P.*, Oct. 1871, p. 447.) When ammonium sulphide is added to an aqueous solution of hydrated chloral, the mixture rapidly turns yellow, and, after passing through several shades of color, finally becomes dark brown. From this liquid diluted sulphuric acid throws down a bulky brown precipitate. This, purified from precipitated sulphur and dried, is a light-brown powder of the composition $C_{18}H_{24}S_{13}N_4O_8$. Hydrogen sulphide gas forms a sulphydrate by its action on hydrated chloral. These reactions are important, as the detection of metallic poisons in toxicological cases by hydrogen sulphide has been complicated by the presence of hydrated chloral. A still more important chemical reaction of hydrated chloral is that which takes place when the hydrated, or either of its other forms, is placed under the influence of an alkali. Chloroform is developed, and along with it a formate of the alkali employed. Thus, in a strong solution of potassium hydroxide, put a pinch of powdered hydrated chloral, and almost instantly the odor of chloroform becomes sensible, and some oil-like globules of chloroform may be seen at the bottom of the vessel. The reaction is as follows:

$C_2HCl_3O.H_2O$	+	KOH	=	
Hydrated chloral		potassium hydroxide		
$CHCl_3$	+	$CHO.OK$	+	H_2O
chloroform		potassium formate		water

This relation of hydrated chloral to chloroform would serve as a ready test of the former, and may be used also to determine its quality, for pure hydrated chloral ought by calculation to yield 76.35 per cent. of chloroform, and the best known yields, according to the table of Mason, 71.5 (72.20 Selden) per cent. If, therefore, the product of chloroform should fall much below the latter percentage, the parcel acted on is probably impure. For other methods of assaying hydrated chloral see Allen, *Com. Org. Anal.*, i. pp. 174 and 175. The following description and tests are given in the U. S. Pharmacopœia. "Separate, rhomboidal, colorless and transparent crystals, having an aromatic, penetrating, and slightly acrid odor, and a bitterish caustic taste; slowly volatilized when exposed to the air. Freely soluble in water, alcohol, or ether; also in chloroform, benzene, petroleum benzin, carbon disulphide, fixed and volatile oils. It liquefies when triturated with about an equal quantity of camphor, menthol, thymol, or phenol. When dried and heated to about 58° C. (136.4° F.), it melts, forming a liquid having a specific gravity of about 1.575, which, at a higher temperature, should not evolve inflammable vapors. Liquefied Hydrated Chloral solidifies to a crystalline mass between 35° and 50° C. (95° and 122° F.).

Hydrated Chloral is decomposed by caustic alkalies, alkaline earths, and ammonia, chloroform and a formate of the base being produced. When warmed with a few drops of aniline and sodium hydroxide T.S., the intensely disagreeable odor of phenyl-isocyanide (isonitril reaction) should be produced. Hydrated Chloral should be dry, and not readily attract moisture in dry air. A freshly prepared, aqueous solution of Hydrated Chloral should be neutral to litmus paper, but it gradually acquires an acid reaction. A neutral alcoholic solution remains neutral permanently. An aqueous solution of Hydrated Chloral (1 in 20), acidulated with nitric acid, should remain unaffected by silver

nitrate T.S. (absence of *hydrochloric acid* and *chlorides*). If 1 Gm. of Hydrated Chloral be placed in a porcelain dish and be covered with 1 Cc. of nitric acid (sp. gr. 1.38) no yellowish coloration of the mixture should be produced at ordinary temperatures, or even after warming the mixture 3 or 4 minutes, nor should yellowish fumes be produced after ten minutes' warming (absence of *chloral alcoholate*)." *U. S.*

"Soluble in less than its own weight of *water, alcohol* (90 per cent.), or *ether,* and in four times its weight of *chloroform.* The aqueous solution is neutral or but slightly acid to *litmus.* On the application of heat Chloral Hydrate fuses to a colorless liquid, which, as it cools, begins to solidify at a temperature of about 120° F. (48.9° C.). In a test-tube it boils, when pieces of broken glass are immersed in it, at from 202° to 206° F. (94.4° to 96.7° C.), and on platinum foil at a slightly higher temperature it volatilizes without residue. In presence of alkaline substances Chloral Hydrate is decomposed and chloroform is liberated. If 4 grammes be heated with 30 cubic centimetres of the *volumetric solution of sodium hydroxide,* no more than 6 cubic centimetres of the *volumetric solution of sulphuric acid* should be required to neutralize the soda which remains free on the completion of the reaction. A solution in *chloroform,* when mixed by agitation with *sulphuric acid,* does not impart color to the acid (absence of certain organic impurities). When 1 gramme of Chloral Hydrate is warmed with 6 cubic centimetres of *water,* and 0.5 cubic centimetre of *solution of potassium hydroxide,* the mixture filtered, sufficient *solution of iodine* added to impart a deep-brown color, and the whole set aside for an hour, a yellow crystalline precipitate of iodoform should not result (absence of chloral alcoholate). Its aqueous solution should not afford any precipitate with *solution of silver nitrate* (absence of free chlorides)." *Br.*

The most delicate test for the presence of chloral alcoholate in hydrated chloral is said to be that with nitric acid. When 1 Cc. of nitric acid (1.38 sp. gr.) is poured over 1 Gm. of hydrated chloral a yellow color should not appear within 10 minutes, even if the mixture be warmed. (*A. J. P.,* 1894, 191.) For other tests for hydrated chloral by Jaworowski, see *Ph. Z. R.,* 1894, 373.

Uses.—When hydrated chloral is ingested in full therapeutic dose (from 15 to 30 grains), it produces in from ten minutes to half an hour a quiet, placid sleep, which usually continues about three hours, when it ceases, generally without any unpleasant symptom during its progress or after its termination. In some instances the ordinary doses fail to cause sleep, and in others the sleep is attended with dreams and hallucinations, and followed by unpleasant symptoms, like those which often succeed other hypnotics, especially opium, such as nausea, headache, unpleasant nervous disorder, etc. These diversities may be ascribed in part to peculiarity of constitution; but more frequently, in all probability, they are owing to morbid conditions existing at the time, which oppose themselves to the proper action of the chloral. In an individual in health hydrated chloral will probably almost always induce a calm sleep, differing little from the natural. Moreover, these unpleasant symptoms are now much more rarely produced than formerly, and there can be but little doubt that they have often been due to the impurities of the drug. The pulse is in this degree of action not affected, or is rendered a little slower; the pupil is contracted, but becomes normal so soon as the subject is awakened; the respiration is deep, full, and regular. When larger amounts are given, the sleep is much deeper, and may pass into profound coma; the respirations fall in number; the pulse is weakened and rendered slower, but may become rapid and irregular if the dose has been toxic; the temperature is reduced; the muscular system is relaxed, and both sensibility and reflex action are diminished. If a fatal dose has been given, all these symptoms are intensified; with coma, intense muscular relaxation, weak, thready pulse, and a pupil contracted at first, but afterwards dilated, the victim gradually sinks into death, paralyzed and anæsthetized. The immediate cause of death is generally a paralytic arrest of respiration, but in many cases there appears to have been a simultaneous arrest of the cardiac action, and it is very possible that fatal syncope may at times occur. At post-mortem examination, congestion of the meninges and substance of the brain and cord, and of the lungs, is commonly found. The blood is thought by Richardson (*M. T. G.,* Sept. 4, 1870) to coagulate less firmly than normal.

After the brain the motor tract of the spinal cord, including the respiratory centre, is most sensitive to the action of hydrated chloral. The loss of voluntary muscular power and the lessening of reflex activity which the drug produces are the result of the spinal influence. Upon the sensory tract of the cord hydrated chloral acts with much less vigor, while the nerves and muscles practically escape its influence. Of course any agent which produces sleep in some measure relieves pain, but the anæsthetic influence of hydrated chloral is far from pronounced, and often patients on waking will complain bitterly of pain suffered during sleep.

The physiological action of hydrated chloral may be summed up as follows. Upon the cerebrum it acts as a most powerful and certain hypnotic; in full doses it acts as an intense depressant upon the centres at the base of the brain, and upon the spinal cord, causing slowing and weakness of the heart's action, probably vasomotor paralysis, slowing of the respiration, and muscular weakness, lessening of reflex activity, with a certain amount of anæsthesia; in fatal doses it causes death generally by arresting respiration through paralysis

of the nerve centres, and finally stopping the heart in diastole. Its action in very small doses is uncertain, but there is considerable evidence to indicate that it irritates or stimulates the spinal and the cardiac, and even the vasomotor, centres. On the vagi and on the motor nerve trunks it has no marked influence. Clinical experience indicates that hydrated chloral acts as a depressant to the heart muscle, although some authorities believe the influence of the drug upon the heart is not direct, but exerted through the nerve-centres. Hydrated chloral has little effect on the secretions, though it is said to somewhat increase the secretion of urine. In man, it is stated by Bouchut that, in accordance with his observations, this secretion is not only increased, but has been found also augmented in density, at the same time reducing Fehling's solution, and rendered brown by potassium hydroxide or bismuth subnitrate, as if a temporary glycosuria were produced. Formic acid has never been found in the urine as a result of the taking of hydrated chloral. (*A. G. M.*, Sept. 1870, p. 346.)

The conversion of hydrated chloral by alkalies in solution into chloroform and formic acid first suggested its use in medicine to Liebreich (*W. M. W.*, August, 1869); and the theory that its action is really due to chloroform generated by the alkalinity of the blood has been received with favor by Personne and other writers, but there are very many facts which militate against the truth of this supposition. Thus, chloroform cannot be detected in either the blood, breath, or excretions of chloralized animals, although chloroform at once manifests itself when it is administered, and in the so-called "salt frogs" of Colnheim, after substitution of warm salt water for the blood of the animal, hydrated chloral acts as upon the normal batrachian.

Hydrated chloral, especially when used continuously, is said to produce in some individuals serious disturbances. Such are vasomotor paralysis, transient skin neurosis, acute purpura, and great prostration of the heart's action sometimes amounting to paralysis of that organ, and sometimes ending fatally, even though the doses of the chloral used were within the limits ordinarily deemed safe. For a full discussion of these phenomena, see Wood's *Therapeutics*. There can be no doubt that great caution should be practised in administering the drug when the heart is very weak or the general powers are much enfeebled. Jolly relates two cases in which 5 grammes (about 75 grains), given every night, caused death, in one case after the fifth dose, and in the second after the thirteenth dose, without abnormal symptoms until after the last dose, when the action of the heart and respiration suddenly ceased, and the patient died. (*N. Y. M. J.*, Nov. 1872.) These cases would appear to justify the statement that there is a possible cumulative action of the drug. Although 480 grains (31 Gm.) have been recovered from, Fuller has recorded a case in which a single dose of thirty grains (2 Gm.) proved fatal in a young lady, and two others in which the same quantity caused alarming symptoms in similar circumstances; so that the highest dose to begin with in ordinary diseases, especially in delicate women, should not exceed twenty grains (1.3 Gm.). In poisoning by hydrated chloral, if the case be seen early, the stomach should be thoroughly evacuated by an emetic or the stomach tube, and the system afterwards supported by cardiac and respiratory stimulants, as whisky, ammonium carbonate, etc. Atropine, digitalis, and strychnine should be administered freely, and the same general measures taken to sustain the respiration as are usually practised in opium poisoning. Atropine is undoubtedly of value when there is failure of respiration, and care should always be taken to maintain the bodily temperature by the application of external heat. Artificial respiration should be practised when necessary.

From what has been said it will be readily perceived that the indications for prescribing this remedy are when sleep is to be induced and spasm relaxed. In purely *nervous insomnia*, and in the same affection attendant on various diseases, as in *acute fevers, active congestion of the brain, cerebral inflammation, mania, delirium tremens*, etc., it is superior to opium; fifteen to twenty or twenty-five grains (1 to 1.3 or 1.6 Gm.) are generally sufficient for a commencing dose, to be repeated in half the quantity in an hour if the first dose fails. The sleep is usually calm and undisturbed for three or four hours, and may be renewed, if required, by the repetition of the dose. When the sleeplessness is due to pain, opium is much more effective than hydrated chloral. The combination of hydrated chloral and morphine is often very useful in procuring sleep for the suffering. As an anæsthetic, hydrated chloral should never be employed; the intravenous use of it, as at one time practised in France, is most dangerous and absolutely unjustifiable. In spasmodic affections hydrated chloral is one of the most powerful remedies known. In *tetanus* and in *strychnine poisoning* it is singularly useful, but must be given in very large doses. In *hysteria, severe chorea*, and other functional or spinal convulsions, it is no less efficient. In *epilepsy* and other forms of cerebral convulsions hydrated chloral is of less service, although it is frequently employed with benefit in *puerperal convulsions*. In *local spasms* it is often of service, and it has been used with success in *strangulated hernia, spasm of the glottis, spasmodic croup, asthma, hiccough*, and even in *incontinence of urine*. Hydrated chloral is possessed of very decided antiseptic properties; a solution of the strength of 30 grains to the ounce will preserve animal tissues for a long time. Locally applied, hydrated chloral is stimulating and antiseptic, and may occasionally be used with very good results in the treatment

of *foul sores, irritable ulcers,* etc., which need stimulation. The solution may vary from five to thirty-one grains to the ounce, according to the exigencies of the case. A. M. Fauntleroy states that if powdered hydrated chloral be sprinkled on adhesive plaster and the whole heated sufficiently to adhere to the skin, and applied while warm, there is produced an increasing burning, and in about ten minutes a blister is formed.

Hydrated chloral is best administered in solution with syrup of orange flowers, or in simple solution. The French sometimes employ *chloral cream,* made of hydrated chloral 5 parts, water 15 parts, white sugar finely powdered 100 parts, flavored with mint, orange, or vanilla. One grain of hydrated chloral is contained in 24 grains of the cream, and a teaspoonful is equivalent to about 3 grains of hydrated chloral. This preparation keeps well, and the dose may be dissolved in a little water. *Chloral liniment* may be made by dissolving 6 parts hydrated chloral in 30 parts oil of sweet almonds. *Chloral ointment,* 6 parts hydrated chloral, 3 parts white wax, 27 parts lard; the lard and wax are melted at a gentle heat, the hydrated chloral added in powder and dissolved. *Chloral plaster,* to produce counter-irritant effects, is prepared by spreading powdered hydrated chloral on Burgundy pitch plaster; care should be taken to distribute it uniformly.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Syrupus Chloral, *Br.*

CHLOROFORMUM. U. S., Br.

CHLOROFORM

(ȼhlō-rọ-fôr′mŭm)

$CHCl_3 = 118.45$

"A liquid consisting of 99 to 99.4 percent., by weight, of absolute Chloroform [$CHCl_3 = 118.45$], and 0.6 to 1 percent. of alcohol. It should be kept in dark amber-colored, glass-stoppered bottles, in a cool and dark place." *U. S.* "Chloroform, or trichloromethane, $CH Cl_3$, to which has been added sufficient Absolute Alcohol to produce a liquid having a specific gravity not less than 1.490, and not more than 1.495. Trichloromethane may be prepared by heating a mixture of chlorinated lime, slaked lime, ethylic alcohol, and distilled water." *Br.*

Trichlormethane, Methenyl Trichloride; Chloroformum Purificatum, *U. S.* 1880; Formylum Trichloratum; Chloroforme Officinal, *Fr. Cod.;* Chloroformium, *P. G.;* Reines Chloroform, Chloroform, *G.;* Cloroformio, *It.;* Chlorido formico, Cloroformo, *Sp.*

Neither the U. S. nor British Pharmacopœias give detailed processes for chloroform. (See U. S. D., 17th ed., 370.)

In the U. S. Pharmacopœia of 1850 a process was given for preparing chloroform; but, as this is never made on a small scale by the apothecary, it was very properly transferred, in 1860, to the Materia Medica Catalogue. *Chloroformum venale,* or commercial chloroform, was introduced, and also a formula for the purification of chloroform; this was very properly dropped in the U. S. P. 1890, as pure chloroform is now furnished by the manufacturers and easily obtainable at a moderate price; the process for purifying chloroform attached to the tests of the U. S. P. (1880) will be found below. The process of the British Pharmacopœia (1885) is for the preparation of the chloroform *ab initio,* with directions which secure its purity if complied with. In this process, the reaction by which the chloroform is produced takes place between the chlorinated lime and the alcohol, the slaked lime being intended probably to lessen the production of the chlorinated pyrogenous oil. As first distilled, the chloroform is very impure, and is directed to be washed first with ordinary water, and afterwards with distilled water, which separate alcohol, chlorine, and probably other contaminating substances. In consequence of the density of the chloroform and its insolubility in water, it readily subsides, forming a distinct layer which may be easily separated. The crude product, after having been freed from alcohol by the washing with water, is purified from the chlorinated pyrogenous oil, which comes over with the chloroform, by agitation with an equal volume of sulphuric acid, which ought to be *pure* and *colorless,* and at least of the density of 1.840. The oil is charred and destroyed by the acid, which becomes yellow or reddish brown, and is partially changed into sulphurous acid. To remove the latter acid, as well as any water present, the chloroform, which floats on the surface of the acid, is removed and agitated well with chloride of calcium and quicklime, then again submitted to distillation, and one per cent. of absolute alcohol added to preserve the chloroform from decomposition. In the U. S. 1880 process (see 16th edition U. S. D.) the method of purification is somewhat different. Instead of equal measures of the impure chloroform and sulphuric acid and an agitation for only 5 minutes, the commercial chloroform is shaken occasionally for 24 hours with but one-fifth of its weight of the acid. To remove any water and acid that may be present, instead of calcium chloride and lime, a little stronger alcohol is mixed with the chloroform in a dry retort, and then lime in coarse powder is added, and the mixture is distilled to dryness.

Purification. U. S. P. 1890.—Chloroform which fails to respond to the official tests (see p. 331) should be purified by the following process. "Chloroform, *four hundred grammes* [or 14 ounces av., 48 grains]; Sulphuric Acid, *eighty grammes* [or 2 ounces av., 359 grains]; Dried Sodium Carbonate, *twenty grammes* [or 308 grains]; Deodorized Alcohol, *four cubic centimeters* [or 65 minims]. Add the Sulphuric Acid to the Chloroform, contained in a glass-stoppered bottle, and shake them together occasionally during twenty-four hours, avoiding

exposure to bright daylight. Separate the lighter Chloroform layer, add to it the Dried Sodium Carbonate, previously rendered anhydrous by heating it in a porcelain capsule on a sand-bath until it ceases to give off aqueous vapor, and shake them together frequently and thoroughly during half an hour. Then transfer the Chloroform to a dry retort, add to it the Alcohol, and distil, by means of a water-bath, at a temperature not exceeding 67.2° C. (153° F.), into a well-cooled receiver, until the distillate measures *two hundred and fifty-five cubic centimeters* [or 8 fluidounces, 298 minims]." *U. S.* 1890.

It sometimes happens that the chloroform purified with sulphuric acid, though apparently pure at first, will not keep, but after some time becomes so loaded with chlorine and hydrochloric acid as to be altogether unfit for respiration. Squibb attributed the fact that chloroform purified by concentrated sulphuric acid does not keep well, to the very purity attained. He believed that perfectly pure chloroform is prone to decomposition, and is rendered more stable by the addition of a small proportion of alcohol, so as to reduce its density to the official standard. This he effected by adding alcohol in the proportion of ten drops to each fluidounce of good chloroform of maximum density (see *Amer. Med. Monthly*, July, 1857). This recommendation was carried into effect in the U. S. 1880 process, and explains the addition of alcohol before distillation. Gregory also attributes the tendency to decomposition to its purity, and to the action of sunlight; having found that those portions which he had purified with the greatest care were soonest decomposed under the influence of light. For methods of preserving chloroform by the use of sulphur, hypophosphorous acid, etc., see *P. J.*, 1895, 261; also 1896, 249.

As chloroform of great purity is *usually* to be purchased in the market, it is not necessary for the pharmacist to apply the official process of purification to every parcel that he may meet, but it is in the highest degree incumbent on him to sell none for inhalation which is not so pure as to stand the tests given in the Pharmacopœia, and if he can obtain none so pure, then to purify it himself.

The intermediate formation of hydrated chloral as a result of the reaction between alcohol and chlorinated lime suggested the preparation of chloroform from hydrated chloral. The advantages which were anticipated from decomposing pure hydrated chloral with alkalies have not altogether been realized, for the product is much more expensive, and the claim of greater stability has not been sustained, as it requires just as much alcohol to preserve it as that made in the usual way.

Chloroform is now made on a large scale both in this country and in Germany by the distillation of acetone with chlorinated lime; indeed, this process has entirely replaced the manufacture from alcohol. Liebig, as long ago as 1832, described the reaction, but it was thought to be not adapted for commercial use. In 1882 the manufacture was begun on a commercial scale at Mannheim, Germany, and since June, 1885, in this country. To get a satisfactory yield a very pure acetone is necessary. When such acetone is taken, a yield of nearly or quite 200 per cent. of chloroform can be obtained. (For an account of the methods of purifying the acetone and distilling with chlorinated lime, see *A. J. P.*, 1889, p. 321.) In July, 1885, a patent was taken out by G. Michaelis of Albany, for the manufacture of chloroform from the liquid products resulting from the decomposition of crude acetates at high temperatures. These liquid products are acetone and other higher ketones. The purified chloroform from acetone has a small quantity of alcohol added to prevent decomposition and bring it to pharmacopœial requirements. Pure methyl alcohol, on the other hand, does not yield chloroform. The erroneous statements on this point generally current are probably due to the fact that commercial wood spirit contains a large percentage of acetone.

E. R. Squibb preferred acetic acid to the acetates in the intermediate step of making acetone, thus avoiding impurities likely to be present in acetates; he believed that the grant of a patent for "acetone chloroform" was deficient in equity. (*Ephem.*, 1896, 1743 to 1757.)

Still another method for the manufacture of chloroform from acetone is described in the French technical journals,—viz., to electrolyze a solution of common salt mixed with acetone. A retort of enamel-lined iron, jacketed at the bottom so as to be heated by steam, and provided with a delivery and condensing tube, is used. A 20 per cent. solution of common salt is introduced into the retort and heated to boiling, when the current is made to pass and a continuous stream of acetone is run in. The nascent chlorine liberated rapidly converts the acetone into chloroform, and it distils over. It is claimed that "190" per cent. of the weight of the acetone taken is obtained as chloroform. Lead electrodes were used at first, but these have been replaced by carbon rods which can be attached to a vertical shaft and made to serve as stirrers. The negative electrode consists of a copper cylinder. (*Revue Scientifique*, Feb. 1893.)

Carbon tetrachloride (CCl_4) has also been proposed (1896) as a source of chloroform, and as it is now made cheaply on a large scale, it may come into use. By the action of hydrochloric acid and zinc, hydrogen is liberated and attacks the carbon tetrachloride, forming chloroform and hydrochloric acid,

$$CCl_4 + H_2 = CHCl_3 + HCl$$

As hydrochloric acid is a product of the reaction, fresh quantities of zinc are attacked, and a new liberation of chloroform follows.

Discovery and History.—Chloroform was discovered by Samuel Guthrie of Sackett's Harbor, N. Y., in 1831, and about the same time by

Soubeiran in France, and Liebig in Germany. Guthrie obtained it by distilling a gallon from a mixture of three pounds of chlorinated lime and two gallons of alcohol of the sp. gr. 0.844, and rectifying the product by redistillation, first from a great excess of chlorinated lime, and afterwards from potassium carbonate. (*Silliman's Journal,* vol. xxi., Jan. 1832, p. 64.) In a subsequent letter to Silliman, dated Feb. 15, 1832, Guthrie states that the substance which he had obtained, "distilled off sulphuric acid, has the specific gravity of 1.486, or a little greater, and may then be regarded as free from alcohol; and if a little sulphuric acid which sometimes contaminates it be removed by washing it with a strong solution of potassium carbonate, it may then be regarded as *absolutely pure.*" (*Ibid.,* vol. xxii., July, 1832, p. 105.) It is thus evident that Guthrie obtained, in a pure state, the substance now called chloroform; but he erroneously supposed his product to be the well known oily liquid of the Dutch chemists, which it greatly resembles, and for the preparation of which he believed he had fallen on a cheap and easy process. Under this impression, he called the substance, in his communications, *chloric ether,* one of the names by which *Dutch liquid,* or *ethene dichloride,* is designated. He was induced to make the preparation from noticing in Silliman's *Elements of Chemistry* a reference to the Dutch liquid as a grateful diffusible stimulant when properly diluted with alcohol and water. (See also *West. Drug.,* 1894, 51.)

Properties.—Chloroform is "a heavy, clear, colorless, mobile and diffusible liquid, of a characteristic, ethereal odor, and a burning, sweet taste. Specific gravity: not below 1.476 at 25° C. (77° F.). Chloroform is volatile even at a low temperature, and boils at 60° to 61° C. (140° to 141.8° F.). It is not inflammable, but its heated vapor burns with a green flame." *U. S.* "A liquid of characteristic odor and pungent sweet taste. Specific gravity 1.490 to 1.495. It should boil between 140° and 143.6° F. (60° and 62° C.)." *Br.* According to Remys (*A. Pharm.,* 3, v. 31), pure chloroform has the sp. gr. of 1.500 at 15° C. (59° F.). Besnou gives the densities of various mixtures of alcohol and the purest commercial chloroform at 4.5° C. (40° F.) as follows:

Specific Gravity.	Chloroform, per cent.	Alcohol, per cent.	Specific gravity.	Chloroform, per cent.	Alcohol, per cent.
1.4945	100.0	0.0	1.4772	97.5	2.5
1.4908	99.5	0.5	1.4602	95.0	5.0
1.4874	99.0	1.0	1.4262	90.0	10.0
1.4840	98.5	1.5	1.4090	87.5	12.5

When pure, it has no action on potassium, except to cover the surface of the metal with small bubbles of gas. Chloroform is a powerful antiseptic. Like creosote, it does not coagulate albumin. It is scarcely acted on by sulphuric acid in the cold, but dissolves readily in alcohol and ether. The alcoholic solution, when moderately diluted with water, forms an aromatic, saccharine liquid of a very grateful taste. A strong alcoholic solution is decomposed by abundance of water, the chloroform separating and subsiding, and the alcohol uniting with the water. "Soluble in about 200 times its volume of cold water, and, in all proportions, in alcohol, ether, benzene, petroleum benzin, and the fixed and volatile oils." *U. S.* It is liable to decomposition by sunlight, or even diffused daylight; and hence the propriety of keeping it in bottles covered with dark paper, in a rather dark place. Chloroform has extensive solvent powers, being capable of dissolving caoutchouc, gutta-percha, mastic, elemi, tolu, benzoin, and copal. Amber, sandarac, lac, and wax are only partially soluble. It also dissolves iodine, bromine, the organic alkalies, the fixed and volatile oils, most resins, and fats. It dissolves sulphur and phosphorus sparingly.

It possesses the power of dissolving a large quantity of camphor, and furnishes the means of administering that medicine in an elegant form. As a general solvent, it has the advantage over ether of not being inflammable, the inflammability of the latter being the cause of frequent accidents. For an extensive list of substances soluble, insoluble, and partly soluble in chloroform, see a paper by Lepage of Gisors, France, copied into *A. J. P.,* 1852, p. 147. It has been found by J. B. Barnes that chloroform has the power of preventing the alcoholic, lactic, and other fermentations, probably by killing the organisms that provoke these processes. Twenty minims preserved sixteen ounces of malt, to which two drachms of yeast had been added, as long as the experiment lasted. The same quantity kept fresh eight fluidounces of milk in a warm place for five days. Mucilage and infusions were preserved for weeks with one minim or even less to the ounce. Similar results were reached by F. J. Barrett and others. (*P. J.,* 1874, pp. 441, 442, 455.) The active properties of chloroform forbid its use as a preservative of medicinal infusions, but from milk it could always be removed by boiling. A. Munz (*P. J.,* 1875, p. 967) proposes the employment of chloroform as a test between chemical and living ferments, since he has found it to have no effect upon the former, though absolutely destructive to the latter.

Composition.—Chloroform is composed of one atom of carbon, one of hydrogen, and three of chlorine. Its simplest derivation in

theory is from marsh-gas (*methane*), CH_4, whence it is often called *trichloro-methane*. While it can be thus produced, by the action of chlorine upon marsh-gas, in practice, it is formed either from alcohol by the action of bleaching powder, from chloral by an alkaline hydroxide, or latterly from acetone and bleaching powder.

The reactions are sometimes complex, but if the temperature be carefully kept at from 70° C. (158° F.) to 73° C. (163.4° F.), they are essentially as follows:

$$C_2H_6O + CaOCl_2 = CaCl_2 + C_2H_4O + H_2O$$

that is, one molecule of bleaching powder, reacting with one of alcohol, yields one of calcium chloride, one of aldehyde, and one of water. The aldehyde formed is then further decomposed, according to the reaction:

$$2C_2H_4O + 6CaOCl_2 = 3CaCl_2 + 3Ca(OH)_2 + 2C_2HCl_3O$$

that is, two molecules of aldehyde, reacting with six of bleaching powder; yield three of calcium chloride, three of calcium hydroxide, and two of chloral. The chloral is, however, decomposed by the free base calcium hydroxide, according to the reaction:

$$2C_2HCl_3O + Ca(OH)_2 = Ca(CHO_2)_2 + 2CHCl_3$$

that is, two molecules of chloral reacting with one of calcium hydroxide yield one of calcium formate and two of chloroform. The reaction for the manufacture from acetone is simpler:

$$2C_3H_6O + 6CaOCl_2 = 2CHCl_3 + 2Ca(OH)_2 + Ca(C_2H_3O_2)_2 + 3CaCl_2$$

Tests.—Chloroform is liable to contain alcohol and ether, both of which lower its specific gravity. If it have a less density than 1.38, it will float instead of sinking in a mixture of equal weights of concentrated sulphuric acid and water after it has cooled. M. Mialhe has proposed the following tests for the presence of alcohol. Drop into distilled water a small quantity of the chloroform. If pure, it will remain transparent at the bottom of the glass; but if it contain even a small proportion of alcohol, the globules will acquire a milky appearance. Soubeiran's method was to agitate almond oil and chloroform together in a tube. If the chloroform is pure, it remains clear; if it contains as much as 5 or 6 per cent. of alcohol, it becomes milky. (*J. P. C.*, Août, 1860, p. 95.) Procter detected alcohol by adding the suspected chloroform to an oxidizing mixture of potassium dichromate and sulphuric acid. If alcohol be present, the deep orange color of the chromic mixture will gradually become green; if absent, no change of color will take place. (*A. J. P.*, 1856, p. 213.) Hoffmann's violet has been suggested as a test. If a small portion is added to chloroform containing alcohol, the solution is colored a deep purple. Boettger recommends adding to the chloroform a solution of molybdic acid in pure, strong sulphuric acid, when even a trace of alcohol will cause an intense blue color. (1879.) Chloroform, when pure, upon being mixed with an equal volume of sulphuric acid, does not color it; but when contaminated with pyrogenous oils it gives the acid a color varying from yellow to reddish-brown, according to the amount of impurity. Alcohol also is detected and removed by sulphuric acid. In applying this test, several fluidounces of chloroform should be used, as a slight change of color cannot be easily seen in a test tube, and care must be taken to see that mechanical impurities, like cork dust, dirt, etc., have been filtered out of the specimen, or the acid will be discolored from this cause. A still more delicate test of the oily impurities, according to Gregory, is the odor which they leave. If chloroform thus contaminated be poured upon the hand, it quickly evaporates, leaving the oily impurities, recognizable by their offensive odor, now no longer covered by that of the chloroform. The pure substance, rubbed on the skin, quickly evaporates, and leaves scarcely any odor. Chloroform sometimes contains Dutch liquid, which may be discovered by adding an alcoholic solution of potassium hydroxide, when the mixture, if this impurity be present, will heat and give off a permanent gas, which is *acetyl chloride*, C_2H_3OCl. (Geuther.) Fuming nitric acid, heated with chloroform to 100° C. (212° F.) in a closed tube for 120 hours, forms a new substance, *chloropicrine*.

Two methods for purifying chloroform, one physical and the other chemical, have attracted much attention. The first of these is the Pictet method of purifying the chloroform by submitting it to very low temperatures, whereby the impurities are first frozen out and filtered off from the chloroform at —70° C., and then the chloroform itself is solidified at from —80° C. to —100° C. and separated from any liquid impurities. It was at first claimed for this "Chloroform Pictet" that it would not be decomposed by sunlight and did not require the addition of alcohol to preserve it. These claims do not seem to be substantiated by later tests. The other method is based on the discovery of R. Anschütz, that chloroform crystallizes out with salicylid, $C_6H_4\begin{cases}CO\\O\end{cases}>$, and *o*-homosalicylid, $C_6H_3(CH_3)\begin{cases}CO\\O\end{cases}>$, while the impurities of chloroform remain. These crystalline compounds contain respectively 33.24 and 30.80 per cent. of chloroform, and this can be liberated from its combination by very moderate heating. The compounds can be kept for a long time in closed vessels in a slight atmosphere of chloroform, and the salicylid and *o*-homosalicylid can be used over and over again. After becoming acid, through exposure to light, chloroform may be readily regenerated, by agitating it with solution of sodium carbonate, and distilling from a little unslaked lime. From what has been said above, chloroform to be kept for use should have the sp. gr. 1.476, and if denser than this, should be brought

to it by the addition of alcohol. It is best kept in cork stoppered bottles. As the cork is not acted on by chloroform, if it become yellow and softened it will indicate the presence of an acid, and thus act as a test. (*A. J. P.*, 1868, p. 289.)

"If 10 Cc. of Chloroform be poured upon a piece of clean, odorless filter paper laid flat upon a warm glass plate, and the plate be rocked from side to side until the liquid is all evaporated, no foreign odor should become perceptible as the last portions disappear from the paper, and the paper should be left odorless. If 10 Cc. of Chloroform be well shaken with 20 Cc. of distilled water, and the liquid be allowed to separate completely, the water should be neutral to litmus paper, and should not be affected by silver nitrate T.S. (absence of *chlorides*), nor colored by potassium iodide T.S. (absence of *free chlorine*). If 40 Cc. of chloroform be shaken with 4 Cc. of colorless, concentrated sulphuric acid in a 50 Cc. glass-stoppered cylinder during twenty minutes, and the liquids be then allowed to separate completely, so that both are transparent, the chloroform should remain colorless, and the acid should appear colorless, or very nearly colorless, when seen in a stratum of not less than 15 Mm. in thickness (absence of *impurities decomposable by sulphuric acid*). If 2 Cc. of the sulphuric acid, separated from the Chloroform, be diluted with 5 Cc. of distilled water, the liquid should be colorless and clear, and, while hot from the mixing, should be odorless, or give but a faint vinous or ethereal odor (absence of *odorous decomposition products*). When further diluted with 10 Cc. of distilled water, it should remain clear, and should not be affected by silver nitrate T.S. (absence of *chlorinated decomposition compounds*)." *U. S.* "On allowing 20 cubic centimetres to evaporate from a large piece of filter-paper placed on a warm plate, no foreign odor is perceptible at any stage of the evaporation. *Water* which has been shaken for five minutes with half its volume of Chloroform, and separated from the Chloroform, should be neutral to *litmus* (absence of acid), should not afford any color with 1 cubic centimetre of *solution of cadmium iodide* and two drops of *mucilage of starch* (absence of free chlorine), and should not yield more than a very slight opalescence with four drops of *solution of silver nitrate* (absence of chlorides). After shaking *sulphuric acid* with ten times its volume of Chloroform for twenty minutes, and setting aside for fifteen minutes, both the acid and the Chloroform should be perfectly transparent and nearly colorless. 2 cubic centimetres taken from the layer of *sulphuric acid,* and diluted with 5 cubic centimetres of *water,* should remain transparent and very nearly colorless, and should have a pleasant odor. When this liquid is further diluted with 10 cubic centimetres of *water,* and stirred with a glass rod, it should still be transparent and colorless, and the addition of four drops of *solution of silver nitrate* should not cause more than a slightly diminished transparency. *Water* which has been shaken with half its volume of Chloroform, previously treated with *sulphuric acid* as described above, should not afford more than a slightly diminished transparency with *solution of silver nitrate.* (The foregoing four tests indicate absence from the Chloroform of products of its decomposition.) It evaporates without residue (absence of fixed matter)." *Br.* These tests imply the presence of but a minute proportion of alcohol, and the total absence of chlorine and those volatile and empyreumatic substances which constitute the most injurious impurities of chloroform. A heat that would be felt through the bottle, on the admixture of sulphuric acid with chloroform would evince the presence of too much alcohol or water. The want of discoloration from the contact of the two liquids shows the absence of empyreumatic oily matter. A color bordering on that of sherry wine would imply an objectionable amount of impurities. The volatile impurities are less volatile than chloroform, and would consequently be the last to escape on the evaporation of the liquid. Impure Chloroform, therefore, leaves a foreign odor behind it when allowed to evaporate from the hand, and especially when from a porcelain plate, in the amount and manner indicated; and if a specimen stand this test well, it may be considered as free from noxious volatile impurity. The slight foreign aroma without pungency, which is given out under these circumstances, is of no injurious significance. It is stated that chloroform made from chloral may be distinguished from other chloroform by its remaining colorless when the sulphuric acid test is employed, and by its leaving no aromatic residue when evaporated, evidences of its absolute purity. It has been claimed that this chloral chloroform does not undergo decomposition, but this has been proved not to be correct. (*A. J. P.*, xlii. 409.)

Uses.—Chloroform, when applied locally, is very irritant and produces decided pain, which may be followed by some numbness and local anæsthesia. If the chloroform be prevented from evaporating, its prolonged contact with the skin is apt to produce blistering. Taken internally, it is absorbed and acts upon the general system. The rapidity of its absorption, and, to some extent, its general effects, depend upon the method in which it is administered. It is commonly exhibited by the mouth or by inhalation. Taken into the stomach in doses of about five minims (0.3 Cc.), it induces only gastric symptoms, chiefly due to its irritant properties; but when there is excessive flatulence, colic, or gastralgia, it not only causes an increased peristalsis and expulsion of any flatus present, but evinces a distinct local narcotic influence by quieting pain and spasm. Taken in doses of 1 to 2 fluidrachms (3.75 to 7.5 Cc.), it produces a narcotism similar to that seen when it is administered by inhalation, the nar-

cotism, however, developing and passing off much more slowly than in the latter case. Chloroform was used internally in *asthma* and other conditions as early as 1832 by Ives of New Haven (*Silliman's Journ.*, xxi, 406, 407), and subsequently in various conditions by several European physicians. In January, 1832, it was employed by Ives by inhalation (*Silliman's Journ.*, vol. xxi, 406), but it was not until November, 1847, that Simpson of Edinburgh brought it forward as more agreeable, efficacious, and convenient in general anæsthesia than ether. The subject of the use of chloroform as an anæsthetic is so important that to be of practical service more space would be required for its discussion than can be afforded in a work like the present, and it need only be said that it is generally considered more convenient but more dangerous than ether. For a full discussion of the subject, therefore, the reader is referred to *Wood's Therapeutics* or to special treatises on anæsthetics.

Locally, chloroform is employed as a very prompt, active counter-irritant and narcotic in *neuralgia*, *colic*, etc., and deep injections of it in the neighborhood of painful nerve trunks have been practised by Roberts Bartholow with asserted good effects. Fournié has found that the vapor from a mixture of equal measures of glacial acetic acid and chloroform is even more effectual, as a local anæsthetic, than that of pure chloroform, producing complete insensibility of the skin in five minutes, if applied from a bottle heated simply by the hand. (*P. J.*, 1862, p. 385.) Chloroform, in vapor, may be used as a topical application to the rectum. Ehrenreich employed it with success in *tenesmus*. A drachm may be vaporized by the heat of warm water, from a bottle, fitted with a flexible tube, inserted into the bowel. Langenbeck of Berlin, prefers chloroform to tincture of iodine as an injection for the radical cure of *hydrocele*. *Chloroform ointment* is made by adding twenty parts of chloroform to a mixture of ten parts of white wax and ninety parts of lard, previously melted together, and allowing the whole to cool.

Chloroform may be gelatinized by agitating it with an equal weight of white of egg in the cold. In three hours it takes the gelatinous form. A stronger preparation may be made by shaking together, in a bottle, four parts of chloroform and one of white of egg, and placing the mixture in water at 60° C. (140° F.). In four minutes the gelatinization is completed. *Gelatinized chloroform* may be applied to the skin, spread on linen, or by friction. *Syrup of chloroform* may be made by adding one fluidounce of spirit of chloroform to fifteen fluidounces of syrup.

When an overdose of chloroform is taken by the mouth, it is essential to empty the stomach by the pump or siphon tube, and then treat the case much as in serious narcosis from inhalation. In a case of suicide by swallowing chloroform, in which death took place in about thirty-four hours, the lining membrane of the larynx and trachea was found inflamed, the bronchi were loaded with a dirty-gray purulent fluid, the lungs were inflamed as in the first stage of pneumonia, and the brain and its membranes congested; but these morbid appearances are not constant.

In relation to the preparations, consisting of chloroform and alcohol, which have been used under the name of "chloric ether," the reader is referred to *Spiritus Chloroformi*.[1]

Dose, of chloroform, five to fifteen minims (0.3 to 0.9 Cc.).

Off. Prep.—Aqua Chloroformi, *U. S.*, *Br.*; Collodium Cantharidatum, *U. S.*; Emulsum Chloroformi, *U. S.*; Linimentum Chloroformi, *U. S.*, *Br.*; Spiritus Chloroformi, *U. S.*, *Br.*; Tinctura Chloroformi et Morphinæ Composita, *Br.*

CHONDRUS. U. S.

CHONDRUS [Irish Moss]

(ĕhŏn'drŭs)

"The dried plant of *Chondrus crispus* (Linné) Lyngbye (Fam. *Gigartinaceæ*)." *U. S.*

Carrageen, Caragahen, Fucus Crispus, Pigwrack, Killeen, Pearl Moss; Carragheen; Carragaheen; Carrageen ou Mousse perlée, *Fr. Cod.*; Mousse Marine perlée, *Fr.*; Carrageen, *P. G.*; Irländisches Moos, Perlmoos, Knorpeltang, *G.*; Fuco carageo, Musco d'Irlanda, Fuco crispo, *It.*; Caragaen, Musgo marino perlado, *Sp.*

Chondrus crispus, Greville, *Alg. Brit.* 129, t. 15; *B. & T.* 305.—*Sphærococcus crispus*, Agardh.—*Fucus crispus*, Linn.—The *Irish moss*, or *carrageen* as it is frequently called, consists of a flat, slender, cartilaginous frond, from two to twelve inches in length, dilated as it ascends until it becomes two or three lines in width, then repeatedly and dichotomously divided, with linear wedge-shaped segments, and more or less curled up so as to diminish the apparent length. The capsules are somewhat hemispherical, and are embedded in the disk of the frond. The plant grows upon rocks and stones on the coast of Europe, and is especially abundant on the southern and western coasts of Ireland, where it is collected. It is also a native of the United States, and is said to be gathered largely on the southern sea coast of Massachusetts, where it is partly torn from the rocks and partly collected upon the beach, on

[1] *Chlorodyne.*—An empirical remedy under this name was first used in London, but is now in some of its imitations very largely employed in various parts of the world. Many formulas are extant. The following has been extensively used in Philadelphia. Morphine hydrochloride 8 grains, water, hydrochloric acid, each 30 minims, chloroform 90 minims, tincture of cannabis indica 1 fluidrachm, hydrocyanic acid, U. S. P., 12 minims, alcohol half a fluidounce, oil of peppermint 2 minims, oleoresin of capsicum 1 minim. The morphine hydrochloride and water are heated in a flask with the hydrochloric acid until a clear solution is produced, then the other ingredients are mixed together, and when the first solution is cold the mixture added to it. This is a dangerous remedy, and should be used with great care in three- to ten-drop doses for an adult. (See *Tinctura Chloroformi et Morphinæ Composita.*)

which it is thrown up during storms. It is prepared for market by spreading it out high on the beach, to dry and bleach in the sun. (Aug. P. Melzar, *Proc. A. Ph. A.*, 1860.) For elaborate accounts of the plant, of its distribution on the sea coast of Massachusetts, and of the mode of gathering and curing, see *U. S. Agricultural Report*, 1866; also *A. J. P.*, 1868, 417; 1895, 596; 1899, 483. Henry Kraemer witnessed the methods pursued on the Massachusetts coast in the collection of Irish moss at Scituate, which appears to be a particularly favorable situation. The season for collection begins late in May and continues to September, June and July being the best months. The moss at present is only found on rocks that are from 15 to 20 feet below the tide, hence women no longer engage in its collection. The men go out in their sail boats or dories at half tide, and come in at half flood. With their long rakes they scrape the moss off the rocks, collecting thus about 50 pounds to the boat, the total for the season at Scituate being about 10,000 pounds. The moss is spread out on the high beach for a week or so, the action of the sun and dew bleaching it. It is then enclosed in hogsheads, in which it is again saturated with sea water by rolling them in the marshes; after which it is again spread out and subjected to the bleaching process, this alternate treatment being repeated four or five times, until the product is of a yellowish or white color. The final drying is done in barns, where the moss is stored until it is packed in 100 lb. barrels at the end of the season. In the course of his journey he had opportunity to observe the *Chondrus* growing and gathered in different localities along the coast, and found it to consist chiefly, if not entirely, of *Chondrus crispus*. While it is stated in Dr. Farlin's "The Marine Algæ of New England" that the closely resembling *Gigartina mamillosa* is common from Boston northward, Kraemer is inclined to believe that *Chondrus crispus* (L.), Lyngbye, is practically the only source of the American drug. (See *Proc. Penn. Pharm. Assoc.*, 1899, 113-116.)

Gigartina mamillosa, Ag., *Phycologia Britannica*, Pl. 199, resembles the true Irish moss, and, growing with it upon the rocks, is often gathered with it. It can, however, be at once distinguished by the numerous papillæ which cover the surface and margins of the fronds and bear the fruit (cystocarps). In chemical and medicinal properties it is probably identical with *C. crispus*.

Irish moss when collected is washed and dried. It is probably sometimes bleached by the use of potassium permanganate and sodium thiosulphate by the same process as that used for bleaching sponge. Herr Schack was led to suspect this through discovering the presence of sulphurous acid in a German specimen. (*Ph. Ztg.*, 1886, p. 87.) In the fresh state it is of a purplish color, but, as found in the shops, is yellowish or yellowish white, with occasionally purplish portions. It is officially described as "usually in light yellow or yellowish-white matted masses; the plant consisting of a slender, somewhat flattened base about one-half the length of the entire frond, which after repeated forking terminates in a number of palmately branching, somewhat enlarged, commonly emarginate or two-lobed segments; translucent, sometimes with fruit bodies embedded near the apex of the segments; somewhat cartilaginous; having a slight sea-weed odor, and a mucilaginous somewhat saline taste. One part of Chondrus boiled for ten minutes with 30 parts of water yields a solution which gelatinizes on cooling, and is not colored blue by iodine T.S." *U. S.* It swells in cold water, but does not dissolve. Boiling water dissolves a large proportion of it, and the solution, if sufficiently concentrated, gelatinizes on cooling. Herberger found 79.1 per cent. of pectin, and 9.5 of mucus, with fatty matter, free acids, chlorides, etc., but neither iodine nor bromine. Dupasquier discovered in it both of these elements, which had generally escaped attention in consequence of their reaction, as soon as liberated, upon the sodium sulphide resulting from the decomposition of the sodium sulphate of the moss when charred. (*J. P. C.*, 3e sér., iii. 113.) The analysis made by Church in 1877 gave: mucilage, 55.4; water, 18.8; mineral matter, 14.2; albuminoids, 9.4; and cellulose, 2.2 per cent. The pectin Pereira thought peculiar, and proposed to call it *carrageenin*.

It is distinguished from gum by affording, when dissolved in water, no precipitate with alcohol; from starch, by not becoming blue with tincture of iodine; from pectin, by yielding no precipitate with lead acetate and no mucic acid by the action of nitric acid. Ch. Blondeau gives the name of *goëmine* to a substance obtained by boiling carrageen (*goémon*, Fr.) for several hours in distilled water, and precipitating the mucilaginous liquid by alcohol. Flückiger, who analyzed this mucilage with care, found in it *no* sulphur, and only 0.88 per cent. of nitrogen. The drug itself yielded not more than 1.012 per cent. of nitrogen. (*Pharmacographia*, 2d ed., 748.) Haedicke, Bauer, and Tollens obtained, on extraction with water containing 0.6 per cent. of sulphuric acid, and further purification by alcohol, a small quantity of a crystalline compound which resembles galactose in its composition, in its action on polarized light, and in its behavior with nitric acid. On oxidation with nitric acid, the dry moss yields from 21.6 to 22.2 per cent. of mucic acid. Carrageenin is said to have been used as a substitute for acacia, under the name of *imitation gum arabic;* the latter occurs in three forms, white, light yellow, and yellow. They all have similar properties, swelling up like tragacanth when mixed with cold water, but not forming a clear solution unless the mixture be boiled, in this latter respect differing from tragacanth or albumen; iodine does not give a blue color, and alcohol does not precipitate the solution, even

when 50 per cent. of it is added. It has mild adhesive properties. (E. C. Federer, *Ph. Era*, 1887, 146.) The mucilage of Irish moss has come into considerable use as an emulsifying agent. (*Proc. A. Ph. A.*, 1887; *A. J. P.*, 1888, 170.)

Uses.—Chondrus is nutritive and demulcent, and, being easy of digestion and not unpleasant to the taste, forms a useful article of diet in cases in which the farinaceous preparations, such as tapioca, sago, barley, etc., are usually employed. It has been particularly recommended in *chronic pectoral affections, scrofulous complaints, dysentery, diarrhœa,* and *disorders of the kidneys and bladder.* It may be used in the form of decoction, made by boiling a pint and a half of water with half an ounce of the moss down to a pint. Sugar and lemon juice may usually be added to improve the flavor. Milk may be substituted for water when a more nutritious preparation is required. It is recommended to macerate the moss for about ten minutes in cold water before submitting it to decoction. Any unpleasant flavor that it may have acquired from the contact with foreign substances is thus removed.

Dose, four drachms (15 Gm.).

CHROMII TRIOXIDUM. U. S. (Br.)

CHROMIUM TRIOXIDE [Acidum Chromicum, Pharm. 1890, Chromic Acid, Chromic Anhydride]

(ghrō′mĭ-ĭ trī-ŏx′ĭ-dŭm)

$CrO_3 = 99.34$

"It should contain not less than 90 percent. of pure Chromium Trioxide (chromic acid anhydride). It should be kept in glass-stoppered bottles, and great caution should be observed to avoid bringing it in contact with organic substances, such as cork, tannic acid, sugar, alcohol, collodion, etc., as serious accidents are liable to result." *U. S.* "Chromic Anhydride, CrO_3, commonly termed chromic acid, is produced by the interaction of sulphuric acid and potassium bichromate." *Br.*

Acidum Chromicum, *Br.*, Chromic Acid, Anhydrous Chromic Acid: Acide Chromique Cristallisé, *Fr. Cod.*; Acidum Chromicum, *P. G.*; Chromsaure, *G.*; Anidride cromica, Acido cromico, *It.*; Acido cromico, *Sp.*

This is not a true acid, but an acid anhydride. It may be obtained by the process official in the former British Pharmacopœia: "Bichromate of Potassium, 30 ounces (av.); Sulphuric Acid, 57 fluidounces (Imp. meas.); Distilled Water, a sufficiency. Dissolve the bichromate of potassium in a mixture of 50 fluidounces (Imp. meas.) of the water and 42 fluidounces (Imp. meas.) of the acid. Set aside for twelve hours, and decant the liquor from the crystals of acid sulphate of potassium that have separated. Heat the liquor to about 185° F. (85° C.), and add the remainder of the acid, and water sufficient to just redissolve any crystals of chromic acid that may have been formed. Allow to cool, collect and drain the crystals, and dry them on porous tiles at a temperature not exceeding 100° F. (37.8° C.) in an air-bath. From the mother liquor more crystals may be obtained on evaporation." *Br.* 1885.

This process yields crystals which are more or less contaminated with sulphuric acid. Vulpius (*A. Pharm.*, 1886, p. 964) shows that commercial chromium trioxide sometimes contains as much as 7 per cent. of sulphuric acid, and that pure chromium trioxide is not scarlet in color, but dark brown-red and steel-glistening, and not deliquescent in ordinary air.

The best yield of pure crystals is said to be according to the method of Zettnow (*Pogg. Ann.*, cxliii. 471), in which 300 Gm. of potassium dichromate are mixed with 500 Cc. of water, and 420 Cc. of concentrated sulphuric acid added, and the mixture allowed to stand for twelve hours in order that the acid potassium sulphate may crystallize out. The mother liquor is then heated to from 80° to 90° C., and 150 Cc. of sulphuric acid added, together with enough water to dissolve the crystals of trioxide which at first separate out. After standing for twelve hours the liquid is poured off from the crystals which have separated, and a second and a third crop may be obtained by concentration. The crystals, having been drained upon a porous plate and washed with pure nitric acid, sp. gr. 1.46, are dried in a current of warm air. For a method by Duviller, in which barium chromate is treated by nitric acid, and chromium trioxide crystallized out of the mother liquor, see *A. J. P.*, 1873, p. 23.

Properties.—Chromium trioxide, as ordinarily seen in commerce, is in the form of anhydrous, acicular crystals, of a brilliant crimson red color and an acid metallic taste, deliquescent, and very soluble in water, forming an orange-red solution; but according to Kebler there may also be found in commerce an impure "chromic acid" made by mixing a solution of sodium dichromate with sulphuric acid and drying the product; it sometimes contains 60 per cent. of acid sodium sulphate (*Am. Drug.*, 1901, 344). The requirements of the U. S. Pharmacopœia (8th Rev.) are that even traces of sulphuric acid shall be absent, and that the color of the crystals be not scarlet. "Small, needle-shaped crystals or rhombic prisms, of a dark purplish-red color and metallic lustre; odorless; destructive to animal and vegetable tissues; deliquescent in moist air. Very soluble in water, forming an orange-red solution. When brought in contact with alcohol, ether, glycerin, and other organic solvents, decomposition takes place, sometimes with dangerous violence. When Chromium Trioxide is heated, its color darkens, and finally becomes black, but it is restored on cooling. At 192° to 193° C. (377.6° to 379.4° F.) it fuses to a reddish-brown liquid, which, on cooling, forms a dark red, brittle mass (often enclosing cavities filled with crystals), furnishing a scarlet powder. Above 250° C. (482° F.) it begins to decompose into green chromic oxide and free oxygen, and, after protracted heating,

leaves a residue of pure chromic oxide, which should yield nothing soluble in water. When warmed with hydrochloric acid, chlorine is evolved." *U.S.* "It is very soluble in *water* and in *ether*. Warmed with *hydrochloric acid*, chlorine is evolved. Mixed with cold *alcohol* (90 per cent.), aldehyde is produced, and a green residue remains. If placed in contact with relatively small proportions of either *alcohol* (90 per cent.), *ether, glycerin,* or some other organic matters, sudden combustion or explosion may ensue. 1 gramme dissolved in 50 cubic centimetres of *water* and acidulated with *hydrochloric acid* should afford only a slight opalescence with *solution of barium chloride* (absence of more than traces of sulphates)." *Br.* Chromium trioxide at a heat above the melting point, gives off half its oxygen, and is converted into the green sesquioxide, Cr_2O_3.

It is a powerful oxidizing and bleaching agent, and gives up its oxygen with great facility to organic matter. The oxidation of weaker alcohol is attended with the production of aldehyde, recognized by the odor; that of stronger alcohol, by inflaming. "A solution of 1 Gm. of Chromium Trioxide in 100 Cc. of water, previously acidulated with a few Cc. of hydrochloric acid, should not be rendered turbid on the addition of 1 Cc. of barium chloride T.S. (absence of *sulphuric acid*). If 1 Gm. of Chromium Trioxide be dissolved in 100 Cc. of water, then 8.3 Cc. (8.28 Cc.) of this solution, when measured into a glass-stoppered bottle (of about 200 Cc. capacity), mixed with 2 Cc. of hydrochloric acid and about 1 Gm. of potassium iodide, after securely closing and shaking for a few minutes, should require, after diluting with 100 Cc. of water and adding 5 Cc. of starch T.S., not less than 22.5 Cc. of tenth-normal sodium thiosulphate V.S. to change the deep blue color to a light green (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 4 percent. of pure Chromium Trioxide)." *U. S.*

Uses.—As a germicide chromium trioxide is asserted by John Dougal (*L. L.*, Dec. 16, 1871), to surpass even phenol. A piece of fresh beef immersed in a solution of chromium trioxide containing only 1 part in 2000 of water became in two days quite black, in six as hard as wood, and at the end of three months remained perfectly free from mould or taint. It is a powerful coagulant of albumin, being, according to Dougal, 10 times stronger than phenol, 15 times stronger than nitric acid, and 20 times stronger than corrosive sublimate. It is, therefore, one of the best tests for albumin. Besides coagulating albuminous substances, it oxidizes decaying organic matter, combines with and neutralizes the escaping ammonia, and decomposes the hydrogen sulphide, reducing it to water and free sulphur. Chromium trioxide is used medicinally principally as an escharotic, in which capacity it acts by rapidly oxidizing and thus decomposing the tissues, while by the loss of one-half its oxygen it is itself converted into the inert sesquioxide. It was first employed as a caustic by Sigmund of Vienna, on the recommendation of Heller. Used in substance, made into a paste with water, its action is not only exceedingly slow and gradual, but deeply penetrating. In saturated solution its action is less penetrating and less gradual. By using a solution more or less dilute, the effect may be graduated according to the degree desired.

It has been much used for the destruction of warts, condylomata, and various superficial growths or tumors, but caution is necessary, as it may give rise to a deep slough if too largely applied, and, according to Gubler, patients have been poisoned, through absorption, by its too extensive application. (*Ed. M. J.*, Sept. 1871, p. 281.) The occasional use of a five per cent. solution of chromium trioxide has been found in Prussia very useful in the treatment of *sweating* or *tender feet,* amongst the soldiery. Care should be taken not to prescribe chromium trioxide in combination with glycerin, or any substance which will cause it to part rapidly with its oxygen; a compounded prescription containing 8 grains of chromium trioxide and 1 drachm of glycerin exploded violently. (*Zeit. Oest. Apoth. Ver.*, June 1, 1875.) It is best to use a simple aqueous solution.

Dose, of chromium trioxide, should not exceed one-fourth of a grain (0.016 Gm.). It is very rarely, if ever, used internally.

Off. Prep.—Liquor Acidi Chromici, *Br.*

CHRYSAROBINUM. U. S., Br.

CHRYSAROBIN

(ȼhrȳs-ą-rǫ-bī′nŭm)

$C_{30}H_{26}O_7 = 494.46$

"A neutral principle extracted from Goa Powder, a substance found deposited in the wood of *Vouacapoua Araroba* (Aguiar) Druce (Fam. *Leguminosæ*). Chrysarobin should be preserved in amber-colored, glass-stoppered vials." *U. S.* "A substance obtained from Araroba by extracting with hot chloroform, evaporating to dryness, and powdering. It consists chiefly of a definite chemical substance also known as chrysarobin, but contains a varying proportion of chrysophanic acid." *Br.*

Chrysarobine, *Fr.*; Chrysarobinum, *P. G.*; Chrysarobin, *G.*; Crisarobina, *It.*

The definition of chrysarobin given by the U. S. Pharmacopœia makes it somewhat doubtful what is intended, but the statement of properties and characteristics has led us to consider the name as synonymous with that of chrysarobin of the British Pharmacopœia, which authority very properly recognizes under distinct headings Crude Chrysarobin (Goa Powder or Araroba) and the Purified Chrysarobin. (See *Araroba*, p. 187.)

Properties.—"A pale orange-yellow, microcrystalline powder, tasteless, odorless, and irri-

tating to the mucous membrane. Specific gravity: 0.920 to 0.922. Soluble in 4812 parts of water, 308 parts of alcohol, 25 parts of benzene, 18 parts of chloroform, 114 parts of ether, 30 parts of amyl alcohol, and 230 parts of carbon disulphide at 25° C. (77° F.); soluble in 2170 parts of water at 80° C. (176° F.), and in 275 parts of alcohol at 60° C. (140° F.); soluble in dilute or concentrated solutions of potassium hydroxide, forming a red-colored liquid, with green fluorescence. Chrysarobin, when heated, contracts and forms a dark mass at 148° C. (298.4° F.), and melts at 157° C. (314.6° F.). When ignited it is partly sublimed and finally entirely consumed. In sulphuric acid it dissolves, forming a deep red solution. On pouring this liquid into water, Chrysarobin is deposited unchanged. On mixing 0.001 Gm. of Chrysarobin with 2 drops of fuming nitric acid, a red-colored mixture is produced, which turns violet on the addition of a few drops of ammonia water (distinction from *chrysophanic acid*, which produces a yellow-colored liquid). On shaking Chrysarobin with lime water for a few minutes, the liquid acquires a violet color (distinction from *chrysophanic acid*, which produces a yellow-colored liquid.) On adding a crystal of potassium dichromate to a solution of Chrysarobin in sulphuric acid, the red color is changed at first to green, then to purple, and finally to brown." *U. S.* The British Pharmacopœia requires that chrysarobin shall be entirely soluble in hot chloroform, almost entirely soluble in hot alcohol (90 per cent.), and that it shall partially dissolve in a solution of potassium hydroxide with the production of a deep reddish-brown color, and shall, when incinerated, not leave more than 1 per cent. of ash. (See *P. J.*, 1892, 543.) Chrysarobin in alkaline solution takes up oxygen readily, even from the air, and changes into chrysophanic acid according to the reaction:

$$C_{30}H_{26}O_7 + 4O = 3H_2O + 2C_{15}H_{10}O_4$$

The difference in physical properties between chrysarobin and chrysophanic acid is well described by Andouard. (See *Proc. A. Ph. A.*, 1895, 864.) When chrysarobin is distilled with zinc dust it yields *methyl-anthracene*, $C_{15}H_{12}$. Liebermann has since established clearly the relationship of chrysarobin to chrysophanic acid, as the latter is a dioxymethyl-anthraquinone, the former is a reduced quinone. Hence its affinity for oxygen, as the reduction products of the quinone class almost always tend to absorb oxygen and again go back to their original condition. Liebermann, in observing the chemical relationship of chrysophanic acid to commercial alizarine and purpurine, was led to study their reduction products (or leuco-compounds), and so discovered a class known as *anthrarobins*, having medicinal properties similar to chrysarobin. (See *Anthrarobin*, PART II.)

Lenirobin, made by the action of acetic acid on chrysarobin, and described as a tetracetate, and *Eurobin*, the triacetate, are recommended as substitutes for chrysarobin, having the advantage of not staining linen indelibly. (*M. R.*, 1898, 466.)[1]

Uses.—When taken internally in sufficient amount, chrysarobin acts as a decided gastro-intestinal irritant, producing large, very watery, brownish stools, and repeated vomiting without much nausea; it has however failed to secure a place as an internal remedy. Chrysarobin has long been used in South America and India as a remedy in *skin diseases*, but the attention of the general profession was first called to it in 1874 by Sir Joseph Fayrer. It is frequently applied in *psoriasis* and very *chronic eczema*, by being rubbed up with water into a dough, which is spread over the diseased spot after it is as far as possible freed from scales by washing. As soon as the dough is dry, it should be covered with a layer of collodion or solution of gutta-percha, and the whole allowed to remain for several days, when it is removed by washing and renewed. In using chrysarobin, care must be observed not to allow it to come in contact with the clothes, as it leaves an indelible stain. It is at present employed largely in the preparation of chrysophanic acid; its action is affirmed to differ from that of chrysophanic acid and to be largely the result of its strong affinity for oxygen, causing it to act as a reducing agent. In *hemorrhoids*, M. S. Kossobudskji claims to obtain extraordinary results. His method is to first wash off the hemorrhoids with a two per cent. solution of phenol or a one per cent. solution of creolin, and then, after thoroughly drying them with absorbent cotton, to apply two or three times daily a salve composed of chrysarobin, 12 grains; iodoform, 4½ grains; extract of belladonna, 9 grains; vaseline, 3¾ drachms. In the treatment of internal hemorrhoids he employs suppositories composed of chrysarobin, 1¼ grains; iodoform, $\frac{1}{10}$ of a grain; extract of belladonna, ¼ of a grain; cacao butter, 30 grains; and sufficient glycerin to make a smooth mass. Chrysarobin is rarely used internally.

Dose, official, one-half grain (0.032 Gm.).

Off. Prep.—Unguentum Chrysarobini, *U. S.*, *Br.*

CIMICIFUGA. U. S. (Br.)

CIMICIFUGA [Black Cohosh, Black Snakeroot]

(cĭm-ĭ-cĭf'ū-gą)

"The dried rhizome and roots of *Cimicifuga racemosa* (Linné) Nuttall (Fam. *Ranunculaceæ.*)" *U. S.* "The dried rhizome and roots of Cimicifuga racemosa, *Ell.*" *Br.*

Cimicifugæ Rhizoma, *Br.*, Actææ Racemosæ Radix; Bugwort, Rattletop; Racine d'Actée à Grappes, *Fr.*; Schwarze Schlangenwurzel, *G.*

Cimicifuga racemosa, Torrey, *Flor.* 219; Carson, *Illust. of Med. Bot.*, i. 9, pl. 3.—*C. ser-*

[1] Under the name of *Chrysarobin oxidum*, Unna has highly recommended in *eczema* a 5 to 10 per cent. solution of a substance produced by the action of sodium peroxide upon chrysarobin suspended in boiling water.

pentaria, Pursh, *Flor. Am. Sept.* p. 372.—*Actæa racemosa,* Willd., *Sp. Plant.* ii. 1139.—*Macrotys actæoides,* Raf.—*Macrotys racemosa,* Eaton's *Manual,* p. 288; *B. & T.* 8.—This is a tall stately plant, having a perennial root, and a simple herbaceous stem, which rises from four to eight feet in height. The leaves are large, and ternately decompound, having oblong-ovate leaflets, incised and toothed at their edges. The flowers are small, white, and disposed in a long, terminal, wand-like raceme, with occasionally one or two shorter racemes near its base. The calyx is white, four-leaved, and deciduous; the petals are minute, and shorter than the stamens; the pistil consists of an oval ovary and sessile stigma. The fruit is an ovoid capsule containing numerous flat seeds. The plant grows in shady or rocky woods from Canada to Florida, flowering in June and July.

Properties.—The dried root consists of a thick, irregularly bent or contorted body or caudex, from one-third of an inch to an inch in thickness, often several inches in length, furnished with many slender radicles, and rendered exceedingly rough and jagged in appearance by the remains of the stems of successive years, which to the length of an inch or more are frequently attached to the root.[1] It is officially described as follows: "Rhizome horizontal in growth, 2 to 15 Cm. long, 1 to 2.5 Cm. thick, with numerous thick, erect or ascending branches about 2.5 Cm. long, each terminated by a deep, cup-shaped scar; roots numerous, brittle, obtusely quadrangular, and about 2 Mm. thick; the whole brownish-black; fracture of rhizome horny, of root short, the rhizome exhibiting a rather large pith, surrounded by numerous whitish, radially sublinear xylem plates; bark thin, firm; the roots having a thick bark and usually a four-rayed wood; odor slight but heavy; taste bitter and acrid." *U. S.* The roots "exhibit in transverse section from three to five wedge-shaped wood-bundles, separated by as many broad medullary rays. Both rhizome and roots are blackened by *test-solution of ferric chloride* (presence of tannic acid)." *Br.* The odor, though not strong, is peculiar and rather disagreeable, and is gradually lost with age. The root yields its virtues to boiling water. Tilghman found gum, starch, sugar, resin, wax, fatty matter, tannic and gallic acids, a black coloring matter, a green coloring matter, lignin, and salts of potassium, calcium, magnesium, and iron. (*A. J. P.,* vi.) It no doubt also contains, when fresh, a volatile principle, with which its virtues may be in some degree associated. Davis separated by distillation a small proportion of volatile oil having decidedly the peculiar odor of the root. He also found albumen, extractive, and silica. The sugar noticed by him was of the uncrystallizable variety, and the resin of two kinds, one soluble in alcohol but not in ether, the other soluble in both these menstrua. (*A. J. P.,* xxxiii.) A crystallizable principle has been obtained by T. Elwood Conard from a strong tincture of the root by treating with solution of lead subacetate, which precipitated resin, tannin, and coloring matters, then filtering, and precipitating the lead by hydrogen sulphide in excess, and allowing the tincture to evaporate spontaneously; and, finally, having treated the residuary powder with petroleum benzin, afterwards washing it with water, dissolving it to saturation in strong alcohol, and treating the solution with alumina. The mixture was allowed to evaporate to a dry mass, which was nearly exhausted with alcohol. The solution, being allowed to evaporate, left behind a crystalline mass, somewhat resembling alum. This substance has little taste, on account of its extreme insolubility in the saliva, but in alcoholic solutions has very strongly the acrid taste characteristic of the fresh root. The crystals are very soluble in cold, and more so in hot alcohol, soluble also in chloroform, and slightly so in ether. They are fusible and inflammable. They are neutral, possessing neither acid nor alkaline properties. Their effects on the system were not determined. (*A. J. P.,* 1871.) L. F. Beach (*A. J. P.,* 1876) obtained from commercial resin of cimicifuga (the so-called cimicifugin or macrotin) a crystalline principle by Conard's process. M. S. Falck (*A. J. P.,* 1884) found in the juice of the fresh plant a crystalline principle resembling the principle announced by Conard. On the other hand, neither F. H. Trimble (*A. J. P.,* 1878) nor Warder and Coblentz were able to obtain a crystalline principle, while C. S. Gallagher obtained crystals of cane sugar from the fluidextract. (*A. J. P.,* 1887.) In view of these facts, it would appear that the active principle is a resinous amorphous body. (See *Drugs and Medicines of North America,* vol. i.)

Uses.—In 1831 cimicifuga was introduced to the notice of the profession by Young. In overdoses it is said to cause general relaxation, vertigo, tremors, decided reduction of the pulse; occasionally it causes vomiting, but its emetic action is never violent, and is probably simply the result of a mild gastric irritation. It certainly, in large doses, produces giddiness, with intense headache and prostration. It has been found by R. Hutchinson to cause in frogs complete anæsthesia by a direct action upon the sensory side of the spinal cord. The same observer noted that toxic doses produce in mammals slowing of the pulse and fall of the arterial pressure, results which appear to be due in part to a direct depressant action upon the heart-muscle or its ganglia, in part to a paralysis of the vasomotor centre. It has been used in the past in *rheumatism, dropsy, hysteria, phthisis,* and various other affections, but at present is employed almost exclusively in the treatment of the *St. Vitus's Dance* of childhood, in which it is an efficient remedy. The *decoction* (1 ounce in a pint) was formerly much used in the dose of two fluidounces (60 Cc.), but is now entirely

[1] For a detailed description of the microscopic character of the root, see *A. J. P.,* 1884, 460; also 1895, 121.

out of vogue. The dose of the *tincture* is one or two fluidrachms (3.75 to 7.5 Cc.). The *fluidextract* is, however, the best preparation; dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.) three or four times a day in water. The *extract* is efficient, and has the advantage that it can be administered in pilular form so as to be practically free from taste. The practitioners calling themselves eclectics use, under the name of *cimicifugin*, or *macrotin*, an impure resin obtained by precipitating a saturated tincture of the root with water; dose, a grain or two (0.065 to 0.13 Gm.). (See *N. J. Med. Rep.*, viii. 247.)

Dose, of powdered cimicifuga, twenty to sixty grains (1.3 to 3.9 Gm.).

Off. Prep.—Extractum Cimicifugæ, *U. S.* (from Fluidextract); Fluidextractum Cimicifugæ, *U. S., Br.;* Tinctura Cimicifugæ, *U. S., Br.*

CINCHONA. U. S.

CINCHONA [Peruvian Bark]

(cĭn-ĉhō'nȧ)

"The dried bark of *Cinchona Ledgeriana* Moens, *Cinchona Calisaya* Weddell, *Cinchona officinalis* Linné, and of hybrids of these with other species of Cinchona (Fam. *Rubiaceæ*). It should yield not less than 5 percent. of total anhydrous cinchona alkaloids, and at least 4 percent. of anhydrous ether-soluble alkaloids when assayed by the process given below." *U. S.* (See page 358.)

Cinchonæ Flavæ Cortex; Yellow Cinchona Bark, Cinchona Flava, *U. S.* 1880, Yellow Cinchona, Calisaya Bark; Cortex Chinæ Calisayæ, Cortex Chinæ Regiæ; China Regia; Königschina, Calisayarinde, *G.;* Quinquina jaune royal, Quinquina Calisaya, *Fr. Cod.;* China gialla, *It.;* Quina calisaya, Quina amarilla, *Sp.*

CINCHONA RUBRA. U. S. (Br.)

RED CINCHONA

(cĭn-ĉhō'nȧ rū'brȧ)

"The dried bark of *Cinchona succirubra* Pavon (Fam. *Rubiaceæ*), or of its hybrids, yielding not less than 5 percent. of anhydrous cinchona alkaloids when assayed by the process given for these alkaloids under Cinchona." *U. S.* "The dried bark of the stem and branches of cultivated plants of Cinchona succirubra, *Pavon*. When used for purposes other than that of obtaining the alkaloids or their salts, it should yield between 5 and 6 per cent. of total alkaloids, of which not less than half should consist of quinine and cinchonidine, as estimated by the following methods." *Br.* (See p. 358.)

Cinchonæ Rubræ Cortex, *Br.;* Red Cinchona Bark; Cortex Chinæ Ruber, China Rubra; Red Peruvian Bark; Red Bark; Quinquina rouge, *Fr.;* Cortex Chinæ, *P. G.;* Chinarinde, Rothe Chinarinde, *G.;* China rossa, *It.;* Quina roja, *Sp.*

Botanical History.

Though the Peruvian bark was introduced into Europe so early as 1640, it was not until the year 1737 that the plant producing it was known to naturalists. In that year La Condamine, on a journey from Quito to Lima, through the province of Loxa, had an opportunity of examining the tree, of which, upon his return, he published a very complete description, with plate, under the name *Quinquina*, stating that three species were recognized. (*Mém. Ac.*, Paris, 1738, p. 226.) Four years later, Linné, without justification, proposed a new name, *Cinchona*, in honor of the Countess of Chinchon, who first made the bark known in Europe. Although the original name has been adopted by several authors, the synonym Cinchona appears in most writings, and the species are at present arranged under that name. Under the rules of nomenclature adopted at the Genoa Congress in August, 1892, the necessity of restoring the name Quinquina is avoided, and we retain the later name Cinchona. Linné recognized but one species, which he called *C. officinalis*, and this continued for a long time to be recognized by the Pharmacopœias as the only source of the Peruvian bark of commerce. But a vast number of plants belonging to the Linnæan genus Cinchona were in the course of time discovered; and the list became at length so unwieldy and heterogeneous that botanists were compelled to distribute the species into several groups, each constituting a distinct genus, and all associated in the natural family of Cinchonaceæ. Seventy-three of those which may be denominated *False Cinchonas* have been enumerated by Weddell. The botanical characters distinguishing the true Cinchonas from the related groups, according to the classification of Bentham and Hooker, are exhibited in the following table:

Cinchoneæ.—Corolla-lobes valvate, imbricate, or contorted. Ovary 2-celled, ovules very many in each cell. Fruit capsular. Seeds numerous, minute, vertical or ascending, peltate, imbricate, winged, albuminous; radicle almost always superior. Trees or shrubs, the stipules (except in Hillieæ) entire.

Subtribe I. EUCINCHONEÆ—Corolla valvate.

Subtribe II. HILLIEÆ—Corolla imbricated or contorted.

I. EUCINCHONÆ.

* Placentæ adnate to the middle of the septum.

** Placentæ ascending or erect from the base of the septum.

*** Placentæ pendulous from the apex of the cells.

† Capsule septicidal, the valves occasionally bifid.

†† Capsule almost always loculicidal.

1. *Cinchona.*—Panicles terminal. Corolla-lobes pubescent on the margins. Capsules dehiscent from the base upward.

2. *Cascarilla.*—Panicles terminal. Corolla-lobes papillose on the margins. Capsules dehiscent from the top downward.

3. *Remijia.*—Panicles or racemes axillary, interrupted.

I. *Cinchona*, L.

Calyx-tube turbinate, pubescent; limb 5-dentate, persistent. Corolla hypocrateriform, pubescent, the tube terete or nearly so, the limb 5-lobed, spreading, smooth within, the margin pilose, valvate. Stamens 5, inserted into the tube of the corolla, the filaments short or elongated; anthers included, or the apex exsert, dorsifixed, linear. Disk pulvinate. Ovary 2-celled; style slender, the branches short, obtuse, within papillose, inserted or sub-exsert. Evergreen trees or shrubs, the branchlets terete or 4-angled. Leaves opposite, petiolate. Stipules interpetiolar, the base glandular within, deciduous. Flowers white, purple, or flesh-colored, fragrant.

For our knowledge of these plants as they existed naturally, we are chiefly indebted to the

following botanists, besides La Condamine, of whom we have before spoken: Joseph de Jussieu, who in the year 1739, explored the country about Loxa, and gathered specimens still existing in the cabinets of Europe; Mutis, who in 1772 discovered Cinchona trees in Colombia, and afterwards, aided by his pupil, Zea, made further investigations and discoveries in the same region; Ruiz and Pavon, who in 1777 began a course of botanical inquiries in the central portions of Lower Peru, and discovered several new species; Humboldt and Bonpland, who visited several of the Peruvian bark districts, and published the results of their observations after 1792; Pöppig, who travelled in Peru so late as 1832, and published an account of his journey about the year 1835; Weddell, whose researches in Bolivia are so well known and have been productive of valuable information in relation to the Calisaya bark and allied species; while Karsten, Caldas, Martius, Ledger, Markham, and other intrepid explorers have in later times largely added to our information. The conclusions concerning the relations of the many forms, based upon the observations and collections of the above-named travellers, have undergone important modifications in view of the behavior of the plants under cultivation. The specific classification of the Cinchonas has always presented great difficulties, owing to the different relative values ascribed by different authors to the several structural characters. Under cultivation it has been seen that these characters are extremely variable, owing partly to the natural tendency of the species to develop strongly marked varieties, and partly to the great freedom with which they hybridize. While these tendencies have been stronger in the cultivated plants, they have evidently not been wanting in a state of nature. Thus we have come to place an entirely new estimate upon the supposed specific characters, and modern authors have been led to deny specific rank to many of the formerly accepted species. The extreme view is that of Otto Kuntze, who recognizes but four full species. This view is probably shared by no one, but Kuntze's general conclusions concerning the great extent of hybridization, and its influence in the production of new forms, are undoubtedly sound.[1] Rusby's studies in the Bolivian plantations led him independently to the same conclusions. Any specific classification, however carefully worked out, must be considered to some extent as matter of opinion merely.

[1] The principal sources of information bearing on this phase of the subject are the several reports of the plantations in Java, India, and Jamaica. Howard's *Quinology of the East Indian Plantations*, Markham's *Peruvian Bark*, Kuntze's *Arten, Hybriden und Cultur der Chininbäume*, Hooper in the *Pharmacographia Indica*, several contributions by Trimen to the *Tropical Agriculturist*, and Rusby in the *Pharmaceutical Record*, Oct. 1887. The literature of the cinchona hybrids is hopelessly confused by the same name being frequently used by different authorities for the different hybrids and the one hybrid having various names. Thus, *C. robusta* of Trimen is known in Ceylon as *C. lanosa*, and in the Neilgherry Hills as *C. magnifolia*, also as *C. pubescens*.

Probably the most satisfactory classification is that of Weddell, revised in 1870. (*Ann. d. Sci. Nat.*, 5th series, vols. xi. and xii.) Bentham and Hooker, in the *Genera Plantarum*, admit the existence of about 36 species, but this number appears entirely too large. The larger number of the species no longer possess more than a botanical and historical interest, as, under the changed conditions brought about by cultivation, their products are no longer collected for the market. The species which have been brought under cultivation for commercial purposes are alone named in the following list. Even this short list has been still further reduced as experience has determined the few species and forms which can be most profitably cultivated. Hence only the four species Nos. I, II, V, and VI of the list, which with their hybrids furnish almost all our bark at the present day, are here described:

I. C. officinalis,
  var. Condaminea,
  " Bonplandia,
  " crispa,
  } yielding crown bark.
II. C. succirubra, yielding red bark.
III. C. pitayensis,
  C. lancifolia,
  C. cordifolia,
  } yielding Colombian bark.
IV. C. nitida,
  C. micrantha,
  C. peruviana,
  } yielding gray bark.
V. C. Calisaya,
VI. C. Ledgeriana,
  } yielding yellow bark.

C. Calisaya, Weddell (*Hist. Nat. des Quinquinas*, p. 30, t. 3).—Tree tall, usually surpassing those about it, the trunk often more than 2 feet in diameter. Leaves petiolate, the blade ovate-oblong to slightly obovate, 3 to 7 inches long by 1 to 3 inches broad, obtuse, the base acute or slightly attenuated, very thin, smooth, and, especially below, with a satiny lustre, above dark green, below emerald-green or deep purple-green, scrobiculate, the glands scarcely visible above. Stipules oblong, about equalling the petioles, very smooth, very obtuse. Panicles ovate to subcorymbose. Calyx pubescent, with a cup-shaped limb and short triangular teeth. Corolla rose-colored (in cultivation often white or nearly so), the tube cylindrical and about 4 lines long, the laciniæ more deeply colored, the edges white-hairy. Stamens included. Capsule ovate, scarcely as long as the flowers. Seeds elliptical lanceolate, the margin irregularly fimbriate-toothed. Bolivia and Southern Peru, 4000 to 6000 feet. Source of the Calisaya or Yellow Bark. The species presents many forms, and two varieties are recognized.

Var. Ledgeriana, Howard, differs from the type chiefly in its thicker, narrower, oblong leaves, with attenuate base, often bluish-green below. It yields a thick and remarkably rich bark, and is probably the most valued of all the cinchonas. Specific rank has been strongly claimed for it.

Var. microcarpa, Weddell, is very similar to the last, with a firm leaf and short pod. It also yields a rich bark. It is not at all improbable that the accepted name "Ledgeriana" of Howard is a mere synonym for the older name *microcarpa* of Weddell.

The *var. Josephiana*, so called, has in reality nothing to do with this species, nor with any other. It is distinct, and yields a thin and worthless bark. In Bolivia it is known as "*Pajinal*," and its presence in the plantation constitutes a serious difficulty. In appearance the plant is considerably like the Ledgeriana, with which it hybridizes freely, and the two, with their hybrids, have been apparently much confused in all plantations except those of Bolivia. Ledgeriana has a tall and slender habit, with a small crown, while Josephiana is shorter and broader, less symmetrical, and generally coarser. The branchlets of the former are blackish, those of the latter bright red.

C. succirubra, Pavon, Mss. (Howard in *P. J.*, Oct. 1856, p. 209, with a figure). Extreme size even greater than that of the last. Branches silvery. Petiole pubescent, leaf ovate to oval, acute with a very short point, the base more or less narrowing, often 6 by 9 inches, dark green and smooth above

below paler and pubescent to a variable degree, especially on the veins, not scrobiculate, the margin slightly revolute. Stipules entire, oblong, obtuse, subamplexicaul. Flowers much as in the last, but rather smaller. Fruit lanceolate. Western slopes of Mt. Chimborazo. The source of the Red Bark.

C. officinalis, Linné (*Sp. Pl.,* ed. i., p. 172).—Petioles smooth, cylindrical, and, like the veins, reddish; blade 4 to 5 inches long, varying from broadly oval to lanceolate, acute at both ends, the margins usually recurved, smooth and deep green above, paler, but bright green below, scrobiculate, the principal veins pubescent. Stipules equalling the petioles, ovate, acute, entire, pubescent. Flowers and fruit much as in *C. Calisaya.* Widely distributed in the equatorial Andes, at an elevation of from 5000 to 7500 feet. The source of the barks known as Pale, Crown, Loxa, Cuenca, and Huanuco. This is the original species, upon which the genus Quinquina or Cinchona was founded. All things considered, it is, perhaps, to be regarded as the principal species of the genus. Its variability is extreme, and it is doubtful if any two authors can be found who agree perfectly as to its limits. The forms of no other species have suffered such vicissitudes of nomenclature as have those of *C. officinalis.* Those which to one author appear easily included within it, in the hands of another serve as types of quite a group of species and varieties. The classification of our present supplies of bark is, however, not materially affected by these considerations.

The specific variations produced by hybridization in the above characters may not be here considered, though it may be stated that they are entirely characteristic. The parentage of a hybrid is ordinarily fully and strongly indicated in its appearance. As a rule, also, the alkaloidal yield takes a mean between that of the parents, but sometimes this is conspicuously not the case.

Geographical Distribution.

The genuine Cinchona trees are natives exclusively of South America. In that continent, however, they are widely diffused, extending from the 19th degree of south latitude, considerably south of La Paz, in Bolivia, to the mountains of Santa Marta, or, according to Weddell, to the vicinity of Caracas, on the northern coast, in about the 10th degree of north latitude. They follow, in this distance, the circuitous course of the great mountain ranges, and for the most part occupy the eastern slope of the second range of the Cordilleras. Except northward from Guayaquil, or a very little to the southward of that latitude, the growth of the Cinchona, other than upon the eastern slopes of the Andes, is impossible even under cultivation. Elsewhere both the western slope and the plateau are entirely too dry or too cold for these plants, which require a moderate and equable temperature and an abundant and fairly constant supply of water. Irrigation cannot supply the place of a humid climate, for the atmosphere as well as the soil must be well charged with moisture. A certain amount of dry weather is, however, required for the ripening of the capsules. Free drainage is an important condition. Cross and others, who have personally inspected the region in the Andes where the best barks are obtained, have found the Cinchona trees only on the well drained slopes, and never on wet ground. With regard to temperature, Cross found that in the region of the *C. officinalis* the variation was from 34° to 70° F., a fall below 40° or a rise above 65° being rare, and the mean range being from 45° to 60°. Humboldt and Caldas place the figures several degrees higher.

For the Red Bark region, Spruce gives the following table:

Mean minimum	61½° F.
Mean maximum	72½°
Highest observed	80½°
Lowest observed	57°
Mean daily variation	10½°

For the Calisaya region, Markham gives the following table:

Mean temperature	69⅝° F.
Highest observed	75°
Lowest observed	56°
Mean daily variation	10½°

An environment suitable for the Cinchona is adapted to such plants as the most elevated of the palms and bamboos, the tree-ferns, arborescent Melastomaceæ, fuchsias, begonias, epiphytic orchids, and the Erythroxylon Coca. The limits of altitude and climatic conditions are closely drawn. In the most southern districts, the trees descend to about 2500 feet, while in the warmest regions they scarcely ascend to the 10,000-foot level. The individual species are for the most part rigidly restricted as to altitude and latitude, and, indeed, it has not always been found easy to detect the climatic conditions which would cause one species or variety to thrive while another very near it would languish. This is especially true of the more valuable forms.

It is to be noted that at present the stocks of wild barks have been enormously reduced, as detailed under Commercial History. Indeed, in certain sections, as the Calisaya district, the tree was practically exterminated in the wild state, so far as relates to a bark supply. From the far interior, however, occasional bales of wild Calisaya have been received. The low price of cultivated bark since 1885 has resulted in checking the destruction of the wild trees, which have begun again to multiply, so that they may possibly become once more common or even abundant. The Crown Bark region of Ecuador is still fairly productive, and in Colombia and Venezuela there are vast supplies of more or less inferior barks which await some favorable change in the market—never very likely to take place—that will render their collection profitable. Even at present a limited and irregular supply of one of these barks is furnished. With the exceptions here noticed, our present supplies of bark are entirely the product of cultivation, to which, therefore, we must give our chief attention.

Cultivation and Production.

The alarming prospect of the failure of the supply of Cinchona bark (see Commercial History) induced Europeans, about the middle of the nineteenth century, to turn their attention to the possibility of introducing the trees to cultivation. So early as 1737, La Condamine had collected a large number of young plants, with a view of conveying them to Europe; but, after having descended the Amazon in safety for more than a thousand leagues, they were

washed overboard, near the mouth of that river, from the boat containing them, and were all lost. After this failure, though the idea of transplanting the Cinchonas was occasionally suggested, nothing was done until 1846, when Weddell, now celebrated for his successful exploration of the region of the Calisaya bark, sent some seeds to France, which were planted with success in the Jardin des Plantes, and thus supplied some of the conservatories of Europe with specimens of the plant. But the first successful effort with a view to great practical results was made in 1853 by the Dutch government, by which Hasskarl, formerly superintendent of the Botanical Garden in Java, was sent to South America on this important mission. A number of young Cinchona plants were forwarded by him directly across the Pacific to Batavia, which they reached before the close of 1854. From these, and from seeds obtained from other sources, which were planted in the mountains of Java, in sites selected for their supposed conformity in climate with the native locality of the Cinchona, have sprung the most important plantations now in existence.

Stimulated by the suggestions of Royle, and by the partial success of the Dutch, the English government engaged, in 1859, the services of Clements R. Markham, who proceeded to Bolivia, in South America, and, after almost incredible hardships, arising partly from the nature of the country and partly from the jealousy of the native authorities, succeeded in collecting and transmitting to England upwards of 400 Calisaya plants. Most of these, however, were so much injured on their way from England to India, by the excessive heat of the Red Sea, that very few, on their arrival in Hindostan, had sufficient life remaining to grow when planted. Happily, the deficiency was supplied by seeds of *C. Calisaya* sent from Java, where they were produced, to Calcutta, at the request of the English Governor-General. While Markham was in Bolivia, other agents were collecting other species in Peru and Ecuador, whence seeds of the pale and red bark Cinchonas reached India, and, being planted in the selected sites, proved to be very productive.

Careful attention to the conditions of growth enumerated under Geographical Distribution was found essential in the selection of sites for the plantations. Those selected were near the Sanitary Station of Ootacamund in the Neilgherry Hills of Southern India, at heights varying from 5000 to 7450 feet. These positions unite the peculiar characters of the native region of the Cinchonas in the Andes, not only as regards elevation and latitude, but also as to atmospheric moisture. Other sites were selected for experimental plantations, and since the first introduction of the Cinchona trees, their culture has been extended to various points from Hakgalla, in the island of Ceylon, to the Himalaya Mountains,— as in the Wynaad, the Coorg, the hills of Travancore, and especially at Peermede in the Presidency of Madras; in Sikkim and Darjeeling in the Presidency of Bengal; at Lingmulla in the Presidency of Bombay; and in the valley of Kangra in the Punjab,—from the southern to the northern extremity of British India. Outside of India and Ceylon, culture by the British has been undertaken in the West Indies, particularly Jamaica, in Guiana, and in the Fiji Islands. The first plants taken by Weddell from Peru to Paris all perished, but the French afterward established plantations in the Isle of Bourbon, at Guadeloupe, and in Algiers, none of which are known now to exist. The Portuguese have established plantations upon the west coast of Africa, and these now yield considerable quantities of bark. Very extensive plantations have been formed, chiefly by the Germans, in Bolivia. A rather large plantation in Colombia is now old enough to be productive. In Mexico and Central America various attempts to introduce the industry have been made. The question of introducing it into the United States has frequently been raised, but it may be stated that there is no spot in North America where the conditions warrant the slightest hope of success in this direction.

The history of Cinchona cultivation affords a striking illustration of the importance of government aid in the establishment of a new industry of this kind. The early and repeated disappointments and failures, owing to the natural obstacles in the way of securing stocks, and to an almost total ignorance of the conditions determining the successful propagation and growth of the plant, and the composition of its bark, were such as to have discouraged the most hopeful of private enterprises. Repeated and expensive expeditions were necessary before the first transplantings were accomplished, and these stocks were preserved and propagated only through the instrumentality of well appointed public gardens and plantations. In Java, after these early difficulties had been surmounted and success apparently attained, it was found that owing to cross fertilization much of the progeny was entirely worthless, and the work of propagation had to be begun anew. The same difficulty was encountered elsewhere, and the slow and expensive method of propagation by cuttings was largely resorted to. In Ceylon the public were slow to become interested, and the officials were obliged not only to give away the young plants, but to solicit experiments with them as a personal favor. In Jamaica a hurricane visited the young and flourishing plantations and almost completely destroyed them. But at length, in spite of all, not only were thriving and permanent government plantations established, but private capital and enterprise upon a vast scale were enlisted. It is not probable that the forests of South America will ever again contribute a very important quota of the world's cinchona supply, or that the plant can be cultivated elsewhere than in Southern Asia with commercial success on a large scale. The question of commercial suc-

cess is dominated not simply by climatological surroundings but also by the price of labor. It is stated that both in India and Java the natives who work in the cinchona forests are paid from one dollar to one dollar and seventy cents per month, without food, according to the age and sex. The ability to extract the bark upon the spot is capable of largely counterbalancing a lack of market facilities; but it so happens that this advantage also inures to the benefit of the Eastern countries. Originally undertaken in India for the purpose of affording a cheap antiperiodic (the crude alkaloids known as "*febrifuge*" or "*quinetum*")[1] home extraction has become a most important industry, and has assumed various forms. Through the influence of the above conditions the locations of the important industry of Cinchona cultivation have been gradually wrought out, and at present about four-fifths of the cinchona barks of the world, outside of India, are furnished by Java. The first shipment from Java was of 900 pounds, in 1869. In 1900 it was 5,390,000 kilogrammes, in 1904, 7,225,000 kilogrammes. It is to be remembered that a great part of the Indian product is not exported.

Much interest has in the past attached to the selection of species of Cinchona for cultivation. In 1889 the trees upon 1779 acres of government plantation in Madras were as follows: *officinalis*, 981,918; *hybrids*, 655,856; *succirubra*, 70,693; *Calisayas*, 273; other kinds, 915, while upon 3000 acres of government plantation in Bengal, with six million trees, calisaya and hybrids represented by far the greater part. In Java in 1891, according to the government report, there were of *Ledgeriana*, 2,659,000; *succirubra*, 1,076,000; *officinalis*, 52,900; *Calisaya*, 2200; *lancifolia*, 1500. According to the report of Verne, to the French Minister of Instruction in 1903 at present the favorite species of cinchona is both in India and Java, *C. Ledgeriana*, which it will be remembered is simply a variety of *C. Calisaya*, and is said to be the richest in quinine of all barks. The small supply of wild bark coming from South America is believed to be chiefly derived from *C. officinalis* and its varieties. In the plantations of South America the attempt is made by the planters to keep the *C. Calisaya* pure, hybridization being avoided as far as possible.

Methods of Cultivation.

The history of Cinchona cultivation teems with evidence as to the difficulty of obtaining pure seeds, owing to the tendency of the plants towards cross-pollination. In every locality where the industry has been established has the disgust of the gardener been excited by the discovery that the plants which he had reared with great care, and upon which he had based great expectations, were contaminated by the admixture of foreign pollen. This was especially true in case of the earlier attempts, before this tendency had become known. Experience at length established the fact that absolute isolation of the seed-trees was essential. One of the curious developments of these experiments was the fact, already referred to, that the value of the progeny was not always assured by the value of its parentage. Some of the hybrids, even when least expected, would develop a surprisingly rich yield; and this tendency has been utilized to develop the most valuable stocks in existence. So certain is it that some of the plants from the best seed will prove worthless, that the careful selection of the seedlings while young is deemed necessary, and in South America, at least, all planting contracts are based upon this expectation, the contractor not being paid for his work until the plants have become old enough to show with certainty the proportion of good plants contained. Both in the selection of the young seedlings and the acceptance of the plantation, the test of identity is found in the leaf. Propagation by cuttings, extensively practised in some localities, has been found too slow and expensive to become general. A thorough preparation of the soil is as beneficial in the case of Cinchona as in that of other crops. Thorough tillage after transplantation is also essential, a free growth of weeds meaning destruction to a large number of the young trees. The cultivation of a secondary crop between the rows of trees is, however, practicable. A large percentage of profit depends upon the selection of a suitable age for collecting the bark. There comes a time when the use of the ground for starting a new crop is more valuable than the gain by permitting the present crop to remain, and after some years an actual deterioration of the bark sets in. This age is not the same for all the trees in the plantation. Several years' difference may occur in the maturing of trees germinated at the same time. In the case of Calisaya it occurs at from 6 to 9 years from seed, and its indication is the "chicken-leg" scaliness of the bark, as described under Classification. The "officinalis" matures somewhat less early. In the Bolivian plantations the most experienced hand is selected as the marker, and the cutters follow him, peeling the trees which he has indicated. How far these careful methods of selection are followed elsewhere, the writer is not informed.

Four principal methods of collecting the bark are in vogue, these being variously modified in different sections. The first is *uprooting*, the most primitive, by which the trees are simply uprooted at the proper age, and the ground replanted. The barks of root, stem, and branches are preserved and marketed separately. The second method is *coppicing*, by

[1] In Java the powdered bark is thrown into a 5 per cent. solution of caustic soda at 50° C. treating this with Java petroleum, separating, treating the petrolic solution with water acidulated with sulphuric acid and evaporating; the result is said to be a quinine containing less than 1 per cent. of cinchonine. (*J. P. C.*, 1901.) It is imported largely into the United States—50,000 kilogrammes a year—but on account of its yellow color is chiefly employed in the making of proprietary medicines rather than tablets.

which, after peeling a quill from the lower portion of the trunk, the latter is cut a few inches from the ground and the remainder of the stem bark and the branch bark are removed. The "coppice" is formed by a second growth of two shoots from each of the stumps. A second coppice is commonly grown, and this is harvested by uprooting. By the third method, *scraping,* the outer bark is scraped off, leaving the liber untouched. This has been found especially applicable to young trees, in which the second growth of bark is rapidly formed and contains 20 to 30 per cent. more alkaloid than that which has been taken off. It seems to be a general opinion among the planters that scraping checks the growth of the tree after it is 5 years old, so that from 3 to 5 years is the age at which it is best practised. The fourth method is known as *mossing.* It having been noticed that the Cinchona alkaloids, especially in any other form than that of sulphate, were apt, on exposure to the direct light of the sun, to become reddened by the generation of coloring matter, at the expense of the alkaloid, it was a very natural inference that a similar change might take place in the living plant, as a consequence of which the proportion of alkaloids they were capable of producing might be greatly diminished. It was also observed that the bark upon that side of the tree where the sun struck it was less rich than that upon the shady side. To obviate this presumed effect, MacIvor was induced to make the experiment of covering the stems of the growing trees with a layer of moss, so as to completely protect the bark against the influence of sunlight. The result was favorable beyond all expectation, and the yield of alkaloids in the bark thus protected is said to be doubled, tripled, or increased even in larger proportion. A tree can thus be made continuously productive; for if a slip is removed longitudinally from the trunk, from top to bottom, by covering the decorticated portion with moss, the bark is renewed at least as rich as previously in the alkaloids, while from time to time other strips may be taken, until the whole of the old bark is removed, and the new ready for removal by a repetition of the same process; and the tree is thus preserved indefinitely, probably for the whole normal length of its life. Hooper says that renewed bark is always of greater value than the mossed, and mossed than the natural, so long as the trees are under 20 years old, for it has been found that after that time the bark ceases to thicken, and the alkaloids remain stationary or even decrease. Perhaps 20 years is even too old. The practical difficulty with the process is that it requires skilled workmen, not always attainable, and hence the "coppicing system" still largely prevails in India. The supplies of suitable moss accessible to the Indian plantations having become exhausted, recourse was had to grass, old rags, paper, straw, hay, etc., all of which have been found to serve the same useful purpose. Regarding the relative amounts of the different forms of bark, we note that Ceylon returns show the following general percentages ranging over a period of four years: renewed, 30 per cent.; natural stem, 25 per cent.; root, 5 per cent.; branch, 40 per cent. Not much is to be learned from these figures, as they must, in the nature of the case, differ very widely according to the method of collection employed. As to composition, it was found that the branch bark (probably due partly to the quantity of wood which inevitably comes away with it) was but one-third as rich in quinine as the natural stem bark, while the renewed bark was twice as rich as the natural stem bark. The root bark was about equal to the natural stem bark. It is difficult to understand the last statement, in view of the well-known fact that an assay of the bark of stem and root of any one tree shows the latter to be much richer. The low result may have been due to the presence of wood, earth, or other foreign matter.

The methods of packing the bark have also undergone important modifications since the early days of cultivation. The extensive adulteration practised when the wild bark brought very high prices led to a demand for it in large pieces which could be readily and quickly examined; hence the appearance of the large *tabla* and *quill* forms, the latter afterwards becoming the standard for the cultivated bark. The bark of the trunk, and sometimes of the branches when very large, is cut into two-foot lengths, and each length removed in a single piece, which in drying rolls up to form a quill. Such peeling can of course be successfully practised only at the appropriate season of the year. The bark or the roots, branches, and dead or dry trunks must be removed by chipping, scraping, or shaving, commonly the latter. The quills, after thoroughly drying, are carefully packed in bales, or preferably in boxes, to avoid breakage, and are marketed in packages of from 100 to 250 pounds. Large quantities of cultivated bark are still marketed in this way, but, increasing competition having lowered prices so that economy in freight has become a very important item, most of the bark is now broken up, and its bulk even reduced by high pressure, and in fact only a trifling amount of wild South American bark comes into commerce. In the year 1897, South America sent to the United States a little over 30,000 pounds of cinchona; in 1901, 6552 pounds; in 1902, 5405 pounds; and in 1903, 7931 pounds, of which $\frac{7}{8}$ came from Venezuela. The effect of cultivation of cinchona upon the world's civilization has been most marked; immense as was the area which yielded the original wild bark its depletion had become very evident before the beginning of the cinchona plantations, and had it not been for these plantations the trees would by this time have been practically extirpated, and quinine only available for the very rich. Cultivation has very greatly increased, not only the quantity but also the quality of bark. For some

years, in India the attempt was made largely to increase the general average in total alkaloids rather than in quinine, so as to increase the production of the impure alkaloids which are so largely used as febrifuges in the British East Indies. Of recent years, however, even in India, efforts have been directed to the obtaining of quinine rather than of inferior alkaloids. The barks of Ceylon have always been of poor quality, while those of Java to-day are probably the best that have ever been put upon the market. The effect of the efforts of arborculturists is well shown by the facts that in 1889 the average percentage of quinine in Java bark was 4; in 1893 it had risen to 4.6; while in the five years, from 1900 to 1904 inclusive, the average quinine percentage of all the Java barks sold in the Amsterdam market was 5.37. The result does great credit to Java, for during the early history of her bark enterprise her plantations were stocked with discouraging quantities of poor or even worthless barks, which have been eliminated by the most steady enterprise and patient industry.

Commercial History.

The above general history of Cinchona leaves little necessary to be said of its commercial history, except to deduce from the facts already presented certain practical conclusions showing the present conditions of supply and demand, these bearing especially upon our concluding remarks concerning pharmacognosy and classification.

For more than a century after Peruvian bark came into use, it was procured almost exclusively from the neighborhood of Loxa. In a memoir published in 1738, La Condamine speaks of the bark of Riobamba, Cuenca, Ayavaca, and Jaen de Bracomoros. Of these places, the first two, together with Loxa, lie within the ancient kingdom of Quito, at the southern extremity; the others are in the same vicinity, within the borders of Peru. The drug was shipped chiefly at Payta, whence it was carried to Spain and thence spread over Europe. Beyond the limits above mentioned the Cinchona was not supposed to exist, until, in the year 1753, a gentleman of Loxa discovered it, while on a journey to Santa Fé de Bogota, in numerous situations along his route, wherever, in fact, the elevation of the country was equal to that of Loxa, or about 6500 feet above the level of the sea. This discovery extended through Quito into Colombia, as far as two degrees and a half north of the equator. But no practical advantage was derived from it; and the information lay buried in the archives of the viceroyalty until subsequent events brought it to light. To Mutis has been awarded the credit of making known the existence of the Cinchona in Colombia, he having claimed its discovery in the neighborhood of Bogota in 1772. Recently great doubt has been thrown upon the justness of this claim. A botanical expedition was afterwards organized by the Spanish government, with the view of exploring this part of their dominions, and the direction was given to Mutis. Its researches eventuated in the discovery of several species of Cinchona in Colombia, and a commerce in the bark soon commenced, which was carried on through the ports of Carthagena and Santa Marta.

To these sources another was added about the same time (1776) by the discovery of the Cinchona in the centre of Peru, in the mountainous region about the city of Huanuco, which lies on the eastern declivity of the Andes, northeast of Lima, at least six degrees south of the province of Loxa. To explore this new locality, another botanical expedition was set on foot, at the head of which were Ruiz and Pavon, the distinguished authors of the *Flora Peruviana.* These botanists spent several years in that region, during which time they discovered numerous species. Lima became the entrepôt for the bark collected around Huanuco, and hence probably originated the name of *Lima bark,* so often conferred, in common language, not only upon the varieties received through that city, but also upon the medicine generally.

Soon after the last mentioned discovery, two additional localities of the Cinchona were found; one at the northern extremity of the continent, near Santa Marta, the other very far to the south, in the provinces of La Paz and Cochabamba, then within the viceroyalty of Buenos Ayres, now in the republic of Bolivia. These latter places became the source of an abundant supply of excellent bark which received the name of Calisaya. It was sent partly to the ports on the Pacific, partly to Buenos Ayres.

The consequence of these discoveries was a vast increase in the supply of bark, which was now shipped from the ports of Guayaquil, Payta, Lima, Arica, Buenos Ayres, Carthagena, and Santa Marta. At the same time the average quality was probably deteriorated; for, though many of the new varieties were possessed of excellent properties, yet equal care in superintending the collection and assorting of the bark could scarcely be exercised in a field so much more extended. The varieties now poured into the market soon became so numerous as to burden the memory if not to defy the discrimination of the druggist, and the best pharmacologists found themselves at a loss to discover any permanent peculiarities which might serve as the basis of a proper and useful classification. The restrictions upon the commerce of South America, by directing the trade into irregular channels, had also a tendency to deteriorate the character of the drug. Little attention was paid to a proper assortment of the several varieties, and not only were the best barks mixed with those of inferior species and less careful preparation, but the products of other trees, bearing no resemblance to the Cinchona, were sometimes added, having been artificially prepared so as to deceive a careless observer. The markets of this country

were peculiarly ill furnished. The supplies, being derived chiefly, by means of a contraband trade, from Carthagena and other ports on the Spanish Main, or indirectly through Havana, were necessarily of an inferior character; and most of the good bark which reached us was imported by our druggists from London, whither it was sent from Cadiz. A great change, however, in this respect took place after the ports on the Pacific were opened to our commerce. The best kinds of bark were thus rendered directly accessible to us, and the trash which formerly glutted our markets became in great measure excluded. Much bark was also imported from Carthagena and other ports of the Caribbean Sea, being brought down the Magdalena River from the mountains of Colombia; and an additional source of supply was opened through the Amazon, though this bark was of inferior quality. More or less perplexity attending the recognition of the barks continued until after the firm establishment of the bark culture and the cheapening of the price, to the exclusion of the worthless varieties, as already described.

The price of the bark was as irregular and uncertain as its quality. The Cinchona forests, being in thinly-inhabited districts, did not, for the most part, belong to individuals, but were open to the enterprise of all who chose to engage in the collection of the bark. As a consequence, the operations were carried on without reference to the future condition of the interest, and most wasteful modes of procedure resulted at length in the almost complete destruction of the source of supply, and in fabulous prices—$350 to $450 per cwt.—being paid for the better grades of bark. To this result private speculation, official intrigue, and national greed all contributed. Various attempts were made to utilize the leaves, flowers, and wood of the tree, but these were found not to contain the active constituents in sufficient amount. Fortunately, cultivation has about abolished all the evils and perplexities attending this trade, and has given us a steady and practically unlimited supply of the finest bark at prices which, compared with those above referred to, are merely nominal.[1] Although this great fall in price resulted in a great financial depression and even brought disaster to some planters whose expenses were greater than could be returned at the rates then prevalent, yet, on the whole, the business has been very profitable, having paid for itself several times over. The depression in 1894 is supposed to have been brought on largely by the very heavy marketing by Ceylon, amounting, Ferguson says, to 82,000,000 pounds in seven years. Much of this marketing was in turn due to a craze for tea planting, on account of which, from 1885 to 1888, 22,000 acres of cinchona were uprooted, throwing upon the market 35,000,000 pounds of bark. A. C. Meyjes, who has devoted much study to the commercial history of Cinchona bark, estimated the annual consumption for 1894 at about 15,000,000 lbs.

One of the most important developments of the modern bark trade is the fixing of the price in accordance with the quality as determined by assay. The most accurate method of selecting a characteristic sample for assay is a subject which has received much study, without the discovery of any method which does not depend for its value upon the discrimination and care exercised in its employment. The plan which is regarded as the safest is to take a given weight, say 8 ounces, from the inner portion of each package constituting the lot, mix and powder the whole of it, and furnish to applicants the required amount of the resulting powder. If any portion of any bale or bales is damaged, care is taken to add a proportionately large fragment of such portion. The bark is then recorded as containing so many units, a "unit" being each per cent. of quinine contained in a pound of bark. In rich bark the units are of course worth more than in poor, owing to the increased yield of alkaloid for the same cost of manufacture.

In the United States, at least, some difficulty has been experienced by druggists in securing the better grades of bark at regular rates, owing to the activity of the manufacturers in draining the market of the most desirable stock. The finer appearing packages of unbroken bark, having been marketed at greater cost, are necessarily held at higher prices. Possessing no special value for manufacturing purposes, these fall to the share of the druggist, but at higher prices than broken bark of the same richness. This fact has led to the recognition of two distinct classes, known as *manufacturers' bark* and *druggists' bark*. Druggists' bark, though in quills or unbroken pieces, and of a much finer appearance than manufacturers' bark, is on the average, inferior in quinine percentage. The druggists' bark finds its entrance into commerce through various channels but the bulk of the cinchona trade, including practically all that is known as manufacturers' bark, centres in Amsterdam and London; of these marts that at Amsterdam is much the more important; in 1903 there were imported into the United States 4,000,000 pounds of cinchona bark, of which 3,000,000 pounds came from the Netherlands, 900,000 from England, and 100,000 from other parts of the world. The bark which is sold in Amsterdam comes almost exclusively from Java; that in London from India, Ceylon, and South America. Manufacturers' bark is sold, without respect to its physical characters or place of origin, entirely by its chemical analysis, the buyer in London being furnished with

[1] One writer, referring to the results of the Ceylon production, says, "We swamped the markets of the world, conferring simultaneously untold benefits on humanity by compelling a reduction in the price of Howards' quinine of more than 75 per cent. . . . Simultaneously we have reduced the value of the unit of quinine in bark against ourselves and all other producers from 2*s.* in 1880 to 3*d.*, and even 1½*d.*, though now 2*d.*"

samples of the different lots of the bark sufficient time before the sale to enable him to make his own analysis, while in Amsterdam the percentage of quinine sulphate in any lot is given in the catalogue and often tagged upon the bale. In London lots are sold by the pound; in Amsterdam by the kilogramme. The dealers calculate the price by the quininic value of the sample. The so-called unit of price of sale is in England the price paid per pound, divided by the percentage of quinine in the bark bought; thus, if 4½ pence per pound has been paid for bark containing 3 per cent. of quinine then the broker marks his unit for that particular lot as 1½ pence per pound. The Dutch unit is calculated in similar manner but in Dutch cents and in decimal weights. A comparison of the cost of Dutch and of English barks bought may be based upon the fact that a Dutch unit of 11 Dutch cents per half kilo is exactly the same as an English unit of 2½ pence per pound.

Formation of the Alkaloids.—In a very careful series of experiments made at the Java governmental cinchona plantations, Lotsy (*Bull. Inst. Botanique Buitenzorg,* 3, 1900,) found that the seeds of *C. succirubra* and *C. Ledgeriana* contain no alkaloids, but that these alkaloids appear in the cotyledons shortly after they become green. They exist chiefly in the bark in combination with a tannic acid. Lotsy found that the percentage of alkaloids is ten times greater in young than in old leaves; also that the petioles are richer in alkaloids than is the blade, and that the branch bark contains more than the trunk bark, and that the root bark is practically free from alkaloids. During the active life of the parenchymatous cells of the leaves, wood, and cortex, the alkaloids can always be found in the active protoplasmic contents, but when these cells pass into the inactive condition, are deposited in the cell-walls. The alkaloids found in the leaves are, however, never crystalline, hence it would appear that these organs produce by direct synthesis, probably as the result of the action of cinchonic acid with ammonia, a fundamental alkaloidal base, which probably in the cambium layer of the tree, and during its deposition in the growing bark, is elaborated into the true cinchona alkaloids.

Classification.

Extreme difficulty attended the earlier attempts to classify the Cinchona barks of commerce,—difficulties not probably encountered elsewhere in the Materia Medica. The varieties have, however, been reduced to a very few, and the whole subject decreased greatly in importance by the chemical method of the sale now in vogue. Most of the discarded barks will be found described in previous editions of this work. We find it necessary to enumerate and describe here only the Pale bark, from *C. officinalis,* the Red bark, from *C. succirubra,* the Yellow bark, from *C. Calisaya* and its var. *Ledgeriana,* and the Hard Yellow or Maracaibo bark, and to refer briefly to the hybrid forms.

First, a few words concerning the forms in which Cinchona bark occurs. We have (1) the large flat pieces or chips of irregular shape and size,—this referring at present almost wholly to the Maracaibo variety; (2) the small chips or broken bark, referring in large part to the root bark, and to other bark broken for close packing; (3) the shaved bark, referring to some root bark and to stem bark taken from dry stems, but chiefly to branch bark; (4) the quill bark, referring to natural bark taken from the stem and root in quill form, this including the uncultivated pale bark and all the varieties of cultivated bark; and (5) the renewed and mossed bark, which may be of any cultivated variety. The classification of all varieties and forms into druggists' and manufacturers' barks enables us to dispense in great part with a description of some of these forms. The manufacturer cares nothing for form, appearance, or structure, and but little for the variety of his supplies. He is interested wholly in its composition, and this he determines by assay. For this reason most of the broken bark goes to him. The druggist requires the quill or large chip bark; so that the great bulk of the branch bark is also thrown, at low prices, upon the hands of the manufacturer.

As regards the root barks, no classified description is available. In their structure they correspond very closely to the stem barks of the same variety. They can be readily distinguished from the latter by their less thickness, lighter external and darker inner color, greater softness, and twisted or contorted structure. They occur in short, irregular quills or chips, or sometimes as shavings, and contain very much more dust than any other form. Except partly as regards structure, the descriptions of stem barks will not apply to branch barks of the same variety, for the characteristic markings do not appear in the young condition. The branch bark appears in shavings, to the inner surfaces of many of which more or less wood adheres. If the branches were shaved while yet fresh, these shavings will be more or less rolled up and curled; but if dry before being removed, this rolling and curling will not occur. Shaved bark taken from living trees is thin, soft, and brittle, consisting of the outer bark only. The large quills are of uniform length from the same plantation, but not necessarily so from different plantations or different sections. They are commonly from 2 to 3 feet in length, but some have been marketed having a length of 5 feet. Usually they represent the entire circumference of the stem, but occasionally only half of it. In drying they roll up very tightly from one or both edges, and rarely one will be wholly or partly involved in another. The periderm, with all its markings, remains intact, and no other form so well displays the natural appearances as this. Mossed bark differs from natural stem bark in its great thickness and weight, less breadth of the quills, freedom from lichens, very dark color, and rough, corrugated or

warty surface. The outer bark or cellular portion bears a greater ratio to the inner or fibrous portion than in natural bark. Renewed bark is lighter, both in color and weight, thinner, soft and brittle, and marked by a very peculiar external smoothness, sometimes very marked indeed. In its general appearance it is strikingly like a root bark, except for the relative straightness of its fibres. Like the mossed bark, it is in narrow, only partly rolled quills or bands, and is entirely free from lichens.

As they differ so greatly among themselves in coloration, lichen-growth, degree and form of exfoliation, structure and consequent fracture, there are but few characters which can be combined in a general description of the Cinchona barks which we consider. The external color varies from light ashy gray to nearly black, the inner varies less in its shades of yellow-brown and red-brown. All are more or less bitter, and most are astringent, but only Loxa bark has a distinctive odor. The fracture is never very long-splintery and never tough. As to structure, the bast fibres are loosely arranged, the radial rows being neither continuous nor very long. The fibres themselves are always unbranched, which distinguishes the true from the false barks, are rather short and obtuse, brittle, and usually easily detached from their bed. Laticiferous ducts and stone-cells may or may not be present. The former become less conspicuous as the bark grows older, so that their relative absence becomes indicative of a stage in which the due proportion of alkaloid should have been acquired.

It may be noted here that by far the greater portion of the alkaloid, particularly quinine, is stored in the outer bark, though that in the inner bark is in a purer state. The latter is not stored in the fibres, but in the cellular tissue between them.

As regards the former classification of barks by color, it referred only in small part to the external color, chiefly to the powder. These colors were never regarded as absolutely characteristic, as the three barks, yellow, red and pale, exhibited gradations by which they mingled at their extremes. Under present conditions, the lines of demarcation have become even more indistinct, and, as a matter of fact, in the market the terms "yellow" and "red" are used with great looseness. It is true that we receive much pure-blooded Yellow Bark, *Ledgeriana* from the East, and *Calisaya* both from there and from South America; but it is also undeniable that much of the bark sold under the several names is of mixed blood, and the typical characters are often greatly obscured. The presence in our market of these mixed forms has made the terms even less valuable than they once were, and dealers cannot be found to agree as to the character of many samples. Nevertheless, the occurrence of the typical forms, and appearance in a hybrid of the blended characters, render it desirable to preserve this classification, and to group the new forms around the types.

Yellow or Calisaya Bark. Cinchona Flava.

The U. S. Pharm. (8th Rev.) defines *Cinchona* as follows: "The dried bark of *Cinchona Ledgeriana,* Moens; *Cinchona Calisaya,* Weddell; *Cinchona officinalis,* Linné, and of hybrids of these with other species of Cinchona (Fam. *Rubiaceæ*)." The description is as follows: "In quills or curved pieces of variable size, usually 2 or 3, sometimes 5 Mm. thick; externally gray, rarely brownish-gray, with numerous intersecting transverse and longitudinal fissures, which have nearly vertical sides; the outer bark may be absent, the color externally being then cinnamon-brown; inner surface light cinnamon-brown, finely striate; fracture of the outer bark short and granular, of the inner finely splintery; powder light brown or yellowish-brown; odor slight, aromatic; taste bitter and somewhat astringent." *U. S.* The bark is scarcely collected in a wild state, but cultivated in all plantations. It is the largest quinine yielder, its amount being 70 to 80 per cent. of the total alkaloids contained in the bark. The var. *Ledgeriana* yields a very valuable hybrid bark with *C. succirubra. C. Calisaya* also hybridizes with the latter species.

Description.—Flat or "table" bark, now very little produced. Quills, unless broken for shipment, large and handsome, 1½ to 2½ feet long, single or double, sometimes as much as 2½ inches in diameter, ⅛ to nearly ¼ inch thick. Externally gray to lightly brownish gray, internally light cinnamon-color, the striæ very fine. Powder light yellowish brown. Its lichens are thin and closely adherent, not rendering it shaggy. External markings very characteristic, consisting of a very light longitudinal ridging or none at all, but of numerous transverse and longitudinal fissures or cracks, the presence and arrangement of which constitute the chief characteristic of Calisaya. Upon the young stems and branches they do not appear. The first to appear are the usually large primary fissures, which encircle the stem at the nodes, or points where pairs of leaves once stood. Subsequently, numerous smaller secondary transverse fissures appear upon the internodes, and these quickly become connected and crossed by longitudinal cracks, thus dividing the periderm up into more or less quadrangular checks, which may remain attached or fall away. This gives to mature Calisaya bark an appearance of scaliness like that upon the tarsus of a fowl, and this is known to the South American collectors by a term which signifies the "chicken-leg appearance." It has also been spoken of as a "carving-like" marking. Like the roughness upon a musk-melon, its great development is regarded as an indication of high quality, and especially is this true of a close proximity of the primary fissures. This roughness is also regarded as a sure indication of maturity. There are excellent distinctions between these and the somewhat similar fissures upon the bark of *C. officinalis.* In the latter they are coarser and more gaping. Even more important is the

absence from Pale Bark of most of the longitudinal cracks, so that it does not become "chicken-legged," or at most only very slightly so. The external color of Yellow Bark is lighter than that of the Pale Bark. Longitudinal ridges are few if any, short, irregular, and inconspicuous. In fine South American bark some very small bright-red spots can be detected upon the periderm. East Indian Calisaya can commonly be recognized by its somewhat dingy or brownish shade of gray, the gray of the South American bark being bright and somewhat bluish-steel-colored.

In structure, the zone of large, rather numerous laticiferous ducts just outside the bast is conspicuous in young, and therefore inferior, samples. The rather small bast fibres are loosely scattered, almost uniformly single or radial arrangement being made out. The fracture is rough-splintery, though not coarse. Stone cells few or none. Odorless, more bitter, and less astringent than the Pale Bark. Ledger bark is the same as Calisaya in all its essential characters, but does not reach so great a size. In hybrids of Calisaya with Succirubra the characters and quality of the latter appear to predominate.[1]

Red Bark. Cinchona Rubra.

This bark is recognized by the U. S. and Br. Pharmacopœias (for definition see page 338). It is described in the U. S. P. (8th Rev.) as "in quills or curved pieces of variable size, the bark 2 to 5 Mm. thick; externally gray or grayish-brown, more or less rough from longitudinal rows of warts, or from warty ridges which are sometimes fissured, the transverse fissures rarely numerous or much intersected, and having their sides sloping; inner surface reddish or orange-brown, distinctly striate; fracture short and granular in the outer, shortly and rather coarsely splintery in the inner bark; slightly odorous; taste bitter and astringent; powder reddish-brown." *U. S.* In the British Pharmacopœia it is described as "imported in quilled or more or less incurved pieces, coated with the periderm, and varying in length from two inches to a foot (five to thirty centimetres) or more—the bark itself from about one-tenth to a quarter of an inch (two and a half to six millimetres) thick, or rarely more; outer surface brownish or reddish brown in color, more or less rough from longitudinal ridges which are most apparent in the branch bark, with numerous warts often running into lines in the larger pieces; in some varieties marked with numerous transverse cracks which have not thickened edges; inner surface brick-red or deep reddish brown, irregularly and coarsely striated; fracture shortly fibrous in the smaller, and finely fibrous in the larger, pieces; powder brownish or reddish brown; no marked odor; taste bitter and somewhat astringent." *Br.*

[1] For the anatomy of the cinchona barks of Java, see Gottfried Meyer, *Zeitschr. f. Naturwissensch.*, Bd. 72.

It is scarcely collected in a wild state, but cultivated in all plantations except those of South America. Demand and production rapidly decreasing. A large alkaloid yielder, but of this only about 20 per cent. is quinine. Largely hybridized with *C. officinalis*. Also hybridized with *C. Calisaya* and its var. *Ledgeriana*.

Description.—Quills similar to those of Calisaya, though running somewhat broader and thicker. Externally of a dingy brown gray, less lichen-bearing than either of the others. Inner surface of a more reddish cinnamon-brown than in Calisaya. Powder reddish brown. The important characteristic of red bark is the prominent longitudinal ridges, many of them short and confluent, with intervening furrows or elongated meshes. The ridges are suberous, bear numerous small warty protuberances, and may be traversed by faint cracks. Transverse fissures may or may not be present in red bark. If so, they are few, short, and irregularly disposed, and not connected by longitudinal cracks to give the checkered appearance of Calisaya. Hybrids with "officinalis" display numerous transverse fissures, and the external color is lighter and more dingy. Fracture short-splintery, not coarse. Odor none. Taste bitter and astringent.

Pale Bark.

Varieties and Synonyms.—Crown Bark, Loxa or Loja Bark, Cuenca Bark, Huanuco Bark. Derived from *C. officinalis*. Collected in a wild state about Loxa and other parts of Ecuador, and cultivated in all plantations except the South American, especially in India. Demand and production decreasing. Quinine constitutes 60 to 70 per cent. of the total alkaloids. Largely hybridized with *C. succirubra*.

Description.—Quills single or double, irregularly broken or entire, 3 or 4 to 15 or 18 inches long by ¼ to ¾, rarely 1 inch in diameter, and having a very wide range in thickness, the natural mostly 1 to 2 lines thick. Shaggy, with more abundant lichens than in any other species, the abundance of these having been considered, not entirely without reason, as an indication of the relative quality. Color of periderm darker than in the other species, but varying much from a brown gray to nearly black. Inner surface of a paler brown than in the other species, finely striate. Powder pale brown. The external markings consist of transverse fissures and longitudinal ridges, some of them wart-bearing. It is only in the thinner samples, in which the warts and fissures scarcely appear, that the ridges are continuous and conspicuous. In the prominence and breadth of its fissures and the inconspicuousness of its ridges, this bark is most distinct from the Red Bark. These characters are yet sufficiently distinct from the somewhat similar ones of Calisaya, as noted in describing that bark.

Fracture short, the inner fibrous zone sharp and narrow. Taste not so bitter as in the others. Odor of the genuine Loxa variety peculiar and

characteristic. Its structure shows the rather short and not numerous bast fibres in short interrupted single or double radial rows, and much disposed to occur in bundles of three to six or more. Stone cells rarely seen, and laticiferous ducts conspicuous only when young.

Hard Yellow, or Maracaibo Bark. Puerto Cabello Bark.

Derivation not at all certain. Collected only in a wild state in the mountains of Southern Colombia, and yielding almost the whole of the inferior wild bark now collected for market. Importation and sale in the United States quite irregular and unimportant. One of the best of the lower-grade barks, but not to be compared with any of those already described. Said to yield about 2 per cent. of crystallizable sulphates, three-fourths of which is quinine sulphate, but a characteristic specimen assayed for this investigation by Virgil Coblentz yielded 2.65 per cent. of total alkaloids, only a trace of which was quinine. Contains a large amount of resin. The common or commercial names by which have been designated the several barks of the northern countries related to this one are of very irregular application. At the time when the trade in them was large and important, the term "Maracaibo Bark" was restricted to the less resinous variety, derived from *C. cordifolia.* It was also formerly sold simply as "Yellow Bark," and it is not impossible that it was sometimes accepted, under this synonym, for Calisaya.[1]

Description.—Rusby described it as occurring in irregular broken pieces, rarely so short as an inch, and mostly from 2 to 5 or 6 inches long, 1 to 2½ or 3 inches broad, and ⅛ to ⅜ of an inch thick. Formerly it included many much smaller fragments as well as much dust, but these portions are now mostly sifted and winnowed out before marketing. The pieces are more or less flat, the thinner and narrower ones somewhat incurved, the broader and thicker recurved. The bark is compact, heavy, and fibrous, Most of the pieces display upon the outer surface more or less of the periderm, forming silvery-white or yellowish-white patches, very thin and rather soft. Occasionally the periderm is instead dark, hard, very rough, and much fissured. From many pieces the entire periderm is absent, disclosing the outer face of the bast, very similar to the inner face. This is compactly and rather finely fibrous, of a deep yellow, with a slight rust-brown tinge. Throughout, the bast is of this structure and color. Between it and the periderm there may be seen with varying distinctness, in most pieces, a characteristic resinous band of irregular width, dark reddish brown and waxy-lustrous on the

[1] False Barks.—In the sixteenth edition of the U. S. Dispensatory may be found an elaborate description of the various false barks which have from time to time entered commerce. Most of this we omit, but the so-called Cuprea Barks at one time were of so much importance that we here insert the matter contained in that edition concerning them. It may be stated, however, that no considerable collection of these barks has been made for some years, and that it does not seem probable that they will again enter commerce. Some fifteen hundred tons of them were said, however, to be stored in London in 1899, the remnant of a much larger quantity of the barks which has been and still is being slowly sold off for unprofessional uses.

Cuprea Bark.—As early as 1820, a Brazilian surgeon, by the name of Remijio, pointed out to his countrymen that the bark of certain small trees or shrubs growing in Brazil was as effective as the Peruvian bark in malarial fevers, and ever since in Brazil these plants have been known by the name of *Quinia de Sera,* or *Quinia de Remijio.* St. Hilaire (*Plantes Us. Bras.*) placed these shrubs in the genus Cinchona, as *C. Remijiana, ferruginea,* and *Vellozii;* but De Candolle (*Prodromus,* iv. 357) erected for them a new genus, Remijia, which has since been universally recognized by botanists. It is distinguished from Cinchona by the fruit capsules opening semi-loculicidally, by its peltate seeds, and by its inflorescence in elongated axillary racemes with opposite fascicles of flowers. In 1857 Cuprea bark appeared in the London market. After its value became known, the search for it in South America became very active; indeed, in Colombia a "fever" is said to have broken out, which caused agriculture to be neglected and deranged the business of the country, while in London the supply was so great as to break the whole cinchona market. S. G. Rosengarten informed us that the bark reached this country from London, and also directly from Colombia. There are two distinct regions which yield it: one is the lower part of the basin of the Magdalena River, in the province of Santander, the trees growing in the mountain chain of La Paz, and the port of export being Bucaramanga; the other the basin of the Orinoco, among the mountains which constitute the eastern branch of the Cordillera of the Andes.

Bentham states that the genus Remijia comprises 13 species; according to the researches of José Triana, but two of these, *R. Purdieana,* Wedd. (*Ann. Sci. Nat.,* 3e sér., xi. p. 272), and R. *pedunculata,* Triana (*Cinchona pedunculata,* Karsten), yield the Cuprea bark of commerce. (*P. J.,* April, 1882.) An exceedingly important fact connected with these trees is that they grow in a dry climate, and in position a little above the level of the sea, and hence without doubt could be cultivated in many intertropical countries where the Cinchonas will not grow. They would in all probability flourish within the limits of the United States.

The specimens of Cuprea bark which have been furnished us as typical by Rosengarten are composed of pieces varying from half an inch to 3 or 4 inches in length, from a quarter to a twelfth of an inch in thickness, strong and hard, varying from a yellowish to a red cinnamon color, and having a somewhat cupreous tint, distinctly curled, *very smooth* upon their inner surface, on their outer surface smoothish, or in the larger specimens rough, with the epidermis usually adherent; marked, except in the very large pieces, with fine wrinkles, and sometimes with transverse or spiral grooves, which are sometimes quite shallow, but often are deeply and sharply cut. The texture is dense and hard, the fracture is short, not fibrous, and free from spicules. The microscopic characters differ from those of the true Cinchonas in the bast cells being small and with their cavity widely open, not obliterated by secondary layers. The shaved transverse section of Cuprea bark is further characterized by a peculiar horny appearance different from that of the true Cinchonas. The bark is also remarkable for its density, which Arnaud gives as from 1.128 to 1.18, and consequently sinks in water. Cuprea bark varies in the percentage of quinine it contains. Rosengarten states that the yield in their laboratories has been from 1 to 2 per cent., and that usually the bark is remarkably free from inferior alkaloids. The complete absence of cinchonidine is said to be characteristic of them. D. Howard and I. Hodgkin, B. H. Paul and Cownley and T. G. Whiffen almost simultaneously announced the discovery of a new alkaloid, *homoquinine* or *ultraquinine,* which there is some reason for believing is a combination of quinine and quinidine. (*Chem. News,* xlv. 6.) The characteristic alkaloid is *cinchonamine,* $C_{19}H_{24}N_2O$, which occurs in colorless crystals, freely soluble in alcohol and chloroform, and fusing at 184° to 185° C. According to the experiments of W. Ellram, it is a feeble protoplasmic poison in cold blooded animals, paralyzing the nerves and muscles without preliminary irritation. In the warm blooded animals it produces epileptic convulsions by irritation of the cerebral cortex.

cut surface. The radial rows of bast fibres are irregular. The fracture is long-fibrous. The odor is distinct, and the taste quite bitter.

Chemical History.

In the analysis of Cinchona bark, the attention of chemists was at first directed exclusively to the action of water and alcohol upon it, and to the determination of the relative proportions of its gummy or extractive and resinous matter. The presence of tannin and of various alkaline or earthy salts in minute quantities was afterwards demonstrated. Fourcroy made an elaborate analysis, which proved the existence of other principles in the bark besides those previously ascertained. Westring was the first who attempted the discovery of an active principle in the bark, on which its febrifuge virtues might depend; but he was not successful. Seguin afterwards pursued the same track, and endeavored, by observing the effects of various reagents, to discover the relative value of different varieties of the drug; but his conclusions have not been supported by subsequent experiment. Deschamps, an apothecary of Lyons, obtained from bark a crystallizable salt of lime, the acid of which Vauquelin afterwards separated, and called *kinic acid* (*quinic acid*). The latter chemist also pushed to a much greater extent the researches of Seguin as to the influence of reagents, and arrived at the conclusion that those barks were most efficient which gave precipitates with tannin or the infusion of galls. Ruess of Moscow, succeeded in isolating a peculiar coloring matter from red bark, which he designated by the name of *cinchonic red,* and obtained a bitter substance which probably consisted in part of the peculiar alkaline principles subsequently discovered. The first step, however, towards the discovery of cinchonine and quinine appears to have been taken by Duncan of Edinburgh, so early as 1803. He believed the precipitate afforded by the infusion of cinchona with that of galls to be a peculiar vegetable principle, and accordingly denominated it *cinchonin.* Gomez, a Portuguese physician, convinced that the active principle of bark resided in this cinchonin, but mixed with impurities, instituted experiments upon some pale bark, which resulted in the separation of a white crystalline substance, considered by him to be the pure *cinchonin* of Duncan. It was obtained by the action of potassium hydroxide upon an aqueous infusion of the alcoholic extract of the bark, and was undoubtedly the principle now universally known by the name of *cinchonine* or *cinchonia.* But Gomez was ignorant of its precise nature, considering it to be analogous to resin. Laubert afterwards obtained the same principle by a different process, and described it under the name of *white matter,* or *pure white resin.* To Pelletier and Caventou was reserved the honor of crowning all these experiments, and applying the results which they obtained to important practical purposes. In 1820 they demonstrated the alkaline character of the principle discovered by Gomez and Laubert, and gave it definitively the name of *cinchonine.* They discovered in the yellow or Calisaya bark another alkaline principle, which they denominated *quinine.* Both these bases they proved to exist in the barks, combined with *quinic* or *kinic acid,* in the state of *cinchonine and quinine quinate.* It was, moreover, established by their labors that the febrifuge property of bark depends upon the presence of these two principles. In 1833, O. Henry and Delondre discovered a new alkaloid, but afterwards, finding its composition in its anhydrous state the same as that of quinine, concluded that it was a hydrate of that base. About 1844, Winckler announced anew the existence of the same principle, which he considered distinct, and named *chinidine,* and, under the similar title of *quinidine,* it has now taken its place among the cinchona alkaloids. In 1853, Pasteur found that what had been considered as quinidine consisted in fact of two alkaloids, for one of which he retained the name of quinidine, and called the other *cinchonidine,* and, on pushing his investigations further, he ascertained that no less than six alkaloids may be obtained from different varieties of Peruvian bark,—namely, *quinine* and *quinidine* isomeric with each other, *cinchonine* and *cinchonidine* also isomeric, and two others, derivatives from the preceding through the agency of heat, viz., *quinicine* from quinine, and *cinchonicine* from cinchonine, each being isomeric with the alkaloid from which it is derived.

The table (page 351) of the natural Cinchona bases is given by A. H. Allen on the authority of Paul and Cownley. In it the alkaloids are arranged according to formulas.

Besides these natural bases we have a number of alkaloids formed by the alteration or treatment of these natural bases, or in some cases molecular compounds of two of the natural bases. They will be noted later in the description of individual bases.

Chinoidine or *Quinoidine* is a term now applied to the resinous substance consisting not only of the *amorphous* natural alkaloids, but of those which are produced artificially through the action of the heat and acids upon the crystalline alkaloids. It was formerly official, but was dropped at the 1890 revision. The following list of bases from Cinchona or allied sources is arranged alphabetically.

APOQUINAMINE. See *Homocinchonine.*

ARICINE, $C_{23}H_{26}N_2O_4$. *Cinchovatine.*—This alkaloid, found in cusco bark, and quite recently in Cuprea bark, was formerly believed by Hesse to be identical with cinchonidine. Pelletier and Corriol obtained *aricine* as far back as 1829 (see note, p. 308, 14th ed. U. S. D.). Its separate existence is now not doubted. It crystallizes in prisms, and its salts are of sparing solubility.

CHAIRAMIDINE, $C_{22}H_{26}N_2O_4 + H_2O$, is an alkaloid obtained from *Remijia Purdieana.*

CHAIRAMINE, $C_{22}H_{26}N_2O_4$, discovered by Hesse in *Remijia Purdieana*, occurs in white needles which are readily soluble in ether and chloroform. (*Ann. Ch. Ph.*, 225, p. 211.)

CINCHAMIDINE, $C_{19}H_{24}N_2O$, is identical with hydrocinchonidine.

CINCHONAMINE, $C_{19}H_{24}N_2O$.—This alkaloid was discovered in 1881 by Arnaud in *Remijia Purdieana* (false cuprea bark). It exists in the proportion of 0.2 per cent., and is usually associated with cinchonine. His process is to treat the bark with milk of lime, dry the mixture, exhaust with boiling alcohol, distil off the alcohol, and take up the residue with diluted hydrochloric acid; cinchonamine hydrochloride crystallizes out, cinchonine hydrochloride remaining in solution. Cinchonamine is insoluble in cold water, soluble in 30 parts of alcohol, more soluble in hot alcohol, and in 100 parts of ether. It is dextrogyrate. For formulas for salts of cinchonamine, see *A. J. P.*, 1884, 156. Physiologically, cinchonamine, according to the experiments of Sée and Bochefontaine, has six times the toxic power of quinine, and has decided sialagogue properties. (*P. J.*, 1885, 791.)

CINCHONICINE, $C_{19}H_{22}N_2O$, being a derivative of cinchonine will be treated elsewhere. (See Index.)

CINCHONIDINE, $C_{19}H_{22}N_2O$.—This alkaloid is treated under the head of its sulphate, which is official in both the U. S. and Br. Pharmacopœias.

CINCHONINE, $C_{19}H_{22}N_2O$, was dismissed from the U. S. (8th Rev.) but its sulphate has been retained and a description of it will be found on page 362.

CINCHOTINE, $C_{19}H_{24}N_2O$ is isomeric with cinchonamine and hydrocinchonine; it dissolves very sparingly in ether.

CONCHAIRAMIDINE, $C_{22}H_{26}N_2O_4 + H_2O$, crystallizes in white needles, and is very soluble in ether, chloroform, alcohol, benzene and acetone. (*Ann. Ch. Ph.*, 225, p. 211.)

CONCHAIRAMINE, $C_{22}H_{26}N_2O_4 + H_2O + C_2H_6O$, also discovered by Hesse, crystallizes with both water and *alcohol of crystallization*. It is soluble in hot alcohol, ether, and chloroform. The alcoholate dissolves in sulphuric acid containing molybdic acid, giving a brown coloration, which soon becomes intensely green. (*Ann. Ch. Ph.*, 225, p. 211.)

CONCUSCONINE, $C_{23}H_{26}N_2O_4$, discovered by Hesse, occurs in the barks of *Remijia*. It is tasteless.

CONQUINAMINE, $C_{19}H_{24}N_2O_2$, occurs with quinamine. According to Allen, it is easily soluble in ether, chloroform and benzene and closely resembles quinamine.

CUPREINE, $C_{19}H_{22}N_2O_2$, was discovered by Paul and Cownley in the bark of *Cinchona cuprea*, or *Remijia pedunculata*, on the upper Orinoco. It crystallizes from alcohol in anhydrous form, but from ether in prisms with $2H_2O$. Cupreine is sparingly soluble in ether or chloroform, but readily soluble in alcohol.

Alkaloid.	Formula.	Melting Point, °C.	Optical Rotation, SD.[1]	Chief Source.
I. *Cinchonine Class:*				
Paricine	$C_{16}H_{18}N_2O$	130	0	*C. lutea* and *C. succirubra* from Darjeeling.
Cinchotine	$C_{19}H_{24}N_2O$	277	+	Crude cinchonine sulphate.
Cinchonamine		194	+121.1	*Remijia Purdieana.*
Hydrocinchonine		256	. .	*C. cuprea.*
Hydrocinchonidine (Cinchamidine)		229	−98.4	Mother liquors of homocinchonidine.
Cinchonine	$C_{19}H_{22}N_2O$	255	+226.5	Various species of *cinchona.* Almost always present.
Cinchonidine		202	−70	Especially *C. rubra.*
Homocinchonidine		207	−107	With cinchonidine.
Cinchonicine		50	+20.1	By heating cinchonine.
Paytine	$C_{21}H_{24}N_2O$	156	−49.5	From white bark of Payta.
Paytamine		. .	. .	
II. *Quinamine Class:*				
Quinamine	$C_{19}H_{24}N_2O_2$	172	+104.5	*C. succirubra* from British India and Java.
Conquinamine		121	+204.6	*C. officinalis, C. Calisaya.*
Javanine	. . . . .	. .	. .	*C. Calisaya* from Java.
Cupreine	$C_{19}H_{22}N_2O_2$	198	−175.3	*C. cuprea* or *Remijia pedunculata.*
III. *Quinine Class:*				
Hydroquinine	$C_{20}H_{26}N_2O_2$	168	−142.2	In mother liquors from quinine sulphate.
Hydroquinidine		166	+	
Quinine	$C_{20}H_{24}N_2O_2$	172	−145.2	*Calisaya officinalis,* etc.
Quinidine		168	+236.8	
Quinicine		60	+44	By heating quinine sulphate.
IV. *Cusconine Class:*				
Chairamine	$C_{22}H_{26}N_2O_4$	233	+100	*Remijia Purdieana* (Cusco or False Cuprea Bark).
Conchairamine		120	+68.4	
Chairamidine		127	+7.3	
Conchairamidine		114	−60	
Concusconine		144	+40.8	
Aricine	$C_{23}H_{26}N_2O_4$	188	−58.2	
Cusconine		110	−54.3	
Cusconidine	$C_{23}H_{28}N_2O_4$	. .	. .	
Cuscamine	. . . . .	218	. .	*C. Pelletierana.*
Cuscamidine		. .	. .	
V. *Anhydro-bases:*				
Dicinchonicine	$C_{38}H_{44}N_4O_2$	40	+66	*C. rosulenta* and *C. succirubra.*
Diquinicine	$C_{40}H_{46}N_4O_3$	. .	+	*C. rosulenta* and "quinoidine."

[1] The values for the specific rotatory power refer to solutions of the free alkaloids in nearly absolute alcohol.

This solution is lævogyrate, alkaline, gives a dark reddish-brown color with ferric chloride, and responds to the thalleioquin test. It forms with sodium hydroxide a definite crystallizable compound containing $C_{19}H_{21}N_2O.ONa$, from the solution of which the alkaloid cannot be extracted by ether. This cupreine-soda is important as furnishing a synthesis of quinine, according to the reaction

$$C_{19}H_{21}N_2O.ONa + CH_3I = C_{20}H_{24}N_2O_2 + NaI$$

(See *Cuprea Bark*, p. 349.)

CUSCAMIDINE, obtained from *C. Pelletierana.*

CUSCAMINE, obtained from *C. Pelletierana.*

CUSCONIDINE is an amorphous alkaloid found in cusco bark, accompanying cusconine.

CUSCONINE, $C_{23}H_{26}N_2O_4.2H_2O$.—This was discovered by Leverköhn. It is a constituent of the cusco bark, *C. pubescens* var. *Pelletierana*, and Hesse has found it in Cuprea bark. It is nearly insoluble in water, soluble in 35 parts of ether, more easily in alcohol, very soluble in chloroform. It may be distinguished from other cinchona alkaloids by forming with sulphuric acid a neutral sulphate, which is amorphous, gelatinous, and yellow, and insoluble in an excess of the acid.

DICINCHONICINE, $C_{38}H_{44}N_4O_2$, *dichonchinine* or *apodicinchonine*, is prepared from cinchonine and cinchonidine, and found in commercial chinoidine. It probably exists in bark in an amorphous condition.

DICINCHONINE, $C_{38}H_{44}N_4O_2$, exists in the bark of *C. rosulenta* and *C. succirubra*, and may also be obtained by fractional precipitation from the mixed amorphous alkaloids before melting, but not from commercial chinoidine.

DIHOMOCINCHONINE, $C_{38}H_{44}N_4O_2$, is an amorphous alkaloid obtained from *C. rosulenta.* It is dextrogyrate.

DIQUINICINE, $C_{40}H_{46}N_4O_2$, also termed *diconchinine* and *apodiquinidine*, is one of the chief amorphous alkaloids in commercial chinoidine; its formula indicates its relation to quinine or quinidine. By deducting one molecule of water from a double molecule of either there results diquinicine, thus:

$$2C_{20}H_{24}N_2O_2 - H_2O = C_{40}H_{46}N_4O_3$$

DIQUINIDINE, *dichonchinine of Hesse*, $C_{40}H_{46}N_4O_3$, is found principally in chinoidine which has been obtained from barks containing quinine and quinidine. It is dextrogyrate, produces a fluorescent solution with diluted sulphuric acid, and responds to the thalleioquin reaction.

HOMOCINCHONICINE, is prepared from homocinchonidine just as cinchonicine and quinicine are prepared from cinchonine and quinine.—*i.e.*, by heating their sulphates.

HOMOCINCHONIDINE, $C_{19}H_{22}N_2O$, is also obtained from *C. rosulenta.* It crystallizes in large prisms, and forms a neutral sulphate containing six molecules of water, and may be found in commerce. Its existence is denied by Skraup.

HOMOCINCHONINE, $C_{19}H_{22}N_2O$, *cinchonidine of Koch*, is obtained from the bark of *C. rosulenta;* it is lævogyrate, and crystallizes from its alcoholic solution in large prisms. It has been mistaken for *aricine.* Homocinchonine is isomeric with *apoquinamine*, which is prepared by boiling quinamine or quinamidine with hydrochloric acid for a short time. It is white, amorphous, soluble in ether, alcohol and diluted hydrochloric acid.

HOMOQUININE, $C_{39}H_{46}N_4O_4 + 4H_2O$, was discovered in 1881 simultaneously by D. Howard and J. Hodgkin, B. H. Paul, A. J. Cownley, and T. G. Whiffen (*P. J.*, 1881, p. 497; 1882, p. 905). It was first noticed by Paul and Cownley on account of the readiness with which it crystallized from its ethereal solution, and is now recognized as a molecular compound of quinine and cupreine of the formula $C_{20}H_{24}N_2O_2.C_{19}H_{22}N_2O_2 + 4H_2O$, and can be obtained by precipitating a solution of sodium cupreinate with one of quinine hydrochloride. It can be resolved into its constituent parts by precipitating the solution with solution of sodium hydroxide, when the quinine may be shaken out with ether, while the cupreine remains in the alkaline liquid as sodium cupreinate. It is freely soluble in alcohol and chloroform, sparingly in ether, from which it crystallizes in proportion as it can take up water. (Hesse.) It is also soluble in diluted sulphuric acid, producing fluorescence, and gives with chlorine water and ammonia a green coloration (thalleioquin). The sulphate coincides exactly in properties with quinine sulphate, except in its behavior with ether. Its tartrate closely resembles cinchonidine tartrate. Homoquinine and its salts behave towards polarized light like quinine.

HYDROCINCHONIDINE, $C_{19}H_{24}N_2O$, bears the same relation to cinchonidine that hydroquinine does to quinine. It is found associated with homocinchonidine in commercial cinchonidine. (*A. J. P.*, 1883, p. 20.)

HYDROCINCHONINE, $C_{19}H_{24}N_2O$, discovered by Caventou, is obtained by treating cinchonine with potassium permanganate. It is soluble in 1300 parts of water, more soluble in alcohol and in ether. The statement that it may be found in commercial cinchonine has not been confirmed. Hesse states that it may be found in Cuprea bark. It is also called *cinchotine.* Von Arlt has shown that the *pseudocinchonine* of Hesse is identical with hydrocinchonine.

HYDROQUINICINE, $C_{20}H_{26}N_2O_2$, an amorphous alkaloid obtained by fusing dry hydroquinine sulphate.

HYDROQUINIDINE (hydroconchinine), $C_{20}H_{26}N_2O_2 + 2\frac{1}{2}H_2O$, is found in commercial quinidine and may be separated by potassium permanganate treatment. It is crystalline, dissolving freely in hot alcohol and in chloroform, but less freely in ether. It gives the thalleioquin reaction like quinine. (*P. J.*, 1882, p. 904.)

HYDROQUININE, $C_{20}H_{26}N_2O_2$, was discovered by Hesse in the mother liquors from which quinine sulphate has been crystallized; he after-

wards found it in the commercial quinine salt to the extent of 4 per cent. Quinine cannot be perfectly freed from hydroquinine even by repeated crystallization of the neutral sulphates, but the hydroquinine can be completely separated by converting the alkaloid into the acid sulphate and recrystallizing this from water or alcohol, when the hydroquinine remains in the mother liquor. (Allen.) According to Hesse, it dissolves freely in alcohol and ether, and, according to Allen, also in chloroform, benzene and ammonia water, and gives the thalleioquin reaction with chlorine water and ammonia like quinine. (*P. J.*, 1882, p. 904.)

JAVANINE, obtained by Hesse from *C. Calisaya* var. *javanica.*

PARICINE, $C_{16}H_{18}N_2O$, is found with quinamine in the bark of *C. succirubra* of Darjeeling, and, according to Hesse, it may be separated from all the cinchona alkaloids with which it associates in solution by treating with sodium carbonate, which precipitates paricine first.

PAYTAMINE, $C_{21}H_{24}N_2O$, is an amorphous alkaloid accompanying paytine.

PAYTINE, $C_{21}H_{24}N_2O_2,H_2O$, was discovered by Hesse in the white Payta bark.

PROTOQUINAMICINE (see *Quinamicine*).

QUINAMICINE is isomeric with quinamidine; it with protoquinamicine is an artificial base, they are both amorphous, and are produced by heating quinamine in contact with diluted sulphuric acid. If the action of sulphuric acid be continued at 120° C. (248° F.) to 130° C. (266° F.), an amorphous brownish substance is formed which may be precipitated by sodium carbonate, and is insoluble in ether. Hesse has named this protoquinamicine.

QUINAMIDINE, *Quinidamia* (*Conchinamine of Hesse*), $C_{19}H_{24}N_2O_2$, is found in *C. rosulenta* and *C. succirubra,* and probably exists in other species of red bark. It crystallizes in long, brilliant prisms, which melt at 123° C. (253.4° F.) A crystalline hydriodide has been produced. Its gold salt like that of quinamine soon decomposes. It may be formed in acid solutions of quinamine through decomposition.

QUINAMINE, *Quinamia,* $C_{19}H_{24}N_2O_2$.—Hesse discovered this cinchona alkaloid in the bark of *C. succirubra* from Darjeeling in 1872. He has since found it in all the East Indian succirubra barks, as well as in the barks of *C. nitida, C. Calisaya,* var. *Schuhkraffti, C. erythrantha, C. erythroderma, C. rosulenta,* and *C. Calisaya* (Para bark), and particularly in *C. Ledgeriana.* De Vrij (*L'Union Pharm.*, 1877, p. 204; *N. R.*, 1877, p. 300) published a process for its preparation. It crystallizes in very long, asbestos-like, white prisms, without water of crystallization. It is nearly insoluble in cold water and in solution of potassium or ammonium hydroxides, more easily in boiling water; is readily dissolved by hot alcohol, which deposits it in crystals, and less readily by diluted alcohol. Ether, petroleum benzin, and benzene dissolve it rather easily at ordinary temperature, more readily when boiling hot, and give it up crystallized on cooling and evaporation. In alcoholic solution it has an alkaline reaction. It neutralizes sulphuric and hydrochloric acids, forming with the latter an amorphous salt, but with the former one that crystallizes with difficulty in hexagonal scales and short prisms. Its solution is dextrogyrate. Quinamine is almost tasteless, but its solutions in acids are very bitter. Its sulphuric acid solution unlike that of quinine is not fluorescent. Its reaction with gold chloride is very characteristic, the solution of the chloride producing with it a yellowish-white precipitate, which soon becomes purple, and separates gold, the supernatant liquid assuming a purplish-red and afterwards a brown color. (For other characters, see *A. J. P.*, 1872, p. 302.)

QUINIDINE, $C_{20}H_{24}N_2O_2$, is isomeric with quinine. It was discovered in 1833 by O. Henry and Delondre, but they afterwards concluded that it was quinine hydroxide, as it had the same composition as quinine. Winckler, in 1844, announced anew the existence of the same alkaloid, which he considered distinct, and named it "*chinidine;*" this substance was not pure, and Pasteur, in 1853, proved that it really consisted of two alkaloids, one of which he called *cinchonidine,* and the other *quinidine.* This view is now generally accepted, although Hesse insists on calling quinidine "*conchinine;*" but the latter name is used to only a limited extent in Germany, and scarcely at all elsewhere.

Quinidine crystallizes from alcohol with $2\frac{1}{2}H_2O$ in large lustrous monoclinic prisms or needles, efflorescent in the air; from ether, permanent rhombohedra with $2H_2O$ are obtained; from boiling water permanent plates with $1\frac{1}{2}H_2O$. (Hesse.) It effloresces on exposure to the air. It is sublimable by heat without change, and is condensed in a crystalline form. It resembles quinine not only in composition, but also in its chemical relations with chlorine and ammonia, being rendered green by the successive action of those agents. According to Herapath, it resembles it also in causing a fluorescent appearance when dissolved in water, which is not the case with either cinchonine or cinchonidine, or is so, at least, in a much less degree. It differs, however, in its greater facility of crystallization, in its much less solubility in ether, and in its influence on polarized light, quinidine producing deviation to the right, and quinine to the left. De Vrij states, as the result of his observation, that quinidine forms a salt of very difficult solubility with hydriodic acid, and that, consequently, when a solution of potassium iodide is added to a solution of quinidine sulphate a white precipitate is deposited. By this test quinidine may be distinguished from the other cinchona alkaloids, and detected when mixed with them in solution, no other yielding a precipitate with potassium iodide. (See *A. J. P.*, xxix. 233.) Herapath proposes another test to distinguish this alkaloid from quinine. If to a solution

of quinine sulphate in acetic acid, tincture of iodine be added, and the mixture heated and then allowed to cool, a beautiful emerald-green compound is formed, while quinidine sulphate treated in the same way yields a brown precipitate. When the mixture of this alkaloid with cinchonidine is exposed to hot air, the crystals of quinidine effloresce, and may be distinguished from the others by their opaque whiteness. Vreven (*C. D.*, March 5, 1898, 400) states that the crystals yielded by Marmé's reagent (potassio-cadmium iodide) with quinidine are different from those obtained from any of the other cinchona alkaloids. They are seen under the microscope to consist of bundles of fine needle-like crystals quite different from those of quinine, cinchonine, and cinchonidine.

Commercial quinidine, consisting generally of quinidine with a much larger proportion of cinchonidine, and sometimes, there is reason to believe, exclusively, or nearly so, of the latter alkaloid, was carefully examined by H. G. Leers. It readily crystallizes from its alcoholic solution, by spontaneous evaporation, in hard, shining, colorless crystals, which are easily pulverized and yield a snow-white powder. They melt without decomposition or loss of water at 175° C. (347° F.), and on cooling concrete into a grayish-white crystalline mass. At a higher heat they take fire, and burn with an odor resembling that of the volatile oil of bitter almond. Their taste is bitter, but less intensely so than that of quinine. Quinidine is soluble, according to Hesse, in 2000 parts of water at 15° C.; in 750 parts of boiling water; in 26 parts of 80 per cent. alcohol at 20° C.; in 22 parts of ether of sp. gr. 0.729 at 20° C., or in 35 parts of the same at 10° C. (Hesse, 1868); according to Dragendorff, in 76.4 parts of ether at 10° C.; but the solubilities of commercial quinidine vary more or less according to the relative quantities of quinidine proper and cinchonidine contained in it. With the acids it forms salts, most of which are beautifully crystallizable, and much more soluble than those of quinine. There are, as of quinine and cinchonine, two classes of the salts of quinidine, which may be considered either as neutral and acid or as basic and neutral. It differs from quinine by its much slighter solubility in ether. From the aqueous solution of its salts the alkalies and their carbonates and bicarbonates throw down pulverulent precipitates not soluble in an excess of the precipitant. With sodium phosphate, silver nitrate, and mercuric chloride it forms white, with gold trichloride light yellow, and with platinic, orange-yellow precipitates. It may be obtained by first precipitating it from the solution of one of its salts by an alkali, and then repeatedly dissolving in alcohol and crystallizing, until it is entirely freed from a greenish-yellow resinous substance which is apt to attend it. From quinine it may be separated by repeated washing with ether.

The sulphate of this alkaloid was official in the U. S. P. 1890, and described as follows:

Quinidinæ Sulphas. U. S. 1890, *Quinidine Sulphate.* $(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O = 780.42$.

"The neutral sulphate of an alkaloid obtained from the bark of several species of Cinchona (nat. ord. *Rubiaceæ*). Quinidine Sulphate should be kept in well-stoppered bottles, in a dark place." *U. S.* 1890.

Quinidine sulphate is, according to one view, neutral, consisting of one molecule each of quinidine, sulphuric acid, and water; according to another, basic, containing two molecules of base, one of acid, and one of water, and therefore a disulphate. It is obtained from the quinidine barks by the same process as that by which quinine sulphate is procured from the quinine-yielding barks. When the two alkaloids are contained in the same bark, the quinidine sulphate (commercial) remains in the mother waters in consequence of its greater solubility. By the addition to its solution of a quantity of sulphuric acid equal to that which it contains, it is converted into the bisulphate (sulphate on the basic view), crystallizable in fine acicular crystals like asbestos, and possessing the formula $C_{20}H_{24}N_2O_2H_2SO_4 + 4H_2O$. Quinidine sulphate was officially described as in "white, silky needles, odorless, and having a very bitter taste; permanent in the air. Soluble, at 15° C. (59° F.), in 100 parts of water, and in 8 parts of alcohol; in 7 parts of boiling water, and very soluble in boiling alcohol; also in 14 parts of chloroform, and in acidulated water; almost insoluble in ether. When heated to 120° C. (248° F.), the salt loses its water of crystallization (4.6 per cent.). Upon ignition, it is slowly consumed, leaving no residue. The salt is neutral or faintly alkaline to litmus paper. An aqueous solution of the salt, when acidulated with sulphuric acid, has a decided, blue fluorescence. On treating 10 Cc. of an aqueous solution (about 1 in 1600) of the salt with 2 drops of bromine water, and then with an excess of ammonia water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents, more dilute solutions will give a paler tint, while more concentrated ones will acquire a deeper color, or deposit a green precipitate. A cold, saturated aqueous solution of the salt yields a white precipitate with potassium iodide test-solution (difference from *quinine sulphate*). An aqueous solution of the salt yields, with barium chloride test-solution, a white precipitate insoluble in hydrochloric acid. Quinidine Sulphate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of *readily carbonizable, organic impurities*), nor produce a red color with nitric acid (difference from *morphine*). If a small quantity of ammonia water be added to 3 Cc. of an aqueous solution of the salt saturated at 15° C. (59° F.), a white precipitate (quinidine) will be produced, which requires more than 30 Cc. of ammonia or more than 30 times its weight of ether to dissolve it (absence of more than small proportions of *other cinchona alkaloids*)." *U. S.* 1890.

The action of quinidine sulphate upon the system is similar to that of quinine, but is less powerful in the proportion of three to two.

QUINICINE, $C_{20}H_{24}N_2O_2$, being a derivative of quinine, will be treated under that head.

QUININE, $C_{20}H_{24}N_2O_2 + 3H_2O$.—This alkaloid has been made official, as have its bisulphate, hydrobromide, hydrochloride, salicylate, and sulphate, and they will be treated under separate heads (see Index).

The following additional substances have been found in Cinchona bark; *Quinic* or *Kinic, Quinovic* or *Kinovic, Quinotannic* or *Cinchotannic acids, Quinovin* or *Kinovin, Cinchonic red,* volatile butyraceous oil, in small quantity, and red and yellow coloring matter. These constituents, arranged alphabetically, will now be considered in detail.

CINCHOCEROTIN, $C_{27}H_{48}O_2$.—This substance was discovered by Kerner in flat Calisaya bark from South America. He obtained it in white, very light, crystalline scales. It is not soluble in boiling water, nor in hydrochloric, diluted sulphuric, or glacial acetic acid, but dissolves readily in ether, chloroform, and alcohol. (*A. J. P.,* 1883, p. 357.)

CINCHOFULVIC ACID.—The *cinchonic red* of Reuss, identical with the *insoluble red coloring matter* of Pelletier and Caventou, $C_{12}H_{14}O_7$, is reddish brown, insipid, inodorous, largely soluble in alcohol, especially when hot, and almost insoluble in ether or water, though the latter dissolves a little at the boiling temperature. The acids promote its solubility in water. It precipitates tartar emetic, but not gelatin; but if treated with a cold solution of potassium or sodium hydroxide, or with ammonia, lime, or baryta with heat, and then precipitated by an acid, it acquires the property of forming an insoluble compound with gelatin. It yields protocatechuic acid, $C_7H_6O_4$, when fused with potassium hydroxide. It is most abundant in the red bark (over 10 per cent.), and least so in the pale.

CINCHOTANNIC ACID. *Cinchotannin,* $C_{14}H_{16}O_9$.—*Tannic acid, tannin,* or *soluble red coloring matter* of Pelletier and Caventou, has been considered as possessing all the properties which characterize the proximate vegetable principles associated together under the name cinchotannic acid. It is a glucoside existing in cinchona barks in the proportion of 3 to 4 per cent. It has a brownish-red color and an austere taste, is soluble in water and alcohol, combines with metallic oxides, and produces precipitates with the salts of iron, which vary in color according to the variety of bark, being deep green with the pale bark, blackish brown with the yellow, and reddish brown with the red. It also forms white precipitates with tartar emetic and gelatin, and readily combines with atmospheric oxygen, becoming insoluble. It must, however, differ materially from the tannic acid of galls, which could not exist in aqueous solutions containing cinchonine and quinine without forming insoluble compounds with them. Rembold has shown that when cinchotannic acid is boiled with diluted sulphuric acid, cinchonic red is produced, sugar being formed at the same time.

FATTY MATTER.—This was first obtained pure by Laubert, and is of a greenish color as obtained from the pale bark, orange yellow from the yellow. It is insoluble in water, soluble in boiling alcohol, which deposits a part of it on cooling, very soluble in ether, even cold, and saponifiable with the alkalies.

QUINIC ACID (*Hexahydrotetraoxybenzoic acid*), $C_7H_{12}O_6$.—This acid was isolated as early as 1790 by Hofmann, an apothecary of Leer, who obtained it from the calcium salt from cinchona. It exists in a number of important plants,—ivy, oak, elm, ash, coffee, etc. It may be desirable to procure the alkaloids in the state of saline combination in which they exist in the bark, since it is possible that they may exert an influence over the system in this state somewhat different from that produced by their combinations with sulphuric or other mineral acids. As it is impossible to procure the quinates immediately from the bark in a pure state, it becomes necessary first to obtain the quinic acid separately, which may thus become of some practical importance. We shall, therefore, briefly describe the mode of procuring it, and its characteristic properties. It is usually prepared from calcium quinate, the residue obtained in the manufacture of quinine sulphate (see *Quininæ Sulphas*) by decomposing an aqueous solution of calcium quinate with oxalic acid, filtering out the precipitated calcium oxalate, and evaporating the filtrate to the crystallizing point; or by evaporating the infusion of bark to a solid consistence, and treating the extract with alcohol, we have in the residue a viscid matter consisting chiefly of mucilage with calcium quinate, which is insoluble in alcohol. If an aqueous solution of this substance be formed, and allowed to evaporate at a gentle heat, crystals of the quinate will be deposited, which may be purified by a second crystallization. The salt thus obtained, being dissolved in water, is decomposed by means of oxalic acid, which precipitates the lime and leaves the *quinic acid* in solution. This may be procured in the crystalline state by spontaneous evaporation, though as usually prepared it is in the form of a thick syrupy liquid. The crystals are transparent and colorless, sour to the taste, soluble in 2 parts of water, but less soluble in alcohol, and almost insoluble in ether. By heating quinic acid or a quinate with manganese dioxide and sulphuric acid, we get yellow crystals of *kinone,* better known as *quinone,* $C_6H_4O_2$, a reaction which may be used for ascertaining the presence of quinic acid. The cinchonine and quinine quinates may be obtained either by the direct combination of their constituents, or by the mutual decomposition of the sulphates of those alkaloids and calcium quinate. *Cinchonine quinate* has a bitter and astringent taste, is very soluble in water, is soluble also in alcohol, and is crys-

tallized with difficulty. *Quinine quinate* is also very soluble in water, but less so in rectified alcohol. Its taste is very bitter, resembling that of yellow bark. It crystallizes in beautiful stellate groups, which are opaque or semi-transparent. The salt is with difficulty obtained free from color, and only by employing the ingredients in a state of extreme purity. (*Ann. Ch. Phys.*, Juillet, 1829.) Lautemann found, in experiments upon himself, that quinic acid, when taken into the system, undergoes a conversion into hippuric acid and in this state escapes with the urine. (*Ann. Ch. Ph.*, cxxv. 9.) Rabuteau has investigated the physiological properties of quinic acid, and has found it closely to resemble the ordinary vegetable acids, being harmless in its effects on the system, and forming with water a refreshing drink like lemonade. Like other vegetable acids, also, it is decomposed in the system, forming, when taken in the state of an alkaline salt, a carbonate of the alkali in the blood, and rendering that fluid alkaline. (*A. J. M. S.*, Oct. 1872, p. 524.) Quinic acid is said by Zwenger to have been found in the leaves of *Vaccinium Myrtillus*, L. (*A. J. P.*, March, 1861, p. 128.) Several esters of quinic acid and compounds with synthetic bases have been recently introduced into medicine, viz.—*chinotropin, sidonal, new sidonal, urosin*, and *ural*.

Quinovin, *Kinovin*, or *Chinovin*. *Kinovic bitter*, $C_{38}H_{62}O_{11}$.—Originally discovered in the false bark called quinquina nova, or new bark, this substance has since been found in Calisaya bark, and probably exists, in greater or less proportion, in all the Cinchona barks. It was detected by De Vrij not only in the bark but also in the wood and leaves of *C. Calisaya* and *C. lucumæfolia*. (*J. P. C.*, Avril, 1860, pp. 225, 258.) It is white, uncrystallizable, almost insoluble in water, but readily dissolved by alcohol and ether. It is very bitter, and, as it is asserted to have no febrifuge virtues, may on this account mislead the judgment in relation to the activity of the bark in which it may be found. Some barks are said to owe their bitterness mainly to this ingredient. Winckler gives, as a certain test of its presence in any bark, copper sulphate, which is indifferent to infusion of bark containing none of this principle, but detects the smallest proportion of it by producing a dirty-green color, soon followed by the deposition of a fine similarly colored powder. This is a salt of copper, and has a very bitter and metallic taste. (See *A. J. P.*, xxv. 343.)

Quinovin in alcoholic solution was shown in 1859 by Hlasiwetz to be resolved by means of hydrochloric acid gas into quinovic acid, $C_{24}H_{38}O_4$, and an uncrystallizable sugar, *mannitan*, $C_6H_{12}O_5$, by assimilation of H_2O. The formation of quinovic acid takes place more easily if kinovin is placed in contact with sodium amalgam and spirit of wine, when after 12 hours mannitan and sodium quinovate are formed. (*Pharmacographia*, 2d ed., p. 364.)

Liebermann and Giesel (*Ber. d. Chem. Ges.*, xvi. 987) believe that two modifications exist, *α-quinovin* and *β-quinovin*, the former in Cinchona, the latter in Cuprea bark: α-quinovin is a white crystalline powder, nearly insoluble in cold and hot water, but soluble in caustic alkalies, lime water, ammonia water, and glacial acetic acid, soluble with difficulty in chloroform, ether, and petroleum benzin; it dissolves in 57 parts of nearly absolute alcohol. β-quinovin closely resembles α-quinovin, but is not soluble in ether, and crystallizes readily from diluted alcohol.

De Vrij proposes the following method of isolating quinovin. Macerate powdered cinchona with a very weak solution of potassium or sodium hydroxides, precipitate the filtered liquid with an acid, redissolve the precipitate in milk of lime to separate the cinchonic red, filter and precipitate the solution boiling hot with hydrochloric acid, separate the precipitate, wash it, express as much as possible, and lastly dry it on porous stones, and powder it. For a process for preparing quinovin from by-products, see Allen's *Organic Analysis*, 1892, vol. iii., Part ii., p. 443. Thus prepared, the quinovic bitter forms soluble compounds with magnesia and lime, and has been employed, in this mode of combination, as a tonic in the hospital of Batavia, with encouraging success. (*J. P. C.*, Avril, 1860, p. 258.)

Quinovic Acid (*Kinovic Acid*).—Resulting from the decomposition of quinovin, and possessing the formula $C_{32}H_{48}O_6$; in white, rhomboidal crystals, insoluble in water, but slightly soluble in ether, somewhat more so in boiling alcohol, but very soluble in ammonia and the fixed alkalies, the solutions frothing like soap water. On adding an acid to an alkaline solution of quinovic acid, a hydrate of quinovic acid is thrown down as a very voluminous jelly, the whole contents of the vessel gelatinizing. Kerner (*Deutsche Klin.*, xx. 81) speaks very favorably of quinovic acid as an excellent and at the same time perfectly safe tonic, which produces no narcotic symptoms, and, given to adults in the quantity of half or three-quarters of an ounce, causes not the slightest ill effect. He prefers it in the form of calcium quinovate, of which forty grains (2.6 Gm.) is the average dose. (*Am. J. M. S.*, Oct. 1869, 543.)

By the experiments of Henry, Jr., and Plisson, it may be considered as established that the alkaloids of the different varieties of bark are combined at the same time with quinic acid and with one or more of the coloring matters which, in relation to these substances, appear to act the part of acids. This idea was originally suggested by Robiquet. (*J. P. C.*, xii. 282, 369.) The compounds of quinine, cinchonine, etc., with the coloring matter are scarcely soluble in water, while their quinates are very soluble.

The odor of bark appears to depend on a *volatile oil*, which Fabroni and Trommsdorff obtained by distillation with water. The oil

floated on the surface of the water, was of a thick consistence, and had a bitterish, acrid taste, with the odor of bark.

Yellow Coloring Matter.—This has little taste, is soluble in water, alcohol, and ether, precipitates neither gelatin nor tartar emetic, and is itself precipitated by lead subacetate.

Incompatibles.—Of the relations of bark to the several solvents employed in pharmacy we shall speak hereafter, under the heads of its tincture and other preparations, where we shall also have an opportunity of mentioning some of the more prominent substances which afford precipitates with its liquid preparations. It is sufficient at present to state that all the substances which precipitate the infusion of bark do not by any means necessarily affect its virtues, as it contains several inert ingredients which form insoluble compounds with bodies that do not disturb its active principles. As *tannic acid* forms with the alkaloids compounds insoluble in water, it is desirable that substances containing this acid in a free state should not be prescribed in connection with the infusion or decoction of bark; for, though these insoluble tannates might be found efficacious if administered, yet, being precipitated from the liquid, they would be likely to be thrown away as dregs, or at any rate would communicate, if agitated, an unpleasant turbidity. The same may be said of the *tincture* and *compound solution of iodine,* which form insoluble compounds with all the cinchona alkaloids, and of the *alkalies, alkaline carbonates,* and *alkaline earths,* which precipitate them from their aqueous solution.

Estimation of Value.—It is evident, from what has been said, that an infusion of bark, on account of the tannin-like principle which it contains, may precipitate gelatin, tartar emetic, and the salts of iron, without having a particle of cinchonine, quinine, or other alkaloid in its composition, and that consequently any inference as to its value, drawn from these chemical properties, would be fallacious; but, as the active principles are thrown down by the tannic acid of galls, no bark can be considered good which does not afford a precipitate with the infusion of this substance.[1]

It is impossible to determine with accuracy the relative proportion of the active ingredients in the different varieties of cinchona, as the quantity is by no means uniform in different specimens of the same variety. The results of the most recent experiments have been already stated under the head of the several varieties of bark described. But it is highly important, in relation to any particular sample of bark, to be able to ascertain its medicinal efficiency, which is measured by the quantity of the peculiar cinchona alkaloids it may contain. In 1880 the U. S. Pharmacopœia for the first time in its history gave a process for assaying Cinchona bark; this was deemed necessary because of the impossibility of judging of the quality of the bark by its physical appearances. The manufacturing chemist never trusts to anything short of a careful chemical assay, and Cinchona bark should never be dispensed or used without having its quality tested or certified to by a competent authority. The following official process of assay is much simpler than that of the U. S. Pharm. 1880, and will give sufficiently accurate results for the uses of the pharmacist. Each manufacturer and quinologist usually has his own secret process, and a method which will accurately differentiate the quantities of the alkaloids is usually difficult and unreliable in the hands of the inexperienced.

Assay (8th Rev.).—"Cinchona, in No. 80 (or finer) powder, *fifteen grammes;* Ether, sp. gr. not above 0.720 at 25° C. (77° F.); Chloroform, Ammonia Water, Distilled Water, Normal Sulphuric Acid V.S., each, *a sufficient quantity.* Introduce the Cinchona into an Erlenmeyer flask or bottle of about 200 Cc. capacity, and add a mixture of 125 Cc. of ether and 25 Cc. of chloroform; then insert the stopper securely, shake the flask vigorously, and allow it to stand for ten minutes. Then add 10 Cc. of ammonia water, and allow it to stand for five hours, shaking at frequent intervals (or continuously with the aid of a mechanical shaker). Next add 15 Cc. of distilled water, shake the flask vigorously, and allow it to stand for a few minutes, so as to cause the powder to settle readily. When the supernatant fluid is quite clear, decant into a measuring flask or cylinder exactly 100 Cc. of the supernatant liquid (representing 10 Gm. of Cinchona), transfer this to a separator and add 15 Cc. of normal sulphuric acid V.S., or sufficient to make the liquid distinctly acid. Shake the separator vigorously for one minute, and allow the two layers of liquid to separate completely. Draw off the lower aqueous layer into a flask. Then add 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water to the separator and shake it vigorously for about one minute, allow the liquids to separate as before, and again draw off the lower aqueous layer into the flask. Repeat the operation, using 5 Cc. of distilled water in the separator (without acid), drawing off the aqueous liquid into the

[1] *Grahe's Test.*—A test of the Cinchona barks containing one or more of their characteristic alkaloids has been proposed by Grahe. It is founded on the fact that when these barks are exposed to destructive distillation a product is obtained of a bright carmine color, which is yielded by no other bark under the same circumstances, and not by cinchona unless it contain one or more of its peculiar alkaloids. Nor do the pure alkaloids afford it; but, if mixed with a little acetic, quinic, tannic, citric, or tartaric acid, they exhibit the reaction, showing that in the bark it takes place between the alkaloids and organic acids contained in it. Grahe applies the test by heating a piece of the bark weighing from five to ten grains in an ordinary test-tube, and gradually increasing the heat to redness. Whitish smoke, and aqueous vapor condensing on the surface of the tube, are first given off, which are soon followed by the appearance of redness in the fumes, and by the deposition, an inch above the heated part, of a red pulverulent film, which is gradually changed into a thick, oily liquid, running down the glass in drops or streaks of a fine carmine color. (*Ch. Cb.,* Feb. 17, 1858, p. 97.)

flask. Filter the combined acid liquids into a measuring cylinder, and wash the filter and flask with enough distilled water to make the contents of the cylinder measure exactly 50 Cc. Pour half (25 Cc.) of the acid liquid into a separator marked No. 1, and the remaining half (25 Cc.) into another separator marked No. 2, which set aside.

I. For Anhydrous Cinchona Alkaloids.—To separator No. 1 (see above) add 25 Cc. of a mixture of chloroform 3 volumes and ether 1 volume, also 5 Cc. of ammonia water, or sufficient to render the liquid alkaline. Insert the stopper and shake the separator carefully for one minute, and then draw off the lower layer into a tared flask or beaker. Add 20 Cc. more of the chloroform-ether mixture to the separator, insert the stopper, and shake the liquid carefully for one minute, again drawing off the lower layer into the tared flask. Repeat the operation with 10 Cc. of chloroform, and draw this off into the tared flask. Evaporate the chloroform-ether solutions in the tared flask or beaker slowly and carefully to dryness on a water-bath. Add 3 Cc. of ether to the dry residue, and again evaporate to dryness. Then place the flask or beaker in an air-bath and heat at 110° C. (230° F.) until the weight after cooling remains constant. The weight of the residue in grammes multiplied by 20 will give the percentage of anhydrous cinchona alkaloids (total alkaloids) in the Cinchona.

II. For Ether-Soluble Alkaloids.—To separator No. 2 (see above), containing the other 25 Cc. of acid liquid, add 25 Cc. of ether and 5 Cc. of ammonia water, or sufficient to render the liquid alkaline. The temperature of the liquid should be kept below 20° C. (68° F.), by cooling it, if necessary. Shake the separator moderately for two minutes, and allow the liquid to stand for ten minutes at 15° C. (59° F.); after the liquids have separated, draw off and reject the lower aqueous layer and transfer the ethereal liquid to a tared beaker. Add 5 Cc. more of ether to the separator, rinse carefully, and add the rinsings to the tared beaker. Evaporate the ether carefully by the aid of a water-bath, dry the beaker and contents in an air-bath at 110° (230° F.) for two hours, cool, and weigh. The weight of the residue in grammes multiplied by 20 gives the percentage of the anhydrous ether-soluble alkaloids contained in the Cinchona.

NOTE.—Ether-soluble alkaloids include quinine, quinidine, and cinchonidine." *U. S.*

The British Pharmacopœia gives the following method for the testing of Red Cinchona bark:

Test. "When used for purposes other than that of obtaining the alkaloids or their salts, it should yield between 5 and 6 per cent. of total alkaloids, of which not less than half should consist of quinine and cinchonidine, as estimated by the following methods.

Mix 20 grammes of Red Cinchona Bark, in No. 60 powder, with 6 grammes of *calcium hydroxide;* slightly moisten the powders with 20 cubic centimetres of *water;* mix the whole intimately in a small porcelain dish or mortar; allow the mixture to stand for an hour or two, when it will present the characters of a moist dark brown powder, in which there should be no lumps or visible white particles. Transfer this powder to a suitable flask fitted with a small reflux condenser, add 130 cubic centimetres of *benzolated amylic alcohol,*[1] boil them together for about half an hour, decant the liquid on to a filter, leaving the powder in the flask; add more of the *benzolated amylic alcohol* to the powder, and boil and decant as before; repeat this operation a third time, then turn the contents of the flask on to the filter, and wash by percolation with more of the *benzolated amylic alcohol* until the Bark is exhausted. Introduce the collected filtrate, while still warm, into a stoppered glass separator; add to it 2 cubic centimetres of *diluted hydrochloric acid,* mixed with 12 cubic centimetres of *water;* shake them well together, and when the acid liquid has separated this may be drawn off, and the process repeated with *water* slightly acidulated with *hydrochloric acid,* until the whole of the alkaloids have been removed. The liquid should then, while warm, be carefully and exactly neutralized with *solution of ammonia,* and concentrated to the bulk of 16 cubic centimetres. If now about 1.5 grammes of *sodium potassium tartrate,* dissolved in twice its weight of *water,* be added to the solution, and the mixture stirred with a glass rod, insoluble tartrates of quinine and cinchonidine will separate completely in about an hour, and these collected on a filter, washed, and dried in a water-oven, will contain eight-tenths of their weight of the alkaloids, quinine and cinchonidine, which, multiplied by 5, gives the weight of those alkaloids present in 100 grammes of the bark. To the mother-liquor from the preceding process add *solution of ammonia* in slight excess. Collect, wash, and dry the precipitate, which will contain the other alkaloids. The weight of this precipitate, multiplied by 5, and added to the percentage weight of the quinine and cinchonidine, gives the percentage weight of total alkaloids." *Br.*

The German Pharmacopœia gives the following method: "The powdered bark is assayed as follows: Shake 20 Gm. of it strongly and repeatedly with a mixture of 10 Gm. of water of ammonia, 20 Gm. of alcohol, and 170 Gm. of ether, and, after a day, decant 120 Gm. of the clear liquid. To this liquid add 3 Cc. of volumetric hydrochloric acid, remove the ether by distillation or evaporation, and again add, if necessary, enough hydrochloric acid to render the solution acid. Then filter, and mix the cold filtrate with 3.5 Cc. of volumetric solution of potassa. When the alkaloids have subsided, drop more of the solution of potassa

[1] "Made by mixing together three volumes of benzol and one of amylic alcohol, and decanting the supernatant fluid from any deposited water." *Br.*

into the clear supernatant liquid, until nothing more is thrown down. Finally, collect the whole of the precipitate on a filter, and wash it repeatedly with small portions of water, until drops of the wash water allowed to come in contact with the surface of a cold, aqueous, neutral, saturated solution of sulphate of quinine no longer produce a turbidity. When the alkaloids have drained, press them gently between bibulous paper, and, having dried them sufficiently in the air to permit their being removed to a watch-glass, dry them completely, first over sulphuric acid, and, finally, by means of a water-bath. The weight of alkaloids procured by this method should not be less than 0.42 Gm. When a small portion of the same is boiled with 300 parts of water, the filtrate, after cooling, should yield flakes of quinine. When to 5 parts of this solution, after being cooled and decanted, 1 part of chlorine water is added, and water of ammonia immediately dropped in, the liquid should acquire a beautiful green color." *P. G.* For E. R. Squibb's method of assay see U. S. D., 18th ed., p. 412.

It is usually sufficient to ascertain the quantity of total alkaloids in bark, for this is really a test of the efficacy of the bark for pharmaceutical purposes, since all the organic alkaline principles contained in it are efficient as medicines, and in all probability in a nearly equal degree. But for manufacturing purposes it is necessary to push the investigation further, and ascertain the proportion of the several alkaloids in the mixture.

De Vrij obtained from bark of *C. officinalis* grown at Ootacamund total alkaloids as high as 11.96 per cent. (9.1 per cent. of which was quinine). The highest yield yet recorded was obtained by De Vrij from Ootacamund bark, 13.5 per cent., the great part of which was quinine.[1] Between these and the barks of lowest value there is every grade of productiveness, down to a mere trace of alkaloidal matter.

The quantities of cinchona and other barks used in the manufacture of quinine imported into the United States during the year 1903 was 3,980,072 lbs, valued at $547,332, and for 1904 3,605,131 lbs., valued at $501,375. In the same years the importations of sulphate of quinine amounted to 2,534,106 oz., valued at $576,404, and 3,059,514 oz., valued at $659,868.

Uses.—This valuable remedy was unknown to the civilized world until about the middle of the seventeenth century, though the natives of Peru are generally supposed to have been long previously acquainted with its febrifuge powers. Humboldt, however, is of a different opinion. In his memoir on the Cinchona forests, he states that it is unknown as a remedy to the Indians inhabiting the country where it grows, and, as these people adhere pertinaciously to the habits of their ancestors, he concludes that it never was employed by them. They have generally the most violent prejudices against it, considering it poisonous, and in the treatment of fever prefer the milder indigenous remedies. Ruiz and Pavon, however, ascribe the discovery to the Indians; and Tschudi states, in his "*Travels in Peru*" (Am. ed., ii. 280), that the inhabitants of the Peruvian forests drink an infusion of the green bark as a remedy in intermittent fever. On the other hand, the statements of Humboldt have been confirmed by the travellers Markham and Spence, the former remarking that the native Indian doctors do not use the bark, and the latter that the Cascarilleros of Ecuador believe that their red bark is used solely for dyeing. It is uncertain whether, as Jussieu stated in 1739, the Jesuit fathers received their knowledge from the Indians, or, as Humboldt believes, discovered the virtues of the drug for themselves, having been led to make trial of it by its extreme bitterness. The Countess Chinchon, wife of the Viceroy of Peru, having in her own person experienced the beneficial effects of the bark is said, on her return to Spain in the year 1640, to have first introduced the remedy into Europe. Hence the name of *pulvis Comitissæ*, by which it was first known. After its introduction it was distributed and sold

[1] *Quinetum.*—Under this name a compound is produced in India and other Eastern countries, which consists of the mixed alkaloids of Red Bark, the object being to produce a cheap febrifuge which will answer all practical purposes and save the cost of refining. De Vrij named it *quinetum quinotannicum* and considered it to be a mixture of the quinotannates of the mixed crude alkaloids. The following formula was adopted by the Dutch Society for the Advancement of Pharmacy: "Red Cinchona bark (the bark of the trunk of *Cinchona succirubra*, grown in Java and India, and containing at least 6 per cent. of alkaloids), in fine powder, 1000 parts; normal hydrochloric acid (volumetric standard), 1000 parts; oxalic acid, 12 parts; solution of soda, q. s.; water, q. s.

Macerate the cinchona with the hydrochloric acid and 3000 parts of water for at least 12 hours, occasionally stirring. Pour the mixture into a percolator, the lower orifice of which is closed by a linen plug, and, as soon as the liquid runs off clear, displace with water until the liquid running from the percolator is no longer precipitated (though it may be colored) by solution of soda.

To the strained liquid (which may amount to perhaps 8000 parts) add the oxalic acid dissolved in a little water, and then add *carefully*, under continued stirring, just enough solution of soda until the precipitate which forms at first separates in coherent flakes. Separate this precipitate (which consists of calcium oxalate and cinchona red) by pouring off as much of the still acid clear liquid as is possible, and filter the remainder. To the united liquids add now an excess of solution of soda, let it settle, and collect the precipitate upon a moistened double filter. Wash it with a weak soda solution until the washings have only a light-red color; then wash with the least possible quantity of water, until the washings begin to have a bitter taste. Let the precipitate drain, dry it in the air, and powder it.

Quinetum is completely soluble in strong, warm alcohol. When 3.1 grammes of quinetum are dissolved in 10 Cc. of normal hydrochloric acid, this solution must be clear, and, on the addition of 2 grammes of Rochelle salt, must yield a precipitate which, when dried, should amount to *at least* 65 per cent. of the weight of the quinetum dissolved." (*N. R.*, 1882, p. 10.)

Febrifuge.—Under this name, the British Indian government has introduced a manufactured product, designed to furnish a cheap but valuable substitute for quinine sulphate. It is largely produced at Sikkim, India, by a modification of Dubreuil's process, which consists in extracting the powdered mixed barks with hydrochloric acid, precipitating the alkaloids by the addition of solution of sodium hydroxide, and shaking out with petroleum, adding to the petroleum solution a calculated quantity of diluted sulphuric acid, evaporating and crystallizing.

by the Jesuits, who are said to have obtained for it the price of its weight in silver. From this circumstance it was called *Jesuits' powder,* a title which it long retained. In 1653, Chifflet, physician to the Archduke Leopold, directed the attention of all Europe to the bark by his work entitled *Pulvis Febrifugus Orbis Americani.* This gave rise to a very active controversy, the high price of the drug aiding very greatly those who opposed its introduction. According to Sturm, twenty doses in 1658 cost sixty florins. It seems first to have been advertised in England for sale in 1658 by a James Thomson, and by 1660 it was much employed. It still, however, encountered much prejudice and ignorance, and was not made official in the London Pharmacopœia until 1677. Sir Robert Talbot (or Talbor) used it as a secret remedy with so much address and success that in 1679 he cured Charles II of a tertian, and subsequently sold his secret to Louis XIV of France, who published it in 1681.

When taken into the stomach, the bark usually excites in a short time a sense of warmth in the epigastrium, which often diffuses itself over the abdomen and even the breast, and is sometimes attended with considerable gastric and intestinal irritation. Nausea and vomiting are sometimes produced, especially if the stomach was previously in an inflamed or irritated state; and its action is not unfrequently accompanied by purging. If the dose of the cinchona bark has been large enough, the symptoms of cinchonism may result. (See *Quinina.*) At one time cinchona bark and its preparations were used as antiperiodics, but at present for such purpose one of its alkaloids is always selected. The best preparation for use as a tonic is the compound tincture.

Dose, ten grains to one drachm (0.65 to 3.9 Gm.).

Off. Prep.—*Cinchona.*—Fluidextractum Cinchonæ, *U. S.;* Tinctura Cinchonæ, *U. S.*

Red cinchona.—Extractum Cinchonæ Liquidum, *Br.;* Infusum Cinchonæ Acidum, *Br.;* Tinctura Cinchonæ, *Br.;* Tinctura Cinchonæ Composita, *U. S., Br.* (from tincture).

CINCHONIDINÆ SULPHAS. U. S.

CINCHONIDINE SULPHATE

(cĭn-ĉhọ-nĭ-dī'næ sŭl'phăs)

$(C_{19}H_{22}N_2O)_2.H_2SO_4 + 3H_2O = 735.05$

"The neutral sulphate $[SO_2(OH)_2.(C_{19}H_{22}N_2O)_2 + 3H_2O]$ of an alkaloid obtained from the bark of several species of Cinchona." *U. S.*

Cinchonidinum sulfuricum; Sulphate of Cinchonidine; Schwefelsaures Cinchonidin, Cinchonidinsulfat, *G.;* Sulfate de Cinchonidine basique, *Fr.;* Solfato di cinconidina, *It.*

This salt is prepared from the mother liquors obtained in the manufacture of quinine sulphate, and is separated from the sulphates of the other alkaloids by fractional crystallization. The British-India and Javanese cultivated red barks usually contain large quantities of cinchonidine. Of the South American barks, probably the Colombian varieties yield the largest proportion of cinchonidine. Owing to some confusion in naming cinchonidine and quinidine, this alkaloid is sometimes incorrectly called in Germany *chinidine.* Skraup's researches on the composition of cinchonine and cinchonidine (1879) established the correctness of the formula $C_{19}H_{22}N_2O$, instead of the long-accepted formula of Pasteur (1853), $C_{20}H_{24}N_2O$. Skraup's formula has been confirmed by Hesse, and is generally accepted by chemists.

Properties.—Cinchonidine sulphate occurs in "white, glistening, silky needles or prisms, permanent in the air, odorless, having a very bitter taste. When crystallized from dilute solutions, it contains six molecules of water of crystallization, and when from concentrated solutions, three molecules. Soluble in 63 parts of water, 72 parts of alcohol, 4400 parts of ether, and in 900 parts of chloroform at 25° C. (77° F.); soluble in 21 parts of water at 80° C. (176° F.), and in 32 parts of alcohol at 60° C. (140° F.). When heated to 100° C. (212° F.), the salt loses its water of crystallization, and at 203° C. (397.4° F.), it darkens, and then melts at 205.3° C. (401.5° F.). At a higher temperature it ignites and is consumed without leaving a residue. The aqueous solution is neutral or only faintly alkaline to phenolphthalein T.S. or litmus T.S., and is lævogyrate. Its aqueous solution yields with barium chloride T.S. a white precipitate, insoluble in hydrochloric acid. On adding ammonia water to the aqueous solution of the salt, a white precipitate (cinchonidine) is produced, which is but slightly soluble in ammonia, but which, when freshly precipitated, dissolves in 10 parts of ether, the greater part afterwards separating in crystals. If sulphuric acid be added to a small quantity of the salt, not more than a faintly yellowish color should be developed (limit of *readily carbonizable organic impurities*). Upon adding to this liquid a crystal of potassium dichromate, a yellowish-green color is produced, which gradually changes to grass-green. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.920 Gm. (absence of an *undue amount of water*). A solution of the salt (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (absence of more than traces of *quinine* or *quinidine sulphates*). If 0.5 Gm. of the salt be macerated, with frequent agitation, at the ordinary temperature, with 20 Cc. of water, 0.5 Gm. of potassium and sodium tartrate then added, the maceration continued, under repeated agitation, for one hour at 15° C. (59° F.), and the mixture filtered, the addition of 1 drop of ammonia water to the filtrate should not produce more than a slight turbidity (absence of more than small quantities of *cinchonine* or *quinidine sulphates*)." *U. S.*

Cinchonidine.—The alkaloid itself is not official; as usually seen it is in white, light, pulverulent masses. It is crystallizable, soluble in 1680 parts of cold and in a somewhat smaller quantity of hot water, in about 20 parts of alcohol, and in 70 parts of ether. It melts at 206.5° C. (404° F.), and on cooling becomes a solid mass of crystals at 190° C. (374° F.). The *acid sulphate* (sometimes called *bisulphate*) is much more soluble in water than the official sulphate. The *cinchonidine salicylate* is neutral and crystalline, insoluble in cold water, sparingly in hot water, easily soluble in alcohol and diluted alcohol. It may be prepared by the direct combination of salicylic acid with the alkaloid. (Rosengarten, *A. J. P.*, 1879, p. 616.) The *hydrobromide* has been employed by Gubler hypodermically. (*N. R.*, 1879, 366.)[1] Königs and Husmann having claimed to have converted cinchonine into cinchonidine by the long-continued action of boiling amyl alcohol and solution of potassium hydroxide, Paul and Cownley have investigated this treatment. They failed to get such conversion, and consider that the cinchonine used by Königs and Husmann must have been impure. (*P. J.*, Feb. 20, 1897.)

Uses.—So far as our knowledge goes, this alkaloid influences the system similarly to quinine, the only difference being that it is less powerful. It may be given in doses one-third greater than those of quinine, but should not be relied on in severe cases.

Dose, five to ten grains (0.32 to 0.65 Gm.).

CINCHONINÆ SULPHAS. U. S.

CINCHONINE SULPHATE

(cĭn-ĉhŏ-nī'næ sŭl'phăs)

$(C_{19}H_{22}N_2O)_2.H_2SO_4 + 2H_2O = 717.17$

"The neutral sulphate $[SO_2(OH)_2.(C_{19}H_{22}N_2O)_2 + 2H_2O]$ of an alkaloid obtained from the bark of several species of Cinchona." *U. S.* "The sulphate of an alkaloid obtained from the bark of various species of Cinchona and Remijia." *Br.* 1885.

Cinchoniæ Sulphas, *Pharm.* 1870; Sulfate de Cinchonine basique, *Fr. Cod.*; Schwefelsaures Cinchonin, Cinchoninum Sulfuricum, Cinchoninsulfat, *G.*; Solfato cinchonico, *It.*; Sulfato de cinconina, *Sp.*

The U. S. P. 1870 process for making Cinchonine Sulphate was as follows: "Take of the mother-water, remaining after the crystallization of Sulphate of Quinine, in the process for preparing that salt, a *convenient quantity;* Solution of Soda, Alcohol, Diluted Sulphuric Acid, Animal Charcoal, in fine powder, each, *a sufficient quantity.* To the mother-water add gradually, with constant stirring, Solution of Soda, until the liquid becomes alkaline. Collect on a filter the precipitate formed, wash it with water, and dry it. Then wash it with successive small portions of alcohol, to remove other alkaloids which may be present. Mix the residue with eight times its weight of water, and, having heated the mixture, add gradually Diluted Sulphuric Acid until it is saturated and becomes clear. Then boil the liquid with Animal Charcoal, filter it while hot, and set it aside to crystallize. Lastly, drain the crystals, and dry them on bibulous paper. By evaporating the mother-liquid, more crystals may be obtained." *U. S.* 1870.

In consequence of its greater solubility, cinchonine sulphate remains behind in the mother water, when quinine sulphate crystallizes, in the process for preparing the latter salt. To separate it from other substances contained in the mother water, it is decomposed by solution of soda, which is preferable to potassa, as it forms a very soluble salt with sulphuric acid, whereas the potassium sulphate, being of difficult solubility, might fall with the precipitated cinchonine. The precipitate may be safely washed with small portions of alcohol, as the alkaloid is almost insoluble in that liquid when cold. It is next reconverted into the sulphate, and the solution, having been boiled with *unpurified* animal charcoal to decolorize it, and at the same time neutralize any possible excess of sulphuric acid which might interfere with the crystallization of the salt, is filtered while hot, and then allowed to stand. It is particularly important that there should be no excess of sulphuric acid while the solution is exposed to heat, as under this influence the alkaloid is much disposed to become uncrystallizable. Hence the advantage of using unpurified animal charcoal or bone black, as the calcium carbonate contained in it neutralizes any excess of the acid. The cinchonine sulphate, held in solution by the liquid while hot, is deposited by it, upon cooling, in crystals.

It may be also prepared by first obtaining cinchonine directly from one of the barks, treating this with water acidulated with sulphuric acid, added gradually until the alkaloid is dissolved, then boiling with purified animal charcoal, filtering the solution while hot, and setting it aside to crystallize.

There are two cinchonine sulphates, the neutral and the acid sulphate. The official salt is the neutral sulphate. It is in "white, hard, lustrous, prismatic crystals; odorless, permanent in the air, and having a bitter taste. At 100° C. (212° F.) it loses its water of crystallization. If crystallized from water it will contain two, and if from alcohol, one, molecule of water of crystallization. Its aqueous solu-

[1] *Cinchonidine Benzoate* may be made by Byasson's process. Sixty parts of benzoic acid are dissolved in two hundred parts of alcohol and poured into a porcelain vessel containing three thousand parts of boiling distilled water; two hundred parts of cinchonidine sulphate are dissolved in two thousand parts of water, using sufficient diluted sulphuric acid to effect the solution; this is precipitated with ammonia, and washed with a small quantity of cold water; the moist precipitate of cinchonidine is added to the hot solution of benzoic acid, and filtered while hot. The solution must be made faintly alkaline by the cautious addition of ammonia. On cooling, the cinchonidine benzoate separates in the form of small, thin, prismatic needles, resembling cinchonidine sulphate. The yield is about two hundred parts. (*Ph. Rec.*, 1884, p. 45.)

tion should not show fluorescence. Soluble in 58 parts of water, 10 parts of alcohol, 2300 parts of ether, and in 69 parts of chloroform at 25° C. (77° F.); soluble in 32 parts of water at 80° C. (176° F.), and in 5.2 parts of alcohol at 60° C. (140° F.). It melts at 198.5° C. (389.5° F.), and leaves no residue on incineration. Its aqueous solution is neutral to litmus paper, and is dextrogyrate. An aqueous solution of Cinchonine Sulphate (1 in 100) yields with barium chloride T.S. a white precipitate, insoluble in hydrochloric acid. One Gm. of the salt dried to constant weight at 100° C. (212° F.) should weigh not less than 0.95 Gm. (absence of an *undue amount of water*). A solution of the salt (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (limit of *quinine* or *quinidine sulphates*). If 1 part of the powdered salt be macerated with frequent agitation in 80 parts of chloroform, at ordinary temperatures, it should be wholly, or almost wholly, dissolved (limit of *quinine* or *cinchonidine sulphates*). The salt should not impart more than a faintly yellowish tinge to sulphuric acid (limit of *readily carbonizable, organic impurities*)." *U. S.* The *acid sulphate*, or *bisulphate*, $C_{19}H_{22}N_2O.H_2SO_4.3H_2O$, is prepared by adding sulphuric acid to the neutral sulphate. According to Baup, 100 parts are soluble in 45 parts of absolute alcohol; it is insoluble in ether. It crystallizes in rhombic octohedrons.

Cinchonine (Cinchonina *U. S.* 1890) $C_{19}H_{22}N_2O = 292.03$, was introduced into the U. S. P. 1880 and dropped in the 8th Revision. Several processes have been employed for the preparation of cinchonine. One of the simplest is the following: Powdered pale bark is submitted to the action of sulphuric or hydrochloric acid very much diluted, and the solution obtained is precipitated by an excess of lime. The precipitate is collected on a filter, washed with water, and treated with boiling alcohol. The alcoholic solution is filtered while hot, and deposits the cinchonine when it cools. A further quantity is obtained by evaporation. If not perfectly white, it may be made so by converting it into a sulphate with diluted sulphuric acid, then treating the solution with animal charcoal, filtering, precipitating by an alkali, and redissolving in alcohol in the manner already mentioned. It may also be obtained from the mother waters of quinine sulphate by diluting them with water, precipitating with ammonia, collecting the precipitate on a filter, washing and drying it, and then dissolving it in boiling alcohol, which deposits the cinchonine in a crystalline form upon cooling. It may be still further purified by a second solution and crystallization. Its formula is now generally accepted as $C_{19}H_{22}N_2O$, the molecular weight of which is 292.03, as proposed by Skraup, instead of the older formula, $C_{20}H_{24}N_2O$, of Pasteur. This alkaloid occurs in "white, lustrous prisms or needles, without odor, at first almost tasteless, but soon developing a bitter after-taste; permanent in the air. Soluble, at 15° C. (59° F.), in 3760 parts of water, and in 116 parts of alcohol; in 3500 parts of boiling water, and in 26.5 parts of boiling alcohol. Also soluble in 526 parts of ether, and in 163 parts of chloroform. At 240° C. (464° F.) the crystals fuse together, and at 258° C. (496.4° F.) they melt, forming a brown liquid. When ignited, they are consumed without leaving a residue. When placed on moistened, red litmus paper, Cinchonine shows an alkaline reaction. On adding to a neutral or not more than faintly acid solution of Cinchonine, or of any of its salts, enough potassium ferrocyanide test-solution to redissolve the precipitate first formed, and afterwards an acid, a golden-yellow precipitate will be formed, which, when redissolved by gently warming the liquid, will separate, on cooling, in minute scales or needles. On adding an excess of ammonia water to a solution of Cinchonine in a diluted acid, the alkaloid will be precipitated. The precipitate is but feebly soluble in ammonia, and should require not less than 300 parts of ether for solution. A solution of Cinchonine (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (absence of more than traces of *quinine* or *quinidine*). Cinchonine should not impart more than a faintly yellowish tinge to concentrated sulphuric acid (limit of *readily carbonizable, organic impurities*)." *U. S.* 1890. Waddington found it to sublime readily, without change, in perfectly characteristic crystals. (*P. J.*, March, 1868, p. 414.) Its alkaline character is very decided, as it neutralizes the strongest acids. Of the salts of cinchonine, the sulphate, nitrate, hydrochloride, phosphate, and acetate are soluble in water. The neutral tartrate, oxalate, and gallate are insoluble in cold water, but soluble in hot water, alcohol, or an excess of acid. Winckler has shown that cinchonine is rendered uncrystallizable or amorphous by sulphuric acid in excess, aided by heat, a fact of importance in the preparation of the sulphate of this alkaloid. (*Chem. Gaz.*, March 15, 1848.) Cinchonine is but little more soluble in carbonic acid water than in pure water, and does not, like quinine, yield crystals of the carbonate on exposure of its carbonic acid solution. (*C. R. A. S.*, Nov. 7, 1853, p. 727.) It differs from quinine by its rotating the plane of polarization to the right, by the want of fluorescence in its solutions, and by its failing to respond to the thalleioquin test.

Exposed to the air, cinchonine does not suffer decomposition, but very slowly absorbs carbonic acid gas, and acquires the property of effervescing slightly with acids. It is precipitated sulphur yellow by gold trichloride. Chlorine water dissolves it or any of its salts without change; but if ammonia be now added, a white precipitate is produced. It is thus distinguishable from quinine. (See *Quinina.*) J. W. Bill, U. S. A., proposed potassium ferrocyanide as a very delicate test of cinchonine. If added to the solution of a salt of this alkaloid,

it produces a yellowish-white curdy precipitate, which is dissolved upon the application of a gentle heat, but is again deposited, when the liquid cools, as an abundant crop of golden-yellow crystals. No other alkaloid exhibits the same reaction. A cloudy precipitate is produced by the same reagent with a salt of quinine; but this does not happen when the ferrocyanide is in excess; and, if the precipitate be dissolved by heat, no subsidence takes place on cooling. Hence, in the application of this test to cinchonine, a slight excess of the ferrocyanide should be added. (*Am. J. S.*, July, 1858, p. 108.)

By the action of potassium permanganate cinchonine is decomposed, with the effect of producing, at first, an entirely distinct neutral principle, *cinchotenine*, $C_{18}H_{20}N_2O_3 + 3H_2O$, and an alkaloid, which the authors named *hydrocinchonine*, $C_{19}H_{24}N_2O$, as it differs from cinchonine (cinchonia) only in having two additional atoms of hydrogen. The cinchotenine, when further oxidized by the same reagent, yields quinoline and pyridine derivatives (see PART II), as *cinchonic* (quinoline-carboxylic) *acid*, $C_9H_6N(COOH)$, and *cinchomeronic* (pyridine-dicarboxylic) *acid*, $C_5H_3N(COOH)_2$.

Uses.—Cinchonine sulphate has the same remedial properties as quinine sulphate, but must be given in somewhat larger dose. It may be taken in pill, or in solution made by the addition of diluted sulphuric acid in the proportion of a minim or two drops for each grain of the salt. To lessen the bitterness in taste, it may be given suspended in syrup, without the use of any acid or with a few grains of powdered licorice added to the mixture.

Dose, tonic, a grain or two (0.065 to 0.13 Gm.) three or four times a day; antiperiodic dose, fifteen to forty grains (1.0 to 2.6 Gm.) between the paroxysms.

CINNALDEHYDUM. U. S.

CINNAMIC ALDEHYDE [Synthetic Oil of Cassia]

(cĭn-năl-dē-hȳ′dŭm)

$C_9H_8O = 131.07$

"An aldehyde obtained from oil of cinnamon or prepared synthetically, containing not less than 95 percent. of pure Cinnamic Aldehyde [$C_6H_5.CH:CH.COH$]. It is nearly identical with the oil distilled from Cassia Cinnamon, and should be kept in small, amber-colored, well-stoppered bottles." *U. S.*

Aldehydum cinnamicum; Phenylacrolein; Aldehyde cinnamique, *Fr.*; Zimmtsaurealdehyd, Zimmtaldehyd, *G.*

Cinnamic aldehyde was introduced into the U. S. Pharmacopœia (8th Rev.) because of its large use in place of Oil of Cassia (Oleum Cinnamomi U. S. P.); it has an advantage over the latter, because of its greater purity and more uniform quality as found in commerce.

Preparation.—Most of the cinnamic aldehyde in commerce is the synthetic product, which is made by oxidizing cinnamyl alcohol, by distilling a mixture of calcium cinnamate and formate to dryness, or as the result of a condensation made by acting on a mixture of benzaldehyde and acetaldehyde with hydrochloric acid gas. It has also been made by mixing 10 parts of benzaldehyde, 15 parts of acetaldehyde, and 10 parts of a 10 per cent. solution of sodium hydroxide diluted with 900 parts of water and setting aside for a week; the two aldehydes will condense, forming cinnamic aldehyde, and water will be eliminated. The reaction is as follows:

$$C_6H_5COH + CH_3COH = C_6H_5.CH:CH.COH + H_2O$$

The natural product can be obtained by agitating oil of cassia with a concentrated aqueous solution of acid sodium sulphite. Soluble sodium cinnamyl-hydroxy-sulphonate, $C_6H_5CH:CHCH(OH)SO_3Na$, is first formed, and this combines with a second molecule of the acid sodium sulphite, forming a sparingly soluble compound, $C_6H_5CHSO_3Na.CH_2.CH(OH)SO_3Na + 2H_2O$. The crystalline precipitate is separated, washed with cold alcohol and decomposed with diluted H_2SO_4, whereby cinnamic aldehyde is formed. This is then rectified by distillation.

Properties.—It is officially described as "a colorless liquid, having a cinnamon-like odor and a burning, aromatic taste. Specific gravity: about 1.047 at 25° C. (77° F.). Optically inactive. It boils at about 250° C. (482° F.), with partial decomposition. Cinnamic Aldehyde should solidify when the temperature is reduced by a freezing mixture of ice and salt, and should melt again at —7.5° C. (18.5° F.). It is sparingly soluble in water, soluble in all proportions in alcohol, ether, and fixed and volatile oils. If the looped end of a piece of clean copper wire be held in a non-luminous flame until it glows, then cooled, and the loop dipped into Cinnamic Aldehyde, ignited, and held so that the liquid burns outside of the flame, then if the loop be slowly brought in contact with the lower outer edge of the flame, no green tinge should be discernible (absence of *chlorinated products*)." *U. S.*

Assay. U. S. (8th Rev.).—"Introduce into a counterpoised 150 Cc. flask, by means of a pipette, 12 drops of Cinnamic Aldehyde, and note the exact weight; add 5 Cc. of distilled water and a few drops of phenolphthalein T.S., and then neutralize the solution exactly by the cautious addition of tenth-normal sodium hydroxide V.S. Add 50 Cc. of a solution of sodium sulphite (1 in 5), and immerse the flask in a water-bath containing boiling water. From a burette add just sufficient half-normal hydrochloric acid V.S. to maintain the neutrality of the mixture, keeping the flask continuously heated and frequently agitated, and adding a drop or two of phenolphthalein T.S. When a permanent condition of neutrality is reached, note the number of cubic centimeters of the

half-normal hydrochloric acid V.S. consumed. Carry out a blank test identical with the foregoing, except that the Cinnamic Aldehyde is omitted, and note the amount of half-normal hydrochloric acid V.S. consumed. Subtract the number of cubic centimeters required in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.033 Gm. of Cinnamic Aldehyde. To find the percentage, multiply the above difference by 0.033 and the product by 100, and divide by the weight of the Cinnamic Aldehyde taken." *U. S.*

Uses.—The medicinal uses of this substance are the same as those of oil of cinnamon.

Dose, one to two minims (0.06 to 0.12 Cc.).

CINNAMOMUM SAIGONICUM. U. S.

SAIGON CINNAMON

(cĭn-nā-mō′mŭm sä-ĭ-gŏn′ĭ-cŭm)

"The bark of an undetermined species of *Cinnamomum* (Fam. *Lauraceæ*)." *U. S.*

Annam cinnamon, China cinnamon, God's cinnamon; Cannelle de Saigon, *Fr.*; Saigonzimmt, *G.*

CINNAMOMUM ZEYLANICUM. U. S. (Br.)

CEYLON CINNAMON

(cĭn-nā-mō′mŭm zē-lān′ĭ-cŭm)

"The inner bark of the shoots of *Cinnamomum zeylanicum* Breyne (Fam. *Lauraceæ*)." *U. S.* "The dried inner bark of shoots from the truncated stocks of Cinnamomum zeylanicum, *Breyn.* Obtained from cultivated trees. Imported from Ceylon, and distinguished in commerce as Ceylon cinnamon." *Br.*

Cinnamomi Cortex, *Br.*; Cinnamomum, *U. S.* 1880; Cinnamon Bark; Cortex Cinnamomi Zeylanici; Cinnamomum Acutum, s. Verum; Cannelle de Ceylan, *Fr. Cod.*; Cannelle, *Fr.*; Brauner Kaneel, Zeylonzimmt, Zimmt, *G.*; Canella, *It.*; Canela, *Sp.*; Kurundu, *Cingalese*; Karua puttay, *Tamil.*

Both *cinnamomum* and *cassia* were terms employed by the ancients, but whether exactly as now understood it is impossible to determine. The term *cassia*, or *cassia lignea*, has been generally used in modern times to designate the coarser barks analogous to cinnamon. It was probably first applied to the barks from Malabar, and afterwards extended to those of China and other parts of Eastern Asia. It has been customary to ascribe *cassia lignea* to the *Laurus Cassia* of Linnæus; but the specific character given by that botanist was so indefinite, and based on such imperfect information, that the species has been almost unanimously abandoned by botanists. The barks sold as cinnamon and cassia in different parts of the world are derived from various species of Cinnamomum.

1. *Cinnamomum zeylanicum*, Nees, *Laurineæ*, 52; Lindley, *Flor. Med.*, 329; Hayne, *Darstel. und Beschreib.*, etc., xii. 263.—*Laurus Cinnamomum*, Linn.—This is a tree about 20 or 30 feet high, with a trunk from 12 to 18 inches in diameter and covered with a thick, scabrous bark. The branches are numerous, strong, horizontal, and declining, and the young shoots are beautifully speckled with dark green and light orange colors. The leaves are opposite for the most part, coriaceous, entire, ovate or ovate-oblong, obtusely pointed, and three-nerved, with the lateral nerves vanishing as they approach the point. There are also two less obvious nerves, one on each side arising from the base, proceeding towards the border of the leaf, and then quickly vanishing. The footstalks are short and slightly channelled, and, together with the extreme twigs, are smooth and without the least appearance of down. In one variety the leaves are very broad and somewhat cordate. When mature, they are of a shining green upon their upper surface, and lighter-colored beneath. The flowers are small, white, and arranged in axillary and terminal panicles.[1] The fruit is an oval berry, which adheres like the acorn to the receptacle, is larger than the black currant, and when ripe has a bluish-brown surface, diversified with numerous white spots. The tree emits no odor perceptible at any distance. The bark of the root has the odor of cinnamon with the pungency of camphor, and yields this principle upon distillation. The leaves have a spicy odor when rubbed, and a hot taste. A volatile oil distilled from them has been introduced into commerce.[2] The petiole has the flavor of cin-

[1] CASSIA BUDS.—This spice consists of the calyx of one or more species of Cinnamomum, surrounding the young ovary, and, as stated by Martius, on the authority of the elder Nees, about one-quarter of the normal size. It is produced in China; and Reeves states that great quantities of it are brought to Canton from the province which affords cassia. The species which yields it, is in all probability the same with that which yields the bark, though it has been ascribed by Nees to *Cinnamomum Loureirii*. In favor of the former opinion is the statement of Christison, that *C. aromaticum*, cultivated in the hot-houses of Europe, bears a flower-bud which closely resembles the cassia bud when at the same period of advancement. Cassia buds have some resemblance to cloves, and are compared to small nails with round heads. The enclosed ovary is sometimes removed, and they are then cup-shaped at top. They have a brown color, with the flavor of cinnamon, and yield an essential oil upon distillation. They may be used for the same purposes as the bark.

[2] The *cinnamon leaf oil*, as formerly imported into Great Britain, was of two kinds, one containing a considerable quantity of a fatty fixed oil, perhaps cinnamon-suet from the fruit, the other a pure volatile oil. The oil was said to be obtained by distilling the leaves after maceration in sea water. It resembled the oil of cloves and pimento in sensible properties, having a brownish color, a penetrating, fragrant odor, and a very pungent taste. According to Stenhouse, it was of the sp. gr. 1.053, had an acid reaction, and consisted of eugenol, a neutral substance with the formula $C_{10}H_{16}$, and a minute proportion of benzoic acid. (*P. J.*, xiv. 319.) This oil seems to have disappeared from commerce; but it has recently been studied by Schimmel & Co. The oil of their own distillation, as also samples distilled in Java, was limpid. sp. gr. 1.056 to 1.060, and contained 87 per cent. of eugenol, and about 0.1 per cent. of cinnamic aldehyde. A cinnamon leaf oil from the Seychelles consisted chiefly of eugenol. It is obvious, therefore, that the addition of oil of cinnamon leaves to Ceylon cinnamon oil will greatly diminish the percentage of aldehyde and raise the eugenol content, which in Ceylon cinnamon oil amounts to only 4 to 8 per cent. (*Schim. Rep.*, April, 1904).

namon. It is a singular fact that the odor of the flowers is to people in general disagreeable, being compared by some to the scent exhaled from newly-sawed bones. The fruit has a terebinthinate odor when opened, and a taste in some degree like that of juniper berries. A fatty substance, called *cinnamon-suet,* is obtained from it when ripe, by bruising it and then boiling it in water, and removing the oleaginous matter which rises to the surface, and concretes upon cooling. It is the prepared bark that constitutes the genuine cinnamon.

This species is a native of Ceylon, where it has long been cultivated. It is said also to be a native of the Malabar Coast, and has at various periods been introduced into Java, the Isle of France, Bourbon, the Cape Verds, Brazil, Cayenne, several of the West India islands, and Egypt, and in some of these places is at this time highly productive, especially in Cayenne, where the plant was flourishing so early as 1755. It is exceedingly influenced, as regards the aromatic character of its bark, by the circumstances of soil, climate, and mode of culture. Thus, we are told by Marshall that in Ceylon, beyond the limits of Negombo and Matura, in the western and southern parts of the island, the bark is never of good quality, being greatly deficient in the aromatic flavor of the cinnamon, and that even within these limits it is of unequal value, from the various influences of exposure, soil, shade, and other circumstances. Cinnamon closely resembling Ceylon cinnamon is said to have been sent to Europe from Brazil.

2. *C. aromaticum,* Nees, *Laurineæ,* 52; Lindley, *Flor. Med.,* 330.—*C. Cassia,* Blume, Ed. Ph.; Hayne, *Darstel. und Beschreib.,* etc. xii. 23.—*Laurus Cassia,* Aiton, *Hort. Kew.,* ii. 427.—Not *Laurus Cassia* of Linn.—This is of about the same magnitude as the former species, and, like it, has nearly opposite, shortly petiolate, coriaceous, entire leaves, of a shining green upon the upper surface, lighter-colored beneath, and furnished with three nerves, of which the two latter vanish towards the point. The leaves, however, differ in being oblong-lanceolate and pointed, and in exhibiting, under the microscope, a very fine down upon the under surface. The footstalks and extreme twigs are also downy. The flowers are in narrow, silky panicles. The plant grows in China, Sumatra, and other parts of Eastern Asia, and is said to be cultivated in Java. It is believed to be the species which furnishes, wholly or in part, the Chinese cinnamon or cassia brought from Canton, and is supposed to be the source of the *cassia buds.*

Besides the two species above described, others have been thought to contribute to the cinnamon and cassia of commerce. In 1839 (*Madras Journ. Lit. and Sci.,* No. 22), Wight stated that in his belief cinnamon was derived from 12 to 18 specifically distinct trees. *C. inners,* Reinw., is distinguished from *C. zeylanicum* by the nervation of its leaves, which are also paler and thinner than those of the official plant, of which, however, it is probably only a variety. It yields the so-called *wild cinnamon* of Japan. *C. nitidum,* growing in Ceylon, Java, and on the mainland of India, is said to have been the chief source of the drug known formerly by the name of *Folia Malabathri* and consisting of the leaves of different species of Cinnamomum mixed together. *C. Culilawan* of the Moluccas yields the aromatic bark called culilawan, noticed in PART II of this work; and similar barks are obtained from another species of the same region, named *C. Rubrum,* and from *C. Sintoc* of Java. *Massoy bark,* from which an aromatic volatile oil is obtained called *oil of massoy,* is the product of *C. Kiamis.* (Gmelin, *Handbook,* xiv. 380.) In the mountains of Eastern Bengal, at a height of 1000 to 4000 feet, flourish *C. obtusifolium,* Nees, *C. pauciflorum,* Nees, and *C. Tamala,* W., and these, with other unknown species, afford quantities of bark which are shipped from Calcutta, Java, Timor, etc., to Europe under the name of *cassia lignea, cassia, cassia vera,* or *wild cassia.* The bark of the *C. pedatinervium,* a tree indigenous to Fiji, yields nearly one per cent. of a white aromatic volatile oil, with a pungent spicy taste. For constitution, etc., see *Proc. Chem. Soc.,* xix. These barks are mostly highly aromatic, resembling cinnamon more or less closely in flavor, and are distinguished by yielding to cold water an abundant mucilage.

Culture, Collection, Commerce, etc.—In Ceylon, cinnamon bark was originally collected exclusively from the tree in a wild state; but the Dutch introduced the practice of cultivating it, which has been continued since the British came into possession of the island. The principal cinnamon gardens are in the vicinity of Columbo, but the plant is grown from the sea-level up to a considerable elevation, giving the finest product, however, on the sandy soil of the coast line. The seeds are planted in a prepared soil at certain distances, and, as four or five are placed in a spot, the plants usually grow in clusters like the hazel-bush. In favorable situations they attain the height of five or six feet in six or seven years; and a healthy bush will then afford two or three shoots fit for peeling, and every second year afterwards from four to seven shoots in a good soil. The cinnamon harvest commences in May and continues until late in October. The first object is to select shoots proper for decortication, and those are seldom cut which are less than half an inch or more than two or three inches in diameter. Before decortication these shoots are trimmed up, and the small pieces, when dried, constitute *cinnamon chips.* The bark is divided by longitudinal incisions, of which two are made in the smaller shoots, several in the larger, and is then removed in strips by means of a suitable instrument. The pieces are next collected in bundles, and allowed to remain in this state for a short time, so as to undergo a degree of fermentation, which facilitates the separation of the epider-

mis. This, with the green matter beneath it, is removed by placing the strip of bark upon a convex piece of wood and scraping its external surface with a curved knife. The bark now dries and contracts, assuming the appearance of a quill. The peeler introduces the smaller tubes into the larger, and connects them also endwise, thus forming a congeries of quills which is about forty inches long. When sufficiently dry, these cylinders are collected into bundles weighing about thirty pounds and bound together by pieces of split bamboo. The commerce in Ceylon cinnamon was formerly monopolized by the East India Company; but the cultivation is now unrestricted, and the bark may be freely exported upon the payment of a fixed duty. It is assorted in the island into three qualities, distinguished by the designations of *first, second,* and *third.* The inferior kinds, which are of insufficient value to pay the duty, are used for preparing oil of cinnamon.

The exportation of cinnamon chips from Ceylon in 1902 was 1,763,679 lbs., and in 1903, 2,253,269 lbs. Immense quantities of cinnamon barks are exported from China, the finest of which is little inferior to that of Ceylon, though the mass of it is much coarser. It passes in commerce under the name of *cassia,* and is said by Reeves to be brought to Canton from the province of Kwangse, where the tree producing it grows very abundantly. (*Trans. Med.-Bot. Soc.,* 1828, p. 26.)[1] It has already been stated that this tree is supposed to be the *Cinnamomum aromaticum;* but we have no positive proof of the fact. It is, indeed, asserted that true cinnamon of very fine grade occurs in China, although it never enters foreign commerce, because of the high price which it commands at home. (*P. J.,* xxi. 1890.) These fine cinnamons are said to be produced in the mountainous district of Annam, or Cochin-China. Cinnamon of good quality is said to be collected in Java, and considerable quantities of inferior quality have been thrown into commerce, as *cassia lignea,* from the Malabar Coast. Manila and the Isle of France are also mentioned as sources whence this drug is supplied. Little, however, reaches the United States from these places. The island of Martinique, Cayenne, and several of the West India islands yield to commerce considerable quantities of cinnamon of various qualities. That of Cayenne is of two kinds, one of which closely resembles, though it does not quite equal, the aroma of Ceylon, the other resembles the Chinese. The former is supposed to be derived from plants propagated from a Ceylonese stock, the latter from plants which have sprung from a tree introduced from Sumatra. By far the greater proportion of cinnamon brought to this country is imported from China. It is entered as *cassia* and *Saigon cassia* at the custom house.

From what source the ancients derived their cinnamon and cassia is not certainly known. Neither the plants nor their localities, as described by Dioscorides, Pliny, and Theophrastus, correspond precisely with our present knowledge; but in this respect much allowance must be made for the inaccurate geography of the ancients. It is probable that the Arabian navigators at a very early period conveyed this spice within the limits of the Phœnician and Grecian and subsequently of Roman commerce.

Properties.—*Ceylon cinnamon* is in cylindrical fasciculi, composed of numerous quills, the larger enclosing the smaller. In the original sticks, which are somewhat more than three feet in length, two or three fasciculi are neatly joined at the end, so as to appear as if the whole were one continuous piece. The finest is of a light brownish-yellow color, almost as thin as paper, smooth, often somewhat shining, pliable to a considerable extent, with a splintery fracture when broken. It has a pleasant, fragrant odor, and a warm, aromatic, pungent, sweetish, slightly astringent, and highly agreeable taste. When distilled it affords but a small quantity of essential oil, which, however, has an exceedingly grateful flavor. It is brought to this country from England, but it is costly. The inferior sorts are browner, thicker, less splintery, and of a less agreeable flavor, and are little if at all superior to the best Chinese. The finer variety of *Cayenne cinnamon* approaches in character that above described, but is paler and in thicker pieces, being usually collected from older branches. That which is gathered very young is scarcely distinguishable from the cinnamon of Ceylon. Ceylon cinnamon is officially described as in "long, closely rolled quills, composed of eight or more thin layers of bark; pale yellowish-brown; outer surface smooth, marked with wavy lines of bast-bundles; inner surface striate; fracture short-splintery; odor agreeably aromatic; taste sweet and warmly aromatic. The yield of ash, when incinerated, should not be over 4 percent." *U. S.*[2]

Chinese cinnamon, or *Cassia* (Cinnamomum Cassia. Cassia Cinnamon. *U. S.* 1890), occurs in tubes from one-eighth of an inch to an inch in diameter, usually single, sometimes double, very rarely more than double. In some instances the bark is rolled very much upon itself, in others is not even completely quilled, forming segments more or less extensive of a hollow cylinder. It is of a redder or darker color than the finest Ceylon cinnamon, thicker, rougher, denser, and breaks with a shorter fracture. It has a stronger, more pungent and astringent but less sweet and grateful taste, and, though of a similar odor, is less agreeably fragrant. It is the kind almost universally kept in our shops. Of a similar character is the cinnamon imported directly from various parts of the East Indies. But under the name of cassia have also been brought to us very inferior kinds of cinnamon, collected from the trunks or large branches of the trees, or in-

[1] For method of collection, see *P. J.,* Feb. 1890.

[2] For an account of the cultivation of *C. zeylanicum,* see *P. J.,* xi. 261; also one containing statistics and interesting notes on Chinese cassia in *P. J.,* 1898, 47.

jured by want of care in keeping, or perhaps derived from inferior species. It is said that cinnamon from which the oil has been distilled is sometimes fraudulently mixed with the genuine. These inferior kinds are detected, independently of their greater thickness and coarseness of fracture, by their deficiency in the peculiar sensible properties of the spice. Chinese cinnamon is "in quills of varying length and about 1 Mm. or more in thickness; nearly deprived of the corky layer; yellowish-brown; outer surface somewhat rough; fracture nearly smooth; odor fragrant; taste sweet, and warmly aromatic." *U. S.* 1890. Cassia is no longer official in the U. S. P. it having been dropped at the 8th Revision.

Saigon cinnamon takes its name from Saigon, the capital of French Cochin-China. It is a thick cassia bark, which has come into European commerce, and was recognized for the first time by the U. S. P. 1890. It is officially described as "in quills about 15 Cm. long, and 10 to 15 Mm. in diameter, the bark 2 or 3 Mm. thick; outer surface gray or light grayish-brown with whitish patches, more or less rough from numerous warts and some transverse ridges and fine longitudinal wrinkles; the inner surface cinnamon-brown or dark brown, granular and slightly striate; fracture short, granular, in the outer layer cinnamon-colored, having near the cork numerous whitish striæ forming an almost uninterrupted line; odor agreeably aromatic; taste sweet, warmly aromatic, somewhat astringent." *U. S.* The odor of this cinnamon is fragrant, the taste is highly aromatic, markedly that of cinnamon, and, in the specimens that we have seen, only slightly astringent. It also occurs in commerce much broken, in which state it commands a somewhat smaller price than in quills. The Saigon buds also are brought into the port of New York. The quality of Saigon cassia, as it is commonly termed in trade journals, is distinctly superior to that of other cassias, and the price which it commands much higher. It is obtained from the *Cinnamomum Loureirii* of Nees, the *Laurus Cinnamomum* of Loureiro, a tree which grows in Cochin-China and Japan. According to Siebold, the bark of the large branches is of inferior quality and is rejected; that from the smallest branches resembles the Ceylon cinnamon in thickness, but has a very pungent taste and odor, and is little esteemed, while the intermediate branches yield an excellent bark, about a line in thickness, which is even more highly valued than the cinnamon of Ceylon, and yields a sweeter and less pungent oil. It yields about 2 per cent. of a volatile oil, *the oil of Nikkei*, having an odor resembling that of cinnamon and citral, a specific gravity at 15° C. of 0.9005, and containing about 27 per cent. of aldehyde, chiefly citral.

Powdered cinnamon is often grossly adulterated with sugar, ground walnut shells, galanga rhizome and various other substances. Galanga, according to Schmitz-Dumont, may be detected by the presence of small club-shaped, rod-shaped, partly bent, microscopic pieces of resino-tannol. (*Ztschr. f. oeff. Chem.*, 1903, No. 2.) Powdered cassia buds are frequently added to the inferior cinnamon powders, but can hardly be looked upon as an adulterant, as they contain a larger proportion of volatile oil than the lower grades of cinnamon.

The *Pharmacographia* gives the following tests for distinguishing powdered cassia from powdered cinnamon, and for recognizing the inferior varieties of cassia. Make a decoction of powdered cinnamon of known genuineness, and one of similar strength of the suspected powder; when cool and strained, test a fluid-ounce of each with one or two drops of tincture of iodine. A decoction of cinnamon is but little affected, but in that of cassia a deep blue-black tint is immediately produced. The cheap kinds of cassia known as *cassia vera* may be distinguished from the more valuable Chinese cassia as well as from cinnamon by their richness in mucilage; this can be extracted by cold water; it is a thick glairy liquid, giving dense ropy precipitates with corrosive sublimate or neutral lead acetate, but not with alcohol.[1]

Microscopic Structure.—Ceylon cinnamon usually consists simply of liber, the outer coatings having been stripped off during its preparation for market. Three layers are distinguishable in the liber. "1. The external surface, which is composed of one to three rows of large thick-walled cells, forming a coherent ring; it is only interrupted by bundles of liber fibres, which are obvious even to the unaided eye. 2. The middle layer is built up of about 10 rows of parenchymatous thin-walled cells, interrupted by much larger cells containing deposits of mucilage, while other cells not larger than those of the parenchyme itself are loaded with essential oil. 3. The innermost layer exhibits the same thin-walled but smaller cells, yet intersected by narrow somewhat darker medullary rays, and likewise interrupted by cells containing either mucilage or essential oil, instead of bundles of liber fibres. Fibres mostly isolated are scattered through the two inner layers, the parenchyme of which abounds in small starch granules accompanied by tannic matter. On a longitudinal section the length of the liber fibres becomes more evident, as well as oil-ducts and gum-ducts." (*Pharmacographia.*)

The coarser cassia bark, or *cassia lignea*, usually has some of the external or corky layer adherent to it, and always the parenchymatous mesophlœum or middle bark, but the liber constitutes the chief mass. Isolated liber fibres and thick-walled cells (stone cells) are scattered

[1] The German Pharmacopœia requires that cinnamon shall yield not more than 5 per cent. of ash, with 1 per cent. of sand. G. Rupp (*Süddeutsch. Ap. Ztg.*, 1899, 267) finds it, however, difficult to get commercial cinnamon that will come up to these requirements. A Chinese cinnamon examined gave 5.79 per cent. of ash, with 2.83 per cent. of sand, while commercial Ceylon cinnamon yielded 6.1 per cent. of ash, with 2.4 per cent. of sand.

even through the outer layers of a transverse section. In the middle zone they are numerous, but do not form a coherent sclerenchymatous ring as in Ceylon cinnamon. The innermost part of the liber shares the structural character of cinnamon, with differences due to age, as, for instance, the greater development of the medullary rays. Oil cells and gum ducts are likewise distributed in the parenchyme of the former. The finest cassia or Chinese cinnamon has the three layers described in Ceylon cinnamon, but is distinguished by the adherent outer parenchymatous and suberous layer.

Chemical Composition.—According to the analysis of Vauquelin, cinnamon contains a peculiar volatile oil, tannin, mucilage, a coloring matter, an acid, and lignin. The tannin is of the variety which yields a greenish-black precipitate with the salts of iron. Thos. R. Thornton (*A. J. P.*, 1895, 400) has examined the tannin of *C. Cassia*. He found it to amount to about 3.90 per cent., as an average of three different determinations on different samples. He found it impossible to extract the tannin by any one of several methods tried, and concludes that it either has the phlobophene (anhydride) character as it exists in the drug or acquires such character when brought into contact with water. Jas. A. Ferguson (1887), in the laboratory of the Philadelphia College of Pharmacy, determined the ash of several samples of Ceylon cinnamon, finding an average of 4 per cent., while in powdered *cassia cinnamon* he found 2.8 and 2.5 per cent. (*A. J. P.*, 1887, 278, 279.) The oil obtained from the Cayenne cinnamon was found to be more biting than that from the Ceylon. Bucholz found in 100 parts of *cassia lignea* 0.8 of volatile oil, 4.0 of resin, 14.6 of gummy extractive (probably including tannin), 64.3 of lignin and bassorin, and 16.3 of water, including loss.

This aromatic yields its virtues wholly to alcohol, and less readily to water. At the temperature of boiling alcohol very little of the oil rises, and an extract prepared from the tincture retains, therefore, the aromatic properties. For an account of the volatile oil, see *Oleum Cinnamomi*.

Uses.—Cinnamon is among the most grateful and efficient of the aromatics. It is warm and cordial to the stomach, carminative, distinctly astringent, and, like most other substances of this class, more powerful as a local than as a general stimulant. It is seldom prescribed alone, though, when given in powder or infusion, it will sometimes allay *nausea*, check *vomiting*, and relieve *flatulence*. It is chiefly used as an adjuvant, and enters into a great number of official preparations. It is often employed in *diarrhœa*, in connection with chalk and astringents, and is of value in *menorrhagia*.

Dose, of powder, ten to twenty grains (0.65 to 1.3 Gm.).

Off. Prep.—*Ceylon cinnamon.*—Aqua Cinnamomi, *Br.;* Decoctum Hæmatoxyli, *Br.;* Pulvis Catechu Compositus, *Br.;* Pulvis Cinnamomi Compositus, *Br.;* Pulvis Cretæ Aromaticus, *Br.;* Pulvis Kino Compositus, *Br.;* Tinctura Cardamomi Composita, *Br.;* Tinctura Catechu, *Br.;* Tinctura Cinnamomi, *Br.;* Tinctura Lavandulæ Composita, *Br.*

Off. Prep.—*Saigon cinnamon.*—Pulvis Aromaticus, *U. S.;* Tinctura Cardamomi Composita, *U. S.;* Tinctura Cinnamomi, *U. S.;* Tinctura Gambir Composita, *U. S.;* Tinctura Lavandulæ Composita, *U. S.;* Tinctura Rhei Aromatica, *U. S.;* Vinum Opii, *U. S.*

COCA. U. S. (Br.)

COCA [Erythroxylon]

(cō'cạ)

"The dried leaves of *Erythroxylon Coca* Lamarck (Fam. *Erythroxylaceæ*), known commercially as Huanuco Coca, or of *E. Truxillense* Rusby, known commercially as Truxillo Coca, yielding when assayed by the process given below, not less than 0.5 percent. of the ether-soluble alkaloids of Coca." *U. S.* "The dried leaves of Erythroxylum Coca, *Lam.*, and its varieties." *Br.*

Cocæ Folia, *Br.;* Coca Leaves; Cuca; Coca, *Fr. Cod.;* Feuilles de Coca, *Fr.;* Cocablätter, *G.;* Coca, *It.;* Coca del Peru, Ipadu, *Sp.*

The coca plants are shrubs or small trees, some of the species reaching the height of fifteen or twenty feet. It is conjectured that the original habitat was in the Peruvian mountains, from 7° South to 10° North, but either spontaneously or through cultivation the coca shrubs have spread until they are found in the whole Eastern curve of the Andes, from the Straits of Magellan to the borders of the Caribbean Sea, growing on the moist sides of the mountains at the elevation of 1,500 to 6,000 feet, the climatic requisites being moisture and equable temperature, with a mean of about 64° F. The wild coca shrub commonly reaches the height of 12 feet, and some species of the genus to 18 feet, but the cultivated coca is usually kept down to about 6 feet. The leaves are gathered three times a year; the first harvest, or preliminary picking, is taken at the time of the trimming of the bushes, from the cut-off twigs. Then, about the end of June, a scanty crop is gathered, while the last crop of the season is gathered in October or November. Harvesting must always take place in dry weather, so that the fresh leaves when spread out in layers two or three inches thick on the drying pavement can be collected in six or eight hours.

The coca plant, which is propagated from the seed in nurseries, begins to yield in eighteen months, and continues productive for half a century. The leaves, when mature, are carefully picked by hand so as to avoid breaking them or injuring the young buds, are slowly dried in the sun, and are then packed in bags (*cestos*) holding from twenty-five to one hun-

dred and fifty pounds each. They were in general use among the natives of Peru at the time of the conquest, and have continued to be much employed to the present time. It is affirmed that nearly ten million dollars' worth, or forty million pounds, are annually produced, some plantations yielding three or four harvests a year. For details as to method of cultivation, etc., see *T. G.*, Jan. 1886; also *C. D.*, 1897, 182. Two varieties of the coca leaf occur in the commerce of the United States, namely, the so-called Huanuco coca and the Truxillo coca, the Huanuco variety being produced in Bolivia, Huanuco, Brazil, Venezuela and Argentina, while the Truxillo coca is produced chiefly in Northern Peru. The great variation in the leaves and other portions of the coca plant, produced by its long continued cultivation, has produced much doubt and discussion as to the specificity and characteristics of the plant; H. H. Rusby has, however, by elaborate study of the subject (*D. C.*, Nov. 1900) solved the problem.

Huanuco coca has been for a long time believed to be obtained from Erythroxylon Coca; this belief is confirmed by Rusby and has been accepted by the Pharmacopœial authorities. The plant was first described in 1786, in *Lamarck's Dictionary,* vol. ii. 393.

Truxillo coca is the product of the *E. Coca Spruceanum* of Burck; the name "spruceanum" was, however, preoccupied before it was used by Burck, and in obedience to the ordinary rules of botanical nomenclature it was changed by Rusby, who regards it as a distinct species, to *E. Truxillense.*

Coca is cultivated in the British East and West Indies, and in Java, and the product is said to appear, in the London markets, under the names of Truxillo coca and Java coca. This coca is entirely distinct from the Truxillo coca of the American market, and does not reach the United States. The coca shrubs of India and Ceylon are the offspring of plants originally sent out from Kew Gardens, which plants were derived from seeds obtained in Huanuco, and were considered by Morris as representing a distinct variety of *E. Coca* to which he gave the name of *E. Nova-Granatense.* According to Rusby, however, this plant is a distinct species, and the same as that previously described by Jacquin, from Colombia, under the name of *E. carthagenense* (the name *E. carthagenense* not being, as it is held in the Kew Index, a synonym of *E. areolatum*).[1]

Properties.—The leaves of the different varieties of coca do not, on the whole, resemble one another at all closely, but are distinguished from most other leaves by a slightly curved line on each side of the mid-rib, running from the base to the apex. This line has the appearance of a rib but is really not of this character, having been produced during development by the peculiar folding of the leaf in the bud. The two commercial varieties are very well described in the U. S. Pharmacopœia as follows:

"*Huanuco Coca.*—Greenish-brown to clear brown, smooth and slightly glossy, thickish and slightly coriaceous, stoutly and very shortly petioled; blade 2.5 to 7.5 Cm. long and nearly elliptical, with a very short and abruptly narrowed basal portion and a short point, the margin entire; midrib marked above by a slight ridge, very prominent underneath, the remaining venation rather obscure, especially above; underneath, a conspicuous line of collenchyma tissue runs longitudinally on either side of the midrib and about one-third of the distance between it and the margin, the enclosed areola being of a slightly different color from the adjacent surface; odor characteristic; taste bitterish, faintly aromatic, followed by a numbness of the tongue, lips, and fauces.

Truxillo Coca.—Pale green, thin, brittle and usually much broken, smooth but not shining, shortly and stoutly petioled; blade 1.6 to 5 Cm. long and one-third to one-half as broad, obovate to oblanceolate, narrowed from near the middle into the petiole, usually with a slight projecting point at the summit, the margin entire; underneath two irregular lines of collenchyma tissue, usually incomplete or obscure, and frequently wanting, run beside the midrib at about one-third the distance from it to the margin; odor more tea-like than that of Huanuco Coca; taste and numbing effect similar." *U. S.*[2] "The midrib itself is prolonged into

[1] The commercial value of cocaine has led to the examination by Eykmann of Java, and Howard of Kew Gardens, of various species of the genus Erythroxylon, other than *E. Coca;* in a number of species the alkaloid was found, but always in too small quantities for commercial purposes. (For details, see *P. J.*, Jan. 1889.) The South American coca is said to vary from 0.02 per cent. up to 1.02 per cent., or even more, in the yield of alkaloids, the average being according to Hesse, in good specimens about 0.8 per cent. Parke, Davis & Co., however, write us that in a very large number of chemical assays they have never been able to obtain more than 0.5 per cent. of cocaine out of any South American coca. It is possible that alkaloidal deterioration occurs during transportation. According to Warden, the alkaloidal yield of India coca varies from 0.36 to 1.67 per cent. The government chemists in Java report that the Java leaf contains over 2 per cent. of cocaine; but a sample obtained directly from Java by Parke, Davis & Co. yielded only 1.06 per cent. of total alkaloids. The total yield of alkaloids is not an exact criterion of the value of the leaves, because in some, and it is said especially in the Ceylon and Java cocas, cocaine constitutes only a small proportion of the total alkaloids. It is not possible to determine the alkaloidal value of a coca by its physical properties, so that at present the large manufacturers of cocaine buy the drug by assay.

It is interesting to note that C. J. H. Warden states (*P. J.*, May, 1888) that India coca can be distinguished by the peculiarities of its cocatannic acid.

[2] In a series of measurements of the Bolivian and Truxillo leaves, H. G. Greenish (*P. J.*, 493) found that the difference in thickness in the two varieties is more apparent than real, the same-sized leaves of the two varieties having the same thickness but the Huanuco leaves averaging much larger and therefore thicker than the others. The chief cause of the lesser fragility of the Huanuco leaf was found to be due to the thickening and lignification of cells in the parenchyma, the increased development of pericyclic fibres in the veinlets, and the increased development of sclereids in the neighborhood of the lines of the under surfaces of the leaf. Greenish affirms that the two leaves can be microscopically distinguished by the fact that the veinlets of the Bolivian leaf are connected with both the upper and the lower epidermis by a bridge of thick-walled lignified fibrous cells.

a minute horny apiculus, which, however, is frequently broken off. Most of the epidermal cells of the under surface are seen in transverse section to project in the form of small papillæ." *Br.*

Chemical Constitution.—In 1853, Wackenroder demonstrated the existence of tannic acid in coca leaves, and in 1859, Stanislaus Martin found in them a peculiar bitter principle, resin, tannin, an aromatic principle, extractive, chlorophyll, a substance analogous to theine, and salts of lime. Previous to this (1855) Gardeke had isolated the crystalline alkaloid and given it the name of *erythroxyline*. Albert Niemann of Goslar, made the first thorough investigation of the leaves, and gave to the alkaloid the name it now usually bears of *cocaine*.[1] The following was his process. The leaves were exhausted with 85 per cent. alcohol acidulated with 2 per cent. of sulphuric acid; the tincture was treated with milk of lime and filtered; the filtrate was neutralized with sulphuric acid, and the alcohol distilled off. The syrupy residue was treated with water to separate resin, and then precipitated by sodium carbonate. The deposited matter was exhausted by ether, and the ethereal solution, after most of the ether had been distilled, was allowed to evaporate spontaneously. The cocaine was thus obtained in colorless crystals, mixed with a yellowish-brown matter of a disagreeable odor, which was separated by washing with cold alcohol. E. R. Squibb's process for cocaine and its hydrochloride is as follows. Coarsely ground coca leaves are repercolated with an aqueous five per cent. solution of sulphuric acid, and a very dense, slightly acid percolate is obtained; this is thoroughly agitated with pure coal oil and an excess of sodium carbonate; the liberated alkaloid is retained by the coal oil, and is nearly free from coloring matter; the oily solution is then agitated with acidulated water, and again precipitated by sodium carbonate in the presence of ether. The ethereal solution of cocaine is treated with diluted hydrochloric acid fractionally, and the nearly colorless solutions of cocaine hydrochloride are cautiously evaporated in shallow porcelain pans almost to dryness. The product is in the form of a white, crystalline, granular powder, and is a nearly pure anhydrous salt. (*Ephem.*, 1887, 906.) For Henrique's process see *Proc. A. Ph. A.*, 1895, 999. Pure cocaine is in colorless, transparent prisms, inodorous, of a bitterish taste, soluble in 704 parts of cold water, more soluble in alcohol, and freely so in ether. The solution has an alkaline reaction and a bitterish taste, leaving a peculiar numbness on the tongue. The alkaloid melts at 98° C. (208.4° F.), and on cooling congeals into a transparent mass, which gradually becomes crystalline. Heated above this point it changes color, and is decomposed. It is inflammable, burning with a bright flame, and leaving charcoal. With the acids it forms soluble and crystallizable salts, which are more bitter than the alkaloid itself. The formula is $C_{17}H_{21}NO_4$. (See *Cocainæ Hydrochloridum*, p. 374.) Niemann also obtained wax, a variety of tannic acid (*cocatannic acid*), and a concrete volatile odorous substance. The presence of *hygrine* in coca leaves is not confirmed. Lossen has examined cocaine, and ascertained that when heated with hydrochloric acid it splits into benzoic acid, methyl alcohol, and a new base which he calls *ecgonine*, of which the formula is $C_9H_{15}NO_3$. Cocaine is, therefore, ascertained to be *methylbenzoylecgonine*,

$$CH_3.N\begin{cases} C_5H_7 \\ | \\ CH(OC_7H_5O)CH_2.CH_2.COOH, \end{cases}$$

while *benzoylecgonine*, which also occurs in coca leaves, is $C_{16}H_{19}NO_4$. Cocaine is thus seen to be the methyl ether of this latter. The fundamental base, ecgonine,

$$CH_3.N\begin{cases} C_5H_7 \\ | \\ CH(OH).CH_2.COOH, \end{cases}$$

forms monoclinic prisms melting at 198° C. A considerable number of closely allied alkaloids, all of which appear to be derivatives of ecgonine, are found in the leaves of *Erythroxylon Coca*. The following list is given in Allen (*Com. Org. Anal.*, 2d ed., vol. iii. part ii., 271), on the authority of Paul and Cownley:

$C_9H_{13}NO_2$, *Anhydro-ecgonine.*
$C_9H_{15}NO_3$, *Ecgonine.*
$C_{16}H_{19}NO_4$, *Benzoyl-ecgonine.*
$C_{17}H_{21}NO_4$, *Benzoyl-ecgonine methyl ester (cocaine).*
$C_{18}H_{21}NO_4$, *Cinnamyl-ecgonine.*
$C_{19}H_{23}NO_4$, *Cinnamyl-ecgonine methyl ester.*
$C_{38}H_{46}N_2O_8$, *Cocayl-ecgonine methyl ester (cocamine).*
$C_{40}H_{50}N_2O_8$, *Homo-cocamine.*
$C_{17}H_{19}NO_2$, *Benzoyl-pseudotropine.*

With the exception of ecgonine and anhydro-ecgonine, all of the bodies in the foregoing list are saponifiable, splitting up when heated to from 80° to 100° C. with hydrochloric acid, or when boiled with alcoholic potassium hydroxide.

As the separation of cocaine from the accompanying alkaloids and products of hydrolysis is difficult, Liebermann (*Ber. d. Chem. Ges.*,

[1] *Benzoyl ψ Tropein. Tropacocaine*, $C_8H_{14}NO.C_7H_5O$. This compound, belonging chemically to the class of Tropeines (see Atropine), was isolated by Geisel from a narrow-leaved coca plant from Java. (*Ber. d. Chem. Ges.*, xxiv. p. 2336.) It is obtained as an oil, which when quite dry solidifies in radiating crystals, melting at 49° C. It has a strong alkaline reaction, and is easily soluble in alcohol, ether, chloroform, benzene, and petroleum benzin. It is decomposed by heating with hydrochloric acid into benzoic acid and pseudo-tropine, $C_8H_{15}NO$.

Tropacocaine has been studied by Arthur P. Chadbourne, who finds that its general action on the system resembles that of cocaine, and that although it is capable of causing death by paralyzing the respiratory centres, and is also in overdose a powerful cardiac depressant, it nevertheless is very much less poisonous than cocaine. On the other hand, Chadbourne's experiments and the clinical researches of Schweigger seem to show that tropacocaine as a local anæsthetic is much more powerful and prompt in its action than cocaine. Notwithstanding various favorable reports, tropacocaine, has, however, failed to come into use as a local anæsthetic.

xxi. 3196) has proposed a synthetic method which avoids these difficulties and at the same time utilizes the amorphous by-products. The mixed bases are boiled with hydrochloric acid, whereby they all suffer hydrolysis with formation of ecgonine; then, by passing dry hydrochloric acid into a solution of ecgonine hydrochloride in methyl alcohol, the hydrochloride of ecgonine methyl ester is formed, which on concentrating the alcoholic solution crystallizes out in prisms. Cocaine is formed when this compound is heated on the water bath with an equal weight of benzoyl chloride until the mixture becomes homogeneous and the evolution of hydrochloric acid ceases. The melted mass is poured into water and separated from the insoluble benzoic acid, when the cocaine is precipitated by ammonia and recrystallized from alcohol. Hesse investigated addition products of ecgonine and produced a crystalline compound of ecgonine and methyl iodide, $C_9H_{15}NO_3$, $CH_3I + H_2O$, and a methyl chloride compound, $C_9H_{15}NO_3,CH_3Cl + H_2O$. (*P. J.*, 1902, 275.) He also extracted four definite compounds, not alkaloids, from the leaves of coca obtained from Java. These bodies are 1. *Cocacitrin,* $C_{23}H_{32}O_{17}$, a yellow crystalline compound with three molecules of water, melting at 186° C. This appears to be a glucoside, yielding a sugar, *cocaose,* which may be identical with *dextrotalose,* since its *osazone* melts at 180° C. 2. *Cocacetin,* $C_{16}H_{12}O_7$, forming yellow needles with three molecules of water of crystallization. This melts at 260° to 265° C. 3. *Cocaflavin,* $C_{34}H_{38}O_{19}$, which forms yellow crystals with four molecules of water. It yields dextrose and galactose on hydrolysis with diluted sulphuric acid, and is, therefore, probably a glucoside. 4. *Cocaflavetin,* containing two methoxy groups, forms greenish-yellow needles with three molecules of water and melts at 230° C. (*P. J.*, April, 1903, 585.) The tannin of coca leaves strikes a green-black with ferric salts, and has received the name of *cocatannic acid.* Romburgh detected traces of *methyl salicylate* in the distillate from coca. (*Chem. Ztg.*, 1895, 130.)

Assay. U. S. (8th Rev.)—"Coca, in No. 60 powder, *ten grammes;* Chloroform, Ether, Normal Sulphuric Acid V.S., Ammonia Water, Distilled Water, Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin or Iodeosin T.S., each, *a sufficient quantity.* Place the Coca in an Erlenmeyer flask, add 50 Cc. of a mixture of chloroform 1 volume and ether 4 volumes and insert the stopper securely. Allow the flask to stand ten minutes, then add 2 Cc. of ammonia water mixed with 3 Cc. of distilled water, and shake the flask well, at frequent intervals, during one hour. Then transfer as much as possible of the contents of the flask to a small percolator which has been provided with a pledget of cotton packed firmly in the neck, and inserted in a separator containing 6 Cc. of normal sulphuric acid V.S., diluted with 20 Cc. of distilled water. When the liquid has passed through the cotton, pack the Coca firmly in the percolator with the aid of a glass rod, and, having rinsed the flask with 10 Cc. of chloroform-ether mixture, transfer the remaining contents of the flask to the percolator by the aid of several small portions (5 Cc.) of a chloroform-ether mixture, using the same proportions as before, and continue the percolation with successive small portions of the same liquid (in all 50 Cc.). Next, shake the separator well for one minute, after securely inserting the stopper, and when the liquids have completely separated, draw off the acid liquid into another separator. Add to the chloroform-ether mixture 10 Cc. of a sulphuric acid mixture, using the same proportions as before, agitate well and again draw off the acid liquid. Repeat this operation once more, drawing off the acid solution as before into the second separator, introduce a small piece of red litmus paper, add ammonia water until the liquid is distinctly alkaline, and shake out with 3 successive portions of ether (25, 20, and 15 Cc.). Collect the ether-solutions in a beaker, place it on a water-bath filled with warm water, and allow the ether to evaporate entirely. Dissolve the residue in 3 Cc. of ether, and let this also evaporate completely. To the alkaloidal residue add 4 Cc. of tenth-normal sulphuric acid V.S. and 5 drops of hematoxylin or iodeosin T.S., then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 4 (the 4 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.03 and this product by 10, to obtain the percentage of ether-soluble alkaloids contained in the Coca." *U. S.* For methods of assaying coca leaves, see Lyons, *Ch. Ph.*, Sept. 1885; Squibb, *Ephem.*, 1887; Dohme, *Proc. A. Ph. A.*, 1893, 159; Prescott, *Organic Analysis; Proc. A. Ph. A.*, 1895, 268; *P. J.*, 1896, 1901, 222, 254; *Ph. Ztg.*, 1901, 965.

Uses.—As a nerve stimulant, coca has been used immemorially by the Peruvian and Bolivian natives. In 1853, Weddell stated that it produces a gently excitant effect, with an indisposition to sleep, in these respects resembling tea and coffee; also that it will support the strength for a considerable time in the absence of food, but does not supply the place of nutriment, and probably in this respect also acts like the two substances referred to. The Indians, while chewing it, mixed with some alkaline substance, as the ashes of certain plants, or lime, pass whole days in travelling or working without food. It is, however, clearly proved that these leaves do not take the place of nutriment, but simply put off the sense of fatigue and hunger, the Indian making up at his evening meal for the day's abstinence. It is probable that they prevent hunger simply by their local benumbing influence upon the nerves of the stomach. Their moderate habitual use

does not seem to be injurious, but the habit is said readily to grow upon the person, and finally the inveterate excessive coca-chewer can be recognized by his uncertain step, general apathy, sunken eyes surrounded by deep purple aureoles, trembling lips, green and crusted teeth, and excessively fetid breath, with peculiar blackness about the corners of the mouth. An incurable insomnia is apt to be developed, emaciation becomes extreme, dropsy appears, and even death results from a condition of general marasmus. When coca is taken in a single large dose it produces a condition of peculiar physical beatitude and calm, followed by a sensation of excessive power, which is affirmed to be accompanied by a real increase of physical ability. Mantegazza took in the course of two hours about 900 grains of the coca leaf, with the result of great increase in the number of the heart-beats and a condition of intoxication resembling that produced by hasheesh. He was possessed by a feeling of intense joyousness, while a succession of visions and phantasmagoria, most brilliant in form and color, trooped rapidly before his eyes. He then passed into a condition of delirious excitement, which was succeeded by a deep sleep lasting three hours.

The symptoms which have just been detailed are those which have been recorded by various writers as produced by the coca leaf in the land of its growth, and especially upon the natives of the country. The action of the alkaloid cocaine, and even of the drug coca, upon North Americans and Europeans, differs essentially from these effects.[1] Numerous cases of poisoning have occurred from the alkaloid; P. Mannheim has collected as many as ninety-nine (*Cleveland Med. Gaz.,* Sept. 1891). In mild cases the ordinary symptoms have been great restlessness and nervous excitement, but no sense of beatitude, rather a condition of fear and terror. With this state come usually distinctly accelerated pulse, increased frequency of respiration, and, perchance, muscular twitchings or even mild convulsions. In the more severe cases of poisoning the symptoms vary; sometimes there have been nausea, vomiting, rapid almost imperceptible pulse, great perspiration, collapse with or without loss of consciousness; in other cases the pulse has been slow and feeble, and sometimes pronounced cyanosis, with slow or almost arrested respiration, has been the most alarming manifestation. The pupils are usually dilated, but are reported in some cases as "contracted." After very large doses convulsions usually occur; they are often violent and epileptiform; not rarely, they are partial, and in many cases opisthotonos has been pronounced. Consciousness rarely escapes; usually it is lost, but sometimes it is merged into a mania with hallucinations and delusions, which mania may become violent and even homicidal, as in a case reported by Mattison. Poisoning has followed both the internal administration and the local uses of the alkaloid. The occasional over-effects of small doses are quite remarkable; thus, four drops of a two per cent. solution in the eye produced in an old lady intoxication which persisted four days; eight drops of a ten per cent. solution in the eye of a girl of twelve years caused violent poisoning; and even one drop of a one per cent. solution in the eye of a child fourteen years old is said to have been followed by violent symptoms. A number of cases are on record in which one grain of the alkaloid given hypodermically has caused severe fainting. Death is reported in several cases from the local use of the remedy, and twelve drops of a four per cent. solution given hypodermically to a girl of eleven caused death in forty seconds. On the other hand, large doses have been recovered from, twenty-two grains by the mouth, ten grains hypodermically, five grains hypodermically, and six grains hypodermically. (See H. C. Wood's *Therapeutics.*)

Although cocaine has been used an enormous number of times as a local application without much stint, and although doses have been given of two grains, it is evidently not safe to apply more than three-fourths of a grain to the mucous membrane of an adult, or to give more than the same amount at a dose, or to use hypodermically more than half a grain.

Cocaine is a cerebral stimulant, producing peculiar mental excitement, ending after large toxic doses in narcosis, with epileptiform convulsions, which are probably of cerebral origin. In the poisoning there is at first increased reflex activity, followed by paralysis of voluntary motion and of reflex activity, which are chiefly due to a direct action upon the spinal cord, the sensory side of the cord being probably more sensitive to the drug than the motor side. Toxic doses depress and finally paralyze the sensory nerves, and in a much less degree the motor nerves. The action of cocaine upon the circulation is less pronounced than is its influence upon the nervous system, but is distinct. By stimulation of the heart and of the vasomotor centres, and perhaps of the vascular muscle fibres, the arterial pressure is increased, while the pulse is accelerated, probably by a depression of the cardio-inhibitory apparatus. Toxic doses of cocaine produce sooner or later a fall of the arterial pressure, which appears to be the result of a

[1] The reason of this difference is not evident. Rusby found that coca treated with Mayer's reagent both before and after exportation gave evidence of a much larger percentage of the alkaloid before the exportation. He believes that during exportation the leaves lose largely of some volatile substance, probably *hygrine.* According to Hesse, however, hygrine is not an alkaloid of coca, but is a foreign body due to impurities in the reagents employed. (*P. J.*, vol. xx. p. 1135, 1891; also vol. xxii. p. 102.) H. C. Wood made some not very thorough tests with preparations of coca made in South America from the fresh drug under the supervision of Rusby and furnished by Parke, Davis & Co., and was not able to detect any difference between their action and that of the parallel preparations made in this country. At present it seems probable that the difference of action under discussion is due simply to difference of race, precisely as with the effects of hasheesh upon Asiatics and upon Europeans.

direct action upon the heart, and the vasomotor system. Upon striated muscles cocaine appears to have a peculiar though very feeble action, which is not manifested during poisoning by it. It is a stimulant to the respiratory centres, increasing the rapidity and fulness of the respirations, but if the dose is sufficiently large, it causes the respirations to become after a time very shallow, and finally paralyzes the respiratory centres. Moderate doses are said to increase, large doses to paralyze, peristalsis.

It has no distinct effect upon the amount of urine secreted but probably decreases the elimination of urea. It is an energetic mydriatic but does not increase intra-ocular pressure nor entirely paralyze the accommodation. Locally applied, cocaine is a very distinct and certain anæsthetic, acting, according to the observations of von Anrep, upon the nerves of special sense as well as upon those of common sensibility. Cocaine penetrates mucous membranes readily, but is not able to pass through the skin, and when given hypodermically so rapidly diffuses itself that its local anæsthetic influence is very fugacious unless the circulation in the part be controlled by mechanical means. Injected so as to come immediately in contact with the large nerve-trunk, it is capable of producing temporary anæsthesia over the whole distribution of the nerve. When applied in concentrated solution to the mucous membrane, it produces at once a marked pallor, which is probably due to a powerful constriction of the blood-vessels caused by a direct action upon their muscle-fibres. In practical medicine cocaine is used for its local effects in benumbing sensibility and relieving pain in all mucous tracts that can be reached by the surgeon. When prescribed in an ointment, soluble salts of cocaine should be used, and sufficient water directed to prevent crystallization. In *burns, painful ulcers, fissures of the anus,* etc., cocaine is a very valuable remedy. It is also employed with success in various local inflammations of the mucous membrane, subduing nervous irritability, and by its constringing influence relieving or even curing acute inflammations. Thus, a mixture of cocaine and bismuth will often arrest an acute *coryza.* In *hay fever,* in the *irritated sore throat* of advanced *phthisis,* in *chronic laryngitis,* in inflamed *hemorrhoids,* and even in *bronchitis* with excessive cough, it often may be locally applied with advantage. The fugaciousness of its effects makes it a valuable mydriatic when it is desired simply to examine the eye-ground. The strength of the solution for local application may vary from 2 to 10 per cent., according to the effects desired. In *coryza* and *hay fever* bougies made with cacao butter, containing each from one-quarter to one-half grain of cocaine, are often very efficacious. At one time it was supposed that cocaine would be of great service by its stimulant influence in *melancholia, neurasthenia, hysteria,* and allied disorders, but experience has shown it to be of very little value in these conditions, and often to increase the symptoms, especially any existing restlessness. It is chiefly valuable as an internal remedy and for its local influence upon the gastro-intestinal tract in *seasickness, excessive vomiting, gastrodynia,* and even in *serous diarrhœa.*

The habitual use of cocaine as a stimulant has in many cases led to the formation of the cocaine habit, with the production of ill health, accompanied by headache, malaise, insomnia, prostration, often faintness, vertigo, and deterioration of the cerebral function. A symptom which is said to be characteristic of chronic cocaine poisoning but which must certainly be rare, was first described by Magnan, and is known as Magnan's symptom. It consists of an hallucination of common sensation, the feeling that some foreign body is under the skin, with an often consequent complaint that grains of sand, worms, or other foreign body are situated in the position named. The immediate withdrawal of the cocaine in cases of the cocaine habit is not usually followed by any serious danger to life; symptoms that may arise are to be met on general principles.

If given in infusion the leaves should be swallowed, as it is by no means certain that they yield their virtues to water. The fluidextract is now official, and is a very eligible preparation; a *tincture of coca,* made in the proportion of one part in five of diluted alcohol, and a *wine of coca,* one in ten, would also be efficient. The *elixir of coca,* as usually dispensed, is too weak to be of much value. (See PART II.)

Dose, of coca, one-half to one drachm (2.0 to 3.9 Gm.).

Off. Prep.—Fluidextractum Cocæ, *U. S.* (*Br.*); Vinum Cocæ, *U. S.* (from fluidextract).

COCAINA. U. S., Br.

COCAINE

(cō-cą-ĭ'ną)

$C_{17}H_{21}NO_4 = 300.92$

"An alkaloid [$C_8H_{13}(C_6H_5CO)NO.COOCH_3$] obtained from several varieties of Coca." *U. S.* "An alkaloid, $C_{17}H_{21}NO_4$, obtained from the leaves of Erythroxylum Coca, *Lam.,* and its varieties." *Br.*

Benzoyl-ecgonine-methyl-ester; Benzoyl-methyl-ecgonine; Cocainum; Cocaïne, *Fr. Cod.*; Cocain, *G.*

The processes for making this alkaloid will be found under *Coca.* Owing to the small yield, it is found more profitable to manufacture cocaine in South America and export it, thus saving the expense of transporting the bulky coca leaves.

Properties.—It is officially described as in "large, colorless, four-sided or six-sided monoclinic prisms, having a slightly bitter taste, and producing on the tongue a temporary numbness. Soluble in 600 parts of water, 5 parts of alcohol, and in 3.8 parts of

ether at 25° C. (77° F.); very soluble in chloroform and warm alcohol; soluble in 260 parts of water at 80° C. (176° F.); soluble in benzene, carbon disulphide, ethyl acetate, in about 14 parts of oil of turpentine, and in about 12 parts of olive oil; insoluble in glycerin. It melts at 98° C. (208.4° F.), and should leave no residue on ignition. If an alcoholic solution of Cocaine be carefully neutralized with hydrochloric acid, and the solution evaporated to dryness, the residue should respond to the reactions and tests given under *Cocainæ Hydrochloridum." U. S.* The British Pharmacopœia gives the following description and tests: "Colorless monoclinic prisms which have a bitter taste followed by a sensation of tingling and numbness. It melts at 204.8° to 208.4° F. (96° to 98° C.). Almost insoluble in *water*, insoluble in *glycerin*, soluble in 10 parts of *alcohol* (90 per cent.), in 4 parts of *ether*, in ½ part of *chloroform*, in 12 parts of *olive oil*, and in 14 parts of *oil of turpentine*. Its solution in *water* acidulated with *hydrochloric acid*, and the dry salt obtained on evaporating this solution, afford the reactions mentioned under 'Cocainæ Hydrochloridum.' Its solution in *water* acidulated with *nitric acid* yields no reaction with the tests for chlorides or sulphates."

Uses.—(See p. 371.) Various salts of the alkaloid have been used in medicine. *Cocaine borate* has been recommended for ophthalmological uses. *Cocaine hydriodide*, $C_{17}H_{21}NO_4$ HI, which occurs in colorless crystals only moderately soluble in water, has been especially recommended by R. Marcus as being suitable for use by cataphoresis for the production of anæsthesia. For medicinal uses see *Coca*.

Dose, one-eighth to one-fourth grain (0.008 to 0.016 Gm.).

Off. Prep.—Oleatum Cocainæ, *U. S.*; Unguentum Cocainæ, *Br.*

COCAINÆ HYDROCHLORIDUM.
U. S., Br.

COCAINE HYDROCHLORIDE [Cocainæ Hydrochloras, Pharm. 1890, Cocaine Hydrochlorate]

(cō-cą-ī'næ hȳ-drǫ-ȼhlō'rĭ-dŭm)

$C_{17}H_{21}NO_4.HCl = 337.10$

"The neutral hydrochloride [$HCl.C_8H_{13}(C_6H_5CO)NO.COOCH_3$] of an alkaloid obtained from several varieties of Coca." *U. S.* "The hydrochloride, $C_{17}H_{21}NO_4$,HCl, of an alkaloid obtained from the leaves of Erythroxylum Coca, *Lam.*, and its varieties." *Br.*

Hydrochlorate of Cocaine; Chlorhydrate de Cocaïne, *Fr. Cod.*; Cocaïnum hydrochloricum, *P. G.*; Cocainhydrochlorid, *G.*; Cloridrato di cocaina, *It.*

Preparation.—Cocaine hydrochloride may be made "by agitating with ether an aqueous solution of an acidulated alcoholic extract of coca made alkaline with carbonate of sodium; separating and evaporating the ethereal liquid; purifying the product by repeating the treatment with acidulated water, carbonate of sodium, and ether; decolorizing; neutralizing with hydrochloric acid, and recrystallizing." *Br.* (1885). It is also made by dissolving cocaine in ether or petroleum benzin, and passing dry hydrochloric acid gas into the solution, when the hydrochloride will separate, this may then be dissolved in alcohol and recrystallized. For physiological and medicinal properties, see *Coca*.

Properties.—It is officially described as in "colorless, transparent, monoclinic prisms, flaky, lustrous leaflets or a white crystalline powder; permanent in the air, containing no water of crystallization; odorless; of a saline, slightly bitter taste, and producing on the tongue a tingling sensation followed by numbness of several minutes' duration. Soluble in 0.4 part of water, 2.6 parts of alcohol, and in 18.5 parts of chloroform at 25° C. (77° F.); soluble in 0.1 part of water at 80° C. (176° F.), and in 1.4 parts of alcohol at 60° C. (140° F.); insoluble in benzene, petroleum benzin, and ether. It melts at about 189.9° C. (373.8° F.). Minute quantities of impurities may reduce the melting point to 180° C. (356° F.) or less. It leaves no residue on incineration. Its aqueous solution is neutral to litmus paper, and is lævogyrate. If silver nitrate T.S. be added to the aqueous solution of the salt (1 in 100), a white precipitate is produced, which is insoluble in nitric acid. On adding 5 drops of a solution of chromium trioxide (1 in 20) to 5 Cc. of a solution of Cocaine Hydrochloride (1 in 50), a yellow precipitate will be produced, which redissolves on shaking; on now adding 1 Cc. of hydrochloric acid, a permanent, orange-colored, crystalline precipitate will be formed. On adding a solution of potassium chromate (1 in 20) to a hydrochloric acid solution of the salt, orange-yellow leaflets of cocaine chromate are precipitated. If mercuric chloride T.S. be added to an aqueous solution of the salt, a white flocculent precipitate is produced. Cocaine Hydrochloride is not colored by cold sulphuric acid, but if a crystal be heated with sulphuric acid, in a test-tube, vapors are produced, from which benzoic acid is deposited on cooling. If three drops of palladous chloride T.S., with 3 Cc. of chlorine water, be added to 3 drops of an aqueous solution of the salt (1 in 20), a red precipitate is produced. When 0.01 Gm. of the salt is dissolved in 2 drops of water, the addition of 1 Cc. of a solution of potassium permanganate (1 in 30) produces a violet precipitate, which appears brownish-violet when collected on a filter. A crystal of the salt dissolved in alcohol yields when stirred with a piece of potassium hydroxide an odor of ethyl benzoate. If 0.1 Gm. of the salt be dissolved in 5 Cc. of distilled water containing 3 drops of diluted sulphuric acid, the addition to this solution of 3 drops of tenth-normal potassium permanganate V.S. will produce a violet color, which should not fade in half an hour (limit of *cinnamyl-cocaine*). If 0.1 Gm. of the salt be

dissolved in 85 Cc. of cold distilled water, in a beaker, and 4 drops of ammonia water added, and the solution stirred vigorously for fifteen minutes, with occasional rubbing of the sides of the beaker with a stirring rod, a crystalline precipitate of cocaine should be formed, and the supernatant liquid should be perfectly clear (limit of *isatropyl-cocaine*). The presence of 0.5 percent. of isatropyl-cocaine will prevent the formation of nearly all of the precipitate, and will cause the supernatant liquid to be opalescent." *U. S.*

The British Pharmacopœia gives the following tests: "It melts at 356° to 366.8° F. (180° to 186° C.). Soluble in half its weight of cold *water*, forming a clear and colorless solution, neutral to *litmus*, and in four times its weight of *alcohol* (90 per cent.) or of *glycerin*. It is insoluble in *olive oil* and almost insoluble in *ether*. It affords a yellow precipitate with *solution of auric chloride;* a white precipitate with *solution of ammonium carbonate*, and also with *solution of borax*. It dissolves without color in cold *sulphuric* or *nitric acid*, but chars with hot *sulphuric acid*, evolving an agreeable odor, and yielding a crystalline sublimate of benzoic acid. Its aqueous solution yields with *solution of potassium hydroxide* a white precipitate soluble in *alcohol* or *ether*, with *solution of picric acid* a yellow precipitate becoming crystalline on standing, with *test-solution of mercuric chloride* slightly acidulated with hydrochloric acid, a white precipitate soluble in hot *water*. Moistened with *nitric acid*, the mixture evaporated to dryness, and a drop of *alcoholic solution of potassium hydroxide* added, a characteristic odor is evolved more or less recalling that of peppermint. A solution containing not less than 1 per cent. gives with excess of *solution of potassium permanganate* a copious red precipitate which does not change color within an hour (absence of cinnamyl cocaine and cocamine or other products derived from cocaine). 0.1 gramme dissolved in 100 cubic centimetres of *water* and 0.25 cubic centimetre of *solution of ammonia* added, affords a clear solution, from which a crystalline deposit should gradually separate on stirring (limit of amorphous alkaloid). It should not afford more than the slightest reactions with the tests for sulphates. Dried for twenty minutes at 204° to 212° F. (95.6° to 100° C.) it should not lose more than 1 per cent. of moisture." *Br.*

Dose, of the salts of cocaine, from one-fourth to one grain (0.016 to 0.065 Gm.).

Off. Prep.—Injectio Cocainæ Hypodermica, *Br.;* Lamellæ Cocainæ, *Br.;* Trochiscus Krameriæ et Cocainæ, *Br.*

COCCUS. U. S., Br.

COCHINEAL

(cŏc'cus)

"The dried female insect, *Pseudococcus cacti* (Linné) Burmeister." *U. S.* "The dried fecundated female insect, Coccus Cacti, *Linn.*, reared on Nopalea coccinellifera, *Salm-Dyck*, and on other species of Nopalea." *Br.*

Coccionella; Cochenille, *Fr. Cod.;* Scharlachwurm, *G.;* Cochinilla, *Sp.*

Pseudococcus is a genus of hemipterous insects, having the snout or rostrum in the thorax, the antennæ filiform, and the posterior part of the abdomen furnished with bristles. The male has two erect wings, the female is wingless. The *P. cacti* is characterized by its depressed, downy, transversely wrinkled body, its purplish abdomen, its short and black legs, and its subulate antennæ, which are about one-third of the length of the body. (*Rees's Cyclopædia.*) Another species, *C. ilicis*, which inhabits a species of oak, is collected in the mountainous parts of the Morea, in Greece, and used as a dye-stuff in the East, under the name of *kermes*, *chermes*, or *alkermes*. The dried insects are nearly globular, smooth, about the size of a pea, and of a reddish-brown color. They yield a carmine-colored powder, and, with a salt of tin, a fine scarlet-red dye. *Pseudococcus cacti* is found wild in Mexico and Central America, inhabiting different species of Cactus and allied genera of plants, and is said to have been discovered also in some of the West India islands and southern parts of the United States.

In Mexico, particularly in the provinces of Oaxaca and Guerrero, it is an important object of culture. The Indians form plantations of the *nopal* (*Nopalea coccinellifera*, Salm, formerly *Opuntia cochinillifera*, Mills), upon which the insect feeds and propagates. During the rainy season, a number of the females are preserved under cover, upon the branches of the plant, and, after the cessation of the rains, are distributed upon the plants without. They perish quickly after having deposited their eggs. These, hatched by the heat of the sun, give origin to innumerable minute insects, which spread themselves over the plant. The males, of which, according to Ellis, the proportion is not greater than one to one hundred or two hundred females, being provided with wings and very active, approach and fecundate the latter. After this period, the females, which before moved about, attach themselves to the leaves, and increase rapidly in size; so that, in the end, their legs, antennæ, and probosces are scarcely discoverable, and they appear more like excrescences on the plant than distinct animated insects. They are now gathered for use, by detaching them by means of a blunt knife, a quill, or a feather, a few being left to continue the race. They are destroyed either by dipping them, enclosed in a bag, into boiling water or by the heat of a stove. In the former case they are subsequently dried in the sun. The males, which are smaller than the full grown females, are not collected. It is said that of the wild insect there are six generations every year, furnishing an equal number of crops; but the domestic is collected only three times annually, the propagation being suspended during the

rainy season, in consequence of the inability of the insect to support the inclemency of the weather. The insect has been taken from Mexico to the Canary Islands; and very large quantities of cochineal have been delivered to commerce from the island of Teneriffe.[1] Its culture is said to have proved successful in Java and Algeria, but unprofitable in Spain.[2]

Cochineal is defined in the U. S. Pharmacopœia as follows: "About 5 Mm. long, somewhat oblong and angular in outline, flat and concave beneath, convex above; externally purplish-gray or purplish-black; transversely wrinkled; easily pulverizable, yielding a dark red powder; odor faint; taste slightly bitter. The coloring matter is soluble in water, alcohol, or ammonia water, slightly soluble in ether, insoluble in fixed and volatile oils; alkalies change the color to purple. Ash not more than 6 per cent." *U. S.*

As found in commerce, the finer cochineal, *grana fina* of Spanish commerce, is in irregularly circular or oval, somewhat angular grains, about one-eighth of an inch in diameter, convex on one side, concave or flat on the other, and marked with several transverse wrinkles. Two varieties of this kind of cochineal are known to the druggist, distinguished by their external appearance. One is of a reddish-gray color, formed by an intermixture of the dark color of the insect with the whiteness of a powder by which it is almost covered, and with patches of a rosy tinge irregularly interspersed. From its diversified appearance, it is called by the Spaniards *cochinilla jaspeada*. It is the variety commonly found in commerce. The other, *cochinilla renegrida*, or *grana nigra*, is dark-colored, almost black, with only a minute quantity of the whitish powder between the wrinkles. The two are distinguished in our markets by the names of *silver grains* and *black grains*. Some suppose the difference to arise from the mode of preparation, the gray cochineal consisting of the insects destroyed by a dry heat; the black, of those destroyed by hot water, which removes the external whitish powder; it is also said that cochineal is blackened by placing the insects with black sand in a bag and swinging backward and forward until some of the juice exudes. According to Faber, who derived his information from a merchant residing in the neighborhood where the cochineal is collected, the silver grains consist of the impregnated female just before she has laid her eggs; the black, of the female after the eggs have been laid and hatched. (*A. J. P.*, xviii. 47.) There is little or no difference in their quality.[3] Another and much inferior variety is the *grana sylvestra*, or wild cochineal, consisting partly of very small separate insects, partly of roundish or oval masses, which exhibit, under the microscope, minute and apparently new-born insects, enclosed in a white or reddish cotton-like substance. It is scarcely known in our drug market.

Cochineal has a faint heavy odor and a bitter, slightly acidulous taste. Its powder is of a purplish-carmine color, tingeing the saliva intensely red. According to Pelletier and Caventou, it consists of a peculiar coloring principle, a peculiar animal matter constituting the skeleton of the insect, stearin, olein, an odorous fatty acid, and various salts. Tyrosin has also been found by De la Rue, and its presence in cochineal confirmed later by von Miller and Rohde. (*Ber. d. Chem. Ges.*, xxvi. 2660.) It was also analyzed by John, who called the coloring principle *cochinilin*. It is, however, universally known now as *carminic acid*. Hlasiwetz and Grabowski (*Ann. Ch. Ph.*, 141, 329) gave it the formula $C_{17}H_{18}O_{10}$, and considered it to be a glucoside, which was decomposed by boiling with diluted sulphuric acid into a non-fermentable sugar and *carmine red*, $C_{11}H_{12}O_7$. The incorrectness of this view has, however, been demonstrated by von Miller and Rohde (*loc. cit.*), who have shown that the purified carminic acid is a dioxymethyl-α-naphthoquinone of the formula $C_{12}H_{11}O_7$, or the double formula $C_{24}H_{22}O_{14}$, and that the carmine red is identical with it. Schunk and Marchlewski (*Ber. d. Chem. Ges.*, xxvii. 2979) have confirmed these results of von Miller and Rohde, and have shown that the reason that the carminic acid as freshly extracted from the cochineal gave the apparent glucoside reaction was that it is impure. They prepared the pure crystallized carminic acid, its anilide, and identified its character as a naphthoquinone derivative. (Recent writers, without modifying the formula above given, have classified carminic acid as a derivative of hydriodene, C_9H_{10}.) It shows no sharp melting point, beginning to decompose at 130° C. Carminic acid is of a brilliant purple-red color, unalterable in dry air, is very soluble in water, soluble in cold and more so in boiling alcohol, insoluble in ether, and without nitrogen. It is obtained by macerating cochineal in ether, and treating the residue with successive portions of boiling alcohol, which on cooling deposits a part of the carminic acid, and yields the remainder by spontaneous evaporation. It may be freed from a small proportion of adhering

[1] Various species of Opuntia are adapted to the support of the cochineal insect, especially plants which are very juicy, with few thorns and a thick skin. It is the *O. Ficus indica* which is chiefly cultivated in Teneriffe, the dry but hot climate of which is peculiarly adapted to the growth both of the plant and the insect. For an account of the mode of rearing the cochineal insect in the Canary Islands, see *P. J.*, Sept. 1871; in Central America, see *A. J. P.*, 1873, 30; *N. R.*, 1880, 175; in Guatemala, see *Ph. Era*, 1893, 227.

[2] In Asia Minor, in the vicinity of Oushak, are great quantities of an insect, closely resembling the Coccus cacti, which feeds on a species of Cistus; but it is unknown whether any quantity has been introduced into general commerce. (*A. J. P.*, xxxv. 455.)

[3] *Cake cochineal* is the name given to a variety of the drug produced in Argentina. A specimen examined by Stark was in flat cakes about one-fourth of an inch thick, and, under the microscope, was seen to consist chiefly of the cochineal insect, mixed with small portions of the thorns and epidermis of the cactus, in consequence of careless gathering. It is inferior for dyeing purposes to the ordinary variety. (*P. J.*, xiv. 346.)

fatty matter by dissolving it in official alcohol and then adding an equal quantity of ether. The pure carminic acid is deposited in the course of a few days. Chlorine readily destroys the carminic acid, and nascent hydrogen reduces it to a leuco body, which again becomes red on exposure to the air. Liebermann found that the coating of the silver cochineal consisted of a peculiar wax, which he named *coccerin*, $C_{30}H_{60}(C_{31}H_{61}O_3)_2$; this is soluble in benzene, but nearly insoluble in ether. (*P. J.*, 1885, 186; from *Ber. d. Chem. Ges.*) The aqueous infusion of cochineal is of a violet-crimson color, which is brightened by the acids and deepened by the alkalies. The coloring matter is readily precipitated. The salts of zinc, bismuth, and nickel produce a lilac precipitate, and those of iron a dark purple approaching to black. The salts of tin, especially the nitrate and the chloride, precipitate the coloring matter of a brilliant scarlet, and form the basis of those splendid scarlet and crimson dyes which have rendered conchineal so valuable in the arts. With alumina the coloring matter forms the pigment called *lake*. The finest lakes are obtained by mixing the decoction of cochineal with fresh gelatinous alumina.

The pigment called *carmine* is the coloring matter of cochineal precipitated from the decoction by acids, the salts of tin, etc., or by animal gelatin, and when properly made is of the most intense and brilliant scarlet. Cochineal-carmine requires for its production a decoction of cochineal itself, and not of carminic acid, the nitrogenized matters being essential to its formation. Liebermann (*Ber. d. Chem. Ges.*, xviii. p. 1971) considers cochineal carmine to be no ordinary compound of a coloring matter with alumina, but to be an alumina albuminate of the carmine coloring matter comparable in some respects to the product from alizarin and alumina with "Turkey-red oil." (See *C. D.*, 1893, 199; *Zeit. angew. Chem.*, 1894.) J. J. Hess proved that if fatty matters found in cochineal were removed by treatment with alcohol, a much more brilliant carmine could be produced. He found in Guatemala cochineal 17 per cent. of a crystalline stearopten, in Java cochineal 7 per cent., and in Canary cochineal 18 per cent. (Dingler, *P. J.*, 235, 88; *N. R.*, 1880, 338.) The degree of coloring power in cochineal may be approximately measured by the decolorizing effect produced by solution of potassium permanganate. For a method of applying this process, the reader is referred to a paper by J. M. Merrick of Boston, in *A. J. P.*, 1871, 263; from *Amer. Chem.*, April, 1871. The Br. Pharm. requires that when cochineal is macerated in water no insoluble powder shall be separated, and that when incinerated with free access of air it shall yield not more than 6 per cent. of ash.

Cochineal has been adulterated by causing certain heavy substances, such as powdered talc, lead carbonate, and barium sulphate, by shaking in a bag or otherwise, to adhere, by means of some glutinous material, to the surface of the insects, and thus increase their weight. Cochineal yields 1.5 per cent. of ash. Five specimens of the drug have been examined, which left in their ashes respectively 8, 12, 16, 18, and 25 per cent. of the salt of barium. (*A. J. P.*, 1870, p. 220.) The fraud may be detected by the absence, under the microscope, of a woolly appearance which characterizes the white powder upon the surface of the unadulterated insect. Metallic lead, which is said frequently to exist in fine particles in the artificial coating, may be discovered by powdering the cochineal and suspending it in water, when the metal will remain behind. Grains of a substance artificially prepared to imitate the dried insect have been mixed with the genuine in France. A close inspection will serve to detect the difference. (*J. P. C.*, 3e sér., ix. 110.) Vermilion and chrome-red (lead dichromate) are said also to have been largely used in the adulteration of carmine, to the extent sometimes of 60 or even 70 per cent. (*P. J.*, 1860, p. 547.) There can be no difficulty in detecting them by the appropriate tests. Starch has been used, according to Maisch, for the same purpose in the United States, and in one specimen he found 57.14 per cent. (*A. J. P.*, xxxiii. 18.) Artificial cochineal, prepared by coloring exhausted cochineal powder with rosaniline and forming it into grains has been found in commerce. It may be recognized by the facility with which it forms a paste with water.

The importations of cochineal have diminished, owing to the gradual replacement of this dye by the newer azo colors. In 1889, 550,000 lbs. were brought into the United States; in 1902, 1903, and 1904, the importations were 140,756 lbs., 114,326 lbs., and 162, 395 lbs., respectively. The reduction in price has been such that at present the production in the Canaries is said not to be remunerative.

Uses.—Cochineal is supposed by some to possess anodyne properties, but is probably useless. In pharmacy it is employed to color tinctures and tooth powders. To infants with *whooping cough*, cochineal in substance is given in the *dose* of about one-third of a grain (0.021 Gm.) three times a day. The *dose*, of a tincture (one part in ten parts of diluted alcohol), is for an adult from twenty to thirty minims (1.3 to 1.8 Cc.). In *neuralgia*, Sauter gave half a tablespoonful (7.5 Cc.) with asserted cure.

Off. Prep.—Tinctura Cardamomi Composita, *U. S., Br.;* Tinctura Cinchonæ Composita, *Br.;* Tinctura Cocci, *Br.*

CODEINA. U. S., Br.

CODEINE

(cō-dē-ī'nạ)

$C_{18}H_{21}NO_3 + H_2O = 314.83$

"An alkaloid $[C_{17}H_{18}(CH_3)NO_3 + H_2O]$ obtained from Opium, or prepared from mor-

phine by methylation. It should be kept in well-stoppered, amber-colored vials." *U. S.* "An alkaloid, $C_{17}H_{18}(CH_3)NO_3,H_2O$, obtained from opium or from morphine." *Br.*

Codeina, Methyl-morphine, Codeia; Codeinum, Codéine, *Fr. Cod.;* Codein, Kodein, *G.;* Codeina, *It., Sp.*

Preparation.—*Codeine*[1] was discovered in 1832 by Robiquet in morphine hydrochloride prepared according to the process of Gregory. It exists in opium combined like morphine with meconic acid, and is extracted along with that alkaloid in the preparation of the hydrochloride. (See *Morphina.*) When the solution of the mixed morphine and codeine hydrochlorides is treated with ammonia, the former alkaloid is precipitated, and the codeine, remaining in solution, may be obtained by evaporation and crystallization. It may be purified by treating the crystals with hot ether, which dissolves them and yields the codeine in colorless crystals on spontaneous evaporation. Codeine is the methyl derivative of morphine, as shown in the formula $C_{17}H_{18}(CH_3)NO_3$. It may be formed artificially from morphine by treating this latter successively with methyl iodide and fixed alkali. (Grimaux, 1881, *J. Chem. S.*, 44, 358.) According to a recent German patent, codeine is made synthetically by the following process: Morphine, 285 Gm., and nitrosomethylurethane, 132 Gm., are dissolved in 1 kilo. of methyl alcohol. With the solution is mixed, constantly stirring, a solution made by mixing 50 Gm. of potassium hydroxide in 800 Gm. of methyl alcohol. When the reaction is complete, the methyl alcohol is distilled off, and codeine is extracted from the residue with benzene, from which it afterwards separates in characteristic crystals. (*C. D.*, 1898, 237.)

Properties.—Codeine occurs in "white, or nearly translucent, orthorhombic prisms, octahedral crystals, or a crystalline powder; odorless, and having a faintly bitter taste; slightly efflorescent in warm air. Soluble in 88 parts of water, 1.6 parts of alcohol, 12.5 parts of ether, and 0.66 part of chloroform at 25° C. (77° F.); soluble in 59 parts of water at 80° C. (176° F.), and in 0.92 part of alcohol at 60° C. (140° F.). At 100° C. (212° F.) it loses its water of crystallization, and melts at 154.9° C. (310.8° F.). When heated in an insufficient amount of water for complete solution, it melts to oily drops, which crystallize on cooling. It leaves no residue on incineration. Its aqueous solution is alkaline to litmus paper, and is lævogyrate. Sulphuric acid (free from nitrous compounds) produces either no color or a slight pinkish tint, which disappears within two minutes, but on heating, a violet color is developed. (The presence of nitrous compounds causes a pink color in the cold). Sulphuric acid containing a trace of ferric chloride produces with Codeine a violet-blue color; sulphuric acid heated, with a drop of nitric acid added, gives a blood-red color; sulphuric acid containing a trace of selenous acid produces a green color, changing rapidly to blue, and then slowly back to grass-green (with morphine it gives a blue color, changing to green, and then to brown); sulphuric acid and Codeine develop no color, but on adding a drop of solution of formaldehyde a violet-blue color is produced (morphine giving an intense purple color). On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding 1 drop of ferric chloride T.S., and then 1 Cc. of Codeine solution (1 in 100), no blue color should be produced at once (absence of *morphine*). If 1 drop of a diluted nitric acid solution (1 drop in 200 Cc. of water) be added to a solution of 0.03 Gm. of Codeine in 2 Cc. of sulphuric acid, a bluish-red tint, gradually changing to blue, will be developed. On sprinkling 0.05 Gm. of Codeine upon 2 Cc. of nitric acid (sp. gr. 1.200) the crystals will turn red, but the acid will acquire only a yellow color (difference from, and absence of, *morphine*)." *U. S.* "The alkaloid dissolves in an excess of *sulphuric acid,* forming a colorless solution, a small quantity of which, when gently warmed on a water-bath with 2 drops of *solution of ammonium molybdate,* or with a trace of *ferric chloride* or *potassium ferricyanide,* develops a blue or bluish-black color, which, on the addition of a minute trace of *diluted nitric acid,* changes to a bright scarlet, becoming orange. Heated to redness in air it yields no ash. Moistened with *nitric acid* the liquid becomes yellow but not red. A 2 per cent. solution of Codeine in *water* acidulated with a few drops of *hydrochloric acid* gives a whitish precipitate with *solution of potassium hydroxide,* but not with *solution of ammonia.* A saturated solution of Codeine in *water* acidulated with *hydrochloric acid* should give no blue color, but

[1] APOCODEINE, $C_{18}H_{19}NO_2$.—This alkaloid, discovered in 1869 by Matthiessen and Wright, is made by heating a concentrated solution of zinc chloride with codeine. It is soluble in alcohol, ether, and chloroform; insoluble in water. It gives a reaction similar to that of apomorphine, but is more stable. According to Guinard and Fröhner, apocodeine does not act as an emetic. According to Combemale and Dixon, a moderate dose increases very greatly intestinal peristalsis, and Dixon affirms that the one to two per cent. neutral solution is an efficient laxative in doses of 1 to 2 Cc., when given subcutaneously. As the result of his experiments, Dixon believes that the increase of peristalsis is due to a paralyzing influence on the inhibitory intestinal nerves. He also found that the toxic dose of apocodeine paralyzes the peripheral vasomotor nerves, producing great fall of blood pressure, with, in the beginning, rapid action of the heart, followed by slow pulse, which he believes is due to paralysis of the accelerator nerve endings. The increase of the reflexes in the poisoning, and the strychnine-like convulsions sometimes seen, are attributed by Dixon to an effect on the sensory side of the spinal cord.

Apocodeine hydrochloride has been introduced into commerce as a laxative; it is employed subcutaneously in doses of 2 Cc. of a one per cent. aqueous solution (*P. J.*, 1901, 665).

A second derivative from codeine, isomeric with it in formula, has been obtained by Merck as a by-product in the manufacture of apocodeine, and has received the name of *pseudocodeine.* It differs from codeine in its higher melting point, 182° C. (359.6° F.), and in its property of being instantly precipitated by ammonia, in the form of crystalline needles, not only from cold but likewise from boiling aqueous solutions of its salts. According to Kobert, it resembles codeine in its physiological action.

only gradually a dull green, on the addition of *test-solution of ferric chloride* and a very dilute solution of *potassium ferricyanide* (absence of morphine and other impurities)." *Br.* When added in excess to boiling water, the undissolved portion melts and sinks to the bottom, having the appearance of an oil. It may be separated from morphine by a solution of potassium or sodium hydroxide, which dissolves the morphine and leaves the codeine. It has an alkaline reaction on test paper, and combines with acids to form salts, some of which are crystallizable, particularly the nitrate. Its capacity of saturation is almost identical with that of morphine. According to Robiquet, 1 part of hydrochloric acid is saturated by 7.837 of codeine, and by 7.88 of morphine. It is distinguishable, however, from the latter principle by the different form of the crystals, which are octahedral, by its solubility in boiling ether, greater solubility in water, and insolubility in alkaline solutions, and by not assuming a red color with nitric acid, or a blue one with ferric salts. Tincture of galls precipitates from its solutions a codeine tannate. Crystallized from an aqueous solution, it contains about 6 per cent. of water, which is driven off at 100° C. (212° F.). The crystals obtained from a solution in ether contain no water.

Uses.—Codeine produces in the lower animals marked convulsive symptoms, with heightened reflexes, disturbances of the respiration and rarely tendency to coma. In man the therapeutic dose acts as an uncertain and feeble analgesic and hypnotic, and in large doses may produce marked restlessness. The symptoms of poisoning by it have been vascular excitement, exhilaration, then depression with great anxiety, nausea and vomiting, pale, cool, clammy skin, slight contraction of pupil, and sleeplessness, with slight delirium. In some cases convulsions have been present. In regard to the toxic dose, there is the greatest difference of statement by physicians. Severe poisoning has been reported from the use of four grains, but according to some practitioners five grains have had no effect, and we have frequently given codeine, prepared by Powers and Weightman of Philadelphia, in doses of from six to eight grains without the production of distinct symptoms. It is very evident that commercial codeine has been and probably still is of varying composition, and the results frequently obtained have been produced by adherent alkaloids. Wm. Weightman once informed us that nearly the whole product of their laboratory went to France, where it appeared to be largely used as a calmative drug, free from many of the objections to opium, but in no way comparing with it in power. It has been highly lauded in the treatment of *diabetes mellitus,* and cases of recovery under its use reported. In the grave form of this disorder we have seen it fail to exert any perceptible influence, but the evidence is sufficient to demand a fair trial of the remedy in any individual case. Medical practitioners often use it to quiet *cough,* to allay *intestinal pain,* and to fulfil various other of the minor narcotic indications for which opium is commonly administered. On account of its frequent contamination with morphine, care should be exercised as to the commencing dose, but no effect at all is to be expected, if the alkaloid be pure, from less than one grain (0.06 Gm.), and this dose may be rapidly increased until some symptoms are produced. It may be given in pill or in syrupy solution.

Dose, one half to two grains (0.032 to 0.13 Gm.).

CODEINÆ PHOSPHAS. U. S., Br.

CODEINE PHOSPHATE

(cō-dē-ĭ'næ phŏs'phās)

$C_{18}H_{21}NO_3.H_3PO_4 + 2H_2O = 430.0$

"The phosphate $[PO(OH)_3(C_{17}H_{18}(CH_3)NO_3) + 2H_2O]$ of an alkaloid obtained from Opium, or prepared from morphine by methylation. It should be kept in well-stoppered, amber-colored vials." *U. S.* "The phosphate, $(C_{17}H_{18}(CH_3)NO_3,H_3PO_4)_2,3H_2O$, of an alkaloid obtained from opium or from morphine." *Br.*

Phosphate de Codéine, *Fr.;* Codeïnum phosphoricum, *P. G.;* Kodeinphosphat, Phosphorsaures Kodein, *G.*

This salt is official for the first time in the U. S. and Br. Pharmacopœias; it has been introduced because of its easy solubility and stability; it may be made by dissolving 1 part of codeine in 1.25 parts of 25 per cent. phosphoric acid (the solution should be slightly acid in reaction); sufficient alcohol is added to precipitate the codeine phosphate. On account of its large percentage of codeine (about 70 per cent.) it is well fitted for hypodermic injections. It occurs in "fine, white, needle-shaped crystals, or a crystalline powder, without odor, and having a bitter taste. It frequently crystallizes with one and a half molecules of water of crystallization. Soluble in 2.25 parts of water, 261 parts of alcohol, 1340 parts of ether, and in 6620 parts of chloroform at 25° C. (77° F.); soluble in 0.46 part of water at 80° C. (176° F.), and in 97 parts of alcohol at 60° C. (140° F.). At 100° C. (212° F.) it loses all of its water of crystallization; above 200° C. (392° F.) it becomes darker in color, and at 235° C. (455° F.) melts to a brown liquid, which rapidly volatilizes. Its aqueous solution reddens blue litmus paper. If silver nitrate T.S. be added to its aqueous solution, a yellow precipitate is produced, which is soluble in diluted nitric acid and in ammonia water. Sulphuric acid (free from nitrous compounds) produces either no color or a slight pinkish tint, which disappears within two minutes; sulphuric acid containing a trace of ferric chloride produces a violet-

blue color; sulphuric acid containing a trace of selenous acid gives a green color, changing rapidly to blue, and then slowly back to grass-green (with morphine it gives a blue color, changing to green, and then to brown). Sulphuric acid and a drop of solution of formaldehyde produce a violet-blue color (morphine an intense purple). On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding 1 drop of ferric chloride T.S., and then 1 Cc. of Codeine Phosphate solution (1 in 100), no blue color should be produced at once (absence of *morphine*). If 0.2 Gm. of Codeine Phosphate be dissolved in 5 Cc. of water and 3 Cc. of potassium hydroxide T.S., and the solution shaken out successively with three portions of chloroform (5 Cc. each) the combined chloroformic solutions, evaporated to dryness in a tared dish, should yield not less than 0.13 Gm. of codeine." *U. S.* "White crystals which have a slightly bitter taste. It is soluble in 4 parts of *water*, much less soluble in *alcohol* (90 per cent.). A 5 per cent. aqueous solution has a slightly acid reaction, and yields a whitish precipitate with *solution of potassium hydroxide*, but not with *solution of ammonia*. It affords the reactions characteristic of Codeine and of phosphates. It loses its water of crystallization when dried at 212° F. (100° C.), and at a higher temperature melts, forming a yellowish-brown liquid. It should yield no characteristic reaction with the tests for chlorides or sulphates. It should not be colored blue by *test-solution of ferric chloride* (absence of morphine)." *Br.*

Uses.—The medicinal properties of codeine phosphate are the same as those of codeine.

Dose, one-half to two grains (0.032 to 0.13 Gm.).

Off. Prep.—Syrupus Codeinæ, *Br.*

CODEINÆ SULPHAS. U. S.

CODEINE SULPHATE

(cō-dē-ī'næ sŭl'phăs)

$(C_{18}H_{21}NO_3)_2.H_2SO_4 + 5H_2O = 780.65$

"The sulphate $[SO_2(OH)_2.(C_{17}H_{18}(CH_3)NO_3)_2 + 5H_2O]$ of an alkaloid obtained from Opium, or prepared from morphine by methylation. It should be kept in well-stoppered, amber-colored vials." *U. S.*

Codeïnum sulfuricum; Sulfate de Codéine, *Fr.*; Kodeinsulfat, Schwefelsaures Kodein, *G.*

Preparation.—Codeine sulphate may be made by dissolving codeine in warm water, adding sufficient sulphuric acid to neutralize, evaporating and crystallizing; 16.71 Gm. of sulphuric acid of official strength will be required to neutralize 100 Gm. of codeine.

Properties.—Codeine sulphate is officially described as in "long, glistening, white, needle-shaped crystals, rhombic prisms, or a crystalline powder, effloresceing in the air, odorless, and having a bitter taste. Soluble in about 30 parts of water, and 1035 parts of alcohol at 25° C. (77° F.); insoluble in chloroform and ether; soluble in 6.25 parts of water at 80° C. (176° F.), and in 340 parts of alcohol at 60° C. (140° F.). The salt loses its water of crystallization at 100° C. (212° F.); chars, decomposes, and partially volatilizes above 200° C. (392° F.), without melting; the residue melts at about 278° C. (532.4° F.). Its aqueous solution is neutral to litmus paper. If barium chloride T.S. be added to an aqueous solution of the salt, a white precipitate is produced, which is insoluble in hydrochloric acid. Sulphuric acid (free from nitrous compounds) produces either no color or a slight pinkish tint, which disappears within two minutes, when added to Codeine Sulphate, but on heating, a violet color is produced; sulphuric acid heated, with a drop of nitric acid added, gives a blood-red color; sulphuric acid containing a trace of selenous acid produces a green color, changing rapidly to blue, and then slowly back to grass-green (with morphine sulphate it gives a blue color, changing to green and then to brown); sulphuric acid and Codeine Sulphate give no color, but on adding a drop of solution of formaldehyde, a violet-blue color is produced (morphine sulphate yielding an intense purple color). If 1 drop of a diluted nitric acid solution (1 drop in 200 Cc. of water) be added to 2 Cc. of a solution of 0.1 Gm. of Codeine Sulphate in 6 Cc. of sulphuric acid, a bluish-red tint, gradually changing to blue, will be developed. On dissolving a small crystal of potassium ferricyanide in 10 Cc. of water, adding 1 drop of ferric chloride T.S., and then 1 Cc. of Codeine Sulphate solution (1 in 100), no blue color should be produced at once (absence of *morphine*)." *U. S.*

Uses.—The medicinal properties of this salt are those of the alkaloid codeine.

Dose, one-half to two grains (0.032 to 0.13 Gm.).

COLCHICI CORMUS. U. S., Br.

COLCHICUM CORM [Colchici Radix, Pharm. 1890, Colchicum Root]

(cŏl'çhĭ-cī cŏr'mŭs)

"The dried corm of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding, when assayed by the process given below, not less than 0.35 percent. of colchicine." *U. S.* "The fresh corm of Colchicum autumnale, *Linn.*, collected in early summer; and the same stripped of its coats, sliced transversely, and dried at a temperature not exceeding 150° F. (65.5° C.)." *Br.*

Bulbus s. Tuber Colchici; Meadow-Saffron Root; Bulbe de Colchique, *Fr. Cod.*; Bulbe de Colchique, de Safran bâtard, *Fr.*; Zeitlosenknollen, *G.*; Bulbo di colchico, *It.*; Bulbo de colquico, *Sp.*

COLCHICI SEMEN. U. S. (Br.)

COLCHICUM SEED

(cŏl′çhĭ-cī sē′mĕn)

"The seed of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding, when assayed by the process given below, not less than 0.55 percent. of colchicine." *U. S.* "The dried ripe seeds of Colchicum autumnale, *Linn.*" *Br.*

Colchici Semina, *Br.;* Colchicum Seeds; Semences de Colchique, *Fr. Cod.;* Semence de Colchique, *Fr.;* Semen Colchici, *P. G.;* Zeitlosensamen, *G.;* Semi di colchico, *It.;* Semilla de colquico, *Sp.*

Colchicum autumnale, Willd., *Sp. Plant.* ii. 272; Woodv., *Med. Bot.,* p. 759, t. 258.—This species of Colchicum, often called *meadow saffron,* is a perennial bulbous plant, the leaves of which appear in spring, and the flowers in autumn. Its manner of growth is peculiar, and deserves notice as connected in some measure with its medicinal efficacy. In the latter part of summer, a new bulb, or *corm,* as the part is now called, begins to form at the lateral inferior portion of the old one, which receives the young offshoot in its bosom and embraces it half round. The new plant sends out fibres from its base, and is furnished with a radical spathe, which is cylindrical, tubular, cloven at top on one side, and half under ground. In September, from two to six flowers, of a lilac or pale-purple color, emerge from the spathe, unaccompanied by leaves. The corolla consists of a tube five inches long, concealed for two-thirds of its length in the ground, and of a limb divided into six segments. The flowers perish by the end of October, and the rudiments of the fruit remain under ground until the following spring, when they rise upon a stem above the surface, in the form of a three-lobed three-celled capsule. The leaves of the new plant appear at the same time, so that in fact they follow the flower instead of preceding it, as might be inferred from the order of the seasons in which they respectively show themselves. The leaves are radical, spear-shaped, erect, numerous, about five inches long, and one inch broad at the base. In the meantime, the new corm has been increasing at the expense of the old one, which, having performed its appointed office, perishes; while the former, after attaining its full growth, sends forth shoots, and in its turn decays. The old corm in its second spring, and a little before it perishes, sometimes puts forth one or more small corms, which are the sources of new plants.

C. autumnale is a native of the temperate parts of Europe and of Northern Africa, growing in moist pastures and meadows. Attempts have been made to introduce its culture into this country, but with no great success, though small quantities of the corm, of apparently good quality, have entered commerce. The flowers possess virtues similar to those of the corm and are recognized by the French Codex.

Colchici Cormus.—The medicinal virtue of the corm depends much upon the season at which it is collected. Early in the spring it is too young to have fully developed its peculiar properties, and late in the fall it has become exhausted by the nourishment afforded to the new plant. The proper period for its collection is from the early part of June, when it has usually attained perfection, to the middle of August, when the offset appears.[1] It may be owing, in part, to this inequality at different seasons that entirely opposite reports have been given of its powers. Krapf ate whole corms without inconvenience; Haller found them entirely void of taste and acrimony, and we are told that in Carniola the peasants use them as food with impunity in the autumn. On the other hand, there can be no doubt of its highly irritating and poisonous nature, when fully developed, under ordinary circumstances. Perhaps soil and climate may have some influence in modifying its character.

The corm is often used in the fresh state in the countries where it grows, as it is apt to be injured in drying, unless the process is carefully conducted. The usual plan is to cut the corm, as soon as possible after it has been dug up, into thin transverse slices, which are spread out separately upon paper or perforated trays and dried with a moderate heat. The reason for drying it quickly after removal from the ground is that it otherwise begins to vegetate, and a change in its chemical nature takes place; and such is its retentiveness of life that, if not cut in slices, it is liable to undergo a partial vegetation even during the drying process. Houlton recommends that the corm be stripped of its dry coating, carefully deprived of the bud or young bulb, and then dried whole. It is owing to the high vitality of the bud that the corm is so apt to vegetate. During desiccation there is great loss of weight, 70 per cent. being the average for a number of years in the laboratory of Allen & Hanburys, in London.

Properties.—The recent bulb or corm of *C. autumnale* resembles that of the tulip in shape and size, and is covered with a brown membranous coat. Internally it is solid, white and fleshy, and, when cut transversely, yields, if mature, an acrid milky juice. There is often a small lateral projection from its base, which is the bud for the development of a new plant; this bud is frequently broken off in drying. When dried, and deprived of its external membranous covering, the corm is of an ash-brown color, convex on one side, and somewhat flattened on the other, where it is marked by a

[1] Christison, however, has found the roots collected in April to be more bitter than those gathered in July, and conjectures that the common opinion of their superior efficacy at the latter season may not be well founded. Schroff states, as the result of his observation, that the autumnal root is much stronger than that dug in the summer. (See *A. J. P.,* xxix. 324.)

deep groove extending from the base to the summit. As found in commerce, it is always in the dried state, sometimes in segments made by vertical sections of the bulb, but generally in transverse circular slices, about the eighth or tenth of an inch in thickness, with a notch at one part of their circumference. "Ovoid, somewhat compressed laterally, and with a groove on one side, or more commonly in transverse, reniform, or longitudinal, ovate slices; externally brownish and finely wrinkled; internally whitish, with numerous circular groups of fibrovascular bundles, giving the surfaces of the transverse sections a papillose appearance; fracture short, mealy; odor slight; taste sweetish, bitter, and somewhat acrid." *U. S.* The cut surface is white and of an amylaceous aspect. Examined with the microscope, the corm is seen to be composed of large irregular cells, full of ovoid, angular, sometimes compound, starch grains, and interspersed with spiral vessels in vascular bundles. The odor of the recent corm is said to be hircine. It is diminished, but not lost, by drying. The taste is bitter, hot, and acrid. Wine and vinegar extract all its virtues.

Colchicum corm contains the alkaloid *colchicine*, $C_{22}H_{25}NO_6$, which was made official in the U. S. P. (8th Rev.); see *Colchicina*. Colchicine is the active principle and as much as 0.4 per cent. is found in good specimens of the corm; the official requirement is that not less than 0.35 per cent. shall be present, to be determined by the following assay:

Assay of Colchicum Corm. U. S. (8th Rev.)—"Colchicum Corm, in No. 60 powder, *ten grammes;* Ether, Chloroform, Alcohol, Ammonia Water, Distilled Water, each, *a sufficient quantity*. Introduce the Colchicum Corm into a 200 Cc. Erlenmeyer flask, and add to it 100 Cc. of a mixture of 77 Cc. of ether, 25 Cc. of chloroform, 8 Cc. of alcohol, and 3 Cc. of ammonia water, insert the stopper securely, and macerate, with frequent shaking, for twelve hours (or preferably for four hours in a mechanical shaker). Filter a sufficient quantity of the liquid into a measuring cylinder until 50 Cc. of filtrate (representing 5 Gm. of Colchicum Corm) have been obtained; then transfer this to a beaker or dish, and evaporate it nearly to dryness by applying a gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether has evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the combined aqueous solutions well for one minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a beaker, and again shake out the aqueous liquid successively with three portions of 10 Cc. each of chloroform, collecting these solutions in the beaker. Evaporate the chloroform completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in 5 Cc. of ether, add 5 Cc. of water, and stir the liquid for a few seconds. Then evaporate the ether on a water-bath containing warm water, and filter the remaining aqueous liquid through a small wetted filter into a separator, washing the dish and filter with 5 Cc. of water, and adding the washings to the separator. Shake out the aqueous liquid with 15 Cc. of chloroform, and when the liquids have separated, draw off the chloroform into a tared flask. Repeat the shaking out successively with three portions of 10 Cc. of chloroform and add each to the tared flask. Evaporate the chloroform completely, dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight, after cooling, remains constant. The weight of the residue multiplied by 20 gives the percentage of colchicine in the Colchicum Corm." *U. S.*

A. T. Thompson states that the milky juice of fresh colchicum produces a fine blue color if rubbed with the tincture of guaiac, and that the same effect is obtained from an acetic solution of the dried corm. He considered the appearance of this color, when the slices were rubbed with a little distilled vinegar and tincture of guaiac, a proof that the drug was good and had been well dried. J. M. Maclagan has shown that this change of color is produced with the albumen, which is not affected if previously coagulated; so that the value of the test consists simply in proving that the drying has not been effected at a heat above 180° F., or the temperature at which albumen coagulates. A very deep or large notch in the circumference of the slices is an unfavorable sign, as it indicates that the bulb has been somewhat exhausted in the nourishment of the offset. The decoction yields a deep blue precipitate with solution of iodine, white precipitates with lead acetate and subacetate, mercurous nitrate, and silver nitrate, and a slight precipitate with tincture of galls. The value of colchicum is best tested by its bitterness. For method of assaying colchicum, by K. Schwickerath, see *Ph. Rund.*, 1893, 282. Important improvements have been made in the assay by Bredemann. (*Ap. Ztg.*, 1903, 18, Nos. 93, 94, 95.)

Colchici Semen.—The seeds of the meadow-saffron ripen in summer, and should be collected about the end of July or beginning of August. They never arrive at maturity in plants cultivated in a dry soil or in confined gardens. (Williams.) They are nearly spherical, about the eighth of an inch in diameter, of a reddish-brown color externally, white within, and of a bitter acrid taste. "Subglobular, about 2 Mm. in diameter, very slightly pointed at the hilum; externally reddish-brown, finely pitted; internally whitish;

tough and of almost bony hardness; nearly inodorous; taste bitter and somewhat acrid." *U. S.* They are chiefly composed of a gray horny albumen, constituted of very thick-walled cells, and surrounded by a closely adherent testa. The leafless embryo is very small, and is situated close to the surface opposite the strophiole. Williams of Ipswich, England, first brought them into notice in 1820 as superior to the corm. Schroff, however, has found that their activity is inferior to that of the dried corm dug in autumn (*A. J. P.*, xxix. 324). A wine, fluidextract, and tincture of the seeds are directed in the U. S. Pharmacopœia. Their dose is slightly less than that of the similar preparations made from the corm.

The U. S. Pharmacopœia (8th Rev.) directs that colchicum seed should contain not less than 0.55 per cent. of colchicine, to be determined by the following process:

Assay of Colchicum Seed. U. S. (8th Rev.) "Colchicum Seed, in No. 60 powder, *ten grammes;* Ether, Chloroform, Alcohol, Ammonia Water, Distilled Water, each, *a sufficient quantity.* Introduce the Colchicum Seed into a 200 Cc. Erlenmeyer flask, and add to it 100 Cc. of a mixture of 77 Cc. of ether, 25 Cc. of chloroform, 8 Cc. of alcohol, and 3 Cc. of ammonia water, insert the stopper securely, and macerate, with frequent shaking, for twelve hours (or preferably for four hours in a mechanical shaker). Filter a sufficient quantity of the liquid into a measuring cylinder until 50 Cc. of filtrate (representing 5 Gm. of Colchicum Seed) have been obtained; then transfer this to a beaker or dish, and evaporate it nearly to dryness by applying a very gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether has evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the combined aqueous solutions well for one minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a tared flask, and again shake out the aqueous liquid successively with three portions of 10 Cc. each of chloroform, collecting these solutions in the tared flask. Evaporate the chloroform completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve the residue in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.) until the weight, after cooling, remains constant. The weight of the residue multiplied by 20 gives the percentage of colchicine in the Colchicum Seed." *U. S.*

Uses.—When taken internally in therapeutic dose, colchicum usually produces no other symptoms than intestinal pains and looseness of the bowels. In some rare cases it is said to give rise to copious diuresis or diaphoresis instead of purging. When larger amounts are exhibited, the purging is more pronounced, and there may be also vomiting. With these symptoms there may be some depression, which seems to be due to the gastro-intestinal irritation rather than to the direct action of the poison. In an overdose, it may produce dangerous and even fatal effects. Excessive nausea and vomiting, abdominal pains, purging and tenesmus, great thirst, sinking of the pulse, coldness of the extremities, and general prostration, with occasional symptoms of nervous derangement, such as headache, delirium, and stupor, are among the results of its poisonous action. A peculiarity of its influence is that when its dose is increased beyond a certain point there is not a corresponding increase in the rapidity of the fatal issue. This is probably because it kills not by a direct influence upon the heart or the nervous system, but by causing gastro-enteritis. On post-mortem examination the alimentary mucous membrane is found much inflamed.

Colchicum was well known to the ancients as a poison, and is said to have been employed by them as a remedy in gout and other diseases. Störck revived its use among the moderns. He gave it as a diuretic and expectorant in *dropsy* and humoral *asthma,* and on the continent of Europe it acquired considerable reputation in these complaints, but the uncertainty of its operation led to its general abandonment, and it had fallen into almost entire neglect, when Want of London, again brought it into notice by attempting to prove its identity with the active ingredient of the *eau médicinale d'Husson,* so highly celebrated as a cure for gout. In James's Dispensatory, printed in 1747, it is said to be used in gout as an external application. The chief employment of the meadow-saffron is at present in the treatment of *gout;* its action has been attributed to a power of increasing uric acid elimination, but the testimony of investigators is so contradictory that no positive conclusion can be drawn, although the probabilities are that it has no effect on the elimination of uric acid.

In preparing colchicum pharmaceutically, if it be desired to retain the colchicine unchanged, both acids and alkalies should be avoided, especially when heat is employed. Of the official preparations, the fluidextract contains the colchicine as in nature; the acetic extract has a portion at least of colchicine in its composition. In the wines, when kept, the colchicine probably passes gradually into colchiceine. But it has not been proved that these latter preparations are in any degree less efficacious remedially, and, in the absence of all experience to the contrary, the inference is that colchiceine may have all the powers of colchicine, for the acetic extract, and the wines after being long kept, have often been used in practice, without having been found less effectual than other preparations of colchicum.

Dose, of the dried corm and seed, from two to eight grains (0.13 to 0.52 Gm.), which may be repeated every four or six hours until its effects are obtained.

Off. Prep.—*Colchicum corm,* Extractum Colchici Cormi, *U. S.* (*Br.*); Vinum Colchici, *Br.*

Off. Prep.—*Colchicum seed,* Fluidextractum Colchici Seminis, *U. S.*; Tinctura Colchici Seminis, *U. S.* (*Br.*); Vinum Colchici Seminis, *U. S.* (from fluidextract).

COLCHICINA. U. S.

COLCHICINE

(cŏl-çhĭ-cī'nȧ)

$C_{22}H_{25}NO_6 = 396.23$

"An alkaloid obtained from Colchicum. It should be kept in dark amber-colored, well-stoppered vials." *U. S.*

Colchicine, *Fr.*; Colchicin, *G.*

The alkaloid *colchicine,* whose nature was first precisely made out by Geiger and Hesse, has been the subject of much controversy, for an account of which the reader is referred to the seventeenth edition of the U. S. Dispensatory, page 427, foot-note. It is now recognized to be the *methyl ester* of *acetyl-trimethyl colchicinic acid,* and has the formula $C_{22}H_{25}NO_6$. When colchicine is heated with 3 parts of hydrochloric acid for two hours on the water bath, it is decomposed, with the formation of *colchicinic acid,* $C_{16}H_{15}NO_5$, and *dimethyl colchicinic acid,* $C_{18}H_{19}NO_5$. When colchicine is boiled with water containing sulphuric acid, it is decomposed thus:

$$C_{22}H_{25}NO_6 + H_2O = C_{21}H_{23}NO_6 + CH_3OH$$

the products formed being *colchiceine* and methyl alcohol. The colchiceine is formed so readily that some of the reactions commonly attributed to colchicine itself are probably due to its decomposition product. Colchiceine, which is *aceto-trimethyl colchicinic acid,* can also be made synthetically by heating *trimethyl colchicinic acid* with acetic anhydride to 100° C. Colchicine has also been built up synthetically from colchiceine, sodium methylate, and methyl iodide, which are heated together to 100° C. (Johanny, Zeisel, *Monatshefte,* 9, 868.) Colchicine is soluble in water and alcohol, also in chloroform, benzene, and amyl alcohol. Dragendorff describes it as soluble in ether, but Zeisel as scarcely so. Insoluble in petroleum benzin. It is colored yellow with concentrated sulphuric acid, and blue, turning to brown and yellow, with nitric acid. It forms precipitates with the usual alkaloidal reagents.

Properties.—The U. S. Pharm. (8th Rev.) officially describes colchicine as in "pale yellow leaflets, or a pale yellow, amorphous powder, turning darker on exposure to light, having an odor suggesting damp hay, and a very bitter taste. Soluble in 22 parts of water, 155 parts of ether, and in 87 parts of benzene at 25° C. (77° F.); soluble in 20 parts of water at 80° C. (176° F.); very soluble in alcohol and chloroform; insoluble in petroleum benzin. After drying over sulphuric acid, it melts if heated to 142.5° C. (288.5° F.). It leaves no residue upon incineration. Its aqueous solution is neutral to litmus paper, lævogyrate, and of a yellow color, which is intensified by mineral acids. With Colchicine, sulphuric acid produces a citron-yellow color, which, upon adding a drop of nitric acid, changes to greenish-blue, then to red, and finally to yellow. On adding an excess of potassium hydroxide, the color is changed to red. Ferric chloride T.S., on being added to an aqueous solution of Colchicine, gives no color, but on heating, a brownish-red color is developed, which changes to brownish-black; if ferric chloride T.S. be added to an alcoholic solution of Colchicine, a garnet-red color is at once produced. To 5 drops of an aqueous Colchicine solution, add 5 drops of fuming nitric acid, 5 drops of ferric chloride T.S., and then heat to boiling, when a yellow solution will be formed, changing to olive-green. When cool, shake the liquid with a little chloroform, when the latter will turn ruby-red, and the aqueous solution will remain green. Sulphuric acid containing a fragment of potassium dichromate gives a greenish-blue color, changing to orange." *U. S.*

Uses.—The alkaloid *colchicine* acts like colchicum, according to Maret and Combemale, in doses of one-twelfth of a grain (0.005 Gm.) producing violent diarrhœa, with diminished urinary secretion; in doses of one-thirty-second of a grain (0.002 Gm.) causing some abdominal disturbance, with increased diuresis. According to J. Sprega, three grains (0.2 Gm.), repeated in three hours, caused violent gastro-enteritis, ending in death in thirty-one hours. (*Gazz. d. Ospitali,* Oct. 1890.) *Colchicine salicylate* is a yellow amorphous powder, soluble in water, alcohol, and ether, the dose being one-hundredth of a grain (0.0006 Gm.) every four hours.

Dose, one-hundred and fiftieth to one-hundredth of a grain (0.0004 to 0.0006 Gm.).

COLLODIUM. U. S., Br.

COLLODION

(cọl-lō'dĭ-ŭm)

Collodion, *Fr. Cod.*; Collodium, *P. G.*; Kollodium, *G.*; Collodio, *It.*; Colodion, *Sp.*

* "Pyroxylin, *forty grammes* [or 1 ounce av., 180 grains]; Ether, *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims]; Alcohol, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]. To the Pyroxylin, contained in a suitable bottle, add the Ether, and allow it to stand for fifteen minutes; then add the Alcohol, and shake the bottle until the Pyroxylin is dissolved. Cork the bottle well, and set it aside

until the liquid has become clear. Finally, decant the clear portion from any sediment which may have deposited, and transfer it to bottles, which should be well corked and sealed. Keep the Collodion in a cool place, remote from lights or fire." *U. S.* "Pyroxylin, 1 *ounce* (Imperial) or 10 grammes; Ether, 36 *fl. ounces* (Imp. meas.) or 360 cubic centimetres; Alcohol (90 per cent.), 12 *fl. ounces* (Imp. meas.) or 120 cubic centimetres. Mix the Ether and the Alcohol; add the Pyroxylin; set aside for a few days; should there be any sediment, decant the clear Collodion." *Br.*

Collodion is a solution of gun cotton. On account of the facility with which ether evaporates, it is the better menstruum for remedial purposes, but gun cotton will not dissolve in that liquid when quite pure, and the addition of strong alcohol is necessary. Formerly the U. S. Pharmacopœia directed that the gun cotton be prepared at the time of making the collodion, giving directions for the purpose, but at the revision of 1870 the process of the British Pharmacopœia was substantially adopted, a formula for the preparation of pyroxylin being given separately in the Pharmacopœia. A process for the preparation of pyroxylin was not introduced into the U. S. Pharmacopœia (8th Rev.), but the British Pharmacopœia still retains a process (see *Pyroxylinum.*) A change has been made, however, in directing the collodion to be decanted from the sediment. In the U. S. P. 1870 the sediment was directed to be re-incorporated with the clear collodion, and the result was the making of a tougher film. This sediment consists of undecomposed filaments of cotton, and these become partially felted as the ethereal liquid evaporates and the film is forming; this direction of the former Pharmacopœia was usually disregarded, although for many purposes the cloudy film is to be preferred.

Acetone has been used as a solvent for pyroxylin and collodion so prepared is on the market.

Properties.—Collodion is a transparent, colorless liquid, of a syrupy consistence and an ethereal odor. When applied to a dry surface, the ether quickly evaporates, and a transparent film is left, having remarkable adhesiveness and contractility. On account of the great volatility of ether, collodion must be kept in bottles well stoppered. When insecurely kept, the liquid thickens and becomes less fit for the use of the surgeon. The thickened liquid sometimes contains acicular crystals. The addition of a mixture of 3 volumes of ether and 1 volume of alcohol will generally restore the collodion to its original condition.

Uses.—Collodion was first applied to the purposes of surgery by J. Parker Maynard[1] of Boston, when a student of medicine, in January, 1847, although, as pointed out by Kahlbaum, Schoenbein, the discoverer of gun cotton, suggested the surgical use of an ethereal solution in 1846 (*Nat. Drug.*, 1902, 8). It is employed for holding together the edges of incised *wounds*, for covering *ulcers*, abraded or diseased surfaces, *chilblains*, *chapped nipples*, etc., with an impervious film not acted upon by water, and for encasing parts which require to be kept without relative motion. It is applied brushed over the part, or by means of strips of muslin. In whatever way applied, the solvent quickly evaporates, and leaves the solid adhesive material, which is soluble neither in water nor in alcohol. The rigid film thus formed contracts with a good deal of force. This property adapts collodion for certain purposes, such as drawing together the edges of wounds, exciting pressure on buboes, etc. When, however, the surgeon desires simply to protect a surface, a flexible, non-contracting film is preferable, and the official flexible collodion should be used. Collodion has been variously medicated, and thus made the vehicle of several important medicines for external application. *Iodized collodion* has been proposed by C. Fleming, for the purpose of obtaining the specific effects of iodine in a rapid manner, especially on *tumors*. It is made by dissolving from ten to twenty grains of iodine in a fluidounce of collodion. Aran has proposed a *ferruginous collodion*, made of equal parts of collodion and tincture of ferric chloride; as a remedy in *erysipelas*. A *caustic collodion* may be prepared by dissolving 4 parts of corrosive sublimate in 30 of collodion. Macke of Sorau, has used this preparation for destroying *nævi materni*. The eschar formed is one or two lines in thickness, and separates in from three to six days, leaving but a trifling cicatrix. (See *A. J. P.*, May, 1858, for formulas in which collodion is made the vehicle of iodine, belladonna, sulphur, etc.) All these medicated collodions are best applied by means of a camel's-hair brush.[2]

[1] Maynard recommended the following formula. Take of sulphuric acid of sp. gr. 1.850 *two parts*, and of nitric acid of sp. gr. 1.450 *one part*. Mix them, and, having permitted the heat to fall to about 100° F., add raw cotton to saturation. Let it macerate for one or two hours; then pour off the acids, wash the cotton till the washings cease to affect litmus paper, and dry thoroughly. The gummy matter thus formed is now to be dissolved in ether of the sp. gr. about .750, or in a mixture of three parts of pure ether and one part of alcohol of 95 per cent. Two ounces of cotton will make about a pint of collodion. (*B. M. S. J.*, 1866, p. 39.)

[2] *Pavesi's Styptic Collodion.*—Collodion, 100 parts; phenol, 10 parts; pure tannin, 5 parts; benzoic acid, 3 parts. Agitate till thoroughly mixed. On evaporation it leaves a brown pellicle, adhering strongly to tissues, and effecting instant coagulation of the blood and albumin.

Belladonna Collodion (*Collodium Belladonnæ*).—Mix 10 fluidounces each of fluidextract of belladonna leaves and ether, and set aside for 12 hours. Decant and dissolve therein 130 grains camphor, 183 grains pyroxylin, 365 grains Canada balsam, 183 grains castor oil. (Naylor.)

Iodoform Collodion is made, according to Moleschott, by dissolving 1 part of iodoform, in fine powder, in 15 parts of flexible collodion. It is recommended for relieving pain caused by gout, and for *orchitis*, *pericarditis*, etc.

Corn Collodion (*Gezow's*) may be made by dissolving 8 grains of extract of Indian hemp in 30 minims of strong alcohol and adding this to a solu-

Off. Prep.—Collodium Flexile, *U. S., Br.;* Collodium Stypticum, *U. S.;* Collodium Cantharidatum, *U. S.* (from flexible collodion).

COLLODIUM CANTHARIDATUM. U. S. (Br.)

CANTHARIDAL COLLODION [Blistering Collodion]

(cŏl-lō′dĭ-ŭm cạn-thăr-ị-dā′tŭm)

Collodium Vesicans, *Br.;* Blistering Collodion; Collodium Cantharidale, s. Vesicans; Collodion vésicant (cantharidé), *Fr.;* Collodium Cantharidatum, *P. G.;* Spanischfliegen-Kollodium, Blasenziehendes Collodium, *G.*

* " Cantharides, in No. 60 powder, *sixty grammes* [or 2 ounces av., 51 grains]; Flexible Collodion, *eighty-five grammes* [or 3 ounces av.]; Chloroform, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Pack the Cantharides firmly in a cylindrical percolator and gradually pour Chloroform upon it until the powder is exhausted. Recover the Chloroform by distillation from a water-bath and evaporate the residue in a tared evaporating dish on a water-bath, until it weighs *fifteen grammes* [or 231 grains]. Dissolve this in the Flexible Collodion, and set it aside in a securely corked bottle, and in a cool place, to become clear by settling. Finally, pour off the clear portion from any sediment which may have deposited, and transfer it to bottles, which should be well corked and sealed. Keep the Cantharidal Collodion in a cool place, remote from lights or fire." *U. S.*

" Blistering Liquid, 20 *fl. ounces* (Imperial measure) or 200 cubic centimetres; Pyroxylin, ½ *ounce* (Imp.) or 5 grammes. Add the Pyroxylin to the Blistering Liquid in a stoppered bottle; shake them together until the Pyroxylin is dissolved." *Br.*

The official process does not differ materially from that of the U. S. P. 1890. Chloroform is used to extract the cantharidin from the powdered cantharides, by percolation; the chloroform is afterwards recovered by distillation, and the oily residue containing the vesicant is dissolved in the collodion. The efficiency of chloroform as a solvent of cantharidin was demonstrated by Procter. The original process of Ilisch was to exhaust, by percolation, a pound of cantharides, with a mixture consisting of a pound of ether and three ounces of acetic ether, and in two ounces of this liquid to dissolve 25 grains of gun cotton. Procter stated that it had been found more advantageous to exhaust the flies with ether, distil off the ether, and mix the oily residue with collodion already prepared of the proper consistence (*A. J. P.,* xxiv. 303); but at the present time owing to the cheapness of chloroform and its advantage over the very inflammable and dangerous ether the official process is greatly preferred. Charles S. Rand (*A. J. P.,* xxii. 18) states that Ilisch's preparation, made with double the proportion of ether, vesicates equally well, and proposes the addition of about 1 per cent. of Venice turpentine, which he has found to prevent the disagreeable and sometimes painful contraction of the collodion upon drying. The preparation may be kept indefinitely, without change, in an opaque glass stoppered bottle, but on exposure to the light, the greenish coloring matter of the flies bleaches, and the liquid becomes yellowish. *Cantharidized collodion* may be made from cantharidin by dissolving four grains of cantharidin in one thousand grains of flexible collodion.

Cantharidal collodion is a very convenient epispastic remedy. It may be applied to the surface by means of a camel's-hair brush, and after the evaporation of the ether, which takes place in less than a minute, may be reapplied if the surface should not be well covered. It produces a blister in about the same time as the ordinary cerate, and has the advantages that it is applied with greater facility, is better adapted to cover uneven surfaces, and retains its place more certainly. According to Rand, if the evaporation of the ether be restrained by a piece of oiled silk immediately after its application, it will act much more speedily.

COLLODIUM FLEXILE. U. S., Br.

FLEXIBLE COLLODION

(cŏl-lō′dĭ-ŭm flĕx′ị-lē)

Collodion élastique, *Fr.;* Collodium elasticum, *P. G.;* Elastisches Collodium, Kollodium, *G.;* Collodio elastico, *It.;* Colodion elastico, *Sp.*

* " Collodion, *nine hundred and twenty grammes* [or 32 ounces av., 198 grains]; Canada Turpentine, *fifty grammes* [or 1 ounce av., 334 grains]; Castor Oil, *thirty grammes* [or 1 ounce av., 25 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Weigh the ingredients, successively, into a tared bottle, and mix them thoroughly. Keep the product in cork-stoppered bottles, in a cool place, remote from lights or fire." *U. S.*

" Collodion, 12 *fl. ounces* (Imperial measure) or 480 cubic centimetres; Canada Turpentine, ½ *ounce* (Imp.) or 20 grammes; Castor oil, ¼ *ounce* (Imp.) or 10 grammes. Mix." *Br.*

The contractility of the collodion film has long been felt as a drawback to its use simply for the purposes of protection. C. S. Rand of Philadelphia, proposed to obviate this by dissolving one part of gun cotton and three of Venice turpentine in twenty parts of ether. To give more flexibility to the film, Sourisseau of Kaiserberg, suggested the addition of one part of elemi to twelve of collodion. According to Startin of London, opacity and elasticity may be imparted at the same time by adding from half a drachm to a drachm of lard, or

tion of 45 grains of salicylic acid in 300 minims of flexible collodion. This is applied with a camel's-hair brush.

Benzoinated collodion (*Collodium Benzoinatum*) is made by mixing 60 Cc. of compound tincture of benzoin, with 5 Cc. of glycerin and 120 Cc. of collodion.

Croton Oil Collodion may be made by mixing equal weights of croton oil and flexible collodion. (*Report on Revision of U. S. Pharm., A. Ph. A.,* 1880.)

some similar fatty matter, previously dissolved in ether, to an ounce of collodion. The qualities of softness and elasticity may also be given by combining collodion with castor oil, in the proportion of thirty parts to two, agreeably to the plan of Guersant, who found it useful, thus modified, in erysipelas; and the proportion of castor oil may be increased if thought desirable. This is the method preferred by the French Codex. An elastic collodion, somewhat similar, in which, besides castor oil, Venice turpentine and white wax are ingredients, has been proposed by E. Lauras. (*P. J.*, xii. 303.) According to Cap and Garot, the most successful way for obtaining an elastic collodion is to mix two parts of glycerin with one hundred of collodion. *Glycerized collodion* is exceedingly supple, does not crack and scale off from the skin, and accommodates itself to the motions of the part. In order to imitate the color of the skin, an ethereal tincture of turmeric or saffron may be added, so as to produce the desired tint. Meller has proposed a solution of shellac in highly rectified alcohol, so as to have a gelatinous consistence, as a substitute for collodion. Of all these plans, probably that followed in the official directions is the best. Tournie recommends, in superficial *cervical adenitis* with redness, painting the part with several layers of flexible collodion every two days. (*M. T. G.*, 1874, p. 540.)

Off. Prep.—Collodium Cantharidatum, *U. S.*

COLLODIUM STYPTICUM. U. S.

STYPTIC COLLODION

(cọl-lō′dĭ-ŭm stўp′tĭ-cŭm)

Collodium Hæmostaticum, Styptic Colloid, Xylostyptic Ether; Collodion styptique, Collodion au tannin, *Fr.*; Tannin-Kollodium, *G.*

* "Tannic Acid, *twenty grammes* [or 308.6 grains]; Alcohol, *five cubic centimeters* [or 81 minims]; Ether, *twenty-five cubic centimeters* [or 406 minims]; Collodion, *a sufficient quantity*, to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Introduce the Tannic Acid, Alcohol and Ether into a graduated bottle, agitate the mixture until the Tannic Acid is thoroughly incorporated and partially dissolved, then add enough Collodion to make up the volume to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], and shake occasionally, until the Tannic Acid is completely dissolved. Keep the product in cork-stoppered bottles, in a cool place, remote from lights or fire." *U. S.*

This collodion is a modification of the *styptic colloid* of B. W. Richardson of London (*P. J.*, 1867, p. 29), a preparation which has had considerable use, particularly in hospitals. Experience has shown, however, that Richardson's formula contained too little tannin; the quantity has been increased in the U. S. process to 20 per cent., but this is more than will usually dissolve. The manipulation in the official formula might be improved by directing the tannic acid to be rubbed into a smooth paste in a mortar with sufficient alcohol, before introducing into the bottle. This would enable the pharmacist to prepare it extemporaneously. When applied on wounded or abraded surfaces, it soon loses the ether and alcohol, and a firm coating is left, in which, besides the tannin and colloidal substance, are the coagulated blood and secretions from the surface, forming a covering for the part by which the air is excluded. The liquid is applied with a camel's-hair brush, or by means of cotton saturated with it, to the edges of wounds closed by stitches, to ulcerated surfaces and bleeding parts. If it be desired to make a special impression on the diseased surface, phenol, creosote, iodine, morphine, etc., may be incorporated with the styptic fluid.[1]

COLOCYNTHIS. U. S. (Br.)

COLOCYNTH [Bitter Apple]

(cŏl-ọ-cўn′thĭs)

"The peeled dried fruit of *Citrullus Colocynthis* Schrader (Fam. *Cucurbitaceæ*)." *U. S.* "The dried pulp of the fruit of Citrullus Colocynthis, *Schrad.*, freed from seeds." *Br.*

Colocynthidis Pulpa, *Br.*, Colocynth Pulp, Bitter Gourd, Apple, or Cucumber, Poma Colocynthidis; Coloquinte, *Fr. Cod.*; Pulpe de Coloquinte, *Fr.*; Fructus Colocynthidis, *P. G.*; Coloquintenapfel, Koloquintenmark, Koloquinten, *G.*; Coloquintide, *It.*; Coloquintida, *Sp.*

Citrullus Colocynthis (L.), Schrad., Engler and Prantl. *Cucumis Colocynthis*, Willd., *Sp. Plant.* iv. 611; Woodv., *Med. Bot.*, 189, t. 71. The *bitter cucumber* is an annual plant, bearing considerable resemblance to the common watermelon. The stems, which are herbaceous and beset with rough hairs, trail upon the ground, or rise upon neighboring bodies, to which they attach themselves by their numerous tendrils. The leaves, which stand alternately on long petioles, are triangular, many-cleft, variously sinuated; obtuse, hairy, of a fine green color on the upper surface, rough and pale on the under. The flowers are yellow, and appear singly at the axils of the leaves. The fruit is a globular pepo, of the size of a small orange, yellow and smooth when ripe, and contains, within a hard, coriaceous rind, a white, spongy pulp, enclosing numerous ovate, compressed, white or brownish seeds.

The plant is a native of Turkey, and abounds in the islands of the Archipelago. It grows also in various parts of Africa and Asia. Burckhardt, in his travels across Nubia, found the country covered with it; Thunberg met

[1] *Carbolized Styptic Colloid.*—In this preparation advantage is taken of the antiseptic and styptic properties of phenol, and a very effective hæmostatic results. It is made by adding ten per cent. of phenol to official styptic collodion.

with it at the Cape of Good Hope, and Ainslie says that it grows in many parts of Lower India, particularly in sandy places near the sea. It is said to be cultivated in Spain, the island of Cyprus, Morocco and in the neighboring countries, and even to have been collected in Japan. Colocynth from the maritime plain between the mountains of Palestine and the Mediterranean is chiefly shipped from Jaffa, and is known as *Turkish colocynth.* It is said to be of superior quality. The fruit is gathered in autumn, when it begins to become yellow, and, having been peeled, is dried quickly in a stove or in the sunshine. Thus prepared, it is imported from the Levant. Small quantities are said to be imported into England from Mogador in the form of brown, unpeeled globular gourds. The so-called *Persian colocynth* of the London markets is very small, and has apparently been compressed in a fresh state, so that the position of the seeds is perceptible through the dry pulp. The microscopic structure and the proportion of the pulp to the seed appear to be the same as in other colocynths. (*P. J.*, xvi. 107.) Colocynth has been grown in New Mexico, but, according to Sayre, the American colocynth possesses only about two-thirds the cathartic action of the Trieste variety.

Properties.—As found in commerce, colocynth is in the shape of whitish balls about the size of an orange, very light and spongy, and abounding in seeds which constitute three-fourths of their weight. The seeds are somewhat bitter, but possess little activity, and, according to Captain Lyon, are even used as food in the north of Africa.[1] When the medicine is prepared for use, they are separated and rejected, the pulpy or medullary matter only being employed. This has a very feeble odor, and a nauseous and intensely bitter taste. The U. S. Pharmacopœia thus describes colocynth: "Globular, from 5 to 10 Cm. in diameter, white or yellowish-white, light, spongy, separable longitudinally into three carpels, each containing near the outer surface numerous ovoid, compressed, whitish or light brown seeds; odor slight; taste intensely bitter. The seeds should be separated and rejected." *U. S.* "It should not yield the characteristic reactions with the tests for starch, and only traces of fixed oil should be removed from it by *ether.* It yields, when dried at 212° F. (100° C.) and incinerated, at least 9 per cent. of ash (indicating absence of seeds)." *Br.* Barclay considers the estimation of ash in powdered colocynth useful in proving its freedom from seeds. The pulp yields from 8.6 to 14 per cent. of ash, the seeds from 2 to 4 per cent., the whole apple 4.6 per cent. (*Am. Drug.*, 1896, 152.) Water and alcohol extract the virtues of colocynth. It is a matter of importance to be able to determine whether the drug miller who usually powders colocynth is careful to reject the seeds. If the seeds have been ground with the dried pulp, the microscope will show the presence of numerous albuminous granules derived from the cotyledons. (W. T. Clark, *P. J.*, vii. 509.) These are best found by putting a small amount of the powder on the glass slide, adding a drop of water, and gently rubbing the cover glass over it; fragments of the double-walled embryo sac show on the outer side elongated, more or less hexagonal, thin-walled cells, and on the inner side irregular, tabular, thick-walled cells. If powdered colocynth contains a large number of starch granules it has probably been adulterated. Vauquelin obtained the bitter principle of colocynth in a separate state, and called it *colocynthin.* According to Meissner, 100 parts of the dry pulp of colocynth contain 14.4 parts of colocynthin, 10.0 of extractive, 4.2 of fixed oil, 13.2 of a resinous substance insoluble in ether, 9.5 of gum, 3.0 of pectic acid (pectin), 17.6 of gummy extract derived from the lignin by means of potassium hydroxide, 2.7 of calcium phosphate, 3.0 of magnesium phosphate, and 19.0 of lignin, besides water.[2] Colocynthin is obtained by boiling the pulp in water, evaporating the decoction, treating the extract thus procured with alcohol, evaporating the alcoholic solution, and submitting the residue, which consists of the bitter principle and potassium acetate, to the action of a little cold water, which dissolves the latter and leaves the greater part of the former untouched. Bastick obtained it by exhausting the pulp with cold water, heating the solution to ebullition, adding lead subacetate so long as a precipitate was produced, filtering the liquor when cold, adding diluted sulphuric acid gradually until it no longer occasioned a precipitate, boiling to expel free acetic acid, filtering to separate lead sulphate, evaporating cautiously nearly to dryness, extracting the colocynthin from the residue by strong alcohol, which left the salts, and finally evaporating the alcoholic solution.

The following process, employed by Walz, yields it in a purer state. Colocynth is exhausted by alcohol of sp. gr. 0.84, the tincture evaporated to dryness, the residue treated with water, and the solution precipitated first with lead acetate and afterwards with lead subacetate. The yellow filtered liquor is then treated with hydrogen sulphide to separate the lead,

[1] Nachtigal confirms this statement of Captain Lyon's, but with the qualification that, before being eaten, the seeds are deprived of their coating by some mechanical means, and the kernels are heated to the boiling point, then washed with cold water, dried, and powdered. Flückiger found a bitter principle in the testa, which accounts for its rejection as food, though rendering improper the rejection of the seed in preparing the extract. He found in the kernels about 45 per cent. of fixed oil and 18 per cent. of albumen. (*A. J. P.*, 1872, 538.)

[2] Walz supposed that he had found another peculiar principle, *colocynthitin.* It was obtained by treating with ether the alcoholic extract previously exhausted by water, decolorizing the ethereal solution with animal charcoal, evaporating to dryness, and dissolving the residue in anhydrous alcohol, which deposited it in crystals on spontaneous evaporation. It is white and tasteless, and is probably a resin. (*N. Jahrbuch der Pharm.*, xvi. 10.)

and, after filtration, with solution of tannic acid, which throws down a compound of tannic acid and colocynthin. This is dissolved in alcohol, the tannin thrown down by lead subacetate, the excess of lead separated, and the liquid digested with animal charcoal, filtered, and evaporated. The residue, washed with anhydrous ether, is pure colocynthin. This is yellowish, somewhat translucent, brittle and friable, fusible by a heat below 100° C. (212°F.), inflammable, more soluble in alcohol than in water, but capable of rendering the latter intensely bitter. Mouchon states that it is insoluble in ether. It is neither acid nor alkaline; but its aqueous solution gives with infusion of galls a copious white precipitate. Its formula, according to Walz, is $C_{56}H_{42}O_{23}$. Upon the same authority it is a glucoside, being resolved by the action of sulphuric acid into sugar and a peculiar resinous substance termed *colocyntheïn,* to which he gives the formula $C_{44}H_{32}O_{13}$. Henke doubts the probability of colocynthin being a glucoside, and states that it is uncrystallizable; he reviews the methods of previous investigators, and obtained by his own process but 0.66 per cent. of colocynthin. (*A. Pharm.,* 1883, p. 200; *A. J. P.,* 1883, p. 301.) According to Johannson, colocynthin, when heated with diluted sulphuric acid, yields colocyntheïn, elaterin, and bryonin. (*A. J. P.,* 1885, p. 451.)[1] An infusion of colocynth, made with boiling water, gelatinizes upon cooling. Neumann obtained from 768 parts of the pulp, treated first with alcohol and then with water, 168 parts of alcoholic and 216 of aqueous extract. (See also paper by George Wagner, *Proc. A. Ph. A.,* 1893, 179.)

Uses.—The pulp of colocynth is a powerful drastic, hydragogue cathartic, producing, when given in large doses, violent griping, and sometimes bloody discharges, with dangerous inflammation of the bowels. Death has resulted from a teaspoonful and a half of the powder. (Christison.) Even in moderate doses it sometimes acts with much harshness, and it is therefore seldom prescribed alone. By some writers it is said to be diuretic. It was frequently employed by the ancient Greeks and the Arabians, though its drastic nature was not unknown to them. Among the moderns it is occasionally used in obstinate dropsy, and in various affections depending on disordered action of the brain. In combination with other cathartics it loses much of its violence, but retains its purgative energy, and in this form is extensively employed. The compound extract of colocynth is a favorite preparation with many practitioners, and, combined with calomel, extract of jalap, and gamboge, it forms a highly efficient and safe cathartic, especially useful in congestion of the portal circle and torpidity of the liver. (See *Pilulæ Catharticæ Compositæ.*) It is best administered in minute division, effected by trituration with gum or farinaceous matter. The active principle has sometimes been employed, and, in the impure state in which it is prepared by the process of Emile Mouchon, may be given in the dose of a grain (0.065 Gm.).

Thunberg states that the fruit of *C. Colocynthis,* at the Cape of Good Hope, is rendered so mild by being properly pickled that it is eaten both by the natives and by the colonists; but, as it is thus employed before attaining perfect maturity, it is possible that the drastic principle may not have been developed.

Dose, one to five grains (0.065 to 0.32 Gm.).

Off. Prep.—Extractum Colocynthidis, *U. S.;* Extractum Colocynthidis Compositum, *U. S.* (from extract), *Br.;* Pilula Colocynthidis Composita, *Br.;* Pilula Colocynthidis et Hyoscyami, *Br.* (from compound pill).

CONFECTIO PIPERIS. Br.

CONFECTION OF PEPPER

(cŏn-fĕc'tĭ-ō pĭp'ĕ-rĭs)

Electuarium Piperis; Electuaire de Poivre, *Fr.;* Pfefferlatwerge, *G.*

"Black Pepper, in fine powder, 2 *ounces* (Imperial) or 40 grammes; Caraway Fruit, in fine powder, 3 *ounces* (Imp.) or 60 grammes; Clarified Honey, 15 *ounces* (Imp.) or 300 grammes. Mix." *Br.* This preparation was intended as a substitute for *Ward's Paste,* which acquired some reputation in Great Britain as a remedy in piles and ulcers of the rectum. To be of service, it must be continued, according to Brodie, for two, three, or four months. Its stimulating properties render it inapplicable to cases attended with much inflammation.

Dose, from one to two drachms (3.9 to 7.7 Gm.), repeated two or three times a day.

CONFECTIO ROSÆ. U. S. (Br.)

CONFECTION OF ROSE

(cŏn-fĕc'tĭ-ō rō'zæ)

Confectio Rosæ Gallicæ, *Br.;* Confection of Roses; Conserva Rosarum; Conserve de Rose, *Fr. Cod.;* Conserve de Rose rouge, *Fr.;* Rosen-Conserve, *G.*

* "Red Rose, in No. 60 powder, *eighty grammes* [or 2 ounces av., 360 grains]; Sugar, in fine powder, *six hundred and forty grammes* [or 22 ounces av., 252 grains]; Clarified Honey, *one hundred and twenty grammes* [or 4 ounces av., 102 grains]; Stronger Rose Water, *one hundred and sixty cubic centimeters* [or 5 fluidounces, 197 minims], to make about *one thousand grammes* [or 35 ounces av., 120

[1] According to Ernst Johannson (*In. Dis.,* Dorpat, 1884) colocynthin can readily be found in the alvine discharges and in the body, after poisoning by it, by the following test: $\frac{1}{10}$ milligramme will give with concentrated sulphuric acid a reddish-yellow color, deepening into red; Froehde's reagent strikes with $\frac{1}{10}$ milligramme a cherry-red color; one part of ammonium vanadanate in 200 parts of concentrated sulphuric acid makes with $\frac{1}{10}$ milligramme a blood-red spot surrounded by a bluish tint; alcohol with sulphuric acid strikes a yellow color, not altered by warming; selenosulphuric acid $(H_2Se_3)SO$ does the same; basic lead acetate and tannic acid precipitate by weak solutions.

grains]. Rub the Red Rose with the Stronger Rose Water previously heated to 65° C. (149° F.), then gradually add the Sugar and Clarified Honey, and beat the whole together until a uniform mass results." *U. S.*

"Fresh Red-Rose Petals, *one pound* (Imperial) or 500 grammes; Refined Sugar, *three pounds* (Imp.) or 1500 grammes. Beat together in a stone mortar." *Br.*

This preparation does not differ from that formerly official.

In the British process the unblown petals only are used, and these should be deprived of their claws; in other words, the rose-buds should be cut off a short distance above their base, and the lower portion rejected. In the last four editions of the U. S. Pharmacopœia, dried roses have been substituted for the fresh, as the latter are not brought to our market. The process is very similar to that of the French Codex. We have been informed, however, that confection of rose is still made in Philadelphia on a large scale from the fresh petals of the hundred-leaved rose and others, by beating them into a pulp with sugar, as in the British process. An excuse for this deviation from the official formula is, that the confection thus made has greater adhesiveness than the official, and is therefore better fitted for the formation of pills. Confection of Rose is slightly astringent, but is used almost exclusively as a vehicle, or to impart consistence to the pilular mass.

CONFECTIO SENNÆ. U. S., Br.

CONFECTION OF SENNA

(con-fĕc'tĭ-ō sĕn'næ)

Electuarium Sennæ Compositum. Electuarium Lenitivum; Electuaire de Séné composé, *Fr. Cod.*; Electuaire lenitif, *Fr.*; Electuarium e Senna, *P. G.*; Sennalatwerge, *G.*; Elettuario lenitivo, *It.*

* "Senna, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Cassia Fistula, bruised, *one hundred and sixty grammes* [or 5 ounces av., 282 grains]; Tamarind, *one hundred grammes* [or 3 ounces av., 231 grains]; Prune, sliced, *seventy grammes* [or 2 ounces av., 205 grains]; Fig, bruised, *one hundred and twenty grammes* [or 4 ounces av., 102 grains]; Sugar, in fine powder, *five hundred and fifty-five grammes* [or 19 ounces av., 252 grains]; Oil of Coriander, *five grammes* [or 77 grains]; Water, *a sufficient quantity*, to make *one thousand grammes* [or 35 ounces av., 120 grains]. Digest the Cassia Fistula, Tamarind, Prune and Fig with *five hundred cubic centimeters* [or 17 fluidounces] of Water in a covered vessel, by means of a water-bath, for three hours. Separate the coarser portions and rub the pulpy mass, first through a coarse hair sieve, and then through a muslin cloth. Mix the residue with *one hundred and fifty cubic centimeters* [or 5 fluidounces] of Water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy mass first obtained. Then, by means of a water-bath, dissolve the Sugar in the pulpy liquid, and evaporate the whole in a tared vessel, until it weighs *eight hundred and ninety-five grammes* [or 31 ounces av., 250 grains]. Lastly, add the Senna and the Oil of Coriander, and incorporate them thoroughly with the other ingredients while they are yet warm." *U. S.*

"Senna, in fine powder, 7 *ounces* (Imperial) or 140 grammes; Coriander Fruit, in fine powder, 3 *ounces* (Imp.) or 60 grammes; Figs, 12 *ounces* (Imp.) or 240 grammes; Tamarinds, 9 *ounces* (Imp.) or 180 grammes; Cassia Pulp, 9 *ounces* (Imp.) or 180 grammes; Prunes, 6 *ounces* (Imp.) or 120 grammes; Extract of Liquorice, 1 *ounce* (Imp.) or 20 grammes; Refined Sugar, 30 *ounces* (Imp.) or 600 grammes; Distilled Water, *a sufficient quantity*. Boil the Figs and Prunes gently with *twenty-four ounces* (Imp.) or four hundred and eighty grammes of Distilled Water in a covered vessel for four hours; add more Distilled Water to make up the quantity to its original volume, and then incorporate the Tamarinds and Cassia Pulp; digest for two hours; rub the softened pulp of the fruits through a hair sieve, rejecting the seeds and other hard parts; to the pulp thus obtained add the Refined Sugar and Extract of Liquorice, dissolving them by the aid of gentle heat; while the mixture is still warm, add to it gradually the mixed Senna and Coriander powders; mix the whole thoroughly; make the weight of the resulting Confection *seventy-five ounces* (Imp.) or fifteen hundred grammes, either by evaporation or by the addition of more Distilled Water." *Br.*

Confection of Senna, when correctly made, is an elegant preparation, and keeps well if properly protected. The present U. S. process differs from that of 1860 in preparing the pulps, as suggested in former editions of this Dispensatory, instead of taking them already prepared. The present preparation contains about 10 per cent. more sugar than that official in 1880. An improvement was made in the process of the U. S. P. 1890 by replacing the coriander seed of the former Pharmacopœias with oil of coriander; it is almost impossible to powder coriander fine enough to avoid hard particles except by drying it to such an extent as to deprive it injuriously of its volatile oil, and the plan of using the oil directly has therefore been adopted. The oil of coriander should be dropped upon a portion of the powdered senna contained in a mortar or suitable vessel and this lightly triturated with the rest of the powdered senna so as to distribute it uniformly; the mixture should then be added to the pulpy mass and the official directions then carried out. It was formerly not uncommon to omit the cassia pulp in this preparation, as the pods were not always to be found in the market; but, as this is next to senna the most active ingredient, the omission was to be regretted. Cassia fistula is now readily procured in commerce, and there can be no excuse for its omission. It has also been proposed to substitute

the fluidextract of senna for the crude drug (*A. J. P.*, xliii. 123); but, as the fluidextract is of such uncertain quality, the leaves themselves are preferable.

A very good, pleasant laxative, admirably adapted to cases of habitual costiveness, especially in pregnant women, and in persons affected with *piles*.

Dose, one to two drachms (3.9 to 7.7 Gm.), at bedtime.

CONFECTIO SULPHURIS. Br.

CONFECTION OF SULPHUR

(cŏn-fĕc'tĭ-ō sŭl'phŭ-rĭs)

Electuarium Sulphuris; Electuaire de Soufre, *Fr.*; Schwefellatwerge, *G.*

"Sublimed Sulphur, 4 *ounces* (Imperial) or 100 grammes; Acid Potassium Tartrate, in powder, 1 *ounce* (Imp.) or 25 grammes; Tragacanth, in powder, 18 *grains* (Imp.) or 1 gramme; Syrup, 2 *fl. ounces* (Imp. meas.) or 50 cubic centimetres; Tincture of Orange, ½ *fl. ounce* (Imp. meas.) or 12.5 cubic centimetres; Glycerin, 1½ *fl. ounces* (Imp. meas.) or 37.5 cubic centimetres. Mix." *Br.*

This is merely a mode of administering the two laxatives, sulphur and potassium bitartrate, and the relative proportion of the latter is so small that it can have little effect. The addition of tragacanth is due to a suggestion of Peter Boa, who found that without it a syrupy layer of liquid formed on top of the confection. (*P. J.*, 1882, 682.) The syrup of orange peel, formerly directed, has been replaced in the Br. Pharm. (1898) by syrup and tincture of orange, evidently because the syrup of orange peel did not keep well, while the glycerin serves to retain the proper consistence of the confection.

Dose, one to two drachms (3.9 to 7.7 Gm.) or more.

CONFECTIONES.

CONFECTIONS

(cŏn-fĕc-tĭ-ō'nēs)

Electuaries; Conserves, Électuaires, Saccharolés mous, *Fr.*; Conserven, Latwergen, *G.*; Elettuario, *It.*; Electuario, *Sp.*

Under the general title of Confections, the Pharmacopœias include all those preparations having the form of a soft solid, in which one or more medicinal substances are incorporated with saccharine matter, with a view either to their preservation or more convenient administration. But two confections have been retained in the Eighth Revision of the U. S. Pharmacopœia. The old division into Conserves and Electuaries has been abandoned; but, as there is some ground for the distinction, we shall make a few general remarks upon each division before proceeding to the consideration of the individual preparations.

Conserves consist of undried vegetable substances and refined sugar beaten into a uniform mass. By means of the sugar, the vegetable matter is enabled to resist for some time the decomposition to which it would otherwise be exposed in the undried state, and the properties of the recent plant are thus retained to a certain extent unaltered. But, as active medicines even thus treated undergo some change, and those which lose their virtues by desiccation cannot be long preserved, the few conserves now used are intended rather as convenient vehicles of other substances than for separate exhibition. The sugar used in their preparation should be in fine powder.

Electuaries are mixtures consisting of medicinal substances, especially dry powders, combined with syrup or honey, in order to render them less unpleasant to the taste, and more convenient for internal use. They are usually prepared extemporaneously; and it is only when their complex nature renders it convenient to keep them ready made, or some peculiarity in the mode of mixing the ingredients requires attention, that they become proper objects for official direction. Their consistence should not be so soft, on the one hand, as to allow the ingredients to separate, nor so firm, on the other, as to prevent them from being swallowed without mastication. Different substances require different proportions of syrup. Light vegetable powders usually require twice their weight, gum-resins two-thirds of their weight, resins somewhat less, mineral substances about half their weight, and deliquescent salts not more than one-tenth. Should the electuary be found, after having been kept for a short time, to swell up and emit gas, it should be beaten over again in a mortar, so that any portion of the sugar which may have crystallized may be again accurately incorporated with the other ingredients. Should it, on the contrary, become dry and hard from the mutual reaction of its constitutents, more syrup should be added, so as to give it the requisite consistence. If the dryness result from the mere evaporation of the aqueous part, water should be added instead of syrup, and the same remark is applicable to the conserves. To prevent the hardening of electuaries, the French writers recommend the use of syrup prepared from brown sugar, which is less apt to crystallize than that made from the refined. Molasses would answer the same purpose, but its taste might be objectionable. Some employ honey, but this is not always acceptable to the stomach. Glycerin and syrupy glucose might sometimes be used with advantage.[1]

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[1] *Confectio Aromatica, Aromatic Confection,* Electuarium Aromaticum; Electuaire (Confection) aromatique, *Fr.*; Aromatische Latwerge, Getwürzlatwerge, *G.*—"Take of Aromatic Powder *four troyounces;* Clarified Honey *four troyounces,* or a *sufficient quantity.* Rub the Aromatic Powder with Clarified Honey until a uniform mass of the proper consistence is obtained." *U. S.* 1870. This confection affords a convenient means of administering the spices contained in it, and an agreeable vehicle for

CONII FOLIA. Br.

HEMLOCK LEAVES

(cǫ-nī'ī fō'lī-ą)

"The fresh leaves and young branches of Conium maculatum, *Linn.*, collected when the fruit begins to form." *Br.*

Poison Hemlock, Spotted Hemlock or Parsley, Fool's Parsley, St. Bennett's Herb, Spotted Cowbane; Hemlock Leaves; Herba Cicutæ Majoris; Ciguë officinale, ou Grande Ciguë (Feuille), *Fr. Cod.*; Feuilles de grande Ciguë, *Fr.*; Herba Conii, *P. G.*; Schierlingskraut, Schierlingsblätter, Schierling, Gefleckter Schierling, *G.*; Foglie di cicuta maggiore, *It.*; Cicuta major, *Sp.*

(See *Conium.*)

CONIUM. U. S. (Br.)

CONIUM [Poison Hemlock]

(cǫ-nī'ŭm)

"The full-grown, but unripe fruit of *Conium maculatum* Linné (Fam. *Umbelliferæ*), carefully dried and preserved, and yielding, when assayed by the process given below, not less than 0.5 percent. of coniine. After being kept for more than two years, Conium is unfit for use." *U. S.* "The dried, full-grown, unripe fruits of Conium maculatum, *Linn.*" *Br.*

Conii Fructus, *Br.*, Hemlock Fruit, Conium Seed; Ciguë ordinaire, Grande Ciguë (Fruit), *Fr. Cod.*; Gefleckter Schierling, Schierlingsfrüchte, *G.*; Frutti di cicuta maggiore, *It.*; Fruto di cicuta, *Sp.*

Conium maculatum, Willd., *Sp. Plant.* i. 1395; Bigelow, *Am. Med. Bot.*, i. 113; Woodv., *Med. Bot.*, p. 104, t. 42.—This is an umbelliferous plant, having a biennial spindle-shaped whitish root, and an herbaceous branching stem, from three to six feet high, round, hollow, smooth, shining, slightly striated, and marked with brownish-purple spots. The lower leaves are tripinnate, more than a foot in length, shining, and attached to the joints of the stem by sheathing petioles; the upper are smaller, bipinnate, and inserted at the division of the branches; both have channelled footstalks, and incised leaflets, which are deep green on their upper surface and paler beneath. The flowers are very small, white, and disposed in compound terminal umbels. The general involucre consists of from three to seven lanceolate, reflected leaflets, whitish at their edges; the partial involucre of three or four leaflets, oval, pointed, spreading, and on one side only. There are five petals, cordate, with their points inflected, and nearly equal. The stamens are spreading, and about as long as the corolla; the styles diverging. The fruit, commonly called seed, is roundish-ovate, a line and a half or rather less in length by a line in breadth, striated, and composed of two plano-convex, easily separable parts, which have on their outer surface five crenated ribs separated by slightly wrinkled furrows. On cross section the absence of oil ducts becomes apparent, and a deep furrow upon the commissural face of the albumen gives a reniform appearance. As kept in the shops, the mericarps are usually separated. They are thus officially described: "Broadly ovoid, greenish-gray, the two carpels of most of the fruits separated, each about 3 Mm. long and about 1.5 Mm. in diameter, ovoid, somewhat curved, the inner, flattened side marked by a deep longitudinal groove, the outer, convex side with five pale yellow, somewhat crenate ribs, the intervening surfaces wrinkled but otherwise smooth; pericarp without oil-tubes; odor slight, but when triturated with a solution of potassium hydroxide, strong, disagreeable, and mouse-like; taste characteristic, disagreeable, afterwards somewhat acrid." *U. S.*

Conium is a native of Europe, and has become naturalized in the United States, where it is also cultivated for medicinal purposes. It grows usually in clusters along the roadsides or in waste grounds, and is found most abundantly near old settlements. It flowers in June and July. The whole plant, especially at this period, exhales a fetid odor, compared by some to that of mice, by others to that of the urine of cats, and narcotic effects result from breathing for a long time air loaded with the effluvia. The plant varies in narcotic power according to the weather and climate, being most active in hot and dry seasons and in warm countries. The hemlock of Greece, Italy, and Spain is said to be much more energetic than that of the north of Europe. As a rule, those plants are most active which grow in a sunny exposure. The term *cicuta*, which has often been applied to this plant, belongs to a different genus. The leaves and fruit are official in the British Pharmacopœia while the fruit alone is official in the U. S. Pharmacopœia. The proper season for gathering the leaves is when the plant is in flower, and Fothergill asserts, from experiment, that they are most active about the time that the flowers begin to fade. The footstalks[1] should be rejected, and the leaflets quickly dried, either in the hot sun, or on

other medicines. The confection is given in debilitated states of the stomach. The dose is from ten to sixty grains (0.65 to 3.9 Gm.).

Confectio Aurantii Corticis, Confection of Orange Peel, Conserva Aurantii; Conserve d'Ecorce d'Orange, *Fr.*; Apfelsinenschalen-Conserve, *G.*—"Take of Sweet Orange Peel, recently separated from the fruit by grating, *twelve troyounces;* Sugar [refined] *thirty-six troyounces.* Beat the Orange Peel with the Sugar, gradually added, until they are thoroughly mixed." *U. S.* 1870. This confection is not used as frequently as it deserves to be. It is, when well made, a grateful aromatic vehicle or adjuvant for tonic and purgative powders.

Confectio Opii, Confection of Opium, which was the modern substitute for the mediæval preparations known as *theriaca* and *mithridate*, has been finally dropped from both Pharmacopœias. One grain of opium was contained in about thirty-six grains of the former United States confection, and in about forty grains of the British. The following is the U. S. Pharmacopœia (1870) formula: "Take of Opium, in fine powder, *two hundred and seventy grains;* Aromatic Powder *six troyounces;* Clarified Honey *fourteen troyounces.* Rub the Opium with the Aromatic Powder, then add the Honey, and beat the whole together until thoroughly mixed." *U. S.* 1870.

[1] Manlius Smith of Manlius, N. Y., has demonstrated that the footstalks are almost destitute of the active alkaline principle. (*Ann. Thér.*, 1873, p. 39.)

tin plates before a fire, or by a stove-heat not exceeding 120° F. They should be kept in boxes or tin cases, excluded from the air and light, by exposure to which they lose their fine green color and become deteriorated. The same end is answered by pulverizing them, and preserving the powder in opaque and well stoppered bottles. But little reliance can be placed on the dried leaves, as, even when possessed of a strong odor and a fine green color, they may be destitute of the narcotic principle. When rubbed with potassium hydroxide they should exhale the odor of coniine. The fruit retains its activity much longer than the leaves. Christison found them to have sustained no diminution of power after having been kept eight years. Hirtz inferred from experiment that extract of the seeds was ten times stronger than that of the leaves. Commercial conium occasionally contains other umbelliferous plants, or it may be almost wholly composed of such plants, and even anise has been used as an adulterant to the fruit. The presence of such impurities is to be recognized by physical examination.

Properties.—The dried leaves of the hemlock have a strong, heavy, narcotic odor, less disagreeable than that of the recent plant. Their taste is bitterish and nauseous; their color a dark green, which is retained in the powder. A slight degree of acrimony possessed by the fresh leaves is said to be dissipated by drying. The seeds have a yellowish-gray color, a feeble odor, and a bitterish taste. Their form has already been described. Water distilled from the fresh leaves has the odor of hemlock, and a nauseous taste, but does not produce narcotic effects. The decoction has little taste, and the extract resulting from its evaporation is nearly inert. From these facts it is inferable that the active principle, as it exists in the plant, is not volatile at 100° C. (212° F.) and, if soluble in water, is injured by a boiling heat. Alcohol and ether take up the narcotic properties of the leaves, and the ethereal extract, which is of a rich dark green color, is stated by A. T. Thompson to have the odor and taste of the plant in perfection, and in the dose of half a grain to produce headache and vertigo. Upon destructive distillation, the leaves yield a very poisonous empyreumatic oil. Geiger was the first who obtained the active principle in a separate state, and proved it to be alkaline. It appears that there are two volatile substances in hemlock; one of them an *oil,* which is in very small quantity, and is obtained by simple distillation; the other, the volatile alkaloid *coniine,* or *conine,* which is the active principle. As it exists in the plant in combination with an acid, it is not readily volatilized, but it freely comes over with the distillate when an alkali has been previously added. The acid of conium Peschier believed to be peculiar, and named *coniic acid.* Other observers assert that it is *malic acid.* Geiger obtained coniine by the following process. He distilled fresh hemlock with potassium hydroxide and water, neutralized with sulphuric acid the alkaline liquid which came over, evaporated this liquid to the consistence of syrup, added anhydrous alcohol so long as a precipitate of ammonium sulphate was afforded, separated this salt by filtration, distilled off the alcohol, mixed the residue with a strong solution of potassium hydroxide, and distilled anew. The coniine passed over with the water, from which it separated, floating on the surface in the form of a yellowish oil. According to Christison, an easier process is to distil cautiously a mixture of a strong solution of potassium hydroxide and the alcoholic extract of the unripe fruit. J. Schorm suggests an improvement in the process, which yields a purer coniine, in *Ber. d. Chem. Ges.,* 1881, 1765; also *N. R.,* Dec. 1881. As obtained by the above process, coniine is in the state of an hydroxide, containing one-fourth of its weight of water and a little ammonia. From the former it may be freed by calcium chloride; from the latter, by exposing it under an exhausted receiver until it ceases to emit bubbles of gas.

The fresh leaves or seeds should be employed in the preparation of coniine, as the alkaloid undergoes decomposition by time and exposure. The seeds contain most of this principle; but even in these it exists in very small proportion. From 6 pounds of the fresh and 9 of the dried seeds, Geiger obtained about an ounce of coniine, while from 100 pounds of the fresh herb only a drachm, and from the dried leaves none. Christison recommends the full grown fruit while yet green, and states that 8 pounds will yield half an ounce of coniine hydroxide, and contain much more. In relation to the relative strength of different parts of the plant, Manlius Smith of New York, gives as the result of a series of carefully conducted experiments that the unripe fruit of the conium is far preferable to the dried leaves, and is even stronger than the full grown fruit, that it may be dried without serious injury, and that a very active preparation may be made from it. He also found that full grown fruit collected in August, and dried in the dark, retained its activity unimpaired for several years. This would appear to contradict in some measure previous opinions of the injurious effects of time. (*P. J.,* Feb. 1869, 491–2.) Farr and Wright (*P. J.,* 1896, 273) confirm the views of Harley and Manlius Smith, and affirm that green fruits are alone reliable. The volatility and tendency to undergo decomposition of coniine probably has its effect even in the dried unripe seed, otherwise it is difficult to explain the fact that in thirteen analyses of commercial conium fruit made by Farr and Wright, the average alkaloidal contents were 0.674; while the average of sixteen analyses of samples collected by themselves was 2.13. (*P. J.,* Feb., 1904.) For a method of assaying conium fruit, by Schwickerath, see *Ph. Rec.,* 1893, 282. The U. S. P. (8th Rev.) adopted the following

assay process, requiring that conium should yield not less than 0.5 per cent. of coniine.

Assay. U. S. (8th Rev.).—"Conium, in No. 60 powder, *ten grammes*, Ether, Alcohol, Ammonia Water, Normal Sulphuric Acid V.S., Sodium Carbonate T.S., Distilled Water, Hydrochloric Acid Solution (5 percent. HCl), each, *a sufficient quantity*. Place the Conium in a 200 Cc. Erlenmeyer flask, add 100 Cc. of a mixture of ether 98 parts, alcohol 8 parts, and ammonia water 3 parts (by volume), insert the stopper securely, and shake the flask at intervals during four hours. After the powder has settled, decant 50 Cc. of the clear liquid into a beaker (representing 5 Gm. of Conium), and add sufficient normal sulphuric acid V.S. to produce a distinctly acid reaction. Evaporate the ether at a gentle heat by the aid of a water-bath; then add 15 Cc. of alcohol, and set the beaker aside in a cool place for two hours to allow the ammonium sulphate to deposit. Filter the liquid; wash the residue and filter with a little alcohol, and add the washings to the filtrate; neutralize any excessive amount of acid with sodium carbonate T.S., being careful to retain a slight acidity. Concentrate the liquid to 3 Cc. by the aid of a gentle heat on a water-bath, add 3 Cc. of distilled water and 2 drops of normal sulphuric acid V.S. Add 15 Cc. of ether to remove traces of fatty matter, pour off the ether-solution and repeat the washing with 15 Cc. of ether. Then transfer the acid liquid to a separator, introduce a small piece of red litmus paper, and add sufficient sodium carbonate T.S. to render the liquid slightly alkaline; then shake out with successive portions of 15, 15, and 10 Cc. of ether. To the combined ether-solutions in a tared beaker, add, drop by drop, sufficient hydrochloric acid solution (5 percent.) to insure an excess of acid, and then evaporate the ether by a gentle heat on a water-bath. Remove the excess of hydrochloric acid by adding to the residue 3 Cc. of alcohol and heating gently to evaporate the liquid, repeat this operation once, and dry the residue at a temperature not exceeding 60° C. (140° F.) until the weight, after cooling in a desiccator, remains constant. The weight of the residue multiplied by 0.777, and this product by 20, gives the percentage of coniine contained in the Conium." *U. S.*

Coniine, $C_8H_{17}N$, has been thoroughly studied by Hofmann (1881), who established the correct formula as given, instead of $C_8H_{15}N$, as it was formerly assumed, and Ladenburg (1886), effected its synthesis from *allyl pyridine* by reduction with sodium in alcoholic solution:

$$C_5H_4(C_3H_5)N + 8H = C_5H_{10}(C_3H_7)N$$

This reaction gives *a-normal propyl piperidine*, which is optically inactive, but by the crystallization of its tartrate splits into *coniine* (dextro-rotatory) and a very similar lævo-rotatory coniine, just as racemic acid splits into dextro-rotatory and lævo-rotatory tartaric acid.

Coniine is in the form of a yellowish oily liquid, of sp. gr. 0.862, of a very acrid taste, and a strong penetrating odor, compared to that of the urine of mice, and recalling the odor of fresh hemlock, though not identical with it. In volatility it resembles the essential oils, readily rising with the vapor of boiling water, but when unmixed requiring for ebullition a temperature of 166° C. (330.8° F.). It is freely soluble in alcohol, ether, and the fixed and volatile oils, and slightly so in water. It unites with about one-fourth of its weight of water to form a hydroxide. It reddens turmeric, and neutralizes the acids, forming with them soluble salts, some of which are crystallizable. With tannic acid it forms an insoluble compound. Like ammonia, it occasions a white cloud when approached by a rod moistened with hydrochloric acid; and the resulting hydrochloride is crystallizable, and not in the least deliquescent. The hydrochloride may also be obtained as a brilliant crystalline mass by dissolving coniine in anhydrous ether and passing dry hydrochloric acid gas through the solution. The salt is very soluble in water and alcohol, but insoluble in ether. It can be heated to 90° C. without decomposition, and melts at 218° C. Coniine coagulates albumin, and precipitates the salts of aluminum, copper, zinc, manganese, and iron. It also precipitates silver nitrate, but in excess redissolves the precipitate. Most of its salts are decomposed by evaporation. When exposed to the air, it speedily assumes a deep brown color, and is ultimately converted into a resinous matter, and into ammonia, which escapes. Under the influence of heat this change takes place with much greater rapidity. The presence of coniine may be detected in an extract or other preparation of hemlock by rubbing it with potassium hydroxide, which instantly develops its peculiar odor.[1] It is a most energetic poison.

In association with coniine in the hemlock are found also the following bases: *Ethyl-piperidine*, $C_7H_{15}N$ or $C_5H_{10}(C_2H_5)N$; *Methyl-coniine*, $C_9H_{19}N$ or $C_5H_9(C_3H_7)N(CH_3)$; *Conhydrine*, $C_8H_{17}NO$ or $C_5H_9(CHOH.CH_2CH_3)NH$; *Pseudo-conhydrine*, $C_8H_{17}NO$ or $C_5H_9(CH_3.CH_2OH.CH)NH$; Methyl-coniine, first obtained by Kekulé and von Planta in commercial coniine, is of minor importance.

Conhydrine is crystallizable, fusible below 100° C. (212° F.), and volatilizable at a higher temperature, diffusing the peculiar odor of

[1] Orfila gives the following additional chemical characters of coniine. Heated in a porcelain dish, it forms white vapors *having a strong odor of celery and of the urine of mice.* Weak tincture of iodine gives a white precipitate, becoming olive with excess of the tincture. *Pure concentrated sulphuric acid does not alter it;* but when the mixture is heated, it becomes first brown, then blood-red, and finally black. *Nitric acid imparts a topaz color*, not changed by heat. Platinum and gold chlorides give yellow precipitates, and corrosive sublimate a white one. Potassium permanganate is immediately decolorized. *Neutral lead acetate gives no precipitate*, nor does the subacetate. The parts of this note in italics indicate the means of distinguishing this alkaloid from nicotine. (See *P. J.*, xi. 89.)

coniine, or one very much like it. Water dissolves it considerably, ether and alcohol freely; and the solution has a strong alkaline reaction. Its formula is given as $C_8H_{17}NO$. By the action of P_2O_5 or fuming hydrochloric acid upon conhydrine is obtained *coniceine,* $C_8H_{15}N$, and water. It may be separated from coniine by exposing the mixed alkaloids to a freezing mixture, expressing, and then repeatedly crystallizing from ether. (*Gmelin,* xiii. 169.) E. Merck obtained a small quantity of a new alkaloid from the high boiling portion of crude coniine. The isolation was accomplished by fractional distillation *in vacuo* and recrystallization. The alkaloid crystallizes in needles, is easily soluble in water, alcohol, ether, benzene, and chloroform, fuses at about 98° C., and boils at 230° to 232° C. According to Ladenburg, the alkaloid is an isomer of conhydrine, having the formula $C_8H_{17}NO$, and for this reason the name *pseudo-conhydrine* was selected. (*Chem. Cb.,* 1891, 414; see also *P. J.,* 1891, 1170.)

Paraconiine.—Coniine was supposed to have been artificially produced by Hugo Schiff. From the reaction of *butyric aldehyde* with an alcoholic solution of ammonia, he obtained two bases, one of which, *dibutyraldine,* yielded, on distillation, first a neutral oily substance, and afterwards a strong alkaline base, which proved to have the physiological properties of natural coniine, but was optically inactive, while true coniine is dextro-rotatory. Since the change in the formula of true coniine it will be seen that the base *paraconiine,* which is $C_8H_{15}N$, is not even isomeric with coniine.

Uses.—Hemlock is supposed to be the narcotic used by the Athenians to destroy the life of condemned individuals, and by which Socrates and Phocion died. It was also used by the ancients as a medicine, but fell into entire neglect until Störck employed and extravagantly praised it. Though fatal to some animals, hemlock is eaten with impunity by others, as horses, goats, and sheep. Anodyne, soporific, antispasmodic, antaphrodisiac, deobstruent, and diuretic properties have been ascribed to it, but it possesses none of them.

Modern research has, however, greatly limited the use of the medicine, rendering its possession of alterative properties extremely doubtful. When taken internally in sufficient dose it produces very profound muscular weakness, associated, it may be, with vertigo and disordered vision. After toxic doses the muscular prostration is extreme, the eyelids droop from weakness, the voice is suppressed, the pupils dilated, the sight almost lost; consciousness is usually preserved to the last, and life finally is extinguished without a struggle. In some cases there have been convulsive movements, and violent cardiac palpitation has been noted. The chief action of the poison is upon the motor nerves, which it paralyzes; the efferent or sensitive nerves are also affected, but to a much less extent. Conium probably exerts no direct influence upon the cerebral centres, but there is some reason for believing that it is a spinal depressant. At present conium is rarely employed by the general practitioner, except in spasmodic affections, such as *chorea* and *whooping cough.* Probably the most frequent use of it is by alienists for the production of calm in cases of *maniacal excitement.*

The juice of the fresh leaves of conium is much used in England, but the fluidextract of the U. S. Pharmacopœia, made from the fruit, is the best of all preparations. The powdered leaves may be given in the dose of three or four grains (0.20 to 0.26 Gm.) twice a day gradually increased until the occurrence of slight vertigo or nausea indicates that it has taken effect. To maintain a given impression, it is necessary to increase the dose even more rapidly than is customary with most other narcotics, as the system becomes very speedily habituated to its influence. In some instances the quantity administered in one day has been augmented to more than two ounces. The strength of the preparations of hemlock is exceedingly unequal, and caution is therefore necessary, when the medicine is given in very large quantities, to employ the same parcel, or, if a change be made, to commence with the new parcel in small doses, so as to obviate any danger which might result from its greater power. Unpleasant consequences have followed a neglect of this precaution. There is also an official tincture, besides the fluidextract, both of which, when properly made, are considered efficient preparations, but the alcoholic extract formerly official was dropped at the 8th Revision because of its uncertain action. The expressed juice of the fresh plant, with a little alcohol for its preservation, is one of the most reliable forms in which the leaves can be used. The powdered seeds should be given in a dose considerably smaller than that of the leaves.[1] The fresh leaves are sometimes used externally as an anodyne cataplasm, and the extract, and an ointment prepared from the leaves, are applied to the same purpose. A plaster made from the extract has also been employed.[2]

Coniine acts precisely as does hemlock, and may be used for the same purposes. The dose is from one-sixth to one-fourth minim (0.01 to 0.015 Cc.). A solution of one part in one hundred of very dilute alcohol has been used with advantage in certain cases of *scrofulous ophthalmia* with photophobia, applied several times

[1] The root, while containing a small proportion of coniine, is too feeble, according to the experiments of John Harley of London, to be used practically with advantage. Harley has found in the root three new proximate principles, one a very bitter resin, which he names *conamarine,* and the two others crystallizable bodies, named respectively *rhizoconin* and *rhizoconolein.* They are all neutral, and, so far as known, medicinally inert. (See *P. J.,* Aug. 1867.)

[2] The following formula of Planche has been approved by the Society of Pharmacy of Paris. Take of extract of hemlock 90 parts, of purified elemi 20 parts, of white wax 10 parts. Melt the resin and wax with a gentle heat and incorporate the extract with the mixture. (*J. P. C.,* Juillet, 1862, p. 46.)

daily by friction about the eyelids. (*J. P. C.*, 3e sér., xix. 219.) Mauthner of Vienna, recommends it especially in the spasmodic contraction of the orbicularis oculi in scrofulous children, using a solution containing half a grain of coniine in a drachm of almond oil, which he applies by a pencil to the eyelids twice or thrice daily. As a collyrium, from one to three drops may be added to six drachms of pure water, and two drachms of mucilage of quince seeds, the whole should then be carefully strained.

Coniine hydrochloride has been recommended for exhibition by G. C. Close, as preferable to the uncombined alkaloid. From half a grain he experienced no sensible effects, but a grain produced the characteristic symptoms of coniine in an even unpleasant degree. These doses are probably dangerous, and not more than a sixth of a grain (0.01 Gm.) should be given as a commencing dose. (*A. J. P.*, 1869, p. 62.) Harley has prepared an acid *coniine benzoate* by adding two molecules of the acid to one of the base, and found the resulting salt effectual in the dose of half a grain. (*P. J.*, Jan. 1871, p. 585.) According to Mourrut, one of the best crystallizable salts of coniine is the *hydrobromide*. The alkaloid is treated with aqueous hydrobromic acid, which causes, especially with the brown variety of coniine, an elevation of temperature, and a disengagement of white fumes of the odor of coniine; the mixture then turns green, and finally blackish-red. The crystals, which form after some time, may be obtained quite colorless by repeated crystallizations. They are colorless prismatic needles, soluble in water and alcohol, less so in ether and chloroform, inodorous and almost tasteless, and are not deliquescent. They should be kept in the dark, otherwise they assume a red tint. The salt has been used by various practitioners with great success in the treatment of *whooping cough*, in doses of about one-twelfth of a grain (0.005 Gm.), if necessary, every hour, for a child three years of age; or one-thirtieth of a grain (0.002 Gm.) for a child of one year; or one-sixth of a grain (0.01 Gm.) for adults. In *sciatica* it has been employed hypodermically in quantities of one-twelfth of a grain (0.005 Gm.) with good results. (*Répert. de Pharm.*, 1876, p. 369; *N. R.*, 1876, 1879, pp. 18, 178.) For an account of Harley's experiments, to determine the relative value of different preparations of conium, see U. S. D., 18th ed. p. 451. He concluded that the green fruit, as the basis of tinctures and extracts, is superior to any other part of the plant, and the spirituous extract of the green fruit should be substituted for the almost worthless extract of the Br. Pharm. (*P. J.*, 1871, p. 585.)

Dose, of conium, three to five grains (0.2 to 0.32 Gm.).

Off. Prep.—Fluidextractum Conii, *U. S.*; Succus Conii, *Br.*; Tinctura Conii, *Br.*; Unguentum Conii, *Br.* (from juice).

CONVALLARIA. U. S.

CONVALLARIA [Lily-of-the-Valley]

(cŏn-văl-lā′rĭ-ą)

"The dried rhizome and roots of *Convallaria majalis* Linné (Fam. *Liliaceæ*)." *U. S.*

Lilium Convallium; Muguet, *Fr. Cod.*; Maiblumen, *G.*; Convallaria, Mughetto, *It.*; Convalaria, Lirio de los valles, *Sp.*

The ordinary lily of the valley of the gardens is a low, perennial herb, having slender running root-stocks, which send up each spring from the scaly sheathing bud two oblong, bright green, smooth leaves, whose long sheathing petioles are so enrolled as to appear like a stalk, and producing in late spring or early summer a one-sided raceme of beautiful, sweet-scented, nodding, bell-shaped flowers, placed upon an angular scape. It is primarily a native of Europe, but may be found in America escaped from gardens, and a plant which grows wild in the higher Alleghanies from Central Virginia to South Carolina seems to be identical with it. The root-stock of the lily of the valley occurs in pieces two to three inches long, covered with a mass of contorted, fine, almost fibrous rootlets. It is much thicker at one end, to which are attached the remains of the petioles and scape, and rapidly or sometimes almost abruptly tapers towards the slender end. The thick end is much gnarled and wrinkled, with leaf-scars. It is officially described as follows: "Rhizome of horizontal growth, somewhat branched, length variable, 1 to 3 Mm. thick, cylindrical, whitish or pale-brown, marked with few circular stem-scars and at each joint with a circle of root-scars or thin, tortuous and branched roots; fracture fibrous but weak; internally whitish; odor distinct; taste sweetish, bitter, and slightly acrid." *U. S.* G. F. Walz found in lily of the valley *convallarin* and *convallamarin*. (*A. J. P.*, 1859, p. 577.) Convallarin is in colorless rectangular prisms, scarcely soluble in water, but sufficiently so as to render the solution acrid and to cause it when shaken to foam like soap and water. It is easily dissolved by alcohol. Its composition is represented by the formula $C_{34}H_{62}O_{11}$, and it is decomposed by long boiling with diluted acids into sugar and *convallaretin*. It is a glucoside. Convallamarin is a white powder, very bitter and afterwards sweetish, soluble in water and alcohol, but not in ether. This also is a glucoside. Its composition is $C_{23}H_{44}O_{12}$, and it is decomposed by heating with diluted sulphuric acid into sugar and *convallamaretin*, the formula of which is $C_{20}H_{36}O_8$. For preparing convallamarin Tanret modifies Walz's method, as follows. An alcoholic tincture made from the whole plant is precipitated with lead subacetate and filtered; the excess of lead is removed with diluted sulphuric acid, avoiding the use of more than is necessary, and, after neutralizing, the tincture is distilled, the last portion of alcohol being

driven off in the open air, then the cooled and filtered liquor is treated with tannin, care being taken to keep the liquid neutral by cautiously adding a diluted solution of sodium carbonate. A compound of tannin and convallamarin is precipitated, which, after washing, is dissolved in 60° alcohol, the solution decolorized with charcoal, decomposed with zinc oxide, filtered, and evaporated to dryness. In this way convallamarin is obtained nearly white, and having the appearance of ordinary digitalin. To free it from the salts that are sometimes carried down by the tannin precipitate, it is a good plan to redissolve it in 90° alcohol, filter, and then evaporate. One kilogramme of the fresh plant collected in the first days of August yielded two grammes of convallamarin. (*P. J.*, 1882, p. 423.) Taken internally the flowers are said to be emetic and cathartic, and their extract purges actively in the dose of half a drachm. They were formerly used in *epilepsy* and against *worms*. The *root*, which is also bitter, has similar purgative properties, and in powder is said to be sternutatory. Hænsel obtained 0.058 per cent. of an aromatic volatile oil from the leaves of Convallaria majalis (*Ph. Centralh.*, 1901, 495).

Uses.—The lily of the valley is stated to have been long used in Russia for the relief of *dropsy*, and in 1880 Troitzky and Bojojawlewsky commended it highly to the notice of the profession in valvular *heart disease*. The effects on the system of convallarin and convallamarin have been investigated by H. Marmé of Germany, with the following results: *Convallarin*, in doses of 3 to 4 grains, acts as a purgative without observable inconvenience to the animals acted on; *convallamarin*, even in small doses, produces active vomiting, whether given by the mouth or injected into the subcutaneous tissue or directly into the veins. The latter principle acts especially on the heart, at first diminishing the number of its pulsations, and afterwards rendering them more frequent and irregular, and causing death in a few minutes after the introduction of the poison. The heart appears to be paralyzed, and cannot be excited after death. The principle acts on the heart through the vagi nerves. From 6 to 8 milligrammes (one-tenth to one-eighth of a grain) cause death when injected into the cervical vein in rabbits. (*N. Y. M. J.*, 1867; *S. Jb.*, 1867, v.) The physiological action of convallamarin has been investigated by a number of observers, with contrary results. Sée finds that in the dog it slows the action of the heart and increases the blood pressure decidedly, while Leubuscher states that its medicinal use does not elevate the arterial pressure. Ott, Coze, and Simon find that the heart is arrested in systole; Sée, that the arrest is diastolic; while Löwenthal, using the same preparation in exactly the same manner and dose upon different animals of the same species, obtained diverse results. Nathanson asserts that the confusion is largely due to the impurity and lack of genuineness in the products used, even Merck having admitted the impurity of his commercial convallamarin. Nathanson found that convallarin produced in man, when given in doses of 0.06 to 0.12 gramme, three or four times daily, only nausea, diarrhœa, and gastric pain, while convallamarin administered in daily amounts, gradually increasing from 0.03 to 0.3 gramme, reduced the rate of the pulse and markedly increased the flow of urine, only in very rare cases causing nausea or vomiting. J. H. Andrews (*Ph. Rev.*, March, 1898) reports a case in which a teaspoonful of the fluidextract of convallaria produced, in a child two years old, stupor with tremors and convulsions, dilated pupils, fall of temperature, rapid feeble pulse, rapid respiration, without gastric intestinal irritation, diuresis and diaphoresis; the patient recovered. In cardiac dropsy Sée gives, of an aqueous extract of the whole plant, 15 to 23 grains a day; Bojojawlewsky each day 50 to 100 grains of the plant in infusion. (See *Fluidextractum Convallariæ.*)

Dose (U. S. P.), seven and a half grains (0.5 Gm.), but the root is never used medicinally.

Off. Prep.—Fluidextractum Convallariæ, *U. S.*

COPAIBA. U. S., Br.

COPAIBA [Balsam of Copaiba, Copaiva]

(cọ-pā'i-bạ)

"An oleoresin derived from one or more South American species of *Copaiba*[1] (Fam. *Leguminosæ*)." *U. S.* "The oleo-resin obtained from the trunk of Copaifera Lansdorfii, *Desf.*, and other species of Copaifera, *Linn.*" *Br.*

Balsamum Copaiferarum; Balsam Copaiba, Balsam Capivi; Copahu, *Fr. Cod.*; Oleo-résine (Baume) de Copahu, *Fr.*; Balsamum Copaïvæ, *P. G.*; Copaiva; Copaivabalsam, *G.*; Balsamo di copaive, *It.*; Copaiba, Balsamo de copaiva, *Sp.*

Copaiba was first noticed in a work published by Purchas, in England, in 1625. The next reference to it was by Cristoval d'Acuña, in 1638. In 1648, Marcgraf and Piso gave a detailed account of the tree which produces it, and the methods of gathering it. Jacquin in 1763 described a species of Copaifera, growing in Martinique, which he named *C. officinalis*. As this was believed to be the same plant with the one observed by Marcgraf in Brazil, it was adopted in the Pharmacopœias, but their identity was denied; and Desfontaines proposed for Jacquin's species the title of *C. Jacquini*, in honor of that botanist. It is now known that many species of Copaifera exist in South America, and all of them, according to Martius,

[1] The change of the generic name from Copaifera to Copaiba is another sacrifice to botanical reform. H. H. Rusby very properly says that this reform, as embodied in Kuntze's *Revisio Generum*, "will cause complete confusion." The generic records are said to be as follows: Copaiba, Mill., *Gard. Dict.* (1739); Copaiva, L., *Mat. Med.* (1749), *fide* O. Kuntze; Copaifera, L., *Gen.* (1762), *fide* O. Kuntze. It is to be hoped that the next Botanical Congress will decide upon names which will stand a reasonable length of time.

yield copaiba. Besides *C. officinalis* or *C. Jacquini*, the following are described by Hayne: *C. guianensis, C. Langsdorffii, C. coriacea, C. Beyrichii, C. martii, C. bijuja, C. nitida, C. laxa, C. cordifolia, C. Jussieui, C. Sellowii, C. oblongifolia*, and *C. multijuga*. Hayne believed that *C. bijuga* was the plant seen by Marcgraf and Piso. The four species to which in the Pharmacographia the production of copaiba is especially attributed are *C. officinalis*, L., *C. guianensis*, Desf., *C. coriacea*, Mart., and *C. Langsdorffii*, Desf.

C. officinalis is a native of Venezuela, and grows in the province of Carthagena, mingled with the trees which afford the balsam of Tolu. It grows also in some of the West India islands, particularly Trinidad and Martinique. Though recognized in earlier editions of the U. S. Pharmacopœia as a source of copaiba, it probably yields little of that now in use. According to Hayne (x. t. 17 f. c.), the species from which most of the copaiba of commerce is derived is *C. multijuga*, growing in the Brazilian province of Para. It was recognized by the U. S. P. 1870; but Bentham, after examining the only specimens extant, asserted that it is not a Copaifera at all. It is probable that *C. guianensis*, which inhabits the neighboring territory of Guiana, especially in the vicinity of the Rio Negro, affords also considerable quantities; and *C. Langsdorffii* and *C. coriacea*, which are natives of the province of Sao Paulo, are thought to yield most of the juice collected in that section of Brazil. *C. nitida*, inhabiting the province of Minas Geraes, probably also contributes to the commercial supplies through the port of Rio Janeiro.

Numerous varieties of true South American copaiba exist in commerce, known under the name of the various ports of shipment. The most important of these varieties are Bahia, Carthagena, Maracaibo, Maranham, Para, Cayenne. Each one of these varieties has been referred (see *P. J.*, 1901, lxvi. 325) to a special species of the genus Copaiba, but there is little reason for supposing that this reference is accurate, and there is much reason for believing that various trees contribute to a single variety of copaiba. The following table according to the researches of Umney and Bennett shows the specific gravities and percentage of oil of the five most important of these copaibas:

Name.	Sp. gr.	Per cent. of oil.	Resin.
Bahia	0.938	49.7	Soft.
Carthagena	0.970	41.3	Brittle.
Maracaibo	0.969	42.5	Firm, but not easily pulverized.
Maranham	0.990	41.8	Brittle.
Para	0.920	62.4	Very soft.

All of the above varieties answered to the solubility and Gurjun balsam tests.

It will be noticed at once that the Para and Bahia specimens examined by Umney failed to comply with the tests of the U. S. Pharmacopœia (1890), and yet, supposing that the oil represents the chief therapeutic principle of copaiba, these varieties lead all the others. The German Pharmacopœia requires that the specific gravity shall be 0.98 to 0.99, and that the acid number shall fall between 75.6 and 84, and the ester number be not more than 8.4. Dieterich. (*P. J.*, April, 1899, and March, 1900.) *Surinam copaiba* is a yellowish or brownish-yellow liquid, varying from thick to thin in consistence; it may be distinguished from Maracaibo copaiba by the fact that one drop of it dissolved in 1 Cc. of acetic anhydride gives a fine blue color on the addition of a drop of sulphuric acid. (*P. J.*, Nov. 1904.)

According to E. Keto, copaiba of Maracaibo has a density of 0.999; a coefficient of acidity of 85.4; of etherification of 6.7; while that of Para has a density of 0.92; a coefficient of acidity of 19.4; of etherification of 7.4.

The juice is obtained by making a square chamber in the stems of the trees, reaching to the very centre; and the operation is said to be repeated several times during the same season. It is asserted that a single tree will yield about eighty-four English Imperial pints. As it flows from the wound, it is clear, colorless, and very thin, but it soon acquires a thicker consistence, and a yellowish tinge. It is most largely collected in the provinces of Para and Maranham, in Brazil, and is brought to this country from the port of Para, in small casks or barrels. Large quantities of it come from Maracaibo, in Venezuela, and from other ports on the Caribbean Sea, whence it is brought in casks, demijohns, cans, jugs, etc. The drug is also exported from Angostura, Cayenne, Rio Janeiro, and some of the West India islands.

Properties.—Copaiba is a clear, transparent liquid, usually of the consistence of olive oil, of a pale yellow color, a peculiar not unpleasant odor, and a bitterish, hot, nauseous taste. Its sp. gr. varies ordinarily from 0.950 to 1.000, but has been known to be as low as 0.916. (Procter, *A. J. P.*, xxii. 292; "from 0.916 to 0.993." *Br.*) It is insoluble in water, but entirely soluble in absolute alcohol, ether, and the fixed and volatile oils. Strong alkaline solutions dissolve it perfectly; but the resulting solution becomes turbid when largely diluted with water. With the alkalies and alkaline earths it forms saponaceous compounds, in which the resin of the copaiba acts the part of an acid. It dissolves magnesia, especially with the aid of heat, and even disengages carbon dioxide from the carbonate of that earth. If triturated with a sixteenth of its weight of magnesia and set aside, it gradually assumes a solid consistence, and a similar change is produced with calcium hydroxide. *Solid Copaiba* or *Mass of Copaiba* was official in the U. S. P. 1890.[1] The essential constituents of copaiba are

[1] **Massa Copaibæ**, U. S. P. (1890). *Mass of Copaiba* [*Solidified Copaiba*]; Pilulæ Copaibæ, *U. S.* 1870; Pilules de Copahu, *Fr.*; Copaiva-Pillen, *G.*—"Copaiva, *ninety-four grammes* [or 3 ounces av., 138 grains]; Magnesia, *six grammes* [or 93 grains]; Water, *a*

volatile oil and resin,[1] with at times small quantities of acids. As it contains no benzoic acid, it cannot with propriety retain its old title of *balsam of copaiva.* The substances which it most closely resembles, both in composition and in properties, are the turpentines. (See *Oleum Copaibæ.*) For a description of an apparatus for distilling the volatile oil, see a paper by R. A. Cripps in *C. D.,* 1892, 282. Cripps found commercial copaiba to contain the following percentages of volatile oil: 40.95, 45, 45.3, 46.4, 47.8, 48.2, 49.6, 50.4, 50.8, 53.3, 59.6. J. C. Umney (*A. J. P.,* 1893, 544) found in African copaiba 39 per cent. of an oil of 0.918 specific gravity and with a rotation of + 20° 42′, the last character distinguishing it from the other varieties which yield lævo-rotatory oils.

"A pale yellow to brownish-yellow, more or less transparent and viscid liquid, sometimes fluorescent; having a peculiar, aromatic odor and a persistent, bitter and acrid taste. Specific gravity: 0.950 to 0.995 at 25° C. (77° F.). Insoluble in water; soluble, or showing at most a slight opalescence, in absolute alcohol, carbon disulphide, petroleum benzin, and in fixed and volatile oils; completely soluble in chloroform and ether. When heated on a water-bath, it should evolve no odor of turpentine, and after forty-eight hours should leave a resinous mass weighing not less than 50 percent. of its original weight. One Gm. of Copaiba, when dissolved in 50 Cc. of alcohol, should require not less than 2.3 Cc., and not more than 2.8 Cc. of half-normal alcoholic potassium hydroxide for neutralization, using 1 Cc. of phenolphthalein T.S. as indicator (presence of a normal proportion of *acid resin*).

When 4 drops of nitric acid (sp. gr. 1.40) and 1 Cc. of glacial acetic acid are mixed in a test-tube, and 4 drops of Copaiba are carefully poured on top of the liquid, no reddish zone should appear; nor should the fluid assume a red or purple color after being shaken (absence of *gurjun balsam*). If 5 Cc. of Copaiba be shaken with 15 Cc. of alcohol, and heated to boiling for one minute, no drops of oil should separate after cooling and standing for an hour (absence of *paraffin oils*). If 20 drops of Copaiba be boiled with 1 Cc. of an alcoholic potassium hydroxide solution (1 in 10) for two minutes and cooled, and then twice its volume of ether be added to the liquid, no gelatinization should occur (absence of *fixed oils*). If 1 Gm. of Copaiba be shaken with 10 Cc. of ammonia water in a stoppered vial, and allowed to stand for twenty-four hours, the liquid will become turbid, but it should not gelatinize, nor should a firm mass be formed (limit of *resin*)." *U. S.* "The volatile oil should be present to the extent of at least 40 per cent., should rotate the plane of a ray of polarized light from 28° to 34° to the left (absence of African copaiba), and should not boil under 482° F. (250° C.)." *Br.*

The *resinous* mass which remains after the distillation of the oil is hard, brittle, translucent, greenish brown, and nearly destitute of odor and taste. By mixing it with the oil in proper proportion, we may obtain a liquid identical or nearly so with the original juice. This resinous mass is of an acid character, and yields a series of amorphous salts; it may be obtained pure by exposing a mixture of 9 parts of copaiba and 2 parts of aqueous ammonia (sp. gr. 0.95) to a temperature of 10° C. In this way crystals of *copaivic acid,* $C_{20}H_{30}O_2$, are obtained. This acid agrees with the *abietic acid* of rosin in composition, but not in properties. Copaivic acid is readily soluble in alcohol, and especially in warmed copaiba itself; much less soluble in ether. When recrystallized from alcohol, copaivic acid fuses at 116° to 117° C. (241° to 242.6° F.). (*A. J. P.,* 1879, p. 305.)

An analogous substance, *oxycopaivic acid,* $C_{20}H_{28}O_3$, was found in 1841 by H. von Fehling in Para copaiba, and Strauss in 1865 extracted *meta-copaivic acid,* $C_{22}H_{34}O_4$, from Maracaibo copaiba. Copaivic acid forms crystallizable salts with alkalies, and *sodium copaivate,* $NaC_{20}H_{29}O_2$, made by combining molecular quantities of the acid and soda, is asserted by Zlamál and Roquette to be more efficient than any other preparation of copaiba. Tschirch (*Harze und Harzbehälter,* 1900, p. 297) obtained from Maracaibo balsam a crystalline resin acid corresponding in many respects with Strauss's metacopaivic acid, to which, however, he gave the formula $C_{11}H_{16}O_2$ finding a melting point 89° to 90° C. as against 205° to 206° for Strauss's acid. Para balsam was found by Tschirch to contain two crystallizable resin acids together with several uncrystallizable ones. African copaiba balsam he found to contain a characteristic acid to which he gave the name *Illurinic acid* and the formula $C_{14}H_{20}O_2$ or possibly $C_{21}H_{30}O_3$. Keto, who worked out the preceding results jointly with Tschirch, has since published some additional results (*J.*

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sufficient quantity. Triturate the Magnesia with a little Water, in a capsule, until the powder is uniformly dampened throughout. Then gradually incorporate with it the Copaiba, so that a uniform mixture may result, place the capsule on a water-bath, and heat during half an hour, frequently stirring. Lastly, transfer the mixture to a suitable vessel, and set this aside until the mass has acquired a pilular consistence." *U. S.* 1890. See U. S. D., 18th ed. p. 854.

[1] **Resina Copaibæ,** U. S. P. (1890), *Resin of Copaiba,* "The residue left after distilling off the volatile oil from Copaiba." *U. S.* Schweitzer first obtained from Copaiba resin *copaivic acid,* which, analyzed by H. Rose, was found to have the formula $C_{20}H_{30}O_2$. When crystallized from alcohol the acid fuses at 116° to 117° C. (240.8° to 242.6° F.). Another acid, *oxycopaivic,* was obtained by von Fehling, and still a third, *metacopaivic acid,* by Strauss. The first of these has the formula $C_{20}H_{28}O_3$, and the second $C_{22}H_{34}O_4$. It is officially described as "a yellowish or brownish-yellow, brittle resin, having a slight odor and taste of copaiba. Soluble in alcohol, ether, chloroform, carbon disulphide, benzol, or amylic alcohol." *U. S.* 1890. Bernatzik exhibited nearly four drachms of this resin in five hours, causing violent gastro-intestinal irritation, with vomiting and purging, besides renal disturbance. The resin is eliminated by the urine, and exerts some influence upon the genito-urinary mucous membrane. It is, however, inferior to either the volatile oil or the balsam. *Dose,* from ten to twenty grains (0.65 to 1.3 Gm.).

P. C., 1902, p. 381). He finds in Para balsam the two crystallizable acids referred to above, one of which he names *paracopaibic acid* with the formula $C_{20}H_{32}O_3$ and fusing point 142° to 145° C., and the other *homoparacopaibic acid*, $C_{18}H_{28}O_3$, fusing at 111° to 112° C. To *illurinic acid* mentioned by Tschirch he gives the formula $C_{20}H_{28}O_3$ and the melting point 128° C.

Copaiba, upon exposure to the air, acquires a deep color, a thicker consistence, and greater density, and, if spread out upon an extended surface, ultimately becomes dry and brittle. This change is owing partly to the volatilization and partly to the oxidation of the essential oil. As it is the soft resin that results from the oxidation of the oil, it follows that the proportion of this resin increases with age. Considerable diversity must, therefore, exist in the drug, and in its physical properties and in the proportions of its ingredients, according to its age and degree of exposure. Similar differences also exist in the copaiba procured from different sources. Thus, that of the *West Indies*, when compared with the *Brazilian*, which is the variety above described, and in common use, is of a thicker consistence, of a deeper or darker yellow color, less transparent, and of a less agreeable, more terebinthinate odor; and specimens obtained from the ports of Venezuela and Colombia were found, upon examination by Vigne, to differ from each other not only in physical properties, but also in their chemical relations. (*J. P. C.*, N. S., i. 52.) The same is true, as observed by Buignet, of their action on polarized light, in which they differ not only in degree, but sometimes also even in direction. (*J. P. C.*, Oct. 1861, pp. 266-7.) It is not impossible that differences may exist in the juice according to the circumstances of its collection. The species of Copaifera from which the juice is collected, as well as the age of the tree, its position, and the season of collection, must also have influence over the product. It is highly probable that the resinous matter results from the oxidation of the oil in the cells of the plant, and that the less elaborated the juice may be, the larger proportion it will contain of the oil. It is said that a volatile oil flows abundantly from a tree near Bogota, which is employed to adulterate the copaiba collected in that vicinity and shipped from Maracaibo and other neighboring ports.[1]

Adulterations.—Copaiba is often adulterated[2] with a fixed oil, especially castor oil, which, in consequence of its solubility, cannot, like the others, be detected by alcohol. Various plans have been proposed for recognizing the castor oil. The simplest is to boil a drachm of the copaiba in a pint of water until the liquid is wholly evaporated. If the copaiba contains a fixed oil, the residue will be more or less soft, according to the quantity present; otherwise it will be hard. Magnesium carbonate, potassium hydroxide, and sulphuric acid have also been proposed as tests. In the late Edinburgh Pharmacopœia it was stated that copaiba "dissolves a fourth part of its weight of magnesium carbonate, with the aid of a gentle heat, and continues translucent." The presence of a small proportion of any fixed oil renders the mixture opaque. One part of potassium hydroxide dissolved in two of water forms a clear solution with nine parts of pure copaiba, and the liquid continues clear when moderately diluted with water or alcohol; but the presence of one-sixth of fixed oil in the copaiba occasions more or less opacity in the liquid, and half the quantity causes the precipitation of white flakes in a few hours. (Stolze.) Turpentine, which is said to be sometimes added to copaiba, may be detected by its odor, especially if the copaiba be heated. According to Redwood, most of the proposed tests of the purity of copaiba are liable to fallacy, and the best measure of its activity is the quantity of volatile oil it affords by distillation. Castor oil, Venice turpentine, linseed oil, or gurjun balsam may be detected by means of petroleum benzin, which makes a clear solution with pure copaiba, but if either of the substances mentioned be present a milky mixture, which soon settles into two layers, is formed, the copaiba solution being on top (*A. J. P.*, July, 1873; *Proc. A. Ph. A.*, xxiv. 191, xxvi. 286). Maisch has found that *ten* volumes of petroleum benzin, instead of *three* as proposed by Wayne, must be added to one of copaiba to get the best results from this test. Indeed, it has been shown that pure copaiba will sometimes show turbidity when mixed with petroleum benzin. (*A. J. P.*, 1877, p. 131.) Hager recommends the use of absolute alcohol, which he says completely dissolves, without turbidity, all the varieties of copaiba except the Para, whose solution on standing clears itself by the deposition of a few white flakes. J. M. Fulton asserts that some pure copaibas are not entirely dissolved by absolute alcohol. (*A. J. P.*, 1877.) For additional tests and criticisms by Beckurts and Brueche, see *A.*

[1] *African Copaiba*, or *Balsam of Illurine*, which reached the London market first in 1891, from West Africa, is a brownish substance, having a consistency similar to the Maracaibo copaiba, and a greenish fluorescence. Its aromatic odor is entirely different from that of copaiba; its taste is biting, with an aftertaste of bitterness. According to Keto (*J. P. C.*, 1902, 381) its density is 0.9905; its coefficient of acidity 55.5; of etherification 8.3. It is soluble in chloroform and petroleum benzin, also in ether, with which it makes an opalescent liquid. Its solution in absolute alcohol, or alcohol of 95 percent, is not limpid. From it Keto separated *illurinic acid*. Its volatile oil is of a pale yellow color, with a strong odor entirely different from that of copaiba. The residue which remains after the distillation consists of two resins, one soluble, the other insoluble, in alcohol. This oleoresin probably shares the medicinal properties of true copaiba, being the product of *Hardwickia Mannii*, a tree closely allied to the true Copaibas.

[2] Some years since, a substance was imported into New York, under the name of *red copaiba*, which did not possess a single characteristic of the genuine drug. It was of a thick, semi-fluid consistence, not unlike that of balsam of Tolu, as it often reaches us, of a brown color similar to that of the same balsam, though darker, and of an unpleasant yet somewhat aromatic odor, recalling that of liquidambar, but less agreeable. Its origin is unknown.

Pharm., 1891, p. 90; also *Proc. A. Ph. A.*, 1892, 635. For Hager's test, see *C. D.*, 1894, 740. Dodge and Olcott (*Am. Drug.*, 1895, 5) describe a test to detect gurjun balsam in copaiba, which Kebler regards as the most reliable yet proposed; it is as follows. Four drops of the suspected sample, dissolved in half a fluidounce of glacial acetic acid, will, if pure, remain colorless and clear, or but slightly cloudy, if from four to six drops of pure nitric acid be dropped into the solution. If the sample be pure gurjun balsam, the mixture will have a deep purple color; if a mixture of the two balsams, the depth of color will vary according to the amount of the adulterant, as small a proportion as 2 per cent. being discoverable; this test is now official. (See also *A. J. P.*, 1896, 143, and 1897, 394.) For a valuable paper on Copaiba by A. R. L. Dohme see *Proc. A. Ph. A.*, 1904, 322.

Uses.—Copaiba is gently stimulant, diuretic, laxative, and in very large doses often actively purgative. It produces, when swallowed, a sense of heat in the throat and stomach, and extends an irritant action not only throughout the alimentary canal, but also to the urinary passages, and in fact, in a greater or less degree, to the whole mucous membrane, for which it appears to have a strong affinity. The urine acquires a peculiar odor during its use, and its odor may be detected in the breath. It sometimes occasions an eruption upon the skin resembling that of measles, and attended with disagreeable itching and tingling, or even violent pemphigus. (*N. Y. M. J.*, Jan. 1873, p. 416.) Nausea and vomiting, painful purgation, strangury and bloody urine, and a general state of fever are caused by excessive doses. As a remedy it has been found most efficient in diseases of the mucous membrane, particularly those of a chronic character. Thus, it is given with occasional advantage in *leucorrhœa, chronic cystitis, chronic dysentery, diarrhœa, hemorrhoids, chronic bronchitis,* and *psoriasis.* The complaint, however, in which it is most employed is *gonorrhœa.* It should not be administered in the first stages, when the inflammation is severe and acute, nor is it applicable to very chronic forms of the disorder, such as gleet. It was formerly much esteemed as a vulnerary, and as an application to *ulcers,* but it is now seldom used externally. Ruschenberger recommends it locally in *chilblains.* (*Med. Examiner,* i. 77.)

Both the volatile oil and the resin are eliminated by the kidneys in an altered condition; if to the urine of a person taking the drug, nitric acid be added, a precipitate is thrown down, which may be mistaken for albumin. The volatile oil is more active than is the resin, which is not, however, inert. Wilks of Guy's Hospital, London, speaks of the resin with great confidence as a hydragogue diuretic in obstinate *dropsy,* given in the dose of fifteen or twenty grains three times a day.

Dose, of copaiba, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.) three times a day, or a smaller quantity repeated more frequently. It may be given dropped on sugar, but in this form is often so exceedingly offensive as to render some concealment of its nauseous qualities necessary. A less disagreeable form is that of emulsion, prepared by rubbing the copaiba first with mucilage, or the yolk of an egg, and sugar, and afterwards with some aromatic water, as that of mint or cinnamon. The *volatile oil,* which is official, may be given in the dose of ten or fifteen minims (0.6 to 0.9 Cc.) in emulsion, or, as is almost universally preferred, in capsules.

CORIANDRUM. U. S. (Br.)

CORIANDER [Coriander Seed]

(cŏ-rī-ăn'drum)

"The dried ripe fruit of *Coriandrum sativum* Linné (Fam. *Umbelliferæ*)." *U. S.* "The dried ripe fruit of Coriandrum sativum, *Linn.*" *Br.*

Coriandri Fructus, *Br.;* Coriander Fruit; Coriandre, *Fr. Cod.;* Koriander, *G.;* Coriandro, *It.;* Cilantro, *Sp.*

Coriandrum sativum, Willd., *Sp. Plant.* i. 1448; Woodv., *Med. Bot.,* 137, t. 53.—This is an annual plant, with an erect, round, smooth, branching stem rising about two feet, and furnished with compound leaves, of which the upper are thrice ternate, with linear pointed leaflets, the lower pinnate, with the pinnæ cut into irregular serrated lobes like those of parsley. The flowers are white or rose-colored, and in compound terminal umbels; the fruit globular, and composed of two concave hemispherical portions. *C. sativum* is a native of Italy, but at present grows wild in most parts of Europe, having become naturalized in consequence of its extended cultivation. The flowers appear in June, and the fruit ripens in August. It is a singular fact that all parts of the fresh plant are extremely fetid when bruised, while the fruit becomes fragrant by drying. This is the official portion. It is brought to us from Europe.

The fruit of the coriander is globular, about an eighth of an inch in diameter, obscurely ten-ribbed, with minute indications of secondary ribs in the furrows, of a grayish or brownish-yellow color, and separable into the two mericarps (half-fruits), which are only bound together by the membranous pericarps. Each half-fruit is provided with two oil tubes on the conjoining face. The whole fruit has the persistent calyx at its base, and is sometimes surmounted by the adhering conical style. Coriander is thus described by the U. S. Pharm.: "Nearly globular, brownish-yellow, smooth, 4 to 5 Mm. in diameter, crowned with the calyx teeth and a short stylopodium; mericarps usually united, each with five prominent, straight primary ribs and four indistinct secondary ribs, the inner surface deeply concave and with two oil-tubes; odor and taste agreeably aromatic." *U. S.* The aromatic taste and odor depend on a *volatile oil,* which may

be obtained separate by distillation. One pound of the seeds yields forty-two grains of the oil. (Zeller.) This is colorless or pale yellow, with an agreeable odor of coriander, a mild aromatic taste, and a sp. gr. varying from 0.87 to 0.88. Its main constituent, according to Semmler (*Ber. d. Chem. Ges.*, xxiv. 206), is what was first called *coriandrol,* but is now recognized as right rotatory *linalool,* $C_{10}H_{18}O$, boiling between 194° and 198° C. Besides this, about 5 per cent. of *dextro-pinene* was isolated, boiling between 156° and 160° C. It is one of the most permanent volatile oils, long resisting oxidation. The fruit's virtues are imparted to alcohol by maceration, and less readily to water.

Uses.—Coriander is a rather feeble aromatic. It is almost exclusively employed in combination with other medicines, either to cover their taste, to render them acceptable to the stomach, or to correct their griping qualities. It was well known to the ancients.

Dose, twenty to sixty grains (1.3 to 3.9 Gm.).

Off. Prep.—Confectio Sennæ, *U. S.* (from oil), *Br.;* Spiritus Aurantii Compositus, *U. S.* (from oil); Syrupus Rhei, *Br.;* Syrupus Sennæ, *U. S.* (from oil); Tinctura Rhei Composita, *Br.;* Tinctura Sennæ Composita, *Br.*

CREOSOTUM. U. S., Br.

CREOSOTE

(crē-ǫ-sō'tŭm)

"A mixture of phenols and phenol derivatives, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech, *Fagus silvatica* Linné or *Fagus ferruginea* Aiton (Fam. *Fagaceæ*)." *U. S.* "A mixture of guaiacol, creosol, and other phenols; obtained in the distillation of wood-tar." *Br.*

Creasotum, *Br.* (1885): Creasote; Créosote du Goudron de Bois. *Fr. Cod.;* Créosote, *Fr.;* Kreosotum, *P. G.;* Kreosot, Buchenholztheerkreosot, *G.;* Creosoto, *It.;* Creosota, *Sp.*

This is a substance discovered in 1830 by Reichenbach in the products of the distillation of wood. This distillation of wood yields products very analogous to one fraction of the coal tar obtained by the destructive distillation of bituminous coal. This fraction is the heavy oil of coal tar, which comes over between 165° C. (329° F.) and 200° C. (392° F.): it is often called "*coal tar creosote,*" and contains a group of phenols, including carbolic acid, now known officially as *phenol,* C_6H_6O, boiling at a temperature not higher than 188° C. (370.4° F.), *cresylic acid,* or *cresol,* C_7H_8O, boiling at from 195° to 205° C. (383° to 401° F.), and *xylenol,* or *dimethyl phenol,* $C_8H_{10}O$, boiling at 211° C. (411.8° F.). Wood tar is a complex mixture of phenoloid bodies. These are chiefly the acid methylic ethers of catechol (or pyrocatechin) and its homologues. For chief constituents, see table page 403.

Preparation.—Creosote is obtained either from wood tar or from crude pyroligneous acid. When wood tar is used, it is distilled until it has attained the consistence of pitch. The distilled liquid divides itself into three layers, an aqueous between two oily layers. The inferior oily layer, which alone contains the creosote, is separated, and saturated with sodium carbonate to remove acetic acid. The liquid is allowed to rest, and the new oil which separates is decanted from it. This oil is distilled, and yields products lighter than water, and a liquid heavier. The latter alone is preserved, and, after having been agitated repeatedly with weak phosphoric acid to neutralize ammonia, is allowed to remain at rest for some time. It is next washed until it is free from acidity, and then distilled with a fresh portion of weak phosphoric acid, care being taken to cohobate from time to time. The oily liquid thus rectified is colorless, and contains much creosote, but also a portion of light oil distillate. To separate the latter, the liquid is mixed with a solution of sodium hydroxide of the density 1.12, which dissolves the creosote, but not the light oil. The oil, which floats from its levity, is then separated, and the alkaline solution of the creosote is exposed to the air, until it becomes brown in consequence of the decomposition of a foreign matter, and is then saturated with sulphuric acid. This sets free the creosote, which is decanted, and again distilled. The treatment by solution of soda, sulphuric acid, etc., is to be repeated until the creosote no longer becomes brown by exposure to the air, but only slightly reddish. It is then dissolved in a stronger solution of soda, and distilled again, and finally redistilled for the last time, rejecting the first portion which comes over, on account of its containing much water, and collecting the next portion; care being taken not to push the distillation too far. The product collected is creosote.

When creosote is extracted from pyroligneous acid, the first step is to dissolve sodium sulphate in it to saturation. The oil which separates and floats above is decanted, and, having been allowed to remain at rest for a few days, is saturated by potassium carbonate with the assistance of heat, and distilled with water. The oleaginous liquid obtained is of a pale yellow color, and is to be treated as above detailed, in relation to the treatment of the corresponding oil obtained from wood tar.

Properties.—Creosote, when pure, is a colorless oleaginous liquid, of the consistence of oil of almonds, slightly greasy to the touch, volatilizable by heat, and having a caustic, burning taste, and a penetrating, disagreeable odor, like that of smoked meat, and analogous to, yet different from, that of phenol. As met with in commerce, it has frequently a brownish tinge. It burns with a sooty flame. Applied in a concentrated state to the skin, it corrugates and then destroys the cuticle, causing a white spot. On paper it leaves a greasy stain, which disappears in a few hours, or in ten minutes if heated to 100° C. (212° F.). Its sp.

gr. is not below 1.072 at 25° C. (*U. S.*), and not below 1.079 at 15.5° C. (*Br.*). It boils between 200° and 220° C., and remains fluid at —27° C. It is a non-conductor of electricity, and refracts light strongly. It is devoid of acid or alkaline reaction. Mixed with water, it forms two layers, one consisting of one part of creosote and about eighty of water, the other, of one part of water and ten of creosote. It dissolves a large proportion of iodine and phosphorus, and a considerable amount of sulphur, especially when assisted by heat. Allen states that in Rhenish creosote guaiacol predominates, while a sample of Morson's creosote from "Stockholm tar," examined by him, boiled at about 217° C., and consisted chiefly of creosol.

The U. S. Pharm. describes creosote as "an almost colorless, yellowish (not pinkish), highly refractive, oily liquid, having a penetrating, smoky odor, and a burning, caustic taste; it should not become brown in color on exposure to light. Specific gravity not below 1.072 at 25° C. (77° F.). Its solution in about 140 parts of water at 25° C. (77° F.) is not perfectly clear. With 120 parts of hot water it forms a clear liquid, which, on cooling, becomes turbid from the separation of minute oily drops (distinction from, and absence of, both *phenol* and so-called *'coal-tar creosote'*). The filtrate from these separated oily globules yields a reddish-brown precipitate with bromine T.S. (distinction from *phenol* and so-called *'coal-tar creosote,'* both of which yield white precipitates). Soluble in all proportions in absolute alcohol, ether, chloroform, carbon disulphide, acetic acid, and fixed and volatile oils. When distilled, most of it comes over between 200° and 220° C. (392° and 428° F.). When cooled to —20° C. (—4° F.), it becomes gelatinous, but does not solidify (difference from *phenol*). It is inflammable, burning with a luminous, smoky flame. Creosote is neutral or only faintly acid to litmus paper. On stirring together equal volumes of Creosote and collodion in a dry test-tube, no permanent coagulum should form (difference from *phenol* and so-called *'coal-tar creosote,'* and limit of the former). If 1 volume of Creosote be mixed with 1 volume of 95 percent. glycerin, a clear mixture will result, from which a creosotic layer, equal to or greater in volume than the Creosote employed, will separate on the addition of one-fourth volume of water (difference from, and limit of, *phenols*). On adding to 10 Cc. of a saturated aqueous solution of Creosote 1 drop of ferric chloride T.S., the liquid develops a clear violet-blue color, which is very transient; it then clouds almost instantly, the color passing rapidly from a grayish-green into a muddy brown, with finally the formation of a brown precipitate (difference from *phenol* and so-called *'coal-tar creosote,'* and limit of the former). If 1 Cc. of Creosote be mixed with 10 Cc. of a solution of potassium hydroxide in absolute alcohol (1 in 5), a solid crystalline mass will form (difference from *phenol* and so-called *'coal-tar creosote,'* and limit of the former). On mixing 2 Cc. of Creosote with 10 Cc. of normal sodium hydroxide V.S., a clear, pale yellow liquid results, which remains unclouded on diluting with 50 Cc. of water (absence of *neutral oils*). If 1 Cc. of Creosote be cautiously and gently shaken with 2 Cc. of petroleum benzin and 2 Cc. of freshly prepared barium hydroxide T.S. until a uniform mixture is produced, upon complete separation three distinct layers are visible, the middle one of which contains the Creosote, unaltered in appearance; while the petroleum benzin should not be blue or muddy, and the aqueous layer should not have acquired a red tint (absence of *cœrulignol* and some *other high-boiling constituents of wood-tar*)." *U. S.*

The British Pharm. describes Creosote as "a colorless or yellowish highly refractive liquid, having a strong empyreumatic odor and acrid taste; neutral or only faintly acid to litmus. It is dissolved by about 150 parts of water at ordinary temperatures, and is more soluble in hot water. It is freely soluble in *alcohol* (90 per cent.), *ether, chloroform, glycerin,* and *glacial acetic acid.* Specific gravity, not below 1.079. It distils between 392° F. (200° C.) and 428° F. (220° C.). A 1 per cent. solution in *alcohol* (90 per cent.), or a half per cent. solution in *water,* with a drop of the *test-solution of ferric chloride,* yields a green coloration, rapidly changing to a reddish brown. It rotates the plane of a ray of polarized light to the left. Dropped on white filtering paper and exposed to a temperature of 212° F. (100° C.), it leaves no translucent stain (absence of less volatile liquids). It is miscible with an equal volume of *collodion* without gelatinization; and, when shaken with 5 times its bulk of *solution of ammonia,* its volume should not be diminished materially (distinction from phenol)." *Br.*

Creosote instantly dissolves ammonia, and retains it with great force. Strong nitric and sulphuric acids decompose it, the former giving

A. *Monohydric Phenols.*

Phenol, or carbolic acid	C_6H_5OH.
Paracresol	$C_6H_4(CH_3)OH$.
Xylenol, or phlorol	$C_6H_3(CH_3)_2OH$.

B. *Methylic Ethers of Dihydric Phenols.*

Guaiacol methyl catecholate	$C_6H_4(OCH_3)OH$.
Creosol methyl homocatecholate	$C_6H_3(CH_3)OCH_3.OH$.
(Homocreosol) methyl cresol, dimethyl guaiacol	$C_6H_2(CH_3)_2OCH_3OH$.
Cœrulignol-propyl-guaiacol	$C_6H_3(C_3H_7)OCH_3OH$.

C. *Methylic Ethers of Trihydric Phenols.*

Dimethyl pyrogallate	$C_6H_3(OCH_3)_2OH$.
Dimethyl methyl-pyrogallate	$C_6H_2(CH_3)(OCH_3)_2OH$.
Dimethyl propyl-pyrogallate (picamar)	$C_6H_2(C_3H_7)(OCH_3)_2OH$.
Methyl propyl-pyrogallate	$C_6H_2(C_3H_7)(OCH_3)(OH)_2$.

(*Allen's Com. Org. Anal.*, 2d ed., vol. ii. p. 565.)

rise to reddish vapors, the latter to a red color, which becomes black on the addition of more of the acid. Diluted nitric acid converts it into a brown resin, which, treated with ammonia, and then dissolved in boiling alcohol, gives, by evaporation, certain salts of ammonia, two of which contain new acids, discovered by Laurent. Hydrochloric acid produces no change in it. Morson of London, gives a test based on the solvent power of glycerin over phenol, which is dissolved by it in all proportions, while pure creosote is insoluble or nearly so, and, consequently, if any liquid assumed to be creosote dissolves largely in glycerin, it probably consists in the whole, or in large part, of phenol. Subsequent experiments appear to show that this test succeeds best with Morson's creosote; beech-wood creosote, although pure, sometimes mixes with glycerin without turbidity. Hager modified Morson's test by using a mixture of 3 parts absolute glycerin and 1 part water. With this fairly good results are obtained, according to Allen. A still better test, according to John A. Clark, is an alcoholic solution of iron perchloride (*Tinct. Ferri Perchlor.*, Br.), which with an alcoholic solution of creosote produces a deep greenish-blue color, but with phenol a light brown. (*A. J. P.*, June, 1873, 269.) Creosote dissolves a large number of metallic salts, and reduces some of them to the metallic state, as, for example, silver nitrate and acetate. *Froehde's reagent* (a solution of 1 part of molybdic acid in 100 parts of sulphuric acid) is recommended by E. W. Davy as a distinguishing test for phenol (*P. J.*, 1878, 1022). A drop or two of the doubtful liquid is to be agitated with two fluidrachms of distilled water, the whole filtered, and a drop or two of the test solution added. Pure creosote gives a brown or reddish-brown reaction on standing or slight warming, passing to a light yellowish brown; with phenol, the brown passing to a maroon soon develops a more or less intense purple. Of all the properties of creosote, the most remarkable is its power of preserving meat. It is this property which has suggested its name, derived from *χρέας*, *flesh*, and *σώζω*, *I preserve*.

Impurities and Adulterations.—Creosote is sometimes adulterated with rectified oil of tar and the fixed and volatile oils. All these substances are detected by strong acetic acid, which dissolves the creosote, and leaves them behind, floating above the creosote solution. Creosote from beech-wood tar, however, is only partially dissolved by hot acetic acid of ordinary strength. Fixed oils are also discovered by a stain on paper not discharged by heat. Any trace of the matter which produces the brownish tinge is detected by the liquid becoming discolored by exposure to sunshine. Commercial creosote sometimes contains phenol and cresol, from coal tar; and, indeed, much of what has been sold for creosote was nothing more than impure phenol. (See *Phenol.*) It has been already stated that phenol strongly resembles creosote; but, as the effects of the two on the system are very different, it is highly desirable to be able to distinguish between them. Tests for this purpose have been given above, and, with those quoted from the Pharmacopœia, are sufficient for the purpose. The large doses in which creosote is now sometimes given makes the sale of the so-called "coal tar creosote" dangerous, for there would be a strong probability that a patient might be given a large dose of phenol with disastrous effects; Merck & Co. have publicly announced that they have ceased to label or market "coal tar creosote."

Uses.—The constitution of even genuine beech-wood creosote varies very greatly in the proportion of guaiacol and creosol and in the amount of monophenols, and it would seem impossible to get under the name of creosote a fixed medicament. Nevertheless, for practical therapeutic purposes creosote is sufficiently constant in its composition, the physiological and therapeutic action of its various constituents being apparently so closely allied as to make variability in the proportion of these constituents of little importance; indeed, our knowledge of the physiological effects of creosote is very imperfect. It rivals phenol in its antiseptic power. It is, when applied locally, a paralyzant to the nerves, and probably to all higher tissues; and it was formerly generally believed to be almost identical in the range and powers of its activity with phenol. If it be true, however, as stated in *S. M.*, July, 1891, that Bouchard has administered it in doses of two and a half drachms without evil result, it cannot be physiologically equivalent to phenol. The correctness of this view is further indicated by the rarity of cases of creosote poisoning in the records of medicine. Freudenthal (*N. Y. M. R.*, April, 1892) reports the case of a woman who took 600 drops of creosote in a very short time, the ingestion being followed almost immediately by unconsciousness, with intense trismus, contracted immobile pupils, and general cyanosis, but in which recovery was made practically without the administration of remedies. He further states that subsequently this same patient, by increasing the dose of creosote, was able to take 500 drops daily without ill effect. Creosote was originally administered in *phthisis* with the idea of destroying the tubercle bacillus. There is, however, no reason for believing that it directly affects the growth of this organism, although it undoubtedly is a very effectual remedy in the disease. Its value is almost in direct proportion to the amount of expectoration,—*i.e.*, to the activity of the catarrhal processes. It acts by influencing the pulmonic catarrh, which, although a secondary result of the bacillus, favors greatly their growth. It is at least of equal service in cases of chronic *non-tubercular inflammation* of the bronchial tubes, and even of the lung structure itself when the disease is of a catarrhal type. To be effective it must be given in as large doses

as the stomach can bear, and its use must be continually kept up for weeks and even months. It may be given in cod liver oil or emulsion, but is usually best tolerated in capsules (three to five minims each). Two of these may be administered at first four times a day, the dose being gradually increased until from thirty to forty minims a day are taken, or some evidences of disagreement with the digestion appear. The remedy should be taken after meals, or the ingestion should be immediately preceded by a glass of milk. Creosote has also been used hypodermically in phthisis. Thus, Perom employed a 10 per cent. solution given in oil of sweet almonds, two injections of eighty minims each being given daily. Dor administered, by intra-tracheal injections, a 5 per cent. solution in recently boiled olive oil, holding that the drug reached the pulmonic alveoli and attacked the disease locally. On account of its local action as a powerful paralyzant of nerve-tissue, creosote is frequently employed with great advantage in cases of *nausea, vomiting,* or *diarrhœa* dependent upon excessive irritability, without acute inflammation, of the gastric or intestinal mucous membrane; it has also been successfully used in the *vomiting of pregnancy* or of *hysteria,* in *cholera morbus, cholera infantum, lienteric diarrhœa, typhoid fever,* and even in *dysentery.* When in these cases there is a tendency to fermentation of the contents of the stomach or bowels, creosote is especially valuable, and may often be combined advantageously with an alkali or chalk. Externally, creosote has been employed for exactly the same diseases as has phenol. Indeed, the latter remedy, on account of its greater cheapness, has almost entirely supplanted creosote. The skin diseases to the treatment of which creosote has been supposed to be best suited are those of a scaly character. In *burns* its efficacy has been insisted on, especially in those attended with excessive suppuration and fungous granulations. In *chilblains* also it is stated to be a useful application. Mixed with four parts of lard, it is said to have proved very serviceable in *erysipelas.* When applied to wounds it acts as a hæmostatic, stopping the capillary hemorrhage, but possesses no power to arrest the bleeding from large vessels. Accordingly, creosote water has been applied locally in *menorrhagia,* and to arrest *uterine hemorrhage* and the bleeding from leech-bites. The ulcers in the treatment of which it has been found most useful are those of an indolent and gangrenous character, in which its several properties of escharotic, stimulant, and antiseptic are usefully brought into play. In all these cases, should the remedy cause irritation, it must be suspended, or alternated with emollient and soothing applications. Injected into fistulous ulcers, it proves a useful resource, by exciting the callous surfaces and disposing them to unite. Wherever there are foul ulcers, gangrenous surfaces, or inflamed serous, mucous, or glandular tissues giving rise to fetid discharges, creosote may be substituted for phenol; as examples may be mentioned fetid *leucorrhœa,* puerperal *metritis,* fetid *otorrhœa,* putrid or *diphtheritic sore throat,* chronic *empyema.* The strength of the application may vary from that of pure creosote, to a single drop in a fluidounce of water, according to the delicacy of the part and the severity of the disease. On account of its local anæsthetic and antiseptic influence, it is much employed by dentists for the obtunding of sensitive dentine and as an ingredient of pastes for the destruction of nerves. One or two drops of the pure substance must be carefully introduced into the hollow of the tooth on a little cotton, avoiding contact with the tongue or cheek. To render it effectual, the hollow of the tooth must be well cleansed before it is applied. A mixture of 15 parts of creosote and 10 of collodion is said to have a jelly-like consistence, and to be usefully applied to carious teeth, which it protects from the air; but, as pure creosote does not coagulate collodion, this remark applies properly to the impure phenol before stated to be commonly sold under the same name.

In an overdose creosote acts as a poison, producing giddiness, obscurity of vision, depressed action of the heart, convulsions, and coma. H. A. Hare has found that sulphuric acid and the soluble sulphates are antidotal to creosote as they are to phenol. Medicinal treatment consists in evacuation of the poison and administration of ammonia and other stimulants.

Under the name of Vapor Creasoti (*Inhalation of Creasote*), the British Pharmacopœia (1885) formerly directed a preparation consisting of 12 minims of creasote and 8 fluidounces of boiling water, which were directed to be mixed in an inhaling apparatus, so arranged that the air should be made to pass through the solution, and then inhaled. It may be used in chronic inflammation of the air passages.

Dose, of creosote, five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Aqua Creosoti, *U. S.;* Mistura Creosoti, *Br.;* Unguentum Creosoti, *Br.*

CRESOL. U. S.

CRESOL

(crē'ŏl)

$C_7H_7.OH = 107.25$

"A mixture [$C_6H_4(CH_3)OH$] of the three isomeric Cresols obtained from coal-tar, freed from phenol, hydrocarbons, and water. It should be preserved in amber-colored bottles, protected from light." *U. S.*

Cresolum, Cresolum Purum; Cresylic Acid, Tricresol, Methylphenol, Oxytoluene; Cresol, *Fr.;* Enterol, Trikresol, Kresol, *G.*

Preparation.—Cresol was introduced into the U. S. P. (8th Rev.) mainly for use in making the official compound solution of cresol

(*Liquor Cresolis Compositus*), an antiseptic solution well adapted for external uses because of its miscibility with water. Crude carbolic acid is an impure form of cresol. Cresol is prepared from coal tar by collecting the distillates coming over between 140° C. and 220° C., and purifying these by treatment with solution of sodium hydroxide and hydrochloric acid.

Properties.—There are three isomeric cresols: *orthocresol,* melting at 31° C. and boiling at 188° C.; *metacresol,* a liquid boiling at 201° C., but not solidifying even at —80° C.; and *paracresol,* forming colorless prisms, melting at 36° C. and boiling at 198° C. These cresols are all obtainable by fractional distillation from that portion of coal tar boiling between 190° and 210° C.[1] Cresol of the U. S. P. is "a colorless or straw-colored refractive liquid, having a phenol-like odor, and turning yellowish-brown on prolonged exposure to light. Specific gravity: 1.038 at 25° C. (77° F.). Cresol is soluble in 60 parts of water at 25° C. (77° F.); miscible in all proportions with petroleum benzin, benzene, alcohol, ether, and glycerin; miscible with alkali hydroxide solutions. It boils at from 195° to 205° C. (383° to 401° F.). If 1 Cc. of Cresol be mixed with 1 Cc. of an aqueous solution of sodium hydroxide (1 in 10), it should dissolve with no appreciable liquid residue (absence of, or limit of, *hydrocarbons*). If 1 Cc. of Cresol be mixed with 1 Cc. of glycerin, a clear solution should be produced, from which, on the addition of 1 Cc. of water, the Cresol should completely separate (absence of, and distinction from, *phenol*)." *U. S.*

Uses.—It is generally believed that cresol is much more active as a germicide than phenol. The statement that it is less toxic than is phenol is probably not correct, although the difficulty of the absorption of cresol makes it act more slowly than does phenol, and it is certainly less caustic. The symptoms of poisoning by it have been identical with those of phenol poisoning. Internally cresol has been used to some extent given in capsules, but is inferior to phenol and has the same range of application. For further information see Cresol preparations, PART II.

Dose, 2 to 3 minims (0.12 to 0.2 Cc.).

Off. Prep.—Liquor Cresolis Compositus, *U. S.*

CRETA PRÆPARATA. U. S., Br.

PREPARED CHALK

(crē'ta præ-pa-rā-ta)

$CaCO_3 = 99.35$

"Native Calcium Carbonate, freed from most of its impurities by elutriation." *U. S., Br.*

Creta Lævigata; Craie lavée, Craie préparée, *Fr.;* Präparirte Kreide, Schlämmkreide, *G.;* Creta preparada, *Sp.*

[1] *Trikresol* is a mixture of orthocresol 35 per cent., metacresol 40 per cent., and paracresol 25 per cent.

Preparation.—Calcium carbonate, in the extended meaning of the term, is the most abundant of simple minerals, constituting, according to its state of aggregation and other peculiarities, the different varieties of calcareous spar, common and shell limestone marble, marl, and chalk. It occurs also in the animal kingdom, forming the principal part of shells, and a small proportion of the bones of the higher orders of animals. It is present in small quantity in most natural waters, being held in solution by the carbon dioxide which they contain. In the waters of limestone districts it is a very common impregnation, and causes purging in those not accustomed to its use. In all such cases, boiling the water, by expelling the carbon dioxide, causes the carbonate to be deposited. It has been shown, however, that calcium carbonate is itself in a slight degree soluble in water; so that a small proportion remains in limestone water which has been long exposed to boiling. That the carbonate is not held in solution by free carbon dioxide is shown by the fact that lime water causes no precipitation. (*J. P. C.,* 4e sér., iii. 147.) Besides being official in the state of chalk, calcium carbonate is also ordered as it exists in marble and oyster shell, and as obtained by precipitation. Chalk occurs abundantly in the south of England and the north of France. It exists massive in beds, and very frequently contains nodules of flint, and fossil remains of land and marine animals. According to F. V. Hayden, chalk beds identical with those of Europe extend for 400 miles along the Missouri River in Dakota. Chalk is an insipid, inodorous, insoluble, opaque, soft solid, generally white, but grayish white when impure. It is rough to the touch, easily pulverized, and breaks with an earthy fracture. It soils the fingers, yields a white trace when drawn across an unyielding surface, and when applied to the tongue adheres slightly. Its sp. gr. varies from 2.3 to 2.6. It is never a perfectly pure calcium carbonate, but contains, besides gritty silicious particles, small portions of alumina and ferric oxide. If pure, it is entirely soluble in hydrochloric acid, but usually a little silica is left. If this solution be not precipitated by ammonia, it is free from alumina and iron. Chalk, on account of the gritty particles which it contains, is unfit for medicinal use until it has been reduced to a very fine powder. The mineral, previously pulverized, should be rubbed with a little water upon a porphyry slab, by means of a muller of the same material. Having been thus very minutely divided, it is agitated with water, which upon standing a short time deposits the coarser particles, and, being then poured off, slowly lets fall the remainder in an impalpable state. The former part of the process is called *levigation,* the latter *elutriation.* The soft mass which remains after the decanting of the clear liquor is made to fall upon an absorbent surface in small portions, which when dried have a conical

shape.[1] Practically, prepared chalk is generally made on the large scale from *whiting* by the manufacturer. (See *P. J.*, vii. 146.)

Properties.—"A white to grayish-white, very fine amorphous powder, often moulded into conical drops; odorless and tasteless; permanent in the air. Almost insoluble in water; insoluble in alcohol; soluble in diluted acetic, hydrochloric, or nitric acids, with copious effervescence, leaving not more than a trifling residue. When heated to full redness, Prepared Chalk gradually loses carbon dioxide, and is converted into calcium oxide." *U. S.*

Uses.—This is the only form in which chalk is used in medicine. It is an excellent antacid; and, as the salts which it forms in the stomach and bowels, if not astringent, are at least not purgative, it is admirably adapted to *diarrhœa* accompanied with acidity. It is also sometimes used in acidity of stomach attending *dyspepsia* and *gout*, when a laxative effect is to be avoided, and it is one of the best antidotes for oxalic acid. It has been employed as an application to *burns* and *ulcers*, which it moderately stimulates, while it absorbs the ichorous discharge and thus prevents it from irritating the diseased surface or the sound skin. It is given internally in the form of powder, or suspended in water by the intervention of gum arabic and sugar. (See *Mistura Cretæ.*) Lozenges of chalk were also official under the name of *Trochisci Cretæ* in the U. S. P. 1890. Prepared chalk is better fitted for chalk mixture than the precipitated calcium carbonate, in consequence of its more impalpable character and greater powers of adhesion.

Dose, from ten to forty grains (0.65 to 2.6 Gm.).

Off. Prep.—Hydrargyrum cum Creta, *U. S.*, *Br.;* Mistura Cretæ, *U. S.* (from compound chalk powder), *Br.;* Pulvis Cretæ Compositus, *U. S.;* Pulvis Cretæ Aromaticus, *Br.*

CROCUS. Br.

SAFFRON

(crō′cŭs)

"The dried stigmas and tops of the styles of Crocus sativus, *Linn.*" *Br.*

Stigmata Croci, Spanish Saffron; Safran, *Fr. Cod.;* Crocus, *P. G.;* Safran, *G.;* Zafferano, *It.;* Azafran, *Sp.*

Crocus sativus, Willd., *Sp. Plant.* i. 194; Woodv., *Med. Bot.*, p. 763, t. 259.—The common cultivated saffron is a perennial plant, with a rounded and depressed bulb or corm, from which the flower rises a little above the ground, upon a long, slender, white, and succulent tube. The flower is large, of a beautiful lilac or bluish-purple color, and appears in September or October. The leaves are radical, linear, slightly revolute, dark green upon their upper surface, with a white longitudinal furrow in the centre, paler underneath, with a prominent flattened midrib, and enclosed at their base, together with the tube of the corolla, in a membranous sheath, from which they emerge soon after the appearance of the flower. The style hangs out on one side between the two segments of the corolla, and terminates in three long convoluted stigmas, which are of a rich orange color, highly odorous, rolled in at the edges, and notched at the summit. The stigmas of the *Crocus orientalis* are used in the East.

C. sativus, or *autumnal crocus*, is believed to be a native of Greece and Asia Minor, where it has been cultivated from the earliest ages. There are three main varieties of it, the French, the Grecian, and the Chinese. The first of these is superior in color and flavor, the second in the amount of yield, while the third is said to unite these qualities. Saffron is also cultivated for medicinal use in Sicily, Spain, France, England, and other temperate countries of Europe. Large quantities of saffron are raised in Egypt, Persia, and Cashmere, whence it is sent to India. Much of the drug reaches the market of Constantinople from the neighborhood of Tiflis and the Caucasus. We cultivate the plant in this country chiefly as a garden flower, although some of the drug of very fine quality has been produced in Pennsylvania; the high cost of labor in America will probably prevent the possibility of its coming into commerce. It is liable to two diseases, which interfere with its culture,—one dependent on a parasitic fungus which attaches itself to the bulb, the other called by the cultivators in France *tacon*, by which the bulb is converted into a blackish powder. (*J. P. C.*, xviii. 41.) Wild saffron is found growing in uncultivated fields in Southern Russia; Tichomirow believes that these are varieties of *C. sativus* and *C. speciosus*, Marsh. Biebr., var. *β-Pallassii* (*C. Palassii*, Marsh. Biebr.). He further states that wild saffron from these sources is in no way inferior to that which is official. (*A. Pharm.*, 1903, 656.)

In England the flowers appear in October, and the leaves continue green through the winter; but the plant does not ripen its seed, and is propagated by offsets from the bulb. These are planted in grounds prepared for the purpose, and are arranged either in rows or in small patches at certain distances. The flowers are gathered soon after they show themselves, as the period of flowering is very short. The stigmas, or summits of the pistils, together with a portion of the style, are separated from the remainder of the flower, and carefully dried by artificial heat, or in the sun. During this process they are sometimes made to assume

[1] "Take of Chalk *a convenient quantity*. Add a little water to the Chalk, and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and, after a short interval, decant the supernatant liquor, while yet turbid, into another vessel. Treat the coarser particles of the Chalk, remaining in the first vessel, in a similar manner, and add the turbid liquid to that previously decanted. Lastly, set the liquor by, that the powder may subside, and having poured off the water, dry the powder." *U. S.* 1870.

the form of a cake by pressure; but the finest saffron is that which has been dried loosely. The two forms are distinguished by the names of *cake saffron* and *hay saffron.* Five pounds of the fresh stigmas are said to yield one pound of the dried. The English saffron, formerly most highly esteemed in this country, has disappeared from our market. What may be sold under the name is probably derived from other sources. Much of the drug is imported from Gibraltar, packed in canisters. Parcels of it are also brought from Trieste and other ports of the Mediterranean. The Spanish saffron is generally considered the best in the United States, although most European writers on Materia Medica give the preference to the French saffron. Genuine *cake saffron* is at present seldom found in commerce. The better grades of Spanish saffron are known as *Valencia* saffron, while *Alicante* saffron is said by Maisch to contain scarcely more than 50 per cent. of genuine saffron. According to Landerer, the stigmas of several other species besides those of *C. sativus* are gathered and sold as saffron in Greece and Turkey.[1]

Properties.—Saffron has a peculiar, sweetish, aromatic odor, a warm, pungent, bitter taste, and a rich deep orange color, which it imparts to the saliva when chewed. The stigmas of which it consists are an inch or more in length, expanded and notched at the upper extremity, and narrowing towards the lower, where they terminate in a slender, capillary, yellowish portion, forming a part of the style. They were officially described in the U. S. P. 1890 as "separate stigmas, or three, attached to the top of the style, about 3 Cm. long, flattish-tubular, almost thread-like, broader and notched above; orange-brown; odor strong, peculiar, aromatic; taste bitterish and aromatic. Saffron should not include the yellow styles. When pressed between filtering paper, it should not leave an oily stain. When chewed it tinges the saliva deep orange-yellow. When soaked in water, it should not deposit any pulverulent, mineral matter, nor show the presence of organic substances differing in shape from that described. On agitating 1 part of Saffron with 100,000 parts of water, the liquid will acquire a distinctly yellow color. No color is imparted to benzin agitated with saffron (absence of *picric acid* and some *other coal-tar colors*). On drying Saffron at 100° C.. (212° F.), it should not lose more than 14 per cent. of its weight (absence of *added water*). When thus dried, and ignited with free access of air, 100 parts of the dry Saffron should not leave more than 7.5 per cent. of ash (absence of *foreign inorganic substances*)." *U. S.* 1890. "Incinerated with free access of air, dried Saffron does not deflagrate (absence of nitrates), and yields about 7 per cent. of ash. It should not lose more than 12.5 per cent. of moisture when dried at 212° F. (100° C.)." *Br.* Analyzed by Vogel and Bouillon-Lagrange, saffron afforded 65 per cent. of a peculiar extractive matter, and 7.5 of an odorous volatile oil, together with wax, gum, albumen, saline matter, water, and lignin. The extractive was named *polychroïte,* from the changes of color which it undergoes by the action of reagents. Weiss (Wiggers and Husemann, *Jahresbericht,* 1868, 35) considered polychroïte to be a glucoside, but later researches have shown that it is a mixture of the glucoside crocin, sugar, and essential oil. (Planchon, *Drogues Simples,* vol. i. 210.) Kayser obtained (*Ber. d. Chem. Ges.,* 1884, 2228) pure *crocin,* having the formula $C_{44}H_{70}O_{28}$, as a yellow powder, easily soluble in water and diluted alcohol, slightly soluble only in absolute alcohol, and giving with concentrated sulphuric acid a deep blue color, which turns violet, then cherry-red, and finally brown. It is easily decomposed by lime or baryta water into *crocetin* and a right-rotating sugar which Kayser calls *crocose.* The crocetin is a red powder, not soluble in water, but easily soluble in alcohol and ether. Its solution in alkalies shows an orange-yellow color, from which solution acids separate it again in orange-colored flocks. Its formula is $C_{34}H_{46}O_9$, or according to Schmuck and Marchlewski, $C_{15}H_{20}O_4$. Kayser also found a colorless bitter principle, to which he gave the name *picro-crocin* or *saffron bitter,* and the

[1] At the International Exhibition in London in the year 1862, Geo. B. Wood noticed a specimen of saffron from the island of Ceylon, closely resembling that from *Crocus sativus.* It consisted of the stigmas of the *Crocus orientalis.* According to Charles A. Heinitsh, saffron was formerly cultivated to a considerable extent in Lancaster County, Pa. The plant requires a rich soil, which should be deeply dug and heavily manured. The bulbs are planted in August, eight inches apart, and the growing plant should be kept free from weeds. The flowering period begins about the middle of September, and continues until the beginning of October. The flowers are picked early in the morning, and the stigmas separated and dried in the shade. This is done every day during the period of flowering. A plot of 72 square feet will produce 9000 stigmas, weighing 420 grains, or from 33 to 36 pounds to the acre. (*A. J. P.,* 1867, p. 38.) In the Apennines the bulbs, which have been left in the ground during the winter without protection, are removed in August, are planted again in September in rows, and four weeks later the collection of the flowers is begun. (See *A. Pharm.,* Aug. 1885.) For an account of the cultivation in England, see *P. J.,* June, 1887. Monthus, an experienced cultivator in France, prefers a dry calcareous soil; plants the bulbs 3 or 4 inches deep; after the harvest in October manures the ground; and renews the planting every three years. He thus prevents the diseases peculiar to the plant. Monthus recommends the *petals* of the flower as applicable to the same purposes as the stigmas, having found them to be possessed of aromatic properties. They demand no peculiar caution in drying; but to preserve them it is necessary to exclude light and moisture. Acids redden them with extreme facility, and alkalies turn them green. He therefore recommends a tincture to be made from them, as a substitute for syrup of violets. He prepares the tincture by macerating 10 parts of the dried flowers in 100 parts of alcohol of 40°, for 48 hours. A longer maceration would destroy the color. Paper may be stained with the tincture, and kept green or red, the former for acids, the latter for alkalies. (*J. P. C.,* Juillet, 1867, 54.) According to Heim, *Crocosma aurea,* Pl., which is cultivated in Southern Africa as a dye-stuff, affords an excellent substitute for saffron, the dried petals giving, when treated with water, a brilliant yellow solution. The yellow coloring matter is more soluble in diluted alcohol and in alkaline solutions than in water, but is insoluble in absolute alcohol and in benzene. The partly dry aqueous extract gives with sulphuric acid a blue coloration, passing to violet, similar to that obtained from saffron.

formula $C_{38}H_{66}O_{17}$, which is also of glucoside character. It is to the essential oil, which, according to Henry, is present to the amount of 10 per cent., that saffron owes its activity. It may be partially separated by distillation. It has the formula $C_{10}H_{14}O$, boils at 208° to 210° C. (406.4° to 410° F.), is yellow, of a hot, acrid, bitterish taste, and heavier than water, in which it is slightly soluble.

Adulterations.—The high price of this medicine gives rise to frequent adulterations. Water is said to be very often added in order to increase its weight. Oil or glycerin is also added for the same purpose, or to improve the appearance. In some specimens the dyed corolla of the crocus with the attached stamens is abundant. Sometimes the flowers of other plants, particularly *Carthamus tinctorius,* or safflower, *Calendula officinalis,* or official marigold, and *arnica,* are fraudulently mixed with the genuine stigmas. They may be known by their shape, which is rendered obvious by throwing a portion of the suspected mass into hot water, to expand them. (See *Carthamus,* PART II.) A specimen of this adulteration has been introduced into the American market, by the name of *African Saffron.* (Maisch, *A. J. P.,* March, 1872, p. 110.) Other adulterations are the fibres of dried beef, the stamens of the crocus, distinguishable by their yellow color, the stigmas previously exhausted in the preparation of the infusion or tincture, and various mineral substances, easily detected upon close examination. The flowers of a Brazilian plant named *Fuminella* have, according to M. J. L. Soubeiran, been employed for the adulteration of saffron. They may be detected by shaking, gently but repeatedly, a large pinch of the suspected saffron over a piece of paper. The flowers of Fuminella, being smaller and heavier, separate and fall, and may be seen to consist of very short fragments, with a color like that of saffron, but a rusty tint which the latter does not possess. (See *Ph. Rev.,* 1898, 258.) J. Müller recommends concentrated sulphuric acid as the most certain test of saffron. It instantly changes the color of pure saffron to indigo blue. (*Chem. Gaz.,* May, 1845.) An adulteration which has been largely practised appears to consist of yellow-colored chalk or barium sulphate, made into a thin paste, probably with honey, and attached to the stigmas, sometimes isolated, sometimes in groups of five or six, enveloping them almost completely. If this saffron be kept in a dry place, and often handled, the paste becomes partly broken up, and the colored powder spreads itself in the mass and the envelope. The chalk can at once be detected by shaking the suspected saffron with water, and treating the precipitated powder with hydrochloric acid, when effervescence will occur. A less than the ordinary brightness of color in the saffron should lead to suspicion of this adulteration. Much can be told as to the purity of saffron by agitating the suspected flowers in distilled water; if the drug be pure the liquid will remain clear, slowly assuming a fine pure yellow tint; the saffron also will retain its red color for hours. Another excellent plan is to scatter a pinch of the flowers upon the surface of warm water, when the stigmas should spread out and display their proper form. Minute fragments of red saunders, which are often added to saffron, may be separated by agitating with water. For an elaborate discussion of adulteration, see *A. J. P.,* 1885, 487.[1] Adulterations of crocus may sometimes be detected by remembering that the pollen grains should be covered with very numerous fine prickles and should have a diameter of close to 98.175 mikrons. In various European markets there has been offered a saffron largely adulterated with borates, chlorides, and other salts of sodium and potassium, and yet retaining the physical properties of saffron of high character. These and other adulterations with inorganic salts can be detected by the amount of ash left on burning, genuine saffron leaving from five to seven per cent. This saffron also yielded immediately to water an orange-yellow color. Further, some of it at least was hygroscopic, so that when rubbed up between the fingers into a ball it retained that form instead of being elastic as is true saffron.

Attention has been called to a product of the Cape of Good Hope, named *Cape saffron,* which has a remarkable resemblance to genuine saffron, having a similar odor, and yielding a similar color to water, though the flowers themselves are differently colored. It is the flower of a small plant very abundant at the Cape, belonging to the family of *Scrophulariaceæ,* and

[1] B. S. Procter has proposed a seemingly efficient color test. One grain of saffron is to be agitated with two drachms of ether, which should become fairly yellow (any over-coloring of the ether indicates aniline or other dye); ether decanted; saffron dried, then agitated with two drachms of rectified spirit, and heated short of ebullition, for about one hour; next dried with two drachms of water in the same manner; this alternate use of spirit and water is to be continued until the solvent ceases to extract color and the fibres are nearly white; the total liquids being made up to exactly two fluidounces should have a color closely resembling that of fourteen grains of potassium dichromate in two ounces of water. In comparison, the best results are obtained by taking eight minims of the standard liquid and diluting it with an ounce of water, half filling a test tube about half an inch in diameter with this diluted standard, then adding to an ounce of water eight minims of the liquid obtained from the sample under examination, and, having half filled a similar test tube with this, holding the two tubes side by side against a sheet of white paper. E. Vinassa recommends that saffron should always be steeped in petroleum before examination under the microscope, and the particles should then all present equality in coloration. Immersion in hydrated chloral and subsequent boiling with water enable the operator easily to detect admixtures of sandal or campeche wood and of safflower. Attention should also be paid to the pollen grains, hairs, and crystals present. Chemical examination shows that the amount of water should not exceed 16 per cent. and the ash 8 per cent. in a good sample, while the tinctorial power may be estimated by comparison with potassium dichromate solution. The capillary behavior of an aqueous solution of saffron is characteristic in that distinct zones of color are produced in strips of filtering paper dipped in the solution, the uppermost zone being terminated by a sharply defined light yellow line. (*Bull. Pharm.,* Nov. 1892.)

is said by Pappé of Cape Town, to possess medicinal virtues closely resembling those of true saffron. The flowers have been used successfully in the convulsions of children. (*P. J.*, vi. 462, 1865.)

Choice of Saffron.—Saffron should not be very moist, nor very dry, nor easily pulverized; nor should it emit an offensive odor when thrown upon live coals. The freshest is the best, and that which is less than a year old should, if possible, be selected. It should possess in a high degree the characteristic properties of color, taste, and odor. When agitated with water it should color it bright yellow, and it should not effervesce in the presence of a diluted acid. If it does not color the fingers when rubbed between them, or if it has an oily feel, or a musty flavor, or a black, yellow, or whitish color, it should be rejected. In the purchase of this drug in cakes, those should be selected which are close, tough, and firm in tearing; and care should be taken to avoid *cakes of safflower.*

As its activity depends, partly at least, on a volatile ingredient, saffron should be kept in well-stoppered vessels. Some recommend that it should be enclosed in a bladder and introduced into a tin case.

Uses.—Saffron was extensively used by the ancients and by mediæval physicians, as a highly stimulant antispasmodic and even narcotic emmenagogue, and is still employed to some extent upon the Continent; but in Great Britain and the United States it has fallen into well deserved and almost complete desuetude. In domestic practice saffron tea is occasionally used in *exanthematous diseases,* to promote the eruption. At present it is chiefly used to impart color and flavor.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Decoctum Aloes Compositum, *Br.;* Tinctura Cinchonæ Composita, *Br.;* Tinctura Croci, *Br.*

CUBEBA. U. S. (Br.)

CUBEB

(cū-bē'bą)

"The dried unripe, but fully grown fruit of *Piper Cubeba* Linné filius (Fam. *Piperaceæ*)." *U. S.* "The dried full-grown unripe fruits of Piper Cubeba, *Linn. fil.*" *Br.*[1]

Cubebæ Fructus, *Br.;* Fructus (s. Baccæ) Cubebæ, Piper Caudatum; Cubebs, Tailed Pepper; Cubèbe, Cubèbe ou Poivre à Queue, *Fr. Cod.;* Cubebæ, *P. G.;* Kubeben, *G.;* Pepe Cubebe, Cubebe, *It.;* Cubeba, *Sp.;* Kebabeh, *Ar.*

[1] The fruit of the *Piper Afzelii* of Lindley, *Cubeba Clusii* of Miquel, figured in the *P. J.* (xiv. 201), is known in commerce as *African cubebs, Ashantee pepper, Guinea pepper,* or *African black pepper.* It was formerly taken to Europe in considerable quantities by the Portuguese, but has been superseded by the more agreeable products of the East Indies. The fruit is one-third smaller than the official cubeb, is more compact, and has a taste more analogous to that of ordinary black pepper. Stenhouse has also shown that it is chemically more analogous to black pepper than to cubeb, as it contains piperin and not cubebin. (*Ibid.,* xiv. 364.) An alleged *African cubebs* which has been sent to London from Cape Coast Castle, in Africa, is the fruit of a plant belonging to the *Xanthoxylaceæ,* probably either a *Toddalia* or a *Vepris.* According to Archer, it is simply aromatic and stimulant, without any of the special virtues of cubeb. (*P. J.,* March, 1865, 463.)

Our knowledge of the false cubeb of commerce up to 1894 was epitomized in the 17th edition of the U. S. D., p. 457. To this account the reader is referred for historical details. In 1894 the subject was much clarified by A. De Wevre, a long abstract of whose memoir may be found in the *P. J.,* xxv. 1894. It appears that the natives of Java recognize three varieties of the cubeb plant under the respective names of *Rinoe katoentjar, Rinoe badak,* and *Rinoe tjaroelock.* Of these the first is true cubeb.

Rinoe badak yields a fruit strongly resembling the genuine cubeb, but having from eight to nine or even twelve rows of cells in the mesocarp, and yielding, when crushed with sulphuric acid, a yellow-brown or orange tone instead of the carmine-red color given by the true cubeb.

Rinoe tjaroelock is believed by De Wevre to be the *Piper crassipes* of Kirkby, and to be simply a variety of *Piper Cubeba,* so that its fruit must be considered to be a true cubeb, though it differs from the official drug in having its pedicel about twice as long as the fruit and flattened throughout, and in having an odor of mace and a more bitter and less burning taste than true cubeb, and yielding, when crushed with sulphuric acid, a brown color only. Its mesocarpic cells are in six or seven rows.

The *large false cubeb* of English commerce, commonly believed to be yielded by *Piper crassipes* of Korth, is a large, globular, brown or blackish fruit borne on a curved pedicel, usually at least twice as long as the fruit; the pedicel is not flattened, and is sometimes tapering, but never dilated, at its free extremity. The fruit measures from 7 to 8.5 Mm., and the pedicel 12 to 23 Mm. The taste is bitter, but does not leave a persistent burning sensation in the mouth. Sulphuric acid gives with the crushed fruit a yellow coloration. So far as De Wevre's examination went, *Piper crassipes* of Korth is identical with *Piper ribesioides,* Wallich.

A *short pedicelled cubeb* which occurs in commerce, in which the feebly aromatic fruit is from 4 to 5 Mm. in diameter and the pedicel 1 Mm., is especially characterized by a layer of small cells under the epidermis, like those of the epidermis, by a hypodermal layer of three or four rows of polygonal uniform stone cells, and by the cubical cells of the endocarp being cutinized in horseshoe fashion,—that is, having the outside wall thinner than the other three (the reverse of what occurs in black pepper).

Keboe cubeb is much larger than the official, being about 7 Mm. in diameter, with a pedicel 16 Mm. long; the color is blackish or grayish black, the surface much wrinkled, the taste acrid, slightly bitter, and pungent, and the strong odor different from that of cubebs. It is said to be yielded by *Piper* (*Pothomorphe*) *mollissimum,* Bl., and the *P. crassipes* of Brunotte.

The fruit of the *Daphnidium Cubeba,* a rather common adulteration of cubeb, has been shown to be identical with that of *Tetranthera citrata.* It is especially characterized by its endocarp, which consists of long, narrow, sclerenchymatous cells, crowded closely together in a single line and arranged radially. The taste of the fruit is slightly bitter and aromatic, but not burning. It has usually no pedicel, and the pericarp contains a plainly dicotyledonous seed without albumen, whereas in the cubeb the embryo is too small for the naked eye to distinguish the cotyledons, the mass of the seed consisting of albumen. The cells of the endocarp have a very narrow linear cavity, and are very distinct from those of cubeb. Even the powder of *Daphnidium Cubeba* is to be recognized from that of a Piper by the absence of small angular starch granules.

Among the other species of Piper whose berries have been found in cubeb,—in the African *P. Clusii,* D. C., and *P. guineense,* Schum., and in the Javanese *P. Lowong,* Bl., and *P. sylvestre,* Lam.,—neither the endocarp nor the hypoderm contains sclerenchymatous cells; while in *P. mollissimum,* Bl., the endocarp is not sclerenchymatous and the hypoderm very sparingly so. De Wevre refers to a species of Rhamnus, certain adulterating berries which occur in the cubeb. These berries are nearly tasteless, with an

Piper Cubeba, Willd., *Sp. Plant.* i. 159; Woodv., *Med. Bot.,* 3d ed., v. 95.—*Cubeba officinalis,* Miquel.—This is a climbing perennial

plant, with a smooth, flexuous, jointed stem, and entire, petiolate, oblong or ovate-oblong, acuminate leaves, rounded or obliquely cordate at the base, strongly nerved, coriaceous, and very smooth. The flowers are diœcious and in spikes, with peduncles about as long as the petioles. The fruit is a globose, pedicelled berry. This species of Piper is a native of Java, Penang, and probably other parts of the East Indies. It is extensively grown in the coffee plantations, supported by the trees which are used for shade, and has been introduced into Ceylon. The dried unripe fruit is the official portion.

Properties.—Cubeb is round, about the size of a small pea, of a blackish or grayish-brown color, and furnished with a short stalk, which is continuous with raised veins that run over the surface of the berry and embrace it like a network. The shell is hard, almost ligneous, and contains within it a single loose seed, covered with a blackish coat, and internally white and oleaginous. "From 10 to 13 Mm. long, the upper portion globoidal, 4 to 5 Mm. in diameter, contracted at the base into a slender stem-like portion, about 6 or 8 Mm. long, pericarp reticulately wrinkled, blackish-gray, about 0.3 Mm. thick; internally light brown, smooth, oily, one-seeded; brittle; of a strongly aromatic, somewhat camphoraceous odor and taste. The powder contains few or no starch grains, and on treatment with sulphuric acid the fragments become wine-colored." *U. S.* "A transverse section of the pericarp exhibits two layers of sclerenchymatous cells, one near the outer, the other near the inner surface, those of the latter being radially elongated. The crushed Fruit imparts a crimson color to *sulphuric acid.*" *Br.*

The odor of the berry is agreeably aromatic; the taste warm, bitterish, and camphorous, leaving in the mouth a peculiar sensation of coolness, like that produced by oil of peppermint. The pericarp of the cubeb berry consists of three layers, the exterior of which is composed of an interrupted row of small, thick-walled cubical sclerenchymatous cells arranged in irregular groups of three or four. The middle layer of the pericarp is composed of loose, undeveloped tissue, interspersed with large oil cells, and contains quantities of starch and sometimes groups of needle-shaped crystals The inner layer is free from starch, and is formed of four rows of parenchymatous cells. At the junction of the inner and middle layers there are usually from ten to twelve distinct woody bundles, chiefly composed of narrow spiral vessels along with a few dotted vessels. The mesocarp is composed of compressed parenchymatous cells, of which there are usually four rows, while the endocarp is formed of long sclerenchymatous cells arranged radially,—*i.e.*, on their ends. The testa consists of one row of large, thick-walled cells. The perisperm is surrounded by red membrane, formed of rather large cells, and is composed of angular parenchymatous cells containing starch and oil. On allowing thin sections to stand in glycerin for a few weeks, crystals are formed both in the pericarp and in the perisperm. The chief characteristics of the powder are described as being a dark-colored and oily aspect, and it is microscopically characterized by the presence of prismatic sclerenchymatous cells.

The most obvious constituent of cubeb is the volatile oil, the proportion of which yielded by the drug varies from 4 to 13 per cent. It is, as shown by Oglialoro, a mixture of an oil, $C_{10}H_{16}$, boiling at 158° to 163° C. (316.4° to 325.4° F.), which is present in very small amount, and is probably pinene or camphene, some dipentene, and two oils of the formula $C_{15}H_{24}$, boiling at 262° to 265° C. (503.6° to 509° F.). One of these, known as *cadinene*, is strongly lævogyrate, and yields a crystallized compound having the formula, $C_{15}H_{24}2HCl$, and melting at 118° C., while the other is less lævogyrate, and does not combine with HCl.

The oil distilled from old cubeb on cooling at length deposits large transparent inodorous octahedra of *camphor of cubeb*, $C_{15}H_{26}O$. E. Schmidt found that this camphor melts at 66.5° C.; simply by standing over sulphuric acid, more rapidly on heating, it gave up water and passed into that fraction of cubeb oil which boils at 260° C., of which it is, therefore, simply the hydroxide. Another constituent of cubeb is *cubebin*. This is an inodorous substance, crystallizing in small needles or scales, melting at 125° C. (257° F.), having a bitter taste in alcoholic solution; it dissolves freely in boiling alcohol, but deposits on cooling, and is abundantly soluble in chloro-

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odor somewhat resembling that of *Daphnidium Cubeba*, are rounded and compressed laterally, with two rather deep furrows, separating the fruit into halves, and have, internally, two cells. Their powder is characterized by the presence of a great number of stone cells, entirely different in form from those of cubebs.

E. M. Holmes and E. D. Gravill (*P. J.*, vol. xv.) give the following tests which may be available in detecting powdered false cubeb. After being crushed, the genuine cubeb gives on a porcelain slab with concentrated sulphuric acid a deep crimson with a distinct carmine tint in it. *P. crassipes* strikes a reddish-brown color, *Daphnidium Cubeba* a yellowish brown color. Iodine gives with a decoction of genuine cubeb a pure blue tint, and with spurious cubeb a dull purple tint. One cubic centimeter of the tincture of true cubeb treated with ten cubic centimeters of strong sulphuric acid (sp. gr. 1.843) develops a deep violet color, the false cubeb similarly treated a deep red-brown. On diluting these mixtures with four fluidounces of distilled water and allowing them to stand, the true cubeb becomes opalescent and changes to a deep blue; that made from the false becomes opalescent and changes to a dirty yellow. In applying these tests to adulterated cubeb, the color developed will, of course, be dependent upon the amount and character of the adulteration. An important conclusion reached by De Wevre is, that it is not possible to detect by microscopic examination with certainty the freedom of a powdered cubeb from adulteration with various berries, especially those yielded by different species of the genus Piper, although the presence of numerous polygonal stone cells would indicate adulteration, while the peculiar prismatic sclerenchymatous cells of the true cubeb indicate genuineness. It would seem to be essential for the pharmacist to buy his cubeb whole, and examine the fruit before powdering.

form. Its composition, according to Weidel (1877), is $C_{10}H_{10}O_3$, and its structural formula, $C_6H_3\begin{cases}O\\O>CH_2\\C_3H_4OH\end{cases}$, shows a close relationship to safrol, $C_6H_3\begin{cases}O\\O>CH_2\\C_3H_5\end{cases}$. Fused with potassium hydroxide it yields proto-catechuic acid. The resin extracted from cubeb consists of an indifferent portion, nearly 3 per cent., and of *cubebic acid*, $C_{13}H_{14}O_7$, amounting to about 1 per cent. (*Pharmacographia*, 2d ed., p. 587.)

The formula of cubebic acid as just given is that of Schmidt. Schultze (*Jahresbericht*, 1873, p. 863), on the other hand, gives to it the formula $C_{28}H_{30}O_7 + H_2O$. According to Capitaine and Soubeiran, *cubebin* is best obtained by expressing cubeb from which the oil has been distilled, preparing from the marc an alcoholic extract, treating this with a solution of potassium hydroxide, washing the residue with water, and purifying it by repeated crystallizations in alcohol. In the official oleoresin of cubeb a deposit takes place consisting chiefly of cubebin, which may be obtained by washing the deposit with a small quantity of cold alcohol to remove adhering resin and oil, and then dissolving repeatedly in boiling alcohol, and crystallizing until the product is white.[1] The volatile oil is official. (See *Oleum Cubebæ*.) By practical trial Bernatzik has satisfied himself that the peculiar virtues of cubeb as a remedy in gonorrhœa depend not on the cubebin or the volatile oil, but on the cubebic acid. When the ethereal extract of cubeb is deprived of its volatile oil by evaporation on a water bath, and of cubebin and wax by deposition, a soft resin is left, the *cubebic acid* of Bernatzik, in which, according to F. V. Heydenreich, who experimented with it as a physiological agent, the diuretic properties reside, the cubebin being without apparent effect, and the volatile oil, though stimulant and carminative, having no diuretic action. The soft resin, which was of the consistence of honey, of a dark olive-green color, and some remaining odor of cubeb, when taken in the dose of ten grains every two hours for six hours, acted as a laxative, and gave the urine a peculiar odor, without increasing its quantity; but in the dose of a drachm, once repeated at an interval of three hours, while it produced the same effects as the smaller dose, it considerably augmented the urine. In still larger doses it produced decided irritation of the urinary passages. (*A. J. P.*, Jan. 1868.) Heydenreich's experiments are confirmatory of Bernatzik's conclusion as to the peculiar active principles of cubeb. Cubeb gradually deteriorates by age, and in powder becomes rapidly weaker, in consequence of the escape of its volatile oil. It should be kept whole, and pulverized when dispensed. The powder is said to be sometimes adulterated with that of pimenta.

Uses.—Cubeb is generally stimulant, with a special direction to the urinary organs. In considerable quantities it excites the circulation, increases the heat of the body, and sometimes occasions headache and giddiness. At the same time it frequently produces an augmented flow of the urine, to which it imparts a peculiar odor. Among its effects are also occasionally nausea and moderate purging, and it is said to cause a sense of coolness in the rectum during the passage of the fæces. We have no evidence that it was known to the ancients. It was probably first brought into Europe by the Arabians, and was formerly employed for similar purposes as black pepper, but it was found much less powerful and fell into disuse. In India it has long been used in *gonorrhœa* and *gleet*, and as a grateful stomachic and carminative in disorders of the digestive organs, and it is at present very frequently given both in this country and in Europe in *gonorrhœa*, after the subsidence of the first active inflammatory symptoms. It has been given also in *leucorrhœa*, *cystorrhœa*, the *urethritis* of women and female children, *abscess of the prostate gland*, *piles*, and *chronic bronchial inflammation*. In connection with copaiba it has been especially recommended in affections of the neck of the bladder and the prostatic portion of the urethra. It is best administered in powder, of which the dose in gonorrhœa is from one to three drachms (3.9 to 11.6 Gm.) three or four times a day. The volatile oil may be substituted, in the dose of ten or twelve minims (0.6 to 0.7 Cc.), suspended in water by means of sugar, though, if the experiments of Bernatzik and Heydenreich are to be relied on, the oil is much less efficient than the soft resin as a remedy in gonorrhœa and in diseases of the urinary passages generally. An alcoholic extract is directed by the U. S. P., and is much used, and, as it contains soft resin or cubebic acid, it is no doubt very efficient. (See *Oleoresina Cubebæ*.) An infusion, made in the proportion of an ounce of cubeb to a pint of water, has been employed as an injection in discharges from the vagina.

Dose, of powdered cubeb, ten grains to one drachm (0.65 to 3.9 Gm.).

Off. Prep.—Fluidextractum Cubebæ, *U. S.*; Oleoresina Cubebæ, *U. S.*; Tinctura Cubebæ, *Br.*; Trochisci Cubebæ, *U. S.* (from oleoresin).

CUPRI SULPHAS. U. S., Br.

COPPER SULPHATE [Cupric Sulphate]

(cū'prī sŭl'phăs)

$CuSO_4 + 5H_2O = 247.85$

"It should contain not less than 99.5 per-cent. of pure Copper Sulphate [$SO_2.O_2Cu +$

[1] E. Schaer calls attention to the similarity in reaction between cubebin and veratrine, aconitine, morphine, and digitalin. (*A. Pharm.*, 1887, p. 531.)

$5H_2O$]." *U. S.* "This salt, $CuSO_4,5H_2O$, may be obtained by the interaction of water, sulphuric acid, and copper or cupric oxide." *Br.*

Cuprum Vitriolatum; Blue Vitriol, Roman Vitriol, Blue Stone; Sulfate de Cuivre, *Fr. Cod.;* Vitriol bleu, Couperose bleu, *Fr.;* Cuprum Sulfuricum, *P. G.;* Schwefelsaures Kupfer, Kupfersulfat, Kupfervitriol, Blauervitriol, Blauer Galitzenstein, *G.;* Solfato di rame, Vitriolo di rame, *It.;* Sulfato cuprico, Vitriolo azul, *Sp.*

Preparation.—Copper sulphate occasionally exists in nature, in solution in the water which flows through copper mines. In this case the salt is procured by merely evaporating the waters which naturally contain it. Another method of obtaining it is to roast the native sulphide in a reverberatory furnace, whereby it is made to pass, by absorbing oxygen, into the state of sulphate. The roasted mass is lixiviated, and the solution obtained evaporated that crystals may form. The salt procured by either of these methods contains a little ferric sulphate, from which it may be freed by adding either an excess of cuprous oxide, which precipitates ferric oxide, or recently precipitated copper subcarbonate, which causes the deposition of the iron as a carbonate. (*A. J. P.,* xxxiv. 507.) A third method is to dissolve copper scales to saturation in sulphuric acid contained in a wooden vessel lined with sheet lead. The scales consist of metallic copper mixed with oxide, and are produced in the process for annealing sheet copper.

Most of the copper sulphate produced at present is obtained as a by-product by the gold, silver, and copper refiners. The production of copper sulphate in the United States is very large. In 1901 the exportations of sulphate amounted to 49,223,183 lbs., valued at $2,324,738, and in 1904 to 26,077,087 lbs., valued at $1,133,686.

In the U. S. Pharmacopœia copper sulphate is presumed to be obtained pure from the manufacturer; the British Pharmacopœia suggests the method in which it may be prepared, without entering into the details of the process. The German Pharmacopœia has two kinds official, *Cuprum sulfuricum,* which corresponds with the former *Cuprum sulfuricum purum,* and *Cuprum sulfuricum crudum,* or commercial sulphate.

Properties.—Copper sulphate has a rich deep blue color, and a strong metallic, styptic taste. It reddens vegetable blue, and crystallizes in "large, transparent, deep blue, triclinic crystals; odorless; of a nauseous, metallic taste; slowly efflorescent in dry air. Soluble in about 2.2 parts of water, 400 parts of alcohol, and 3.5 parts of glycerin at 25° C. (77° F.), and in 0.5 part of boiling water. When heated to 30° C. (86° F.), the salt loses 2 of its 5 molecules of water (14.43 percent.), and is converted into a pale blue amorphous powder. Two more molecules of water are lost at 100° C. (212° F.), while the fifth is retained until 200° C. (392° F.) is reached, when a white, anhydrous powder remains (63.9 percent. of the original weight). At a still higher temperature, sulphur dioxide and oxygen are given off, and a residue of black cupric oxide is left. The aqueous solution (1 in 20) has a blue color, and shows an acid reaction with blue litmus paper. If a drop of the solution be placed upon a bright piece of iron, a red film of metallic copper will be produced. With potassium ferrocyanide T.S. the solution yields a deep reddish-brown precipitate. Barium chloride T.S. produces in the solution a white precipitate, insoluble in hydrochloric acid. If ammonia water be added to the solution, drop by drop, a pale blue precipitate of cupric hydroxide is formed, which redissolves in an excess of ammonia water, forming a deep azure-blue solution. If hydrogen sulphide gas be passed through 10 Cc. of the aqueous solution of the salt (1 in 20), to which 1 Cc. of diluted hydrochloric acid has been added, until all of the copper is precipitated as sulphide, one-half of the colorless filtrate should not be colored or rendered turbid upon the addition of ammonia water, nor should the remaining portion of the filtrate yield, upon evaporation, a weighable residue (limit of *iron, aluminum,* etc.). If the aqueous solution of the salt (1 in 20) be heated to boiling with an excess of sodium hydroxide T.S., until all of the copper has been converted into black cupric oxide, it will yield a colorless filtrate, which, after acidulation with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121)." *U. S.* "Soluble in 3.5 parts of cold *water,* forming a solution which strongly reddens *litmus;* very soluble also in *glycerin,* almost insoluble in *alcohol* (90 per cent.). It affords the reactions of copper and of sulphates. It should yield no characteristic reaction with the tests for lead, arsenium, zinc, or aluminium, and not more than the slightest reactions with the tests for iron." *Br.* When heated, copper sulphate first melts in its water of crystallization, and then dries and becomes white. If the heat is increased, it next undergoes the igneous fusion, and finally, at a high temperature, loses its acid, cupric oxide being left. Four of the molecules of water of crystallization can be driven off at 100° C. (212° F.); but the fifth goes off only at a temperature of from 220° C. (428° F.) to 240° C. (464° F.), when the anhydrous salt remains. Potassium hydroxide, sodium hydroxide, and ammonia throw down from it a bluish-white precipitate of hydrated cupric oxide, which is immediately dissolved by an excess of the last mentioned alkali, forming a rich deep blue solution, called *aqua sappharina.* It is decomposed by the alkaline carbonates, and by borax, lead acetate and subacetate, ferric acetate, silver nitrate, mercuric chloride, potassium tartrate, and calcium chloride, and it is precipitated by all astringent vegetable infusions. If it becomes very green on the surface by the action of

the air, it contains ferric oxide. This oxide may also be detected by ammonia, which will throw it down along with the copper oxide, without taking it up when added in excess. When copper sulphate is obtained from the *dipping liquid* of manufacturers of brass or German silver ware, it is always contaminated with zinc sulphate, as pointed out by S. Piesse. This liquid is at first a mixture of sulphuric and nitric acids, but becomes, at last, nearly saturated with copper. When zinc is present in copper sulphate, it will be taken up by solution of potassium hydroxide added in excess, from which it may be thrown down, after filtration, in white flocks, by a solution of bicarbonated alkali.

Uses.—Copper sulphate is irritant or mildly escharotic, and when in diluted solution, stimulant and astringent. At one time it was given in *epilepsy* and other nervous diseases, but at present it is never used internally, except for its influence upon the gastro-intestinal mucous membrane. In *chronic diarrhœa* with ulceration it is often a useful remedy. In doses of 5 grains it acts as a powerful, prompt emetic, without causing general depression or much nausea, but is too irritant to be used freely. Externally it is employed in solution as a stimulant to ill-conditioned *ulcers*, as an escharotic for destroying *warts*, fungous *granulations*, and callous edges, and as a styptic to bleeding surfaces. It is found, in not a few instances, to promote the cicatrization of ulcers, and is not infrequently employed, with that view, as a wash for *chancres*. The preparation called *cuprum aluminatum* (*lapis divinus—pierre divine*) is made, according to the French Codex, by mixing, in powder, three ounces, each, of copper sulphate, potassium nitrate, and alum, heating the mixture in a crucible, so as to produce aqueous fusion, then mixing in a drachm of powdered camphor, and, finally, pouring out the whole on an oiled stone to congeal. The mass, when cold, is broken into pieces, and kept in a well-stoppered bottle. It is often desirable to employ copper sulphate, as a caustic, in the form of pencil. Its tendency to effloresce interferes with its use in this way in the pure state. Llovet recommends for the purpose a mixture of one part of potassa-alum and two of copper sulphate, which are to be first powdered, and then gradually melted together in a porcelain vessel, and poured into moulds made of bronze. (*Gaz. des Hôp.*, Juillet 28, 1863.) Another mode of preparing *pencils of copper sulphate* is to rub briskly together four parts of that salt and one of borax, and to mould the plastic mass which results, into the desired form. (*A. J. P.*, March, 1864, p. 106.) An elongated cone is the best form, made by selecting suitable crystals and turning them in a lathe to the desired form; or they may be made by filing the crystals, and finishing with sand-paper.

Dose, of copper sulphate, as an astringent, one-fourth of a grain (0.016 Gm.); as an emetic, five grains (0.32 Gm.), repeated in fifteen minutes if necessary, but not oftener than once. As a stimulant wash, the solution may be made of the strength of two, four, or eight grains to the fluidounce of water. For its effects as a poison, see *Cuprum*.

CUPRUM.

COPPER

(cū′prŭm)

Cu = 63.1

"Fine Copper wire, about No. 25 wire gauge, or about 0.02 inch." *Br.* 1885.

Cupreum Filum; Fil de Cuivre, Cuivre, *Fr.*; Kupfer, Kupferdraht, *G.*; Rame, *It.*; Cobre, *Sp.*

This metal is very generally diffused in nature, and exists principally in four states; as native copper, as an oxide, as a sulphide, and as a salt. Its principal native salts are the silicate, carbonate, arsenate, and phosphate. In the United States it occurs in various localities, but especially in the neighborhood of Lake Superior, in Montana, Arizona, Alaska and East Tennessee. The principal producing copper mines of Europe are those of Spain and Portugal and of Mansfeld in Germany. Chili and Japan are also relatively large producers at present.

The total production of copper in the United States has increased very rapidly in recent years, and now is more than half of the world's annual production. It was, for 1902, 699,508,644 lbs., valued at $90,936,124, and for 1903, 730,044,517 lbs., valued at $94,905,787. The three most productive states are Montana, Michigan, and Arizona, in the order named. The consumption of copper in the United States for 1903 was 566,429,885 lbs., and the exports for the same year 310,729,524 lbs.

Properties.—Copper is a brilliant, sonorous metal, of a reddish color, and very ductile, malleable, and tenacious. It has a slightly nauseous taste, and emits a disagreeable odor when rubbed. Its texture is granular, and its fracture hackly. Its sp. gr. is 8.92 to 8.95, and its fusing point 1398° C. (2538° F.) according to Daniell, being intermediate between the fusing points of silver and gold. Its atomic weight is given at 63.5, or, according to the most accurate determinations, 63.1. Exposed to the air it undergoes a slight tarnish. Its combinations are numerous and important. With oxygen it forms two well characterized oxides, a red suboxide, better known as *cuprous* oxide, Cu_2O, and a black oxide, known as *cupric* oxide, CuO. While a cuprous chloride, iodide, and sulphide are known, it is the cupric oxide chiefly that unites with the several acids to form the copper salts. With metals copper forms numerous alloys, of which that with zinc, called brass, and that with tin, called bronze, are the most useful.

Characteristics.—Copper is recognized by its color, and the effects of tests on its solution in nitric acid. This solution, with potassium hydroxide, sodium hydroxide, and ammonia, yields a blue precipitate, soluble in excess of the latter alkali, with which it forms a deep azure-blue liquid. Potassium ferrocyanide occasions a brown precipitate of copper ferrocyanide, and a bright plate of iron immersed in the solution immediately becomes covered with a film of metallic copper.[1] Potassium ferrocyanide is a very delicate test for minute portions of copper in solution. Another test, proposed by Verguin, is to precipitate the copper in the metallic state on platinum by electrochemical action. For this purpose a drop of the (acid) liquid to be examined is placed on a slip of platinum foil, and a slip of bright iron is brought in contact with the platinum and the liquid. If copper be present it will be instantly precipitated on the surface of the platinum.

Action on the Animal Economy.—Copper in its pure state is nearly inert, but in combination it is highly deleterious. (For an account of the action of copper upon water see *Aqua*, page 162.) Nevertheless a minute portion of the metal has been found in the human body. According to Millon, copper, when it exists in the blood, is, like the iron, attached to the red corpuscles. To bring the copper into a state favorable for ready detection, he advises that the blood, as it escapes from a vein, be received in about three times its bulk of water, and the mixture poured into a bottle of chlorine and agitated. The whole, upon being rapidly filtered, furnishes a liquid in which copper is readily detected. Wackenroder found copper in the blood of man, but does not consider it a constant and normal constituent. He also detected this metal in the blood of domestic animals living on a mixed diet, but not in their blood when nourished on vegetable food only. (*Chem. Gaz.*, May 1, 1854.) It has been found in the feathers of certain birds, as of a grass-green paroquet from Australia, which is said to frequent districts of the country where copper is found. (*Ibid.*, Oct. 24, 1873, p. 212.) The soluble combinations of copper, when taken in poisonous doses, produce a coppery taste in the mouth; nausea and vomiting; violent pain in the stomach and bowels; frequent black and bloody stools; small, irregular, sharp, and frequent pulse; faintings; burning thirst; difficulty of breathing; cold sweats; paucity of urine, and burning pain in voiding it; violent headache; cramps, convulsions, and finally death. The best antidote is potassium ferrocyanide, given freely, which forms with the poison the very insoluble copper ferrocyanide. Soap and alkalies are also antidotal. Before the antidote can be procured, large quantities of milk should be given and white of eggs mixed with water, which act favorably by forming copper caseinate and copper albuminate, but these compounds should be evacuated as soon as possible by vomiting and purging. Should vomiting not take place, the stomach tube may be employed. The symptoms of slow poisoning by copper are, according to Corrigan of Dublin, a cachetic appearance, emaciation, loss of muscular strength, colicky pains, cough without physical signs, and retraction of the gum, with a persistent purple edge, quite distinct from the blue edge produced by lead. (*Braithwaite's Retrospect*, Am. ed., xxx. 303.) But there is much doubt whether these symptoms can be produced by the metal. (See H. C. Wood's *Therapeutics*.)

In medico-legal examinations, where cuprous poisoning is suspected, Orfila recommends that the viscera be boiled in distilled water for an hour, and that the matter obtained by evaporating the filtered decoction to dryness be carbonized by nitric acid. The carbonized product will contain the copper. By proceeding in this way there is no risk of obtaining the copper which may happen to pre-exist in the animal tissues. This method of search is preferable to that of examining the contents of the stomach and intestines, from which copper may be absent, while it may have penetrated the different organs by absorption, especially the abdominal viscera.

Vessels of copper which are not coated with tin should not be used in pharmaceutical or culinary operations, for, although the metal uncombined is inert, yet the risk is great that the vessels may be acted on and a poisonous salt formed.

CUSPARIÆ CORTEX. Br.

CUSPARIA BARK

(cŭs-pā'rĭ-æ cōr'tĕx)

"The dried bark of Cusparia febrifuga, *DC.*" *Br.*

Angustura, *U. S.* 1870: Angustura (Angostura) Bark, Carony Bark; Cortex Angusturæ: Angusture vraie, *Fr. Cod.*; Angusture, *Fr.*; Angusturarinde, *G.*; Corteccia dell' Angustura, *It.*; Corteza de Angostura, *Sp.*

This bark was dropped from the U. S. Pharmacopœia at the revision of 1880.

The subject of Angustura bark in its botanical relations has been involved in some confusion. The drug was at first supposed to be derived from a species of Magnolia, and was referred by some to *Magnolia virginiana* of this country. Humboldt and Bonpland were the first to throw light upon its true source. When at Angostura, a South American city on the Orinoco, they received specimens of the foliage of the plant from which the bark was obtained,

[1] Thoms (*Zeit. An. Chem.*, 94, 464) asserts that if to a solution too dilute to give a sensible reaction with potassium ferrocyanide be added a solution of potassium iodide, a yellow coloration is produced which becomes violet with starch paste. This test, in absence of deoxidizing agents, will show as little as 1 to 500,000.

and afterwards believed that they had found the same plant in a tree growing in the vicinity of Cumana. This latter they had the opportunity of personally inspecting, and were therefore enabled to describe accurately. Unable to attach it to any known genus, they erected it into a new one with the title of *Cusparia,* a name of Indian origin, to which they added the specific appellation of *febrifuga.* On their authority, *Cusparia febrifuga* was generally believed to be the true source of the medicine, and was recognized as such by the London College. A specimen having in the mean time been sent by them to Willdenow, the name of *Bonplandia* was imposed on the new genus by that celebrated botanist, and it was subsequently adopted by Humboldt and Bonpland themselves, in their great work on equinoctial plants. Hence the title of *Bonplandia trifoliata,* by which the tree is described in many works on Materia Medica. De Candolle, however, having found in the description all the characters of the genus *Galipea* of Aublet, rejected both these titles, and substituted that of *Galipea cusparia,* which was adopted by the London College, and for a time was retained in the British Pharmacopœia. But, after all these changes, it appears from the researches of Hancock, who resided for several months in the country of the Angustura bark tree, that it is doubtful whether the plant described by Humboldt and Bonpland is that which yields the drug, and not another species of the same genus. Among other striking differences between them is their different sizes, the tree described by Humboldt and Bonpland being at least sixty feet high, while that from which the bark is obtained is said to be never more than twenty feet. Hancock proposed for the plant of the Orinoco the title of *Galipea officinalis,* which was adopted in the U. S. P. 1870. This name was afterwards changed by Hancock to *Cusparia officinalis* (syn. *C. trifoliata,* H. et B., also (Willd.) Engl., and *Angostura Cusparia,* R. et Sch., of New Granada and Cumana), Fam. *Rutaceæ;* but at present the specific name *Angostura* of Richard seems to have precedence. *Bonplandia Angostura,* Rich., *Cusparia Angostura* (Rich.), Lyons.

Cusparia febrifuga, Humb.—*Cusparia officinalis,* Hancock, *Trans. Lond. Medico-Bot. Soc.*—*Galipea Cusparia,* St. Hilaire; *B. & T.,* vol. i. 43.—This is a small tree, irregularly branched, rising to the medium height of twelve or fifteen feet, with an erect stem from three to five inches in diameter, and covered with a smooth gray bark. The leaves are alternate, petiolate, and composed of three leaflets, which are oblong, pointed at each extremity, from six to ten inches in length, from two to four in breadth, and supported upon the common petiole by short leafstalks. They are very smooth and glossy, of a vivid green color, marked occasionally with small whitish round spots, and, when fresh, of a strong odor resembling that of tobacco. The flowers are numerous, white, arranged in axillary and terminal peduncled racemes, and of a peculiar unpleasant odor. The fruit consists of five bivalve capsules, of which two or three are commonly abortive. The seeds, two of which are contained in each capsule, one often abortive, are round, black, and of the size of a pea. The tree grows abundantly on the mountains of Carony, between the 7th and 8th degrees of N. latitude, and is well known in the missions near the Orinoco, upwards to two hundred miles from the ocean. It flourishes at the height of from six hundred to one thousand feet above the level of the sea. Its elegant blossoms, which appear in vast profusion in August and September, add greatly to the beauty of the scenery.

The bark is generally brought from the West Indies packed in casks; but, according to Brande, the original package as it comes from Angostura consists of the leaves of a species of palm, surrounded by a net-work of sticks.

Properties.—"Occurs in flattened or curved pieces, or in quills, generally about four or five inches (ten or twelve centimetres) long, an inch (twenty-five millimetres) wide, and one-twelfth of an inch (two millimetres) thick. The outer layer usually consists of a gray or yellowish cork which is often soft and easily removed, disclosing a hard, dark brown inner layer; the inner surface is light brown and frequently laminated. The fracture is short and resinous; on the fractured surface many white points are visible. A transverse section exhibits numerous cells filled with acicular crystals of calcium oxalate and small oil glands, but seldom any sclerenchymatous tissue other than small isolated groups of bast fibres. Odor musty; taste bitter." *Br.* Calcium oxalate raphides are abundant in the bark, but the most characteristic peculiarity is the presence of numerous cells a little larger than the other parenchymatous cells and completely filled with oil or a yellowish resin. The odor of Angustura bark is peculiar and disagreeable when fresh, becoming fainter with age; the taste is bitter and slightly aromatic, leaving a sense of pungency at the end of the tongue. According to Fischer, it contains volatile oil, bitter extractive, a hard and bitter resin, a soft resin, a substance analogous to caoutchouc, gum, lignin, and various salts. Oberlin and Schlagdenhauffen (1878) found in the bitter extractive an alkaloid, *angosturine,* $C_{10}H_{40}NO_{14}$, which melts at 85° C., is crystallizable, and is turned red by pure sulphuric acid, and green by sulphuric acid with admixture of nitric acid. The volatile oil, which may be obtained by distillation with water, is of a pale yellowish color, lighter than water, of an acrid taste, and with the odor of the bark. Beckurts and Froeger (Gildemeister and Hoffman, *Ætherische Oele,* p. 601) found as its essential ingredient a sesquiterpene alcohol, $C_{15}H_{26}O$, to

which they give the name *galipol.* It boils between 260° and 270° C. and is optically inactive. *Cadinene,* $C_{15}H_{24}$, is also present and gives left rotatory character to the oil. A small quantity of an inactive sesquiterpene, *galipene,* is also present, as well as traces of a terpene which is probably *pinene.* The *cusparine* of Saladin has not been found by other investigators. Beckurts and Nehring (*A. J. P.,* 1892, 410) announced the discovery of four alkaloids in Angustura bark,—viz., *galipine,* $C_{20}H_{21}NO_3$, melting at 115.5° C. (240° F.) and crystallizing in slender lustrous needles of white color; *galipidine,* $C_{19}H_{19}NO_3$, melting at 111° C. (231.8° F.) and crystallizing in silky lustrous plates of white color; *cusparine,* $C_{20}H_{19}NO_3$ ($C_{19}H_{17}NO_3$, Körner), melting at 89° C. (192.2° F.) and readily soluble in alcohol, ether, chloroform, acetone, and benzene, more sparingly in light petroleum; and *cusparidine,* $C_{19}H_{17}NO_3$, melting at 78° C. (172.4° F.) and crystallizing in minute slender white needles. Its salts are less soluble than those of galipine and galipidine, but more readily than those of cusparine. The four alkaloids are tertiary bases. (See also *A. Pharm.,* 233 (1895, No. 6), 410.) Beckurts and Nehring also extracted the essential oil, amounting to 1.5 per cent. It had a sp. gr. at 15° C. (59° F.) of 0.956. Distilled under a pressure of 35 Mm. it commenced to boil at 153° C. (307.4° F.) and the greater part distilled between 200° and 220° C. (392° to 428° F.) the last portions becoming solid when artificially chilled. (See also *A. Pharm.,* 1897, 518.) They found the bitter principle *angosturine,* which when purified was white and melted at 58° C. (136.4° F.). A glucoside was also found, the solution of which fluoresced; but it was not fully investigated.

A. T. Thompson states that precipitates are produced with the infusion by the solutions of ferrous sulphate, antimony and potassium tartrate, copper sulphate, lead acetate and subacetate, mercuric chloride, silver nitrate, and pure potassium hydroxide, by nitric and sulphuric acids, and by the infusions of galls and yellow cinchona; but how far these substances are medicinally incompatible with the bark it would be difficult to determine.[1]

Uses.—Angustura bark has long been used by the natives[2] of South America and the West Indies as a stimulant tonic. In large doses it also evacuates the stomach and bowels, and is often employed for this purpose in South America. It is said to be peculiarly efficacious in bilious *diarrhœas* and *dysenteries,* and has been recommended in *dyspepsia* and other diseases requiring a tonic treatment. The testimony, however, of practitioners in Europe and the United States is not strongly in its favor, and it is probably better adapted to tropical diseases than to those of temperate climates.

It may be given in powder, infusion, tincture, fluidextract, or extract.

Dose, of the extract, five to fifteen grains (0.32 to 1 Gm.), which, however, according to Hancock, is inferior to the powder or infusion. To obviate nausea, it is frequently combined with aromatics. (See *Infusum Cusparіæ.*)

Dose, in substance, ten to thirty grains (0.65 to 2.0 Gm.). In larger quantities it is apt to produce nausea.

Off. Prep.—Infusum Cusparіæ, *Br.;* Liquor Cusparіæ Concentratus, *Br.*

CUSSO. U. S., Br.

KOUSSO [Brayera]

(cūs'sō)

"The dried panicles of the pistillate flowers of *Hagenia abyssinica* (Bruce) Gmelin (Fam. *Rosaceæ*)." *U. S.* "The dried panicles of pistillate flowers of Brayera anthelmintica, *Kunth.*" *Br.*

Kooso; Kusso; Cousso, *Fr. Cod.;* Kousso, *Fr.;* Flores Koso, *P. G.;* Kosoblüthen, Koso, Kusso, Cusso, *G.;* Kousso, Cosso, *It.;* Couso, *Sp.*

Hagenia abyssinica, Gmelin, *B. & T.* 102.—*Brayera anthelmintica,*[3] Kunth; De Cand., *Pro-*

[1] False Angustura Barks.—Under this title, European writers describe a poisonous bark which was introduced on the Continent mixed with true Angustura bark. It is distinguished by its greater thickness, hardness, weight, and compactness; by its resinous fracture; by the appearance of its epidermis, which is sometimes covered with a ferruginous efflorescence, sometimes is yellowish gray and marked with prominent white spots; by the brownish color and smoothness of its internal surface, which is not, like that of the genuine bark, separable into laminæ, by the yellowish white powder which it yields; by its total want of odor, and its intense tenacious bitterness. When steeped in water it does not become soft like the true Angustura. Pelletier and Caventou found it to contain *brucine.* (See *Nux Vomica.*) In consequence of the presence of this principle, a drop of nitric acid upon the internal surface of the bark produces a deep red spot. The same acid, applied to the external surface renders it emerald-green. In true Angustura bark a dull red color is produced by the acid on both surfaces. The *false Angustura* was at first supposed to be derived from *Brucea ferruginea,* L'Herit, *B. antidysenterica,* Lam., but at present is ascribed to *Strychnos Nux vomica.* (See also *A. J. P.,* 1892, 115, and *P. J.,* 1895, 722.) An alkaloid, *brucamarine,* has been separated from *Brucea sumatrana,* Roxb.

Brazilian Angustura Bark, the product of *Esenbeckia febrifuga,* A. Juss, consists of slightly curved pieces 8 to 10 inches long, about $\frac{1}{8}$ of an inch in thickness, of a persistently bitter taste. The outer surface is usually ashen gray, and always marked with longitudinal red or black spots on a yellow ground; the inner surface is reddish with paler, distinct, elongated fibres. On maceration the bark does not swell. (Oberlin and Schlagdenhauffen, *J. P. C.,* xxviii.)

[2] *Columbia Angustura Bark.*—From time to time a false angustura bark, supposed to be a product of *Angustura braziliensis* or *Cusparia trifoliata* from Columbia, has appeared in the London market. For minute description see *P. J.,* August, 1903. In this bark, E. W. Pollard has found besides fixed and volatile oil, a bitter amorphous alkaloid, whose physiological activities have not been tested. This bark is especially distinguished from true angustura by the large and numerous concentrically arranged groups of sclerenchymatous cells, revealed by the microscope in its transverse section.

[3] According to *Index Kewensis. Brayera anthelmintica,* Kunth, is the correct name. *Hagenia abyssinica,* Gmelin, the synonym, the genus Hagenia not being acknowledged.

drom., ii. 580; Pereira, *Mat. Med.,* 3d ed., ii. 1818.—*Banksia abyssinica,* Bruce.—This is a tree about twenty feet high, growing on the table-land of Abyssinia, at an elevation of from three thousand to eight thousand feet. The branches exhibit circular cicatrices, left by the fallen leaves. These are crowded near the ends of the branches, large, pinnate, sheathing at the base, with opposite, lanceolate, serrate leaflets, villose at the margin, and nerved beneath. The unisexual flowers are tinged with purple, pedicelled, with an involucre of four roundish, oblong, obtuse, membranous bracts, and are arranged in fours, upon hairy, flexuous, bracteate peduncles, with alternate branches. They are small and of a greenish color, becoming purple. These and the unripe fruit are the parts of the plant employed. The petals are apt to be wanting in the dried flowers. They are brought from Abyssinia packed in boxes, reaching Europe chiefly by way of Aden and Bombay. The Abyssinian name of the medicine has been variously spelled by European writers kosso, koosso, cusso, cosso, etc. The fruit of the tree is said to be used as an anthelmintic in Abyssinia, but Dragendorff failed to detect any active principle in it.[1]

Properties.—The dried flowers are in unbroken though compressed clusters. The male flowers are usually collected, so that ordinarily the general color of the mass is greenish yellow or light brown; sometimes the female flowers constitute the bulk of the drug, which then has a distinct reddish tint, and is often known in commerce as *red kousso.* In accordance with our Pharmacopœia, this commercial variety should alone be used. The male flowers are often found mixed with the female flowers, when loose (not in bundles), as high as 12 per cent. of this adulteration having been noticed by Meyer and Sandlund. (*Ph. Ztg.,* 1893, No. 99.) The official description is as follows: "In rolls or compressed bundles from 25 to 40 Cm. long, reddish-brown, each branch arising from the axil of a sheathing bract, and each flower furnished at its base with two rounded bracts; calyx-tube top-shaped, pubescent, and bearing a circle, resembling an outer calyx, of five rigid, spreading, obovate, purple-veined bracts, which are larger than the five usually shrivelled and incurved oval calyx-lobes; the five caducous petals usually absent in the drug; carpels two; styles exserted and stigmas broad and hairy; odor slight; taste bitter. The large stems should be rejected." *U. S.* As the medicine, from its high price, is apt to be adulterated, it should be procured in the unpowdered state, in which the botanical characters of the flower will sufficiently test its genuineness. It has a fragrant balsamic odor, and the taste, slightly perceptible at first, becomes in a short time somewhat acrid and disagreeable. Analyzed by Wittstein, it was found to contain, in 100 parts, 1.44 of fatty matter and chlorophyll, 2.02 of wax, 6.25 of bitter acrid resin, 0.77 of tasteless resin, 1.08 of sugar, 7.22 of gum, 24.40 of tannic acid, 40.97 of lignin, 15.71 of ashes, with 0.14 part of loss. In 1855 it was studied by Clemens Willing (*Ch. Cb.,* 1855, 224), who found a small quantity of tannin, volatile oil, crystallizable acid, and a bitter resin. In 1858 Pavesi (*Viertelj. f. Prak. Pharm.,* viii. 505) made a further chemical study of the drug; but we are chiefly indebted to Bedall of Munich, for determining that the bitter acrid resin of Wittstein is equivalent to the *tæniin* of Pavesi, and for the name of *kosin.* It may be obtained by treating kousso repeatedly with alcohol to which calcium hydroxide has been added; the residue is boiled with water, the liquids are mixed, filtered, and distilled, and the residue treated with acetic acid, which precipitates the kosin in a white flocculent form, soon becoming denser and resin-like, and, on drying, yellowish, or, at a higher temperature, brown. The product is 3 per cent. In bulk, kosin has an odor like that of Russian leather, a persistent bitter and acrid taste, a yellowish or yellowish-white color, and an indistinct crystalline appearance under the microscope. It is very sparingly soluble in water, but freely so in alcohol, ether, and alkaline solutions. (*A. J. P.,* 1872, 394.) Its formula, according to Flückiger, is $C_{31}H_{38}O_{10}$. It fuses at 142° C. (287.6° F.), and remains after cooling an amorphous yellow mass, but if touched with alcohol it immediately assumes the form of stellate tufts of crystals. This may be repeated at pleasure, kosin not being altered by cautious fusion. (*Pharmacog.,* 2d ed., 258.) Leichsenring (*A. Pharm.,* 1894, 50) has re-examined kousso, and finds an inactive crystalline principle to which he gives the name *protokosine,* and an amorphous substance, *kossotoxine,* which he considers the active principle of the drug; the latter is a yellowish powder, fusing at 80° C., and not obtainable in a crystalline state. It is easily soluble in alcohol, ether, benzene, carbon disulphide, and insoluble in water.

Sodium kosinate has been recommended by Pavesi as a very eligible preparation for obtaining the virtues of kosin; a process is given in *Am. Drug.,* 1884, 96; *A. J. P.,* 1885.

Uses.—Kousso is highly valued in Abyssinia as a vermifuge. Bruce speaks of it in his travels, and gives a figure of the plant. Brayer, a French physician practicing in Constantinople, published a treatise on it at Paris in 1823. It was in his honor that Kunth adopted the generic title of the plant. Much attention has been attracted to this valuable medicine, and trials made with it have proved that it has extraordinary efficacy in the destruction and expulsion of the *tape-worm.* Its effects when taken internally are not very striking. In the ordinary dose it sometimes

[1] It is stated that in Abyssinia, honey gathered directly after the flowering season from beehives in gardens planted with kousso plants, is used in doses of a teaspoonful as a very effective tænicide.

produces heat of stomach, nausea, and even vomiting, and shows a tendency to act on the bowels, though this effect is not always produced. It appears to act exclusively as a poison to the worms, and has been found equally effectual in both kinds of tape worm. The medicine is taken in the morning upon an empty stomach, a light meal having been made the preceding evening. A previous evacuation of the bowels is also recommended. The flowers are given in the form of powder, mixed with half a pint of warm water, the mixture being allowed to stand for fifteen minutes, then stirred up, and taken in two or three draughts at short intervals. The medicine may be preceded and followed by lemonade. The medium dose for an adult is half an ounce (15.5 Gm.), which may be diminished one-third for a child of twelve years, one-half for one of six years, and two-thirds for one of three years. Should the medicine not act on the bowels in three or four hours, a brisk cathartic should be administered. One dose is said to be sufficient to destroy the worm. Should the quantity mentioned not prove effectual, it may be increased to an ounce (31 Gm.).

Pure kosin has been considerably used in Germany in doses of thirty grains (2 Gm.), taken in two or four powders; but Buchheim found *pure* kosin less powerful as an anthelmintic than that which was not pure, while Arena (*Ph. Z. R.*, 1879, 655) believes that kosin is not the active principle at all, but that the activity of kousso resides exclusively in the green, slightly bitter resin, which is soluble in alcohol and ether. If this view be correct, it explains the greater efficacy of freshly powdered kousso, for the green resin turns yellow by age and loses its power, and Arena's investigations further indicate that the amorphous kosin of commerce is preferable to the pure principle. It is a yellowish-brown mass, which may be given in doses of from seven to fifteen grains (0.45 to 1.0 Gm.), repeated every half hour until four doses are taken, to be followed in an hour by a full dose of castor oil. So far as we know, no cases of poisoning by kousso or its active principle are on record, but it has been found by Rochebrune to be capable of causing centric convulsions in the lower animals.

Dose, of kousso, half an ounce (15.5 Gm.); of kosin, seven to fifteen grains (0.45 to 1.0 Gm.).

CYPRIPEDIUM. U. S.

CYPRIPEDIUM [Lady's Slipper]

(çÿp-rĭ-pē'dĭ-ŭm)

"The dried rhizome and roots of *Cypripedium hirsutum* Miller (*Cypripedium pubescens* Willdenow) or of *Cypripedium parviflorum* Salisbury (Fam. *Orchidaceæ*)." *U. S.*

Rhizoma Cypripedii; Yellow Lady's Slipper Root, Yellow Indian Shoe, Yellow Moccasin Flower, Yellow Noah's Ark, Venus' Shoe, Male Nervine, American Valerian; Racine de Cypripède jaune, Valériane américaine, *Fr.*; Gelbfrauenschuhwurzel, *G.*

Under the common name of *lady's slipper,* or *moccasin plant,* several species of Cypripedium inhabit the woods in different parts of the United States. They are small plants, with large, many-nerved, plaited leaves, sheathing at the base, and large often beautiful flowers, of a shape not unlike the Indian moccasin, whence they derive one of their common names. Their generic name of Cypripedium (Κύπρις, *Venus,* and πόδιον, *sock*) had a similar origin. Several of them have been used by American physicians, the root being the part employed. R. P. Stevens of Ceres, Pennsylvania, says of them that he has found the *C. reginæ,* Walt. (*C. spectabile,* Salisb.), and *C. acaule,* Ait., especially when growing in dark swamps, to be possessed of narcotic properties, and to be less safe than the *C. parviflorum,* Salisb., which is gently stimulant with a tendency to the nervous system, and is quite equal to valerian. He has employed it advantageously in *hysteria,* and in the pains of the joints, following *scarlet fever.* (*N. Y. Journ. Med.,* iv. 359.) E. Ives considers *C. hirsutum,* Mill., and *C. reginæ,* Walt., identical in their effects, but *C. reginæ* more powerful (*Trans. Am. Med. Assoc.,* iii. 312). The roots of the two species, *C. hirsutum* and *C. parviflorum* are indiscriminately found in commerce and sold under the same name.

Cypripedium hirsutum, Mill., *Gard. Dict.,* 1768.—*C. pubescens,* Willd., *Sp. Plant.,* 1805, iv. 142.—The *yellow lady's slipper,* as this plant is called from the color of its flowers, has a simple often flexuous, pubescent, leafy stem, from one to two feet high. The leaves are pubescent, ovate-lanceolate, acuminate, narrowing at the base, about four or five inches long by two in breadth, alternate, sessile, and sheathing. The flower is usually solitary and terminal, with four divisions of the perianth, the two outer cohering nearly to the apex, the inner longer, narrower, undulatory or twisted, and the lip an inch or two in length, swelling sac-like, and of a yellow color. The fruit is an oblong capsule, tapering at each end, recurved, pubescent, and peduncled. The plant is indigenous, growing abundantly in rich, moist woods throughout the United States.

Cypripedium parviflorum, Salisbury, *Lady's Slipper. Small-flowered Yellow Lady's Slipper.*—This is a perennial plant with a leafy stem, a foot or two in height, and comparatively small yellowish-green flowers, appearing in May. The specific character of the flower, which is that also of the plant, is that the lobe of the style is triangular and acute; the outer petals are oblong-ovate and acuminate; the inner linear and contorted; the lips shorter than the petals, and compressed. This species grows extensively through the United States, south of the Potomac, east and west of the Alleghanies, and in several of the Northern States, particularly New York, Michigan, Connecticut and Vermont.

"Rhizome of horizontal growth, curved, 3 to 10 Cm. long, 2 to 6 Mm. thick, orange-brown to dark-brown, the upper side beset with numerous circular, cup-shaped scars, closely covered below with simple wiry roots varying from 3 to 15 Cm. in length; fracture of rhizome short, white, that of roots somewhat fibrous; odor distinct, heavy, valerian-like; taste sweetish, bitter, and somewhat pungent." *U. S.* Maisch gives a distinctive description of the roots of the two species, of which the following is a condensed account. Of *C. hirsutum*, Mill., the rhizome is almost horizontal, in its greatest length nearly four inches, slightly bent with a shallow downward curve, from one-eighth to three-sixteenths of an inch thick, with numerous deeply concave scars left by the stems, having fully the width of the rhizome. The rootlets are numerous, several inches in length, sometimes even nine inches or more, about one-fourteenth of an inch thick, without branches, somewhat undulate, and, though attached to the rhizome on all sides, are abruptly turned downward, owing to its horizontal position in the ground. Their color is yellowish brown, becoming much darker on drying, which causes longitudinal wrinkles. The cortical part of both species is colored blue by iodine. The rhizome of *C. parviflorum* is altogether different from the former, being bent nearly at right angles three or four times, each section about ¾ of an inch long, and the whole length, while only about two inches in a straight line from end to end, is yet actually three inches along the course of the rhizome. This is about ⅛ of an inch thick, and has stem-scars about the same in width, with about three in each bend. The rootlets, which are attached to all sides of the rhizome, are numerous, four to six inches long, less undular than those of *C. hirsutum*, Mill., and of a brighter color, being a decided orange-brown when fresh, and changing little on drying. (*A. J. P.*, 1872, 297.) Poisonous properties have been attributed to *C. reginæ*, Salisb., and *C. hirsutum*, Mill. (see *Geol. Nat. Hist. Survey, Minnesota Bull.*, 9, part i.), but it has been shown that the secretion from the glandular hairs simply exerts an irritant action.

Senega and hydrastis roots are sometimes found accidentally mixed with those of cypripedium, probably from the plants having a common habitat.

Properties.—Cypripedium has a somewhat aromatic odor, which diminishes by time, and a bitter, sweetish, peculiar, and in the end somewhat pungent taste. It yields its virtues to water and alcohol. The root has been analyzed by Henry C. Blair, who found it to contain a volatile oil, a volatile acid, tannic and gallic acids, two resins, gum, glucose, starch, and lignin. (*A. J. P.*, 1866, p. 494.) The eclectic preparation *cypripedin* is said to be a resinoid, obtained by precipitating with water a concentrated tincture of the rhizome. The substance thus obtained is complex, and has no claim to the name given it, which ought to be reserved for the active principle when discovered. It is probable that the virtues of the rhizome reside in a volatile oil and a bitter principle.

Uses.—Cypripedium appears to be a gentle nervous stimulant or antispasmodic, and has been used for the same purposes as valerian, though less powerful. E. Ives of New Haven, Conn., commends the remedy in *hypochondriasis* and *neuralgia*. It may be used in powder, infusion, or tincture.

Dose, of the powder, fifteen grains (1 Gm.), three times a day. The resinoid, obtained by precipitating the tincture, has been given in doses varying from half a grain to three grains (0.032 to 0.20 Gm.).

Off. Prep.—Fluidextractum Cypripedii, *U. S.*

DECOCTA. U. S.

DECOCTIONS

(dę-cŏc'tą)

Tisanes par décoction, Décoctions, *Fr.*; Abkochungen, *G.*; Decotti, *It.*; Cocimiento, *Sp.*

Decoctions are solutions of vegetable principles, obtained by *boiling* the substances containing these principles in water. Vegetables generally yield their soluble ingredients more readily, and in larger proportion, to water maintained at the point of ebullition, than to the same liquid at a lower temperature. Hence decoction is occasionally preferred to infusion as a mode of extracting the virtues of plants, when the call for the remedy is urgent, and the greatest possible activity in the preparation is desirable. The process should be conducted in a covered vessel, so as to confine the vapor over the surface of the liquid, and thus prevent the access of atmospheric air, which sometimes exerts an injurious agency upon the active principle. The boiling, moreover, should not, as a rule, be long continued, as the ingredients of the vegetable are apt to react on one another, and thus lose, to a greater or less extent, their original character. The substance submitted to decoction should if dry be either powdered or well bruised, if fresh should be sliced, so that it may present an extensive surface to the action of the solvent; and previous maceration for some time in water is occasionally useful by overcoming the cohesion of the vegetable fibre. Should the physician not happen to prescribe this preliminary comminution, the pharmacist should not omit it.

All vegetable substances are not proper objects for decoction. In many the active principle is volatile at a boiling heat, in others it undergoes some change unfavorable to its activity, and in a third set is associated with inefficient or nauseous principles, which, though insoluble or but slightly soluble in cold water, are abundantly extracted by that liquid at the boiling temperature, and thus encumber, if they do not positively injure, the preparation. In all these instances, infusion is preferable to

decoction. Besides, by the latter process more matter is often dissolved than the water can retain, so that upon cooling a precipitation takes place and the liquid is rendered turbid, and this constitutes the greatest objection to this class of preparations. When the active principle is thus dissolved in excess, the decoction should always be strained while hot, so that the matter which separates on cooling may be mixed again with the fluid by agitation at the time of administering the remedy. In compound decoctions, the ingredients may be advantageously added at different periods of the process, according to the length of boiling requisite for extracting their virtues; and, should one of them owe its activity to a volatile principle, the proper plan is, at the close of the process, to pour upon it the boiling decoction, and allow the liquor to cool in a covered vessel.

As a rule, glass or earthenware vessels should be preferred, as those made of metal are sometimes corroded by the ingredients of the decoction, which thus become contaminated. Vessels of clean cast-iron or common tin, or of block tin, are preferable to those made of copper, brass, or zinc; but iron pots should not be used where astringent vegetable substances are concerned.

Decoctions, from the mutual reaction of their constituents, as well as from the influence of the air, are apt to spoil in a short time. Hence they should be prepared only when wanted for use, and should not be kept, when the weather is warm, for a longer period than forty-eight hours.

The tendency of modern medicine and pharmacy has been decidedly against the employment of decoctions; their nauseous taste, bulky dose, repulsive appearance, and nonpermanent character have been powerful reasons for causing their retirement, while the use of tinctures and fluidextracts has largely increased. In the 1880 revision of the U. S. Pharmacopœia the number of official decoctions was reduced to two, and a general formula was appended for the guidance of the pharmacist. The U. S. P. 1890 reduced the strength of the general formula for decoctions from 10 per cent. to 5 per cent, and this strength was retained in the Eighth Revision of the U. S. P., as will be seen from the following: "An ordinary Decoction, the strength of which is not directed by the physician, shall be prepared by the following formula: Take of * The Substance, coarsely comminuted, *fifty grammes* [or 1 ounce av., 334 grains]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Introduce the Substance into a suitable vessel provided with a cover, pour upon it *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of cold Water, cover it well, and boil for fifteen minutes. Then allow it to cool to about 40° C. (104° F.), express, strain the expressed liquid, and pass enough cold Water through the strainer to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms].

Caution.—The strength of Decoctions of energetic or powerful substances should be specially prescribed by the physician." *U. S.*

The two decoctions of the U. S. P. 1890, *Decoctum Cetrariæ* and *Decoctum Sarsaparillæ Compositum*,[1] were both dismissed in the Eighth Revision and only the general formula retained.

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[1] *Decoctum Sarsaparillæ Compositum*, U. S. 1890. *Decoctum Sarsæ Compositum*, Br. 1885.—Under the name of *Lisbon Diet Drink* a preparation was at one time so largely used in chronic syphilis that its imitation under the above names was recognized both in the Br. and U. S. Pharmacopœia as Compound Decoction of Sarsaparilla. The formula of the U. S. Pharmacopœia of 1890 was as follows: "Sarsaparilla, cut and bruised, *one hundred grammes* [or 3 ounces av., 230 grains]; Sassafras, in No. 20 powder, *twenty grammes* [or 308 grains]; Guaiacum Wood, rasped, *twenty grammes* [or 308 grains]; Glycyrrhiza, bruised, *twenty grammes* [or 308 grains]; Mezereum, cut and bruised, *ten grammes* [or 154 grains]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms,]. Boil the Sarsaparilla and Guaiacum Wood for half an hour in a suitable vessel with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water. Then add the Sassafras, Glycyrrhiza, and Mezereum, cover the vessel well, and macerate for two hours. Finally strain, and add enough cold Water, through the strainer, to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

Compound Decoction of Sarsaparilla was at one time very largely used as an alterative in secondary syphilis and chronic rheumatism, especially as an adjuvant to mercurials and iodides. It was given in doses of from four to six fluidounces (120 to 180 Cc.) three or four times a day, but has passed into deserved desuetude. The *Decoction of Zittmann* (*Decoctum Zittmanni*) is a preparation of Sarsaparilla much used in Germany for similar purposes as our compound decoction of sarsaparilla; and, as it has attracted some attention in this country as a remedy in obstinate ulcerative affections we give the formula of the German Pharmacopœia, which is generally followed in its preparation. *Decoctum Sarsaparillæ Compositum Fortius*, P. G. [*Zittmann's Stronger Decoction.*] *Stärkeres Zittmannsches Decoct.*—"Take of Sarsaparilla root, cut, *one hundred parts;* pour upon it common water, *two thousand six hundred parts*, digest for twenty-four hours; then add of sugar powdered, alum powdered, each, *six parts* and heat them in a covered vessel, in a steam bath, for three hours, stirring frequently. Towards the end of the boiling, add of anise bruised, fennel seed bruised, each, *four parts;* senna cut, *twenty-four parts;* liquorice root cut, *twelve parts*. Strain by expression, and set aside for a short time. The clear decanted liquid should be *two thousand five hundred parts*. When not otherwise directed, a colature of two thousand five hundred grammes is divided into eight portions.

N. B.—When Decoctum Zittmanni is prescribed, it is prepared in a similar manner, except that to the sugar and alum are added of mild chloride of mercury, *four parts;* cinnabar (red sulphide of mercury), *one part*, enclosed in a linen bag." *P. G.*

Decoctum Sarsaparillæ Compositum Mitius, P. G. [*Zittmann's Milder Decoction.*] *Milderes Zittmannsches Decoct.*—"Take the residue of the stronger decoction and sarsaparilla root, cut, *fifty parts;* pour upon them common water, *two thousand six hundred parts*, and expose to the heat of a steam bath for three hours in a covered vessel, stirring frequently. Towards the end of the operation add of lemon peel, cassia bark, small cardamoms, liquorice root, each, cut and bruised, *three parts*. Strain by expression, and set aside for a short time. The clear decanted liquid should be *two thousand five hundred parts*. When not otherwise directed, a colature of two thousand five hundred grammes is divided into eight portions." *P. G.* Mercury was detected by Wiggers in this decoction in very small proportion. It should not be prepared in metallic vessels, lest the mercurial in solution should be decomposed. The decoction may be drunk freely.

DECOCTUM ALOES COMPOSITUM. Br.

COMPOUND DECOCTION OF ALOES

(dẹ-cŏc'tŭm ăl'ọ-ēṣ cọm-pōṣ'ị-tŭm)

Tisane (Décocté) d'Aloès composée, *Fr.;* Zusammengesetztes Aloëdecoct, *G.*

"Extract of Barbados Aloes, ½ *ounce* (Imperial) or 10 grammes; Myrrh, Saffron, Potassium Carbonate, of each, ¼ *ounce* (Imp.) or 5 grammes; Extract of Liquorice, 2 *ounces* (Imp.) or 40 grammes; Compound Tincture of Cardamoms, 15 *fl. ounces* (Imp. meas.) or 300 cubic centimetres; Distilled Water, *a sufficient quantity.* Reduce the Extract of Barbados Aloes and the Myrrh to coarse powder, and boil them and the Potassium Carbonate and the Extract of Liquorice with *one pint* (Imp. meas.) or four hundred cubic centimetres of Distilled Water in a covered vessel for five minutes; add the Saffron; when the liquid is cool add the Tincture of Cardamoms; set aside in the covered vessel for two hours; strain through flannel; pass sufficient Distilled Water through the strainer to make *fifty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Compound Decoction of Aloes." *Br.*

This is essentially the former process of the British Colleges. The direction is properly given to rub the aloes, myrrh, and potassium carbonate together before the addition of the other ingredients. The effect of the alkaline carbonate is, by combining with the resin of the myrrh and the insoluble portion of the aloes, to render them more soluble in water, while the licorice assists in the suspension of the portion not actually dissolved. The tincture of cardamom is useful not only by its cordial property, but also by preventing spontaneous decomposition. This decoction is said not to filter clear when first made, but, if kept for some time, to deposit insoluble matter, and then to become bright and clear on filtering. (*P. J.*, xiv. 491.) J. F. Brown proposes to prepare a concentrated decoction which keeps for a long time unchanged. (*C. D.*, 1896, 425.)

Long boiling impairs the purgative property of aloes, and the same effect is thought to be produced, to a certain extent, by the alkalies, which certainly qualify its operation and render it less apt to irritate the rectum. This decoction, therefore, is milder as a cathartic than aloes itself; it is also more tonic and cordial, from the presence of the myrrh, saffron, and cardamom, and derives antacid properties from the potassium carbonate. It is given as a gentle cathartic, tonic, and emmenagogue, and is especially useful in *dyspepsia, habitual constipation,* and atonic *amenorrhœa.* The decoction should not be combined in prescription with acids, acidulous salts, or other bodies incompatible with the alkaline carbonate.

Dose, from one-half to two fluidounces (15 to 60 Cc.).

DECOCTUM GRANATI CORTICIS. Br.

DECOCTION OF POMEGRANATE BARK

(dẹ-cŏc'tŭm grạ-nā'tī cŏr'tị-cīs)

Decoctum Granati Radicis, *Br.* (1885); Decoctum Corticis Radicis Granati; Apozème d'Ecorce de Racine de Grenadier, *Fr. Cod.;* Granatwurzelrinden-Abkochung, *G.*

"Pomegranate Bark, in No. 10 powder, 4 *ounces* (Imperial) or 200 grammes; Distilled Water, *a sufficient quantity.* Boil the Pomegranate Bark with *twenty-four fluid ounces* (Imp. meas.) or twelve hundred cubic centimetres of Distilled Water in a suitable vessel for ten minutes; strain; pour enough Distilled Water over the contents of the strainer to make *one pint* (Imp. meas.) or one thousand cubic centimetres of the strained Decoction." *Br.*

This decoction has double the quantity of bark in the Br. Pharm. 1898 over the Br. Pharm. 1885, the quantity of root bark in the latter for one pint being two ounces.

For the uses of this decoction, see *Granati Cortex.*

Dose, one-half to two fluidounces (15 to 60 Cc.).

DECOCTUM HÆMATOXYLI. Br.

DECOCTION OF LOGWOOD

(dẹ-cŏc'tŭm hæ-mạ-tŏx'y-lī)

Tisane (Décocté) de Bois de Campêche, *Fr.;* Blauholz-Abkochung, *G.*

"Logwood, in chips, 1 *ounce* (Imperial) or 50 grammes; Cinnamon Bark, bruised, 70 *grains* (Imp.) or 8 grammes; Distilled Water, *a sufficient quantity.* Boil the Logwood with *twenty-four fluid ounces* (Imp. meas.) or twelve hundred cubic centimetres of Distilled Water in a suitable vessel for ten minutes, adding the Cinnamon Bark towards the end of the time; strain; pour enough Distilled Water over the contents of the strainer to make *one pint* (Imp. meas.) or one thousand cubic centimetres of the strained Decoction." *Br.*

We prefer the old U. S. formula, which ordered an ounce of the logwood to be boiled with two pints down to a pint, and doubt much whether the wood is exhausted by a boiling of ten or fifteen minutes. The cinnamon of the Br. formula is in general a very suitable addition, but there might be circumstances under which it would be better omitted, and in this case, as in others, any addition to the simple decoction might be left to the judgment of the prescriber.

This is an excellent astringent in *diarrhœas* of relaxation.

Dose, for an adult, two fluidounces (60 Cc.); for a child about two years old, two or three fluidrachms (7.5 to 11.25 Cc.).

DIGITALIS. U. S. (Br.)

DIGITALIS [Foxglove]

(dĭg-ĭ-tā'lĭs)

"The dried leaves of *Digitalis purpurea* Linné (Fam. *Scrophulariaceæ*), collected from plants of the second year's growth, at the commencement of flowering." *U. S.* "The dried leaves of Digitalis purpurea, *Linn.* Collected from plants commencing to flower." *Br.*

Digitalis Folia, *Br.,* Digitalis Leaf; Digitalis Leaves, Foxglove Leaves; Fairy Cap, Fingers, Thimbles, or Bells, Lady's Glove, Purple Foxglove, Flop-dock, Throatwort, Cottagers; Digitale, *Fr. Cod.;* Feuilles de Digitale Pourprée (de grande Digitale), Digitale Pourprée, Doigtier, *Fr.;* Folia Digitalis, *P. G.;* Purpurrother Fingerhut, Fingerhutkraut, Fingerhutblätter, *G.;* Digitale, *It.;* Digital (Hoja de), Dedalera, *Sp.*

Digitalis purpurea (L.), Willd., *Sp. Plant.* iii. 383; Woodv., *Med. Bot.,* p. 218, t. 78.—The foxglove is a beautiful plant, with a biennial or perennial fibrous root, which in the first year sends forth large tufted leaves, and in the following summer a single erect, downy, and leafy stem, rising from two to five feet, and terminating in an elegant spike of purple flowers. The lower leaves are ovate, pointed, about eight inches in length and three in breadth, and stand upon short, winged footstalks; the upper are alternate, sparse, and lanceolate; both are obtusely serrate, and have wrinkled velvety surfaces, of which the upper is a fine deep green, the under paler and more downy. The flowers are numerous, and attached to the upper part of the stem by short peduncles, in such a manner as generally to hang down upon one side. At the base of each peduncle is a floral leaf, which is sessile, ovate, and pointed. The calyx is divided into five segments, of which the uppermost is narrower than the others. The corolla is monopetalous, bell-form, swelling on the lower side, irregularly divided at the margin into short obtuse lobes, and in shape and size not unlike the end of the finger of a glove, a circumstance which has suggested most of the names by which the plant is designated in different languages. Its mouth is guarded by long soft hairs. Externally, it is in general of a bright purple; internally, it is sprinkled with black spots upon a white ground. There is a variety with white flowers. The filaments are white, curved, and surmounted by large yellow anthers. The style is simple, and supports a bifid stigma. The seeds are numerous, very small, grayish brown, and contained in a pyramidal two-celled capsule.[1]

Foxglove grows wild in the temperate parts of Europe, where it flowers in the middle of summer. In this country it is cultivated both for ornament and for medicinal use. The leaves are the part generally employed. Much care is requisite in selecting, preparing, and preserving them, in order to insure their activity. They should be gathered in the second year, immediately before or during the period of inflorescence, and those only chosen which are full-grown and perfectly fresh (Geiger); but the observations of F. Schneider would lead to the conclusion that they are much stronger when not gathered before the latter part of summer or the beginning of autumn. (*A. J. P.,* 1870, p. 221.) It is said that those plants are preferable which grow spontaneously in elevated places exposed to the sun. (Duncan.) As the leafstalk and midrib are comparatively inactive, they may be rejected. Withering recommends that the leaves should be dried either in the sunshine, or by a gentle heat before the fire, and care should be taken to keep them separate while drying. Pereira states that a more common and, in his opinion, a preferable mode is to dry them in a basket in a dark place in a drying stove. It is probably owing, in part, to the want of proper attention in preparing digitalis for the market that it is often inefficient. The dried leaves should be kept in tin canisters, well closed so as to exclude light and moisture; or they may be coarsely ground, and the well-dried powder preserved in well-stoppered and opaque bottles.

As foxglove deteriorates with age, it should be frequently renewed, as often, if possible, as once a year. Its quality must be judged of by the degree in which it possesses the characteristic properties of color, odor and especially taste. It is said to be sometimes adulterated, but if it is bought in leaf, there can be little difficulty, to one acquainted with the characters of the genuine leaves, in detecting the sophistication. German digitalis consists of the leaves of wild plants, whereas English digitalis is from cultivated plants. According to England, comparative experiments made in the Philadelphia Hospital have shown the English digitalis to be much more uniform and active than is the German drug. This may be because the English variety is more carefully freed from leafstalks, since Broeker found the parenchyma to yield five times as much digitalin as did the leafstalks. On account of our lack of chemico-physiological knowledge concerning the active principles of digitalis, and the obstacles which make physiological assay practically unreliable, the greatest difficulty exists in determining the exact medicinal value of samples of digitalis. Wholeness, fine physical appearance and freshness of the leaves, with freedom from petioles, afford the best foundation for judgment, even though they are not an absolute guarantee of superior activity. The percentage of digitoxin is not a correct measure of value, as has been shown by various investigators. It is important to

[1] *Digitalis ambigua* contains, according to Paschkis, the same constituents as *D. purpurea* (*Ap. Ztg.,* 1888), while in therapeutic studies made in Sudenburg-Magdeburg Hospital the preparations of *D. grandiflora* were found to be at least as active as are those of the official plant. (*S. Jb.,* 271, p. 51.)

remember that not only does the digitalis leaf, but also such preparations as the tincture, deteriorate with keeping.[1]

The seeds contain more of the active principle than the leaves, are less likely to suffer in drying, and keep better, but are little used. So far as the relative strength of these two parts can be determined from that of their alcoholic extracts, it would appear, from the experiments of Hirtz, that the seeds are ten times stronger than the leaves. (See *A. J. P.*, xxxiii.)

Properties.—Foxglove is without odor in the recent state, but acquires a faint narcotic odor when dried. The color of the dried leaf is a dull pale green, modified by the whitish down upon the under surface; that of the powder is a fine deep green. "Usually in more or less crumpled and broken fragments; ovate to oval, from 10 to 30 Cm. long, 5 to 15 Cm. broad, abruptly contracted into a winged petiole from 5 to 10 Cm. long; thin, dull and rather pale green or grayish underneath; upper surface wrinkled, sparsely hairy; lower surface densely and finely hairy, the venation conspicuously reticulated; margin crenate or erose-dentate; the midrib and principal veins broad and flat, usually purplish, the lower veins continued into the wings of the petiole; odor slight, characteristic; taste strongly bitter. In the powder, stone-cells, star-shaped hairs, and calcium oxalate crystals are absent." *U. S.* "The transverse section exhibits a mesophyll free from crystals of calcium oxalate." *Br.* Digitalis yields its virtues both to water and to alcohol. It contains, besides active principles, a volatile oil, a fatty matter, a red coloring substance analogous to extractive, chlorophyll, albumen, starch, sugar, gum, lignin, and salts of potassium and lime, among which, according to Rein and Haase, is acid potassium oxalate. Morin of Geneva, discovered in the leaves two acids: one fixed, called *digitalic acid*, the other volatile and resembling valerianic acid, which he proposed to name *antirrhinic acid* (*P. J.*, vii. 294). England (*A. J. P.*, 1892, 361) found about 5 per cent. of fixed oil in digitalis leaves. Morries obtained a narcotic empyreumatic oil by the destructive distillation of the leaves. The yield of ash from digitalis leaves is usually put down at from 7 to 10 per cent., and this is in accord with the result reached by F. H. Alcot with British leaves. (*P. J.*, Jan. 1903.) On the other hand, M. Greshoff (*P. J.*, Dec. 1902) has obtained in various samples of German digitalis, after the leaves have been freed from sand and the leaf-stalks removed, a yield of from 16.4 to 25 per cent. of ash.

[1] The research of H. Ziegenbein (*A. Pharm.*, Sept. 1902), made upon fourteen samples of wild and cultivated leaves from different localities, shows that the activity of digitalis varies very greatly, according to locality and probably also to the variety of the plant; that the unbroken leaves greatly depreciate on long keeping, and that the powdered leaves depreciate very rapidly; that the toxicity of digitoxin obtained from a given quantity of the dried leaves is from 2.6 to 6.6 less than that of the extract of the same leaves. (See *A. Pharm.*, Sept. 1902, also *P. J.*, Dec. 1902.)

Under the name of *digitalin*[1] there have long been in commerce two distinct substances obtained from digitalis, both of them crude mixtures of the glucosidal principles. The *French* digitalin was that originally prepared by Homolle. It is a whitish powder, of a neutral reaction, soluble in 2000 parts of cold and in 1000 parts of hot water. It is this digitalin which was formerly recognized by the U. S. and Br. Pharmacopœias. The so-called *German* digitalin is distinguished from the French by being, in great part or entirely, freely soluble in water.

In 1871, Nativelle received from the French Academy the prize of Orfila for the discovery of the active principle of digitalis. The method of preparation, as finally improved and modified by himself, and published in the *J. P. C.*, xx. 1874, p. 81, and also a process which has the advantage of being far shorter and more readily carried out, devised by Tanret (*Ibid.*, Oct. 1875), may be found on p. 1143, 14th ed., U. S. D.

According to the researches of Schmiedeberg (*P. J.* (3), v. 741), confirmed by Kiliani (*P. J.* (3), xxii. 1061, and (4), i. 29), the seeds and

[1] *French digitalin* may be prepared according to the following process, which was recommended by the British Pharmacopœia (1867):

"Take of Digitalis Leaf, in coarse powder, *forty ounces* [avoirdupois]; Rectified Spirit, Distilled Water, Acetic Acid, Purified Animal Charcoal, Solution of Ammonia, Tannic Acid, Oxide of Lead in fine powder, Pure Ether, of each, a *sufficiency*. Digest the Digitalis with a gallon [Imperial measure] of the Spirit for twenty-four hours at a temperature of 120°; then put them into a percolator, and, when the tincture has ceased to drop, pour a gallon [Imp. meas.] of Spirit on the contents of the percolator, and allow it slowly to percolate through. Distil off the greater part of the Spirit from the tincture, and evaporate the remainder over a water-bath until the whole of the alcohol has been dissipated. Mix the residual extract with five [fluid] ounces of Distilled Water to which half an ounce [avoird.] of Acetic Acid has been previously added, and digest the solution thus formed with a quarter of an ounce of Purified Animal Charcoal; then filter, and dilute the filtrate with Distilled Water until it measures a pint [Imp. meas.]. Add Solution of Ammonia nearly to neutralization, and afterwards add one hundred and sixty grains of Tannic Acid dissolved in three [fluid] ounces of Distilled Water. Wash the precipitate that will be formed with a little Distilled Water; mix it with a small quantity of the Spirit and a quarter of an ounce of the Oxide of Lead, and rub them together in a mortar. Place the mixture in a flask, and add to it four [fluid] ounces of the Spirit; raise the temperature to 160°, and keep it at this heat for about an hour. Then add a quarter of an ounce of Purified Animal Charcoal; put it on a filter, and from the filtrate carefully drive off the Spirit by the heat of a water-bath. Lastly, wash the residue repeatedly with pure Ether." According to the method of Walz (Husemann, *Die Pflanzenstoffe*, p. 900), *German digitalin* is prepared by extracting under pressure one part of digitalis with eight parts of alcohol, evaporating, digesting the residue with successive portions of water so long as they acquire a bitter taste, uniting the liquids, and treating them with litharge and lead acetate until a portion filtered for testing is no longer precipitated by lead acetate. Sulphuric acid is added to the filtrate to precipitate the lead, and, after filtration, neutralized with ammonia, and the liquid precipitated by tannic acid. The precipitate having been well washed and pressed, is rubbed up with freshly precipitated lead oxide, the mass boiled with alcohol, and, after the lead has been separated by precipitation with sulphuric acid, and most of the alcohol distilled off, the residue is allowed to slowly evaporate, the crude digitalin being left behind.

leaves of *Digitalis purpurea* contain a preponderating amount of a glucoside, *digitonin*. They contain in addition three other substances which possess the power of acting on the heart, namely, crystallizable *digitoxin* and two amorphous glucosides, *digitalin* and *digitalein*.

DIGITONIN forms fully one-half of the mixed glucosides from the digitalis seed and the principal portion of German "digitalin," from which it may be prepared by extraction with and crystallization from 85 per cent. alcohol. Digitonin softens at 225° C. and melts completely at 235° C. The crystals dissolve sparingly in cold water, more readily in hot, to an opalescent solution which froths on agitation. It cannot be crystallized from water. The aqueous solution is lævo-rotatory ($[a]_D = -49$ at 25° C.), and is precipitated by tannin, ammoniacal lead acetate, and baryta water. Digitonin is only slightly soluble in absolute alcohol, and still less so in ether, chloroform, or petroleum benzin. It forms a crystalline compound with amyl alcohol. According to Kiliani digitonin has the formula $C_{27}H_{46}O_{14} + 5H_2O$, and when boiled with strong alcohol and hydrochloric acid splits up into *dextrose, galactose,* and *digitogenin,* the last body separating in warty masses on cooling.

DIGITOXIN is characterized by its free solubility in alcohol and choloroform, slight solubility in ether, and insolubility in petroleum benzin. It crystallizes from alcohol in pearly scales or needles which melt at 240° C. It is quite insoluble in water, to which it does not impart even a bitter taste. Warmed with strong hydrochloric acid, it gives a yellow or greenish coloration, which is one of the reactions ascribed to the "digitaline crystallisée" of the French Codex. Schmiedeberg states that it is not a glucoside, but Kiliani asserts that upon heating its alcoholic solution with hydrochloric acid it splits up into *digitoxigenin* and a glucose *digitoxose*. The reaction for this is now considered to be:

$$C_{34}H_{54}O_{11} + H_2O = C_{22}H_{32}O_4 + C_6H_{12}O_4$$

Digitoxin is found mainly in the leaves (Kiliani stating that it is not found in the seeds at all), but Keller (*P. J.*, July 24, 1897) finds it also in the seeds in smaller amount. It is the most poisonous of the constituents of digitalis.

DIGITALIN (*Digitalinum verum* of Kiliani) forms a white amorphous powder or soft white grains which remain unchanged when heated to 200° C., at 210° C. begin to aggregate, and towards 217° C. melt, becoming yellow. When treated with water the particles of digitalin swell up and dissolve slightly, giving a solution which foams strongly on agitation. It is dissolved sparingly by cold proof spirit (1 to 100), but in considerable amount by hot rectified spirit or absolute alcohol. When a minimum of alcohol is used, the solution on cooling becomes almost solid from the separation of a thick magma of granules, which are, however, destitute of crystalline structure. This peculiar behavior affords a valuable means of testing its purity, as only a small percentage of the other glucosides with the digitalin prevents the formation of the granules. The minutest admixture of amorphous glucosides also rapidly causes an intense yellow coloration. Digitalin is very sparingly soluble in ether or chloroform. When digitalin is heated with diluted hydrochloric acid, an insoluble resinous substance almost immediately separates out; Schmiedeberg termed this *digitaliresin*. By operating in alcoholic solution, Kiliani avoids the separation of resin, and finds that digitalin splits up as a glucoside into *digitaligenin, glucose,* and *digitalose,* thus:

$$C_{29}H_{46}O_{12} + H_2O = C_{16}H_{22}O_2 + C_6H_{12}O_6 + C_7H_{14}O_5$$

Kiliani found that commercial *digitalinum purum* contained but 5.5 per cent. of true digitalin.

DIGITALEIN is considered to be a distinct glucoside by Schmiedeberg, but Kiliani, who worked over it later, regards its independent existence as questionable.

DIGITIN of Schmiedeberg is also considered by Kiliani to be simply digitonin.

The above résumé of our present knowledge clearly shows that the chemistry of digitalis cannot be considered as settled; but it also clearly shows that no digitalin completely represents digitalis. Moreover, the digitalin of commerce varies greatly. (See *A. Pharm.*, 1895, 299; also 1895, 698.)

No satisfactory assay process has yet been devised for digitalis and hence the U. S. P. (8th Rev.) contains no process. The amount of digitoxin present in digitalis has been proposed by several investigators as a means of standardizing it, but it is by no means clear that this would prove a reliable criterion (*Ber. d. Chem. Ges.*, 1897; *Pharm. Rev.*, 1901, 514; *D. C.*, 1902, 223; *P. J.*, 1902, 663; *Chem. News*, 1903, 123; *A. Pharm.*, 1903, 358). Physiological tests have also been proposed by Moschkowitsch, Focke and others based upon the action of digitalis preparations upon the hearts of frogs, but the experiments of Moschkowitsch point out that the individuality, age, weight, sex, species, source (habitat), of the frogs and the time of the year that the frogs are used, materially affect the value of the test. The physiological assay of digitalis is, however, used by manufacturers as a comparative test of value. J. Gordon Sharp proposed a test for digitalis based upon the fact that the leaves contain an enzyme, which acts on amygdalin producing an odor like that of bitter almond with hydrocyanic acid. (*P. J.*, 1902, 236.)

Uses.—Experiments upon the lower animals, confirmed by clinical observation, have shown that digitalis acts primarily and with most force upon the circulation, producing a great rise in the arterial pressure. The increased blood force is due partly to increased cardiac action and partly to vasomotor spasm. Upon the heart digitalis acts by stimulating the pe-

ripheral ends of the inhibitory nerves and also the cardiac muscle. By the first influence it produces prolongation of the diastole; by the second, an increased putting forth of power in the systole. The work done by the heart under the influence of the drug is much beyond normal. After a toxic dose the systolic irritation overbalances the diastolic stimulation, and the pulse becomes dicrotic, because the diastole is aborted by an interrupting systole. Finally, the apex of the heart never dilates, diastole is continually interrupted by systolic contractions, and the aortic system remains empty, because the left ventricle never relaxes sufficiently to receive blood. In the frog at least the final cessation of the heart's action is not due to paralysis, but to spasm, the heart ceasing not in diastole, but in systole; the warm blooded heart, however, seems incapable of continuous spasm and usually relaxes completely immediately before death.

This résumé of our knowledge of the physiological action clearly indicates the proper use of the drug. It is indicated when the heart is weak,—not absolutely, but relatively weak, or, in other words, when the work required of the heart is greater than its power. When digitalis is administered in ordinary doses, it produces at first no distinct effect; but if the dose be repeated, after a time the pulse becomes less frequent. The pauses between the beats are longer than before, and the individual beat is longer, fuller, and stronger, indicating that the heart is acting with more force than normal. When the reduction of the pulse rate has commenced, it is likely to continue for some days, and even to increase for a time, although the use of the remedy be intermitted, slowness and permanency of action being characteristic of digitalis. In some cases, gastric disturbances, and even nausea, vomiting, and diarrhœa, are produced by the therapeutic doses of the drug. If sufficient of the remedy has been taken into the system, the pulse may fall to 35 or 40 a minute, still preserving the peculiarity of a distinctly dicrotic beat. Now a very peculiar phenomenon may often be witnessed. While the patient is quiet in the horizontal position the pulse is very slow and strong, but when he rises to his feet it becomes at once rapid, irregular, small, and feeble, and even hobbling. During the milder operation of digitalis there may be some sense of cerebral disturbance, brow-tightness, and even a confusion of thought and giddiness. After toxic doses the symptoms are severe; a feeble, scarcely perceptible pulse, nausea and vomiting, stupor or delirium, cold sweats, extreme prostration of strength, hiccough, convulsions, and syncope have in several cases preceded the fatal issue.

The dilated heart is of course a weak heart, and simple *cardiac dilatation* is one of the strongest indications for the use of digitalis, while cardiac hypertrophy is a contra-indication. It must not be forgotten, however, that in *valvular disease*, the heart, although stronger than normal, may be relatively weak, because the leakage at the diseased valve requires more power to overcome its effect than even the increased strength of the cardiac muscle is able to give. Hypertrophy exists, but is not sufficient to be compensatory. In all forms of valvular lesion, when the hypertrophy is not compensatory, digitalis is very useful. It is also to be employed (hypodermically) in sudden cardiac exhaustion from any cause. *Dropsy* is very frequently the result of a general venous repletion, which also interferes with the function of the kidneys. Under these circumstances digitalis is a favorite remedy, and also acts as a decided diuretic. In these cases the result is in greater or less part due to the improvement of the circulation, but the drug has some tendency, even in health, to provoke diuresis. It is especially when it fails to do this that the so-called cumulative action is likely to be witnessed. After giving the drug for a long time without apparent effect, suddenly symptoms so severe as to be toxic are manifested. In aneurism, or when from any reason the coats of the vessels are thin or fragile, digitalis is contra-indicated. We have seen a dilated aorta ruptured by the powerful blood-current produced by the drug.

Externally applied, digitalis sometimes acts speedily and powerfully as a diuretic, and has proved useful in dropsy. For this purpose the fresh leaves bruised, or the dried leaves made into a poultice, or flannels wet with the tincture, may be applied to the abdomen and on the inside of the thighs. Ch. Hoffman has shown by experiments on himself that the active matter of digitalis is capable of being absorbed through the skin, and that its effects on the system may be obtained by means of baths.[1] A case is recorded in which a cataplasm of the leaves applied to the abdomen for the relief of obstinate and dangerous suppression of urine, and repeated in six hours, brought on excessive diuresis, with a discharge amounting to probably 8 gallons in less than 24 hours, producing fatal exhaustion. (*M. T. G.*, Jan. 1868.)

Digitalis is administered in substance. The dose of the powder is one grain (0.065 Gm.), repeated twice or three times a day, and gradually increased until some effect is produced upon the head, stomach, pulse, or kidneys, when it should be omitted or reduced. The question as to which of the preparations of digitalis is preferable is a very important one. All the active principles are soluble in alcohol; the tincture (*Tinctura Digitalis*), therefore,

[1] Hoffman, during a period of 44 days, took 16 baths prepared with 300 liters of water and 250 grammes of digitalis leaves. After the third bath he began to feel the effects of the medicine,—namely, a peculiar uneasiness, and a reduction of the pulse 4 or 5 pulsations per minute; and this condition persisted several hours. At the eighth bath the uneasiness was increased, and the pulse decreased from 68 to 51. After the sixteenth bath the pulse fell to 48. (*J. P. C.*, Juillet, 1867, p. 37.)

fully represents the crude drug. According to Kobert, in the making of the fluidextract digitoxin is precipitated as an insoluble powder. If this is correct, the fluidextract does not as fully represent the crude drug as does the tincture. It is, however, very possible, indeed probable, that digitoxin should be precipitated in one method of making a fluidextract and not in another, so that it cannot be considered demonstrated that the U. S. P. fluidextract, contains no digitoxin. As digitoxin is not soluble in water, it would seem, *a priori,* probable that it and the other constituents of the so-called French or insoluble digitalin would be left behind in making an infusion, but certainly the infusion of digitalis is an active preparation and is preferred by many practitioners. It is possible that the superiority claimed by some clinicians for the infusion, which we have elsewhere otherwise explained (see page 655), is in fact due to the absence from it of active substances which are present both in the crude digitalis and in the tincture. A careful chemical physiological investigation of the relative activities of the preparations of digitalis seems to us urgently needed, but the probabilities are that all the official preparations are active when they have been carefully made from well selected leaves.

The subject of the therapeutic activity and value of the different non-official preparations of digitalis is one of great difficulty, and at present of doubt. In these paragraphs we propose to consider only the commercial products or educts of digitalis which are for sale in the market. These commercial preparations are of two characters, the so-called digitalins—which should be looked upon either as purified extracts of digitalis or crude glucosidal products.

As already stated (p. 425), there are two digitalins; of these *Digitalinum gallicum,* or French digitalin, official in the French and Belgian Pharmacopœias, is almost insoluble in water, and is said to consist largely of a glucoside allied to digitoxin. (See *P. J.,* 1898, 506.) The dose of the commercial article is put down at one two hundred and sixtieth of a grain (0.00025 Gm.), rapidly increased to one-fortieth of a grain (0.0016 Gm.) per day, the maximum daily dose being one-thirtieth of a grain (0.002 Gm.). The granules of Homolle, which were formerly used in Europe, each contained a milligramme, or about the seventieth of a grain, probably equivalent, on the average, to a grain and a half of digitalis of medium strength. One of these globules is usually given as a commencing dose. Forty of them taken with a view to suicide, though followed by copious vomiting, produced the most alarming prostration, with a weak pulse, from 46 to 48 in a minute, intermittent, and at times scarcely perceptible. The patient, however, ultimately recovered. (*Ann. Thér.,* 1858, 103.)

Digitalinum germanicum, digitalin of the German Pharmacopœia, is soluble in water and alcohol but almost insoluble in chloroform; it is believed to be a mixture of digitalein, crystallized digitalin, digitonin, and digitalin of Kiliani. It formerly was employed quite largely, but fell into desuetude probably on account of its having habitually been given in too small doses, as insisted upon by Henry Beates. The dose was formerly considered to be one-fiftieth to one-thirtieth of a grain (0.0013 to 0.002 Gm.), but according to the clinical reports of Beates, and the experiments of Arnold and Wood, Jr., one-fourth of a grain (0.016 Gm.) is about equivalent to 15 minims of the tincture of digitalis, so that it may be given with safety in doses of one-eighth to one-fourth of a grain. This conclusion is in accord with the statement to us of Merck & Co. that in the manufacture of German digitalin the average yield is from 4 to 5 per cent. On this basis, if German digitalin did nearly represent digitalis, it would be from twenty to twenty-five times as strong, so that four-tenths of a grain of it would stand for eight grains of digitalis, or about eighty minims of the tincture. Except for the convenience of administration, German digitalin has no superiority, however, over the older preparations. Much of it upon the market is probably badly made. As a hypodermic agent we have found it as irritant as is the tincture of digitalis. Physiological tests made by Lyons and Famuliner upon frogs showed that Merck's digitalin, which was found to be very uniform in strength, was nearly 30 times as strong as a sample of digitalis of average quality. (*Proc. A. Ph. A.,* 1902, 424.)

Digitalinum crystallizatum or *digitin* is commonly affirmed to be physiologically inactive, though Laffron asserts that it is as powerful as digitoxin.

Digitonin is asserted by authorities to be similar in its physiological action to saponin, which has, on the other hand, apparently been demonstrated to be the physiological antagonist of digitalis. It is evident, therefore, that digitonin, so far as our present knowledge is concerned, cannot be used as the representative of digitalis.

Of *digitalein,* it is asserted that when given in doses of from one-sixty-fourth to one-thirtieth of a grain (0.001 to 0.002 Gm.), two to four times a day, it acts as a heart tonic and diuretic similarly to digitalis. According to Merck & Co., the average yield of digitalein is 1 per cent., which would make the dose contained in one grain of digitalis the one-hundredth of a grain (0.0006 Gm.). It, however, represents such a small fraction of the activities of digitalis that a much larger dose would seem to be required. In this case the dose given by authorities evidently is below that which by calculation would appear to be safe. It is not probable, however, that digitalein nearly represents digitalis.

Digitoxin has been proven by the experiments of J. P. Arnold and H. C. Wood, Jr., of Zeltner, and of Cushny, to affect the circulation of the lower animals as does digitalis, and it has been recommended as acting more quickly and favorably in cardiac diseases than do the older preparations of digitalis, by Potain, Potteiz, Starck, Masius, Corin, and other clinicians. That it is an efficient drug is established, but that it has distinct advantages is not apparent. It is locally very irritant and probably at least as prone as is digitalis to derange the digestion. Its tendency to cumulative action, so marked in the experiments of Frankel, has been confirmed in those of Arnold and H. C. Wood, Jr., and clinically by Zeltner. Moreover, the general verdict is that it acts more slowly than does digitalis. When given in solution it is probably precipitated in the alimentary canal and absorbed with great slowness. It is so insoluble in neutral menstrua, and so irritant, that it is unfit for hypodermic use.[1]

Further, there is much uncertainty as yet as to its strength compared with digitalis. Digitoxin is, however, according to Zeltner one thousand times, according to Bosse fifteen hundred times, more active than digitalis; while Curioni gives as the minimum ordinary single dose the one-hundred and twentieth of a grain, the maximum dose one-sixtieth of a grain. In our opinion the commencing dose in any case should not exceed the two-hundred and fortieth of a grain (0.00025 Gm.).

Dose, of digitalis leaves, one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Extractum Digitalis, *U. S.* (from fluidextract); Fluidextractum Digitalis, *U. S.;* Infusum Digitalis, *U. S., Br.;* Tinctura Digitalis, *U. S., Br.*

ELASTICA. U. S. (Br.)

RUBBER [Caoutchouc]

(ĕ-lăs'tĭ-cạ)

"The prepared milk-juice of several species of *Hevea* Aublet (Fam. *Euphorbiaceæ*), known in commerce as Para Rubber." *U. S.* "The prepared milk-juice of Hevea brasiliensis, *Muell. Arg.,* and probably other species; known in commerce as pure Para rubber." *Br.*

Caoutchouc, *Br.;* India-Rubber; Resina Elastica, Gummi Elasticum; Caoutchouc, *Fr. Cod.;* Kautschuk, Federharz, *G.;* Caucho, Cahuchu, Goma elastica, *Sp.*

Rubber was made official in the U. S. P. 1890 because of its use in making mustard paper.

The widespread destruction of the native rubber trees, especially in the valley of the Amazon, with other causes, slowly led to experiments in the cultivation of the plants. The first important trials were made in Assam in 1860, since which time, especially under the fostering care of the British Government, much has been accomplished. The attempts, however, to acclimatize the *Castilloa elastica* and the *Hevea brasiliensis* in Ceylon and India finally failed. More successful were the plantations of the *Manihot Glaziovii,* which has been found to thrive well at an altitude of about 6000 feet in Ceylon, and also in India, and which bids fair to be the great india-rubber tree of the future, especially in view of the fact that cultivation was stimulated by the rapid disappearance of the wild Landolphias in the French Congo; government experiments have proven that the Manihot grows well in that region.

In Brazil, india-rubber is procured from the trees by making vertical cuts with a narrow-bladed hatchet, in the bark, in the period between the end of August and the first of January, and collecting the latex as it falls, drop by drop, often to the amount of more than one fluidounce from each incision. Generally in Central and South America, as well as in Africa and Asia, the method of tapping the trees is similar, though the period of year at which the best yield of latex is obtained varies. The old method of obtaining rubber, by the cutting down of the tree, is probably no longer followed, except in Congo (Free) State. When collected the latex is caused to coagulate, usually by the use of heat, dry or moist, artificial or natural. The Para rubber owes its peculiar physical character to the fact that the coagulation of the latex is produced by smoking it. In Africa, and to some extent in America, coagulation is effected by the addition of certain chemicals, notably alum, sulphuric acid, common salt, soap, and citric acid.

The importance of india-rubber in the arts is evinced by the fact that in the fiscal year ending June, 1904, 59,015,551 pounds, valued at $40,444,250, were brought into the United States. Of this amount 33,109,112 pounds came directly from Brazil, while 21,000,000 pounds reached the United States through Europe.

India-rubber or caoutchouc is a hydrocarbon obtained from the milky juice of certain tropical plants. This milky juice is contained chiefly in the so-called laticiferous vessels, situated in the internal zone of the bark, which are composed of isolated cells, so arranged as to form large vessels with many ramifications. A hydrocarbon is formed by the protoplasm of the cells which belong to the fundamental parenchymatous structure of the

[1] *Hypodermic solution of digitoxin.*—Corin affirms (*Nouv. Rem.,* 1895, 200) that the addition of water, or physiological fluid, or serum, while it will precipitate alcoholic solutions of 20 per cent. strength of digitoxin, will not affect a solution made in accordance with the following formula: Digitoxin, 2 to 3 milligrammes; Chloroform, 0.6 Cc.; Alcohol (90 per cent.), 12 Cc.; Water, a sufficient quantity to make 150 Gm. To be taken in three doses.

Madsen of Copenhagen, states that one cubic centimeter (16 minims) of so-called *Petit's solution* will dissolve one milligramme (one sixty-fourth of a grain) of digitoxin; and that four minims of this solution (one two hundred and fortieth of a grain) is the hypodermic dose. *Petit's solution,* glycerin 333 parts, alcohol 95 parts, water to 1000 parts.

bark and not to the fibro-vascular bundles. That the hydrocarbon is a waste product, incapable of use in the economy of the plant, is believed by some naturalists; that it is necessary to the life of the plant, as believed by other naturalists, is not yet proved, the probabilities, however, are in favor of the latter view.

The latex as it first exudes from the wounded plant is said to have some resemblance to the milk of the goat, containing suspended microscopic granules which are affirmed by Adriani to have a diameter of not more than two or three micromillimeters. In its best forms the yield of pure india-rubber from the latex or milk juice, should be as much as 32 per cent.

Although various milky-juice plants of the temperate countries contain the hydrocarbon, india-rubber is a product only of the tropical and sub-tropical countries. It is said to be obtained for commercial purposes from at least 90 species of plants, representing five different botanical families, namely:—the Euphorbiaceæ, Artocarpaceæ, Moraceæ, Apocynaceæ, and Asclepiadaceæ.

The india-rubber producing *Euphorbiaceæ* are chiefly South American trees, inhabiting the region from extreme Southern Brazil to Northern Venezuela. The most important of these belong to the genus Hevea. The *Hevea brasiliensis* (*Siphonia brasiliensis*) yields the most esteemed commercial rubber. The *Hevea guaianensis* has been acclimatized and is cultivated in Ceylon, British India, and other parts of Southern Asia. In the Gaboon Coasts, Congo, and Ceylon, the *Manihot Glaziovii* has been cultivated.

The india-rubber producing *Moraceæ* have a very wide distribution throughout tropical countries. Of the South American species the most important is the *Castilloa elastica,* a large tree which inhabits Mexico, Central America, Northern South America, and the West Indies, and formerly produced the bulk of the india-rubber of Mexico and Central America. In Asia and Africa the most important india-rubber Moraceæ belong to the genus *Ficus;* the chief species being the *Ficus indica,* L., of Southern Asia and the Philippine Islands, familiarly known as the *Banyan tree;* and the *Ficus elastica,* Roxb., of India and Java, known as the *india-rubber plant* of our hot-houses.

Belonging to the *Apocynaceæ* are numerous *bind-weeds,* natives of Africa, Asia, and various parts of Oceania. The most important of these belong to the genus Landolphia, large woody bind-weeds which grow over the trees of Liberia, Gaboon, Angola, Zanzibar, Madagascar, and other portions of Africa, reaching a length of 80 feet, and a trunkal diameter of 6 inches, covering large masses of ground and making forests almost impassible. From them comes the bulk of African rubber. The apocynaceous genus *Vahea* is represented in both South America, Eastern, Western and Central Africa; while the genus *Willoughbeia* grows in Southern Asia, and has been acclimatized in Australia.

Properties.—Rubber occurs in large flat pieces, or moulded into various shapes. The latter are formed by applying successive layers of the juice upon moulds of clay, which are broken and removed when the coating has attained a sufficient thickness and consistence. In the drying of these layers they are exposed to smoke, which gives to the concrete mass a blackish color. Rubber is officially described as "in flask-shaped or roundish masses, or in pieces of the same having sharply incised surfaces and exhibiting a laminated structure; floating on water; externally brownish to brownish-black; internally of a lighter tint, mottled; odor creosote-like; nearly tasteless. Pure Para Rubber is insoluble in water, dilute acids, or dilute solutions of the alkalies; soluble in chloroform, carbon disulphide, oil of turpentine, petroleum benzin, and benzene; when heated to about 125° C. (257° F.) it melts, remaining soft and adhesive after cooling." *U. S.* "In elastic masses of varying thickness, brownish black externally and mottled with a pale tint internally; insoluble in *water,* ethylic alcohol, alkaline solutions, or dilute acids, soluble in *chloroform, oil of turpentine, carbon bisulphide, benzol,* and *petroleum spirit.* When heated to about 257° F. (125° C.) it melts, remaining soft and adhesive after cooling. Odor characteristic, somewhat empyreumatic; nearly tasteless." *Br.*

Chemical Constitution.—The juice of the rubber trees, when it concretes by exposure to the air, assumes on the outer surface a yellowish-brown color, while the mass remains white or yellowish-white within. It is said that a little alum facilitates the coagulation, while ammonia retards it, so that a little of the latter may be advantageously added, when it is desired to keep the milky juice in the liquid state. (R. Spruce, *P. J.,* xv. 118.) The recent juice contains, according to Faraday, 1.9 per cent. of vegetable albumen, traces of wax, 7.13 per cent. of a bitter nitrogenous substance soluble in water and alcohol, 2.9 of a substance soluble in water but insoluble in alcohol, 56.37 soluble in water with a little free acid, and only 31.7 of the pure elastic principle to which chemists have given the name of caoutchouc. Besides these principles, the concrete juice, as it reaches us, generally contains soot, derived from the smoke used in drying it. *Pure caoutchouc,* or rubber, is nearly colorless, and in thin layers transparent. It is highly elastic, lighter than water, without taste and odor, fusible at about 120° C. (248° F.), remaining unctuous and adhesive upon cooling, inflammable at a higher temperature, insoluble in water, alcohol, the weak acids, and alkaline solutions, soluble in ether when entirely freed from alcohol, soluble also in chloroform and most of the fixed and volatile oils, though, in the latter, at the expense of its elasticity. It

is said, however, that the oils of lavender and sassafras dissolve it without change, and that when precipitated by alcohol from its solution in oil of cajuput it is still elastic. But its best solvents, for practical purposes, are coal naphtha or petroleum benzin, the empyreumatic oil obtained by distilling caoutchouc itself, and pure oil of turpentine. According to Bolley, the best method of effecting its solution, for the preparation of a varnish, is first to digest it, cut in small pieces, in carbon disulphide, which converts it into a jelly, and then to treat this jelly with petroleum benzin. A larger proportion is thus taken up than by any other method. Rubber is not affected by atmospheric air, chlorine, hydrochloric or sulphurous acid gas, or ammonia. Rubber chemically is composed of a mixture of polyterpenes. When destructively distilled, it yields *isoprene*, C_5H_8, and *dipentene*, $C_{10}H_{16}$. When isoprene is treated with concentrated hydrochloric acid, it is polymerized, and a substance obtained which resembles caoutchouc and is probably identical with it. When rubber is vulcanized, it may contain from 2 to 20 per cent. of sulphur, of which, however, not more than the lower amount is chemically combined, the rest being held mechanically, and capable of removal by treatment with caustic alkalies.[1] Bouchardat succeeded in preparing from isoprene an artificial caoutchouc by acting upon the isoprene with saturated hydrochloric acid in sealed tubes.

Uses.—Rubber is so insoluble that it cannot be absorbed in any form into the blood. It is used enormously in the arts for an infinite variety of purposes. In chemistry and surgery it has also numerous applications.

[1] By the action of sulphur, rubber acquires properties which greatly increase its value in the arts. It either becomes pliable, soft, and tough, or if the amount of sulphur be increased, of a horny consistence, but preserves its elasticity under the influence both of heat and cold, is compressible with great difficulty, and resists the ordinary solvents such as petroleum and oil of turpentine. In this state it is said to be *vulcanized*. The discovery of the process of *vulcanization* is ascribed to Charles Goodyear of New York. (*Chem. Gaz.*, x. 193.) It consists in submitting rubber in thin sheets to the action of a mixture composed of 40 parts of carbon disulphide and 1 of sulphur chloride. For fuller details the reader is referred to the *J. P. C.* (3e sér., xvii. 205.) The same object may be effected by other methods. When thin layers of rubber are immersed for two or three hours in melted sulphur at the heat of 116° C. (240° F.), they are penetrated by the sulphur, but undergo no change of properties. If now heated in an inert medium to a temperature of from 135° C. (275° F.) to 160° C. (320° F.), a chemical reaction takes place, and the vulcanized product is obtained. The same result takes place if the rubber be first pounded with from 12 to 20 per cent. of finely powdered sulphur, and then heated to the temperature requisite for vulcanization. In either case a portion of uncombined sulphur remains mechanically mixed with the vulcanized rubber, from which it may be separated by various solvents, such as solutions of potassium or sodium hydroxide, carbon disulphide, oil of turpentine, anhydrous ether, etc. The *desulphurated* product thus obtained, while exempt from the disadvantages arising from the reaction of free sulphur, is more porous than before. (*Ibid.*, xxi. 366.) For details of these two processes,—viz., vulcanization by heat with sulphur or metallic sulphides, and cold vulcanization with solutions of sulphur chloride,—see Sadtler's *Industrial Organic Chemistry*, pp. 99–101.

Off. Prep.—Charta Sinapis, *U. S., Br.;* Emplastrum Adhæsivum, *U. S.;* Liquor Caoutchouc, *Br.*

ELATERINUM. U. S., Br.

ELATERIN

(ĕl-ă-tē-rī′nŭm)

$C_{20}H_{28}O_5 = 345.60$

"A neutral principle obtained from elaterium, a substance deposited by the juice of the fruit of *Ecballium Elaterium* (Linné) A. Richard (Fam. *Cucurbitaceæ*)." *U. S.* "Elaterin, $C_{20}H_{28}O_5$, is the active principle of Elaterium." *Br.*

Elaterine, Elatine, *Fr.;* Elaterin, *G.;* Elaterina, *Sp.*

Preparation.—Elaterin was introduced into the Pharmacopœias on account of the well-known variability in quality of commercial elaterium. (See *Elaterium* and *Trituratio Elaterini.*) Care must be taken to examine the elaterin, which is itself liable to be adulterated. It may be procured by evaporating an alcoholic tincture of elaterium to the consistence of thin oil, and throwing the residue while yet warm into a weak boiling solution of potassium hydroxide, this holds the green resin in solution, and the elaterin crystallizes as the liquor cools. Hennell obtained it by treating with ether the alcoholic extract procured by the spontaneous evaporation of the tincture. This consists of elaterin and the green resin, the latter of which, being much more soluble in ether than the former, is completely extracted by this fluid, leaving the elaterin pure. But, as elaterin is also slightly soluble in ether, a portion of this principle is wasted by Hennell's method. By evaporating the ethereal solution, the green resin is obtained separate. Hennell says that this was found to possess the purgative property of elaterium, as it acted powerfully in a dose less than one-third of a grain. But the effect was probably owing to the presence of a portion of elaterin which had been dissolved by the ether. Flückiger prefers to exhaust elaterium with chloroform, and add to the percolate ether, which precipitates elaterin. The precipitate may be dissolved in chloroform and recrystallized. This process was adopted by the Br. Pharm. 1885.

Properties.—It is in "minute, white, hexagonal scales or prismatic crystals; without odor, and having a slightly acrid, bitter taste; permanent in the air, and containing no water of crystallization. Insoluble in water; soluble in 262 parts of alcohol, 318 parts of ether, 22 parts of chloroform, 272 parts of benzene, and 200 parts of amyl alcohol at 25° C. (77° F.); soluble in 75 parts of alcohol at 60° C. (140° F.). When heated to 190° C. (374° F.) it turns yellow, and at 216° C. (420.8° F.) it melts, forming a yellowish-brown liquid. On ignition, it is consumed without leaving any

residue. Its solutions are neutral to litmus paper. Sulphuric acid colors it yellow, the color changing gradually to scarlet. Sulphuric acid containing a trace of ammonium vanadate produces a blue color, changing to green and then to brown. Sulphuric acid containing a drop of formaldehyde gives a brown color. Sulphuric acid containing a trace of potassium dichromate produces an olive-green color, gradually turning darker. If a crystal of Elaterin be added to a little hydrochloric acid, and this evaporated to dryness, the residue washed with hot water, and afterwards treated with sulphuric acid, a brownish-red (amaranth) color will be produced. An alcoholic solution of Elaterin should not be precipitated by tannic acid T.S., mercuric chloride T.S., or platinic chloride T.S. (absence of, and difference from *alkaloids*)." *U. S.* "With melted phenol it yields a solution which, on the addition of sulphuric acid, acquires a crimson color, rapidly changing to scarlet." *Br.* Ernst Johannson (*In. Dis.*, Dorpat, 1884) gives the following reactions for elaterin besides those mentioned in the Pharmacopœia. In all of them elaterin is held in alcoholic solution. Froehde's reagent gives a green color passing into brown which fades away. Vanadinsulphuric acid with the fortieth of a milligramme produced a splendid blue color passing into a clear green, finally into reddish brown. After mixing with selenic acid and an addition of sulphuric acid, in a few minutes a red-brown color develops, which is not so deep as that which is produced by sulphuric acid. Kohler's reaction is produced by dissolving elaterin in a few drops of concentrated hydrochloric acid, evaporating the acid in a water bath, washing the white, amorphous residue with boiling water, and adding some concentrated sulphuric acid, when an amaranth-red color develops. By means of these reactions Johannson has been able to find elaterin in large quantities in the fæces of animals poisoned by it, but no trace in the blood or urine or any part of the organism.

Morries obtained 26 per cent. from the best British elaterium, 15 per cent. from the worst, and only 5 or 6 per cent. from the French, while a portion procured according to the directions of the London College yielded to Hennell upwards of 40 per cent. The Br. Pharmacopœia directs that the proportion of elaterin should not be less than 20 per cent. Experiments by John Williams satisfactorily prove that the fruit, exhausted of the free juice from which elaterium is obtained, contains very little if any elaterin, certainly not enough to compensate for the cost of its extraction. (*Chem. News*, 1860, p. 124.)

Uses.—Elaterin represents all the activities of elaterium; to which it is preferable on account of the greater uniformity of its effects.

Dose, one-twentieth to one-tenth of a grain (0.003 to 0.006 Gm.).

Off. Prep.—Pulvis Elaterini Compositus, *Br.*; Trituratio Elaterini, *U. S.*

ELATERIUM. Br.

ELATERIUM

(ĕl-ą-tē'rī-ŭm)

"A sediment from the juice of the fruit of Ecballium Elaterium, *A. Richard.*" *Br.*

Extractum Elaterii; Elaterium, Elaterion, *Fr.*; Elaterium, *G.*; Elaterio, *It., Sp.*

Ecballium Elaterium (L.), A. Rich.—*Momordica Elaterium*, Willd., *Sp. Plant.* iv. 605; Woodv., *Med. Bot.*, 192, t. 72.—*Ecbalium agreste*, Richard; Lindley, *Med. and Œcon. Bot.*, 95.—*Ecbalium officinale*, Nees.—The *wild* or *squirting cucumber* is a perennial plant, with a large fleshy root, from which rise several round, thick, rough stems, branching and trailing like the common cucumber, but without tendrils. The leaves are petiolate, large, rough, irregularly cordate, and of a grayish-green color. The flowers are yellow, and proceed from the axils of the leaves. The fruit has the shape of a small oval cucumber, about an inch and a half long, an inch thick, of a greenish or grayish color, and covered with stiff hairs or prickles. When fully ripe, it separates from the peduncle, and throws out its juice and seeds with considerable force through an opening at the base, where it was attached to the footstalk. The name of squirting cucumber was derived from this circumstance, and the scientific and official title is supposed to have had a similar origin, though some authors maintain that the term *elaterium* was applied to the drug rather from the mode of its operation upon the bowels than from the projectile property of the fruit.[1]

Preparation.—This species of Ecballium is a native of the south of Europe, and is cultivated in Great Britain, where, however, it perishes in the winter. Elaterium is the substance spontaneously deposited by the juice of the fruit, when separated and allowed to stand. From the experiments of Clutterbuck, it has been supposed that only the free juice about the seeds, which is obtained without expression, affords the product. The substance of the fruit itself, the seeds, as well as other parts of the plant, have been thought to be nearly or quite inert. From the statements made by Bell (see note, next page), these opinions must probably be somewhat modified; but there is no doubt that strong expression injures the product. When the fruit is sliced and placed upon a sieve, a perfectly limpid and colorless juice flows out, which soon becomes turbid, and in the course of a few hours begins to deposit a sediment. This, when collected and carefully dried, is very light and pulverulent, of a yellowish-white color, slightly tinged with green. It is the genuine elaterium, and was found by Clutterbuck to purge violently in the dose of

[1] From the Greek ἐλαύνω, *I drive*, or ἐλατήρ, *driver*. The word *elaterium* was used by Hippocrates to signify any active purge. Dioscorides applied it to the medicine of which we are treating.

one-eighth of a grain. But the quantity contained in the fruit is very small. Clutterbuck obtained only six grains from forty cucumbers. Commercial elaterium is often a weaker medicine, owing in part, perhaps, to adulteration, but much more to the mode in which it is prepared. In order to increase the product, the juice of the fruit is often expressed with great force, and there is reason to believe that it is sometimes evaporated so as to form an extract, instead of being allowed to deposit the active matter. The French elaterium is prepared by expressing the juice, clarifying it by rest and filtration, and then evaporating to a suitable consistence. As the liquid remaining after the deposition of the sediment is comparatively inert, it will be perceived that the preparation of the French Codex must be relatively feeble. The following are the directions of the British Pharm. (1885): "Cut the fruit lengthwise, and lightly press out the juice. Strain it through a hair sieve, and set aside to deposit. Carefully pour off the supernatant liquor; pour the sediment on a linen filter, and dry it on porous tiles, in a warm place. The decanted fluid may deposit a second portion of sediment, which can be dried in the same way." The latter portion deposited is of a lighter color. (Pereira.) The slight pressure directed is necessary for the separation of the juice from the somewhat immature fruit employed. The perfectly ripe fruit is not used, as, in consequence of its disposition to part with its contents, it cannot be carried to market. In the British Pharmacopœia, the former name of *Extractum Elaterii* of the London College has been very properly abandoned, as the preparation is in no correct sense of the word an extract. Elaterium is brought chiefly from England, but it is probable that a portion of the elaterium of which Pereira speaks as coming from Malta reaches our market also.[1]

Properties.—The *best elaterium* is in thin flat or slightly curled cakes or fragments, often bearing the impression of the muslin upon which it was dried, of a greenish-gray color becoming yellowish by exposure, of a feeble odor, and a bitter, somewhat acrid taste. It is pulverulent and inflammable, and so light that it floats when thrown upon water. When of inferior quality, it is sometimes dark-colored, much curled, and rather hard, breaking with difficulty, or presenting a resinous fracture. "In light, friable, flat or slightly curved, opaque cakes, about one-tenth of an inch (two and a half millimetres) thick; pale green, grayish green, or yellowish gray in color; fracture finely granular; odor faint, tea-like; taste bitter and acrid. It should not give the characteristic reactions with the tests for carbonates or for starch, and should yield half its weight to boiling *alcohol* (90 per cent.). When exhausted with *chloroform*, the solution evaporated, the residue washed with *ether*, and the process of solution, evaporation, and washing repeated, Elaterium should yield 25 per cent., or not less than 20 per cent., of Elaterin." *Br.*[2] The *Maltese elaterium* is in larger pieces, of a pale color, sometimes without the least tinge of green, destitute of odor, soft, and friable, and not infrequently gives evidence of having been mixed with chalk or starch. It sinks in water, and usually contains so little elaterin that it should be employed only as a source of that principle. In the analyses of T. A. Elwood,

[1] The following notice of the cultivation of the elaterium plant and the preparation of the drug at Mitcham, in Surrey, England, condensed from a paper by Jacob Bell in the *P. J.*, for October, 1850, may have some interest for the American reader. The seeds are sown in March, and the seedlings planted in June. In luxuriant plants the stem sometimes acquires an extraordinary breadth. In one instance, though not thicker than the forefinger where it issued from the earth, it was in its broadest part four inches wide and half an inch thick. A wet season interferes with the productiveness of the plant. At the spontaneous separation of the fruit, it throws out its juice sometimes to the distance of twenty yards; and hazard of injury to the eyes is incurred by walking among the plants at their period of maturity. A bushel of the fruit weighs 40 pounds, and the price varies from 7 to 10 shillings sterling. In the manufacture of elaterium, which begins early in September, the fruit, having been washed, if necessary, to cleanse it from earthy matters, is sliced longitudinally into halves, and then submitted to expression, wrapped in a hempen cloth, in a common screw press. Considerable force is used in the expression. The juice is then strained through hair, cypress, or wire sieves, and set aside for deposition. The deposit usually takes place in three or four hours. When this part of the process is completed, the supernatant liquor is carefully poured off, the deposit is placed on calico cloths resting on hair sieves, and allowed to drain for about twelve hours, after which it is removed by a knife, spread over small cloths, and dried on canvas frames in the drying-stove. About half an ounce of fine elaterium is obtained from a bushel of fruit. Some obtain more, but the product is inferior, in consequence of the use of too much force in the expression. Good elaterium has a pale pea-green tint; that of inferior quality is of a duller hue. The juice expelled in bursting is said to undergo very little change in the air, while that expressed from the ripe fruit immediately afterwards becomes milky, and deposits elaterium. The recently burst fruit, therefore, is nearly if not quite as good for the preparation of the drug as that collected before perfect maturity. For a paper on the cultivation of the elaterium plant at Hitchin, Herts, England, see *A. J. P.*, 1860, p. 163; at Market Deeping, *P. J.*, Sept. 1881, p. 239.

[2] H. W. Jones and F. Ransom detail an improved method of assaying elaterium in the *Year-Book of Pharmacy*, 1886, p. 442; it is as follows: "Macerate 1 gramme of finely powdered elaterium with chloroform in a covered dish for a few hours, then transfer to a minature glass percolator (*e.g.*, the barrel of a small glass syringe) plugged with cotton, and wash with chloroform, allowing about 10 Cc. to pass through the marc after the menstruum has begun to pass in a colorless condition. Place the percolate in a small dish, and evaporate off the chloroform at a gentle heat. Treat the residue with a small quantity of pure, absolute ether, and transfer to a small percolator or funnel, plugged with cotton. Wash with pure ether until at least 10 Cc. have passed through colorless, and reserve the ethereal washings. Redissolve the elaterin, so obtained, by passing chloroform through it while still in the funnel or percolator, and evaporate the chloroformic solution once more to dryness in a small dish. Treat the residue so obtained with ether, exactly as before. Allow the united ethereal washings to evaporate spontaneously until the bulk is reduced to about 3 Cc. Transfer this liquid to a small cylinder (*e.g.*, a 10 Cc. measure), and allow the separated elaterin to deposit. Carefully decant the colored supernatant liquid, add 4 Cc. of pure ether to the residue, and again decant after deposition has taken place. Finally dissolve the elaterin in the cylinder with the aid of chloroform, and wash out the larger amount previously collected in the funnel with the same solvent. Unite the chloroformic solutions, evaporate in a tared dish, dry on a water-bath, and weigh."

the average yield of English elaterium was 21.5 per cent., of Maltese elaterium 15.3 per cent. (*P. J.*, Nov. 1891.)

Clutterbuck first observed that the activity of elaterium resided in the portion of it soluble in alcohol and not in water. This fact was afterwards confirmed by Paris, who found that the alcoholic extract, treated with boiling distilled water, and afterwards dried, had the property of purging in minute doses, while the remaining portion of the elaterium was inactive. The subsequent experiments of Hennell of London, and Morries of Edinburgh, which were nearly simultaneous, demonstrated the existence of a crystallizable matter in elaterium which is the active principle, and has been named *elaterin.* (See *Elaterinum.*) According to Hennell, 100 parts of elaterium contain 44 of elaterin, 17 of a green resin (*chlorophyll*); 6 of starch, 27 of lignin, and 6 of saline matters. The alcoholic extract which Paris called *elatin* is probably a mixture of elaterin and the green resin or chlorophyll. Walz (1859) found in the juice of the fruits and herb of *Ecballium,* as well as in that of *Cucumis prophetarum,* L., a second crystallizable bitter principle, *prophetin,* and the amorphous substances *ecballin* or *elateric acid, hydro-elaterin,* and *elateride,* all of which require further examination.

Choice of Elaterium.—The inequality of elaterium depends probably more on diversities in the mode of preparation than on adulteration. Sometimes, however, it is greatly sophisticated, and large quantities are said to have been imported into this country consisting mainly of chalk colored green artificially. (B. Canavan, *N. Y. J. Pharm.,* iii.) It should possess the sensible properties above indicated as characterizing good elaterium, should not effervesce with acids, and should yield from one-sixth to one-fourth of elaterin. (See *Elaterinum.*)

Uses.—Elaterium is a powerful hydragogue cathartic, and in a large dose generally excites nausea and vomiting. If too freely administered, it operates with great violence upon both the stomach and bowels, producing inflammation of these organs, which has in some instances eventuated fatally. It also increases the flow of urine. The fruit was employed by the ancients, and is recommended in the writings of Dioscorides as a remedy in mania and melancholy. Sydenham and his contemporaries considered elaterium highly useful in dropsy, but, in consequence of some fatal results from its incautious employment, it fell into disrepute, and was generally neglected till again brought into notice by Ferriar. It is now considered one of the most efficient hydragogue cathartics in the treatment of *dropsy.* The full dose of commercial elaterium as formerly found in commerce was often from one to two grains (0.065 to 0.13 Gm.), but, as the quality has greatly improved, this dose might now be much too large, and the best plan is to give it in the dose of one-sixth to one-fourth of a grain (0.010 to 0.016 Gm.), repeated every hour till it operates, and increased if necessary. It should be observed that these doses are inapplicable to the very old and feeble and those prostrated by disease. Two-fifths of a grain (0.025 Gm.) proved fatal by purging in an ill and feeble lady of 70 years. (*A. J. P.,* 1868, p. 373.) The dose of Clutterbuck's elaterium is the eighth of a grain (0.008 Gm.), that of elaterin is from the twentieth to the fifteenth of a grain (0.003 to 0.004 Gm.). One grain may be dissolved in a fluidounce of alcohol with four drops of nitric acid, and from 25 to 30 minims (1.6 to 1.8 Cc.) may be given diluted with water, but the granule affords a preferable method.

Dose, one-tenth to one-half a grain (0.006 to 0.032 Gm.).

ELIXIR ADJUVANS. U. S.

ADJUVANT ELIXIR

(ĕl-ĭx'ĭr ăd'jŭ-vănz)

Elixir adjuvant, *Fr.;* **Gewürzhaftes Lakritzenelixir,** *G.*

* "Fluidextract of Glycyrrhiza, *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims]; Aromatic Elixir, *eight hundred and eighty cubic centimeters* [or 29 fluidounces, 363 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix, and filter if necessary." *U. S.*

Uses.—This elixir is used as a vehicle for the administration of various medicinal preparations; it was introduced into the U. S. Pharmacopœia (8th Rev.) mainly to furnish an alternative elixir to aromatic elixir which is similarly used. The presence of the glycyrrhiza aids in disguising or obtunding the taste of bitter or disagreeable substances.

ELIXIR AROMATICUM. U. S.

AROMATIC ELIXIR [Simple Elixir]

(ĕl-ĭx'ĭr ăr-o-măt'ĭ-cŭm)

Elixir aromatique, *Fr.;* **Aromatisches Elixir,** *G.*

* "Compound Spirit of Orange, *twelve cubic centimeters* [or 195 minims]; Syrup, *three hundred and seventy-five cubic centimeters* [or 12 fluidounces, 326 minims]; Purified Talc, *thirty grammes* [or 1 ounce av., 25 grains]; Alcohol, Distilled Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. To the Compound Spirit of Orange add enough Alcohol to make *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]. To this solution, add the Syrup in several portions, agitating after each addition, and afterwards add, in the same manner, *three hundred and seventy-five cubic centimeters* [or 12 fluidounces, 326 minims] of

Distilled Water. Mix the Purified Talc intimately with the liquid, and then filter through a wetted filter, returning the first portions of the filtrate until a transparent liquid is obtained. Lastly, wash the filter with a mixture of *one volume* of Alcohol and *three volumes* of Distilled Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This official preparation takes the place of the former elixir of orange, and by many is regarded as more agreeable. Its introduction grew out of the necessity for some official action which would enable pharmacists readily to furnish elixirs when called for by an extemporaneous or speedy process. The aromatic elixir is, of course, merely a base or vehicle, and in many cases the medicinal substance may be simply dissolved in the elixir. It may be necessary to add some insoluble, inert powder, like precipitated chalk, magnesium carbonate, etc., to the liquid before filtering, in order to obtain a perfectly transparent elixir, and it is customary in many parts of the country to color the preparation with cochineal or caramel.

Off. Prep.—Elixir Adjuvans, *U. S.;* Elixir Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Liquor Ferri et Ammonii Acetatis, *U. S.*

ELIXIR FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U. S.

ELIXIR OF IRON, QUININE AND STRYCHNINE PHOSPHATES

(ĕl-ĭx'ĭr fĕr'rī quĭ-nī'næ ĕt strȳch-nī'næ phŏs-phā'tŭm)

Elixir des Phosphates de Fer, de Quinine et de Strychnine, *Fr.;* Elixir von phosphorsauren Eisen, Chinin und Strychnin, *G.*

• "Soluble Ferric Phosphate, *seventeen and one-half grammes* [or 270 grains]; Quinine, *eight and seventy-five hundredths grammes* [or 135 grains]; Strychnine, *two hundred and seventy-five milligrammes* [or 4¼ grains]; Phosphoric Acid, *two cubic centimeters* [or 32 minims]; Ammonium Carbonate, in translucent pieces, *nine grammes* [or 139 grains]; Alcohol, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Acetic Acid, *twenty-eight and sixty-five hundredths grammes* [or 1 ounce av., 5 grains]; Ammonia Water, Distilled Water, Aromatic Elixir, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Quinine and Strychnine in the Alcohol, then add the Phosphoric Acid and *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Aromatic Elixir. Add the Acetic Acid to the Ammonium Carbonate, contained in a suitable vessel, and when solution is complete, neutralize with Ammonia Water and add enough Distilled Water to make the product measure *fifty cubic centimeters* [or 1 fluidounce, 331 minims]. Mix the solution of Ammonium Acetate with the solution of the alkaloids, and add enough Aromatic Elixir to make the liquid measure *eight hundred and eighty cubic centimeters* [or 29 fluidounces, 363 minims]. Dissolve the Ferric Phosphate in *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of Distilled Water, by the aid of a gentle heat, and if the solution be acid to litmus paper, neutralize exactly with Ammonia Water, and add enough Aromatic Elixir to make the product measure *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims]. Finally, mix the two solutions and filter if necessary." *U. S.*

This elixir was introduced into the U. S. Pharmacopœia (8th Rev.) because it is largely used and deserved this recognition. The process is essentially that recommended by Caspari; the ferric phosphate and the alkaloids can be retained in solution in the elixir with the aid of an excess of phosphoric acid, but this makes the elixir unpleasantly acid to the taste; ammonium acetate is used to retain the ferric phosphate in solution with the other ingredients and to make a finished elixir which can be mixed with aqueous solutions without producing turbidity, and remain clear at low temperatures. This elixir should be preserved in amber-colored bottles protected from the light, otherwise the pale greenish color which it has when first made will disappear and be replaced by a brownish tint followed often by precipitation.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

ELIXIRIA.

ELIXIRS

(ĕl-ĭx-ĭr'ĭ-ą)

Cordials; Elixirs, *Fr.;* Elixire, *G.*

Elixirs as they are known in modern American pharmacy are aromatic, sweetened, spirituous preparations, containing small quantities of active medicinal substances. They differ greatly from the liquids formerly termed elixirs, from the fact that the first object sought for in the modern elixir is an agreeable taste, and usually this is attained only by such sacrifices as to render the effect of the medicine almost *nil,* while the principal activity is due to the alcohol, which has proved in many cases very injurious. These considerations have prevented an extensive official recognition of elixirs, and the U. S. Pharm. 1890 recognized but two, one of which, the Aromatic Elixir, has been introduced merely as a vehicle. In the U. S. P. (8th Rev.) two elixirs were introduced, Adjuvant Elixir and Elixir of Iron, Quinine and Strychnine Phosphates.

Owing to their extensive use by practitioners all over our country, it became necessary to notice some of the most important in this commentary, and in the 15th edition of the Dispensatory a number of formulas for elixirs

were inserted in PART I. Elixir of Orange, official in the U. S. Pharm. 1880, may be made by the formula in the foot-note.[1]

EMPLASTRA.

PLASTERS

(ĕm-plăs'trą)

Emplâtres, *Fr.;* Pflaster, *G.* Empiastri, *It.;* Emplastos, *Sp.*

Plasters are solid compounds intended for external application, adhesive at the temperature of the human body, and of such a consistence as to render the aid of heat necessary in spreading them. Spread plasters having rubber in their composition are most largely used; they are usually perforated. Some plasters have as their basis a compound of olive oil and litharge, constituting the Emplastrum Plumbi of the Pharmacopœias. Others owe their consistence and adhesiveness to resinous substances, or to a mixture of these with wax and fats.

In the preparation of the plasters, care is requisite that the heat employed be not sufficiently elevated to produce decomposition, nor so long continued as to drive off any volatile ingredient upon which the virtues of the preparation may in any degree depend. After having been prepared, they are usually shaped into cylindrical rolls, and wrapped in paper to exclude the air. Plasters should be firm at ordinary temperatures, should spread easily when heated, and, after being spread, should remain soft, pliable, and adhesive, without melting, at the heat of the human body. When long kept, they are apt to change color and to become hard and brittle, and, as this alteration is most observable upon their surface, it must depend chiefly upon the action of the air, which should therefore be excluded as much as possible. The defect may usually be remedied by melting the plaster with a moderate heat and adding a sufficient quantity of oil to give it the due consistence.

Plasters are prepared for use by spreading them upon leather, linen, or muslin, according to the particular purposes they are intended to answer. Leather is most convenient when the application is made to the sound skin, linen or muslin when the plaster is used as a dressing to ulcerated or abraded surfaces, or with the view of bringing and retaining together the sides of wounds. The leather usually preferred is white sheepskin, or the kind known commercially as "hemlock splits." A margin about one-fourth or half an inch broad should usually be left uncovered, in order to facilitate the removal of the plaster, and to prevent the clothing in contact with its edges from being soiled. An accurate outline may be obtained by pasting upon the leather a piece of paper so cut as to leave in the centre a vacant space of the required dimensions, and removing the paper when no longer needed. The same object may often be accomplished by employing two narrow rulers of sheet tin graduated in inches, and so shaped that each of them may form two sides of a rectangle. These may be applied in such a manner as to enclose within them any given rectangular space, and may be fixed by weights upon the leather, or preferably adjusted by set screws, while the plaster is spread. For any other shape, as in the instance of plasters for the breast, pieces of tin may be employed having a space within, corresponding to the required outline. The spreading of the plaster is most conveniently accomplished by the use of a spatula or plaster iron. This may be heated by means of a spirit lamp. Care must be taken that the instrument be not so hot as to discolor or decompose the plaster, and special care is requisite in the case of those plasters which contain a volatile ingredient. A sufficient portion of the plaster should first be melted by the heated instrument, and, having been received on a piece of coarse stiff paper, or in a shallow tin tray open on one side, should, when nearly cool, be transferred to the leather, and applied quickly and evenly over its surface. By this plan the melted plaster is prevented from penetrating the leather, as it is apt to do when applied too hot. Before removing the paper from the edge of the plaster, if this has become so hard as to crack, the iron should be drawn over the line of junction. When linen or muslin is used, and the dimensions of the portion to be spread are large, as is often the case with adhesive plaster, the best plan is to pass the cloth "on which the plaster has been laid through a machine formed of a spatula fixed by screws at a proper distance from a plate of polished steel." A machine for spreading plasters is described by M. Hérent in the *J. P. C.*, 3e sér., ii. 403. (See U. S. D., 18th edition, p. 498, also *N. R.*, 1879, p. 337.)

The spreading of plasters has become to a great extent a lost art to the pharmacists of this country, owing to the introduction of machine-spread plasters, which contain india-rubber in the adhesive composition. These are reasonably permanent, and do not require the application of heat. When made by reliable manufacturers they are in many cases to be preferred, but the introduction of immense quantities of worthless ones by unscrupulous makers has caused many practitioners to direct plasters to be spread by the pharmacist from official plaster. The perforation or "porous-

[1] *Elixir Aurantii*, U. S. 1880. *Elixir of Orange. Simple Elixir.*—"Oil of Orange Peel, *one part* [or two and a half fluidrachms]; Cotton, *two parts* [or half an ounce av.]; Sugar, in coarse powder, *one hundred parts* [or twenty-five ounces av.]; Alcohol, Water, each, *a sufficient quantity*, to make *three hundred parts* [or about four pints]. Mix Alcohol and Water in the proportion of *one part* [or one pint] of Alcohol to *three parts* [or two and a half pints] of Water. Add the Oil of Orange to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack tightly in a conical percolator, and gradually pour on the mixture of Alcohol and Water, until *two hundred parts* [or three and one-fourth pints] of filtered liquid are obtained. In this liquid dissolve the Sugar by agitation, without heat, and strain." *U. S.* 1880.

ing" of plasters is usually accomplished on a large scale by expensive apparatus. J. J. Edmondson read a paper before the Pennsylvania Pharmaceutical Association in 1887 giving the process for manufacturing rubber-mass plasters as carried on by Johnson & Johnson of New York. It is as follows: The ingredients employed are—rubber, two parts; Burgundy pitch, one part, gum olibanum, one part. This may vary with some special plasters, but they constitute the component parts of the mass used for the majority.

The crude rubber is at first steeped in hot water, to cleanse and soften it, then the rubber is passed through the washer and crusher, where it is subjected to severe pressure between two corrugated rolls, eight inches in diameter and one foot wide, while a stream of water falling continually washes it thoroughly, and it comes out in sheets somewhat softened. After these sheets are dried, which requires a number of days, they are passed through the grinder, where they are crushed between two smooth rollers, fourteen inches in diameter and thirty-six inches across. This thoroughly softens the rubber and makes it plastic, so that it can be readily worked up with the other ingredients. The principal operation, the mixing, then takes place. The medication must be carefully combined, and the whole manipulation so managed that the plaster will be uniform, so that age or varying temperature shall not affect it. This operation is performed by means of rollers, sixteen inches in diameter, arranged so that one revolves at twice the speed of the other. Between these large rollers the mass is passed with whatever medication is required: *e. g.*, when a belladonna mass is to be made, a certain amount of the stock mass is taken and extract of belladonna in the proportions corresponding to the formula in the Pharmacopœia. These are repeatedly passed through the rollers until the extract of belladonna is thoroughly mixed with the mass, care being taken to keep the temperature from rising high enough to decompose or affect the alkaloids. The spreading is also done by rollers, into which the thoroughly mixed mass is fed at the same time that the cloth is fed, the thickness of the plasters being governed by the adjusting of screws on the side of the machine.

The rubber base is pliable, adhesive, it will not become too hard or too soft, but will yield up the medication to the absorbents of the skin, and its properties will be retained indefinitely.[1]

[1] Certain plasters formerly recognized by the U. S. Pharmacopœia have been dropped in the various revisions, but as they are still liable to be called for we append the formulas for their preparation.

Emplastrum Aconiti. Aconite Plaster.—"Take of Aconite Root, in fine powder, *sixteen troyounces;* Alcohol, Resin Plaster, each, *a sufficient quantity.* Moisten the Aconite Root with six fluidounces of Alcohol, and pack it in a conical percolator. Cover the surface with a disk of paper, and pour upon it ten fluidounces of Alcohol. When the liquid begins to drop, cork the percolator, and, having closely covered it to prevent evaporation, set it aside in a moderately warm place for four days. Then remove the cork, and gradually pour on Alcohol until two pints of tincture have been obtained or the Aconite Root is exhausted. Distil off a pint and a half of alcohol, and evaporate the residue to a soft uniform extract by means of a water-bath. Add to this sufficient Resin Plaster, previously melted, to make the mixture weigh sixteen troyounces, and then mix them thoroughly." *U. S.* 1870.

Emplastrum Antimonii. Antimonial Plaster.—"Take of Tartrate of Antimony and Potassium, in fine powder, *a troyounce;* Burgundy Pitch *four troyounces.* Melt the Pitch by means of a water-bath, and strain; then add the powder, and stir them well together until the mixture thickens on cooling." *U. S.* 1870.

This is a useful formula, although no longer official. It affords one of the most convenient methods of obtaining the local pustulating effects of tartar emetic. For its effects and uses, see *Antimonii et Potassii Tartras.*

Emplastrum Arnicæ. U. S. 1890. *Arnica plaster.* "Extract of Arnica Root, *three hundred and thirty grammes* [or 11 ounces av., 280 gr.]; Resin Plaster, *six hundred and seventy grammes* [or 23 ounces av., 277 gr.], to make *one thousand grammes* [or 35 ounces av., 120 gr.]. Add the Extract to the Resin Plaster, previously melted by means of a water-bath, and mix them thoroughly." *U. S.* 1890.

Emplastrum Ferri. U. S. 1890. *Iron Plaster.* [*Strengthening Plaster.*] *Emplastrum Roborans, Br.* 1867.—"Ferric Hydrate, dried at a temperature not exceeding 80° C. (176° F.), *ninety grammes* [or 3 ounces av., 76 grains]; Olive Oil, *fifty grammes* [or 1 ounce av., 334 grains]; Burgundy Pitch, *one hundred and forty grammes* [or 4 ounces av., 410 grains]; Lead Plaster, *seven hundred and twenty grammes* [or 25 ounces av., 173 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Lead Plaster and Burgundy Pitch by means of a water-bath, and add the Olive Oil; then add the Ferric Hydrate, and stir constantly until the mixture thickens on cooling." *U. S.* 1890.

Emplastrum Picis Burgundicæ. U. S. 1890. *Burgundy Pitch Plaster.*—"Burgundy Pitch, *eight hundred grammes* [or 28 ounces av., 96 grains]; Olive Oil, *fifty grammes* [or 1 ounce av., 334 grains]; Yellow Wax, *one hundred and fifty grammes* [or 5 ounces av., 127 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt together the Burgundy Pitch and Yellow Wax, then incorporate the Olive Oil, and stir constantly, until the mass thickens on cooling." *U. S.* 1890.

The object of the wax and olive oil is to give a proper consistence to the Burgundy pitch, and to prevent its great tendency to become brittle. Lavigne proposes to obviate the tendency of Burgundy pitch plaster to crack by incorporating with it caoutchouc, in the following method. Soften 35 parts, by weight, of caoutchouc, in small pieces, by warming it with 13 parts of petroleum in a close vessel. Melt together 300 parts of Burgundy pitch and 25 parts of white wax. Warm the solution of caoutchouc in a suitable vessel, add gradually, with constant stirring, the melted pitch and wax, and finally incorporate thoroughly with the mass 3 parts of glycerin. (*J. P. C.*, 4e sér., ix. 131.)

Emplastrum Resinæ. U. S. 1890. *Resin Plaster.* "Resin, in fine powder, *one hundred and forty grammes* [or 4 ounces av., 410 grains]; Lead Plaster, *eight hundred grammes* [or 28 ounces av., 96 grains]; Yellow Wax, *sixty grammes* [or 2 ounces av., 51 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Lead Plaster and Yellow Wax together with a gentle heat; then add the Resin, and, when it is melted, mix the mass thoroughly." *U. S.* 1890.

EMPLASTRUM ADHÆSIVUM. U. S. (Br.)

ADHESIVE PLASTER

(ĕm-plăs'trŭm ăd-hæ'sĭ-vŭm)

Emplastrum Resinæ, *Br.;* Resin Plaster; Emplâtre Adhésif, Emplâtre Résineux, *Fr.;* Emplastrum adhæsivum, *P. G.;* Heftpflaster, *G.;* Empiastro adesivo, *It.*

* "Rubber, cut in small pieces, *twenty grammes* [or 308.6 grains]; Petrolatum, *twenty*

grammes [or 308.6 grains]; Lead Plaster, *nine hundred and sixty grammes* [or 33 ounces av., 378 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Rubber at a temperature not exceeding 150° C. (302° F.); add the Petrolatum, and continue the heat until the Rubber is dissolved. Add the Lead Plaster to the hot mixture; continue the heat until it becomes liquid, then strain, allow it to cool, and stir until it stiffens." *U. S.*

"Resin, 4 *ounces* (Imperial) or 100 grammes; Lead Plaster, 2 *pounds* (Imp.) or 800 grammes; Hard Soap, 2 *ounces* (Imp.) or 50 grammes. Melt each ingredient separately at as low a temperature as possible; mix." *Br.*

The name of this plaster was changed in the U. S. P. (8th Rev.) to adhesive plaster, it was formerly termed resin plaster and is still so named in the British Pharmacopœia. It differs from lead plaster in being more adhesive and somewhat more stimulating. It resembles the common adhesive plaster of commerce, and is much employed for retaining the sides of wounds in contact, and for dressing ulcers according to the method of Baynton, by which the edges are drawn towards each other and a firm support is given to the granulations. The U. S. (8th Rev.) formula differs from that official in 1890 in the use of rubber and petrolatum in place of yellow wax and rosin; the object of these additions to the lead plaster base is to give pliability and greater adhesiveness. It is used in several official plasters. As prepared by the Dublin College it contained soap, which gave it greater pliability, and rendered it less liable to crack in cold weather, without impairing its adhesiveness, and the process of that College has been adopted in the British Pharmacopœia. It is usually spread upon muslin, and the spreading is best accomplished, on a large scale, by means of a machine, as described in the general observations upon plasters. It is kept ready spread by the pharmacist; but, as the plaster becomes less adhesive by long exposure to the air, the supply should be frequently renewed. Adhesive plaster originally employed by Baynton contained only six drachms of rosin to the pound of lead plaster. To obviate the possibility of irritating the skin, Herpin recommends the addition of lead tannate, the proportion of which, when adhesiveness is required in the plaster, should not exceed one-twentieth, but under other circumstances may be increased to one-twelfth. (*Bull. de Thérap.*, xlviii. 155.)

The addition of Burgundy pitch or turpentine is objectionable, as they greatly increase the liability of the plaster to irritate the skin, and thus materially interfere with the purposes for which the preparation was chiefly intended.

Off. Prep.—Emplastrum Belladonnæ, *U. S.*, *Br.;* Emplastrum Calefaciens, *Br.;* Emplastrum Capsici, *U. S.;* Emplastrum Opii, *U. S.*, *Br.*

EMPLASTRUM AMMONIACI CUM HYDRARGYRO. Br.

AMMONIACUM AND MERCURY PLASTER

(ĕm-plăs'trŭm ăm-mo-nī'ą-cī cŭm hȳ-drär'gy-rō)

Ammoniac Plaster with Mercury; Emplâtre de Gomme Ammoniaque mercuriel, *Fr.;* Quecksilber- und Ammoniak-pflaster, Quecksilberhaltiges Ammoniakpflaster, *G.*

The U. S. P. 1890 process is appended.

"Ammoniac, *seven hundred and twenty grammes* [or 25 ounces av., 173 grains]; Mercury, *one hundred and eighty grammes* [or 6 ounces av., 153 grains]; Oleate of Mercury, *eight grammes* [or 123 grains]; Diluted Acetic Acid, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Lead Plaster, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Digest the Ammoniac with the Diluted Acetic Acid, in a suitable vessel, avoiding contact with metals, until it is entirely emulsified; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling. Triturate the Oleate of Mercury with the Mercury gradually added, until globules of the metal cease to be visible. Next add, gradually, the Ammoniac, while yet hot; and finally, having added enough Lead Plaster, previously melted by means of a water-bath, to make the mixture weigh *one thousand grammes* [or 35 ounces av., 120 grains], mix the whole thoroughly." *U. S.* 1890.

"Ammoniacum, 12 *ounces* (Imperial) or 328 grammes; Mercury, 3 *ounces* (Imp.) or 82 grammes; Olive Oil, 56 *grains* (Imp.) or 3.5 grammes; Sublimed Sulphur, 8 *grains* (Imp.) or 0.5 gramme. Heat the Olive Oil; add the Sulphur to it gradually, stirring until they are uniformly blended; with this mixture triturate the Mercury until metallic globules are no longer visible; add the Ammoniacum, previously purified by boiling with successive portions of water, passing the resulting emulsions through, while rubbing the residues on, a hair sieve, and, after mixing, evaporating the emulsions to a suitable consistence." *Br.*

Ammoniac plaster (*Emplastrum Ammoniaci,* U. S. P. 1880) was not recognized in the last U. S. and Br. Pharmacopœias. (See U. S. D., 17th ed., 492.) Ammoniac plaster with mercury U. S. 1890 did not differ materially from that produced by the formula of the U. S. P. 1880. The use of diluted acetic acid to facilitate the straining of the ammoniac is an improvement over the water formerly used. The use of lead plaster to bring up the weight is needless, in our opinion. The use of the oleate of mercury is to aid in the extinguishment of the mercury and the compound formed by it probably adds to the efficiency. When ammoniac not previously prepared is used, as it is not fusible by heat, it must be brought to the proper consistence by softening it in a small quantity of hot water, straining and evaporating. This

plaster unites with the stimulant power of the ammoniac the specific properties of the mercury, which is sometimes absorbed in sufficient quantity to affect the gums. It is used as a discutient in *enlargement of the glands,* tumefaction of the joints, nodes, and other indolent swellings, especially when dependent on a venereal taint. It is also sometimes applied over the liver in *chronic hepatitis.*

EMPLASTRUM BELLADONNÆ.
U. S., Br.

BELLADONNA PLASTER

(ĕm-plăs'trŭm bĕl-la-dŏn'næ)

"Belladonna Plaster should contain not less than 0.38 percent. nor more than 0.42 percent. of mydriatic alkaloids." *U. S.*

Emplâtre de Belladone, *Fr.;* Belladonna-Pflaster, *G.;* Emplasto de belladonna, *Sp.*

* "Extract of Belladonna Leaves, *three hundred grammes* [or 10 ounces av., 255 grains]; Adhesive Plaster, *seven hundred grammes* [or 24 ounces av., 303 grains], to make about *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Adhesive Plaster on a water-bath, add to it the Extract of Belladonna Leaves, softened by the heat of a water-bath, and continue the heat, stirring constantly until the mixture is perfectly homogeneous; then allow it to cool. Spread Belladonna Plasters made with a rubber base should yield, when assayed by the process given below, not less than 0.38 percent. nor more than 0.42 percent. of mydriatic alkaloids." *U. S.*

"Liquid Extract of Belladonna, 4 *fl. ounces* (Imperial measure) or 100 cubic centimetres; Resin Plaster, 5 *ounces* (Imp.) or 125 grammes. Evaporate the Liquid Extract of Belladonna on a water-bath until it is reduced in weight to *one ounce* (Imp.) or twenty-five grammes; add the Resin Plaster previously melted; mix. This Plaster contains 0.5 per cent. of the alkaloids of Belladonna Root." *Br.*

The U. S. Pharmacopœia (8th Rev.) provides a standard not only for the plaster made by the process above given, but for rubber base belladonna plasters, which are so largely employed throughout the country. For the official process the extract of belladonna leaves used is the standardized official extract containing 1.4 per cent. of mydriatic alkaloids; for the rubber base plasters made by the manufacturers not less than 0.38 per cent. nor more than 0.42 per cent. of mydriatic alkaloids is the standard.

Assay of Belladonna Plaster (Rubber Base). U. S. (8th Rev.)—"Belladonna Plaster, spread upon cloth, *ten grammes;* Chloroform, Ammonia Water, Alcohol, Distilled Water, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., each, *a sufficient quantity.* Into a suitable beaker containing 50 Cc. of chloroform and 3 Cc. of ammonia water, introduce the Belladonna Plaster cut into strips. Stir until the Plaster is entirely removed from the cloth; then pour off the chloroform into another beaker, wash the cloth with 25 Cc. of chloroform and 1 Cc. of ammonia water carefully, and add the washings to the chloroformic solution first obtained. If necessary, repeat the washing with 25 Cc. of chloroform, and add this also to the chloroformic solution. Then dry the cloth at a low temperature; cool and weigh it, and subtract its weight from the original weight of the Plaster. To the chloroformic solution, add four-fifths of its volume of alcohol, stir gently, and allow the liquid to stand until all of the rubber has separated in a compact mass. Then pour off the supernatant liquid into a separator of 250 Cc. capacity, and, having prepared a solution of sulphuric acid by diluting 40 Cc. of normal sulphuric acid V.S. with 60 Cc. of distilled water, add 20 Cc. of the solution to the separator, and agitate for two minutes, rotating gently. Draw off the chloroformic solution into another separator, shake this with 10 Cc. of the sulphuric acid solution, and add the acid solution to that in the first separator. Repeat until the acid washings cease to give a reaction with mercuric potassium iodide T.S.; combine the acid liquids, and, having rendered this solution alkaline with ammonia water, shake out the alkaloids with three successive portions of 25, 15, and 10 Cc. of chloroform. Collect these in a flask, distil off all of the chloroform with the aid of a water-bath. To the alkaloidal residue add a slight excess of tenth-normal sulphuric acid V.S., noting the quantity used, and then add 10 drops of chloroform and, after rotating, evaporate the latter by means of a water-bath. Then add 5 drops of hematoxylin T.S., and, rotating, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from the number of cubic centimeters of tenth-normal sulphuric acid V.S. first added, and divide the difference by the number of grammes of Belladonna Plaster separated from the cloth; multiply the quotient by 0.0287, and this product by 100, which will give the percentage of mydriatic alkaloids in the Belladonna Plaster." *U. S.*

This plaster was formerly prepared, in both Pharmacopœias, with the extract made from the inspissated juice of the leaves, but in the U. S. P. 1880 an alcoholic extract of the root was substituted, with the effect of rendering the plaster easier to be spread and more adhesive, and giving it a light yellowish-brown color, without a shade of green. The official preparation is now of a brownish-green color, due to the extract of belladonna leaves. It is a useful anodyne application in *neuralgic* and *rheumatic pains.* We have seen the constitutional effects of belladonna result from its external use. T. W. Worthington proposed a formula for making belladonna plaster with caoutchouc in the *A. J. P.,* xliii. 153. (See page 436.) Machine-

spread belladonna plaster can be found in the market which was admitted by a representative of the manufacturer to contain no extract of belladonna whatever. For methods of assaying belladonna plasters see *A. J. P.*, 1898, 182, 293. Extract of scopola is largely used by manufacturers in making rubber base belladonna plaster.

EMPLASTRUM CALEFACIENS. Br.

WARMING PLASTER

(ĕm-plăs'trŭm căl-ē-fā'cĭ-ĕns)

Warm Plaster; Emplâtre de Poix cantharidé, *Fr.*; Pechpflaster mit Canthariden, *G.*

Cantharidal pitch plaster or warming plaster is not official in the U. S. P. (8th Rev.); the process of the U. S. P. 1890 is appended.[1]

"Cantharides, in coarse powder, 4 *ounces* (Imperial) or 100 grammes; Yellow Beeswax, 4 *ounces* (Imp.) or 100 grammes; Resin, 4 *ounces* (Imp.) or 100 grammes; Resin Plaster, 3¼ *pounds* (Imp.) or 1300 grammes; Soap Plaster, 2 *pounds* (Imp.) or 800 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 500 cubic centimetres. Infuse the Cantharides in the Distilled Water for six hours; squeeze strongly through calico; evaporate the expressed liquid on a water-bath till reduced to one-third; add the other ingredients; melt on a water-bath; stir until the ingredients are thoroughly mixed." *Br.*

This plaster is an excellent rubefacient, more active than Burgundy pitch, yet in general not sufficiently so to produce vesication. As prepared by the U. S. 1870 process it occasionally blistered, and the proportion of cantharides was, therefore, considerably diminished in the U. S. 1880 and 1890 formulas. This was unfortunate; for, while such a reduction may render the plaster insufficiently active in most cases, it does not entirely obviate the objection, as the smallest proportion of flies, or even the Burgundy pitch alone, would vesicate in certain persons. In whatever mode, therefore, this plaster may be prepared, it cannot always answer the expectations which may be entertained, and the only plan, when the skin of any individual has been found to be very susceptible, is to accommodate the proportions to the particular circumstances of the case. Much, however, may be accomplished by care in the preparation of the plaster, towards obviating its tendency to blister. If the flies of the *cerate of cantharides* have been coarsely pulverized, the latter particles, coming in contact with the skin, will exert upon the particular part to which they may be applied their full vesicatory effect, while if reduced to a very fine powder they would be more thoroughly enveloped in the other ingredients, and thus have their strength much diluted. Hence the cerate, when used as an ingredient of the warming plaster, should contain the cantharides as minutely divided as possible, and the direction given in the U. S. 1890 process to strain it through cloth of fine texture should be carefully observed. The plan of keeping the cerate used in this preparation for a considerable time at the temperature of 100° C. (212° F.), and then straining it so as to separate the flies, is a good one, but it would be better yet to substitute cerate *of the extract* of cantharides for the cerate of cantharides. (See *Ceratum Cantharidis.*) The mode frequently pursued of preparing the warming plaster by simply sprinkling a very small proportion of powdered flies upon the surface of Burgundy pitch is altogether objectionable. It has been objected to the former U. S. plaster that it is liable to be too soft in hot weather. G. C. Close, ascribing this inconvenience to the proportion of lard in the cerate employed, proposed to obviate it by substituting Burgundy pitch plaster for Burgundy pitch, and powdered cantharides for the cerate, and offered a formula in accordance with this suggestion. (See *A. J. P.*, 1867, p. 20; from *Proc. A. Ph. A.*, 1866.)

Warming plaster is employed in *chronic rheumatism*, and in chronic internal diseases attended with inflammation, such as *catarrh*, *asthma*, *pertussis*, *phthisis*, *hepatitis*, and the sequelæ of *pleurisy* and *pneumonia*.

[1] *Emplastrum Picis Cantharidatum*, U. S. 1890. "Cerate of Cantharides, *eighty grammes* [or 2 ounces av., 359 grains]; Burgundy Pitch, *a sufficient quantity*, to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Cerate of Cantharides on a water-bath containing boiling water, and continue the heat for fifteen minutes; then strain it through a piece of muslin of close texture so that the Cantharides will be retained on the muslin. To the strained liquid add a sufficient quantity of Burgundy Pitch to make the whole weigh *one thousand grammes* [or 35 ounces av., 120 grains], render the mixture homogeneous by stirring, remove the heat, and stir the mass until it thickens on cooling." *U. S.* 1890.

EMPLASTRUM CANTHARIDIS. Br.

CANTHARIDES PLASTER

(ĕm-plăs'trŭm căn-thăr'ĭ-dīs)

See *Ceratum Cantharidis.* U. S.

EMPLASTRUM CAPSICI. U. S.

CAPSICUM PLASTER

(ĕm-plăs'trŭm căp'sĭ-cī)

Sparadrapum Capsici; Sparadrap de Capsique, *Fr.*; Capsicumpflaster, *G.*

* "Oleoresin of Capsicum, *twenty-five hundredths of a gramme* [or 4 grains]; Adhesive Plaster, spread on fabric, *a sufficient quantity*. Apply the Oleoresin of Capsicum to the surface of the Adhesive Plaster by means of a brush, so as to form a thin coating over an area fifteen centimeters [five and fifteen-sixteenths inches] square, leaving a margin around the sides." *U. S.*

This affords a convenient way of obtaining the rubefacient effects of capsicum; of course the practice will be for the pharmacist to employ machine-spread adhesive plaster as the base; although, with a little experience, very good work can be done by hand.

EMPLASTRUM HYDRARGYRI. U. S., Br.

MERCURIAL PLASTER

(ĕm-plăs'trŭm hȳ-drär'gy̆-rī)

Emplastrum Mercuriale; Emplâtre mercuriel, *Fr. Cod.*; Emplastrum Hydrargyri, *P. G.*; Quecksilberpflaster, *G.*; Empiastro mercuriale, *It.*

* "Mercury, *thirty grammes* [or 1 ounce av., 25 grains]; Oleate of Mercury, *one gramme* [or 15 grains]; Hydrous Wool-Fat, *ten grammes* [or 154 grains]; Lead Plaster, *fifty-nine grammes* [or 2 ounces av., 36 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Mercury with the Oleate of Mercury until the former is thoroughly divided, then add the Hydrous Wool-Fat, and continue the trituration until globules of Mercury are no longer visible. Add the mixture to the Lead Plaster, which has previously been melted in a tared dish, and incorporate thoroughly, adding, if necessary, sufficient Lead Plaster to make the product weigh *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

"Mercury, 3 *ounces* (Imperial) or 82 grammes; Olive Oil, 56 *grains* (Imp.) or 3.5 grammes; Sublimed Sulphur, 8 *grains* (Imp.) or 0.5 gramme; Lead Plaster, 6 *ounces* (Imp.) or 164 grammes. Heat the Olive Oil; add the Sulphur to it gradually; stir until they are uniformly blended; with this mixture triturate the Mercury until metallic globules are no longer visible; add the Lead Plaster previously melted; mix." *Br.*

The present official process differs from that of the U. S. Pharm. 1880 in employing oleate of mercury and hydrous wool-fat for the purpose of extinguishing the mercury; this it does effectually, and at the same time increases the efficiency of the mercurial constituent. The quantity of mercury is 30 per cent. The British preparation is stronger, containing nearly 50 per cent.

The U. S. and former British processes may be considered identical in their results. The sulphuretted oil which was employed in the process of the London College to facilitate the extinguishment of the mercury was abandoned in the first British Pharmacopœia, as just in proportion to the increased facility of the process it lessened the efficacy of the resulting plaster, mercury sulphide being wholly inert. Nevertheless, the Br. Pharmacopœia has in its last revision revived the old London formula. Thomas Blunt has found it almost impossible to divide the mercury sufficiently by trituration with oil and rosin, and the resulting plaster was so crumbly that it could not be formed into rolls; but on substituting a weight of Venice turpentine equal to that of the oil and rosin combined, he found it to answer completely. An objection, however, to the turpentine is, that it might render the plaster too irritant for susceptible skins. (*P. J.*, 1864, p. 56.)

This plaster is employed to produce the local effects of mercury upon syphilitic lesions of the skin and other chronic tumefactions of the bones or soft parts, dependent on a syphilitic taint. It occasionally affects the gums.

From observations made in France by Serres and others, it appears that the mercurial plaster of the Codex[1] (*Emplastrum* (*Emplâtre*) *de Vigo cum Mercurio*) has the power, when applied over the eruption of *small pox*, before the end of the third day from its first appearance, to check its progress and prevent suppuration and pitting. This operation of the plaster, so far from being attended with an increase of the general symptoms, seems to relieve them in proportion to the diminution of the local affection. That the local effect is not ascribable to the mere exclusion of the air is proved by the fact that the use of lead plaster was not followed by the same results. It is probable that other mercurial preparations would answer the same purpose.

EMPLASTRUM MENTHOL. Br.

MENTHOL PLASTER

(ĕm-plăs'trŭm mĕn'thŏl)

Emplâtre de Menthol, *Fr.*; Mentholpflaster, *G.*

"Menthol, 1½ *ounces* (Imperial) or 30 grammes; Yellow Beeswax, 1 *ounce* (Imp.) or 20 grammes; Resin, 7½ *ounces* (Imp.) or 150 grammes. Melt the Beeswax and Resin together; when the mixture approaches the temperature of 160° or 170° F. (71.1° or 76.7° C.), stir in the Menthol until dissolved." *Br.*

This is an official plaster of the British Pharmacopœia, having been introduced in the additions in 1885; the present plaster is, however, 5 per cent. weaker in menthol than that formerly official. It is a mild counter-irritant, intended especially for relief in localized *neuralgia* and *rheumatic pains*.

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[1] *Emplastrum* (*Emplâtre*) *de Vigo cum Mercurio.* "Take of simple plaster [lead plaster] *forty ounces;* yellow wax *two ounces;* resin *two ounces;* ammoniac, bdellium, olibanum, and myrrh, each, *five drachms;* saffron *three drachms;* mercury *twelve ounces;* turpentine [common European] *two ounces;* liquid storax *six ounces;* oil of lavender *two drachms.* Powder the gum-resins and saffron, and rub the mercury with the storax, turpentine and oil of lavender in an iron mortar until completely extinguished. Melt the plaster with the wax and resin, and add to the mixture the powders. When the plaster shall have been cooled, but while it is yet liquid, add the mercurial mixture, and incorporate the whole thoroughly." This should be spread upon leather or linen cloths, and applied so as effectually to cover the part to be protected.

EMPLASTRUM OPII. U. S., Br.

OPIUM PLASTER

(ĕm-plăs'trŭm ō'pĭ-ī)

Emplastrum Opiatum, Emplastrum Cephalicum, s. Odontalgicum; Emplâtre d'Opium, Emplâtre céphalique (temporal, odontalgique, calmant), *Fr.;* Opiumpflaster, Hauptpflaster, *G.*

* "Extract of Opium, *six grammes* [or 92.5 grains]; Water, *eight cubic centimeters* [or 130 minims]; Adhesive Plaster, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Extract of Opium with the Water until it is uniformly soft; add it to the Adhesive Plaster, which has been previously melted in a tared dish on a water-bath, and continue the heat with constant stirring until the product weighs *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

"Opium, in very fine powder, 1 *ounce* (Imperial) or 10 grammes; Resin Plaster, 9 *ounces* (Imp.) or 90 grammes. Melt the Resin Plaster on a water-bath; stir in the Opium gradually." *Br.*

We decidedly prefer the extract of opium, as employed in the present U. S. process, to the powdered opium of the British formula. It not only forms a better plaster, but, being soluble, is more likely to produce the anodyne effect desired, by being brought by the perspiration to the liquid state necessary for its absorption. The use of water in the present process is also an advantage, as it enables the opium to be more thoroughly incorporated with the other ingredients; but care should be taken that the moisture is well evaporated. The opium plaster is intended to be used for the relief of *rheumatic* and other *pains* in the parts to which it is applied.

EMPLASTRUM PICIS. Br.

PITCH PLASTER

(ĕm-plăs'trŭm pī'cĭs)

Burgundy Pitch Plaster; Emplastrum Picis Burgundicæ; Emplâtre de Poix de Bourgogne, *Fr.;* Burgunder-Pechpflaster, *G.*

"Burgundy Pitch, 26 *ounces* (Imperial) or 520 grammes; Frankincense [Terebinthina, U. S.], 13 *ounces* (Imp.) or 260 grammes; Resin, 4½ *ounces* (Imp.) or 90 grammes; Yellow Beeswax, 4½ *ounces* (Imp.) or 90 grammes; Olive Oil, 2 *ounces* (Imp.) or 40 grammes; Distilled Water, 2 *fl. ounces* (Imp. meas.) or 40 cubic centimetres. Add the Olive Oil and the Water to the Frankincense, Burgundy Pitch, Resin, and Beeswax, previously melted together; evaporate with constant stirring to a proper consistence." *Br.*

This is a rubefacient plaster, which closely resembles the Burgundy pitch plaster of the U. S. P. 1890. (See page 436.) The expressed oil of nutmeg directed in the Br. Pharm. of 1885 was not retained in the present British authority; it was an unnecessary addition. This plaster is applicable to catarrhal and other pectoral affections, *chronic inflammation of the liver,* and *rheumatic pains* in the joints and muscles. It often keeps up a serous discharge, which requires that it should be frequently renewed. The irritation which it excites is sometimes so great as to render its removal necessary.

EMPLASTRUM PLUMBI. U. S., Br.

LEAD PLASTER [Diachylon Plaster]

(ĕm-plăs'trŭm plŭm'bī)

Emplastrum Lithargyri, *Br.* 1864; Emplastrum Diachylon Simplex, Emplastrum Album Coctum; Litharge Plaster; Emplâtre simple, *Fr. Cod.;* Emplâtre de Plomb (de Litharge), Emplastrum simplex, *Fr.;* Emplastrum Lithargyri (simplex), *P. G.;* Emplastrum Cerusæ, Froschlaichpflaster; Bleipflaster, Diachylonpflaster, *G.;* Empiastro diachilon, *It.;* Emplasto de plomo simple, Emplasto simple, *Sp.*

* "Soap, dried, and in coarse powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Lead Acetate, *sixty grammes* [or 2 ounces av., 51 grains]; Water, *a sufficient quantity.* Dissolve the Soap in *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of hot Water and strain the solution. Dissolve the Lead Acetate in *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of hot Water, and at once filter the solution into the warm Soap solution, stirring constantly. When the precipitate has subsided, decant the liquid, and wash the precipitate thoroughly with hot Water. Transfer the mass to a warm slab, kneading it thoroughly to free it from water. Finally, roll the plaster into cylindrical forms and wrap them in paraffined paper." *U. S.*

"Lead Oxide, 1 *pound* (Imperial) or 400 grammes; Olive Oil, 2 *pounds* (Imp.) or 800 grammes; Distilled Water, 16 *fl. ounces* (Imp. meas.) or 400 cubic centimetres or a sufficient quantity. Boil all the ingredients together gently by the aid of a steam-bath; keep them simmering for four or five hours, stirring constantly until the product acquires a proper consistence for a plaster; add more of the Distilled Water during the process if necessary." *Br.*

The importance of this plaster, as the basis of most of the others, requires a somewhat detailed account of the principles and manner of its preparation. A very important change was made in the process for lead plaster in the U. S. Pharmacopœia (8th Rev.). The old method of boiling litharge, olive oil, and water together, which is still official in the British Pharmacopœia, was discarded and the precipitation method introduced. The resulting product is chemically nearly identical with that made by the boiling process and is much whiter

in color, while the adhesiveness of the present plaster seems to be superior to that of the U. S. P. 1890.[1]

The reaction in the U. S. P. (8th Rev.) process, disregarding the palmitin present, is as follows:

$$\underset{\text{Sodium oleate}}{2NaC_{18}H_{33}O_2} + \underset{\text{Lead acetate}}{Pb(C_2H_3O_2)_2} = \underset{\text{Lead oleate}}{Pb(C_{18}H_{33}O_2)_2} + \underset{\text{Sodium acetate}}{2NaC_2H_3O_2}$$

In the British process and that of the U. S. P. 1890 a reaction takes place between the oil and water, resulting in the development of *glycerin,* and of two acid bodies, *oleic* and *palmitic acids,* to which, when animal fat is employed instead of olive oil, a third is added,—namely, *stearic acid.* The plaster is formed by a union of these acids with the oxide, and, prepared according to the directions of the Pharmacopœias, is in fact a lead oleo-palmitate, and if the olive oil contained stearin it would be a lead oleo-stearo-palmitate. The glycerin remains dissolved in the water, or mechanically mixed with the plaster. That such is the correct view of the nature of this compound is evinced by the fact that, if the lead oxide be separated from the plaster by digestion at a moderate heat in very dilute nitric acid, the fatty matter which remains will unite with litharge with the greatest facility, without the intervention of water. The fixed or fatty oils are compounds of the free fatty acids mentioned and the radical *glyceryl.* When boiled with the lead oxide and water, the fatty acids combine with the metallic oxide to form the plaster, and the glyceryl unites with the hydroxyl and becomes glycerin. The British process does not provide for the separation of the glycerin and the plaster is not kneaded to separate the water, both of which, in our opinion, are necessary to produce the best result and which form part of the U. S. P. 1890 process.

The reaction between olein and lead oxide is as follows:

$$\underset{\text{Olein}}{2C_3H_5(C_{18}H_{33}O_2)_3} + \underset{\text{Litharge}}{3PbO} + \underset{\text{Water}}{3H_2O} = \underset{\text{Lead oleate}}{3Pb(C_{18}H_{33}O_2)_2} + \underset{\text{Glycerin}}{2C_3H_5(OH)_3}$$

The radical glyceryl (C_3H_5) is a triad, and combines with three groups of a fatty acid or three groups of hydroxyl (OH).

Other oleaginous substances and other metallic oxides are susceptible of the same combination, and some of them form compounds having the consistence of a plaster; but, according to Henry of Paris, no oily matter except animal fat can properly be substituted for olive oil, and no metallic oxide, not even one of the other oxides of lead, for litharge. He ascertained, moreover, that the English litharge is preferable for the formation of lead plaster to the German. From experiments of Soubeiran, it appears that massicot or even minium may be substituted for litharge, and a plaster of good consistence be obtained, but that a much longer time is required for completing the process than when the official formula is followed. Owing to the necessity for its partial deoxidation, the use of minium requires a longer continuance of the process than when massicot is employed. According to Davallon, it is important that the olive oil employed should be pure, for when adulterated, as it frequently is, it yields an imperfect product.

N. S. Thomas prepared a good plaster by substituting lard for olive oil, in the proportion of eight pounds of lard to five of litharge (*A. J. P.,* xix. 175), and we are told that it is a common practice in this country to make lead plaster with a mixture of lard oil and olive oil. Mueller uses equal parts of lard, olive oil, and litharge, having previously heated the litharge until a small sample causes no effervescence when dropped into nitric acid, showing the absence of carbonate. (*Ph. Ztg.,* 1879, p. 70; *A. J. P.,* 1879, p. 190.) It is said that the English plaster makers rarely follow the Br. Pharm. direction, preferring the recipe of the old London Pharmacopœia, which contains more litharge and yields a much firmer and less adhesive product.[1] (*P. J.,* 3d ser., p. 701, 716.)

The process of the United States Pharmacopœia by precipitation is well adapted for making comparatively small quantities of lead plaster, but some manufacturers prefer the boiling process when large quantities are to be made, and the following details are retained: The vessel in which the lead plaster is prepared

[1] *Emplastrum Plumbi.* U. S. 1890.—"Lead Oxide, *three thousand two hundred grammes* [or 112 ounces av., 383 grains]; Olive Oil, *six thousand grammes* [or 211 ounces av., 282 grains]; Water, *a sufficient quantity.* Mix the Lead Oxide, previously passed through a No. 80 sieve, intimately with about one-half of the Olive Oil, by trituration, and add the mixture to the remainder of the Oil contained in a bright copper boiler of a capacity equal to at least four times the bulk of the ingredients. Then add *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of boiling Water, and boil the whole together, over a fire, constantly stirring with a wooden spatula, until a small portion, when dropped into cold water, is found to be pliable and tenacious. From time to time add a little Water to replace that lost by evaporation. When the contents of the boiler have acquired a whitish color and are perfectly homogeneous, transfer them to a vessel containing warm Water, and as soon as the mass has sufficiently cooled, knead it well with the Water so as to remove the glycerin, renewing the Water from time to time, as long as it may be necessary. Finally divide the mass into rolls of suitable size." *U. S.* 1890.

[1] *Schwarze's Mutterpflaster, Emplastrum Fuscum* of the German Pharmacopœia, is made by boiling 64 parts of olive oil with 32 parts of very finely powdered red lead in a copper kettle until the mass is dark brown, and then adding 16 parts of yellow wax. *Emplastrum Fuscum Camphoratum* is the same, with the addition of 1 per cent. of camphor.

Zinc Plaster.—De Mussey, having witnessed inconveniences from lead plaster in consequence of the absorption of the lead, substituted for it a plaster with a basis of zinc oxide, which he has found to answer very well in practice. It cannot be made by direct combination of the oxide, and it is necessary to have recourse to the method of double decomposition. Solutions of white olive oil soap and of zinc sulphate being mixed, a copious precipitate takes place of zinc oleo-palmitate, which, after being washed and dried, may be combined with resins, oil, and wax, to give it the necessary consistence. (*J. P. C.,* xxvii. 100.)

should be of such a size that the materials will not occupy more than two-thirds of its capacity. The oil should be first introduced, and the litharge then sprinkled in by means of a sieve, the mixture being constantly stirred with a spatula. The particles of the oxide are thus prevented from coalescing in small masses, which the oil would not easily penetrate, and which would therefore delay the process. While the water exerts an important chemical agency in the changes which occur, it is also useful by preventing too high a temperature, which would decompose the oil, and cause the reduction of the oxide. The waste must, therefore, be supplied by fresh additions as directed in the process, and the water added for this purpose should be previously heated, as otherwise it would not only delay the operation, but by producing explosion might endanger the operator.

During the continuance of the boiling, the material should be constantly stirred, and the spatula should be repeatedly passed along the bottom of the vessel, from side to side so as to prevent any of the oxide, which is disposed by its greater density to sink to the bottom, from remaining in that situation. The materials swell up considerably, in consequence partly of the vaporization of the water, partly of the escape of carbon dioxide, which is liberated by the oily acids from some lead carbonate usually contained in the litharge. The process should not be continued longer than is sufficient to produce complete union of the ingredients, and this may be known by the color and consistence of the mass. The color of the litharge gradually becomes paler, and at length almost white when the plaster is fully formed. The consistence increases with the progress of the boiling, and is sufficiently thick when a portion of the plaster, taken out and allowed to cool upon the end of a spatula, or thrown into cold water, becomes solid, without adhering in this state to the fingers. The portion thus solidified should not present, when broken, any red points, which would indicate the presence of a portion of uncombined litharge. When the plaster is formed, it should be removed from the fire, and after a short time cold water should be poured upon it. Portions should then be detached from the mass, and, having been well kneaded under water, in order to separate the viscid solution of glycerin contained in the interior, should be formed into cylindrical rolls, and wrapped in paper. Such, at least, has been the course of proceeding usually recommended. But Davallon maintains that the presence of glycerin in the plaster is useful by keeping it in a plastic state, and that washing and kneading are injurious, the former by removing the glycerin, the latter by introducing particles of air and moisture into the mass, which is thus rendered more disposed to rancidity. (*A. J. P.*, xv. 274; from *Journ. de Chim. Méd.*) By employing steam heat in the preparation of this plaster, the risk of burning it is avoided. Bernbeck found that lead plaster could be preserved from hardening and oxidation if kept in air tight canisters. (*Ph. Ztg.*, 1881, p. 589.)

C. Lewis Diehl found it almost impossible, in following the U. S. directions of 1860, to obtain a plaster wholly free from uncombined litharge. He obviated the difficulty by first rubbing the sifted litharge with about half its weight of oil, then stirring the mixture with the remainder of the oil, in a tinned copper kettle, adding the water, and heating to 212° F. until a uniform plaster was formed. (*A. J. P.*, 1867, p. 385.)

Uses.—This plaster, which has long been known under the name of *diachylon*, is used as an application to excoriated surfaces and to slight wounds, which it serves to protect from the action of the air. It may also be beneficial by the sedative influence of the lead which enters into its composition. A case is on record in which lead colic resulted from its long continued application to a large ulcer of the leg. (*Am. J. M. S.*, xxiii. 246.) J. M. Bigelow reports a case of excessive sweating of the feet cured by putting the patient in bed for thirteen days and keeping the feet enveloped in strips of lead plaster. (*N. R.*, Oct. 1875.) Its chief use is in the preparation of other plasters.[1]

Off. Prep.—Emplastrum Adhæsivum, *U. S.* (*Br.*); Emplastrum Hydrargyri, *U. S.*, *Br.*; Emplastrum Plumbi Iodidi, *Br.*; Emplastrum Saponis, *U. S.*, *Br.*; Unguentum Diachylon, *U. S.*

EMPLASTRUM PLUMBI IODIDI. Br.

LEAD IODIDE PLASTER

(ĕm-plăs'trŭm plŭm'bī ī-ŏd'ĭ-dī)

Emplâtre d'Iodure de Plomb, *Fr.*; Jodbleipflaster, *G.*

"Lead Iodide, 2 *ounces* (Imperial) or 50 grammes; Lead Plaster, 1 *pound* (Imp.) or 400

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[1] *Logan's Plaster.*—Take of Litharge, Lead Carbonate, each, 1 *pound;* Castile Soap, *twelve ounces;* Butter (fresh), *four ounces;* Olive Oil, *two and a half pints;* Mastic, in powder, *two drachms.* It is to be understood that the pound and ounce are of the avoirdupois weight. Having mixed the Soap, Oil, and Butter, add the Litharge, and boil the mixture gently, constantly stirring, for an hour and a half, or until it shall assume a pale brown color; then increase the heat somewhat, and continue to boil, until a portion of the liquid, dropped on a smooth board, is found not to adhere to it on cooling; then remove it from the fire, and mix the mastic with it. Logan's plaster is yet employed by regular practitioners as a protective and discutient application.

Plaster of Lead Carbonate.—This was originally introduced into our Pharmacopœia as a substitute for *Mahy's plaster*, at one time much employed in some parts of the United States, but was omitted in the edition of 1840. It is a good application to surfaces inflamed or excoriated by friction, and may be resorted to with advantage in those troublesome cases of cutaneous irritation, and even ulceration, which are likely to occur upon the back and hips during long continued confinement to one position. We give the process as contained in the Pharmacopœia of 1830. "Take of Carbonate of Lead *a pound;* Olive Oil *two pints;* Yellow Wax *four ounces;* Lead Plaster *a pound and a half;* Florentine Orris, in powder, *nine ounces.* Boil together the Oil and Carbonate of Lead, adding a little water and constantly stirring, till they are thoroughly incorporated; then add the

grammes; Resin, 2 *ounces* (Imp.) or 50 grammes. Finely powder the Lead Iodide; mix it with the Lead Plaster and Resin previously melted together at as low a temperature as possible." *Br.*

This is a local discutient plaster, which may also be used with other means to affect the system. (See *Plumbi Iodidum.*)

EMPLASTRUM SAPONIS. U. S., Br.

SOAP PLASTER

(ĕm-plăs'trŭm sā-pō'nĭs)

Emplâtre de Savon, *Fr. Cod.;* Emplastrum cum Sapone, *Fr.;* Emplastrum Saponatum, *P. G.;* Seifenpflaster, *G.;* Emplasto de jabon, *Sp.*

* "Soap, dried, and in coarse powder, *ten grammes* [or 154 grains]; Lead Plaster, *ninety grammes* [or 3 ounces av., 76 grains]; Water, *a sufficient quantity,* to make about *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Soap with enough Water to reduce it to a semi-liquid state; then mix it with the Lead Plaster previously melted, incorporate thoroughly by stirring, and evaporate to the proper consistence." *U. S.*

"Hard Soap, 6 *ounces* (Imperial) or 150 grammes; Lead Plaster, 2¼ *pounds* (Imp.) or 900 grammes; Resin, 1 *ounce* (Imp.) or 25 grammes. Melt each ingredient separately at a low temperature; mix; evaporate, with constant stirring, to a proper consistence." *Br.*

The present U. S. formula is an improvement upon that of a former edition of the Pharmacopœia. By directing the soap to be in powder instead of sliced, it may be more thoroughly incorporated with the plaster. Greater plasticity is secured, in some degree, in the British process by the use of resin. Diehl adopted the plan of first rubbing the soap with its weight of water, then straining the mixture through coarse muslin, and lastly reducing the residue with a proportionate quantity of water, before stirring the whole into the melted plaster. (*A. J. P.,* 1867, p. 386.) Soap plaster is considered discutient, and is sometimes used as an application to tumors, where a dressing is required. Somewhat softer in its character, the soap cerate,[1] formerly official, may be found useful.

Off. Prep.—Emplastrum Calefaciens, *Br.;* Emplastrum Cantharidis, *Br.*

Wax and Plaster, and, when these are melted, sprinkle in the Orris, and mix the whole together." By this process a good plaster may be prepared, rather too soft at first, but soon acquiring the proper consistence.

[1] *Ceratum Saponis.* U. S. 1870. *Soap Cerate.* (Cérat de Savon, *Fr.;* Seifencerat, *G.*)—"Take of Soap Plaster *two troyounces;* White Wax *two troyounces and a half;* Olive Oil *four troyounces.* Melt together the Plaster and Wax, add the Oil, and, after continuing the heat a short time, stir the mixture until cool." *U. S.* 1870.

Soap cerate is thought to be cooling and sedative, and is used in scrofulous swellings and other instances of chronic external inflammation.

EMULSA.

EMULSIONS

(ę-mŭl'są)

Emulsions, *Fr.;* Emulsiones, *G.;* Emulsiones, *It., Sp.*

Under this head are included in the U. S. Pharmacopœia liquid preparations in which oleaginous substances are suspended in aqueous fluids by the intervention of gum or other viscid matter. The preparations forming the present class of emulsions were termed Mixtures in earlier pharmacopœias, and it is to be regretted that under this indefinite term are still grouped liquids of many kinds; the separation of these into proper classes is only a question of time, and the introduction of this new class into the Pharmacopœia of 1890 marked the first step in the direction of greater accuracy in defining pharmaceutical preparations, and more system in classification. The object of emulsions is usually to facilitate the administration, to conceal the taste, or to obviate the nauseating effects of unpleasant medicines, and their perfection depends upon the intimacy with which the ingredients are blended. Some skill and care are requisite for the production of uniform and perfect emulsions. As a rule, the body to be suspended should be thoroughly mixed by trituration with the substance intended to act as the intermedium, before the aqueous vehicle is added. In the case of the liquid balsams and oils, if gum arabic is employed as the intermedium it should be previously brought to the state of mucilage of the consistence directed in the U. S. Pharmacopœia. When a fixed oil or balsam is to be made into an emulsion, the method most employed abroad is to add one part of gum to two or three of the oil, in a mortar, triturate until the mixture is complete, and then add at once twice as much water as gum used, and triturate rapidly until the oil is completely emulsified, then gradually add the remainder of the vehicle with constant trituration. Agitation in a bottle is sometimes substituted for trituration. The plan most largely used in this country is to make the emulsion with mucilage. Having a broad flat pestle and a mortar perfectly free from grease, put in a little mucilage, rub it around the mortar, add about half as much oil, triturate from the centre so as to emulsify this, then add more mucilage, then oil, and so on until the operation is completed. Care is required never to get the oil in excess of the mucilage. This plan seems to accord with the principle laid down by R. Rother (*Ch. Ph.,* 1872, p. 25), that the most perfect and rapid emulsifier is a perfect emulsion. The proportion of gum and water necessary to make a good emulsion with the fixed oils varies with the oil. Thus, while castor oil requires only two drachms of the gum and three drachms of water to the ounce, most other fixed oils require half their weight of gum, and a weight of water equal

to half that of the oil and gum united. These quantities being well rubbed together, any desirable amount of water may afterwards be gradually added, and will readily incorporate with the other ingredients. The white of egg has been frequently ordered by physicians as the suspending substance, but it is inferior for this purpose to the yolk, or to gum arabic. When the white is used it should be well beaten, and incorporated with the oleaginous or balsamic substances before the water is added. Quillaja, saponin, and other substances having similar properties have been proposed as emulsifying agents, but they are objectionable on account of their medicinal activity. Emulsifying agents should be inert.

EMULSUM AMYGDALÆ. U. S. (Br.)

EMULSION OF ALMOND [Milk of Almond]

(ę-mŭl'sŭm ą-mŷg'dą-læ)

Mistura Amygdalæ, *Br.;* Almond Mixture; Mistura Amygdalæ, U. S. P. 1880; Emulsio Amygdalæ, s. Amygdalarum, Emulsio Simplex; Milk of Almonds; Simple Emulsion; Emulsion d'Amande, *Fr. Cod.;* Lait d'Amande, *Fr.;* Mandelemulsion, Mandelmilch, *G.;* Emulsione di mandorle dolci, *It.;* Emulsion comun, *Sp.*

* "Sweet Almond, *sixty grammes* [or 2 ounces av., 51 grains]; Acacia, in fine powder, *ten grammes* [or 154 grains]; Sugar, *thirty grammes* [or 1 ounce av., 25 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Having blanched the Almond, add the Acacia and Sugar, and beat them, in a mortar, until they are thoroughly mixed. Then rub the mass with *nine hundred cubic centimeters* [or 30 fluidounces] of water, at first very gradually added, until a uniform mixture results. Strain this into a graduated vessel, and wash the mortar and strainer with enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the whole thoroughly. This emulsion should be freshly prepared when required." *U. S.*

"Compound Powder of Almonds, 2 *ounces* (Imperial) or 20 grammes; Distilled Water, 16 *fl. ounces* (Imp. meas.) or 160 cubic centimetres. Triturate the Powder with a little of the Distilled Water so as to form a thin paste; gradually add the remainder of the Distilled Water; strain through fine muslin." *Br.*

These preparations are essentially the same, the gum and sugar which enter into the U. S. formula directly being ingredients of the compound powder of almonds of the British. The gum arabic in these formulas is introduced not so much for its demulcent properties as to assist in the suspension of the insoluble ingredients of the almonds. The same formula will answer for the preparation of an *emulsion of bitter almonds.* The oleaginous matter of the almonds is suspended in the water by means of their albumen, gum, and sugar, forming a milky emulsion. When the almonds themselves are employed, as in the U. S. process, care should be taken to reduce them to the consistence of a paste previously to the addition of the water, and with each successive portion of fluid a uniform mixture should be formed before another portion is added. Common water, when pure, may be properly substituted for the distilled. Great care should be taken to select the almonds perfectly free from rancidity. The emulsion is not permanent.[1] Upon standing, the oil rises like thick cream to the surface, and the separation is effected more quickly by heat, alcohol, and the acids, which coagulate the albumen. The preparation is closely analogous to milk in chemical relations and appearance. In warm weather it soon becomes sour.

Uses.—Emulsion of almond has a bland taste, and may be used as an agreeable, nutritive demulcent in catarrhal and dysenteric affections and irritation of the urinary passages. To be of service it must be freely employed. It is occasionally employed as an emollient lotion and as a vehicle for less agreeable medicines, but should not be used with any considerable quantity of tinctures, acidulous salts, or other acid substances.

Dose, two to eight fluidounces (60 to 240 Cc.).

EMULSUM ASAFŒTIDÆ. U. S.

EMULSION OF ASAFETIDA [Milk of Asafœtida]

(ę-mŭl'sŭm ăs-ą-fœt'į-dæ)

Asafetida Mixture; Mistura (Lac) Asafœtidæ, Mistura Asafœtida, U. S. P. 1880; Mixture (Lait) d'Asafœtida, *Fr.;* **Asafœtidaemulsion, Stinkasantmilch,** *G.*

* "Asafetida, in selected tears, *forty grammes* [or 1 ounce av., 180 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Asafetida, in a warmed mortar, with *nine hundred cubic centimeters* [or 30 fluidounces] of Water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and rinse the mortar and strainer with enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the whole thoroughly." *U. S.*

The present 4 per cent. official emulsion slightly exceeds in strength the mixture of the U. S. P. 1870, which contained but 3 per cent.

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[1] *Concentrated Emulsion of Almonds.*—H. P. Reynolds prepares a permanent preparation which when mixed with three times its bulk of water, makes an emulsion which cannot be distinguished from the official, by using the following formula. Take of Sweet Almonds [blanched], Sugar, Glycerin ("C. P."), each, one ounce; Powdered Gum Arabic one drachm; Water two ounces. Rub to a uniform paste, strain through muslin, evaporate by a heat not exceeding 150° F. to the consistency of a fresh solid extract, flavor to suit.

of asafetida. This emulsion is less stimulant than the tincture, and more prompt in its action than the pill. Its excessively disagreeable odor and taste are, however, objections, which induce a frequent preference for the last mentioned preparation. It is very often employed as an enema. From two to four fluidounces (60 to 120 Cc.) may be given by the rectum. D. Ackerman prepares a concentrated emulsion of asafetida, which will keep if excluded from the light, by using a mixture of three-fourths of pure water and one-fourth of diluted acetic acid as the menstruum. For cleaning mortars in which asafetida has been rubbed, he recommends solution of potassium hydroxide, followed by bitter almond water or paste, and soap and water. (*A. J. P.*, 1874, p. 268.)

Dose, one-half to one fluidounce (15 to 30 Cc.).

EMULSUM CHLOROFORMI. U. S.

EMULSION OF CHLOROFORM

(ę-mŭl'sŭm ęhlō-rǫ-för'mī)

Chloroform Mixture; Emulsio Chloroformi; Mistura Chloroformi, U. S. P. 1880; Emulsion de Chloroforme, *Fr.;* Chloroformemulsion, *G.*

* "Chloroform, *forty cubic centimeters* [or 1 fluidounce, 169 minims]; Expressed Oil of Almond, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Tragacanth, in very fine powder, *ten grammes* [or 154 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Introduce the Tragacanth into a perfectly dry bottle of sufficient capacity, add the Chloroform, and shake the bottle thoroughly, so that every part of the surface may become wetted. Then add about *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and incorporate it by vigorous shaking. Next add the Expressed Oil of Almond, in several portions, shaking after each addition, and when the Oil has been thoroughly emulsified, add enough Water, in divided portions, shaking after each addition, to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* The chloroform mixture of the U. S. P. 1880 [1] was an excellent preparation; the present emulsion is not quite identical, there being no camphor in it. The expressed oil of almond renders the emulsion more permanent, and the proportion of chloroform is slightly less than in the U. S. P. 1880 chloroform mixture, being 4 per cent. instead of 5 per cent. as formerly. This emulsion affords an easy and agreeable method of administering chloroform; the emulsion is permanent and does not separate on standing. The chloroform makes it keep long unchanged.

Dose, two to eight fluidrachms (7.5 to 30 Cc.).

[1] "Purified Chloroform, *eight parts* [or two fluidrachms]; Camphor, *two parts* [or forty-five grains]; Fresh Yolk of Egg, *ten parts* [or half a fluidounce]; Water, *eighty parts* [or four fluidounces], to make *one hundred parts* [or about five fluidounces]. Rub the Yolk of Egg in a mortar, first by itself, then with the Camphor, previously dissolved in the Chloroform, and lastly, with the Water, gradually added, so as to make a uniform mixture." *U. S.* 1880.

EMULSUM OLEI MORRHUÆ. U. S.

EMULSION OF COD LIVER OIL

(ę-mŭl'sŭm ō'lę-ī mör'rhŭ-æ)

Emulsion de Huile de Foie de Morue, *Fr.;* Leberthranemulsion, *G.*

* "Cod Liver Oil, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Acacia, in fine powder, *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]; Syrup, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Oil of Gaultheria, *four cubic centimeters* [or 65 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Acacia with the Cod Liver Oil in a dry mortar until uniformly mixed, then add at once *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water and triturate lightly and rapidly until a thick homogeneous emulsion is produced; to this add the Oil of Gaultheria and the Syrup, with enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and mix thoroughly.

NOTE.—The Oil of Gaultheria may be replaced, if desired, by a suitable quantity of oil of bitter almond or other suitable flavoring." *U. S.* This emulsion was introduced into the U. S. P. (8th Rev.) for the purpose of affording a simple process for making a reasonably palatable and permanent preparation of cod liver oil. The continental method employed is best adapted for stock emulsions; to those who object to the taste of a combination of syrup and an oil with a fishy taste, the emulsion may be flavored with bruised celery seed and salt and then strained.

Dose, two to four fluidrachms (7.5 to 15 Cc.).

EMULSUM OLEI MORRHUÆ CUM HYPOPHOSPHITIBUS. U. S.

EMULSION OF COD LIVER OIL WITH HYPOPHOSPHITES

(ę-mŭl'sŭm ō'lę-ī mör'rhŭ-æ cŭm hȳ-pǫ-phŏs-phī'tį-bŭs)

Emulsion de Huile de Foie de Morue avec les Hypophosphites de Chaux, de Soude et de Potasse, *Fr.;* Leberthranemulsion mit unterphosphorigsauren Salzen, *G.*

* "Cod Liver Oil, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Acacia, in fine powder, *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]; Calcium Hypophosphite, *ten grammes* [or 154

grains]; Potassium Hypophosphite, *five grammes* [or 77 grains]; Sodium Hypophosphite, *five grammes* [or 77 grains]; Syrup, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Oil of Gaultheria, *four cubic centimeters* [or 65 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Acacia with the Cod Liver Oil in a dry mortar until uniformly mixed, then add at once *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water and triturate lightly and rapidly until a thick, homogeneous emulsion is produced, add the Oil of Gaultheria and incorporate thoroughly; dissolve the Hypophosphites in *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, mix the solution with the Syrup, and add the liquid gradually to the emulsion with continued trituration. Lastly, add enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and mix thoroughly.

NOTE.—The Oil of Gaultheria may be replaced, if desired, by a suitable quantity of oil of bitter almond or other suitable flavoring." *U. S.*

This process of the U. S. P. (8th Rev.), like that for the emulsion of cod liver oil, is intended to furnish a means of providing a uniform preparation which will take the place of many different proprietary emulsions on the market, for this can be prescribed by physicians without violating a code of ethics.

Dose, two to four fluidrachms (7.5 to 15 Cc.).

EMULSUM OLEI TEREBINTHINÆ. U. S.

EMULSION OF OIL OF TURPENTINE

(ẹ-mŭl'sŭm ō'lẹ-ī tẹr-ẹ-bĭn'thị-næ)

Emulsion d'Essence de Térébenthine, *Fr.;* Terpentinölemulsion, *G.*

* "Rectified Oil of Turpentine, *fifteen cubic centimeters* [or 243 minims]; Expressed Oil of Almond, *five cubic centimeters* [or 81 minims]; Syrup, *twenty-five cubic centimeters* [or 406 minims]; Acacia, in fine powder, *fifteen grammes* [or 231 grains]; Water, *a sufficient quantity,* to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Introduce the Acacia into a perfectly dry bottle of sufficient capacity, add the Rectified Oil of Turpentine and the Expressed Oil of Almond and shake the bottle thoroughly. Then add about *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of Water and incorporate it by vigorous shaking. When the Oil has been completely emulsified, add first the Syrup, in several portions, shaking after each addition, and then enough Water, in divided portions, shaking after each addition, to make the product measure *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]." *U. S.*

The U. S. P. (8th Rev.) introduced this emulsion with the view of providing a simple and fairly permanent preparation. Rectified oil of turpentine should be used exclusively. The process is much like the one recommended by J. Winchell Forbes, and a mortar and pestle are not needed to produce a perfect emulsion.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

ERGOTA. U. S., Br.

ERGOT [Ergot of Rye, Spurred Rye]

(ër'gọ-tạ)

"The sclerotium of *Claviceps purpurea* (Fries) Tulasne (Fam. *Hypocreaceæ*), replacing the grain of rye, *Secale cereale* Linné (Fam. *Gramineæ*). Ergot should be moderately dried, and not exposed to a damp atmosphere. After being kept more than one year, it is unfit for use." *U. S.* "The sclerotium of Claviceps purpurea, *Tulasne,* originating in the ovary of Secale cereale, *Linn.*" *Br.*

Secale Clavatum, Mater Secalis, Clavus Secalinus; Rye Smut, Mother of Rye, Cockspur Rye; Ergot de Seigle, *Fr. Cod.;* Ergot, Seigle Ergoté (noir), Blé Cornu, *Fr.;* Secale Cornutum, *P. G.;* Mutterkorn, Kornmutter, Rogenmutter, Zapfenkorn, Hungerkorn, *G.;* Segala cornuta, Grano speronato, *It.;* Cornezuelo de centeno, *Sp.*

In all the Gramineæ, or grass tribe, and in some of the Cyperaceæ, the place of the seeds is sometimes occupied by a morbid growth which, from its resemblance to the spur of a cock, has received the name of *ergot,* adopted from the French. This product is most frequent in the rye, *Secale cereale,* and from that grain was adopted in the first edition of the U. S. Pharmacopœia, under the name of *secale cornutum,* or *spurred rye.* In the edition of 1840 the name was changed to *ergota.* It is probable that this morbid growth has similar properties from whatever plant derived, and the fact has been proved in relation to the ergot of wheat. (See *A. J. M. S.,* N. S., xxxii. 479,[1] also *Iowa Med. Journ.,* iv. 93.)

[1] Tulasne found that dissimilar sclerotia collected from twelve species of grasses, produced fructification identical with that of the ergot of rye, so that it is probable that many apparently dissimilar ergots are specifically identical, their appearance being modified by the species of grass which they inhabit. It is further probable that all ergots have medicinal properties which agree in character though not in intensity. The short thick ergot which gathers upon the wild rice of Minnesota, *Zizania aquatica,* L., has long been used as an abortifacient and oxytocic by the Indian women; while according to Parke, Davis and Co., the wild ergot growing on various species of *Agropyrum* and *Elymus* in the Western United States, is fully equal medicinally to the official plant. M. Leperdriel, Jr., affirms that the *ergot of wheat* is destitute of the poisonous properties of that of rye, and is less liable to change. Bentley of London, found that of two specimens, one of the ergot of rye, the other of wheat, which had been kept under similar circumstances for ten years, the former was quite destroyed, while the latter was apparently unchanged. Ergot is rarer in wheat than in rye, and in the head of the former there is generally but one and very rarely more than two of the diseased grains. It is produced usually in wheat in wet seasons, and on that side of the head most exposed to the damp-

Investigations of Tulasne have shown that ergot is not the diseased grain of the rye, but the *sclerotium* of a fungus, the *Claviceps purpurea,* Tulasne. This fungus has three stages in its life history. The development of the *sphacelia,* or first stage, commences with that of the pistil, which serves as a soil for it. The ovary of the rye consists of a cellular membrane of two coats, the outer of which has a thick parenchyma, white and gorged with juice; the inner is very delicate and green. The sphacelia, when it takes possession of the ovary, identifies itself with the outer parenchyma, and in some measure replaces it, being as it were borne by the inner membrane. It rapidly increases, taking the form of the ovary, and almost obliterating its cavity. The ovule is either entirely wanting, or may be seen, on a careful examination, in an imperfect form. For some time the parasite is represented entirely by the sphacelia, which is an oblong, fungous mass, almost homogeneous, soft and tender, marked on its surface by numerous sinuous furrows, and having within many irregular cavities, which, as well as the outer coat, are uniformly covered with linear parallel cells. From the summits of these peripheric cells, internal as well as external, issue oval capsules, from .005 to .007 Mm. in length, which spread upon neighboring objects, and especially the glumes of the flowers they inhabit. They are a kind of reproductive cells, called conidia, which are produced by many fungi long before the perfect plant is developed. Tulasne calls them "*spermatie.*" In the early stage the sphacelia does not affect the top of the ovary; and the stigmas attached. The stamens often abort; but the filaments and anthers may sometimes be seen buried in the tissue of the sphacelia, and altered by its action. Sometimes the ovule is not completely aborted, but it is certainly never developed into a normal grain. In all ergotized plants the pistils and stigmas, when they remain, are often covered with a mouldiness, consisting of spores and entangled filaments, which end by covering the parts with an abundant ashy or sooty powder. This is a different fungus, and was confounded by Quekett with the ergot plant. It is found as well in the non-ergotized as in the ergotized flowers, and in those of plants which do not bear ergot. At a somewhat advanced period of the development of the sphacelia, there exudes, especially from the summit, a very adhesive juice, which spreads over that structure, bearing along with it an immense number of the seedlets or "*spermaties.*" This leaves on the surface when dry an oily appearance, and afterwards the spots, where it remains, become brownish or blackish. But this exudation does not appear until the sphacelia has ceased to constitute the whole plant.

At the base of the sphacelia is produced a compact body, violet-black without and white within, which is the ergot in a rudimentary state. With this commences the second stage in the development of the fungus. The young ergot is everywhere invested by the tissue of the sphacelia (which Tulasne calls also *spermagonia,* from its office); but, as it increases, it seems to be placed below the spermatopherous apparatus, and raises it steadily out of the floral bracts which concealed it, ending by supporting it wholly at its summit. Sometimes it carries with it the atrophied ovary, which still shows the hairs that crowned it, and some remains of the stigmas. It results that the ergot, which is technically the *sclerotium* of the fungus, remains for some time concealed in the sphacelia, so that this seems to constitute the whole plant; but, when the function belonging to this has been fulfilled, it begins to dry, and is much deformed. The ergot, on the contrary, increases in all directions, and soon appears above the glume. As it augments, the thin coating which it has received from the spermatopherous tissue, especially below, gradually becomes thinner, and seems to disappear, so that its surface, instead of being uniformly violet-black, is only here and there covered with the remains of the tissue, or with a deposit of the conidia or "*spermatie.*" Nevertheless, the sphacelia, deformed, shrunken, and worn away by rains and other causes, remains long at the top of the ergot, along with the abortive ovary, etc., and may even continue to adhere when the ergot is detached from the plant. The time required for full development of the sphacelia and the ergot or sclerotium varies. In an example under the observation of Tulasne, at least a month elapsed after the appearance of the sphacelia before the growth was completed.

Ergot has absolutely nothing in common with normal grain. The anatomical structure and all the physical characters of ergot are those of the mushrooms, or rather of a sclerotic mycelium. The parenchyma, which is whitish, dry, and brittle, consists in all its parts of irregular, globular, or polyhedric thick-walled cells, intimately united, and filled with a limpid oil, but feebly colored by iodine. The superficial utricles, which alone are colored, have an outer wall thicker than the inner, and the color

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ness. It is shorter and much thicker than the ergot of rye, being about half an inch long and three-quarters of an inch or more in circumference, and cleft into two or three divisions. In color and odor it resembles the spurred rye. (*P. J.,* March and April, 1863.)

The *ergot of oats* is said to be of a black color, measuring from ten to twelve millimeters in length and three to four in thickness, and to have been used in Algeria as a substitute for rye ergot. (*L. M. R.,* March, 1888.) The *ergot of diss,* an Algerian reed, *Ampelodesma tenax,* has appeared in commerce to some extent. It is, when small, slightly curved, but when long (6 to 9 centimeters) it takes a spiral turn from right to left, the longitudinal furrows being present on the inner face. It is thinner, dryer, and more brittle than the ergot of rye, and has been used for the preparation of an ergotine or extract closely resembling the official one, but said to be of a clearer red or brown color. Lallemand asserts that the ergot of diss is twice as strong as the ergot of rye, and states that it is abundant and readily collected. It is also stated to be less hygroscopic and less apt to be attacked by acari than is the official article. (*P. J.,* xvi. 684, 1886.)

of these is what gives its characteristic hue to ergot. Not the least trace of starch is to be detected. If ergot is planted in a suitable soil, evidences of germination are seen in about three months. Little globular prominences appear on its surface, which gradually enlarge, and raise themselves upon cylindrical stems, and finally become perfect pilei or fruiting fungi, producing elongated, rod-like spores in flask-shaped cavities which open by a little pore. These little fungi belong to the genus *Sphæria.* As they increase, the interior of the ergot becomes exhausted, by contributing to their growth. Falling to the ground, in its natural course, the ergot in the soil germinates, and produces pilei, the spores of which, carried up with the juices of rye, become lodged in the ovary, where they begin the course of life and progress which has been delineated. Different grains are probably infested with different species of Claviceps, but there is no reason to think that any other species is concerned in the product of any official variety of ergot. (*Annales des Sciences Naturelles,* 3e sér., xx. 5, 1853.) The ergot usually projects out of the glume or husk beyond the ordinary outline of the spike or ear. In some spikes the place of the seeds is wholly occupied by the ergot, in others only two or three spurs are observed. It is said to be much more energetic when collected before than after harvest. Rye has generally been thought to be most subject to the disease in poor and wet soils, and in rainy seasons, and intense heat succeeding continued rains has been said to favor its development, especially if these circumstances occur at the time the flower is forming. It is now, however, asserted that moisture has little or nothing to do with its production. It should not be collected until some days after it has begun to form, as, according to Bonjean, if gathered on the first day it does not possess the poisonous properties which it exhibits when taken on the sixth day. (See *P. J.,* Jan. 1842.) Ergot enters commerce chiefly from Russia, Germany, and Spain. Of the three varieties the Spanish ergot is considered the best, yielding usually from 13 to 15, sometimes as high as 18, per cent. of extractive. It is somewhat darker-colored, rather shorter, and more uniform than is the German ergot. An ergot of excellent quality has been sent from the Canary Islands to England.

Properties.—Ergot is in solid, brittle yet somewhat flexible grains, from a third of an inch to an inch and a half long, from half a line to three lines in thickness, cylindrical or obscurely triangular, tapering towards each end, obtuse at the extremities, usually curved like the spur of a cock, marked with one or two longitudinal furrows, often irregularly cracked or fissured, of a violet-brown color and often somewhat glaucous externally, yellowish-white or violet-white within, of an unpleasant odor when in mass, resembling that of putrid fish, and of a taste which is at first scarcely perceptible, but ultimately disagreeable and slightly acrid. "Subcylindrical, obscurely three-angled, tapering toward both ends but obtuse, somewhat curved, 1.5 to 3 Cm. long and about 3 Mm. thick; externally purplish-black, longitudinally furrowed on each side, more conspicuously on the concave side; fracture short, pinkish or reddish-white; odor peculiar, heavy, increased by trituration with potassium hydroxide T.S.; taste disagreeable." *U. S.* Ergot yields its virtues to water and alcohol. The aqueous infusion or decoction is claret-colored, and has an acid reaction. It is precipitated by lead acetate and subacetate, silver nitrate, and tincture of galls, but affords with iodine no evidence of the presence of starch. Long boiling impairs the virtues of the medicine.

Assay.—The attempt to assay preparations of ergot by the action upon the comb of the domestic cock seems to us of doubtful utility, since it is at present uncertain whether the action of ergot upon the uterus and upon the blood vessels is due to the same principle or to several—it may be antagonistic—substances. Keller's method of chemical assay is based upon the fact that the vaso-constricting power of ergot is largely due to the alkaloid *cornutine,* which may be readily extracted with ether. Before extraction, however, it is necessary to remove the fixed oils, which can be accomplished by percolation with purified petroleum benzin, as follows:

25 Gm. of dried powdered ergot are percolated with petroleum benzin until a small portion of the percolate shows no residue upon evaporation. The ergot is then dried and shaken in a flask with 125 Cc. of ether for ten minutes, after which a mixture of 1 Gm. of calcined magnesia, with 20 Cc. of water, is added and the flask again agitated for thirty minutes. 100 Cc. of the ethereal liquid are now drawn off and filtered through cotton into a separator containing 25 Cc. of a 0.5 per cent. hydrochloric acid solution; after vigorous shaking the aqueous portion is decanted. This process should be repeated twice afterwards with 15 and 10 Cc. respectively of the acid solution. The collected acid liquids are then rendered alkaline with ammonia water and shaken out several times with ether, the ethereal solutions are collected in a tared flask and evaporated to dryness; the weight of the residue multiplied by 5 shows the percentage of alkaloid present, which should be about 0.2 per cent.

Ergot has been analyzed by Vauquelin, Winckler, Wiggers, Wright, Legrip, Wenzell, Tanret, Dragendorff, and several others. Wright supposed the virtues of ergot to reside in the fixed oil, which he therefore recommended as a substitute for the medicine. The *oil of ergot,* when obtained from grains recently collected, is, according to Wright, often quite free from color, but as usually prepared it is reddish brown. It has a disagreeable, somewhat acrid taste, is lighter than water, and is soluble in alcohol and alkaline solutions. It is prepared by forming an ethereal tincture of ergot by the process of

displacement, and evaporating the ether with a gentle heat. It may be more cheaply prepared by substituting petroleum benzin for ether. Experience has shown that, though the oil thus prepared with ether may have produced effects analogous to those of ergot, they were to be ascribed rather to some principle extracted along with the oil by the menstruum than to the oil itself, for, when procured by expression, this has been found to be inactive, although Procter has ascertained that it contains a little *secalin*, one at least of the active principles of ergot, which may be separated from it by washing with acidulated water. According to T. R. Baker, the oil has a taste and odor similar to those of castor oil, with which it also agrees in ultimate composition, and yields analogous results in saponification. (*A. J. P.*, xxiv. 101–2.) T. C. Herrmann investigated specially the chemical constitution of the oil of ergot. As obtained by means of ether, it was brownish yellow, of an aromatic odor and acrid taste, viscid, of the sp. gr. 0.9249, and without the drying property. It consists of 22.703 per cent. of palmitic acid, 69.205 of oleic acid, and 8.091 of glycerin. (*N. R.*, 1872, p. 238; from *Buchner's Repertorium*, 1871, p. 283.) The *sugar of ergot* was found by Mitscherlich to be *mycose*, $C_{12}H_{22}O_{11}$. According to Wenzell (*A. J. P.*, May, 1864), ergot of rye contains two peculiar alkaloids, which he designated *ecboline* and *ergotine*, and claimed to be the active principles of the drug. The two bases of ergot are, according to Wenzell, combined with *ergotic acid*, the existence of which has been further admitted by Ganser. It is said to be a volatile body yielding crystallizable salts.

A crystallizable, colorless alkaloid, *ergotinine*, $C_{35}H_{40}N_4O_6$, which is probably identical with Wenzell's ergotine, was isolated (1877–78) by Tanret. He obtained it to the amount of 0.04 per cent., some amorphous ergotine, moreover, being present. The solutions of ergotinine turn greenish and red very soon; they are fluorescent. Sulphuric acid imparts to it a red, violet, and finally blue hue. The *ecboline* of Wenzell was named by Kobert *cornutine*. C. C. Keller asserts that *picrosclerotine*, *cornutine*, and Tanret's *ergotinine* are identical, and that ergot contains but one alkaloid which persists in it for one year unaltered. This alkaloid is crystalline, insoluble in water, soluble in alcohol and chloroform, slightly soluble in ether; by sulphuric acid it is colored violet blue. (*Chem. Ztg.*, 1894, 105; *Proc. A. Ph. A.*, 1895, 542.) C. Jakoby (*Ph. Centralh.*, 1897, 58) believes that he has isolated from ergot three chemically different bodies, *chrysotoxin*, *secalintoxin*, and *sphacelotoxin*. All of these are, however, therapeutically similar. It is affirmed that chrysotoxin fully represents ergot pharmacologically, and retains its activity unaltered for years, whereas sphacelotoxin and secalintoxin do not.

Dragendorff and several of his pupils believe that they have isolated the following *amorphous* principles of the drug: 1, *sclerotic acid*, said to be a very active substance, used chiefly in subcutaneous injections; about 4 per cent. of colorless acid may be obtained from good ergot of rye; 2, *scleromucin*, a mucilaginous matter which may be precipitated by alcohol from aqueous extracts of the drug; 3, *sclererythrin*, the red coloring matter probably allied to anthrachinon and the coloring substances of madder, chiefly to purpurin; 4, *scleroiodin*, a bluish-black powder soluble in alkalies; 5, *fusco-sclerotinic acid*; 6, *picrosclerotine*, apparently a highly poisonous alkaloid; lastly, 7, *scleroxanthin*, $C_7H_7O_3 + H_2O$, and 8, *sclerocrystallin*, $C_7H_7O_3$, which have been obtained in crystals; their alcoholic solution is but little colored, yet assumes a violet hue on addition of ferric chloride.

Tanret also observed in ergot of rye a volatile *camphoraceous* substance.

For an improved process for making sclerotic acid, by Podwissotzky, see *N. R.*, 1883, p. 271. Voswinkel obtained from ergot a brown amorphous substance, which he proved by hydrolysis to yield *mannose*. The body is a hemi-cellulose, and the name *mannan* has been given to it. He states that Dragendorff's sclerotic acid and scleromucin are identical with mannan. (*Ph. Centralh.*, 1891, p. 531.)

Kobert (*Ph. Centralh.*, 1884, p. 607; All, *Das Mutterkorns*, Leipzig, 1884) found three physiologically active principles: 1st, *ergotic acid*, which he considers the principle constituent of the sclerotic acid of Dragendorff and Podwissotzky, and which is isolated by precipitation with ammoniacal lead subacetate; 2d, *sphacelic acid*, which can be isolated by taking advantage of the insolubility of the free acid in water and its solubility in alcohol; 3d, the alkaloid *cornutine*, which is not identical with the crystalline or with the amorphous ergotinine of Tanret; it is readily soluble in alcohol, and is obtained from an alkaline aqueous solution by agitation with ether. This alkaloid is said to be very poisonous. Kobert's conclusions have been questioned by Tanret (*P. J.*, 1885, p. 889), but the former reaffirms his statements and believes that ergotinine is worthless, and that the activity of fresh ergot is due to sphacelic acid and cornutine as above described: the important fact, however, is noted that these latter principles entirely lose their properties on keeping; he therefore proposes that they be made into pills and coated to protect them. (*A. Pharm.*, 1886, p. 597.) Kobert's process [1] for

[1] Exhaust the drug with water, acidulated with hydrochloric acid, neutralize the aqueous solution nearly with sodium carbonate, evaporate *in vacuo* at a very low temperature to a syrupy consistence, and treat with alcohol. Filter, distil off the alcohol carefully, and treat the nearly dry product with anhydrous ether, which removes any ergotinine present. After making the residue alkaline with sodium carbonate it is treated with acetic ether, and the solution shaken with water containing a little citric acid, which removes the cornutine in an almost pure state. This process is repeated, and it is finally precipitated from its acetic ether solution by anhydrous ether. Prepared in this way, cornutine will, if kept dry, and not exposed to light, remain unchanged. (The author kept some for three years.) (*Y. B. P.*, 1891, p. 190.)

cornutine we append in a foot-note (page 450). For assay of ergot by A. R. L. Dohme, see *Proc. A. Ph. A.*, 1895, 263.

The odor of ergot is no doubt owing to the liberation of its volatile alkaloid, probably in consequence of a slow decomposition of the native salt. A method of detecting ergot in a mixed powder, rye flour for example, is thus afforded. If, on the addition of solution of potassium hydroxide, the odor of ergot be perceived, the presence of the drug is sufficiently proved.

Ergot, when perfectly dry and kept in well-stoppered bottles, will retain its virtues for a considerable time, but exposed to air and moisture it speedily undergoes chemical change and deteriorates. Gobley kept for more than ten years, perfectly sound, some ergot which he had selected from the year's harvest, carefully sifted, wiped with linen, then exposed to a heat of from 50° to 60° C. for three or four hours, and finally put into small boxes, holding each about 30 Gm. (a troyounce), previously heated with the ergot, and finally closed air tight with pitch. (*J. P. C.*, Mar. 1873, p. 216.) It is, moreover, apt to be attacked by a minute worm, which consumes the interior of the grain, leaving the exterior shell and an excrementitious powder. This insect is sometimes found in the ergot before removal from the plant. In the state of powder the medicine still more readily deteriorates, but Dragendorff believes that the decay is due to oxidization of the fatty principles of the ergot, and can be prevented by depriving the ergot of its oil before powdering. (*A. P. S.*, xxv.) This has since been confirmed by Zschiesing, who preserved ergot for two years, and Bombelon, who kept ergot in good condition for nine years, by previously removing the fixed oil with ether. (*Ph. Ztg.*, No. 49, p. 51; *A. J. P.*, 1881, p. 457.) It is best, as a rule, to renew it every year or two. M. Viel recommends that it should be well dried at a gentle heat, and incorporated with double its weight of loaf sugar, by means of which, if protected from moisture, it will retain its virtues for many years. According to Zanon, the same result is obtained by stratifying it with well washed and perfectly dried sand, in a bottle from which air and light are excluded. Camphor and powdered benzoin are said to prevent injury from worms. Aymoiner immerses fresh ergot in an ethereal solution of tolu, dries it, and preserves in tightly closed bottles.

Uses.—Ergot can scarcely be considered as a poison, since an ounce of the fluidextract rarely produces, except in the pregnant, any obvious symptoms unless it be nausea, and we have administered the same preparation in daily dose of three ounces continuously for several weeks without producing distinct symptoms. Large doses are liable, it is true, to produce abortion in pregnant women, but even this result is uncertain, and we know of but one instance of fatal poisoning by it unless the death was produced by the abortion. The symptoms of the recorded cases of poisoning have been paleness, and, as most characteristic, an especial coldness of the surface, partial paralysis with numbness and tingling in the limbs, feebleness of the pulse, restlessness, and finally stupor or delirium.

In the fatal case narrated by Pratschke, uneasiness in the head, oppression of stomach, diarrhœa, urgent thirst, burning pains in the feet, tetanic spasms, violent convulsions, and death ensued upon eating freely of ergotized grain. (*London Med. Gaz.*, Oct. 1850, p. 579.) The long continued and free use of ergot is highly dangerous, even when no immediate effects are perceptible. Fatal epidemics in different parts of the continent of Europe, particularly in certain provinces of France, have long been ascribed to the use of bread made from rye contaminated with this fungus.[1] Dry gangrene, typhus fever, and disorder of the nervous system attended with convulsions, are the forms of disease which have followed the use of this unwholesome food. It is true that ergot has been denied to be the cause, but accurate investigations made by competent men upon the spot where the epidemics have prevailed, together with experiments upon inferior animals,[2] leave no room for reasonable doubt that at least the gangrenous affection alluded to has resulted from it.

Upon the lower animals ergot acts as upon man. Besides its influence upon the uterus, the most important physiological action of the drug is upon the vasomotor nervous system. It has been abundantly proved that in full therapeutic dose it raises remarkably the arterial pressure by producing a general vasomotor spasm. This spasm is almost certainly the result of a stimulation of the vasomotor nerve centres, but there are still some authorities who believe that the drug acts peripherally upon the muscular coats of the vessels or upon the nerves connected therewith.

On the continent of Europe, in Germany, France, and Italy, ergot has long been empirically employed by midwives for promoting the contraction of the uterus, and its German name of *mutterkorn* implies a popular acquaintance with its peculiar powers. But the attention of the medical profession was first called to it by Stearns of Saratoga County, N. Y. (*New York Medical Repository*, 1807.) In its operation upon the pregnant uterus, it produces a constant unremitting contraction and rigidity, rather than that alternation of spasmodic effort and relaxation which is observable in the natural process of *labor*. Hence, unless the os uteri

[1] Hofmann states that one-tenth per cent. of ergot can be detected in bread by macerating 30 grains of coarsely grated bread in 40 grains of ether and 20 drops of diluted sulphuric acid for 24 hours, straining, shaking with solution of sodium bicarbonate and allowing to stand, when the solution separates and is of a violet color. (See also *N. R.*, 1883.)

[2] An epidemic among sheep was caused by eating ergotized grain. (See *P. J.*, x. 195.)

and external parts are sufficiently relaxed, the medicine is likely to produce injury to the fœtus by the incessant pressure which it maintains, and the death of the child is thought not unfrequently to have resulted from its injudicious employment. The cases to which it is thought to be especially adapted are those of lingering labor, when the os uteri is sufficiently dilated and the external parts sufficiently relaxed, when no mechanical impediment is offered to the passage of the child, and the delay is ascribable solely to want of energy in the uterus. Other cases are those in which the death of the fœtus has been ascertained, and when great exhaustion or dangerous constitutional irritation imperiously calls for speedy delivery. The medicine may also be given to promote the expulsion of the placenta, to restrain inordinate hemorrhage after delivery, and to hasten the discharge of the fœtus in protracted cases of *abortion*. In women subject to dangerous *flooding*, a dose of ergot given immediately before delivery is said to be very beneficial in its effects.

Ergot is also much used to cause the expulsion of coagula of blood, polypi, and hydatids from the uterine cavity, and even a number of successful cases of its employment for the destruction by strangulation of *fibroid tumors of the uterus* have been reported. In *uterine hemorrhage*, unconnected with pregnancy, the medicine is very useful, and it is probably the most used and most efficient of all remedies in pulmonary and other similar internal *hemorrhages*. Its action in these cases is no doubt the result of the contracting power it has over the smaller vessels. This action of ergot upon the blood vessels suggests its employment in those cases in which there is local or general dilatation of the blood vessels. It has been used in *pulmonic congestion* with apparent good results, and it has been highly lauded in the first stages of *pneumonia* by several clinicians, especially by J. E. Kelly (*Med. Register*, 1887, vol. x.), as giving immediate relief when injected hypodermically in low forms of pulmonary hyperæmia such as occur in *typhoid fevers*. It will probably also be found of service as a vasomotor stimulant in surgical *shock*, and has been much used against *cerebral congestion*, in *spinal congestion*, in *colliquative sweats*, and in *diabetes insipidus*. In *apoplexy*, owing to its pronounced tendency to increase the blood pressure, it must be given with the greatest caution if at all. The best preparation of ergot for internal administration, except when an immediate influence is desired, is the official solid extract given in capsules. The fluidextract is perhaps absorbed a little more quickly, but it is much more apt to sicken the stomach. The dose of solid extract is 5 to 30 grains (0.32 to 2.0 Gm.); of the fluidextract, half a fluidrachm to two fluidrachms (1.8 to 7.5 Cc.). In *hemorrhoids*, and in *varicose veins* of the leg, it has been injected into the diseased tissue with success, but probably acts only by producing a severe local inflammation.

Under the name of *ergotine*, usually with the name of the maker attached, a number of purified extracts of ergot are upon the market. They may be used in doses of from 5 to 10 gr. (0.32 to 0.65 Gm.), but have no advantage over the official preparations. *Bonjean's ergotine* is made by exhausting ergot with water, evaporating to the consistence of syrup, precipitating the albumen, gum, etc., by a large excess of alcohol, decanting the clear liquid, and evaporating to the consistence of a soft extract. When promptness and certainty of action are required, ergot may be used hypodermically. Solutions of extract of ergot are very prone to undergo speedy decomposition, and, as such altered solutions are very irritating, it is important that solutions for hypodermic use be made freshly, especially as the experiments of Engelmann (*D. M. W.*, Sept. 30, 1886) have shown that the addition of ordinary antiseptic agents to such solutions, unless in very large amount, simply delays decomposition, and that the changes may be far advanced although the preparations seem to the eye unaltered. Notwithstanding all possible precautions, the hypodermic injections of ergot have a tendency to produce local inflammations and abscesses, but the danger may be reduced to a minimum by absolute obedience to the following directions: Extract of ergot, five grains, should be dissolved in twenty minims of recently boiled water, and two or three drops of glycerin and half a drop of phenol be added. This solution should be filtered to remove any solid particles, and then at once be thrown deeply into the cellular tissues.

Dujardin-Beaumetz gives the dose of Tanret's crystallized ergotine for hypodermic use as 5 milligrammes (seven-hundredths of a grain). (*B. G. T.*, xciv. 236.) Sclerotic acid does not represent ergot, as was, so far as concerns the commercial article, shown by experiments made in the laboratory of the University of Pennsylvania; indeed, the research of Nikitin, who claims that it is the active principle, affords abundant evidence that it is not so. (*L. M. R.*, 1879, p. 21.)

Dose, of ergot, fifteen to sixty grains (1 to 3.9 Gm.).

Off. Prep.—Extractum Ergotæ, *U. S.*, *Br.;* Fluidextractum Ergotæ, *U. S.* (*Br.*); Infusum Ergotæ, *Br.;* Injectio Ergotæ Hypodermica, *Br.* (from extract); Tinctura Ergotæ Ammoniata, *Br.;* Vinum Ergotæ, *U. S.* (from fluidextract).

ERIODICTYON. U. S.

ERIODICTYON [Yerba Santa]

(ĕr-ĭ-o-dĭc'tŷ-ŏn)

"The dried leaves of *Eriodictyon californicum* (Hooker and Arnott) Greene (Fam. *Hydrophyllaceæ*)." *U. S.*

Mountain Balm, Consumptive's Weed, Bear's Weed, Gum Bush.

Eriodictyon [*Eriodictyum*] *californicum* (Hook. and Arn.), Greene (*E. glutinosum*, Benth.), is a low evergreen shrub growing abundantly upon dry hills in California. It is glabrous, resinous to the feeling, with lanceolate leaves from three to six inches long, irregularly more or less serrate, sometimes entire, whitened beneath, between the reticulations, by a minute and close tomentum, above glabrous. The corolla is half an inch long, tubular funnel-form; the calyx is about one-sixth of an inch long, and sparsely hirsute. The leaf structure has been studied by F. W. Ritter. (See *A. J. P.*, 1895, 565.)

E. tomentosum, which grows often along with *E. californicum*, especially in the southern part of California, is readily distinguished by its dense coat of short villous hairs, whitish or rusty-colored with age. It is also a larger shrub than *E. californicum*, has its corolla somewhat salver-form, and its leaves oblong or oval, and obtuse.

Properties.—The leaves of eriodictyon have already been sufficiently described, but they are further characterized by the U. S. Pharmacopœia as "usually occurring in fragments; entire leaf oblong-lanceolate, 5 to 15 Cm. long and 1 to 3 Cm. broad, acute at the apex, narrowed below into a short, broad petiole, the margin more or less incurved, entire or irregularly serrate, or crenate-dentate; upper surface yellowish-green, smooth, covered with a brownish resin; lower surface whitish or yellowish-white, conspicuously reticulated and densely tomentose; brittle, but flexible in a damp and warm atmosphere; odor somewhat aromatic; taste balsamic and sweetish." *U. S.* H. S. Wellcome (*Pharm.*, 1876, p. 73) found the drug to contain two aromatic resins, while an aqueous infusion of leaves which had been exhausted by alcohol yielded an intensely bitter extract. According to the analysis of Chas. Mohr (*A. J. P.*, 1879, 549), it contains tannic acid and 8 per cent. of an acrid, bitter resin, upon which its activity is believed to depend, also a minute quantity of volatile oil. R. Rother describes (*A. J. P.*, 1887, p. 225) an acid resin which forms with bases quite soluble salts. The acid resin was obtained at the conclusion of the spontaneous volatilization of the several solvents as a green-yellow transparent mass. Thal (*Ph. Z. R.*, 1883, p. 209) showed the presence of *ericolin*, $C_{34}H_{56}O_{21}$.

Uses.—Eriodictyon has long been used in California as a bitter tonic, and also as a stimulant balsamic expectorant. There is considerable testimony to its usefulness in *asthma, chronic bronchitis*, and allied conditions; also in chronic inflammation of the genito-urinary tract. Attention has been called by Kier to its remarkable power of disguising the taste of quinine. It is best exhibited in the form of the official fluidextract, the dose of which is one-half to one drachm (1.8 to 3.75 Cc.); a solid extract has been made, which may be given in doses of from five to fifteen grains (0.32 to 1.0 Gm.). In cases of asthma, eriodictyon is often used by smoking. The aromatic syrup is well adapted as a vehicle for quinine.

Dose, fifteen to sixty grains (1.0 to 3.9 Gm.).

Off. Prep.—Fluidextractum Eriodictyi, *U. S.*

EUCALYPTI GUMMI. Br.

EUCALYPTUS GUM

(eū-cạ-lĭp′tī gŭm′mi)

Australian or Eucalyptus Kino; Red Gum.

"A ruby-colored exudation, or so-called red gum, from the bark of Eucalyptus rostrata, *Schlecht*, and some other species. Imported from Australia." *Br.*

A kino-like exudation is obtained in Australia from various species of Eucalyptus, but the commercial is chiefly yielded by *E. rostrata*, which occurs over a wide area along watercourses in Australia and New South Wales. It is a large, gregarious tree, with almost linear-pointed leaves and shining bark, and is especially characterized by the long beak upon the operculum of its seed vessel. The gum is obtained by cutting the tree, inserting a piece of bent tin, and catching the red, thick liquid in a vessel. The average yield is said to be about one quart per tree. In a few days the liquid hardens into a kino-like mass.

Red gum occurs in commerce in grains or small masses of a purplish-red, ruby-red, or garnet color, closely resembling ordinary kino, but somewhat more brilliant, with a distinctly bitterish taste, tough, and adhering to the teeth. It does not equal kino in astringency. From 80 to 90 per cent. of it is soluble in cold water, forming a neutral solution. It is almost entirely soluble in alcohol (90 per cent.). For further description, see "Australian Kino," under *Kino*. In the analyses made by J. H. Maiden, red gum yielded about 4.5 per cent. of tannic acid. (*A. J. P.*, 1897.) It is used for *diarrhœas* of relaxation, and other affections for which kino has been employed, and is also largely employed as the basis of lozenges and gargles.

Dose, from two to ten grains (0.13 to 0.65 Gm.).

Off. Prep.—Trochiscus Eucalypti Gummi, *Br.*

EUCALYPTOL. U. S.

EUCALYPTOL [Cineol]

(eū-cạ-lĭp′tŏl)

$C_{10}H_{18}O = 152.98$

"An organic oxide (cineol), obtained from the volatile oil of *Eucalyptus Globulus* Labillardiére (Fam. *Myrtaceæ*), and from other sources. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Eucalyptol, *Fr. Cod.*; Cinéol, Terpane, Cajeputol, *Fr.*; Terpan, *G.*; Eucaliptol, *Sp.*

This was a new official liquid of the U. S. P. 1890. In the distillation of eucalyptus leaves, the portion which comes over between 170° C. (338° F.) and 178° C. (352.4° F.) is set aside as crude eucalyptol. To obtain it pure a redistillation from potassium hydroxide or calcium chloride is necessary. It is very liquid, nearly colorless, with a strong, aromatic, camphoraceous odor, is slightly soluble in water, but very freely soluble in alcohol. Nitric acid produces with it a crystallizable acid; by the action of phosphoric anhydride (*J. P. C.*, 4e sér., xii. 204) it is converted into *eucalyptene*, $C_{10}H_{16}$, a substance allied to cymene, and *eucalyptolen*.

C. Jahns (*A. J. P.*, 1885, p. 237) gave the formula $C_{10}H_{18}O$ to eucalyptol, and showed it to be identical with cajuputol, or, as it is now generally known, *cineol*. Wallach (*Ann. Ch. Ph.*, 248, pp. 278 to 283) showed that the oil from *E. Globulus* contained cineol (eucalyptol) and *dextro-pinene*, while that from *E. amygdalina*, Labill., contained cineol and *lævo-phellandrene*. (See *Eucalyptus*.)

The U. S. Pharmacopœia describes it as follows: "A colorless liquid, having a characteristic, aromatic, and distinctly camphoraceous odor, and a pungent, spicy, and cooling taste. Specific gravity: 0.925 at 25° C. (77° F.). Soluble in all proportions in alcohol. Boiling point: 176° to 177° C. (348.8° to 350.6° F.). Eucalyptol is optically inactive (distinction from the *oil of eucalyptus* and *many other volatile oils*). When exposed to a temperature somewhat below 0° C. (32° F.) it solidifies to a mass of colorless, needle-shaped crystals, which liquefy at —1° C. (30.2° F.). If 1 Cc. of Eucalyptol be placed in a freezing mixture and an equal volume of phosphoric acid be gradually added, a solid white crystalline mass of cineolphosphoric acid should result, and if warm water be then added the cineol will separate. If 5 Cc. of Eucalyptol be shaken with 5 Cc. of sodium hydroxide T.S., it should not diminish in volume. Its alcoholic solution should be neutral to litmus paper, and if to 5 Cc. of this solution a drop of ferric chloride T.S. be added, there should not be produced a brownish or violet color (absence of *phenols*)." *U. S.*

Uses.—Eucalyptol has been used with good results, instead of oil of eucalyptus, as a stimulant expectorant in *catarrhal pneumonia*, chronic *bronchitis*, *bronchorrhœa*, and other catarrhal conditions of the respiratory mucous membrane. Its vapor volatilized with steam in an inhaling apparatus is efficient. It has also been employed in chronic *inflammation* of the *genito-urinary* mucous membrane, and locally as an antiseptic dressing to *ulcers*, and as a counter-irritant in *neuralgia* and *rheumatism*.

Dose, five to ten minims (0.3 to 0.6 Cc.) four to six times a day, best administered in capsules. Its solution in fatty oil has been used hypodermically.

Off. Prep.—Liquor Antisepticus, *U. S.*

EUCALYPTUS. U. S.

EUCALYPTUS

(eū-cą-lŷp'tŭs)

"The dried leaves of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*), collected from the older parts of the tree." *U. S.*

Blue Gum-tree Leaves, Australian Fever-tree Leaves, Eucalyptus Leaves; Eucalyptus, *Fr. Cod.*; Feuilles d'Eucalyptus, *Fr.*; Eucalyptusblätter, *G.*; Eucalitto, *It.*; Eucalipto (Hoja de), *Sp.*

The genus Eucalyptus is composed of evergreens, most of them large trees, principally known as *Gum trees*, *Woolly butts*, *Iron barks*, etc., natives of Australia and Tasmania, forming, it is stated, about three-fourths of the whole vegetation of those countries. At least one hundred and forty species have been described, but there seems to be much obscurity in regard to the specific distinction of the various forms.[1]

Most of the species do not require excessive heat for their perfecting, and some of them are able to resist moderate frosts. Over forty species are being grown successfully in the United States, and in the neighborhood of Los Angeles and other points in California a pure oil is said to be commercially produced. On account of the rapidity of their growth and the hardness and indestructibility of their timber, many of the species are very valuable for economic purposes. A number of the species are said to be cultivated in the Southwest as a source of honey. (See *Bulletin No. 35 of the U. S. Bureau of Forestry.*)

E. Globulus, Labill.; *B. & T.* ii. 109.—The young operculum conical, the length of the four-sided cupule, the adult depressed and mucronate in the middle; axillary peduncles very short, one-flowered; leaves alternate, lanceolate, subfalcate.

According to Albert Schneider, the tree *E. Globulus* produces two distinct leaf forms. Of these the earlier are comparatively thin, rather large, ovate and cordate at the base, and are almost free from medicinal properties, while the so-called isolated leaves, which appear later, are thick, sickle-shaped, pointed, and not cordate at the base. (*P. J.*, lix. 191.)

This is one of the largest known trees, attaining sometimes a height of 300 or even 350 feet, with a smooth, ash-colored bark; leaves a foot in length, and varying, according to age, from a glaucous white to a bluish-green color; and large pinkish-white axillary flowers, sometimes single, sometimes in clusters. Although its wood is very resinous, hard, and durable, the tree is remarkable for the rapidity of its growth, reaching, under favorable circumstances, fifty feet of height in five or six years. It flourishes best in valleys having a rich, moist soil, and has very

[1] See Bentham, *Flora Australiensis;* Baron F. von Mueller's *Eucalyptographia*, 1879 to 1884. Baker and Smith (*A Research on the Eucalypts*, Sydney, 1902), arrange the species in seven different groups, according to the chemical characteristics of the oils which they produce.

It is stated that the leaves of the *E. rebaudianum*, of Paraguay, are used in that country in place of sugar, which they exceed in sweetening power.

largely been naturalized in semi-tropical countries, partly on account of its economic value, but chiefly because of the reputation it enjoys as a means of overcoming malaria. Its sanitary powers appear to be established, numerous notoriously miasmatic stations and districts having been rendered healthful by its growth. It is probable that the destruction of the miasma is due not so much to emanations from the tree as to the fact that it evaporates water so rapidly from its innumerable large leaves as to drain the swamps and marshes in which it is planted. It is possible, however, that the large amount of volatile oil which must escape from it has some effect, and it is even affirmed (*A. J. P.*, 1875, p. 423) that the parasitic phylloxera will not attack grape-vines growing near it.

The eucalyptus oil of commerce is, indeed, composed chiefly of the oils of *E. amygdalina* and *E. dumosa*, which yield a very much larger product than does the official species. The oils of *E. piperita* and *E. hæmastoma* have a peppermint odor, and that of *E. citriodora* a citron-like odor, while the oil of *E. staigeriana* exactly resembles the oil of verbena; it is probable that these oils will come into commerce for the purposes of the perfumer.

Properties.—The leaves are the official portion of the plant and are officially described as follows: "Petiole twisted, 2 to 3 Cm. long; blade lanceolately scythe-shaped, from 15 to 30 Cm. long, 2 to 4 Cm. broad, tapering above, rounded or very abruptly contracted at the oblique base, coriaceous, pale green, pellucid-punctate; venation inconspicuous, anastomosing near the entire margin; odor aromatic and somewhat camphoraceous; taste aromatic, bitter, and cooling." *U. S.*

In March, 1870, Cloez (*J. P. C.*, 4e sér., xii. 201) reported an elaborate chemical study of the eucalyptus leaves, and his results have been substantially confirmed by Debray (*De l'Eucalyptus Globulus*, Paris, 1872), Rabuteau (*Mém. de l'Académie*, Nov. 1872), and Broughton (*P. J.*, 3d ser., iii. 463). Cloez found, besides chlorophyll, resin, tannin, and inert substances, an essential oil, upon which the virtues of the drug appear to depend. Of this oil the fresh leaves afforded 2.75 parts per hundred, the recently dried leaves 6 parts; leaves which had been kept some time yielded a much smaller percentage. In the distillation, the oil for a time comes over freely at from 170° C. (338° F.) to 178° C. (352.4° F.); subsequently another portion of oil distils at 188° C. (370.4° F.) to 190° C. (374° F.), and finally a very minute portion does not volatilize until the temperature reaches 200° C. (392° F.). Cloez believes the oil to be composed of two camphors, differing in their volatility. The bulk of the oil yielded is the portion first distilled; to this Cloez has given the name of *eucalyptol*, or, as it is now also called, *cineol*, $C_{10}H_{18}O$. (See previous article.) Gildemeister and Hoffmann (*Aetherische Oele*, 1899, p. 690) divide the eucalyptus oils into 5 groups according to their constituents, viz: Group 1, Cineol (or Eucalyptol) containing oils, of which group *Eucalyptus Globulus* is the most important; Group 2, Citronellal containing oils, of which group *Eucalyptus maculata* is the most important; Group 3, Citral containing oils, of which *E. staigeriana*, F. von Muell., is the typical example; Group 4, Peppermint smelling oils, of which *Eucalyptus piperita* is an example; and Group 5, Less known oils of varying odor.

Schimmel & Co. (*Semi-Annual Report*, April, 1897) gave a list of some fifteen varieties of eucalyptus oils from the different Eucalyptus species. In their report for October, 1904, they give the sources and state the properties and components of 109 different eucalyptus oils obtained by them from Baker and Smith, Curators of the Technological Museum of Sydney, N. S. W.

According to Duquesnel, the oil of eucalyptus is adulterated—with alcohol, to be detected by means of fuchsin, which is insoluble in the pure oil but soluble in that containing even a very small percentage of alcohol; with fixed oil, to be detected by boiling with water, when the fixed oil remains on the surface; with essential oil of copaiba or turpentine, to be detected by means of the boiling point, that of eucalyptol being 170° C. (338° F.), that of oil of turpentine 155° C. (311° F.), that of oil of copaiba 260° C. (500° F.). (*J. P. C.*, 4e sér., xvi. 45.)

Uses.—Whatever medicinal virtues eucalyptus possesses beyond astringency reside in the volatile oil. This when applied locally acts as a powerful irritant. When taken internally in doses of from 20 to 30 drops, it causes increased rapidity of pulse and general excitation, with restlessness and increased venereal appetite, usually followed by a feeling of calmness and repose, ending in sleep. In some cases, disturbance of the bowels, fever, constitutional disturbance, and even symptoms of cerebral congestion have been produced. In animals small doses produce the same effect as in man, and after large doses symptoms of general depression are manifested by falling of the arterial pressure, progressive diminution of temperature, muscular weakness deepening into paralysis, loss of sensibility, irregular respiration, and finally death from failure of respiration. Upon man, when taken in sufficient quantity, the oil exerts a similar influence. In a case noted by Gimbert, 80 drops of the oil produced in an old man a feeling of great internal heat, followed by almost complete loss of power and of feeling in the limbs, and after 75 drops Binz noted somewhat similar phenomena. The palsy produced by toxic doses is due to a direct action upon the spinal cord. Taken internally, it is eliminated by the breath, to which it imparts its odor, and also, in a condition of oxidation, by the kidneys, to the secretion of which it gives a strong odor of violets. Gimbert found that in rabbits it augmented to a marvelous extent the excretion of urea. The reputation once enjoyed

by the oil of eucalyptus as being a valuable antiperiodic, antispasmodic and antineuralgic was not well founded. Its chief importance in practical medicine is as a stimulant expectorant in advanced stages of *acute bronchitis* and in *chronic bronchitis*. It has been especially praised in *asthma*, given internally or preferably by inhalation by means of cigarettes, which may be made by rolling up the dried leaves, or the vapor from boiling water containing the oil may be inhaled. It has also been used in chronic *genito-urinary inflammations* and as a local stimulant, antiseptic application, in *skin diseases*. Although, as shown by Binz and Gimbert, it acts distinctly upon low forms of life, it is very rarely if ever used as an antiseptic. Various formulas have been published for tinctures, fluidextracts, etc., but either the oil or eucalyptol should be preferred.

Dose, of eucalyptus, ten to thirty grains (0.65 to 2 Gm.); of the oil, five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Fluidextractum Eucalypti, *U. S.*

EUGENOL. U. S.

EUGENOL [Synthetic Oil of Cloves]

(eū'ǧe-nŏl)

$C_{10}H_{12}O_2 = 162.86$

"An unsaturated, aromatic phenol [$C_6H_3(OH)(OCH_3).C_3H_5$ 4 : 3 : 1], obtained from Oil of Cloves and other sources. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Allylguaiacol. Allylmethylpyrocatechol; Eugenol, *Fr.*; Oleum Caryophyllorum, *P. G.*; Eugenol, *G.*

Eugenol is extracted on a large scale from oil of cloves and utilized as the starting point in the manufacture of artificial vanillin (see *Vanillinum*). It is officially described as "a colorless, or pale yellow, thin liquid, having a strongly aromatic odor of cloves, and a pungent and spicy taste. Exposure to air causes it to become darker and thicker. Specific gravity: 1.066 to 1.068 at 25° C. (77° F.). Eugenol is miscible with alcohol in all proportions, and should be soluble in 2 parts of 70 percent. alcohol. Boiling point: 251° to 253° C. (483.8° to 487.4° F.). It is optically inactive. When 1 part of Eugenol is dissolved in 12 parts of sodium hydroxide T.S. and 18 parts of water are added, a clear solution should result, which becomes turbid when exposed to the air. A mixture of 1 part of Eugenol and 20 parts of hot water should redden litmus paper very slightly. Five Cc. of the cold, clear filtrate from this mixture, upon the addition of 1 drop of ferric chloride T.S., should show a transient grayish-green color, but not a blue or violet color (absence of *phenol*)." *U. S.*

Uses.—Eugenol may be used for the same purposes as oil of cloves.

Dose, two to five minims (0.12 to 0.3 Cc.).

EUONYMUS. U. S. (Br.)

EUONYMUS [Wahoo]

(eū-ŏn'y-mŭs)

"The dried bark of the root of *Euonymus atropurpureus* Jacquin (Fam. *Celestraceæ*)." *U. S.* "The dried root bark of Euonymus atropurpureus, *Jacquin*." *Br.*

Euonymi Cortex, *Br.*; Euonymus Bark; Cortex Euonymi; American, Indian Arrow-wood; Ecorce d'Evonymus, *Fr. Cod.*; Spindlebaum, Pfaffenhütchen, Spillbaumrinde, *G.*

Euonymus atropurpureus, Willd., *Sp. Plant.* i. 1132; Gray's *Manual*, p. 81; figured in Griffith's *Med. Bot.*, p. 219.—The plant has been named variously *wahoo*, *spindle-tree*, and *burning-bush*. It is a tall, erect shrub, with quadrangular branchlets, and opposite, petiolate, oval-oblong, pointed, serrate leaves. The flowers, which stand in loose cymes on axillary peduncles, are small and dark purple, with sepals and petals commonly in fours. The capsule or pod is smooth and deeply lobed. The plant is indigenous, growing throughout the Northern and Western States, and sometimes cultivated for the beauty of its crimson fruit.

The plants belonging to this genus are shrubs or small trees, presenting in the autumn a striking appearance from the rich red color of their fruit, which has obtained for them the name of *burning-bush*. *E. americanus* and *E. europæus* have been cultivated in gardens as ornamental plants. Two or more of the species have been used in medicine. Their properties are probably similar, if not identical. Grundner, who experimented with the fruit of *E. europæus*, found it to have no other effect than that of a diuretic. (*Ph. Cb.*, 1847, p. 873.) An oil expressed from the seeds is used in Europe for the destruction of vermin in the hair, and sometimes also as an application to old sores. (*Ibid.*, 1851, p. 641.) Griffith says that the seeds of this and other species are purgative and emetic, and that the leaves are poisonous to sheep and other animals feeding on them. He states also that the inner bark of *E. tingens* is beautifully yellow, and used in India for dyeing, and in diseases of the eye. (*Med. Bot.*, p. 220.) It is probable that much of the wahoo of our drug stores has been obtained from *E. americanus*, which is distinguished from *E. atropurpureus* by its rough, warty, depressed pods, and almost sessile, thickish leaves. This bark was introduced into the last British Pharmacopœia in the supplement.

Properties.—The dried bark is in thin pieces, whitish with a darker grayish epidermis, brittle, of a feeble, peculiar, not disagreeable odor, and a bitterish slightly sweetish taste, and somewhat pungent after-taste. "In quilled or curved pieces, 3 to 7 Cm. long and 0.5 to 5 Mm. thick; outer surface ashy or pale brownish-gray, with small, dark, scaly patches of soft cork; inner surface whitish or light brown, smooth; fracture short, whitish, with projecting, silky, modified

bast fibres; odor distinct; taste sweetish, bitter and somewhat acrid." *U. S.* It imparts its virtues to water and alcohol. Analyzed by Wm. T. Wenzell, it was found to contain a bitter principle which he named *euonymin*, asparagin, a soft resin, a crystallizable resin, a yellow resin, a brown resin, fixed oil, wax, starch, albumen, glucose, pectin, and various salts of organic and inorganic acids. Euonymin was obtained by agitating with chloroform a tincture made with diluted alcohol, separating the chloroformic solution and allowing it to evaporate spontaneously, treating the residue with ether, dissolving what was left in alcohol, adding lead acetate to the solution, filtering, precipitating the lead with hydrogen sulphide, and evaporating. The euonymin obtained was uncrystallizable, intensely bitter, soluble in water and alcohol, and neutral in its reactions. It was abundantly precipitated from its solution by lead subacetate and phosphomolybdic acid. (*A. J. P.*, 1862, p. 387.) W. P. Clothier found the bark to yield no volatile oil on distillation. According to the same writer, if a concentrated tincture be poured into water, a dark yellow substance will be thrown down, containing resin and fixed oil, which is the *euonymin* of the eclectics,[1] very improperly so named, as, though it contains a portion of the active principle, it is a very complex substance. Clothier found the bark to purge actively without griping. (*Ibid.*, 1861, p. 491.) Frank V. Cassaday (*A. J. P.*, 1889, p. 284) found 1.30 per cent. of volatile oil and resin, 1.48 per cent. of *euonic acid* and resin, 2.10 per cent. of euonymin and resin, together with the usual plant constituents. Kubel has discovered in the fresh inner bark of *E. europæus* a saccharine, crystallizable substance, closely resembling mannite, but differing in its crystalline form and in its melting point. He calls it *euonymite*. (*J. P. C.*, Dec. 1862, 523.)

Uses.—This bark was first introduced into notice, as a remedy for *dropsy*, under the name of Wahoo,[2] by George W. Carpenter. In some cases it acts as a mild cathartic, but at other times it fails to produce purgation. We have also seen distinct evidences of an irritant influence upon the gastro-intestinal mucous membrane. Cholagogue properties have been ascribed to it, and probably with correctness, as in the experiments of Rutherford it was found to act most powerfully in causing hepatic secretion in dogs, and in some clinical studies we have made it seemed to have a similar action on man. The fluidextract of it is an efficient preparation, and may be given in doses, as a purgative, of one to two fluidrachms (3.75 to 7.5 Cc.); as a laxative, of half a fluidrachm to one fluidrachm (1.8 to 3.75 Cc.). (See also *Extractum Euonymi, U. S.*, and *Extractum Euonymi Siccum, Br.*)

Dose, of euonymus, five to fifteen grains (0.32 to 1.0 Gm.).

Off. Prep.—Extractum Euonymi, *U. S.* (from fluidextract) (*Br.*); Fluidextractum Euonymi, *U. S.*

[1] For an examination of commercial *euonymin* (the eclectic resinoid) by Paul Thibault, see *N. R.*, 1883, 294.

[2] The name of Wahoo or Waahoo (pronounced (*Wawhoo*) was given to it by the Indians. The same name has also been applied to *Ulmus alata*, of the Southern States, and has thus led to mistakes.

EUPATORIUM. U. S.

EUPATORIUM [Boneset, Thoroughwort]

(eū-pa-tō′rĭ-ŭm)

"The dried leaves and flowering tops of *Eupatorium perfoliatum* Linné (Fam. *Compositæ*)." *U. S.*

Herba Eupatorii Perfoliati; Indian Sage, Thorough-stem, Cross-wort, Thorough-wax, Sweating Plant; Herbe d'Eupatoire perfoliée, Herbe à fièvre, Herbe parfaite, *Fr.*; Durchwachsener Wasserhanf or Wasserdost, *G.*

Of this numerous genus, comprising not less than thirty species within the limits of the United States, most of which probably possess analogous medicinal properties, *E. perfoliatum* alone now holds a place in our national Pharmacopœia, *E. purpureum* and *E. teucrifolium* having been discarded at the revision of 1840. They merit, however, a brief notice, if only for their former official rank.

Eupatorium purpureum, or *gravel root*, is a perennial herbaceous plant, with a purple stem, five or six feet in height, and furnished with ovate-lanceolate, serrate, rugosely veined, slightly scabrous, petiolate leaves, placed four or five together in the form of whorls. The flowers are purple, and consist of numerous florets contained in an eight-leaved involucre. It grows in swamps and other low grounds, from Canada to Florida, and flowers in August and September. The root has, according to Bigelow, a bitter aromatic and astringent taste, and is said to be diuretic. Its vulgar name boneset indicates the popular estimation of its virtues. J. U. Lloyd found in it an apparently new, yellow, neutral, crystalline principle, *euparin*. (*A. J. P.*, 1890.) This euparin, with a number of derivatives, has been prepared by C. C. Mauger (*A. J. P.*, 1894, 120) and analyzed. The formula $C_{12}H_{11}O_3$ is assigned to it.

Eupatorium verbenæfolium, Michx., *Flor. Am.* ii. 98.—*E. teucrifolium*, Willd., *Sp. Plant.* iii. 1753.—*E. pilosum*, Walt., *Flor. Car.*, 199, commonly called *wild horehound*, is also an indigenous perennial, with an herbaceous stem, which is about two feet high, and supports sessile, distinct, ovate, acute, scabrous leaves, of which the lower are coarsely serrate at the base, the uppermost entire. The flower-heads are small, white, composed of five florets within each involucre, and arranged in the form of a corymb. The plant grows in low wet places from New England to Georgia, and abounds in the Southern States. It is in flower from August to November. The whole herb is used. In sensible

properties it corresponds with *E. perfoliatum,* though less bitter and disagreeable, and has been used for similar purposes and in like manner. *E. incarnatum* and *E. aromaticum* are said to contain an aromatic principle similar to if not identical with coumarin, obtained by Guibourt from *Dipteryx odorata,* or Tonka bean. (See *P. J.,* Oct. 1874, 303.) The roots of *E. aromaticum* are said to be sold in the Western United States under the name of *white snakeroot. E. cannabinum,* of Europe, the root of which was formerly used as a purgative, and *E. triplinerve,* Vahl (*E. Aya-pana,* Vent.), of Brazil, the leaves of which at one time enjoyed a very high reputation, have fallen into neglect. The *Aya-pana* is an aromatic bitter, like *E. perfoliatum,* but weaker, and is said to be still occasionally met with in European commerce. (*A. J. P.,* 1887, 154; *Ph. Era,* 1898, 293.) *E. villosum* is used in Jamaica, under the name of *bitter-bush,* in the preparation of beer, as a tonic, and as a stimulant in low zymotic diseases. (*P. J.,* Oct. 1866; *A. J. P.,* 1887, 155.) *E. collinum* is included in the Mexican Pharmacopœia.

Eupatorium perfoliatum, Willd., *Sp. Plant.* iii. 1761; Bigelow, *Am. Med. Bot.,* i. 33; Barton, *Med. Bot.,* ii. 125.—*E. connatum,* Michx.—*E. salviæfolium,* Linné.—*Thoroughwort,* or *boneset,* is an indigenous perennial plant, with numerous herbaceous stems, which are erect, round, hairy, from two to five feet high, simple below, and trichotomously branched near the summit. "Usually occurring in fragments; leaves opposite, the pair united at the base, from 8 to 20 Cm. long and 1.5 to 5 Cm. broad, tapering regularly from near the base to an acute apex, crenate-serrate, rugosely veined, rough and bright green above, yellowish-gray-green, tomentose and resinous-dotted beneath; flower-heads small, numerous, corymbed, with a campanulate involucre of lance-linear imbricated scales and with from 10 to 15 tubular yellowish-white florets, having a bristly pappus in a single row; odor faintly aromatic; taste strongly bitter." *U. S.* The leaves serve to distinguish the species at the first glance. They may be considered either as perforated by the stem, *perfoliate,* or as consisting each of two leaves, joined at the base, *connate.* In the latter point of view, they are opposite and in pairs, which decussate each other at regular distances upon the stem; in other words, the direction of each pair is at right angles with that of the pair immediately above or beneath it. They are narrow in proportion to their length, broadest at the base where they coalesce, gradually tapering to a point, serrate, much wrinkled, paler on the under than on the upper surface, and beset with whitish hairs, which give them a grayish-green color. The uppermost pairs are sessile, not joined at the base. The flowers are white, numerous, supported on hairy peduncles, in dense corymbs, forming a flattened summit. The involucre, which is cylindrical and composed of imbricated, lanceolate, hairy scales, encloses from twelve to fifteen tubular florets, having their border divided into five spreading segments. The anthers are five, black, and united into a tube, through which the bifid filiform style projects.

This species of Eupatorium inhabits meadows, the banks of streams, and other moist places, growing generally in bunches, and abounding in almost all parts of the United States. It flowers from the middle of summer to the end of October. All parts of it are active, but the herb only is official. It has a faint odor, and a strongly bitter, somewhat peculiar taste. The virtues of the plant are readily imparted to water and alcohol. W. Peterson found it to contain a peculiar bitter principle, chlorophyll, resin, a crystalline matter of undetermined character, gum, tannin, yellow coloring matter, extractive, lignin, and salts. (*A. J. P.,* xxiii. 210.) Bickley found also albumen, gallic acid, and signs of volatile oil. (*Ibid.,* xxvi. 495.) Peter Collier, chemist of the Department of Agriculture, submitted it to analysis, finding 18.84 per cent. of bitter extractive, which he considers the constituent of medicinal importance, 2.87 per cent. of an indifferent crystalline substance, obtained from the alcoholic extract, and traces only of a volatile oil. (*Ibid.,* 1879, p. 342.) George Latin (*A. J. P.,* Aug. 1880) found a glucoside, *eupatorin,* and a crystallizable body of the nature of a wax. O. F. Dana, Jr., obtained 3.80 per cent. of extract with petroleum benzin; 4.60 per cent. with ether; 33.80 per cent. with alcohol; 24.80 per cent. with water; 5.80 per cent. with alkali. (*A. J. P.,* 1887, p. 229.) A number of analyses of *E. perfoliatum* have been published within the last decade by Dana, Latin, Franz, and Kaercher, but neither the crystalline principle nor any of its salts had been analyzed until Shamel (*Am. Chem. J.,* 1892, p. 224) published an analysis of the nitrate. He gives for it the formula $C_{20}H_{25}O_{36}HNO_3$.

Uses.—Eupatorium is tonic, diaphoretic, and in large doses emetic and aperient, and was at one time employed as an antiperiodic. Given in warm infusion, so as to produce vomiting or copious perspiration, at the commencement of *influenza,* of *muscular rheumatism* or a *general cold,* it will sometimes abort the attack. As a tonic it is given with advantage in *dyspepsia,* general debility, and other cases in which the simple bitters are employed. H. S. Wilkins has found the infusion useful in the expulsion of *tapeworm.* (*A. J. P.,* 1874, p. 295.)

With a view to its tonic effects, it is best administered in substance, or cold infusion. The aqueous extract has been used with advantage. When the diaphoretic operation is required in addition to the tonic, the infusion should be administered warm, and the patient remain covered in bed. As an emetic and cathartic, a strong decoction, prepared by boiling an ounce with three half-pints of water to a pint, may be given in doses of from four fluidounces to a half-pint (120 to 240 Cc.), or more. (See *Fluidextractum Eupatorii.*)

Dose, twenty to thirty grains (1.3 to 2.0 Gm.).

Off. Prep.—Fluidextractum Eupatorii, *U. S.*

EXTRACTA.

EXTRACTS

(ęx-trăc'tą)

Extraits, *Fr.;* Extrakte, *G.;* Estratti, *It.;* Extractos, *Sp.*

Extracts, as the term is employed in the Pharmacopœias, are solid preparations, resulting from the evaporation of the solutions of vegetable principles, obtained either by exposing a dried drug to the action of a solvent, or by expressing the juice from a fresh plant. A distinction was formerly made between those prepared from the infusions, decoctions, or tinctures, and those from the expressed juices of plants, the former being called *Extracta,* the latter *Succi Spissati,* but the distinction has been generally abandoned. There is no such essential difference between these two sets of preparations as to require that they should be separately classed, and something is gained in the simplicity of nomenclature, as well as of arrangement, which results from their union.

The composition of extracts varies with the nature of the vegetable, the character of the solvent, and the mode of preparation. The object is generally to obtain as much of the active principle of the plant with as little of the inert matter as possible, though sometimes it may be desirable to separate two active ingredients from each other, when their effects upon the system are materially different; this may be accomplished by employing a menstruum which, while it dissolves one, leaves the other untouched. The proximate principles most commonly present in extracts are gum, sugar, starch, tannin, extractive, coloring matter, salts, and the peculiar principles of plants, to which, when an alcoholic solvent is employed, may usually be added resinous substances, fatty matter, and frequently more or less essential oil, gum and starch being excluded when the menstruum is pure alcohol. Of these substances, as well as of others which, being soluble, are sometimes necessarily present in extracts, we have taken occasion to treat under various heads in this commentary. There is one, however, which, from its supposed almost uniform presence in this class of preparations, and from the influence it is thought to exert upon their character, deserves particular consideration in this place. We allude to *extractive,* or, as it is sometimes called, *extractive matter.*

It has long been observed that in most vegetables there is a substance, soluble both in water and alcohol, which, in the preparation of extracts, undergoes chemical change during the process of evaporation, imparting to the liquid, even if originally limpid, first a greenish, then a yellowish brown, and ultimately a deep brown color, and becoming itself insoluble. This substance, originally called *saponaceous matter* by Scheele, afterwards received the more expressive name of *extractive,* derived from its frequent presence in extracts. Its existence as a distinct principle is denied, or at least doubted, by some chemists, who consider the phenomena supposed to result from its presence as depending upon the mutual reaction of other principles, and in relation to Peruvian bark it appears to have been proved that the insoluble matter which forms during its decoction in water is a compound of starch and tannin. A similar compound must also be formed in other cases when these two principles coexist; but they are not always present in the same vegetable, nor can all the changes which have been attributed to extractive be accounted for by their union, even when they are present; so that, until further light is shed on the subject, it is best to admit the existence of a distinct class of substances, which, though not the same in all plants, possess sufficient identity of character to be entitled, like sugars, resins, etc., to a generic name. The most important property of extractive is its disposition to pass, by the influence of atmospheric air at a high temperature, into an insoluble substance. If a vegetable infusion or decoction be evaporated in the open air to the consistence of an extract, then diluted, filtered, and again evaporated, and the process repeated so long as any insoluble matter is formed, the whole of the extractive will be separated from the liquid, while the other ingredients may remain. If chlorine be passed through an infusion or decoction, a similar precipitate is formed with much greater rapidity. The change is usually ascribed to the absorption of oxygen by the extractive, which has, therefore, been called, in its altered condition, oxidized extractive; but De Saussure ascertained that, though oxygen is absorbed during the process, an equal measure of carbon dioxide is given out, and the oxygen and hydrogen of the extractive unite to form water in such a manner as to leave the principle richer in carbon than it was originally. The name of oxidized extractive is, therefore, obviously incorrect, and Berzelius proposed to substitute for it that of *apotheme,* synonymous with deposit; apotheme seems to be similar in properties to *humin.* According to Berzelius, apotheme is not completely insoluble in water, but imparts a slight color to that liquid when cold, and is rather more soluble in boiling water, which becomes turbid upon cooling. It is still more soluble in alcohol, and is freely dissolved by solutions of the alkalies and alkaline carbonates, from which it is precipitated by acids. It has a great tendency, when precipitated from solutions, to unite with other principles, and to carry them along with it, thus acquiring properties somewhat different according to the source from which it is obtained. In this way also, even when the extractive of a plant is itself medicinally inert, its conversion into apotheme may be injurious by causing a precipitation of a portion of the active prin-

ciple, and in practical pharmaceutical operations this change should always, if possible, be avoided. With these preliminary views, we shall proceed to the consideration of the practical rules necessary to be observed in the preparation of extracts. We shall treat of the subject under the several heads of—1, the extraction of the soluble principles from the plant; 2, the method of conducting the evaporation; 3, the proper condition of extracts, the changes they are liable to undergo, and the best method of preserving them.

1. *Extraction of the Soluble Principles.*

There are two distinct modes of obtaining, in a liquid state, the principles which we wish to extract: 1, by expression alone; 2, by the agency of a solvent, with or without expression.

1. By Expression.—This method is applicable to recent vegetables. All plants cannot be usefully treated in this way, as many have too little juice to afford an appreciable quantity upon pressure, and of the succulent a considerable portion do not yield all their active principles with their juice. Succulent fruits, and various acrid and narcotic plants, are proper subjects for this treatment. The plants should be operated upon, if possible, immediately after collection. Battley of London, recommended that, if not entirely fresh, they should be revived by the immersion of the stalks in water for twelve or eighteen hours, and those only used which recover their freshness by this management. They should then be cut into pieces, and bruised in a stone mortar till brought to a pulpy consistence. When the plant is not very succulent, it is necessary to add a little water during this part of the process, in order to dilute the juice. After sufficient contusion, the pulp is introduced into a linen or canvas bag, and the liquid parts expressed. Brande states that light pressure only should be employed, as the extract is thus procured greener, of a less glutinous or viscid consistence, and, in his opinion, more active than when considerable force is used in the expression. (*Practice of Pharmacy.*) The juice thus obtained is opaque, and usually green, in consequence of the presence of green wax or chlorophyll, and of a portion of the undissolved vegetable fibre in minute division. By heating the juice to about 71.1° C. (160° F.) the albumen contained in it coagulates, and, involving the chlorophyll and vegetable fibre, forms a greenish precipitate. If the liquid be now filtered, it becomes limpid and nearly colorless, and is prepared for evaporation. The clarification, however, is not absolutely necessary, and is generally neglected. Sometimes the precipitate carries with it a considerable portion of the active principle, in which case it should be subsequently incorporated with the juice, when reduced by evaporation to the consistence of syrup. Ether added to the expressed juices of plants enables them to be kept long without injurious change. Lepage of Gisors, France, has kept the juice of belladonna in this way more than ten years, and found it, at the end of that time, to yield an extract identical in physical, chemical, and physiological properties with that obtained from the fresh juice. If this fact is found to be of general applicability, it will be of considerable importance, as enabling the pharmacist to supply himself at pleasure with extracts to be relied on, without reference to the season.

2. By Solution.—The active principles of dried vegetables can be extracted only by means of a liquid solvent. The menstruum usually employed is either water or alcohol, or a mixture of the two. Water, on account of its cheapness, is always preferred, when circumstances do not strongly call for the use of alcohol. It has the advantage, moreover, that it may be assisted in its action, if necessary, by a higher degree of heat than the latter. Pump water is often unfit for the purpose, in consequence of the quantity of its saline matter, which in some instances may exert an unfavorable influence on the active principle, and must always be left in the extract. Rain, river, or distilled water should be preferred. Alcohol is employed when the principles to be extracted are insoluble or but slightly soluble in water, as in the case of the resins; when it is desirable to avoid in the extract inert substances, such as gum and starch, which are dissolved by water and not by alcohol; when the heat required to evaporate the aqueous solution would dissipate or decompose the active ingredients of the plant, as the volatile oils or the active principles of sarsaparilla; when the reaction of the water itself upon the vegetable principles is injurious; and, finally, when the nature of the substance to be exhausted requires so long a maceration in water as to endanger spontaneous decomposition. The aqueous solution requires to be quickly evaporated, as this fluid rather promotes than counteracts chemical changes, while an alcoholic tincture may be preserved unaltered for an indefinite period. An addition of alcohol to water is sufficient to answer some of the purposes for which the former is preferable, and the employment of both fluids is essential, when the virtues of the plant reside in two or more principles, all of which are not soluble in either of these menstrua. In this case it is usually better to submit the vegetable to the action of the two fluids successively than of both united. Extracts obtained by the agency of water are called *aqueous extracts;* those by means of alcohol, undiluted or diluted, *alcoholic* or *spirituous extracts.* Sometimes the term *hydro-alcoholic* is applied to extracts obtained by the joint agency of alcohol and water.

The method of preparing the solution is not a matter of indifference. The drug should be thoroughly bruised, or reduced to a coarse powder, so as to allow the access of the solvent to all its parts, and yet not so finely pulverized as to prevent a ready precipitation of the undissolved or inactive portion. When water is alone employed, it has been customary to boil

the medicine for a considerable time, and, if the first portion of liquid does not completely exhaust it, to repeat the operation with successive portions until the whole of the active matter is extracted. This may be known by the sensible properties of the liquid, and by its influence upon reagents. But the boiling temperature produces the decomposition of many vegetable principles, or at least so modifies them as to render them inert, and the extracts prepared by decoction are usually less efficient than those made with a less degree of heat. From numerous experiments upon extracts, Orfila concluded that their virtues were less in proportion to the heat employed. It has, therefore, been recommended to substitute for decoction the process of maceration, digestion, or hot infusion, in the first of which the liquid acts without heat, in the second is assisted by a moderately increased temperature sustained for a considerable time, and in the third is poured boiling hot upon the vegetable matter and allowed to stand for a short period in a covered vessel. When the active principles are readily soluble in cold water, *maceration* is often preferable to the other modes, as starch, which is inert, is thus left behind; but in many instances the preparation would spoil before the extraction would be completed. By *digestion,* though the solvent power of water is moderately increased, the advantage is often more than counterbalanced by the increased disposition to spontaneous decomposition. *Hot infusion,* therefore, is to be preferred where the vegetable does not readily yield its virtues to cold water. It has the advantage, moreover, in the case of albuminous substances, that the albumen is coagulated, and thus prevented from increasing the bulk of the extract, without adding to its virtues. A convenient mode of performing this process is to introduce the solid material into a vessel with an opening near the bottom temporarily closed, or into a funnel having a notched cork in its mouth, then to pour on the boiling water, and, having allowed it to remain a sufficient length of time, to draw it off through the opening. This operation may be repeated until the water comes away without any obvious impregnation.

It is always desirable to obtain the solution in the first place as concentrated as possible, so as to prevent the necessity of long continued evaporation, which injures the extract. It is better, therefore, to incur the risk, both when decoction and infusion are employed, of leaving a portion of the active matter behind, than to obtain a very weak solution. When successive portions of water are employed, those which are least impregnated should be brought by evaporation to the strength of that first obtained before being mixed with it.

Sometimes the filtering of a turbid infusion or decoction, before evaporation, causes the resulting extract to keep better, by removing substances which, besides undergoing decomposition, may act as a ferment, and occasion the decomposition of the active matter of the extract.

When alcohol is employed as a menstruum, the vegetable should be macerated in it for one or two weeks, and care should be taken that the tincture be as nearly saturated as possible. The extraction may be hastened by substituting digestion for maceration, as the moderate heat employed, while it facilitates the action of the alcohol, has in this case no effect in promoting decomposition, and the influence of the atmospheric air may be excluded by performing the process in close vessels. When alcohol and water are both used, it is best, as a rule, to exhaust the substance with each separately, as the two menstrua require different modes of treatment. In whichever of these modes the extraction is effected, it requires the assistance of occasional agitation, and when the vegetable matter is very porous, and absorbs a large quantity of the solvent, expression must be resorted to.

Acetic acid has been introduced into use as a menstruum in the preparation of extracts. It is supposed to be a better solvent of the active principles of certain substances than either water or alcohol alone. According to Girolamo Ferrari, the acrid narcotics, such as aconite, hemlock, hyoscyamus, and stramonium, yield much stronger extracts with distilled vinegar than with water, and still stronger with alcohol to which strong acetic acid has been added. (*J. P. C.,* 3e sér., i. 239.) This acid is used in the preparation of the extracts of colchicum and nux vomica. Experiments have shown that strong acetic acid (60 per cent.) is a powerful solvent for the active properties of various drugs, particularly those which contain volatile oils, and in many cases a 10 per cent. acetic acid is an excellent menstruum for making extracts; for these the name *acetract* has been proposed. (*Proc. A. Ph. A.,* 1897, 416.) E. R. Squibb has used acetic acid largely for extracts. (*West. Drug.,* 1897, 123.)

Ether also is now used to a considerable extent in the preparation of certain extracts. Having the property of dissolving volatile oil and resin, and of evaporating at a temperature insufficient to volatilize the oil, it is admirably adapted for the preparation of extracts from those substances the virtues of which reside in the two principles referred to. An ethereal tincture is first prepared by the process of percolation, and the ether is then allowed to escape by spontaneous evaporation, or distilled off at a very moderate heat. The oleoresinous extracts thus obtained are usually of a thick fluid or semi-fluid consistence. Several of them now rank among the official preparations, in the U. S. P., under the title of *Oleoresinæ.*

The process of *percolation* has in this country been very advantageously applied to the preparation of extracts, both with water and spirituous menstrua. It has the following great advantages: 1, that it enables the soluble principles to be sufficiently extracted by cold water, thereby avoiding the injury resulting from heat in decoction and hot infusion; 2, that it effects the extraction much more quickly than can be

done by maceration, thereby not only saving time, but also obviating the risk of spontaneous decomposition; and, 3, that it affords the opportunity of obtaining highly concentrated solutions, thus diminishing the injurious effects of the subsequent evaporation. While thus advantageous, it is less liable in this particular case than in others to the objection of yielding imperfect results if not well performed, for, though an inexpert or careless operator may incur loss by an incomplete exhaustion of the substance acted on, and the extract may be deficient in quantity, it may still be of the intended strength and quality, which is not the case with infusions or tinctures unskilfully prepared upon this plan. In the U. S. P., all the extracts to which the process is applicable are prepared by percolation, and with merely sufficient previous maceration or digestion to thoroughly soften the tissues. In the Br. Ph., the process is applied, as it were, hesitatingly to some of the extracts, and withheld in others to which it seems equally appropriate. In the process of percolation the drug must first be reduced to the proper degree of fineness. The U. S. P. (8th Rev.) gives the following directions.

"*Fineness of Powder.*—The fineness of powder is expressed, in the Pharmacopœia, either by descriptive words (generally so in the case of brittle or easily pulverizable substances), or in terms expressing the number of meshes to a linear inch of the sieve through which the powder will pass. The corresponding values, in terms of metric measures of length, are added below in parentheses, but it has not been deemed advisable, in this revision, to substitute them in the text of the Pharmacopœia for those at present in use. The diameter of the wire (gauge number) used in making sieve cloth has an important influence upon the size of the mesh, and it is necessary to specify in each case the thickness of the wire.

These different forms of expression correspond to each other as follows:

A *very fine* powder	should pass through a sieve having 80 or more meshes to the linear inch (30 meshes to the centimeter) which should be made from gauge No. 38 wire—	= No. 80 powder.
A *fine* powder	should pass through a sieve having 60 meshes to the linear inch (24 meshes to the centimeter) which should be made from gauge No. 36 wire—	= No. 60 powder.
A *moderately fine* powder	should pass through a sieve having 50 meshes to the linear inch (20 meshes to the centimeter) which should be made from gauge No. 35 wire—	= No. 50 powder.
A *moderately coarse* powder	should pass through a sieve having 40 meshes to the linear inch (16 meshes to the centimeter) which should be made from gauge No. 33 wire—	= No. 40 powder.
A *coarse* powder	should pass through a sieve having 20 meshes to the linear inch (8 meshes to the centimeter) which should be made from gauge No. 28 wire—	= No. 20 powder.

In certain cases, powders of a different degree of fineness (*e.g.*, No. 30, No. 12) are directed to be taken." *U. S.*

"*Percolation,* as directed in the U. S. Pharmacopœia, consists in subjecting a substance or a mixture of substances, in powder, contained in a vessel called a percolator, to the solvent action of successive portions of a certain menstruum in such a manner that the liquid, as it traverses the powder in its descent to the receiver, shall be charged with the soluble portion of it, and pass from the percolator free from insoluble matter.

When the process is successfully conducted, the first portion of the liquid, or percolate, passing through the percolator, will be nearly saturated with the soluble constituents of the substance treated; and if the quantity of menstruum be sufficient for its exhaustion, the last portion of the percolate will be nearly free from color, odor, and taste, other than those of the menstruum itself.

Percolators.—The percolator most suitable for the quantities contemplated by this Pharmacopœia should be nearly cylindrical, or slightly conical, with a funnel-shaped termination at the smaller end. The neck of this funnel-end should be rather short, and should gradually and regularly become narrower toward the orifice, so that a perforated cork, bearing a short glass tube, may be tightly wedged into it from within until the end of the cork is flush with the outer edge of the orifice. The glass tube, which must not project above the inner surface of the cork, should extend from 3 to 4 Cm. beyond the outer surface of the cork, and should be provided with a closely fitting rubber tube, at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band holding the tube in position.

The shape of a percolator should be adapted to the nature of the drug to be operated upon. For drugs which are apt to swell, particularly when a feebly alcoholic or an aqueous menstruum is employed, a *conical* percolator is preferable. A *cylindrical* or only slightly tapering percolator may be used for drugs which are not liable to swell, and when the menstruum is strongly alcoholic, or when ether or some other volatile liquid is used for extraction. The size of the percolator selected should be in proportion to the quantity of drug extracted. When properly packed in the percolator, the drug should not occupy more than two-thirds of its height. The percolator is best constructed of glass, but, unless otherwise directed, may be made of any suitable material not affected by the drug or menstruum.

The percolator is prepared for percolation by gently pressing a small tuft of cotton into the neck above the cork, and this may then be moistened by pouring a few drops of the menstruum upon the cotton, to facilitate the passage of the first portion of percolate, which is often very dense.

The Process.—The powdered substance to be percolated (which must be uniformly of the fineness directed in the formula, and should be perfectly air-dry before it is weighed) is put into a basin, the specified quantity of menstruum is poured on, and the powder thoroughly stirred with a spatula, or other suitable instrument, until it appears uniformly moistened. The moist powder is then passed through a coarse sieve—No. 40 powders, and those which are finer, requiring a No. 20 sieve, while No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper and the whole quantity poured from this into the percolator. It is then shaken down lightly and allowed to remain in that condition for a period varying from fifteen minutes to several hours, unless otherwise directed; after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly, in proportion to the character of the powdered substance and the alcoholic strength of the menstruum, strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately fitting disk of filtering paper, or other suitable material, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions be accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached, in this, a height corresponding to its level in the percolator, which is now closely covered to prevent evaporation. The apparatus is then allowed at rest for the period of time specified in the formula.

To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of a bottle previously marked for the quantity of liquid to be percolated, if the percolate is to be measured, or of a tared bottle, if the percolate is to be weighed; and by raising or lowering this receiver the rapidity of percolation may be increased or decreased as may be desirable. A layer of menstruum must constantly be maintained above the powder, so as to prevent the access of air to its interstices, until all has been added, or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by inverting a bottle containing the entire quantity of menstruum over the percolator so that its mouth may dip beneath the surface of the liquid, the bottle being of such shape that its shoulder will serve as a cover for the percolator.

When the dregs of a tincture, or of a similar preparation, are to be subjected to percolation, after maceration with all or with the greater portion of the menstruum, the liquid portion should be drained off as completely as possible, the solid portion packed in a percolator, as before described, and the liquid poured on, until all has passed from the surface, when immediately a sufficient quantity of the original menstruum should be poured on to displace the absorbed liquid, until the prescribed quantity has been obtained.

Repercolation.—Authority is given (by the U. S. P. 8th Rev.) to employ, where it may be applicable, the process of repercolation, without change of the initial menstruum.

Rate of Flow.—It is obvious that the success of the process of percolation largely depends upon the regulation of the flow of the percolate; if this should be too rapid, incomplete exhaustion will result, but if too slow, valuable time may be wasted. The rate of flow for extracts and fluidextracts for 1000 Gm. of powder should range from two to five drops a minute; for official quantities of tinctures and preparations of about the same strength from eight to fifteen drops a minute, and the word "slowly" throughout the text is understood to mean a rate of flow corresponding to this; it is evident that the proper rate of flow should vary with the quantity and character of the drug used and the density of the menstruum.

Maceration.—Percolation is not suitable for exhausting some drugs and the process of maceration is employed for some of the tinctures (Aloes, Asafetida, Sweet Orange Peel, Tolu, etc.). Specific directions will be found under each process, and maceration should be conducted at a moderately warm temperature, about 15° to 20° C. (59° to 68° F.), and in a shady place." *U. S.*

For an account of E. R. Squibb's process of repercolation, see *Fluidextracta.*

Some prefer the mode of expression to that of percolation. This also is applicable both to aqueous and to alcoholic menstrua. The substance to be acted upon is mixed with the menstruum, cold or hot according to circumstances, and the mixture is allowed to stand from twelve to twenty-four hours. The liquid part is then filtered off, and the remainder submitted to strong pressure, in a linen bag, by means of a common screw press, or other convenient apparatus. Another portion of the menstruum may then be added, and pressure again applied, and, if the substance is not sufficiently exhausted, the same operation may be performed a third time. Frequently only a single expression is required, and very seldom a third. The quantity of menstruum added must vary with the solubility of the principles to be extracted. According to Mohr, the method of expression has the advantages over that of the percolation, that it yields solutions of more uniform concentration, that it does not require the materials to be so carefully powdered, or otherwise so skilfully managed, in order to insure favorable results, and, finally, that it occupies less time.

2. *Mode of Conducting the Evaporation.*

In evaporating the solutions obtained in the modes above described, attention should always be paid to the fact that the extractive matter is constantly becoming insoluble at high temperatures with the access of air, and that other chemical changes are going on, sometimes not less injurious than this, while the volatile principles are expelled with the vapor. The operator should, therefore, observe two rules: 1, to conduct the evaporation at as low a temperature as is consistent with other objects; 2, to exclude atmospheric air as much as possible, and, when this cannot be accomplished, to expose the liquid the shortest possible time to its action. The injurious influence of atmospheric air is much greater at the boiling point of water than at a less heat, even allowing for the longer exposure in the latter case, and therefore a slow evaporation at a moderate heat is preferable to the more rapid effects of ebullition. Bearing these principles in mind, we shall proceed to examine the different modes in practice. First, however, it is proper to observe that decoctions generally let fall, upon cooling, a portion of insoluble matter, and it is a question whether this should be rejected, or retained so as to form a part of the extract. Though it is undoubtedly in many instances inert, as in that of the insoluble substance formed during the decoction of certain vegetable substances, yet, as it frequently also contains a portion of the active principle which a boiling saturated solution necessarily deposits on cooling, and as it is difficult to decide with certainty when it is active and when otherwise, the safest plan, as a rule, is to allow it to remain.

The method of evaporation formerly resorted to in the case of aqueous solutions is rapid boiling over a fire. The more quickly the process is conducted, the better, provided the liquid is to be brought to the boiling point, for the temperature cannot exceed this, and the length of exposure is diminished. But, where this method is employed, it should never be continued until the completion of the evaporation, for when most of the water has escaped, the temperature can no longer be kept down to the boiling point, and the extract is burnt. The caution, therefore, should always be observed of removing the preparation from the fire before it has attained the consistence of thick syrup, and completing the evaporation, either by means of a water bath, or in shallow vessels at a moderate heat. When large quantities of liquid are to be evaporated, it is best to divide them into portions and evaporate each separately, for, as each portion requires less time for evaporation than the whole, it will thus be a shorter time exposed to heat. (Mohr.) But the mode of evaporation by boiling is always objectionable, and should be employed only in cases where the principles of the plant are so fixed and unchangeable as to authorize their extraction by the method of decoction.

Evaporation by means of the water bath, from the commencement of the process, is safer than the plan just mentioned, as it obviates all danger of burning the extract; but, as the heat is not supplied directly from the fire, the volatilization of the water cannot go on so rapidly, and, the temperature being nearly the same, when the water bath is kept boiling, there is greater risk of injurious action from the air. The liquid should be stirred during the process. The use of the steam bath has become very general in this country, as it requires a smaller consumption of fuel, and the heat imparted to the liquid, while sufficient to evaporate it, may be less than 100° C. (212° F.). The apparatus consists of an ordinary boiler, containing water, the vapor of which is conducted through a pipe into the evaporating vessels, communicating with each other by means of iron steam pipes. These vessels have the form of an ordinary copper basin, to the inside of which is riveted a shallow tinned copper evaporating basin, intended to contain the liquid to be evaporated. The vapor from the boiler circulates between these vessels, and the water into which it condenses is allowed to escape through a steam valve attached to the bottom of each vessel. The liquid to be evaporated is first distributed in two or three basins, but when considerably concentrated, is transferred to a single one, where it is stirred towards the close of the process to hasten the evaporation. The heat applied to the liquid can be easily regulated by the steam valves.

As the heat capable of being applied by boiling water to the evaporating liquid does not exceed 93.3° C. (200° F.), while that by steam can, by a moderate pressure, be increased to the boiling point or beyond it, the evapora-

tion by the latter agency may be much more rapid than by the former, when the pressure is from ten to twenty pounds to the square inch; so that there is a temptation to raise the heat to a degree seriously injurious to the product. Evaporation, therefore, by steam heat always requires caution and a stirring device should be used. The water bath is much less liable to be abused. In this respect the latter method has the advantage.

A good plan of evaporation, though slow, is to place the liquid in a broad, shallow vessel, exposed in a stove or drying room to a temperature of about 100° F., or a little higher, taking care that the air have free access in order to facilitate the evaporation. This mode is particularly applicable to those cases in which maceration or infusion is preferred to decoction for extracting the active principles. Berzelius says that we may thus usually obtain the extract in the form of a yellowish transparent mass, while extracts prepared in the ordinary way are almost black, and are opaque even in very thin layers. Even when the liquid is boiled at first, the process may often be advantageously completed in this manner. It has been proposed to effect the evaporation at the common temperature, by directing a strong current of air, by means of a pair of smith's bellows, over the surface of the liquid, and in reference to substances which are injured by heat and not by atmospheric air the plan will be found useful.

Plans have been proposed and carried into execution for performing evaporation without the admission of atmospheric air. The apparatus for *evaporation in vacuo,* now largely used by manufacturing pharmacists, is well calculated to meet this object, at the same time that, by removing the atmospheric pressure, it enables the water to rise in vapor more rapidly, and at a comparatively low temperature.

A convenient plan of excluding the air, though it does not at the same time meet the object of reducing the degree of heat, is to distil off the water in close vessels. Berzelius says that this is the best mode of concentration next to that *in vacuo.* Care, however, must be taken that the fire be not too long applied, lest the extract should be burnt. The process should, therefore, be completed by means of the water bath.

In the concentration of alcoholic solutions, distillation should always be performed, as not only is the atmospheric air thus excluded, but the alcohol is recovered, if not absolutely pure, certainly fit for the purpose to which it was originally applied. Here also the water bath should be employed, to obviate any possible risk of injury from the fire. When the decoction or infusion and the tincture of the same vegetable have been made separately, they should be separately evaporated to the consistence of syrup, and then mixed together while they are of such a consistence as to incorporate without difficulty. The object of this separate evaporation is that the spirituous extract may not be exposed to the degree of heat, or lengthened action of the air, which is necessary in the ordinary mode of concentrating the infusion or decoction.

In every instance, care should be taken to prevent any portion of the extract from becoming dry and hard on the sides of the evaporating vessel, as in this state it will not readily incorporate with the remaining mass. The heat therefore, should be applied to the bottom and not to the sides of the vessel.

Inasmuch as the yield of extracts is largely dependent on the character of the menstruum used in the percolation, it follows that there must necessarily be a great variation in the strength of commercial extracts. C. H. LaWall has prepared a valuable table giving the yield of extract by various drugs. (*Proc. A. Ph. A.,* 1897, 414.) For methods of assay, see various official processes.

3. *Condition and Preservation of Extracts.*

Extracts may be prepared of three different degrees of consistence: soft so that they may be readily made into pills, hard in order that they may be pulverized, and in a fine, dry powder. The soft extracts always contain a notable percentage of water. In astringent extracts, the evaporation should be carried to dryness. Those obtained from the expressed juices of plants are apt to attract moisture from the air, in consequence of the deliquescent nature of the salts existing in the juice. They are thus rendered softer, and more liable to become mouldy upon the surface. Others, especially such as contain much chlorophyll, harden by time, in consequence of the escape of their moisture, and it not unfrequently happens that small crystals of saline matter are formed in their substance; sodium chloride in small cubes is sometimes found in certain old extracts, having slowly crystallized as they hardened. John Attfield of London, has made a chemical examination of the crystals found in numerous extracts, and ascertained that in a large number they consisted of potassium chloride, and in a comparatively few of potassium nitrate. Potassium chloride was detected in the extracts of belladonna, hemlock, sarsaparilla (compound), colchicum seed, stramonium seed, and aconite; potassium nitrate in the extracts of belladonna, hyoscyamus, and lettuce; and sodium sulphate in extract of stramonium seed. (*P. J.,* March, 1862, p. 448.) The air, moreover, exercises an unfavorable chemical influence over the softer extracts, which are enfeebled, and ultimately become nearly inert, by the same changes which they undergo more rapidly in the liquid state at an elevated temperature. If an extract be dissolved in water, and the liquid be saturated with common salt or any other very soluble salt of difficult decomposition, the greater part of it will be precipitated, in consequence of

the insolubility of this class of substances in saline solutions. The precipitate may be again dissolved in pure water.

Abstracts, which were official in the U. S. P. 1880, were not re-introduced in the U. S. P. (8th Rev.), as they did not come into general use; this is unfortunate, as they had many advantages, and are used in certain sections of the country. A description and a typical formula, with comments, are appended.[1] Abtracts of the following eleven drugs were official in 1880: aconite, belladonna root, conium, digitalis, hyoscyamus, ignatia, jalap, nux vomica, podophyllum, senega, and valerian. C. S. N. Hallberg favors the use of a menstruum of three measures of alcohol with one of chloroform for abstracts, and prefers the term *"quatract"* to *"abstract."* (*Proc. A. Ph. A.,* 1894, 245.)

Extracts, in order that they may keep well, should be placed in glazed earthenware, glass, or porcelain jars, and completely protected from the access of the air. This may be effected by covering their surface with a layer of melted wax, or with a piece of paper moistened with strong spirit, then closing the mouth of the vessel with a cork, spreading wax or rosin over this, and covering the whole with leather or a piece of bladder. The application of alcohol to the surface has a tendency to prevent mouldiness. Should the extract become too moist, it may be dried by means of a water bath; should it, on the contrary, be too dry, the proper consistence may be restored by softening it in the same manner and incorporating with it a little distilled water. Martin (1880) proposes to preserve extracts in a soft condition by surrounding the vessel containing the extract by another of larger diameter, which is furnished with a tight cover, the space between the two vessels being filled with crystallized sodium sulphate, which gradually parts with its water of crystallization and prevents the extract from becoming hard and dry.

When extracts which are too soft are subjected to a moderate temperature, fermentation may set in; E. Cocardas describes the various forms of "Penicillium-ferment" which are found in such extracts, and concludes that the ferment causes them to undergo changes similar to those effected by heat,—viz., the absorption of oxygen and the disengagement of carbon dioxide. (*P. J.,* 1886, p. 590.)

Powdered Extracts.—These extracts are largely superseding soft extracts for reasons given in preceding paragraphs; the difficulty of making them arises from the injurious influence of heat upon concentrated percolates of organic substances, but by the use of vacuum apparatus, suitable absorptive diluents and care, they should be made successfully.

General Formula for Official Powdered Extracts.—Evaporate the Fluidextract of the drug at a temperature not exceeding 70° C. (158° F.) with constant stirring, to complete dryness. Reduce the product to a fine powder and add enough powdered glycyrrhiza to make the finished extract weigh —— Gm. Mix thoroughly. Permission is given by the U. S. P. (8th Rev.) to use instead of powdered glycyrrhiza the dried and powdered marc from the same drug. Powdered extracts should be kept in tightly closed vials and in a cool place.

Some extracts when powdered have a tendency to cohere. According to Geiseler, this may be obviated by the addition of sugar of milk or powdered licorice root, two or three parts of the former and one part of the latter to one of the extract being sufficient for the purpose. (*Ph. Cb.,* 1850, p. 238.) Mohr recommends the following plan of drying and preserving extracts. Take equal parts of powdered licorice-root and of the extract, rub them well together in a mortar, put the resulting paste into an earthen vessel with a flat bottom, place this in another of iron, a little deeper, containing calcium chloride thoroughly dried by heat insufficient to melt it; then enclose

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[1] ABSTRACTA. *Abstracts.*—Abstracts are solid powdered preparations containing the soluble constituents of the drugs from which they are made, and to which they bear a definite and uniform relation. These preparations were first introduced into the U. S. Pharmacopœia of 1880, and have many advantages over ordinary extracts. They are prepared by evaporating an alcoholic tincture of a drug spontaneously and at a low temperature, mixing it with a sufficient quantity of dried sugar of milk to make the final product when dry weigh one-half the weight of the drug, and then powdering it. The following general formula exhibits the typical former official process.

General Formula.—Drug, in No. 60 powder, *two hundred parts* [or four ounces av.]; Sugar of Milk, recently dried and in fine powder, Alcohol, each, *a sufficient quantity,* to make *one hundred parts* [or two ounces av.]. Moisten the drug with *eighty parts* [or one and three-quarter fluidounces] of Alcohol, and pack firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the drug is exhausted. Reserve the first *one hundred and seventy parts* [or three and one-half fluidounces] of the percolate, evaporate the remainder to *thirty parts* [or half a fluidounce] at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or one ounce av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or two ounces av.], reduce it to a fine, uniform powder. Preserve the powder in a well-stopped bottle.

The advantages possessed by abstracts may be briefly stated as follows:

1. Each abstract represents twice the strength of the drug or fluidextract from which it is prepared.

2. They are dry powders, if properly made, and thus are permanent and portable; not subject to precipitation as fluidextracts are; not liable to become hard, tough, and variable in strength, as is the case with extracts.

3. Injurious exposure to heat is entirely avoided, and the official process requires no apparatus but such as either is at hand in the pharmacy or can be easily obtained by a pharmacist operating upon the small scale.

4. The final thorough trituration of the dry powder reduces the soluble and active constituents of the drug to a pulverulent condition, the diluent is soluble, and the fine state of division of abstracts is the most favorable condition that a powder can possess to secure efficient medication. (Remington's *Practice of Pharmacy,* 4th ed., p. 456.)

the whole with a cover fitted to the iron vessel, and allow them to stand for a day or more. When the mixture is quite dry, powder it, and add so much of the powdered root as to make the weight double that of the original extract. This process was substantially adopted in the German Pharmacopœia (1882). The old process of using dextrin as a diluent was found very objectionable, principally on account of the tendency of the extracts to reabsorb moisture. Four parts of extract are now mixed with three parts of finely powdered licorice-root, and dried in a porcelain dish at 40° to 50° C. (104° to 122° F.) until the mixture ceases to lose weight. The mass is then rubbed to powder, and sufficient powdered licorice-root added to make the whole weigh eight parts, or double the weight of extract used. In our opinion, this method is not so good as that formerly adopted for abstracts. The German powdered extracts are always half the strength of the extracts, no relation whatever with the drug is established, and the variations in the yield of extract from different drugs have been repeatedly shown to be great. Kirchmann proposes exsiccated sodium sulphate as a diluent instead of dextrin, licorice-root, etc. (*Ph. Ztg.*, 1881, 116.) A. B. Lyons of Detroit (1898), has introduced *scale extracts*. These do not, as a class, bear a definite relation to the drug; they are assayed, however, and acacia is used as a means of preserving their dry condition; they are easily pulverized, and are very convenient for dispensing.

The plan of incorporating a little glycerin with extracts has been recommended for such extracts as require it, 10 per cent. of glycerin being added to the liquid extract before evaporating to a pilular consistence. By its unchangeable liquid character, glycerin keeps the extract soft, so that it can be readily made into pills, and it also exercises a favorable influence through its chemical properties. The U. S. P. (8th Rev.) directs the use of glycerin for this purpose as follows: "When it is desired to preserve a solid extract (for instance, of Gentian, Taraxacum, etc.) in a plastic condition, suitable for making pills, or for other purposes, it is recommended that there be incorporated with it, after it has been evaporated to the proper consistence, and while it is still warm, 10 percent. of its weight of glycerin." *U. S.* It is preferable to add a definite weight of the glycerin to the percolate. If it were added to the menstruum, owing to the variation in the yield of extracts from plants, some would be too soft, and at another time, in the case of a large yield of extract, the quantity of glycerin would be insignificant.

Extracts from recent plants should be prepared at the season when the plant is medicinally most active; a good rule is to prepare them once a year; but the demand for extracts from fresh drugs has declined rapidly of late, as it has been found that properly dried drugs yield extracts of uniform strength.

Nine extracts were dismissed at the last revision of the U. S. Pharmacopœia, these were as follows:[1] aconite, arnica root, cinchona,

[1] *Extractum Aconiti*, U. S. 1890. *Extract of Aconite.* "Aconite, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity*. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three thousand cubic centimeters* [or 100 fluidounces] of tincture are obtained, or the Aconite is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate, evaporate the remainder in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], add the reserved portion, and evaporate, at or below the above-mentioned temperature, until an extract of a pilular consistence remains." *U. S.* 1890.

This extract has been very properly abandoned by the U. S. P. (8th Rev.), as it has been shown that heat injuriously affects liquid preparations of aconite. For comments see 18th ed. U. S. D., p. 538.

Dose, one-sixth of a grain to one-fourth of a grain (0.01 to 0.016 Gm.)

Extractum Arnicæ Radicis, U. S. 1890. The omission of *Emplastrum Arnicæ* from the Eighth Revision of the U. S. P. very properly led to the dismissal also of the Extract of Arnica Root, since although the dose was given in the books as from three to five grains (0.2 to 0.32 Gm.) the extract was probably never used internally. The following process is that of the U. S. P. of 1890.

"Arnica Root, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Arnica Root is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate; evaporate the remainder to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], at a temperature not exceeding 50° C. (122° F.), mix the residue with the reserved portion, and evaporate, at or below the above-mentioned temperature, to a pilular consistence." *U. S.* 1890.

Extractum Cinchonæ, U. S. 1890. *Extract of Cinchona.*—"Cinchona, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *three thousand cubic centimeters* [or 101 fluidounces, 212 minims]; Water, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Diluted Alcohol, *a sufficient quantity*. Mix the Alcohol and Water, and having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 400 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then Diluted Alcohol, until *four thousand cubic centimeters* [or 135 fluidounces, 122 minims] of tincture are obtained, or the Cinchona is exhausted. Distil off the Alcohol from the tincture by means of a water-bath, and evaporate the residue, on a water-bath, to a pilular consistence." *U. S.* 1890.

The above former official process is excellent, and if proper care be taken in executing the process, both in relation to the percolation and the avoidance of too high a temperature, the extract will fully represent the virtues of the bark.

Uses.—The extract of Peruvian bark is at present much less employed than before the discovery of quinine. It is still, however, occasionally prescribed as a tonic in combination with other medicines.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.), equivalent to about a drachm (3.9 Gm.) of the powdered bark.

conium, iris, jalap, juglans, podophyllum, and uva ursi. Five extracts were added as follows: malt, cascara sagrada, scopola, stramonium, and sumbul.

Extractum Conii, U. S. (1890). *Extract of Conium.* Extract of Hemlock; Extrait de Ciguë (Semence), *Fr. Cod.;* Schierlingsextract, *G.*—"Conium, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, twenty cubic centimeters [or 324 minims]; Diluted Alcohol, *a sufficient quantity.* Mix the Acetic Acid with *nine hundred and eighty cubic centimeters* [or 33 fluidounces, 66 minims] of Diluted Alcohol, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 70 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three thousand cubic centimeters* [or 101 fluidounces, 212 minims] of tincture are obtained or until the Conium is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate, and evaporate the remainder, in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], mix this with the reserved portion, and evaporate, at or below the above-mentioned temperature, to a pilular consistence." *U. S.* 1890.

Under the present name two extracts are found in commerce, one, that of the U. S. P. (1890), an alcoholic extract made from conium fruit, the other, the British (1885) extract, made from the fresh leaves and young branches of the plant. In the U. S. extract acetic acid is used to fix the alkaloid coniine.

The most important point in making the Br. Ph. (1885) extract is to evaporate the juice without an undue degree of heat. At a temperature of 100° C. (212° F.), or upwards, its active principle undergoes rapid decomposition, being converted into resinous matter and ammonia. This is detected by the operator by the ammoniacal odor mixed with that which is peculiar to the plant. The juice always to a certain extent undergoes this decomposition when evaporated over a fire, and is not exempt from it even when the heat is regulated by a water bath. Hence the propriety of the directions in the Br. Ph. (1885). An excellent plan in the evaporation is to conduct it first in a vacuum, and afterwards in shallow vessels with a current of air at common temperatures. By the direction to heat the juice to the boiling point, or 93.3° C. (200° F.) (*Br.*), and then to filter, whereby the inert albumen is coagulated, and, with the equally inert chlorophyll and vegetable fibre, is separated from the liquid before evaporation, the extract is procured in a more concentrated state, and, besides, deprived of substances which might favor its decomposition. Long continued exposure to the air is productive of the same result as too much heat, so that old extracts are frequently destitute of activity. (*J. P. C.*, xxii. 416.) No one of the extracts is more variable in its qualities than this. The season at which the herb is collected, the place and circumstances of its growth, the method of preparing the extract, are all points of importance, and are all too frequently neglected. The activity of any specimen of the extract may be in some measure judged of by rubbing it with potassium hydroxide, which, disengaging the coniine and rendering it volatile, gives rise to the peculiar mouse-like odor of that principle. If no odor be evolved under these circumstances, the extract may be deemed inert.

The extract of conium prepared without separating the chlorophyll has a fresh olive or green color. It should have a strong narcotic, somewhat fetid odor, and a bitterish saline taste. According to Brande, from three to five pounds are obtained from one cwt. of the leaves. M. Recluz obtained rather more than an ounce from sixteen ounces.

Dose, of the U. S. P. 1890 extract, one-half to one grain (0.032 to 0.065 Gm.), of the British extract, two grains (0.13 Gm.), two, three, or four times a day, to be gradually increased *pro re nata*, in pill or solution.

Extractum Jalapæ. U. S. 1890. *Extract of Jalap.* "Jalap, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity.* Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 400 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Jalap is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, add the residue to the reserved portion, and evaporate to a pilular consistence." *U. S.* 1890.

EXTRACTUM ALOES. U. S.

EXTRACT OF ALOES

(ęx-trăc'tŭm ăl'ǫ-ēş)

Extrait d'Aloès, *Fr.;* Extractum Aloës, *P. G.;* Aloeextract, *G.;* Estratto di aloe acquoso, *It.*

* "Aloes, *one hundred grammes* [or 3 ounces av., 231 grains]; Boiling Water, *one thousand* drical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Jalap is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, add the residue to the reserved portion, and evaporate to a pilular consistence." *U. S.* 1890.

Extractum Podophylli. U. S. 1890. *Extract of Podophyllum.*—"Podophyllum, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity.* Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Podophyllum is exhausted. Distil off the Alcohol from the tincture by means of a water-bath, and evaporate the residue, on a water-bath, to a pilular consistence." *U. S.* 1890.

This is possessed of the purgative properties of the root, and may be given in the dose of from one to three grains (0.065 to 0.2 Gm.). From experiments made by John R. Lewis, it is probable that the alcoholic extract would be more powerful as a purgative than the official preparation; but it does not follow that it would be more serviceable. (See *A. J. P.*, xix.)

Extractum Stramonii Seminis. U. S. 1890. *Extract of Stramonium Seed.*—"Stramonium Seed, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity.* Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three thousand cubic centimeters* [or 101 fluidounces, 212 minims] of tincture are obtained, or the Stramonium Seed is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; mix this with the reserved portion, and by means of a water-bath, evaporate, at or below the before-mentioned temperature, to a pilular consistence." *U. S.* 1890.

Extractum Uvæ Ursi. U. S. 1890. *Extract of Uva Ursi.*—"Uva Ursi, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity.* Mix *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Uva Ursi is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 min-

cubic centimeters [or 33 fluidounces, 6½ fluidrachms]. Mix the Aloes with the Boiling Water in a suitable vessel, stirring constantly until the particles of Aloes are thoroughly disintegrated, and allow the mixture to stand for twelve hours; then pour off the clear liquid, strain the residue, and evaporate the mixed liquids to dryness with the aid of a water-bath or steam-bath." *U. S.*

The object of this preparation is to afford an aloes purified from mechanical impurities. The process is based upon the British formulas for extracts of Barbados aloes and Socotrine aloes, but the former is alone official in the Br. Pharm. (See below.) With an official purified aloes, the necessity for this preparation is not obvious.[1] An extract made with cold distilled water was formerly official in the German Pharmacopœia, as was also the vitriolated extract, "*Extractum Aloes Acido Sulfurico Correctum,*" made by suspending eight parts of extract of aloes in thirty-two parts of distilled water, adding drop by drop one part of pure sulphuric acid, and evaporating in a porcelain vessel to dryness.

Dose, two to ten grains (0.13 to 0.65 Gm.).

EXTRACTUM ALOES BARBADENSIS. Br.

EXTRACT OF BARBADOS ALOES

(ẹx-trăc'tŭm ăl'ọ-ēṣ bär-bą-dĕn'sĭs)

Extrait d'Aloès des Barbades, *Fr.;* **Barbados-Aloe-extrakt,** *G.*

"Barbados Aloes, in small fragments, 1 *pound* (Imperial) or 1000 grammes; Distilled Water, boiling, 1 *gallon* (Imp. meas.) or 10 litres. Add the Barbados Aloes to the Distilled Water and stir well until they are thoroughly mixed; set the mixture aside for twenty-four hours; decant; strain; evaporate the strained liquid to dryness at a temperature not exceeding 140° F. (60° C.)." *Br.*

The revised direction, to evaporate at a temperature not exceeding 140° F. (60° C.), instead of "by a current of warm air," is an improvement. *Extract of Socotrine Aloes,* made by a similar process, was dropped at the last revision of the British Pharmacopœia.

Dose, two to six grains (0.13 to 0.4 Gm.).

Off. Prep.—Decoctum Aloes Compositum, *Br.;* Extractum Colocynthidis Compositum, *Br.;* Tinctura Aloes, *Br.*

EXTRACTUM ANTHEMIDIS. Br.

EXTRACT OF CHAMOMILE

(ẹx-trăc'tŭm ąn-thĕm'ị̣-dĭs)

Extrait de Camomille Romaine, *Fr.;* **Extractum Chamomillæ Romanæ; Römisch-Kamillenextrakt,** *G.*

"Chamomile Flowers, 1 *pound* (Imperial) or 1000 grammes; Oil of Chamomile, 15 *minims* (Imp. meas.) or 2 cubic centimetres; Distilled Water, 1 *gallon* (Imp. meas.) or 10 litres. Boil the Chamomile Flowers with the Distilled Water until the volume is reduced to one-half; strain; press; filter; evaporate the filtrate to the consistence of a soft extract; add the Oil of Chamomile towards the end of the process." *Br.*

According to Brande, one cwt. of dried chamomile flowers affords upon an average 48 pounds of extract.

This extract has a deep brown color, with the bitter taste and aroma of chamomile. It much better represents the chamomile than did the old Edinburgh extract, which, being obtained by decoction and inspissation, contained none of the volatile oil of the plant. In the present British process care is taken not only to avoid boiling, but also to supply any possible loss of oil during the cautious evaporation, by the addition of a small portion near the close of the process. The extract may be given for the same purpose as the flowers, but is most used as a vehicle for other tonics in the pilular form. An extract may be prepared having the peculiar flavor as well as bitterness of chamomile, by macerating the flowers in water, and evaporating the infusion *in vacuo.*

Dose, two to ten grains (0.13 to 0.65 Gm.).

EXTRACTUM BELLADONNÆ FOLIORUM. U. S. (Br.)

EXTRACT OF BELLADONNA LEAVES

[Extractum Belladonnæ Foliorum Alcoholicum, Pharm. 1890]

(ẹx-trăc'tŭm bĕl-lą-dŏn'næ fō-lĭ-ō'rŭm)

"An Extract containing one per cent. of the alkaloids of Belladonna Root." *Br.*

Extractum Belladonnæ Alcoholicum, *Br.;* also *U. S.* 1880; Extrait de Belladone (Racine), *Fr. Cod.;* Spirituöses Tollkirschenextrakt, *G.;* Estratto di belladonna idroalcoolico, *It.;* Extracto alcoholico de belladona, *Sp.*

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ims] of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, on a water-bath, to a pilular consistence." *U. S.* 1890.

Dose, from five to ten grains (0.32 to 0.65 Gm.).

[1] *Glycerite of Aloes. Glycerole of Aloes.*—Under the latter name, Chausit brought to the notice of the profession a preparation consisting of an alcoholic extract of aloes dissolved in glycerin. Haselden prepared this by the following method. Macerating half an ounce of aloes in four fluidounces of alcohol until dissolved, he filtered the tincture through bibulous paper, evaporated it to the consistence of molasses, and, while it was still warm, added enough glycerin to make four fluidounces. Finding that the aloes was wholly dissolved, with the exception of a little impurity, he concluded that the spirit might very well be dispensed with, and the aloes used directly in the process. Accordingly he proposes to substitute the following method. Mix well in a mortar half an ounce of Socotrine aloes, in fine powder, and four fluidounces of glycerin; transfer the mixture to a bottle, and agitate occasionally for several days; if the aloes be not now dissolved, heat for fifteen minutes by a water bath, and strain through linen to separate impurities. The resulting liquid is of a bright mahogany color, and of the consistence of glycerin. The preparation has been recommended as an external remedy in *lichen agrius* and the excoriations of *eczema*, applied by means of a camel's hair brush. (*P. J.*, 1859, p. 322.) For the mode of preparing a *fluidextract of aloes* with the aid of glycerin, by Procter, see *Proc. A. Ph. A.*, 1863, p. 240.

* "Belladonna Leaves, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity.* Mix *two thousand cubic centimeters* [or 67 fluidounces, 5 fluidrachms] of Alcohol with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 fluidrachms] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until *three thousand cubic centimeters* [or 101 fluidounces, 3½ fluidrachms] of tincture are obtained, or the Belladonna Leaves are exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence. When assayed by the process given below, Extract of Belladonna Leaves should contain 1.4 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 percent." *U. S.*

"Evaporate *one fluid ounce* (Imperial measure) or fifty cubic centimetres of Liquid Extract of Belladonna, in a counterpoised basin, on a water-bath, to the consistence of a moderately firm extract; weigh. The difference between the weight of the residue and *three quarters of an ounce* (Imp.) or thirty-seven and a half grammes gives the weight of Milk Sugar to be used as a diluent for each *fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Liquid Extract.

Evaporate *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of Liquid Extract of Belladonna to the consistence of a thin syrup; add to it the required quantity of Milk Sugar determined from the data obtained from the foregoing experiment; continue the evaporation until the extract weighs *fifteen ounces* (Imp.) or seven hundred and fifty grammes. This Alcoholic Extract of Belladonna contains one-third the proportion of alkaloids present in average samples of the Alcoholic Extract of Belladonna of the British Pharmacopœia of 1885." *Br.*

The alcoholic extracts of belladonna of the U. S. P. 1880 and 1890 were made from the leaves, in deference to a prejudice which seems to have a strong following. The British Pharmacopœia introduced in the 1885 revision for the first time an alcoholic extract of belladonna, but it differed from the U. S. extract in being made from the root instead of the leaves. (See *Extractum Belladonnæ Viride*, p. 471.) The British alcoholic (root) extract (1898) is 66 per cent. weaker than the Br. Pharm. 1885 extract; it now contains 1 per cent. of the alkaloids of belladonna root, and is only 25 per cent. stronger than the liquid extract. While the advantage of establishing a definite relation between the two is apparent, in our opinion it would have been better not to have reduced the strength so enormously as 66 per cent.; the extract could have been made to contain 1½ per cent. of alkaloids, and, besides, this would have conveniently made the extract just double the strength of the liquid extract. The reduction in strength was no doubt made for the purpose of avoiding accidents in dispensing due to having two official Extracts of Belladonna. The dose of both British extracts is now the same. (*P. J.*, 1895, 795.) The absence of chlorophyll in an extract made from the root would cause ointments, cerates, plasters, etc., made from it to be deficient in the characteristic green color so much prized, but there can be no question of the greater uniformity in strength of the root.

Assay. U. S. (8th Rev.)—"Extract of Belladonna Leaves, *five grammes,* Alcohol, Ammonia Water, Distilled Water, Chloroform, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S. or Iodeosin T.S., each, *a sufficient quantity.* Introduce the Extract of Belladonna Leaves into a small beaker and dissolve it in a mixture consisting of alcohol 5 Cc., distilled water 10 Cc., ammonia water 2 Cc., and chloroform 20 Cc. When dissolved, transfer it to a separator, rinsing the beaker with a little alcohol and adding the rinsings to the separator. Insert the stopper securely and shake the separator for half a minute. Draw off the chloroformic layer into a second separator, and add to the first separator 10 Cc. more of chloroform. Shake it for half a minute, allow to separate, and again draw off the chloroformic layer into the second separator. Repeat this with 10 Cc. more of chloroform. To the united chloroformic liquids in the second separator, add 5 Cc. of normal sulphuric acid V.S. and 10 Cc. of distilled water, and shake it for half a minute. Draw off the chloroformic layer, after the liquids have separated, into the first separator, after cleaning it thoroughly, and the aqueous layer into a beaker, and repeat the process by adding to the first separator 10 Cc. of distilled water and 1 Cc. of normal sulphuric acid V.S. Draw off the chloroformic layer, rejecting the same, and then run the acid aqueous layer into the beaker. Pass the combined acid aqueous solutions through a pledget of purified cotton into the first separator, after cleaning it thoroughly, rinsing the second separator, the beaker, and the funnel with about 10 Cc. of distilled water. To the first separator, add 15 Cc. of

chloroform, a small piece of red litmus paper and enough ammonia water to produce a distinctly alkaline reaction. Shake the separator for half a minute, and when the liquids have separated, draw off the chloroformic layer into a beaker. Repeat this process with two portions of 10 Cc. each of chloroform, and evaporate the combined chloroformic liquids in the beaker to dryness on a water-bath containing warm water; dissolve the residue in 3 Cc. of ether and allow the latter to evaporate completely. To the alkaloidal residue add 5 Cc. of tenth-normal sulphuric acid V.S. and 5 drops of hematoxylin T.S. (or iodeosin T.S.), then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0287, and this product by 20, to obtain the percentage of mydriatic alkaloids contained in the Extract of Belladonna Leaves. The figure 0.0287 represents the weight in grammes of mydriatic alkaloids (mainly atropine) required to neutralize 1 Cc. of tenth-normal sulphuric acid V.S." *U. S.*

Uses.—The formula for this extract does not differ essentially from that official in the former revision; it is a good preparation, and is official in the French Codex. It is much used externally. Thus, in *rigidity* of the *os uteri,* it is applied at intervals to the neck of the uterus, mixed with simple ointment in the proportion of one drachm to an ounce; but care must be taken not to affect the system too powerfully, and the preparation, therefore, should be used in a small quantity at first. In *irritability* of the *bladder, chordee, spasm* of the *urethra* or of the *rectum,* it may either be rubbed in the form of ointment upon the perineum, or be used in the form of suppository; but care is requisite not to introduce it too freely into the bowel. It is sometimes smeared upon the bougie, mixed with oil, in the treatment of stricture of the urethra. In the form of ointment it has been beneficially employed in *phimosis* and *paraphimosis,* and in that of plaster or ointment, in local *neuralgic* or *rheumatic pains.* (See *Emplastrum Belladonnæ.*)

Dose, internally, from one-sixth to one-third of a grain (0.010 to 0.021 Gm.).

Off. Prep.—Emplastrum Belladonnæ, *U. S.;* Pilulæ Laxativæ Compositæ, *U. S.;* Pilulæ Podophylli, Belladonnæ et Capsici, *U. S.;* Suppositoria Belladonnæ, *Br.;* Unguentum Belladonnæ, *U. S.*

EXTRACTUM BELLADONNÆ VIRIDE. Br.

GREEN EXTRACT OF BELLADONNA

(ẹx-trăc'tŭm bĕl-la-dŏn'næ vĭr'i-dē)

"Bruise the fresh leaves and young branches of Atropa Belladonna, *Linn.,* in a mortar; press out the juice and heat it to 130° F. (54.4° C.); separate the green coloring matter by a calico filter; heat the strained liquid to 200° F. (93.3° C.); filter. Evaporate the filtrate on a water-bath to the consistence of a thin syrup; add to it the green coloring matter previously separated and passed through a hair sieve, stir the whole together, and evaporate at a temperature not exceeding 140° F. (60° C.) to the consistence of a soft extract." *Br.* This extract is identical with the Br. Pharm. 1885 extract of belladonna leaves made from the recent plant.

Dose, from one-fourth to one grain (0.016 to 0.065 Gm.).

EXTRACTUM CANNABIS INDICÆ. U. S., Br.

EXTRACT OF INDIAN CANNABIS

(ẹx-trăc'tŭm căn'na-bĭs ĭn'di-cæ)

Extract of Indian Hemp; Extrait de Chanvre de l'Inde, *Fr. Cod.;* Indischer Hanfextrakt, *G.*

* "Indian Cannabis, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity.* Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Indian Cannabis is exhausted. Distil off the Alcohol from the percolate by means of a water-bath, and evaporate the residue, in a porcelain dish, on a water-bath, to a pilular consistence." *U. S.*

"Exhaust Indian Hemp, in coarse powder, with Alcohol (90 per cent.) by percolation; evaporate the percolate to the consistence of a soft Extract." *Br.*

It will be noticed that the English name of the drug was changed in the U. S. Pharmacopœia 1890 to Indian Cannabis, to prevent its being mistaken for the root of *Apocynum cannabinum,* which is also called Indian Hemp. Several mistakes have occurred through this unfortunate confusion of nomenclature.

Although there is some difference in the details of the two processes, the preparations of the U. S. and Br. Pharmacopœias are practically identical. Procter investigated the subject of the tests for the purified extract or resin, and came to the following conclusions: its peculiar odor when moderately heated, its indifference to alkalies, and its solubility in alcohol, ether, chloroform, benzene, and oil of turpentine are characteristic though not entirely distinctive properties. The best test, he found, was nitric

acid (sp. gr. 1.38), which acts slowly when cold, but with heat rapidly, evolving red fumes, and converting the resin into an orange-red resinoid substance which, when washed and dried, closely resembles gamboge in color. (*Proc. A. Ph. A.*, 1864.) Care should be observed in selecting the drug for making this extract, and old Indian cannabis should be rejected. The limit of age in India is said to be three years. (*P. J.*, 1894, 246; *Rép. de Pharm.*, 1894, 257.) The preparation varies exceedingly in strength, so that it is wisest to begin with a small *dose*, one-quarter of a grain (0.016 Gm.), and rapidly increase the amount given until some effect is produced.

Off. Prep.— Tinctura Cannabis Indicæ, *Br.*

EXTRACTUM CIMICIFUGÆ. U. S.

EXTRACT OF CIMICIFUGA

(ẹx-trăc'tŭm cĭm-ị-cĭf'ù-gæ)

Extract of Black Cohosh; Extrait d'Actée à grappes, *Fr.*; Cimicifugaextrakt, *G.*

* "Fluidextract of Cimicifuga, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Glycyrrhiza (peeled, Russian), in No. 80 powder, *a sufficient quantity*, to make *twenty-five grammes* [or 386 grains]. Evaporate the Fluidextract of Cimicifuga in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to complete dryness. Reduce the product to a fine powder and add enough powdered Glycyrrhiza to make the finished Extract weigh *twenty-five grammes* [or 386 grains]. Mix thoroughly." *U. S.*

This extract was introduced for the reason that although the fluidextract and tincture represent the virtues of cimicifuga, the alcohol present in both is therapeutically contra-indicated, and the exceedingly disagreeable taste of the drug is entirely masked if the extract be prescribed in the form of a pill, with proper additions, such as extract of licorice, or if the pill be coated or enclosed in a capsule.

Dose, of the extract, from three to ten grains (0.2 to 0.65 Gm.).

EXTRACTUM COLCHICI. Br.

EXTRACT OF COLCHICUM

(ẹx-trăc'tŭm cŏl'ɕhị-cī)

"Crush fresh Colchicum Corms, deprived of their coats; press out the juice; allow the feculence to subside; decant; heat the clear liquid to 212° F. (100° C.); strain through flannel, and evaporate at a temperature not exceeding 160° F. (71° C.) to the consistence of a soft extract." *Br.*

The U. S. extract is an acetic extract of the corm (see *Extractum Colchici Cormi*); the British is made by evaporating the juice of fresh corms.

In Great Britain a preparation called *preserved juice of colchicum* is given in the dose of five minims (0.3 Cc.) or more. It is made by expressing the fresh corm, allowing the juice to stand for forty-eight hours that the feculent matter may subside, then adding one-fourth of its bulk of alcohol, allowing it again to stand for a short period, and ultimately filtering.

Dose, of the British extract, from fresh corms, one to two grains (0.065 to 0.13 Gm.).

EXTRACTUM COLCHICI CORMI. U. S.

EXTRACT OF COLCHICUM CORM

[Extractum Colchici Radicis, Pharm. 1890, Acetic Extract of Colchicum]

(ẹx-trăc'tŭm cŏl'ɕhị-cī cör'mī)

Extrait de Colchique acetique, *Fr.*; Zeitlosen Essigextrakt, *G.*

* "Colchicum Corm, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims]; Water, *a sufficient quantity*. Mix the Acetic Acid with *fifteen hundred cubic centimeters* [or 50 fluidounces, 346 minims] of Water, and, having moistened the powder with *five hundred cubic centimeters* [or 16 fluidounces, 436 minims] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then Water, until the Colchicum Corm is exhausted. Evaporate the percolate in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence.

When assayed by the process given below, Extract of Colchicum Corm should contain 1.4 percent. of colchicine. If the Extract should be found by assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 percent." *U. S.*

Assay. U. S. (8th Rev.)—"Extract of Colchicum Corm, *four grammes*, Chloroform, Alcohol, Ether, Distilled Water, Ammonia Water, each, *a sufficient quantity*. Dissolve the Extract of Colchicum Corm in 20 Cc. of distilled water, carefully transfer the solution to a graduated flask, and add sufficient alcohol to make the liquid measure 100 Cc. Shake the flask well, allow it to stand for five minutes,

filter, and collect 50 Cc. of the filtrate (representing 2 Gm. of the Extract), and evaporate it to dryness in a porcelain dish by means of a water-bath. Add to the residue 10 Cc. of ether and 5 Cc. of distilled water, stir the mixture well and heat it gently until the ether is evaporated. After cooling, pour off the aqueous solution, filtering it into a separator, retaining as much of the insoluble matter in the dish as possible. Again treat the residue with 10 Cc. of ether, and 5 Cc. of water, and proceed as before; rinse the dish and filter with a little water and collect all of the aqueous liquids in the separator. Introduce a small piece of red litmus paper into the separator, add enough ammonia water to render the liquid alkaline, and then shake it out with three successive portions of chloroform, of 20, 15, and 10 Cc., respectively. Collect the combined chloroformic solutions in an Erlenmeyer flask, evaporate the chloroform, and add to the alkaloidal residue two successive small portions of alcohol, evaporating the alcohol each time. Now add to the residue a mixture of 5 Cc. of distilled water and 10 Cc. of ether, agitate the liquid gently and evaporate the ether; after cooling, filter the aqueous liquid into a separator. Rinse the flask with distilled water, pass the rinsings through the filter into the separator, and shake out the aqueous solutions with three successive portions of chloroform, 20, 15, and 10 Cc. respectively. Collect the combined chloroformic solutions in a tared Erlenmeyer flask, evaporate the chloroform, and treat the alkaloidal residue with two successive small portions of alcohol, evaporating the alcohol each time, and dry the residue, at 100° C. (212° F.), to a constant weight. The weight multiplied by 50 will give the percentage of colchicine in the Extract of Colchicum Corm." *U. S.*

As the fresh colchicum corm is rarely to be had in this country, the U. S. Pharmacopœia employs the dried corm; its process, if properly conducted, will afford a very efficient extract. In preparing this extract according to the British process, by expression from the recent corm, there will be experienced some inconveniences, which would seem to render the U. S. process under all circumstances preferable. (*P. J.*, xiii. 62.) The acetic extract of colchicum made from fresh corms was abandoned by the Br. Ph. 1898. The acetic acid menstruum in the U. S. preparation is a good solvent for colchicine.

Dose, from one-fourth to one grain (0.016 to 0.065 Gm.).

EXTRACTUM COLOCYNTHIDIS. U. S.

EXTRACT OF COLOCYNTH

(ẹx-trăc'tŭm cŏl-o-cŷn'thị-dĭs)

Extractum Colocynthidis Alcoholicum; Extrait de Coloquinte, *Fr. Cod.*; Extractum Colocynthidis, *P. G.*; Koloquintenextrakt, *G.*; Estratto di coloquintide idroalcoolico, *It.*

* "Colocynth, freed from the seeds, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity.* Reduce the Colocynth to a coarse powder by grinding or bruising, and macerate it in *thirty-five hundred cubic centimeters* [or 118 fluidounces, 167 minims] of Diluted Alcohol for four days, with occasional stirring; then express strongly, and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and gradually pour Diluted Alcohol upon it until the tincture and expressed liquid, mixed together, measure *five thousand cubic centimeters* [or 169 fluidounces, 33 minims]. Distil off the Alcohol from the mixture by means of a water-bath, evaporate the residue to dryness, and reduce the dry mass to powder. Extract of Colocynth should be kept in well-stoppered bottles." *U. S.*

The colocynth should always be deprived of its seeds, following the directions of the U. S. Pharmacopœia, before being submitted to the action of the menstruum. Duncan found 3500 grains of colocynth to contain 2770 grains of seeds, which, when they were boiled by themselves, yielded almost nothing to water. Squibb found selected fruits to yield from 25.8 to 34 per cent. of medullary part, and this, when well exhausted by diluted alcohol, was found to yield 60.7 to 60.8 per cent. of dry extract, while from the whole fruit, including pulp and seeds, from 15.69 to 20.6 per cent. was obtained, according to the degree of dryness. (*A. J. P.*, 1857, p. 98.) Boiling water extracts such a large amount of pectin and mucilage from colocynth that either the decoction or the hot infusion gelatinizes on cooling, and the extract made by means of it is therefore loaded with inert matter, and, besides, is liable to become mouldy, or so tough and hard as to resist trituration and formation into pills. Hence many years ago the London College, following in this respect the old French Codex, directed, in the last edition of its Pharmacopœia, maceration with cold water; but diluted alcohol has been found to be a much better menstruum, and has accordingly been adopted in the U. S. Pharmacopœia process, while in the British Pharmacopœia the simple extract has been discarded altogether. The chief, if not exclusive, use of the alcoholic extract is in the preparation of the compound extract.

This preparation should never be substituted for an extract prepared with a menstruum containing a larger percentage of water, because the water extracts a large quantity of mucilaginous and inert matter. Commercial extract of colocynth may be often found in the market made with an aqueous menstruum.

Dose, one-half grain (0.032 Gm.).

Off. Prep.—Extractum Colocynthidis Compositum, *U. S.*

EXTRACTUM COLOCYNTHIDIS COMPOSITUM. U. S., Br.

COMPOUND EXTRACT OF COLOCYNTH

(ẹx-trăc'tŭm cŏl-o-cȳn'thi-dĭs cọm-pŏs'i-tŭm)

Extrait de Coloquinte composé, *Fr.;* Zusammengesetztes Koloquintenextrakt, *G.*

* "Extract of Colocynth, *one hundred and sixty grammes* [or 5 ounces av., 282 grains]; Purified Aloes, *five hundred grammes* [or 17 ounces av., 279 grains]; Cardamom, in No. 60 powder, *sixty grammes* [or 2 ounces av., 51 grains]; Resin of Scammony, in fine powder, *one hundred and forty grammes* [or 4 ounces av., 411 grains]; Soap, dried and in coarse powder, *one hundred and forty grammes* [or 4 ounces av., 411 grains]; Alcohol, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Heat the Purified Aloes, contained in a suitable vessel, on a water-bath, until it is completely melted; then add the Alcohol, Soap, Extract of Colocynth, and Resin of Scammony, and heat the mixture at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous, and a thread taken from the mass becomes brittle when cool. Then withdraw the heat, thoroughly incorporate the Cardamom with the mixture, and cover the vessel until the contents are cold. Finally, reduce the product to a fine powder. Compound Extract of Colocynth should be kept in well-stoppered bottles." *U. S.*

"Colocynth Pulp, 6 *ounces* (Imperial) or 150 grammes; Extract of Barbados Aloes, 12 *ounces* (Imp.) or 300 grammes; Scammony Resin, 4 *ounces* (Imp.) or 100 grammes; Curd Soap, in shavings, 4 *ounces* (Imp.) or 100 grammes; Cardamom Seeds, in the finest powder, 1 *ounce* (Imp.) or 25 grammes; Alcohol (60 per cent.), 1 *gallon* (Imp. meas.) or 4 litres. Macerate the Colocynth Pulp in the Alcohol for four days; press out the tincture; remove the alcohol by distillation; add the Extract of Aloes, Scammony Resin, and Soap; evaporate to the consistence of a firm extract, adding the Cardamoms towards the end of the process." *Br.*

The Br. Pharm. (1898) substituted Barbados aloes for the Socotrine variety, and increased the proportion of soap from three to four ounces. The object of the soap is to improve the consistence of the mass, which, when hardened by time, it renders more soluble in the liquors of the stomach. It may possibly also serve the purpose of qualifying the action of the aloes. In the U. S. process the extract is in the form of powder, which is very convenient for admixture with other substances; while if given uncombined, it may be readily made into pills by suitable additions. The alternative of using the scammony or its resin, in the first British formula, which appeared to us very objectionable, has been abandoned in the present edition, and the resin only directed. It was objected to the U. S. compound extract of 1860 that it was apt to gripe in consequence of deficiency in the proportion of the aromatic ingredient, and the addition of some aromatic oil, as oil of cloves, was recommended; this was remedied in the revision of 1870 by increasing the proportion of cardamom. The plan of having the powders simply mixed was liable to the objection that the mixture was not likely to be so thoroughly effected as to obtain a uniform result, and hence the U. S. Pharm. 1880 adopted Squibb's suggestion, to melt together all the ingredients unpowdered, except the cardamom, add a little alcohol, and, when the mixture is thoroughly made, to stir in the powdered aromatic, and finally to reduce the whole to a fine powder. The active principle of the cardamom (the volatile oil) is thus not dissipated, but absorbed by the other ingredients, and one of the objections to the British process is avoided,—*i.e.*, the necessity for directing cardamom in "the finest" powder, the previous desiccation of the cardamom, which is a requisite if a fine powder is desired, being very wasteful of the volatile oil.

This extract is an energetic and safe cathartic, possessing the activity of its three purgative ingredients, with comparatively little of the drastic character of the colocynth and scammony. It may be still further and advantageously modified by combination with rhubarb, jalap, calomel, etc., with one or more of which it is often united in prescription. We are informed that much of the extract sold in this country is made with inferior scammony and aloes and an insufficient proportion of colocynth, so that it is comparatively inert. Compound extract of colocynth should be looked on with suspicion when cheap, and the pharmacist should always prepare it for himself. (See *Am. Drug.*, 1896, 152.)

Dose, as a laxative, one to two grains (0.065 to 0.13 Gm.); as a purgative, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Pilulæ Catharticæ Compositæ, *U. S.;* Pilulæ Catharticæ Vegetabiles, *U. S.*

EXTRACTUM DIGITALIS. U. S.

EXTRACT OF DIGITALIS

(ẹx-trăc'tŭm dĭg-i-tā'lĭs)

Extractum Digitalis Alcoholicum; Extrait de Digitale (alcoolique), *Fr. Cod.;* Digitalisextrakt; Fingerhutextrakt, *G.;* Estratto di digitale idroalcoolico, *It.;* Extracto alcoholico de digital, *Sp.*

* "Fluidextract of Digitalis, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Fluidextract of Digitalis in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), with constant stirring, until it is reduced to a pilular consistence." *U. S.*

This was first introduced into the U. S. Pharmacopœia of 1860, though less needed than many others, because the dose of digitalis itself is small, and very little can be gained on

the point of strength. The alcoholic extract of digitalis contains all the virtues and may be used for all the purposes of the powdered leaves. According to Vielguth and Nentwich, the amount of alcoholic extract obtained from dried digitalis by cold displacement is 27.1 per cent. (*A. J. P.*, May, 1859.)

Dose, one-fourth of a grain (0.016 Gm.).

EXTRACTUM ERGOTÆ. U. S., Br.

EXTRACT OF ERGOT

(ẹx-trăc'tŭm ër'gọ-tæ)

Extractum Hæmostaticum; Ergotin, *Br.* (1898); Extrait de Seigle Ergoté, *Fr. Cod.;* Extractum Secalis cornuti, *P. G.;* Mutterkornextrakt, *G.;* Estratto di segala cornuta, *It.*

* "Ergot, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Hydrochloric Acid, *fifty grammes* [or 1 ounce av., 334 grains]; Monohydrated Sodium Carbonate, *eight and one-half grammes* [or 131 grains]; Glycerin, *twelve and one-half grammes* [or 193 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]. Mix *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Alcohol with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water, and, having moistened the powder with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of the mixture, pack it firmly in a cylindrical percolator; then add sufficient menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Ergot is exhausted. Evaporate the percolate in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), to *two hundred and fifty grammes* [or 8 ounces av., 358 grains]; add *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of water, and stir; filter when cold, rinse the dish with a little Water, and add this to the filter. Add the Diluted Hydrochloric Acid to the filtrate; then set it aside for twenty-four hours; filter, wash the contents of the filter with Water until the washings no longer have an acid reaction, and add the washings to the filtrate. To this, add gradually the Monohydrated Sodium Carbonate, and, when the evolution of carbon dioxide has ceased, evaporate the liquid in a tared dish until it weighs *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; add the Glycerin, and continue the evaporation, at the above-named temperature, until the weight of the Extract is reduced to *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]." *U. S.*

"Ergot, in No. 40 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (60 per cent.), *a sufficient quantity;* Distilled Water, *a sufficient quantity;* Diluted Hydrochloric Acid, 7½ *fl. drachms* (Imp. meas.) or 47 cubic centimetres; Sodium Carbonate, 175 *grains* (Imp.) or 20 grammes. Moisten the powdered Ergot with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; pack the damp powder in a percolator; percolate with the Alcohol until the Ergot is exhausted. Evaporate the percolate to *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres; add *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of Distilled Water; filter when cold, washing the residue with a little Distilled Water. Add the Diluted Hydrochloric Acid to the filtrate; set aside for twenty-four hours; filter; wash the residue with Distilled Water until the washings no longer have an acid reaction, adding the washings to the filtrate; add the Sodium Carbonate to the latter; evaporate to a soft extract." *Br.*

This official extract leaves little to be desired. The U. S. and the British preparations are modelled upon Keller's process. (*S. W. P.*, 1894, 141.) The object of the addition of hydrochloric acid is to precipitate out the flocculent sclererythrin, the coloring matter of ergot. The sodium carbonate neutralizes the acid, a small quantity of sodium chloride remaining in the extract. This is much the best preparation of ergot, being the only one that should be used hypodermically, and much less likely to cause nausea when given by the mouth. For method of hypodermic use, see *Ergota.* It is well adapted for suppositories, and has been applied topically to the os uteri, the desired dose being put on a dossil of absorbent cotton. Internally it is best given in gelatin capsules, since pills are likely to flatten.

Dose, from five to fifteen grains (0.32 to 1.0 Gm.).

Off. Prep.—Injectio Ergotæ Hypodermica, *Br.*

EXTRACTUM EUONYMI. U. S. (Br.)

EXTRACT OF EUONYMUS

(ẹx-trăc'tŭm eū-ŏn'ẏ-mī)

Extractum Euonymi Siccum, *Br.;* Dry Extract of Euonymus; Extract of Wahoo; Extrait d'Evonymus atro-purpureus, *Fr. Cod.;* Extrait de Fusain Américaine, *Fr.;* Spindelbaumextrakt, Spillbaumrindenextrakt, *G.*

* "Fluidextract of Euonymus, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Glycyrrhiza (peeled, Russian), in No. 80 powder, *a sufficient quantity,* to make *twenty-five grammes* [or 386 grains]. Evaporate the Fluidextract of Euonymus in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to complete dryness. Reduce the pro-

duct to a fine powder, and add enough powdered Glycyrrhiza to make the finished extract weigh *twenty-five grammes* [or 386 grains]. Mix thoroughly." *U. S.*

"Euonymus Bark, in No. 20 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (45 per cent.), *a sufficient quantity;* Calcium Phosphate, *a sufficient quantity.* Moisten the powdered Euonymus Bark with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; pack in a percolator; gradually pour on more of the menstruum until the Euonymus is exhausted; collect the liquid and evaporate the alcohol; thoroughly dry the residue; powder the product as far as possible and mix it with one-fourth of its weight of Calcium Phosphate, continuing the drying and powdering until a satisfactory preparation is obtained; then immediately transfer it to a well-closed bottle." *Br.* Dry and powdered extract of euonymus is frequently but erroneously termed "*euonymin.*"

Dose, one to three grains (0.065 to 0.2 Gm.).

EXTRACTUM GENTIANÆ. U. S., Br.

EXTRACT OF GENTIAN

(ĕx-trăc'tŭm gĕn-tī-ā'næ)

Extrait de Gentiane. *Fr. Cod.;* Extractum Gentianæ, *P. G.;* Enzianextrakt, *G.;* Estratto di genziana acquoso, *It.;* Extracto acuoso de genciana, *Sp.*

* "Gentian, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Water, *a sufficient quantity.* Moisten the powder with *four hundred cubic centimeters* [or 13 fluid-ounces, 252 minims] of Water, and let it macerate for twenty-four hours; then pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the Gentian. Reduce the liquid to three-fourths of its bulk by boiling, and strain; then, by means of a water-bath, evaporate to a pilular consistence." *U. S.*

"Infuse Gentian Root in ten times its weight of Distilled Water for two hours; boil for fifteen minutes; pour off; press; strain; evaporate the liquid to the consistence of a soft extract." *Br.*

The plan of percolation with cold water is admirably adapted to the extraction of the active principles of gentian. By the use of cold water, starch and pectic acid are left behind, while any albumen that may be taken up is disposed of by the subsequent boiling and straining.

The extract, however, may be advantageously made by macerating the root in two parts of water for thirty-six hours, then expressing in a powerful press, again macerating with additional water, and in like manner expressing, and evaporating the united expressed liquors. Guibourt and Cadet de Vaux obtained by maceration in cold water an extract not only greater in amount, but also more transparent, more bitter, and possessing more of the color and odor of the root, than that prepared by decoction. Guibourt attributes this result to the circumstance that, as gentian contains little if any starch, it yields nothing to boiling which it will not also yield to cold water, while decoction favors the combination of a portion of the coloring matter with the lignin. But this opinion requires modification, now that it is understood that gentain contains pectic acid, which water will extract when boiling hot, but not when cold. Gentian, according to Brande, yields half its weight of extract by decoction.

As ordinarily procured, the extract of gentian has an agreeable odor, is very bitter, and of a dark brown color approaching to black, shining, and tenacious. It is frequently used as a tonic, in the form of pill, either alone or in connection with metallic preparations; but the practice of some pharmacists of using it indiscriminately as a pill excipient is deserving of severe censure.

Dose, from five to ten grains (0.32 to 0.65 Gm.).

EXTRACTUM GLYCYRRHIZÆ. U. S.

EXTRACT OF GLYCYRRHIZA [Extract of Licorice]

(ĕx-trăc'tŭm glĭç-ĭr-rhī'zæ)

"The commercial extract of the root of *Glycyrrhiza glabra* Linné, or of *Glycyrrhiza glandulifera* Waldstein and Kitaibel (Fam. *Leguminosæ*)." *U. S.*

Extractum Liquiritiæ; Liquorice, Licorice; Extrait de Réglisse, *Fr. Cod.;* Suc de Réglisse, Sucre noir, *Fr.;* Succus Liquiritiæ, *P. G.;* Lakriz, Lakritzensaft, Süssholzsaft, *G.;* Estratto di liquirizia, Sugo di liquirizia, *It.;* Extracto acuoso de regaliz, Regaliza en ballos, *Sp.*

Licorice is an article of export from the north of Spain, particularly Catalonia, where it is obtained in the following manner. The roots of the *G. glabra,* having been dug up, thoroughly cleansed, and half dried by exposure to the air, are cut into small pieces, and boiled in water until the liquor is saturated. The decoction is then allowed to rest, and, after the dregs have subsided, is decanted, and evaporated to the proper consistence. The extract, thus prepared, is formed into rolls from five to six inches long by an inch in diameter, which are dried in the air, and wrapped in laurel leaves.

The British Pharmacopœia gives a process for making extract of licorice. (See page 478.) The U. S. Pharmacopœia directs that not less than 60 per cent. of it should be soluble in cold water.

Much licorice is prepared in Calabria, according to Fée, from the *G. echinata,* which abounds in that country. The process is essentially the same as that just described, but conducted with greater care, and the Italian licorice is purer and more valuable than the Spanish. It is in cylinders, generally somewhat smaller than the Spanish, and usually stamped with the manufacturer's brand. Most of the extract brought to this

country comes from Messina and Catania in Sicily and Naples, from Seville and Saragossa in Spain, and from Smyrna in Turkey. Perhaps in no other part of the world is more licorice consumed than in the United States, from four to five thousand tons having been imported annually before 1860; but the article is now made on an extensive scale in this country, very successfully, with the best modern appliances, and of such good quality as to have almost driven the foreign article out of the market. The principal use of Extract of Licorice is in the manufacture of chewing tobacco, that in the form of rolls as sold by the druggists being a comparatively small portion of the whole amount consumed.

Crude Licorice, Licorice Paste, or *Licorice Mass,* as it is variously termed, is found in the market in cases ranging from two hundred and fifty to four hundred pounds, of a hard pilular consistence and, as its name implies, in a mass, which has been run into the case while hot and then allowed to cool.

Licorice is usually in cylindrical rolls, somewhat flattened, and often covered with bay-leaves. We have seen it abroad and in this market in large cubical masses. When good, it is very black, dry, brittle, breaking with a shining fracture, of a very sweet, peculiar, slightly acrid or bitterish taste, and almost entirely soluble, when pure, in boiling water.

It is described officially as "in flattened cylindrical rolls, from 15 to 18 Cm. long, and from 15 to 30 Mm. thick; of a glossy black color. It breaks with a sharp, conchoidal, shining fracture, and has a very sweet, peculiar taste. Not less than 60 percent. of it should be soluble in cold water." *U. S.* Neumann obtained 460 parts of aqueous extract from 480 parts of Spanish licorice. It is, however, considerably less soluble in cold water. It is often impure from accidental or fraudulent addition or careless preparation. Starch, sand, the juice of prunes, etc., are sometimes added, and carbonaceous matter, and even particles of copper, are found in it, the latter arising from the boilers in which the decoction is evaporated. Four pounds of the extract have yielded two drachms and a half of metallic copper. (Fée.) In different commercial specimens examined by Chevallier he found from 9 to 50 per cent. of insoluble matter. (*J. P. C.*, xxx. 429.) This is by no means, however, always impurity. In the preparation of the extract by decoction, a portion of matter originally insoluble, or rendered so by decoction, is taken up, and is, in fact, necessary to the proper constitution of the licorice. When this is prepared with cold water, or even with hot water by simple displacement, the extract attracts moisture from the air, becomes soft, and loses the characteristic brittleness of the drug. The additional substances taken up in decoction serve to protect the extract against this change. Delondre has obtained the same result by using steam as the solvent. He prepares from the root an excellent licorice, having all the requisite qualities of color, taste, and permanence, by passing steam, in suitable vessels, through the coarse powder of the root. The vapor thoroughly penetrates the powder, and is drawn off as it condenses. With about 500 lbs. of the root, this treatment is continued for twelve hours, and repeated at the end of five days. The liquors are collected, decanted, clarified with about 4 lbs. of gelatin, and quickly evaporated. After being put into the form of cylinders, the extract is kept for ten days in a drying room, at a temperature of 77° F. (*Ibid.*, p. 433.) A bitter or empyreumatic taste is a sign of inferior quality in licorice. As ordinarily found in commerce, it requires to be purified. (See *Extractum Glycyrrhizæ Purum;* also *Glycyrrhizinum Ammoniatum.*)

Licorice contains *glycyrrhizin,* $C_{24}H_{36}O_9$, a glucoside, partly free and partly in combination with ammonia, to which combination the characteristic sweet taste of licorice is due. The glycyrrhizin when boiled with dilute acids decomposes into *glycyrrhetin,* $C_{18}H_{26}O_4$, and a fermentable sugar.

According to Mellor (*A. J. P.*, 1898, 23, 54, 136) the best process for estimating glycyrrhizin is as follows: The best menstruum with which to treat the commercial powdered extract is a mixture of 40 Cc. ammonia water, 240 Cc. of alcohol, and sufficient water to make a liter. After extraction, filter, and precipitate with diluted sulphuric acid. Of twelve samples examined, the highest was a Greek licorice with 27.78 per cent., and the lowest a Spanish with 5.28 per cent. of glycyrrhizin. Of insoluble matter, the highest was a Spanish with 36.52 per cent., and the lowest a Greek with 5.95 per cent. The average yield, however, was strongly in favor of American licorice. Tobacco manufacturers dissolve 10 Gm. in 100 Cc. of water, add 200 Cc. of alcohol, and allow it to stand over night. The insoluble matter will then have mostly settled; the filtrate is acidulated with sulphuric acid.

The so called *refined licorice,* found in commerce in small cylindrical pieces not thicker than a pipestem, is prepared by dissolving the impure extract in water without boiling, straining the solution, and evaporating. The object of this process is to separate not only the insoluble impurities, but also the acrid oleoresinous subtance which is extracted from the licorice root and is necessarily mixed with the unrefined extract. It is customary to add, during the process, a portion of sugar, gum, flour, starch, or perhaps glue. These additions, or something equivalent, are necessary to obviate the deliquescent property of the pure licorice. According to Delondre, 15 per cent. of gum is the proper proportion, when this substance is used; Geiseler has found sugar of milk to lessen the disposition of the extract to absorb moisture; but he considers the best addition, on the whole, to be very finely powdered licorice root, which should be used in the proportion of 1 part to 16 of

the purified extract. (*A. J. P.*, xxviii. 225.) The preparation is sometimes attacked by small worms, probably in consequence of the farinaceous additions. Excellent licorice is prepared in some parts of England, from the root cultivated in that country. The *Pontefract cakes* are small lozenges of licorice made in the vicinity of Pontefract, England. For methods of assaying extract of licorice, see *A. J. P.*, 1896, 663; also 1898, 23, 136.

Uses.—Licorice is a useful demulcent, much employed in cough mixtures, and frequently added to infusions or decoctions in order to cover the taste or obtund the acrimony of the principal medicine. It is used in pharmacy to impart consistence to pills and troches, and to modify the taste of other medicines.

Off. Prep.—Pilulæ Ferri Iodidi, *U. S.*; Trochisci Ammonii Chloridi, *U. S.*; Trochisci Cubebæ, *U. S.*; Trochisci Glycyrrhizæ et Opii, *U. S.*

EXTRACTUM GLYCYRRHIZÆ PURUM. U. S. (Br.)

PURE EXTRACT OF GLYCYRRHIZA

(ĕx-trăc'tŭm glĭ̆c-ĭr-rhī'zæ pū'rŭm)

Extractum Glycyrrhizæ, *Br.*; Extract of Liquorice; Extractum Glycyrrhizæ Depuratum, Succus Liquiritiæ Depuratus; Extrait de Réglisse pur, *Fr.*; Succus Liquiritiæ depuratus, *P. G.*; Gereinigter Süssholzsaft, Reines Lakriz, *G.*

* "Glycyrrhiza, peeled, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Ammonia Water, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; Glycerin, Distilled Water, each, *a sufficient quantity*. Mix the Ammonia Water with *three thousand cubic centimeters* [or 101 fluidounces, 212 minims] of Distilled Water, and, having moistened the powder with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of the mixture, allow it to macerate in a closed vessel for twenty-four hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first the remainder of the menstruum, and then Water, until the Glycyrrhiza is exhausted. Lastly, evaporate the liquid in a tared porcelain dish, by means of a water-bath, to a pilular consistence, and while the mass is still warm, incorporate with it 5 percent. of its weight of Glycerin." *U. S.*

"Liquorice Root, in No. 20 powder, 1 *pound* (Imperial) or 1000 grammes; Distilled Water, 4 *pints* (Imp. meas.) or 5 litres. Mix the Liquorice Root with *two pints* (Imp. meas.) or two and a half litres of the Distilled Water; set aside for twenty-four hours; strain; press; to the pressed marc add the remainder of the Distilled Water and set aside the mixture for six hours; strain; press; mix the strained liquids; heat to 212° F. (100° C.); strain through flannel; evaporate to the consistence of a soft extract." *Br.*

The necessity for a pure extract of licorice must be apparent to every pharmacist; the very variable quality of the commercial extract has frequently led to disappointment. The official process affords a preparation which is unexceptionable, the ammonia rendering the glycyrrhizin soluble, yet care must be taken in its evaporation, as it is very easily injured by too much heat, which gives it an empyreumatic taste, destroying at once its usefulness as an agreeable adjuvant.

Off. Prep.—Confectio Sennæ, *Br.*; Decoctum Aloes Compositum, *Br.*; Mistura Glycyrrhizæ Composita, *U. S.*

EXTRACTUM HÆMATOXYLI. U. S.

EXTRACT OF HEMATOXYLON

(ĕx-trăc'tŭm hæ-mą-tŏx'y-lī)

Extract of Logwood; Extractum Ligni Campechiani; Extrait de Bois de Campêche, *Fr.*; Campecheholzextract, *G.*

* "Hematoxylon, rasped, *one thousand grammes* [or 35 ounces av., 120 grains]; Water, *ten thousand cubic centimeters* [or 338 fluidounces, 66 minims]. Macerate the Hematoxylon with the Water for forty-eight hours. Then boil (avoiding the use of metallic vessels) until one-half of the Water has evaporated; strain the decoction, while hot, and evaporate it to dryness." *U. S.*

This is one of the few instances in which decoction in the preparation of extracts is not considered objectionable. Iron vessels should not be employed in the process, in consequence of the presence of tannic acid. The evaporation should be carried so far that the extract may be dry and brittle when cold. About 20 lbs. of it are obtained from one cwt. of logwood. (Brande.) It is of a deep ruby color, and an astringent, sweetish taste, and has all the medicinal virtues of the wood. If given in pills, these should be recently made, as when long kept they are said to become so hard as sometimes to pass unchanged through the bowels. The extract, however, is best administered in solution. This extract is said to be prepared largely in Yucatan and other parts of Mexico.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

EXTRACTUM HYOSCYAMI. U. S. (Br.)

EXTRACT OF HYOSCYAMUS

(ĕx-trăc'tŭm hȳ-ŏs-cȳ'ą-mī)

Extractum Hyoscyami Viride, *Br.*, Green Extract of Hyoscyamus; Extract of Henbane; Extrait de Jusquiame (feuille), *Fr. Cod.*; Extractum Hyoscyami, *P. G.*; Bilsenkrautextrakt, *G.*; Estratto di giusquiamo idroalcoolico, *It.*; Extracto alcoholico de beleno, *Sp.*

* "Fluidextract of Hyoscyamus, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Fluidextract of Hyoscyamus in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.

When assayed as directed below, Extract of Hyoscyamus should contain 0.3 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 0.3 percent." *U. S.*

Assay. U. S. (8th Rev.)—"The method to be employed is identical with that given for Extract of Belladonna Leaves, page 470, using *ten grammes* of Extract of Hyoscyamus instead of the quantity of Extract of Belladonna Leaves there directed, and multiplying the product by 10 instead of 20." *U. S.*

"Bruise fresh leaves, flowering tops, and young branches of Hyoscyamus niger, *Linn.;* press out the juice and heat it gradually to 130° F. (54.4° C.); separate the green coloring matter by a calico filter; heat the strained liquid to 200° F. (93.3° C.); filter. Evaporate the filtrate to the consistence of a thin syrup; add to it the green coloring matter previously separated and passed through a hair sieve; stir the whole together, and evaporate at a temperature not exceeding 140° F. (60° C.), to the consistence of a soft extract." *Br.*

Solon and Soubeiran have shown that the insoluble matter separated from the expressed juice of hyoscyamus by filtering, and that coagulated by heat, are nearly if not quite inert; so that the juice may be usefully clarified before evaporation. (*A. J. P.,* viii. 228.) The retention of the chlorophyll, however, as provided for in the British formula, is thought to be advantageous. This kind of extract of hyoscyamus is chiefly derived from England. Brande says that one cwt. of the fresh herb affords between four and five pounds. Recluz obtained one part from sixteen.

The extract is of a dark olive color, of a narcotic rather unpleasant odor, and a bitterish, nauseous, slightly saline taste. It retains its softness for a long time, but at the end of three or four years becomes dry, and exhibits, when broken, small crystals of potassium nitrate and sodium chloride. (Recluz.) Like all the inspissated juices, it is of variable strength, according to its age, the care used in its preparation, and the character of the leaves. (See *Hyoscyamus.*)

Much depends on the choice of the leaves, and too little attention is paid to this point. In reference to the biennial plant, there seems to be no doubt that the leaves of the second year are much more efficacious than those of the first, and should, therefore, always be selected. It is stated under Hyoscyamus that the leaves should be gathered soon after the plant has flowered. Charles Cracknell gives more particular directions. He thinks the plant is in a fit state for collection during only a very short period, namely, when the flowers at the top are blown, but have not yet begun to fade, and the seed vessels and seeds which have been formed are still soft and juicy. For other observations on the preparation of this extract, see a paper by Cracknell in *A. J. P.* (xxiii. 245). T. B. Groves found that an extract obtained by inspissating the juice of the stems was altogether inferior to another obtained in like manner from the leaves, being not only less in amount, but also lower in quality. (*P. J.,* 1862.)

The U. S. P. extract is a much more reliable and active preparation than the inspissated juice, or, as it is usually termed, English extract. It is of a dark olive color, with the peculiar odor of hyoscyamus. In the use of the English extract it is advisable to begin with a moderate dose, two or three grains (0.13 or 0.2 Gm.), and gradually to increase the quantity until some effect is experienced, and the degree of efficiency of the particular parcel employed is ascertained. It is usually given in pill.

Dose, from one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Pilulæ Cartharticæ Vegetabiles, *U. S.;* Pilula Colocynthidis et Hyoscyami, *Br.*

EXTRACTUM JALAPÆ. Br.

EXTRACT OF JALAP

(ĕx-trăc'tŭm jă-lā'pæ)

Extrait de Jalap, *Fr.;* Jalapenextrakt, *G.*

"Jalap, in coarse powder, 1 *pound* (Imperial) or 1000 grammes; Alcohol (90 per cent.), 4 *pints* (Imp. meas.) or 5 litres; Distilled Water, 1 *gallon* (Imp. meas.) or 10 litres. Macerate the powdered Jalap in the Alcohol for seven days; press out the tincture, filter, and then remove the alcohol by distillation, leaving a soft extract. Again macerate the residue of the Jalap in the water for four hours; express; strain through flannel; evaporate to the consistence of a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F. (60° C.) to the consistence of a firm extract." *Br.*

This extract was retained in the U. S. Pharmacopœia of 1890, but was dismissed in the Eighth Revision owing to the fact that the resin of jalap (see *Resina Jalapæ*) represents more fully the activity of the drug and both were not needed. It was intended to replace the abstract formerly official. The U. S. 1890 extract was simply an alcoholic extract, differing from the extract official in 1870, and also from the present British extract, in containing *no aqueous extract* whatever. (See page 468.)

Jalap contains a considerable quantity of starch, which is extracted by decoction, but left behind by cold water, and, as this principle serves only to impede the filtration or straining, and to augment the bulk of the extract, without adding to its virtues, cold water is very properly used in the process, if water is used at all. The use both of alcohol and of water was formerly deemed necessary, in order to extract all the medicinal qualities of the drug, and they were employed successively, under the impression that

the previous removal of the resin by the former facilitates the action of the latter; but A. B. Taylor satisfactorily determined that the substance which water will extract from jalap previously exhausted by alcohol has no observable influence on the system, he having taken 240 grains of the matter thus extracted without effect. (*Proc. A. Ph. A.*, 1864, p. 215.) It was shown, moreover, that the aqueous extract of jalap is hygroscopic, and that it is the cause of the inconvenient hardening of the powdered extract. The substitution of dried sugar of milk for the inert, hygroscopic, aqueous extract was certainly an improvement (see *Abstracta*, page 466); but the use of alcohol alone as a menstruum in the U. S. P. 1890 process made a stronger preparation, and thus a smaller pill could be made in all cases where extract of jalap was prescribed. According to Cadet de Gassicourt, water at ordinary temperatures, and in the old mode, acts so slowly that fermentation takes place before the active matter is all dissolved. Hence, if the extract be prepared without percolation, the residue, after the tincture has been decanted, should be digested with water at a temperature of about 90° or 100° F., which, while it is insufficient for the solution of the starch, enables the solvent to take up the active matter with a sufficient degree of rapidity.

One cwt. of jalap afforded, according to Brande, about fifty pounds of aqueous extract and fifteen of resin. The product of the former was somewhat less by infusion than by decoction, and the extract was proportionately stronger. There is reason to believe, as we have been informed on good authority, that what is sold for extract of jalap is sometimes prepared from tubers which have been previously exhausted of their resin by alcohol, and a spurious substance has been offered in considerable quantities in our markets for extract of jalap, which Bullock and Parrish proved to owe its purgative property to 42 per cent. of gamboge. (*A. J. P.*, 1862, p. 113.)

Extract of jalap is of a dark brown color, slightly translucent at the edges, and tenacious when not perfectly dry. It contains the resin and gummy extractive, and, consequently, has all the medicinal properties of the root; but it is not often exhibited alone, being chiefly used as an ingredient of purgative pills, for which it is adapted by its comparatively small bulk. It is most conveniently kept for use in the form of powder, which, however, is apt to attract moisture and to aggregate into a solid mass, unless carefully excluded from the air.

Dose, from two to eight grains (0.13 to 0.5 Gm.).[1]

[1] *Fluidextract of Jalap.*—The following process has been proposed by Procter. Take of jalap, in coarse powder, 16 troyounces; sugar, 8 troyounces; potassium carbonate, half a troyounce; alcohol, water, each, q. s. Add to the jalap one pint of a mixture consisting of two parts of alcohol and one of water, and set aside for twenty-four hours. Then put the mixture into a percolator, and pour on it diluted alcohol until half a gallon has passed. Evaporate the filtered liquid one-half, add the sugar and potassium carbonate, and evaporate to 12 fluidounces. Put the liquid, while warm, into a pint bottle, add four fluidounces of alcohol, and mix. The potassium carbonate renders the resin soluble in water, and probably favorably qualifies the irritating properties of the jalap. A fluidrachm of this extract would represent a drachm of jalap, so that the dose should be from 15 to 30 minims (0.9 to 1.8 Cc.). (*A. J. P.*, xxix. 108.)

EXTRACTUM KRAMERIÆ. U. S., Br.

EXTRACT OF KRAMERIA

(ęx-trăc'tŭm krą-mē'rī-æ)

Extract of Rhatany; Extractum Ratanhæ; Extrait de Ratanhia, *Fr. Cod.*; Ratanhaextrakt, *G.*; Estratto di ratania acquoso, *It.*; Extracto acuoso de ratania, *Sp.*

• "Krameria, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Water, *a sufficient quantity*. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, pack it in a conical glass percolator, and gradually pour Water upon it, until the infusion passes but slightly imbued with the astringency of the Krameria. Heat the liquid to the boiling point, strain, and evaporate the strained liquid, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), to dryness." *U. S.*

"Macerate coarsely powdered Krameria Root in twice its weight of Distilled Water for twenty-four hours; pack in a percolator; and percolate with more Distilled Water until the Krameria Root is exhausted. Evaporate the liquid to dryness." *Br.*

In selecting a plan for the preparation of this extract, it was undoubtedly wise to adopt percolation, with cold water as the menstruum. It is absolutely necessary to the success of the process that the root should be well and uniformly comminuted; the "No. 40 powder" of the U. S. Pharmacopœia is, therefore, preferable to the "coarse powder" of the British. The wood of the root yielded to Procter only 6.8 per cent. of extract, while the bark separated from the wood yielded 33 per cent. As the wood is of difficult pulverization, the inference is obvious that, in powdering the roots, the ligneous portion may be rejected with advantage. (*A. J. P.*, xiv. 270.) As a prolonged exposure of the infusion to the air is attended with the absorption of oxygen and the production of insoluble apotheme, it is desirable that the evaporation should be conducted rapidly, or in a vacuum. There scarcely appears to be occasion, in the case of rhatany, for heating and filtering the infusion before evaporation, the only use of which is to get rid of albumen, and this is not among the recognized ingredients of the root.

Very inferior extracts of rhatany are often sold. Such is the South American extract, which has been occasionally imported. As the product obtained by decoction is greater than that afforded by the official plan, the temptation to substitute the former is not always resisted, although it has been shown to contain nearly 50

per cent. of insoluble matter. Some druggists prepare the extract with an alcoholic menstruum, with a view to the greater product, but the extract thus prepared has from 20 to 30 per cent. less of the active principle than the official. A substance has been shown to us, said to have been imported as extract of rhatany from Europe, which was nearly tasteless, and was plausibly conjectured to be the dried coagulated matter of old tincture of kino.

Extract of krameria should have a reddish-brown color, a smooth shining fracture, and a very astringent taste, and should be almost entirely soluble in water. Its virtues may be considered as in proportion to its solubility. It is much used for all the purposes for which the astringent extracts are employed.

Dose, from five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Trochisci Krameriæ, *U. S.* (*Br.*); Trochiscus Krameriæ et Cocainæ, *Br.*

EXTRACTUM LEPTANDRÆ. U. S.

EXTRACT OF LEPTANDRA

(ęx-trăc'tŭm lęp-tăn'drę)

Extract of Culver's Root; Extrait de Leptandra, *Fr.;* Leptandrawurzelextrakt, *G.*

* "Fluidextract of Leptandra, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Glycyrrhiza (peeled, Russian), in No. 80 powder, *a sufficient quantity,* to make *twenty-five grammes* [or 386 grains]. Evaporate the Fluidextract of Leptandra in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to complete dryness. Reduce the product to a fine powder and add enough powdered Glycyrrhiza to make the finished Extract weigh *twenty-five grammes* [or 386 grains]. Mix thoroughly." *U. S.*

This extract will furnish practitioners who have been in the habit of prescribing the so-called *leptandrin,* with a uniform preparation.

Dose, from five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Pilulæ Catharticæ Vegetabiles, *U. S.*

EXTRACTUM MALTI. U. S.

EXTRACT OF MALT

(ęx-trăc'tŭm mâl'tī)

Essence (Extrait) de Malt, *Fr.;* Malzextrakt, *G.*

* "Malt, in coarse powder, not finer than No. 12, *one thousand grammes* [or 35 ounces av., 120 grains]; Water, *a sufficient quantity.* Upon the powder, contained in a suitable vessel, pour *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water, and macerate for six hours. Then add *four thousand cubic centimeters* [or 135 fluidounces, 122 minims] of Water, heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath, or vacuum apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey.

Extract of Malt should be kept in well-closed vessels, in a cool place." *U. S.*

Under the name of extract of malt, two distinct preparations have been put upon the market, the one being a very strong beer, the other an extract prepared from malt, and chiefly composed of dextrin and glucose, with some albumen and phosphates. The object of the U. S. process is to obtain all of the soluble principles of malt in a permanent form. To secure this, strict attention to the details of the process is necessary. Good extract of malt should contain no starch, have the consistence of thick honey, a brown color, and should be free from empyreumatic taste. A great deal of commercial extract of malt is adulterated with glucose to a surprising extent.

The above process does not differ materially from that of L. W. Jassey (*J. P. C.,* 4e sér., xvi. 440), who recommends the following method.[1] Macerate malt for three hours in its weight of cold water, then add four times its weight of water, and carefully raise the temperature to 65° C. during one hour. Filter, boil the residue with three parts of water for a quarter of an hour, remove from the fire, and allow to cool to 75° C., filter, and express the residue. Mix the liquids, maintain for some time at a temperature of 50° C., until the starch is converted into sugar. Reduce to one-third the volume by gentle boiling, allow to stand over night, filter through a woollen strainer, and evaporate upon a water bath to the consistence of an extract. A *dry extract of malt* has come into extensive use as an infants' food, made by artificially drying the thick syrupy extract. It is in the form of a straw-colored, coarse powder, and is given dissolved in milk or water. O. F. Romer and H. R. Randoll of Brooklyn, have patented several improvements in the process of making extract of malt,—namely, 1, the properly ground malt is treated with an alkaline solution, in order to neutralize the fatty acids which usually impart a bad taste to the product; 2, the extract is separated from the solid matters by pressing in press cloths, where-

[1] Fellerer recommends the following as being a practical method for the production of malt extract: 1 kilo of malt is broken up and mixed with 1500 Cc. of water of 50° C. and 10 drops of concentrated hydrochloric acid. The mash must be kept for two hours at a temperature of 45° C., after which 3500 Cc. of water at 65° C. is added. After two hours, during which time the temperature must be kept at 60°, it is strained, the liquid filtered through coarse cloth and evaporated *in vacuo.* Malt extract prepared in this way is darker than the usual preparations in the market (which are often clarified by means of albumin), but is sweet and pleasant to the taste. If a lighter color is desired, the temperature should not be allowed to rise above 45° to 50° C.; this has, however, the disadvantage of producing an extract of less sweetness. The hydrochloric acid aids the diastasic action very materially. (*Ph. Ztg.,* 1897, 897.)

by it is obtained as a clear liquid with scarcely any loss. (*N. R.*, 1880, 179.) Pharmaceutically, extract of malt has been used as an emulsifying agent; it makes a good basis for a cod liver oil emulsion, for which purpose it is admirably adapted therapeutically.

Dose, from one to four fluidrachms (3.75 to 15 Cc.).

EXTRACTUM NUCIS VOMICÆ. U. S., Br.

EXTRACT OF NUX VOMICA

(ĕx-trăc'tŭm nū'cĭs vŏm'ĭ-cæ)

"Extract of Nux Vomica, when assayed by the following process, should be found to contain 5 percent. of strychnine." *U. S.*

"An Extract containing 5 per cent. of Strychnine." *Br.*

Extractum Nucum Vomicarum Spirituosum (vel Alcoholicum); Extrait de Noix Vomique, *Fr. Cod.*; Extractum Strychni, *P. G.*; Weingeistiges Krähenaugenextrakt, Brechnussextrakt, Strychnossamenextrakt, *G.*; Estratto di noce vomica alcoolico, *It.*; Extracto alcoholico de nuez vomica, *Sp.*

• "Nux Vomica, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, Water, Alcohol, Sugar of Milk, dried and in fine powder, each, *a sufficient quantity*. Mix *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Acetic Acid with *thirteen hundred cubic centimeters* [or 43 fluidounces, 460 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then Water, until the percolate passes but faintly imbued with bitterness, and the Nux Vomica is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and, having heated the remainder to boiling, filter, and evaporate the filtrate to a soft extract; dissolve this in the reserved portion, and add enough Water to make the liquid measure *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims]. To the liquid thus obtained, add *three thousand cubic centimeters* [or 101 fluidounces, 212 minims] of Alcohol, shake the mixture well, and set it aside for twenty-four hours, with occasional agitation. Filter the liquid through paper, and wash the residue in the filter with a mixture of Alcohol three volumes, and Water one volume, until the washings are only faintly bitter. Evaporate the filtrate and washings in a porcelain dish, on a water-bath, to dryness. Determine, by the method given below, the percentage of strychnine in the dry Extract; ascertain, by calculation, the amount of strychnine in the remainder of the Extract; add to this enough well-dried Sugar of Milk to bring the quantity of strychnine in the final dry Extract of Nux Vomica to 5 percent. of the total weight; and, when thoroughly powdered and mixed, transfer the Extract to small, well-stoppered vials.

Extract of Nux Vomica, when assayed by the following process, should be found to contain 5 percent. of strychnine." *U. S.*

Assay. U. S. (8th Rev.)—"Extract of Nux Vomica, *two grammes;* Distilled Water, Ether, Chloroform, Ammonia Water, Sulphuric Acid Solution (3 percent. H_2SO_4), Nitric Acid (sp. gr. 1.40), Sodium Hydroxide Solution (1 in 10), Tenth-normal Sulphuric Acid V.S., Fiftieth-Normal Potassium Hydroxide V.S., Iodeosin T.S., each, *a sufficient quantity*. Introduce the Extract of Nux Vomica into a beaker, and dissolve it in 25 Cc. of a mixture of 16 Cc. of ether, 5 Cc. of chloroform, and 4 Cc. of ammonia water. When dissolved, transfer it to a separator, rinsing the beaker with a little chloroform and adding the rinsings to the separator. Insert the stopper securely and shake the separator carefully for a few minutes. Draw off the aqueous layer into another separator, washing the ether-solution and separator with a little water, and adding this to the second separator. Then shake out the aqueous liquid with two portions of 15 and 10 Cc., respectively, of chloroform, and add these to the first separator. If a few drops of the liquid left in the second separator still give a reaction with mercuric potassium iodide T.S. after acidulating, repeat the shaking out with 10 Cc. more of chloroform. Now shake out the chloroformic solution in the first separator with three portions of 15, 10, and 10 Cc. of sulphuric acid solution (3 percent.), and collect the combined acid solutions in another separator. Introduce a small piece of red litmus paper, add enough ammonia water to render the liquid alkaline, and extract the mixture with three portions, respectively, of 15, 10, and 10 Cc. of chloroform. Draw off the chloroformic solutions into a beaker, and evaporate the chloroform with the aid of a water-bath. Dissolve the alkaloidal residue in the beaker in 15 Cc. of 3 percent. sulphuric acid solution by the aid of a water-bath, and allow the liquid to cool. To this solution add 3 Cc. of a cooled mixture of equal volumes of nitric acid (specific gravity 1.40) and distilled water, and after rotating the liquid a few times, set it aside for exactly ten minutes, stirring it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10), and wash the beaker three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not quite turbid, add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating

motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter, wetted with chloroform, into a flask. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the flask, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath, very carefully, to avoid decrepitation. To the alkaloidal residue, add 10 Cc. of tenth-normal sulphuric acid V.S., 5 drops of iodeosin T.S., about 90 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. until the aqueous liquid just turns pink. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 10 (the 10 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.0332, and this product by 50, which will give the percentage of strychnine contained in the Extract of Nux Vomica." *U. S.*

"Liquid Extract of Nux Vomica, 11 *fl. ounces* (Imperial measure) or 550 cubic centimetres; Milk Sugar, in fine powder, *a sufficient quantity*. Ascertain the proportion of Milk Sugar required for *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Liquid Extract by the following experiment on *one fluid ounce* (Imp. meas.) or fifty cubic centimetres.

Evaporate *one fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Liquid Extract of Nux Vomica in a counterpoised dish on a water-bath to a moderately firm extract, and weigh. The difference between the weight of the extract and *one hundred and thirty-one and a quarter grains* (Imp.) or fifteen grammes, multiplied by ten, will give the amount of Milk Sugar required for the remaining *ten ounces* (Imp. meas.) or five hundred cubic centimetres of the Liquid Extract of Nux Vomica.

Distil the alcohol from *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Liquid Extract of Nux Vomica; to the residue add the quantity of Milk Sugar shown to be required by the above experiment; mix; evaporate to the consistence of a firm extract, which should weigh *three ounces* (Imp.) or one hundred and fifty grammes." *Br.*

The process of the Br. Pharm. directs the evaporation of the standardized liquid extract of nux vomica and the addition of sufficient sugar of milk to the residue to make the extract contain 5 per cent. of strychnine. The finished product "has about two-thirds the total alkaloidal strength of the Extract of Nux Vomica of the Br. Pharm. of 1885." *Br.*

Extract of nux vomica differs from that of the U. S. Pharm. 1890 in its mode of preparation. Acetic acid is the most effective menstruum for nux vomica, but it has the disadvantage of also extracting inert constituents; it leaves the fixed oil in the marc and this is a great point in its favor. The object of concentrating the acetous liquid extract, adding alcohol and filtering, is to precipitate the inert constituents.

The U. S. P. (8th Rev.) standard of strength for extract of nux vomica differs from that of the U. S. P. 1890 in that the former requires 5 per cent. of strychnine while the latter demanded 15 per cent. of total alkaloids. The gain has been in the direction of greater definiteness and the adoption of the same standard as that used by the British Pharmacopœia. The assay process is practically that of H. N. Gordin.

If the extract is kept in powder, it is apt to agglutinate into a tough mass. According to Zippel, this may be prevented by adding a little water before the close of the evaporation, and then continuing the evaporation to dryness. Recluz obtained from sixteen ounces of nux vomica the average product of one ounce and a quarter; the yield by the U. S. process should be about 25 per cent. of the weight of the drug used. (See *Proc. A. Ph. A.*, 1894, 551, 643; *P. J.*, 1894, 137.)

Dose, one-fourth to one-half of a grain (0.016 to 0.032 Gm.).

Off. Prep.—Tinctura Nucis Vomicæ, *U. S.*

EXTRACTUM OPII. U. S., Br.

EXTRACT OF OPIUM

(ẹx-trăc'tŭm ō'pĭ-ī)

"An Extract containing 20 per cent. of morphine. *Br.*[1]

Extractum Thebaicum; Extrait d'Opium, *Fr. Cod.*; Extrait Thébaïque, *Fr.*; Extractum Opii, *P. G.*; Opiumextrakt, *G.*; Estratto di oppio acquoso, *It.*; Extracto acuoso de opio, *Sp.*

* "Powdered Opium, *one hundred grammes* [or 3 ounces av., 231 grains]; Sugar of Milk, recently dried and in fine powder, Water, each, *a sufficient quantity*. Rub the Powdered Opium, in a mortar, into a smooth paste with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water; then transfer to a bottle of the capacity of *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], wash the mortar with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of water in successive portions, and add the washings to the contents of the bottle. Cork the bottle, and shake it vigorously once every two hours during twelve hours. Then filter through a rapidly acting, double filter, and pour water on the magma slowly, until the filtrate passes nearly colorless and only faintly bitter.

Concentrate the filtrate and washings in a tared dish, on a water-bath, until the contents weigh about *two hundred grammes* [or 7 ounces av., 24 grains], and allow the Extract

[1] The U. S. P. (8th Rev.) requires extract of opium to contain 20 per cent. of crystallized morphine, while the morphine in the British extract is anhydrous: the latter is therefore about 6 per cent. stronger than the U. S. P. extract.

to become cold. Then weigh it accurately, transfer *twelve grammes* to an Erlenmeyer flask having a capacity of about *one hundred cubic centimeters*, and determine in this portion the amount of morphine by the process of assay given below, using the same quantities of liquids as there directed for *four grammes* of the dry Extract. In another portion of *five grammes* determine the amount of water by drying it in a flat-bottomed dish, at 100° C. (212° F.), until it ceases to lose weight. From the results thus obtained, ascertain by calculation the amount of morphine and of water contained in the remainder of the Extract, add to this enough well-dried Sugar of Milk to bring the quantity of morphine in the final dry Extract to 20 percent., then evaporate the whole to dryness, reduce it to powder, and transfer it to small, well-stoppered vials." *U. S.*

"Opium, sliced, 1 *pound* (Imperial) or 1000 grammes; Distilled Water, 6 *pints* (Imp. meas.) or 7½ litres. Set aside the sliced Opium with one-third of the Distilled Water for twenty-four hours; express the liquid; thoroughly mix the residue of the Opium with another third of the Distilled Water; set aside for twenty-four hours; express; repeat the operation with the remaining third of the Distilled Water; mix the liquids; strain through flannel; evaporate to about *half a pound* (Imp.) or five hundred grammes.

Test.—Analyzed as described under 'Opium,' using 7 grammes of the Extract in place of the 14 grammes of Opium, this Extract should yield 20 per cent. of morphine. To obtain Extract of Opium of proper strength and consistence, stronger and weaker extracts may be mixed, and stronger extracts may be diluted with Distilled Water or with Milk Sugar as may be necessary." *Br.*

Assay.—"Extract of Opium, dried at 100° C. (212° F.), *four grammes;* Ammonia Water, *two and two-tenths cubic centimeters;* Alcohol, Ether, Water, Lime Water, each, *a sufficient quantity*. Dissolve the Extract of Opium in 30 Cc. of water, filter the solution through a small filter, and wash the filter and residue with water, until all soluble matters are extracted, collecting the washings separately. Evaporate, in a tared dish, on a water-bath, first, the washings to a small volume, then add the first filtrate, and evaporate the whole to a weight of 10 Gm. Rotate the concentrated solution in the dish, until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the dish with a few drops of water at a time, until the entire solution weighs 15 Gm. Add 7 Gm. (or 8.5 Cc.) of alcohol, shake the flask well, then add 20 Cc. of ether, and repeat the shaking. Now add the ammonia water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours, or over night.

Remove the stopper carefully, and, should any crystals adhere to it, brush them into the flask. Place in a small funnel two rapidly acting filters, of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ether-solution as completely as possible upon the inner filter. Add 15 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 15 Cc. of ether. Then pour into the filter the liquid in the flask, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when the liquid has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 10 Cc. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-liquor, and afterwards wash them with alcohol (previously saturated with powdered morphine), added drop by drop from a pipette. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc., or more if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.), until its weight remains constant, then carefully transfer the crystals of morphine to a tared watch-glass and weigh them.

Transfer the crystals (which are not quite pure) to an Erlenmeyer flask, add lime water in the proportion of 10 Cc. for each 0.1 Gm. of morphine, and shake the flask at intervals for twenty-five minutes. Pass the liquid through two counterpoised, rapidly acting, plainly folded filters, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), and rinse the flask with additional lime water, passing the washings through the filter until the filtrate, after acidulation, no longer yields a precipitate with mercuric potassium iodide T.S. Then press the filters between bibulous paper, dry them to a constant weight, and weigh the contents of the inner filter, using the outer as a counterpoise. Subtract the weight of the insoluble matter, on the filter, from the weight of the impure morphine previously found, and the difference, multiplied by 25, will be the percentage of pure crystalline morphine contained in the Extract of Opium." *U. S.*

The process for the U. S. P. extract differs from that formerly official in several particulars, powdered opium being used instead of opium, and notwithstanding that the powdered opium is standardized, the extract is assayed, and the percentage of morphine adjusted to 20 per cent., so that the extract of opium can now be depended upon to contain slightly more than twice as much morphine as opium of the minimum official strength. The U. S. P. extract is about 1-9th stronger than that of U. S. 1890.

The U. S. P. (8th Rev.) process is a great improvement over those formerly official; in addition to the definite strength of the extract, its reduction to a pulverulent form will enable the pharmacist to dispense it more accurately and conveniently.

As purely aqueous preparations of opium have been found to agree better with certain individuals than opium alone or its alcoholic preparations, there is reason to believe that there are in the crude drug one or more principles, which are capable of causing nausea, headache, nervous disturbances, etc., and which are insoluble in water, though extracted by alcohol or ether. (See *Opium Deodoratum.*)

Dose, one-fourth to one grain (0.016 to 0.065 Gm.).

Off. Prep.—Extractum Opii Liquidum, *Br.;* Emplastrum Opii, *U. S.*

EXTRACTUM OPII LIQUIDUM. Br.

LIQUID EXTRACT OF OPIUM

(ĕx-trăc'tŭm ō'pī-ī lĭq'uĭ-dŭm)

"A Liquid Extract containing ¾ grain of morphine in 110 minims (0.75 gramme in 100 cubic centimetres)." *Br.*

"Extract of Opium, ¾ *ounce* (Imperial) or 18.75 grammes; Distilled Water, 16 *fl. ounces* (Imp. meas.) or 400 cubic centimetres; Alcohol (90 per cent.), 4 *fl. ounces* (Imp. meas.) or 100 cubic centimetres. Mix the Extract of Opium with the Distilled Water; set aside for an hour, stirring frequently; add the Alcohol; set aside in a cool place for twenty-four hours; filter. The product should measure *one pint* (Imp. meas.) or five hundred cubic centimetres. Specific gravity from 0.985 to 0.995.

Test.—Analyzed as described under 'Tinctura Opii,' this Liquid Extract should yield an amount of morphine, reckoned as anhydrous, corresponding to not less than 0.7 gramme nor more than 0.8 gramme in 100 cubic centimetres. Each fluid ounce of Liquid Extract of Opium represents 16½ grains of Extract of Opium; 20 cubic centimetres represent 0.75 gramme." *Br.*

In the last revision of the British Pharmacopœia this preparation was reduced in morphine strength 25 per cent.

It is a good preparation, one which has long been needed, and in the absence of which from the Pharmacopœia empirical preparations have obtained a certain vogue. It is well known that in opium there are principles soluble in alcohol but not in water, which often produce various disagreeable effects not experienced from the aqueous extract; what was wanted was a liquid preparation meeting this demand. All that was required was to make an aqueous solution of solid extract, and to add something to preserve it. The British Pharmacopœia uses alcohol for the purpose, and in the original formula employed it in such proportion that an Imperial pint of the liquid should contain three fluidounces of the spirit, or between one-sixth and one-seventh by measure. But this amount of alcohol, according to Squire, is insufficient for its preservation, and should be doubled. In the present Pharmacopœia the spirit has been increased to four fluidounces, and the water diminished from seventeen to sixteen fluidounces; but even with this increase the spirit constitutes only one-fifth, which is considerably short of the proportion recommended by Squire. A preparation similar to the British was made some years since by Eugene Dupuy of New York. (See *Opium.*) In the *Deodorized Tincture of Opium* of the U. S. Pharmacopœia the advantages of the preparation have, we think, been still better secured.

Dose, five to thirty minims (0.3 to 1.8 Cc.).

EXTRACTUM PHYSOSTIGMATIS. U. S., Br.

EXTRACT OF PHYSOSTIGMA

(ĕx-trăc'tŭm phȳ-sŏ-stĭg'mă-tĭs)

Extract of Calabar Bean; Extractum Fabæ Calabaricæ; Extrait de Fève de Calabar, *Fr. Cod.;* Kalabarbohnenextrakt, Physostigmaextrakt, *G.*

* "Physostigma, in No. 80 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Glycyrrhiza, (peeled, Russian), in No. 80 powder, each, *a sufficient quantity.* Moisten the Physostigma with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three thousand cubic centimeters* [or 101 fluidounces, 3½ fluidrachms] of percolate are obtained, or the Physostigma is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; mix this with the reserved portion, and evaporate, at or below the above-mentioned temperature, on a water-bath, to dryness. Remove *one gramme* of the Extract, and assay this by the process given below; from the results thus obtained, ascertain by calculation the amount of ether-soluble alkaloids contained in the remainder of the Extract, add to this enough powdered Glycyrrhiza to bring the quantity of the alkaloids in the finished powdered Extract to 2 percent., reduce to powder, mix thoroughly, and transfer it at once to well-stoppered, amber-colored vials. Extract of Physostigma, when assayed by the following process, should be found to contain 2 percent. of ether-soluble alkaloids." *U. S.*

"Calabar Bean, in No. 40 powder, 1 *pound* (Imperial) or 1000 grammes; Alcohol (90 per cent.), 4 *pints* (Imp. meas.) or 5 litres; Milk Sugar, in fine powder, *a sufficient quantity*. Mix the powdered Calabar Bean with *one pint* (Imp. meas.) or twelve hundred and fifty cubic centimetres of the Alcohol; set aside in a closed vessel for forty-eight hours, agitating occasionally; transfer to a percolator; when the liquid ceases to pass, add the remainder of the Alcohol so that it may slowly percolate through the powder; remove the marc and subject it to pressure; add the expressed liquid to the percolate; filter; recover most of the alcohol by distillation; transfer the residue to a counterpoised basin, and evaporate to the consistence of a very soft extract; weigh; then add three times its weight of Milk Sugar and mix thoroughly to produce a firm Extract. This preparation is one-fourth the strength of the Extract of Calabar Bean of the British Pharmacopœia of 1885." *Br.*

Assay. U. S. P. (8th Rev.)—"Extract of Physostigma, *one gramme;* Alcohol, Diluted Alcohol, Ether, Sodium Bicarbonate, Normal Sulphuric Acid V.S., Distilled Water, Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Iodeosin T.S., each, *a sufficient quantity*.

Transfer the Extract of Physostigma to a small porcelain dish, add 5 Cc. of diluted alcohol, and digest for five minutes in a water-bath below boiling temperature; then add about 5 Gm. of very clean, fine quartz sand, and evaporate to dryness on a water-bath, triturating thoroughly with a pestle to secure uniform admixture. When dry, carefully transfer the contents of the dish to an Erlenmeyer flask, add 100 Cc. of ether, and shake the flask. Then add 10 Cc. of an aqueous solution of sodium bicarbonate (1 in 20), and shake the contents vigorously at intervals for one hour. Allow the mixture to stand, and, when settled, decant 50 Cc. of the ether-solution into a separator, to which add a small piece of blue litmus paper, sufficient normal sulphuric acid V.S. to render the liquid acid, and 10 Cc. of distilled water. Shake the separator well for one minute, and draw off the aqueous layer into another separator. Repeat the shaking-out process, using 2 Cc. of normal sulphuric acid V.S. and 8 Cc. of distilled water, and add the acid aqueous layer to the second separator; again repeat the extraction, using 1 Cc. of normal sulphuric acid V.S. and 9 Cc. of distilled water, and add this to the second separator. To the combined acid liquids in the second separator, add 25 Cc. of ether, a small piece of red litmus paper, and sufficient sodium bicarbonate solution (1 in 20) to render it alkaline. Shake the separator for one minute, allow the liquids to separate, and draw off the ether into a beaker. Repeat the shaking-out process with 20 Cc. and again with 15 Cc. of ether added to the separator; shake each time for one minute, allow the liquids to separate, and draw off the ether into the beaker. Carefully evaporate the ether from the combined solutions by means of a water-bath, and, when dry, dissolve the residue in 2 Cc. of tenth-normal sulphuric acid V.S.; rinse the solution carefully into a 200 Cc. flask with distilled water, add enough distilled water to bring the volume to about 90 Cc., add 25 Cc. of ether, and having shaken the flask, add 5 drops of iodeosin T.S., then titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., until, after shaking, the aqueous liquid just acquires a pink color. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 2 (the 2 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0273, and this product by 200; the result will be the percentage of ether-soluble alkaloids contained in the Extract of Physostigma." *U. S.* As alcohol is the best solvent for the active principles of the bean, it is preferred in making the extract, and as it is possible to assay physostigma the U. S. P. (8th Rev.) changed the process so as to make this extract contain a definite proportion of alkaloids by assaying a small portion of the extract made by evaporating the tincture to dryness and from the results thus obtained determining the quantity of powdered glycyrrhiza necessary to make the finished powdered extract contain 2 per cent. of alkaloids.

Dose, from one-twelfth to one-fourth of a grain (0.005 to 0.016 Gm.).

EXTRACTUM QUASSIÆ. U. S.

EXTRACT OF QUASSIA

(ĕx-trăc'tŭm quäs'sĭ-æ)

Extrait de quassia amara, *Fr. Cod.;* Extrait de Quassie (Bois amer), *Fr.;* Quassiaextrakt, *G.;* Estratto di quassia acquoso, *It.*

* "Quassia, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Water, Sugar of Milk, recently dried and in fine powder, each, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Moisten the Quassia with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water, pack it firmly in a conical percolator, and gradually pour Water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its bulk by boiling, and strain; then evaporate, by means of a water-bath, to dryness and add enough Sugar of Milk to make the Extract weigh *one hundred grammes* [or 3 ounces av., 231 grains]. Mix thoroughly, reduce to fine powder, and transfer to well-stoppered bottles." *U. S.*

The British Pharmacopœia (1898) no longer recognizes Extract of Quassia.

A change was made in the process for this extract at the last revision of the U. S. Pharmacopœia. The former extract of pilular consistence was dropped and a powdered extract

adopted, of which 1 grain represents 10 grains of quassia. This extract is scarcely half the strength of the former extract. The pilular aqueous extract of quassia was dark brown or black, and excessively bitter; it was likely to become dry and disposed to crumble by time. It concentrates a greater amount of tonic power within a given weight than any other extract of the simple bitters, and may, therefore, be given with great advantage in cases in which it is desirable to administer this class of substances in as small a bulk as possible.

Dose, from one to two grains (0.065 to 0.13 Gm.).

EXTRACTUM RHAMNI PURSHIANÆ. U. S. (Br.)

EXTRACT OF CASCARA SAGRADA

(ĕx-trăc'tŭm rhăm'nī pürsh-I-ā'næ)

Extractum Cascaræ Sagradæ, *Br.;* Extrait de Cascara Sagrada, *Fr. Cod.;* Cascara Sagrada-Extrakt, Amerikanisches Faulbaumrindenextrakt, *G.;* Extracto alcoholico de cascara sagrada, *Sp.*

* "Cascara Sagrada, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, Glycyrrhiza (peeled, Russian), in No. 80 powder, each, *a sufficient quantity,* to make *two hundred and fifty grammes* [or 8 ounces av., 358 grains]. Mix *one hundred and twenty-five cubic centimeters* [or 4 fluidounces, 109 minims] of Alcohol with *eight hundred and seventy-five cubic centimeters* [or 29 fluidounces, 282 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the drug is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder on a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup. Mix this with the reserved portion, and continue the evaporation, at or below the above-mentioned temperature, to dryness. Reduce the Extract to fine powder, and add enough powdered Glycyrrhiza to make the product weigh *two hundred and fifty grammes* [or 8 ounces av., 358 grains]. Mix thoroughly." *U. S.*

"Moisten Cascara Sagrada, in No. 20 powder, with Distilled Water, and let it remain a few hours to soften and swell; then place it loosely in a percolator and percolate with more Distilled Water until it is exhausted. Evaporate on a water-bath to dryness." *Br.* This powdered extract was made official in the U. S. P. (8th Rev.) for the first time; 1 part of the extract represents 4 parts of the drug.

The present British preparation (1898) is a dry extract. This preparation well represents the virtues of the bark, and furnishes a good means of administering this purgative in pilular form.

Dose, from two to eight grains (0.13 to 0.5 Gm.).

EXTRACTUM RHEI. U. S., Br.

EXTRACT OF RHUBARB

(ĕx-trăc'tŭm rhē'ī)

Extractum Rhei Alcoholicum; Extrait de Rhubarbe, *Fr. Cod.;* Extractum Rhei, *P. G.;* Rhabarberextrakt, *G.;* Estratto di rabarbaro acquoso, *It.;* Extracto acuoso de ruibarbo, *Sp.*

* "Fluidextract of Rhubarb, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Fluidextract of Rhubarb in a porcelain dish, by means of a water-bath, with constant stirring, at a temperature not exceeding 50° C. (122° F.), to a pilular consistence." *U. S.*

"Moisten Rhubarb Root, in No. 20 powder, with Alcohol (60 per cent.), and set aside for forty-eight hours; transfer to a percolator; slowly pass as much of the Alcohol as may be sufficient to exhaust the Rhubarb Root. Remove most of the alcohol by distillation, and evaporate the residual liquid to dryness." *Br.*

The U. S. P. (8th Rev.) extract is practically identical with that of the former revision, notwithstanding the fact that the present extract is made by evaporating the fluidextract, because the menstruum for exhausting the rhubarb was the same in each case, *i.e.,* 4 volumes of alcohol and 1 volume of water.

The British extract (1898) is now nearly identical with the U. S. preparation; the menstruum used for the former is, however, slightly more aqueous. Rhubarb yields all its active matter to water and alcohol; but, unless the evaporation be performed with great care and with a moderate heat, it is certain that the purgative principle is to a greater or less extent injured or dissipated in the process, and the extract may thus become even less efficient than the root. Among other consequences which result from the boiling temperature is the formation of a compound of the tannin and starch, which is insoluble in cold water, and upon its precipitation probably carries with it a portion of the purgative principle. There is, moreover, reason to believe that this principle is volatilizable by heat, and that a portion of it escapes with the vapor. When properly prepared, the extract has decidedly the peculiar odor of rhubarb.

Dose, from two to ten grains (0.13 to 0.65 Gm.).

EXTRACTUM SCOPOLÆ. U. S.

EXTRACT OF SCOPOLA

(ęx-trăc'tŭm scǫ-pō'læ)

Extrait de Racine de Scopola, *Fr.;* Scopolawurzelextrakt, *G.*

* "Fluidextract of Scopola, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Fluidextract of Scopola in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), with constant stirring, to a pilular consistence. When assayed as directed below, Extract of Scopola should contain 2 percent. of mydriatic alkaloids. If the extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 2 percent." *U. S.*

Assay of Extract of Scopola. U. S. (8th Rev.)—"The method to be employed is identical with that given for Extract of Belladonna Leaves, using *two grammes* of Extract of Scopola instead of the quantity of Extract of Belladonna Leaves there directed. [See page 470.] The product must be multiplied by 50 instead of 20." *U. S.*

This extract was introduced into the U. S. Pharmacopœia (8th Rev.) for the first time. It is largely used by the manufacturers of Belladonna plasters, as it has been shown to contain mydriatic alkaloids equal in therapeutic value to those found in belladonna, and the proportion of the alkaloids is more uniform in the various lots of root in commerce when compared with belladonna root.

Dose, one-eighth to one-fourth of a grain (0.008 to 0.016 Gm.).

EXTRACTUM STRAMONII. U. S., Br.

EXTRACT OF STRAMONIUM

(ęx-trăc'tŭm strą-mō'nĭ-ī)

Extrait de Stramoine (feuille), *Fr. Cod.;* Stechapfelblätterextrakt, *G.*

* "Fluidextract of Stramonium, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Fluidextract of Stramonium in a porcelain dish, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), with constant stirring, to a pilular consistence. When assayed as directed below, Extract of Stramonium should contain 1.4 percent. of mydriatic alkaloids. If the Extract should be found by the assay to contain more than this percentage, sufficient powdered sugar of milk should be added to reduce it to the standard of 1.4 percent." *U. S.*

"Pack Stramonium Seeds, in No. 40 powder, in a percolator; exhaust the powder by slow percolation with Alcohol (70 per cent.); remove most of the alcohol from the percolate by distillation; evaporate the residual liquid to the consistence of a firm extract." *Br.*

Assay of Extract of Stramonium. U. S. (8th Rev.)—"The method to be employed is identical with that given for Extract of Belladonna Leaves, using *five grammes* of Extract of Stramonium." *U. S.* (See page 470.)

This extract differs from that formerly official, because it is now made by evaporating the fluidextract of stramonium *leaves;* the U. S. P. 1890 extract and the British extract are made from the *seed.* The change was made because it was shown that the leaves were as uniform in quality as the seeds and a reliable assay process could be provided which would definitely fix the quality; the fixed oil present in the seeds constitutes an objection to their use. The use of 70 per cent. alcohol by the British Pharmacopœia will probably make a stronger extract by rejecting some of the inert constituents of the seeds soluble in water. According to the table of Recluz, sixteen ounces of the seed afford two ounces and two drachms of extract by maceration in diluted alcohol, and one ounce and a half by decoction.

Dose, from one-sixth to one-fourth of a grain (0.010 to 0.016 Gm.).

Off. Prep.—Unguentum Stramonii, *U. S.*

EXTRACTUM STROPHANTHI. Br.

EXTRACT OF STROPHANTHUS

(ęx-trăc'tŭm strǫ-phăn'thī)

Extrait de Strophantus Kombé (Semence), *Fr. Cod.;* Strophantusextrakt, *G.*

"Strophanthus Seeds, reduced to No. 30 powder, and dried at 110° F. (43.3° C.), 1 *ounce* (Imperial) or 25 grammes; Purified Ether, Alcohol (90 per cent.), Milk Sugar, of each *a sufficient quantity.* Pack the dried powder in a percolator, and, having moistened it with the Ether, macerate for twenty-four hours; then allow percolation to proceed, continuing the addition of the Ether until the liquid passes through colorless. Remove the marc from the percolator, and dry it, gradually heating it to 120° F. (48.9° C.). Again reduce it to powder, repack in the percolator, and moisten with the Alcohol. Macerate for forty-eight hours, then pour on successive quantities of the Alcohol, percolating slowly, until *half a pint* (Imp. meas.) or two hundred and fifty cubic centimetres of liquid is obtained. Evaporate most of the alcohol; transfer the residual liquid to a counterpoised basin; concentrate until the liquid begins to thicken; then add sufficient finely powdered Milk Sugar to produce *two ounces* (Imp.) or fifty grammes of Extract, in powder." *Br.*

This preparation of the British Pharmacopœia closely resembles an "abstract" of the U. S. P. 1880; an important detail, in our opinion, has been neglected in not washing the fatty matter extracted by the ether with diluted alcohol to remove active constituents held by the fatty substances, then evaporating the solu-

tion and incorporating the residue with the extract. The U. S. and Br. processes for the tincture overcome the necessity for the use of ether by employing alcohol containing enough water to leave the fatty substances in the percolator residue, and the same expedient might have proved of value in the process for this preparation.

This extract fills a very decided want of a solid preparation of strophanthus that can be administered in pill and capsule, and is without doubt efficient. A grain of it may be considered to represent five minims of the U. S. (8th Rev.) tincture of strophanthus.

Dose, as given in the British Pharmacopœia, from one-fourth to one grain (0.016 to 0.065 Gm.).

EXTRACTUM SUMBUL. U. S.

EXTRACT OF SUMBUL

(ĕx-trăc'tŭm sŭm'bŭl)

Extract of Muskroot; Extrait de Racine de Sumbul, *Fr.;* Sumbulwurzelextrakt, Moschuswurzelextrakt, *G.*

* "Fluidextract of Sumbul, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Fluidextract of Sumbul in a porcelain dish, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), with constant stirring, to a pilular consistence." *U. S.* This is a new official extract, intended to furnish a convenient method of administering sumbul in the form of pills or capsules.

Dose, two to five grains (0.13 to 0.32 Gm.).

EXTRACTUM TARAXACI. U. S., Br.

EXTRACT OF TARAXACUM

(ĕx-trăc'tŭm tă-răx'ă-cī)

Extract of Dandelion; Extrait de Dent-de-lion, *Fr.;* Löwenzahnextrakt, *G.;* Estratto di tarassaco acquoso, *It.*

* "Taraxacum, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity.* Mix *one hundred and twenty-five cubic centimeters* [or 4 fluidounces, 109 minims] of Alcohol with *eight hundred and seventy-five cubic centimeters* [or 29 fluidounces, 282 minims] of Water, and, having moistened the powder with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of the mixture, pack it in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Taraxacum is exhausted. Evaporate the percolate, by means of a water-bath, to a pilular consistence." *U. S.*

"Crush fresh Taraxacum Root; press out the juice; allow the feculence to subside; heat the liquid to 212° F. (100° C.), and maintain the temperature for ten minutes; strain; evaporate to the consistence of a soft extract." *Br.*

The inspissated taraxacum juice of the former U. S. Pharmacopœias has been superseded by the present hydro-alcoholic extract, because of the very variable quality of the former; if the root is of good quality a better extract can be made by percolation and evaporation in the usual way.

The extract made from the juice is undoubtedly stronger when prepared from the root alone than from the whole plant. It is important that the root should be collected at the right season. The juice expressed from it in the spring is thin, watery, and of a feeble flavor; in the latter part of the summer, and in autumn, thick, opaque, cream-colored, very bitter, and abundant, amounting to one-third or one-half its weight. It may be collected in August, and afterwards until severe frost. According to Squire, frost has the effect of diminishing the bitterness and increasing the sweetness of the root. An extract prepared by inspissating the juice is more efficient than that prepared in the old way by decoction. The inspissation should be effected by exposing the juice in shallow vessels to a current of warm dry air, or by evaporation in a vacuum, and should not be unnecessarily protracted. Long exposure during evaporation changes the bitterness of the juice into sweetness, which is a sign of inferiority. In the British process it is wisely directed that before the evaporation of the juice it shall be exposed for a short time to a heat sufficient to coagulate the albumen, which is then separated and rejected as useless; it is indeed injurious, by favoring decomposition. As often found in the shops, the extract is dark-colored, sweet, and in all probability nearly inert. Houlton took more than an ounce of it in a day, without any sensible effect. (*P. J.,* i. 421.) When prepared from the root and leaves together, it has a greenish color. Brande states that one cwt. of the fresh root affords from twenty to twenty-five pounds of extract by decoction in water. The expressed juice yields from 11 to 25 per cent. of extract, the greatest product being obtained from plants collected in November, and the least in April and May. This extract deteriorates by keeping. It is conveniently given in an aromatic water.

Dose, from fifteen grains to a drachm (1 to 3.9 Gm.) three times a day.

FEL BOVIS. U. S.

OXGALL

(fĕl bō'vĭs)

"The fresh bile of *Bos taurus* Linné." *U. S.*

Fel Bovinum, Fel Tauri, Bilis Bubula, Ox Bile; Bile de Bœuf, *Fr. Cod.;* Ochsengalle, Rindsgalle, *G.;* Hiel de toro, *Sp.*

Chemical researches of a very thorough character have thrown much light on the subject of the constituents of gall. The most characteristic constituents of all galls, of whatever origin, are, first, the sodium or potassium salts of certain resinous acids known collectively as the "gall acids," and, secondly, certain coloring matters known as "gall pigments." The gall acids thus far made known are *glycocholic acid,* $C_{26}H_{43}NO_6$; *taurocholic acid,* $C_{26}H_{45}NSO_7$; *hyoglycocholic acid,* $C_{27}H_{43}NO_6$; *hyotaurocholic acid,* $C_{27}H_{45}NSO_6$; and *chenotaurocholic acid,* $C_{29}H_{49}NSO_6$. Of these, the first two occur in oxgall as sodium salts, although sometimes (in green gall) the first one is absent. The solutions of these gall acids, as well as their alkaline salts, give on addition of sugar and a drop of sulphuric acid a clear and strong purplish-red color (Pettenkofer's gall test). Drechsel modifies Pettenkofer's test as follows. Add to the concentrated alkaline solution of the biliary salts syrupy phosphoric acid. Next add a little cane sugar, and heat the test tube by setting it in the neck of a flask containing boiling water. After a short heating a characteristic red or reddish-violet color will make its appearance, even if only traces of biliary acids are present. (*N. R.*, 1882, p. 120.) They are also decomposed by the action of baryta water into non-nitrogenous acids and amido-compounds, as will be seen in the following reactions:

$$\underset{\text{Glycocholic acid.}}{C_{26}H_{43}NO_6} + H_2O = \underset{\text{Cholic acid.}}{C_{24}H_{40}O_5} + \underset{\text{Glycocoll (amido-acetic acid).}}{C_2H_5NO_2}$$

$$\underset{\text{Taurocholic acid.}}{C_{26}H_{45}NO_7S} + H_2O = \underset{\text{Cholic acid.}}{C_{24}H_{40}O_5} + \underset{\text{Taurine (amido-ethyl-sulphonic acid).}}{C_2H_7NO_3S}$$

The gall pigments are such unstable organic coloring matters that their individuality cannot be said to be thoroughly established. The researches of Staedeler (*Verhand. d. Naturf. Ges. in Zürich,* 8) and R. Maly (*Ann. Ch. Ph.,* 132, 129) have, however, given us a better knowledge of them. They are *bilirubin,* $C_{32}H_{36}N_4O_6$; *biliverdin,* $C_{32}H_{36}N_4O_9$; *bilifuscin,* $C_{16}H_{20}N_2O_4$; and *biliprasin,* $C_{16}H_{22}N_2O_6$. Of these, the first two seem to exist originally in the gall, and the others are probably derived from them. Hoppe-Seyler (*Ber. d. Chem. Ges.,* 7, p. 1065) has shown that the hæmoglobin and hæmatin of the blood can be changed into hydrobilirubin, a derivative of bilirubin, so that the origin of these gall pigments seems to be clearly shown. Oxgall contains, in addition, *cholesterine, choline, urea,* fats, which are the *glycerides of acetic and propionic acids,* mucus, and some inorganic salts, such as sodium and potassium chlorides, and sodium, potassium, calcium, and magnesium phosphates. The *sodium glycocholate* and *taurocholate* may be separated in the following manner. Dry oxbile is treated with absolute alcohol, and the tincture precipitated by ether in excess. Both salts are deposited, and the glycocholate crystallizes upon standing, the taurocholate remaining in an amorphous form, resembling oily or resinous matter. They may be separated more completely by taking advantage of their different relations to lead acetate and subacetate. Both the acids are precipitated by the subacetate, the glycocholate only by the acetate. If the deposit above referred to be dissolved in water, solution of lead acetate will throw down a lead glycocholate, while the addition of the lead subacetate to the remainder will precipitate the taurocholate. The acids may be separated from the salts of lead by sulphuric acid, and then recombined with soda. Both these glycocholates have been used in medicine as hepatic stimulants, and have been especially recommended in *gall-stones.*

Properties.—"A brownish-green or dark green, somewhat viscid liquid, having a peculiar, unpleasant odor, and a disagreeable, bitter taste. Specific gravity: 1.015 to 1.025 at 25° C. (77° F.). It is neutral, or has a faintly alkaline reaction upon litmus paper. A mixture of 2 drops of Oxgall and 10 Cc. of water, when treated, first, with a drop of a freshly prepared solution of 1 part of sugar in 4 parts of water, and afterwards with sulphuric acid, cautiously added, until the precipitate first formed is redissolved, gradually acquires a brownish-red color, changing, successively, to carmine, purple, and violet." *U. S.*

Dose, five to twenty grains (0.32 to 1.30 Gm.).

Off. Prep.—Fel Bovis Purificatum, *U. S.* (*Br.*).

FEL BOVIS PURIFICATUM. U. S. (Br.)

PURIFIED OXGALL

(fĕl bŏ'vĭs pū-rĭ-fĭ-cā'tŭm)

"The purified gall of the Ox; Bos Taurus." *Br.* 1885.

Fel Bovinum Purificatum, *Br.,* Purified Ox Bile; Fel Tauri Depuratum; Extractum Fellis Bovini; Extrait de Fiel de Bœuf, *Fr. Cod.;* Gereinigte Ochsengalle (Rindsgalle), *G.;* Bile cristallizzata di platner, *It.;* Hiel de toro preparada, *Sp.*

• "Oxgall, *three hundred cubic centimeters* [or 10 fluidounces, 69 minims]; Alcohol, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Evaporate the Oxgall, in a tared porcelain dish, on a water-bath, to about *one hundred grammes* [or 3 ounces av., 231 grains], then add to it the Alcohol, mix the whole thoroughly, and set it aside, well covered, for three or four days. Then decant the clear solution, filter the remainder, and, having mixed the liquids and distilled off the Alcohol, evaporate the residue to a pilular consistence." *U. S.*

"Evaporate *one pint* (Imperial measure) or five hundred cubic centimetres of fresh Ox Bile to one quarter of its volume; shake it with *half a pint* (Imp. meas.) or two hundred and fifty cubic centimetres of Alcohol (90 per cent.); set the mixture aside until the solid matter has subsided; decant the clear solution, and filter the remainder, washing the filter and

contents with a little more Alcohol (90 per cent.). Distil off most of the Alcohol from the mixed liquids, and evaporate the residue in a porcelain dish, by the heat of a water-bath, until it acquires the consistence of a thick extract." *Br.*

The object of this preparation is to furnish purified concentrated Oxgall in a condition in which it can be satisfactorily prescribed for internal administration. The addition of alcohol to the concentrated liquid is made for the purpose of separating albuminous matter.

Properties.—The U. S. Pharmacopœia describes Purified Oxgall, and requires it to respond to the following tests: "A yellowish-green, soft solid, having a peculiar odor, and a partly sweet and partly bitter taste. Very soluble in water and in alcohol. A solution of 1 part of Purified Oxgall in about 100 parts of water behaves toward sugar and sulphuric acid in the same manner as the solution mentioned under *Fel Bovis*. An aqueous solution of Purified Oxgall should be clear, and should remain transparent upon the addition of an equal volume of alcohol (evidence of proper purification)." *U. S.* "A yellowish-green hygroscopic substance, having a taste partly sweet and partly bitter, soluble in *water* and in *alcohol* (90 per cent.). A solution in twenty or thirty times its weight of *water*, when treated, first with a drop of freshly made syrup consisting of one part of Refined Sugar and four of *water*, and then with *sulphuric acid* cautiously added until the precipitate at first formed is redissolved, gradually acquires a cherry-red color, which changes in succession to carmine, purple, and violet. Its aqueous solution gives no precipitate on the addition of *alcohol* (90 per cent.) (absence of unpurified ox bile)." *Br.*

Refined oxgall, much used by painters, is prepared, according to Gray, in the following manner. Take of "fresh oxgall, one pint; boil, skim, and add one ounce of alum, and keep it on the fire for some time; to another pint, add one ounce of common salt in the same manner; keep them bottled up for three months; then decant off the clear; mix them in an equal proportion; a thick yellow coagulum is immediately formed, leaving the refined gall clear and colorless."

Uses.—Bile was formerly highly valued as a remedy in numerous complaints, and was considered peculiarly applicable to cases attended with deficient biliary secretion. Its use has, however, passed out of vogue, probably with insufficient reason, as it has been proven that the bile salts are the most powerful stimulants to the secretory activity of the liver known. We have employed it in large doses in *catarrhal jaundice* with apparently excellent results. Also, at our suggestion it has been used as a local application to sinuses and foul sores in horses, with favorable reports; recent researches show that the bile of venomous snakes, and probably to a less extent the bile of other animals, is antidotal to snake venom. (See *Snake Venom*, PART II.)

Dose, five to twenty grains (0.32 to 1.30 Gm.).

FERRI ARSENAS. Br.

IRON ARSENATE [Arseniate of Iron, Br. 1885]

(fĕr'rī är'sę-năs)

"Ferrous arsenate, $Fe_3(AsO_4)_2,6H_2O$, with ferric arsenate and some iron oxide." *Br.*

Ferrum Arsenicum; Ferrous Arsenate; Arséniate Ferreux, *Fr. Cod.*; Arséniate de Fer, *Fr.*; Arsensaures Eisen, Arsensaures Eisenoxydul, *G.*; Arseniato ferroso-ferrico, *It.*; Arseniato de hierro, *Sp.*

"Ferrous Sulphate, 20¾ *ounces* (Imperial) or 415 grammes; Sodium Arsenate, dried, 26½ *ounces* (Imp.) or 530 grammes; Sodium Bicarbonate, 4½ *ounces* (Imp.) or 90 grammes; Distilled Water, boiling, *a sufficient quantity*. Dissolve the Sodium Arsenate in about *five pints* (Imp. meas.) or two litres, and the Ferrous Sulphate in about *six pints* (Imp. meas.) or two thousand four hundred cubic centimetres of the Distilled Water; mix the solutions; add the Sodium Bicarbonate dissolved in a little cold Distilled Water; stir thoroughly; collect the resulting precipitate on a calico filter; wash until free from sulphates; squeeze the washed precipitate between folds of strong linen in a screw-press; dry it on porous bricks in a warm air-chamber, the temperature of which does not exceed 100° F. (37.8° C.)." *Br.*

This is an official salt of the British Pharmacopœia. The washed precipitate described in the process is ferrous arsenate ($Fe_3As_2O_8$). A portion of ferrous arsenate remains dissolved in the solution. This is precipitated by the sodium bicarbonate, which also neutralizes the sulphuric acid liberated during the reaction, and carbon dioxide is evolved, thus:

$$3FeSO_4.7H_2O + 2Na_2HAsO_4 + 2NaHCO_3 = Fe_3(AsO_4)_2.6H_2O + 3Na_2SO_4 + 17H_2O + 2CO_2$$

Ferrous arsenate is white when first formed, but quickly turns green on exposure to the air during the process of washing and drying, and finally becomes a ferroso-ferric arsenate of the probable composition $3Fe(FeO)AsO_4.16H_2O$. It is an amorphous powder, without odor or taste, insoluble in water, but readily dissolved by hydrochloric acid. The British Pharmacopœia gives the following characters of the salt: "A tasteless amorphous powder of a greenish color, insoluble in *water*, but readily dissolved by *hydrochloric acid*. It affords the reactions characteristic of ferrous and ferric salts and of arsenates. Each gramme dissolved in an excess of *sulphuric acid* diluted with *water* should not cease to give a blue precipitate with *solution of potassium ferricyanide* until at least 6.7 cubic centimetres of the *volumetric solution of potassium bichromate* have been added, corresponding to nearly 12½ per cent. of hydrous,

or 10 per cent. of anhydrous, ferrous arsenate. It should yield no characteristic reaction with the tests for sulphates." The quantitative test proves that there is a due proportion of ferrous oxide present; for the potassium dichromate oxidizes the ferrous oxide, and until this is wholly converted into ferric oxide a blue precipitate continues to be produced, ceasing, however, when the conversion is complete. Thomas S. Barrie (*C. D.*, 1900, 484) found that iron arsenate is of variable composition and that the percentage of ferrous oxide affords no reliable indication of the amount of arsenic anhydride in the dried iron arsenate. For Nicholl's method of estimating the quantity of arsenic in iron arsenate see *Y. B. P.*, 1903, 572, 577.

Uses.—Ferrous arsenate is said to unite the virtues of the two metals which enter into its composition, but the quantity of iron in any permissible dose is so small as to be nearly or quite insignificant, and the activity of the medicine is in fact due to the arsenic alone. The complaints in which it has been found efficient are those in which arsenic in other forms has proved to be a most valuable remedy, and, judging from our own observation, there is no one of them in which the common solution of potassium arsenite will not produce all the effects that can be obtained from the arsenical preparations, with which this ought undoubtedly to be ranked rather than with the chalybeates. Should the coexistence of an anæmic state of the system with any disease requiring the use of arsenic indicate the joint use of iron, it would be unsafe to depend on ferrous arsenate alone. This remedy is peculiarly useful in chronic affections of the skin, especially those of a scaly character, as *lepra, psoriasis,* and the advanced stage of *eczema* and *impetigo.* It is useful also in *lupus,* and, mixed with twelve times its weight of simple cerate, may be employed externally in *cancerous ulcers,* though much caution is requisite.

Dose, from one-tenth to one-eighth of a grain (0.006 to 0.008 Gm.), of which about one-half is ferrous oxide.

FERRI CARBONAS SACCHARATUS. U. S., Br.

SACCHARATED FERROUS CARBONATE

(fĕr'rī cär'bo-năs săc-ça-rā'tŭs)

"Saccharated Ferrous Carbonate should contain not less than 15 percent. of Ferrous Carbonate [$FeCO_3 = 115.05$], and should be kept in small, well-stoppered bottles." *U. S.* "Ferrous oxycarbonate, $xFeCO_3,yFe(OH)_2$, more or less oxidized, mixed with sugar; the ferrous salt, if reckoned as carbonate, $FeCO_3$, forming about one-third of the mixture." *Br.*

Saccharated Iron Carbonate; Saccharated Carbonate of Iron; Carbonas Ferrosus Saccharatus; Saccharure de Carbonate Ferreux, *Fr.*; Ferrum Carbonicum Saccharatum, *P. G.*; Zuckerhaltiges Kohlensaures Eisen, Zuckerhaltiges Ferrocarbonat, *G.*

• "Ferrous Sulphate, *fifty grammes* [or 1 ounce av., 334 grains]; Sodium Bicarbonate, *thirty-five grammes* [or 1 ounce av., 103 grains]; Sugar, in fine powder, Distilled Water, each, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Ferrous Sulphate in *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of hot Distilled Water, and the Sodium Bicarbonate in *five hundred cubic centimeters* [or about 17 fluidounces] of Distilled Water at a temperature not exceeding 50° C. (122° F.), and filter the solutions separately. To the solution of Sodium Bicarbonate contained in a flask having a capacity of about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] add, gradually, the solution of Ferrous Sulphate, and mix thoroughly by rotating the flask. Fill the flask with boiling Distilled Water, cork it loosely, and set the mixture aside. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a siphon, and then fill the flask again with hot Distilled Water, and shake it. Again draw off the clear liquid, and repeat the washing with hot Distilled Water in the same manner until the decanted liquid gives merely a slight cloudiness with barium chloride T.S. Finally drain the precipitate thoroughly on a muslin strainer, transfer it to a porcelain dish containing *eighty grammes* [or 2 ounces av., 360 grains] of Sugar, and mix it intimately. Evaporate the mixture to dryness, by means of a water-bath, reduce it to powder, and mix intimately with it, if necessary, enough well-dried Sugar to make the final product weigh *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

"Ferrous Sulphate, 2 *ounces* (Imperial) or 40 grammes; Ammonium Carbonate, 1¼ *ounces* (Imp.) or 25 grammes; Distilled Water, boiling, 2 *gallons* (Imp. meas.) or 6400 cubic centimetres; Refined Sugar, 1 *ounce* (Imp.) or 20 grammes. Dissolve the Ferrous Sulphate and the Ammonium Carbonate each in one-quarter of the Distilled Water; add the former to the latter with brisk stirring, in a deep cylindrical vessel; cover this so as to protect it as much as possible from the air; set the mixture aside for twenty-four hours; separate the supernatant liquid from the precipitate by means of a siphon; pour on the remainder of the Distilled Water; stir well; after subsidence remove the clear liquid; collect the precipitate on a calico filter; subject it to expression; triturate it with the Refined Sugar in a porcelain mortar; dry the mixture at a temperature not exceeding 212° F. (100° C.)." *Br.*

This was introduced into the U. S. P. in 1880; the process is identical with that of the former German Pharmacopœia. When solutions of ferrous sulphate and sodium carbonate are mixed together, there are formed, by double decomposition, sodium sulphate which remains in solution, and ferrous carbonate which falls as a pale-blue precipitate. This precipitate begins immediately to alter in nature by the ab-

sorption of oxygen, and, if washed and dried in the ordinary way, becomes ferric oxide, associated with a small quantity of the ferrous carbonate, which has escaped change. As the preparations of iron containing ferrous oxide are the most esteemed, the change which this precipitate undergoes has always been a matter of regret, and various attempts have been made to prevent it. Saccharine matter has been ascertained to possess the required preservative properties, and in the preparation under consideration it is used to prevent the ferrous carbonate as first precipitated from passing into the ferric hydroxide.

Becker, a German physician, was the first to suggest the use of saccharine matter as a means of protection against the absorption of oxygen, and the idea was carried out by Klauer, a German chemist, who first made the saccharated ferrous carbonate. The use of boiling distilled water in the process is to avoid the action of the air contained in unboiled water. The washed precipitate is pressed so as to free it from water as far as possible, and then incorporated with the sugar in fine powder. The mode of treating the precipitate unnecessarily exposes it to the action of the air, and the late London method of incorporating it with the sugar immediately after washing was on this account preferable. The final drying temperature should not exceed 54.5° C. (130° F.).[1] (See *A. Pharm.*, Jan. 1878; *N. R.*, 1878, 1881.)

Properties.—"A greenish-brown powder, gradually becoming oxidized by contact with air, without odor, and having at first a sweetish, afterwards a slightly ferruginous taste. Only partially soluble in water, but completely soluble upon the addition of hydrochloric acid, with copious evolution of carbon dioxide, forming a clear, greenish-yellow liquid. If 1 Gm. of Saccharated Ferrous Carbonate be dissolved in 5 Cc. of hydrochloric acid, and the solution diluted with water until it measures 50 Cc., portions of this solution will yield a blue precipitate with both potassium ferrocyanide T.S. and potassium ferricyanide T.S., but should not give more than a slight cloudiness with barium chloride T.S. (absence of *sulphate*). If 1.15 Gm. of Saccharated Ferrous Carbonate be dissolved in 10 Cc. of diluted sulphuric acid, and the solution diluted with water to about 100 Cc., it should require not less than 15 Cc. of tenth-normal potassium permanganate V.S. to impart a permanent pink tint to the liquid, corresponding to not less than 15 percent. of ferrous carbonate." *U. S.*

Saccharated ferrous carbonate is frequently seen in small coherent lumps, usually of a grayish-brown color, permanent in the air, having a sweet, styptic taste, and wholly and readily soluble in warm hydrochloric acid, diluted with half its volume of water, with effervescence. According to the last revision of the British Pharmacopœia, it is described as being in "small coherent lumps or powder, of a brownish-gray color with a sweet, feebly chalybeate taste. It dissolves with effervescence in warm *hydrochloric acid* diluted with half its volume of *water*. Each gramme, dissolved in excess of warm Concentrated Phosphoric Acid and diluted with *water*, should not cease to give a blue precipitate with *solution of potassium ferricyanide* until at least 29 cubic centimetres of the *volumetric solution of potassium bichromate* have been added. It should yield only the slightest characteristic reactions with the tests for sulphates." The presence of ferric oxide is a defect, which is avoided in Vallet's ferruginous mass.

Its solution in diluted hydrochloric acid is but slightly affected by potassium ferrocyanide, showing the presence of the ferric salt in only small proportion, but yields a copious blue precipitate with the ferricyanide, proving the abundance of the ferrous compound. The same solution should give but a very slight precipitate with barium chloride, evincing that very little either of ferrous or of sodium sulphate has escaped the washing process. The quantitative tests determine the quantity of ferrous salt present, requiring in the British test the stated amount of the potassium bichromate to convert it into the ferric chloride, and of potassium permanganate in the test of the U. S. Pharmacopœia.

Uses.—This preparation is an excellent chalybeate, possessing the advantages of having nearly all the iron in it in the ferrous state, and of being readily soluble in acids. Originally introduced into the official list by the Edinburgh College, it appeared for the first time in the Dublin and London Pharmacopœias of 1850 and 1851. It is undoubtedly more active than the ferric subcarbonate, and must be used in a smaller dose. It is, however, inferior to Vallet's ferruginous mass, in the preparation of which the anti-oxidizing influence of saccharine matter is much more fully applied.

Dose, of the saccharated ferrous carbonate, from five to thirty grains (0.32 to 2.0 Gm.), given in the form of pill.

[1] *Saccharated Ferric Oxide. Saccharum Ferrugineum.*—This is a combination of sugar and ferric oxide. It is soluble and of a pure sweet taste. According to the method of Siebert, to prepare it dissolve two parts of iron in twenty-four parts of nitric acid, sp. gr. 1.2; evaporate the filtrate to fifteen parts; when *quite cool*, dissolve twelve parts of sugar in the filtrate, and add an excess of a solution of twelve parts of sugar in twelve parts of 20 per cent. ammonia water. After setting aside for twenty-four hours, precipitate this with four or five times its volume of strong alcohol; collect the precipitate, partially dry with bibulous paper, intimately mix the moist mass with its own weight of powdered sugar, and dry by a moderate heat. It is a good antidote for arsenic. (*A. J. P.*, xl. 324, 326. See also *Neues Repertor. für Pharm.*, xviii. 36.) Keutmann (*Int. Pharm. Gen. Anz.*, 1893, 214) dissolves ferrous sulphate in water, precipitates the solution (placed in a bottle) with ammonia water, fills the bottle with water, decants, washing the precipitate repeatedly with hot water; the precipitate is placed in a porcelain dish containing pulverized sugar warmed, a small quantity of alkali added, and hydrogen peroxide added to complete the oxidation; the mixture is then dried.

FERRI CHLORIDUM. U. S.

FERRIC CHLORIDE [Iron Perchloride]

(fĕr′rī ȼhlō′rĭ-dŭm)

"Ferric Chloride should contain not less than 22 percent. of metallic iron in the form of chloride." *U. S.*

Sesquichloride (Perchloride) of Iron, Chloride of Iron; Ferrum Muriaticum Oxydatum, Chloridum vel Chloruretum Ferricum, Ferri Perchloridum; Chlorure ferrique, *Fr. Cod.*; Perchlorure de Fer, *Fr.*; Ferrum Sesquichloratum, *P. G.*; Eisenchlorid, *G.*; Cloruro ferrico, *Sp.*

* "Solution of Ferric Chloride, *one hundred grammes* [or 3 ounces av., 231 grains], to make *forty grammes* [or 1 ounce av., 180 grains]. Evaporate the Solution of Ferric Chloride on a water-bath until it weighs *forty grammes* [or 1 ounce av., 180 grains]; then set it aside in a glass-covered vessel, until it forms a crystalline mass. Lastly, break the salt into pieces, and keep it in glass-stoppered bottles, protected from light." *U. S.*

The U. S. P. (8th Rev.) does not give a process for making this salt directly from metallic iron, but simply evaporates the official solution of ferric chloride. The former U. S. P. directed a process which had been adopted with but little alteration from that of Wittstein. (*Prac. Pharm. Chem.*, Darby's transl., p. 265.) When iron is heated with hydrochloric acid, water is decomposed, the hydrogen escapes with effervescence, and the oxygen uniting with the iron forms ferrous oxide, which reacts with the hydrochloric acid to form water and ferrous chloride.[1] The next step of the process is to convert the ferrous chloride into the ferric salt. This is effected by treating it with hydrochloric and nitric acids and heating until red fumes no longer escape. The following reaction explains this:

$$6FeCl_2 + 2HNO_3 + 6HCl = 6FeCl_3 + 2NO + 4H_2O$$

The solution is then evaporated, and, on cooling, concretes into a crystalline mass. The relative proportions of iron and the two acids are adjusted very nearly to the production of these results. There are two crystallized chlorides, one, $FeCl_3 + 3H_2O$, which is very deliquescent, the other, $FeCl_3 + 6H_2O$, which is less so, but which, when allowed to stand over sulphuric acid, liquefies and slowly deposits crystals of the first chloride, $FeCl_3 + 3H_2O$, losing half of its water of hydration.[2]

The requirement of the U. S. P. (8th Rev.) that ferric chloride should contain not less than 22 per cent. of metallic iron, is low. If the solution from which it is made contains not less than 10 per cent. of iron, as is required, the salt should theoretically contain not less than 25 per cent. of iron; but on account of the avidity with which it absorbs moisture an allowance on this account is proper.

Properties.—It is in "orange-yellow, crystalline pieces, odorless, or having a faint odor of hydrochloric acid, and a strongly styptic taste. Very deliquescent in moist air. Freely and completely soluble in water and in alcohol; also in a mixture of 1 part of ether and 3 parts of alcohol. At 35.5° C. (96° F.) the salt fuses to a reddish-brown liquid. When strongly heated, it decomposes, losing water and hydrochloric acid, while the anhydrous salt sublimes, leaving a residue of ferric oxide. The dilute, aqueous solution of the salt shows an acid reaction with blue litmus paper, yields a brownish-red precipitate with ammonia water, a blue precipitate with potassium ferrocyanide T.S., and a white precipitate, insoluble in nitric acid, with silver nitrate T.S. If 1 Gm. of the salt, dissolved in 25 Cc. of boiling water, be treated with an excess of ammonia water, the filtrate should be colorless, and, after acidulation with hydrochloric acid, 20 Cc. of the solution should not respond to the Time-Limit Test for *heavy metals* (see PART III). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and an aqueous solution of the salt (1 in 10), the crystal should not become brown in color, nor should a brownish-black color be developed around it within five minutes (limit of *nitric acid*). If to a solution of the salt (1 in 50) a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced, which should not turn at once to a green or greenish-blue (absence of *ferrous salt*). If 1 Gm. of dry Ferric Chloride be dissolved in sufficient water to measure 100 Cc., then 55.5 Cc. of this solution, when measured into a glass-stoppered flask of the capacity of about 250 Cc., followed by 3 Cc. of hydrochloric acid, and 2 Gm. of potassium iodide, should, after securely stoppering the flask and heating for half an hour at 40° C. (104° F.), and cooling, require not less than 22 Cc. of tenth-normal sodium thiosulphate

[1] The Paris Pharmaceutical Society have adopted the following preparations of ferrous chloride, made by dissolving iron in hydrochloric acid and evaporating the filtered solution rapidly to dryness.

Syrup of Ferrous Chloride.—Dissolve 5 grammes of dry ferrous chloride in 20 grammes of orange-flower water, and add 800 grammes syrup of gum and 175 grammes syrup of orange-flower.

Pills of Ferrous Chloride.—Dry ferrous chloride, powdered marshmallow-root, each 10 grammes, mucilage sufficient. Make into 100 pills, which are to be silvered.

[2] *Syrupus Ferri Chloridi* (Edel). *Syrup of Iron Chloride.*—Take of Solution of Chloride of Iron (U. S. P.), 208 minims; Potassium Citrate, 224 grains; Citric Acid, 60 grains; Water, 8 fluidounces; Glycerin, 5 fluidounces; Syrup, 16 fluidounces. Dissolve the potassium citrate and citric acid in the water, add the iron solution, and when the reaction ceases filter the solution, then add the glycerin and syrup. (*D. C.*, 1894, 246.)

Tasteless Iron Chloride is made by adding an alkaline citrate in solution to a solution of iron sesquichloride, in such proportion that there shall be two molecules of the former to three molecules of chlorine. Usually from 120 to 140 grains of citric acid saturated with soda, potassa, or ammonia are required for the preparation of an ounce of a tincture of corresponding strength to the official tincture. The addition should be made to the liquor, and the final solution must not contain more than 40 per cent. of alcohol. R. Rother affirms that these so-called salts are mere mixtures of iron citrate and iodide or chloride of the alkali used. (*A. J. P.*, 1876, p. 171.)

V.S. for complete decolorization (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.* It contains a variable proportion of water according to the crystalline forms it is made to assume, having about 40 per cent., or six molecules, when in fine acicular crystals, and only 22 per cent., or two and a half molecules, when in the form of larger tables.

Uses.—Ferric chloride is used almost exclusively in the form of tincture or liquor, and in reference to its effect and application we refer to *Tinctura Ferri Chloridi* and *Liquor Ferri Chloridi*. Excepting deliquescence, it keeps without change. When used, it may be dissolved in water in such proportions as may be required. Six, three, two, and one and a half drachms to a fluidounce of water have been recommended, the stronger solutions being used in the treatment of *varices*, the weaker for injection into *aneurisms*, and for application to *bleeding surfaces*, etc. J. Z. Lawrence of England, has used it as a styptic in a semi-deliquesced state and found it extremely efficient. He keeps it in a bottle, in which it gradually deliquesces, and while it is in this condition he applies the thick liquid portion, by means of a brush of spun glass, to the bleeding surface.

FERRI CITRAS. U. S.

FERRIC CITRATE

(fĕr'rī cī'trăs)

"It should contain Ferric Citrate corresponding in amount to not less than 16 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light." *U. S.*

Citrate of Iron; Citras Ferricus; Citrate de Sesquioxide de Fer, Citrate ferrique, *Fr.;* Ferrum Citricum Oxydatum, *P. G.;* Ferricitrat, Citronensaures Eisenoxyd, Eisencitrat, *G.;* Citrato di ferro, *It.;* Citrato ferrico, *Sp.*

No process is given in the U. S. P. (8th Rev.) for ferric citrate. The process of the U. S. P. 1890 and that for the solution of ferric citrate are appended.[1]

Ferric citrate is not a definite chemical salt, but a compound containing ferric citrate, to which the following formula has been assigned: $Fe_2(C_6H_5O_7)_2.6H_2O$. The German Pharmacopœia requires that it shall contain the equivalent of 19 to 20 per cent. of metallic iron. This amount is undoubtedly too high. The U. S. P. (8th Rev.) requires not less than 16 per cent. It is important, in making it, that an excess of citric acid be avoided, and the ferric hydroxide

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[1] "Solution of Ferric Citrate, *a convenient quantity.* Evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

Liquor Ferri Citratis, U. S. 1890. *Solution of Ferric Citrate.*—"An aqueous solution of Ferric Citrate, corresponding to about 7.5 per cent. of metallic iron." *U. S.* 1890.

"Solution of Ferric Sulphate, *one thousand and fifty grammes* [or 37 ounces av., 16 grains]; Citric Acid, *three hundred grammes* [or 10 ounces av., 255 grains]; Ammonia Water, *eight hundred and eighty cubic centimeters* [or 29 fluidounces, 363 minims]; Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Ammonia Water with *three thousand cubic centimeters* [or 101 fluidounces, 213 minims] of cold Water, and the Solution of Ferric Sulphate with *ten thousand cubic centimeters* [or 338 fluidounces, 70 minims] of cold Water. Add the latter solution slowly to the diluted Ammonia Water, with constant stirring. Pour the mixture on a wet muslin strainer, and allow the liquid to run off and the precipitate to drain. Then remove the moist mass from the strainer, mix it well with *six thousand cubic centimeters* [or 202 fluidounces, 426 minims] of cold Water, again pour it on the strainer, and let it drain. Repeat this washing with several successive portions of cold Water in the same manner, until the washings cease to produce more than a slight cloudiness with barium chloride test-solution. Then allow the precipitate to drain completely, transfer it to a porcelain capsule, add the Citric Acid, and heat the mixture, on a water-bath, to 60° C. (140° F.), stirring constantly, until the precipitate is dissolved. Lastly, filter the liquid, and evaporate it, at the above-mentioned temperature, until it weighs *one thousand grammes* [or 35 ounces av., 120 grains]." *U. S.* 1890.

In this process, the ferric hydroxide is first obtained by treating solution of ferric sulphate with ammonia, and is then combined, by the aid of heat, with the citric acid, thus forming a solution of ferric citrate. It might appear, from the phraseology of the process, that in the direction to add the citric acid to the precipitated hydroxide, the addition of water to hold the resulting citrate in solution had been omitted; but the precipitate, even after draining, retains mechanically quite sufficient water for the purpose, so much, indeed, that evaporation is necessary at the end of the process to reduce the bulk to the required standard. The temperature is limited to 60° C. (140° F.), because, though a moderate heat promotes the solution, a high degree of it diminishes the solubility of the oxide, and thus interferes with the process.

The solution is "a dark brown liquid, odorless, and possessing a slightly ferruginous taste. Specific gravity, about 1.250 at 15° C. (59° F.). Upon evaporating 100 Gm. of the Solution, in a thin layer, on plates of glass, about 42.5 to 43 Gm. of garnet-red scales will be obtained. The Solution has an acid reaction upon litmus paper, and is not precipitated, but rendered darker in color, by ammonia water. With potassium ferrocyanide test-solution it affords a bluish-green color or precipitate, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid. On heating the Solution with potassium or sodium hydrate test-solution, it will yield a brown precipitate, without evolving vapor of *ammonia.* If a portion of the Solution, diluted with 4 volumes of water, be deprived of its iron by boiling it with an excess of potassium or sodium hydrate test-solution, and the filtrate slightly acidulated with acetic acid, a portion of this liquid, when allowed to stand for some time, should not give a white, crystalline precipitate (absence of *tartrate*). If to another portion of the acidulated and cooled filtrate a little calcium chloride test-solution be added, and the liquid heated to boiling, it should gradually deposit a white, crystalline precipitate. If 1.12 (1.1176) Gm. of the Solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch test-solution, it should require about 15 Cc. of sodium hyposulphite decinormal volumetric solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 0.5 per cent. of metallic iron)." *U. S.* 1890. It keeps for a long time without change, and answers admirably well for preparing solid ferric citrate and the chalybeate salts containing it, and for introducing it into extemporaneous mixtures. Each fluidounce of it contains about half a troyounce of ferric citrate. It may be given as a ferruginous tonic, in the dose of ten minims (0.6 Cc.), equivalent to five grains (0.32 Gm.) of the salt, several times a day.

be thoroughly washed to free it from sulphates, otherwise brilliant scales will not be formed. (See process in footnote.)

Properties.—Ferric citrate is in "thin, transparent, garnet-red scales, without odor, and having a slightly ferruginous taste. Slowly but completely soluble in water at 25° C. (77° F.), and readily soluble in hot water, but diminishing in solubility with age; insoluble in alcohol. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper (absence of *citrates* or *tartrates* of the *alkali metals*). An aqueous solution of the salt shows an acid reaction with blue litmus paper, and is not precipitated, but rendered darker in color, by ammonia water. With potassium ferrocyanide T.S. the aqueous solution yields a bluish-green color or precipitate, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid (difference from *iron and ammonium citrate*). If Ferric Citrate be heated with potassium hydroxide T.S., it yields a brownish-red precipitate, without evolving ammonia. If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually afford a white crystalline precipitate. Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, should not deposit a white crystalline precipitate (absence of *tartrate*). If 0.555 Gm. of Ferric Citrate be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., with the aid of a gentle heat, and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 16 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.*

Uses.—Ferric citrate was introduced to the notice of the profession, in 1831, by Béral of Paris. It is a pleasant chalybeate, and is best given in solution.

Dose, of the salt, from three to ten grains (0.2 to 0.65 Gm.).

FERRI ET AMMONII CITRAS.

U. S., Br.

IRON AND AMMONIUM CITRATE [Ammonio-Ferric Citrate, Soluble Ferric Citrate]

(fĕr'rī ĕt ąm-mō'nī-ī cī'trăs)

"It should contain Iron and Ammonium Citrate corresponding in amount to not less than 16 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light." *U. S.*

Citrate of Iron and Ammonia; Ferri et Ammoniæ Citras, *Br.* 1867; Ferrum Citricum Ammoniatum, Ferri Ammonio-Citras, Ferro-Ammonium Citricum; Ammonio-Citrate of Iron, Soluble Citrate of Iron; Citrate de Fer et d'Ammoniaque (de Fer ammoniacal), *Fr. Cod.;* Citrate Ferrique Ammoniacal, *Fr.;* Citronensaures Eisenoxyd-Ammonium (Ammoniak), Ferriammoniumcitrat, *G.;* Citrato ferrico-ammonico, *Sp.*

The U. S. P. 1890 process was as follows: "Solution of Ferric Citrate, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Ammonia Water, *forty cubic centimeters* [or 1 fluidounce, 169 minims]. Mix the solution of Ferric Citrate with the Ammonia Water, evaporate the mixture, by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

"Solution of Ferric Sulphate, 10 *fl. ounces* (Imperial measure) *or a sufficient quantity,* or 200 cubic centimetres or a sufficient quantity; Solution of Ammonia, 23 *fl. ounces* (Imp. meas.) *or a sufficient quantity,* or 460 cubic centimetres or a sufficient quantity; Citric Acid, 4 *ounces* (Imp.) or 80 grammes; Distilled Water, *a sufficient quantity.* Prepare ferric hydroxide as follows: Mix *sixteen fluid ounces* (Imp. meas.) or three hundred and twenty cubic centimetres of the Solution of Ammonia with *two pints* (Imp. meas.) or eight hundred cubic centimetres of Distilled Water; gradually add to this the Solution of Ferric Sulphate, previously diluted with *two pints* (Imp. meas.) or eight hundred cubic centimetres of Distilled Water; stir constantly and briskly, taking care that ammonia is, finally, in slight excess as indicated by the odor; set aside the mixture for two hours, stirring it occasionally; pour it on a calico filter; when the liquid has drained away, wash the precipitated ferric hydroxide with Distilled Water until free from sulphates.

Dissolve the Citric Acid in its own weight of Distilled Water; warm the mixture on a water-bath; add the ferric hydroxide, previously well drained; stir them together until nearly the whole of the hydroxide has dissolved, or until the Citric Acid is saturated with ferric hydroxide (prepared, if necessary, from more of the Solution of Ferric Sulphate); let the solution cool; add *five and a half fluid ounces* (Imp. meas.) or one hundred and ten cubic centimetres of Solution of Ammonia; filter through flannel, adding some Distilled Water if necessary; evaporate to the consistence of syrup, the presence of a very slight excess of ammonia being maintained; dry in thin layers on flat porcelain or glass plates at a temperature not exceeding 100° F. (37.8° C.); remove the dry flakes of Iron and Ammonium Citrate." *Br.*

In the U. S. Pharmacopœia 1890, the process consisted simply in evaporating a mixture of solution of ferric citrate and ammonia water. In the British, ferric hydroxide is first precipitated from a solution of the ferric sulphate, then digested at a moderate heat with a solution of citric acid, and lastly neutralized by ammonia. It has, however, been found by E. R. Squibb that a heat above 82.1° C. (180° F.) acts injuriously in the preparation of the ferric citrate, and the boiling heat directed in the British Pharmacopœia of 1864 was, therefore, improper. (*A. J. P.*, xxvii. 297.) This error has been corrected in the present Br. Pharmacopœia, which directs that the salt should be dried at a heat not above 38° C. (100° F.). In the U. S. 1890 formula the ferric citrate was used already prepared, in the British it is prepared in the process. The solution should be concentrated to a syrupy consistence before being poured out on porcelain or glass to dry, and it is important that the heat employed in the concentration should not exceed that indicated. Like most of the scaled iron salts, this preparation is not a true chemical compound, the ammonia not being in the proportion to form a double salt; it would be better to name it "ammoniated iron citrate."

J. U. Lloyd (*N. R.*, 1879, 323) states that it is usually difficult to adjust accurately the quantity of the ammonia in this process, and proposes to use a definite quantity of a fixed salt, like ammonium citrate, instead. His process will be found in the footnote.[1] R. Rother recommends the following method: Dissolve 272 parts of ferric citrate in three or four times its weight of water with heat, add 79 parts of ammonium carbonate, evaporate, and scale in the usual manner. (*A. J. P.*, 1887, p. 166.)

Properties.—Iron and ammonium citrate is more soluble than the citrate. It is in "thin, transparent, garnet-red scales, without odor, and having a saline, mildly ferruginous taste; deliquescent in moist air. Readily and completely soluble in water, but insoluble in alcohol. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction with red litmus paper (absence of *citrates* or *tartrates* of the *alkali metals*). An aqueous solution of the salt is neutral to litmus paper. The aqueous solution is not precipitated, but rendered darker in color, by ammonia water. With potassium ferrocyanide T.S. the solution does not afford a blue color or precipitate, unless it be acidulated with hydrochloric acid (difference from *ferric citrate*). If Iron and Ammonium Citrate be heated with potassium hydroxide T.S., it yields a brownish-red precipitate, and ammonia is evolved. If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually deposit a white, crystalline precipitate. Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, should not yield a white, crystalline precipitate (absence of *tartrate*). If 0.555 Gm. of the salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 16 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as an indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.* "When incinerated with free access of air, it leaves 31 or 32 per cent. of ferric oxide, which is not alkaline to *litmus* (absence of fixed alkali). Heated with *solution of potassium hydroxide* it evolves ammonia and deposits ferric hydroxide. The alkaline solution from which the iron has separated does not, when slightly supersaturated with *acetic acid*, give any crystalline precipitate (absence of tartrates). It should not yield more than the slightest characteristic reactions with the tests for sulphates." *Br.* Its precise chemical constitution is not determined; but Méhu (*Jahresb.*, 1873, 570), on evaporating a solution of ferrous citrate in ammonia to dryness, obtained a salt of the formula $Fe_2(NH_4)_2.(C_6H_5O_7)_2 + 3H_2O$.

Uses.—This salt is a pleasant chalybeate, in doses of 5 grains (0.32 Gm.). According to Paris, it may be mixed with the carbonated alkalies without decomposition, and given in a state of effervesence with citric acid. It should be prescribed when ferric citrate is desired in solution, as it is not suited for administration in the form of pills, owing to the presence of ammonia, which renders it too soluble, and causes the pills to flatten after they have been made, and frequently to cohere in one solid mass. The official ferric citrate should always be used for pills, as it is more slowly dissolved.

Dose, from three to eight grains (0.2 to 0.5 Gm.).

Off. Prep.—Vinum Ferri, *U. S.* (*Br.*).

[1] Prepare a solution of ammonium citrate from citric acid 8 oz. av., and ammonia water q. s.

Add the ammonia water to the citric acid until in slight excess, then evaporate the solution until it measures sixteen fluidounces.

Then take of solution of iron tersulphate 16 fluidounces; citric acid 4 ounces av.; distilled water and ammonia water, each, a sufficient quantity; solution of ammonium citrate 5 fluidounces. Prepare hydrated ferric oxide from the solution of iron tersulphate. Having drained it, place in an evaporating dish and add the citric acid, warm upon a steam or water bath, and stir until the citric acid is dissolved, then add the solution of ammonium citrate and stir until the hydrated oxide is dissolved, filter and evaporate to the consistence of thick syrup, spread upon glass with a brush, and dry. The yield will be 4234 grains.

FERRI ET AMMONII SULPHAS. U. S.

FERRIC AMMONIUM SULPHATE [Ammonio-Ferric Sulphate, Ammonio-Ferric Alum, Iron Ammonium Alum]

(fĕr'rī ĕt ąm-mō'nī-ī sŭl'phās)

$FeNH_4(SO_4)_2 + 12H_2O = 478.69$

"It should contain, in the uneffloresced condition, 99.5 percent. of pure Ferric Ammonium Sulphate, and not less than 11.5 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light." *U. S.*

Ferrum Sulfuricum Oxydatum Ammoniatum; Ferrum Ammonio-Sulphuricum, Ferri Ammonio-Sulphas, Sulphas Ammonico-Ferricus, Alumen Ammoniacale ferricum, Iron Alum; Sulfate de Fer et d'Ammoniaque, Sulfate de Fer (ferrique) ammoniacal, Alun de Fer ammoniacal, *Fr.*; Schwefelsaures Eisenoxyd-Ammonium, Ammoniakalischer Eisenalaun, Ferriammoniumsulfat, *G.*

The present Pharmacopœia does not give a process for preparing this salt; that of the U. S. P. 1870 will be found below.[1]

This is an ammonia iron-alum, in which the place of the aluminum oxide (alumina) is occupied by the ferric oxide. It is prepared by heating the solution of ferric tersulphate with ammonium sulphate until the latter salt is dissolved, and then allowing the solution to cool. The two salts unite to form iron and ammonium sulphate, which, being insoluble in the amount of liquid employed, crystallizes when it cools. The process is based on that of Wm. Hodgson (*A. J. P.*, 1856, p. 305).

Properties.—Ammonio-ferric alum is in "pale violet, octahedral crystals, without odor, and having an acid, styptic taste; efflorescent on exposure to the air. Soluble in 2.7 parts of water at 25° C. (77° F.), and in 0.8 part of boiling water; insoluble in alcohol. When strongly heated, the crystals fuse, lose their water of crystallization, expand, and finally leave a pale brown residue. The aqueous solution of the salt has a slightly acid reaction upon blue litmus paper, and yields with potassium ferrocyanide T.S. a blue precipitate, and with barium chloride T.S. a white precipitate insoluble in hydrochloric acid. With potassium hydroxide T.S. Ferric Ammonium Sulphate yields a brownish-red precipitate, and if the mixture be heated, ammonia gas is evolved. If the iron be wholly precipitated from a solution of the salt by treating it with an excess of potassium hydroxide T.S., the resulting filtrate when neutralized with hydrochloric acid, and then mixed with ammonia water, should not yield a white, gelatinous precipitate (absence of *aluminum*). The addition of 3 Cc. of nitric acid to 30 Cc. of a solution of the salt (1 in 20), followed by a few drops of silver nitrate T.S., should not produce any turbidity (absence of *chlorides*). If 0.555 Gm. of the uneffloresced crystals of the salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 11.5 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron.)." *U. S.* According to H. Rose, the pure salt is white, and gives a colored solution with water, in consequence of the formation of a basic ferruginous salt. This decomposition is prevented by dissolving it in diluted sulphuric acid, when the solution is colorless. Instead of ammonium sulphate, potassium sulphate may be employed with the solution of ferric tersulphate, in which case a potassium iron-alum is produced, called *potassio-ferric alum*, which has all the properties, physical and remedial, of the ammonio-ferric salt, and the two appear to have been indiscriminately used.

Uses.—The iron-alums were brought to the notice of the Pharmaceutical Society of London in Dec. 1853, by Lindsley Blyth, as a new remedy, prescribed in St. Mary's Hospital. Tyler Smith found them to be more astringent than common alum, and devoid of the stimulating effects of the other salts of iron. Ferric alum is certainly useful in passive *leucorrhœas*, and its saturated solution has been strongly recommended as a styptic.

Dose, from five to ten grains (0.32 to 0.65 Gm.), to be repeated twice or three times a day.

FERRI ET AMMONII TARTRAS. U. S.

IRON AND AMMONIUM TARTRATE [Ammonio-Ferric Tartrate]

(fĕr'rī ĕt ąm-mō'nī-ī tär'trăs)

"It should contain Iron and Ammonium Tartrate corresponding in amount to not less than 13 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light." *U. S.*

Ferrum Tartaricum Ammoniatum, Ferri Ammonio-Tartras; Ammonio-Tartrate of Iron; Tartrate Ferrico-ammonique, *Fr. Cod.*; Tartrate de Fer et d'Ammoniaque, Tartrate ferrique ammoniacal, *Fr.*; Weinsaures Eisenoxyd-Ammonium, *G.*

No process is given in the U. S. P. (8th Rev.) for iron and ammonium tartrate. The process of the U. S. P. 1890 is appended.[1]

[1] *Ferri et Ammonii Sulphas.*—"Take of Solution of Tersulphate of Iron *two pints;* Sulphate of Ammonium *four troyounces and a half.* Heat the Solution of Tersulphate of Iron to the boiling point, add the Sulphate of Ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air." *U. S.* 1870.

[1] "Solution of Ferric Sulphate, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Tartaric Acid, *twenty-nine grammes* [or 1 ounce av., 10 grains]; Distilled Water, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Ammonia Water, Water, each, *a sufficient quantity.* To *one hundred and ten cubic centimeters* [or 3 fluidounces,

Properties.—This salt is in "thin, transparent scales, varying in color from garnet-red to reddish-brown, without odor, and having a sweetish, slightly ferruginous taste; slightly deliquescent in the air. Very soluble in water; insoluble in alcohol. When strongly heated, the salt chars, emits fumes having the odor of burning sugar, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper (absence of *citrates* or *tartrates* of the *alkali metals*). An aqueous solution of Iron and Ammonium Tartrate should be neutral to litmus paper, and is not precipitated, but rendered darker in color, by ammonia water. With potassium ferrocyanide T.S. the solution does not yield a blue color or precipitate, unless it be acidulated with hydrochloric acid. If Iron and Ammonium Tartrate be heated with potassium hydroxide T.S., it yields a brownish-red precipitate, and ammonia is evolved. If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., the filtrate, when slightly acidulated with acetic acid, will gradually deposit a white, crystalline precipitate. If 0.555 Gm. of the dry salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 13 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.*

Dose, as a mild chalybeate, from five to ten grains (0.32 to 0.65 Gm.).

FERRI ET POTASSII TARTRAS.

U. S. (Br.)

IRON AND POTASSIUM TARTRATE
[Potassio-Ferric Tartrate]

(fĕr'rī ĕt pǫ-tăs'sī-ī tăr'trăs)

"It should contain Iron and Potassium Tartrate corresponding in amount to not less than 15 percent. of metallic iron, and should be kept in well-stoppered bottles, protected from light." *U. S.*

Ferrum Tartaratum, *Br.;* Tartarated Iron; Ferri Potassio-Tartras, Ferrum Tartarizatum, Tartras Ferrico-Potassicus, s. Potassico-Ferricus, s. Ferrico-Kalicus, Ferri-Kalium Tartaricum; Tartarated (tartarized) Iron, Ferro-Tartrate of Potassium; Tartrate Ferrico-potassique, *Fr. Cod.;* Tartrate de Fer et de Potasse, Tartare Chalybé, Tartre martial, *Fr.;* Kaliumferritartrat, Weinsaures Eisenoxyd-Kali, Eisenweinstein, *G.;* Tartrato ferrico-potassico, *It.;* Tartrato ferrico-potasico, *Sp.*

No process is given in the U. S. P. (8th Rev.) for iron and potassium tartrate; that of the former Pharmacopœia will be found below.[1]

"Solution of Ferric Sulphate, 10 *fl. ounces* (Imperial measure) or 200 cubic centimetres; Solution of Ammonia, 16 *fl. ounces or a suffi-*

345 minims] of Ammonia Water, previously diluted with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of cold Water, add, with constant stirring, the Solution of Ferric Sulphate, previously diluted with *thirteen hundred cubic centimeters* [or 43 fluidounces, 460 minims] of cold Water. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a siphon, then mix the precipitate intimately with about *fifteen hundred cubic centimeters* [or 50 fluidounces, 346 minims] of cold Water, again draw off the clear liquid, and repeat the washing with Water in the same manner until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Then transfer the precipitate to a wet muslin strainer, allow it to drain, and express the water as completely as possible. Dissolve one-half of the Tartaric Acid in the Distilled Water, neutralize the solution exactly with Ammonia Water, then add the other half of the Tartaric Acid, and dissolve it by the application of a gentle heat. Now add the moist ferric hydrate, in successive portions, stirring constantly, and continue the heat, which should not exceed 60° C. (140° F.), until the hydrate is dissolved. Filter the solution while hot, evaporate it in a porcelain vessel, at or below the above-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

This process does not differ essentially from that of Procter. (*A. J. P.*, 1841, p. 276.) Ammonium tartrate is prepared, which is converted into bitartrate by the addition of tartaric acid, and the excess of acid is then combined with ferric hydroxide freshly prepared from the official solution of ferric sulphate. A double salt of ammonium and iron tartrate is thus made in solution; by filtering, concentrating, and scaling, the salt is then obtained; this, theoretically, must be considered as consisting of one molecule of tartaric acid and two molecules of base, one consisting of ammonia and the other of ferric oxide, $2(FeO)NH_4.C_4H_4O_6.3H_2O$. It is hardly probable that the salt has exactly this chemical composition, as the scaled salts cannot be said to be definite compounds. The proportion of tartaric acid has been considerably reduced, as it was found to be excessive in previous formulas, and it might be diminished still further with advantage.

[1] "Solution of Ferric Sulphate, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Potassium Bitartrate, *thirty-eight grammes* [or 1 ounce av., 148 grains]; Distilled Water, *three hundred cubic centimeters* [or 10 fluidounces, 69 minims]; Ammonia Water, Water, each, *a sufficient quantity*. To *one hundred and ten cubic centimeters* [or 3 fluidounces, 345 minims] of Ammonia Water, previously diluted with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of cold Water, add, under constant stirring, the Solution of Ferric Sulphate, previously diluted with *thirteen hundred cubic centimeters* [or 43 fluidounces, 460 minims] of cold Water. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a siphon, then mix the precipitate intimately with about *fifteen hundred cubic centimeters* [or 50 fluidounces, 346 minims] of cold Water, again draw off the clear liquid, and repeat the washing with Water in the same manner until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Then transfer the precipitate to a wet muslin strainer, allow it to drain, and express the water as completely as possible. Mix the Potassium Bitartrate with the Distilled Water in a porcelain vessel, heat the mixture, on a water-bath, to a temperature not exceeding 60° C. (140° F.), and gradually add the moist ferric hydrate, stirring constantly until it is dissolved. Filter the liquid while hot, and let the filtrate stand in a cool, dark place for twenty-four hours. Then stir it well with a porcelain or glass spatula, so that the precipitate which has formed in it may be thoroughly incorporated with the liquid. Now add, very cautiously, just enough Ammonia Water to dissolve the precipitate, evaporate the solution in a porcelain vessel, at or below the above-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

cient quantity (Imp. meas.) or 320 cubic centimetres or a sufficient quantity; Acid Potassium Tartrate, in powder, 3 *ounces and* 146 *grains* (Imp.) or 66.5 grammes; Distilled Water, *a sufficient quantity.* Prepare ferric hydroxide from *ten fluid ounces* (Imp. meas.) or two hundred cubic centimetres of Solution of Ferric Sulphate as directed under 'Ferri et Ammonii Citras.'

Mix the ferric hydroxide intimately with the Acid Potassium Tartrate in a porcelain dish; let the mixture stand for twenty-four hours; heat to a temperature not exceeding 140° F. (60° C.), add gradually *a pint and a half* (Imp. meas.) or six hundred cubic centimetres of Distilled Water; stir constantly until nothing more will dissolve; filter; evaporate at a temperature not exceeding 140° F. (60° C.) to the consistence of syrup; dry in thin layers on flat porcelain or glass plates in a drying closet at a temperature not exceeding 100° F. (37.8° C.); remove the dry flakes of Tartarated Iron." *Br.*

The object of this process is to combine the excess of acid in the potassium bitartrate with ferric hydroxide. The plan of Soubeiran in the main is adopted,—namely, that of dissolving the moist ferric hydroxide to saturation in a mixture of the bitartrate and water, aided by a moderate heat. The oxide is obtained from the solution of ferric sulphate, which is precipitated by ammonia. Potassium hydroxide, which was used in the former British process, is not a good precipitant, because the alkali adheres obstinately to the precipitated oxide, and cannot be completely separated even by repeated washings. The oxide should be gradually added to the bitartrate and water, heated to 60° C. (140° F.), as recommended by Soubeiran, at which temperature the oxide dissolves more readily and in larger quantity than when a higher temperature is employed. Besides, in the latter case, a portion of the ferric oxide is converted into ferrous oxide. (*Gmelin's Handbook,* x. 315). In the U. S. 1890 process the addition of ammonia water to the cooled filtrate dissolves the precipitated insoluble ferric tartrate, and is in accordance with the recommendation of J. U. Lloyd (*N. R.,* 1879, p. 324), who asserts that this modification renders the salt more soluble without interfering with its stability. G. H. Chas. Klie suggested this improvement in *A. J. P.,* 1876, p. 170. (See also *N. R.,* 1878, p. 21.) In both formulas the liquid is poured out on a plane surface so as to dry in scales. When duly carried into effect, they yield a product at all times identical, and having all the required qualities of the salt. W. Lyon (*P. J.,* 1902, 530) proposes to substitute potassium and sodium tartrate for the acid potassium tartrate used in the British Pharm. process, believing that the resulting scaled salt will retain its ready solubility for a much longer time than will the official preparation; he uses the following proportions: Solution of ferric sulphate 300 Cc.; Solution of ammonia 480 Cc. or a sufficient quantity; potassium and sodium tartrate 176 Gm. The official process and directions are otherwise followed. For Roger's process for this salt and the manufacture of *Boules de Mars* (balls of iron and potassium tartrate), see U. S. D., 17th ed., 611.

Ure proposed *ferrous tartrate* for medicinal use. He made it by acting on clean iron filings, or bits of iron wire, with a solution of tartaric acid. It is a pulverulent salt, insoluble in water, and possessing a mild chalybeate taste.

Properties.—Iron and potassium tartrate is in "thin, transparent scales, varying in color from garnet-red to reddish-brown, without odor, and having a sweetish, ferruginous taste; slightly deliquescent in the air. Very soluble in water; insoluble in alcohol. When strongly heated, the salt chars, emits fumes having an odor resembling that of burning sugar, and finally leaves a dark brown residue, having a strongly alkaline reaction, and effervescing with acids (distinction from *iron and ammonium tartrate*). An aqueous solution of Iron and Potassium Tartrate should be neutral to litmus paper, and is not precipitated, but rendered darker in color, by ammonia water. With potassium ferrocyanide T.S. the solution does not afford a blue color or precipitate, unless it be acidulated with hydrochloric acid. When heated with potassium hydroxide T.S., the salt yields a brownish-red precipitate. If an aqueous solution of the salt (1 in 10) be deprived of its iron by boiling with an excess of potassium hydroxide T.S., the filtrate, when slightly acidulated with acetic acid, will gradually deposit a white, crystalline precipitate. If 0.555 Gm. of the dry salt be dissolved in 15 Cc. of water and 2 Cc. of hydrochloric acid, in a glass-stoppered flask having a capacity of about 100 Cc., and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 15 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.* "The aqueous solution, when acidulated with *hydrochloric acid,* affords a copious blue precipitate with *solution of potassium ferrocyanide,* but none or only a greenish turbidity with *solution of potassium ferricyanide.* When the salt is boiled with *solution of sodium hydroxide,* a reddish-brown precipitate separates, and the filtered solution, when slightly acidulated with *acetic acid,* yields, as it cools, a crystalline deposit, especially if the solution is previously mixed with a little *alcohol* (90 per cent.). By incinerating 10 grammes at a red heat, washing the residue with *water,* and again incinerating with free access of air, a residue of ferric oxide is obtained weighing not less than 3 grammes." *Br.* According to the view of its nature taken in the U. S. Pharmacopœia, it

is a double salt, consisting of one molecule of ferric tartrate and one of potassium tartrate:

$$Fe_2(C_4H_4O_6)_3 + K_2C_4H_4O_6 + H_2O$$

Flückiger (*Pharmaceutische Chemie,* 2d ed., 573, 1888), on the other hand, considers the salt formed to be one in which Fe_2O_2 is present as a bivalent group, and gives it the formula:

$$C_4H_4O_6K_2 + C_4H_4O_6(Fe_2O_2) + 4H_2O$$

The salt is incompatible with astringent vegetable infusions, which give rise to a dark-colored precipitate.

Uses.—Iron and potassium tartrate is a mild, agreeable chalybeate, with but little astringency. It is well borne by the stomach, taken fasting or with the food. Its slight taste and ready solubility make it one of the best ferruginous preparations for children.

Dose, for an adult, five to ten grains (0.32 to 0.65 Gm.), given preferably in solution.

FERRI ET QUININÆ CITRAS. U. S., Br.

IRON AND QUININE CITRATE

(fĕr′rī ĕt quĭ-nī′næ cī′trās)

"It should contain not less than 11.5 percent. of dried quinine, and ferric citrate corresponding in amount to not less than 13.5 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light." *U. S.*

Ferri et Quiniæ Citras, *Br.* 1867, *U. S.* 1870; Citrate of Iron and Quinia; Citrate de Fer et de Quinine, *Fr.;* Chininum Ferro-Citricum, *P. G.;* Eisen-chinincitrat, Citronensaures Eisen-Chinin, *G.*

No process is given in the U. S. P. (8th Rev.) for iron and quinine citrate; the U. S. P. 1890 process is appended.[1]

"Solution of Ferric Sulphate, 9 *fl. ounces* (Imperial measure) or 180 cubic centimetres; Quinine Sulphate, 2 *ounces* (Imp.) or 40 grammes; Diluted Sulphuric Acid, 3 *fl. ounces* (Imp. meas.) or 60 cubic centimetres; Citric Acid, 6 *ounces and* 60 *grains* (Imp.) or 123 grammes; Solution of Ammonia, Distilled Water, of each, *a sufficient quantity.* Prepare ferric hydroxide from *nine fluid ounces* (Imp. meas.) or two hundred cubic centimetres of Solution of Ferric Sulphate as directed under 'Ferri et Ammonii Citras.'

Mix the Quinine Sulphate with eight times its weight of Distilled Water; add the Diluted Sulphuric Acid; when the salt is dissolved precipitate the quinine with a slight excess of Solution of Ammonia; collect the precipitate on a filter; wash it with *three pints* (Imp. meas.) or twelve hundred cubic centimetres of Distilled Water.

Dissolve the Citric Acid in its own weight of Distilled Water; warm the solution on a water-bath; add the ferric hydroxide, previously well drained; stir them together; when the hydroxide has dissolved, add the precipitated quinine; continue the agitation until this also has dissolved; let the solution cool; add, in small quantities at a time, *three fluid ounces* (Imp. meas.) or sixty cubic centimetres of Solution of Ammonia, diluted with *four fluid ounces* (Imp. meas.) or eighty cubic centimetres of Distilled Water; stir briskly, allowing the quinine which separates with each addition of ammonia to dissolve before the next addition is made; filter the solution; evaporate it to the consistence of a thin syrup; dry the latter in thin layers on flat porcelain or glass plates at a temperature of 100° F. (37.8° C.); remove the dry flakes of Iron and Quinine Citrate." *Br.*

The *official* iron and quinine citrate has never been very largely used, because of its slow solubility,[1] the manufacturers supplying

[1] "Ferric Citrate, *eighty-five grammes* [or 2 ounces av., 436 grains]; Quinine, dried at 100° C. (212° F.) to a constant weight, *twelve grammes* [or 186 grains]; Citric Acid, *three grammes* [or 46 grains]; Distilled Water, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Ferric Citrate in *one hundred and sixty cubic centimeters* [or 5 fluidounces, 197 minims] of Distilled Water by heating on a water-bath at a temperature not exceeding 60° C. (140° F.). To this solution add the Quinine and Citric Acid, previously triturated with *twenty cubic centimeters* [or 325 minims] of Distilled Water, and stir constantly until the Quinine and Citric Acid are dissolved. Lastly, evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

[1] *Liquor Ferri et Quininæ Citratis.* U. S. 1880. *Solution of Citrate of Iron and Quinine.* (Citrate de Fer et de Quinine liquide, *Fr.;* Citronensaures Eisen- und Chinin-Lösung, *G.*)—"Citrate of Iron and Ammonium, *sixty-five parts* [or five hundred and sixty-eight grains]; Quinine, dried at 100° C. (212° F.), until it ceases to lose weight, *twelve parts* [or one hundred and five grains]; Citric Acid, *twenty-eight parts* [or two hundred and forty-five grains]; Alcohol, *thirty parts* [or six fluidrachms]; Distilled Water, *a sufficient quantity,* to make *two hundred parts* [or four ounces av.]. Dissolve the Citrate of Iron and Ammonium in *two hundred parts* [or four fluidounces] of Distilled Water, contained in a tared porcelain capsule, heat the solution to 60° C. (140° F.), on a water-bath, add the Citric Acid, and, when it is dissolved, add the Quinine, stirring the mixture until a perfect solution has been obtained. Evaporate this to *one hundred and sixty parts* [or three ounces av.], allow it to cool, add the Alcohol, and finally enough Distilled Water to make the solution weigh *two hundred parts* [or four ounces av.]." *U. S.* 1880.

The introduction of this solution in the U. S. P. 1880 grew out of the necessity for a soluble form of iron and quinine citrate. That comparatively insoluble salt, the official iron and quinine citrate, has been but little used, while the readily soluble preparation of the manufacturers, which contained ammonia, was in extensive demand, and is now official. It was believed that the above solution would come into use, as it bears a definite and easily remembered relation toward the official salt (see *Ferri et Quininæ Citras*), being *exactly half its strength,* but these expectations were not realized, and the solution was not introduced into the U. S. P. 1890 or 8th Revisions.

Properties.—"A dark greenish-yellow to yellowish-brown liquid, transparent in thin layers, odorless, having a bitter and mildly ferruginous taste, and a slightly acid reaction. On supersaturating the diluted solution with a slight excess of ammonia, the color of the liquid is deepened and a white, curdy precipitate is thrown down, which is soluble in ether and answers to the reaction of quinine (see *Quinina*). A small portion of the filtrate, when mixed with test-solution of potassium ferrocyanide, does not produce a blue color or precipitate, unless it is acidulated with hydrochloric acid. If another portion of the filtrate be deprived of its iron, by boiling with an excess of potassa, the concentrated and cooled filtrate precipitated by test-solution of

a salt which is readily soluble, due to the presence of ammonia. But by the introduction of a soluble iron and quinine citrate (see *Ferri et Quininæ Citras Solubilis*) the salt is now furnished in a very convenient form for use in solutions, while the above comparatively insoluble salt may be retained for use in pills, for which it is much better adapted. The British Pharmacopœia preparation contains ammonium citrate and is therefore more like the soluble citrate of iron and quinine of the U. S. P. 8th Rev.

The use of ferrous sulphate by the former British process was abandoned, and the solution of ferric sulphate retained. From this the freshly precipitated ferric hydroxide is obtained by precipitation with ammonia. The next step is to separate quinine from the sulphate, by simply dissolving the salt in water with the aid of sulphuric acid, and then precipitating by ammonia. Thirdly, the hydroxide and quinine are dissolved successively, aided by the heat of a water bath, in solution of citric acid, whereby an iron and quinine citrate is obtained. The ammonia is added in order to render the iron and quinine citrate more soluble by the agency of a portion of ammonium citrate. It is important that the ammonia should not be added in excess; on the contrary, the solution should retain a slight acid reaction. (Fleurot.) After evaporation, the salt is dried, as in the other process, on glass or porcelain, so as to be obtained in thin scales.

No analysis has been made that determines precisely the chemical composition of this "scaled salt." It is undoubtedly a mere mixture of the iron and quinine citrates, the British containing ammonium citrate.

The characters of the U. S. salt, as given in the Pharmacopœia, are the following: "Thin, transparent scales, of a reddish-brown color, without odor, and having a bitter, mildly ferruginous taste; slowly deliquescent. Slowly but completely soluble in cold water, more readily soluble in hot water, partially soluble in alcohol. Its solubility is diminished by age. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper (absence of *citrates* or *tartrates* of the *alkali metals*). The aqueous solution of the salt shows an acid reaction with blue litmus paper. On the addition of a slight excess of ammonia water the color of the solution is deepened, and a white, curdy precipitate is produced. The filtrate from this precipitate does not afford a blue color with potassium ferrocyanide T.S., unless it be acidulated with hydrochloric acid. Another portion of the filtrate, heated with an excess of potassium hydroxide T.S., deposits a brownish-red precipitate. If an aqueous solution of the salt (1 in 10) be deprived of its iron and quinine by boiling with an excess of potassium hydroxide T.S., and the filtrate slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, gradually deposits a white, crystalline precipitate. Another portion of the acidulated and cooled liquid, when allowed to stand for some time, should not deposit a white, crystalline precipitate (absence of *tartrate*)." *U. S.*

Assay for the Quinine.—"Introduce 1.11 Gm. of Iron and Quinine Citrate into a dish, and, with the aid of a gentle heat, dissolve it in 20 Cc. of water. Transfer the solution, together with the rinsings of the dish, to a separator, allow the liquid to become cold, then add 5 Cc. of ammonia water and 10 Cc. of chloroform, and shake the separator for one minute. Allow the liquids to separate, draw off the chloroformic layer, and shake the residuary liquid a second and a third time with portions of 10 Cc. each of chloroform. Allow the combined chloroformic solutions to evaporate spontaneously in a tared dish, and dry the residue at 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.1276 Gm. (corresponding to at least 11.5 percent. of dried quinine), and should conform to the reactions and tests under *Quinina*.

Assay for the Iron.—Heat the aqueous liquid, from which the quinine has been removed in the manner just described, on a water-bath, until the odor of chloroform and of ammonia have disappeared, allow it to cool, and dilute it with water to the volume of 50 Cc. Transfer 25 Cc. of the liquid to a glass-stoppered flask having the capacity of about 100 Cc., add 3 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and, after securely closing the flask, allow the mixture to stand for half an hour at 40° C. (104° F.). After it has been allowed to cool, it should require not less than 13.5 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.*

The British Pharmacopœia (1898) gives the following description and tests: "In thin scales of a greenish golden-yellow color, somewhat deliquescent. Soluble in half its weight of cold *water*. The solution is very slightly acid, and yields precipitates which are reddish brown with *solution of potassium hydroxide*,

calcium chloride, and the new filtrate heated to boiling, a white granular precipitate is produced. On heating the solution with potassa, vapor of ammonia is evolved. The solution contains 6 per cent. of quinine. It may be assayed as follows: Dilute 8 Gm. of the solution with water to 30 Cc., introduce it, with any rinsings, into a glass separator, add an aqueous solution of 0.5 Gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 Cc. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule, on a water bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 Gm." *U. S.* 1880.

Uses.—The medicinal virtues of this solution are those of iron and quinine citrate. It may be given in the dose of from 10 to 20 minims (0.6 to 1.3 Cc.).

white with *solution of ammonia,* blue with *solution of potassium ferrocyanide* and with *solution of potassium ferricyanide,* and grayish black with *solution of tannic acid.* The salt has a bitter, chalybeate taste. When incinerated with free access of air, it leaves a residue which when moistened with *water* is not alkaline to test-paper (absence of fixed alkali). 5 grammes dissolved in 45 cubic centimetres of *water* and treated with a slight excess of *solution of ammonia* should yield a white precipitate, which, when dissolved out by repeated treatment of the liquid with *ether,* and the latter evaporated, and the residue completely dried at 248° F. (120° C.), weighs 0.75 gramme. This precipitate is almost entirely soluble in a little *purified ether;* when burned it leaves but a minute residue; neutralized by *sulphuric acid,* it should answer to the characters of and tests for Quinine Sulphate." *Br.*

Owing to the comparative cheapness of the alkaloid quinine at the present time the tendency to substitute other cinchona alkaloids has greatly diminished, and the introduction of an official assay process furnishes an excellent check to these practices.

Amorphous quinine or chinoidine was sometimes substituted for the crystallizable alkaloid. For the detection of this fraud, de Vrij proposed a method which depended upon the fact that oxalic acid forms with crystallizable quinine, in a chloroformic solution, white crystals of quinine oxalate without discoloration. (See *N. R.,* 1881, 10.)

When dissolved by the aid of an acid, it forms a solution which, decolorized by a little purified animal charcoal, turns the plane of polarization strongly to the left,—a character of quinine, cinchonine turning it to the right. (Squire.) The salt is said to be sometimes adulterated by cinchonine, which would be at once detected by the test of solubility in ether and the effect on polarized light, above given. Oscar Zinn (*A. J. P.,* 1877, 550) examined six commercial samples, two of which contained no quinine, but cinchonine. H. G. Drueding found three out of six samples deficient in quinine. As it occurs in the British market, it is of exceedingly variable composition, containing, according to J. C. Braithwaite, who examined thirty-five different specimens, a proportion of quinine varying from 1.5 to 17 per cent. (*P. J.,* 1868, 157.) The proportion of alkaloid appears to be usually below the standard. (A. W. Gerrard, *Ibid.,* March, 1873, 763.) According to C. H. Wood (*Ibid.,* 2d ser., x. 644), this salt undergoes a rapid change of composition when exposed to the influence of the direct rays of the sun.

The official process of assay will doubtless bring to light all shortcomings. (See results of examination of commercial iron and quinine citrate by E. C. Federer, *Proc. Mich. Pharm. Assoc.,* 1887, or *Ph. Era,* 1887, p. 357.)

Iron and quinine citrate combines the virtues of its two bases, and may be given in all cases in which they are jointly indicated, preferably in pill form.

Dose, as a tonic, five or six grains (0.32 to 0.4 Gm.), containing about half a grain (0.032 Gm.) of dry quinine, three or four times a day. This dose may be increased if desired.

FERRI ET QUININÆ CITRAS SOLUBILIS. U. S.

SOLUBLE IRON AND QUININE CITRATE

(fĕr'rī ĕt quĭ-nī'næ cī'trās sŏ-lū'bĭ-lĭs)

"It should contain not less than 11.5 per cent. of dried quinine, and ferric citrate corresponding in amount to not less than 13.5 per cent. of metallic iron. It should be kept in well-stoppered bottles, protected from light." *U. S.*

The U. S. P. (8th Rev.) does not contain a process for soluble iron and quinine citrate; the U. S. P. 1890 process is as follows: "Ferric Citrate, *eighty-five grammes* [or 2 ounces av., 436 grains]; Quinine, dried at 100° C. (212° F.) to a constant weight, *twelve grammes* [or 186 grains]; Citric Acid, *three grammes* [or 46 grains]; Ammonia Water, Distilled Water, each, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Ferric Citrate in *one hundred and sixty cubic centimeters* [or 5 fluidounces, 197 minims] of Distilled Water, by heating on a water-bath at a temperature not exceeding 60° C. (140° F.). To this solution add the Quinine and Citric Acid previously triturated with *twenty cubic centimeters* [or 325 minims] of Distilled Water, and stir constantly until the Quinine and Citric Acid are dissolved. Then add gradually, and with constant stirring, *fifty cubic centimeters* [or 1 fluidounce, 331 minims], or *a sufficient quantity,* of Ammonia Water, so that, after the addition of each portion of the latter, the precipitated Quinine will be redissolved and the liquid acquire a greenish-yellow tint. Lastly, evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

This official preparation was first added to the list in 1890, in answer to a demand which was very persistent. The iron and quinine citrate formerly official and the one in the U. S. P. (8th Rev.) are comparatively insoluble salts, and better adapted for use in pills; but the combination of iron, quinine, and citric acid is wanted more frequently in solution, and hence a salt which can be quickly dissolved is a desirable addition; the only difference between the two salts consists in greater solu-

bility, and this is effected by the use of ammonia water. See *Liquor Ferri et Quininæ Citratis,* U. S. P. 1880, page 501.

Properties.—The U. S. Pharmacopœia (8th Rev.) describes it as in "thin, transparent scales, of a greenish, golden-yellow color, without odor, and having a bitter, mildly ferruginous taste; deliquescent. Rapidly and completely soluble in cold water, partially soluble in alcohol. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction upon red litmus paper (absence of *citrates* or *tartrates* of the *alkali metals*). An aqueous solution of the salt shows a slightly acid reaction with blue litmus paper. On the addition of a slight excess of ammonia water the color of the liquid is deepened, and a white, curdy precipitate is produced. With potassium ferrocyanide T.S. a portion of the filtrate from this precipitate does not yield a blue color or precipitate, unless it be acidulated with hydrochloric acid. When heated with potassium hydroxide T.S., the salt affords a brownish-red precipitate, and ammonia is evolved. If an aqueous solution of the salt (1 in 10) be deprived of its iron and quinine by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually deposit a white, crystalline precipitate. Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, should not give a white, crystalline precipitate (absence of *tartrate*). Soluble Iron and Quinine Citrate, when assayed for Quinine and Iron by the method described under *Ferri et Quininæ Citras,* should respond to the same requirements as the latter." *U. S.* See modification of process by F. A. Sieker (*Ph. Rund.,* 1895, 36).

Uses.—Soluble iron and quinine citrate is employed medicinally for the same purposes as iron and quinine citrate (see page 501).

Off. Prep.—Vinum Ferri Amarum, *U. S.*

FERRI ET STRYCHNINÆ CITRAS. U. S.

IRON AND STRYCHNINE CITRATE

(fĕr'rī ĕt strȳc̆h-nī'næ cī'trăs)

"It should contain not less than 0.9 nor more than 1 percent. of strychnine, and ferric citrate corresponding in amount to not less than 16 percent. of metallic iron. It should be kept in well-stoppered bottles, protected from light." *U. S.*

Ferri et Strychniæ Citras, *U. S.* 1870; Citrate de Fer et de Strychnine, *Fr.;* Citronensaures Eisen-Strychnin, *G.*

The U. S. P. (8th. Rev.) does not contain a process for this preparation; that of the U. S. P. 1890 is as follows: "Iron and Ammonium Citrate, *ninety-eight grammes* [or 3 ounces av., 200 grains]; Strychnine, *one gramme* [or 15.4 grains]; Citric Acid, *one gramme* [or 15.4 grains]; Distilled Water, *one hundred and twenty cubic centimeters* [or 4 fluidounces, 27 minims], to make *one hundred grammes* [or 3 ounces av., 230 grains]. Dissolve the Iron and Ammonium Citrate in *one hundred cubic centimeters* [or 3 fluidounces, 181 minims] of Distilled Water, and the Strychnine, together with the Citric Acid, in *twenty cubic centimeters* [or 325 minims] of Distilled Water. Mix the two solutions, evaporate the mixture by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

Iron and strychnine citrate, although long used in medicine, was first recognized in the U. S. P. 1870. The U. S. P. 1890 formula did not differ essentially from that of the U. S. P. 1870.

This salt is well adapted for administration in pilular form, but should never be prescribed in solution. E. R. Squibb has shown that a whitish deposit will begin to settle from the solution within two or three hours after it is made, and continue to increase for several days; the deposit was found to contain fifty per cent. of strychnine. When ammonia water or ammonium citrate was added, the precipitate was redissolved, but the solution could not be made permanent by the addition, as the precipitate reappeared. There might be dangerous or alarming symptoms if this solution were dispensed without shaking. (*Ephem.,* June, 1888, p. 1128.)

Properties.—It is officially described as in "thin, transparent scales, varying in color from garnet-red to yellowish-brown, without odor, and having a bitter, slightly ferruginous taste; deliquescent in moist air. Readily and completely soluble in water, partially soluble in alcohol. When strongly heated, the salt chars, and finally leaves a residue of ferric oxide, which, when moistened with hot water, should not show an alkaline reaction with red litmus paper (absence of *citrates* or *tartrates* of the *alkali metals*). The aqueous solution of Iron and Strychnine Citrate is slightly acid to litmus paper, and is not immediately precipitated, but rendered darker in color, by ammonia water. With potassium ferrocyanide T.S. the aqueous solution does not yield a blue color or precipitate, unless it be acidulated with hydrochloric acid. On heating with potassium hydroxide T.S. the salt affords a brownish-red precipitate, evolving ammonia. If an aqueous solution of the salt (1 in 10) be deprived of its iron and strychnine by boiling with an excess of potassium hydroxide T.S., and the filtrate be slightly acidulated with acetic acid, a portion of the cooled liquid, when mixed with a little calcium chloride T.S., and again heated to boiling, will gradually

deposit a white, crystalline precipitate. Another portion of the acidulated and cooled liquid, when allowed to stand for twenty-four hours, should not deposit a white crystalline precipitate (absence of *tartrate*)." *U. S.*

Assay for the Strychnine.—" Dissolve 4.44 Gm. of Iron and Strychnine Citrate, in a separator, in 15 Cc. of water, add 5 Cc. of ammonia water and 10 Cc. of chloroform, and shake the separator for one minute. Allow the liquids to separate, draw off the chloroformic layer, and shake the residuary liquid a second and a third time with portions of 10 Cc. each of chloroform. Allow the combined chloroformic liquids to evaporate spontaneously in a tared dish, and dry the residue at 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.04 (0.0399) Gm., nor more than 0.0444 Gm. (corresponding to not less than 0.9 nor more than 1 percent. of strychnine), and should respond to the reactions and tests given under *Strychnina*.

Assay for the Iron.—Heat the aqueous liquid, from which the strychnine has been removed in the manner just described, on a water-bath, until the odors of chloroform and of ammonia have disappeared, allow it to cool, and dilute it with water to the volume of 100 Cc. Transfer 25 Cc. of the liquid to a glass-stoppered flask having the capacity of about 100 Cc., add 4 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and, after securely closing the flask, allow the mixture to stand for half an hour at 40° C. (104° F.). After it has been allowed to cool, it should require not less than 32 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid, starch T.S. being used as indicator (each Cc. of tenth-normal sodium thiosulphate V.S. indicating one-half percent. of metallic iron)." *U. S.* It contains 1 per cent. of strychnine, there being in five grains one-twentieth of a grain of the alkaloid.

Uses.—It is an efficient tonic, but has no advantages over the two active substances it contains when given conjointly in an uncombined state, and has the great disadvantage that the dose of one principle cannot be varied independently of that of the other.

Dose, from three to five grains (0.20 to 0.32 Gm.), in pill.

FERRI HYDROXIDUM. U. S.

FERRIC HYDROXIDE [Ferri Oxidum Hydratum, Pharm. 1890, Ferric Hydrate, Hydrated Oxide of Iron]

(fĕr'rī hȳ-drŏx'ĭ-dŭm)

$Fe(OH)_3 = 106.14$

Ferri Peroxidum, Ferri Sesquioxidum; Ferri Oxidum Rubrum; Hydrous Peroxide of Iron; Ferric Oxyhydrate; Ferrugo; Hydrated Peroxide of Iron, Hydrated Oxide of Iron, Hydrated Sesquioxide of Iron, Moist Peroxide of Iron; Hydras Ferricus; Oxyde (sesqui) de fer Bihydraté, *Fr. Cod.*; Sesquioxide (Peroxide) de Fer hydraté humide, Hydrate de Péroxyde de Fer gélatineux, *Fr.*; Feuchtes Eisenoxydhydrat, Gegengift der Arsenigensaure, *G.*; Ossido ferrico idrato, *It.*; Hidrato ferrico gelatinoso, *Sp.*

* " Solution of Ferric Sulphate, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Ammonia Water, *one hundred and thirty-eight cubic centimeters* [or 4 fluidounces, 320 minims]; Water, *a sufficient quantity*. To the Ammonia Water, previously diluted with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of cold Water, add, with constant stirring, the Solution of Ferric Sulphate, previously diluted with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of cold Water. As soon as the precipitate has subsided, draw off the clear liquid by means of a siphon, then mix the precipitate intimately with about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of cold Water, again draw off the clear liquid after subsidence of the precipitate, and repeat this operation, until a portion of the decanted liquid gives not more than a slight cloudiness with barium chloride test solution. Finally, transfer the precipitate to a wet muslin strainer, and, after it has drained, mix it with sufficient cold Water to make the mixture weigh *three hundred grammes* [or 10 ounces av., 255 grains]." *U. S.*

This preparation was introduced into the U. S. Pharmacopœia on account of its importance as an antidote to arsenic trioxide or arsenous acid. It is frequently used in the official processes as the source of iron when it is desired to produce a ferric compound, but the directions for making it always accompany the preparation in which it is used, because of the difficulty of preserving the ferric hydroxide. In the former processes the first step was to convert ferrous sulphate into ferric sulphate; but in the present, the official solution of ferric sulphate is taken already containing the iron in the proper state of oxidation. This is simply treated with ammonia water (*U. S.*), which throws down the oxide combined with water, constituting the hydrated oxide required.

It is the duty of the apothecary to be always prepared to make this antidote, by keeping the necessary solutions for its precipitation. Magnesia is probably a better precipitant than ammonia water. (See next article.) In most cases of arsenical poisoning, minutes are of immense importance, and time must be lost in washing the precipitated iron if the official process be adhered to. Magnesia is not only not irritant, but is itself antidotal to arsenic; so that the precipitated mass may be given at once to the patient. The hydroxide should not be kept in stock, but when ordered as an antidote should be freshly prepared.

The British Pharmacopœia (1898) no longer includes ferric hydroxide. This is to be regretted, for, although not a stable preparation, an official process to be used in the emergency arising from arsenical poison should be quickly available; in our opinion every Pharmacopœia should contain an official antidote to arsenic.

Properties.—Ferric hydroxide, as directed by the U. S. formula, " is a brownish-red

magma, wholly soluble in hydrochloric acid without effervescence." *U. S.* As prepared by the Dublin process, in which it was heated to redness, it lost the second molecule of water, and became the anhydrous sesquioxide (Fe_2O_3), identical with the *colcothar* of commerce.

The monohydrated sesquioxide is a reddish-brown, tasteless, insoluble powder, differing from colcothar in containing a molecule of water. Hence, "heated to dull redness in a test-tube it yields about 10 per cent. of moisture." *Br.* (1885). It should not be deliquescent, and should dissolve entirely in hydrochloric acid without effervescence. Its solution in diluted hydrochloric acid yields a copious blue precipitate with potassium ferrocyanide, but none with the ferricyanide, showing that it contains ferric oxide but no ferrous oxide. If it contains copper, its hydrochloric solution will deposit this metal on a bright piece of iron. Dawies states that if the hydrated oxide recently prepared be kept for four days in boiling water it loses a large proportion of its water, containing at the end of that time only 5.77 per cent.; the larger portion of the oxide has, therefore, become dehydrated, and the same thing happens at a lower temperature, 41.1° C. (106° F.), as in two or three months it becomes of a brick-red color, and is but slightly soluble in nitric acid. (*J. P. C.*, 4e sér., iv. 400.) This oxide is not used as a medicine. It was employed in making iron plaster, *Emplastrum Ferri* (U. S. P. 1890), troches of iron, *Trochisci Ferri* (U. S. P. 1890), and reduced iron, for which purposes other forms of oxidized iron would answer as well. The former Dublin *rubigo ferri*, or *rust of iron*, formed by exposing moistened iron wire to the air until converted into rust, is essentially the sesquioxide, containing a little ferric carbonate, and does not differ materially from the iron subcarbonate formerly official.[1]

If exposed to a red heat it loses the combined water, and becomes the anhydrous sesquioxide, less easily soluble in acids, improper for medicinal use, and altogether without effect as an antidote. Kept for some time in the pulpy state, it loses half its combined water, and becomes less soluble in acids and less efficient as an antidote. Hirsch has given some useful details in making precipitated ferric oxide upon a comparatively large scale, in *Am. Drug.*, 1884, 66.

Uses.—Ferric hydroxide is not an eligible ferruginous preparation for medicinal use. Its antidotal powers in poisoning by arsenic, the manner in which it acts, the circumstances which impair its efficiency, and the mode of using it, are fully explained under *Arseni Trioxidum*. Its power of rendering arsenic trioxide insoluble is readily shown by agitating a solution of the acid with a considerable excess of the moist oxide, filtering, and then testing the filtered solution for the arsenic; not a trace of the metal can be detected, even by hydrogen sulphide. It is stated, however, to be inferior as an antidote to the saccharated oxide. Ferric hydroxide as obtained by the U. S. formula contains a little ammonia, which is thought by some to assist its antidotal powers. At least it has been ascertained that the sesquioxide when precipitated by potassium hydroxide, as formerly directed by the Dublin College, is less efficient than when precipitated by ammonia, and must be employed in quantities three or four times as large to produce the same effect. The dry hydroxide rubbed up with water is in the same proportion weaker than the pulpy hydroxide. Ferric carbonate (formerly official) possesses antidotal powers to arsenic, though in an inferior degree; but this statement will not apply to it after it has been exposed to a red heat, to which it is improperly subjected by some manufacturing chemists. By ignition it becomes anhydrous, and altogether inefficient as an antidote.

FERRI HYDROXIDUM CUM MAGNESII OXIDO. U. S.

FERRIC HYDROXIDE WITH MAGNESIUM OXIDE

[Ferri Oxidum Hydratum cum Magnesia, Pharm. 1890, Arsenic Antidote, Ferric Hydrate with Magnesia]

(fĕr′rī hȳ-drŏx′ĭ-dŭm cŭm măg-nē′shĭ-ī ŏx′ĭ-dō)

Antidotum Arsenici; Antidote to Arsenious Acid; Hydrated Oxide of Iron with Magnesia; Contre-poison de l'arsenic, *Fr.*; Gegengift des Arseniks, Gegengift der Arsenigensaure, *G.*; Hidrato ferrico magnesico, *Sp.*

[1] *Ferri Subcarbonas*, U. S. 1870; *Subcarbonate of Iron; Sesquioxide of Iron; Red Oxide of Iron; Precipitated Carbonate of Iron; Aperitive Saffron of Mars.*—"Take of Sulphate of Iron *eight troyounces*; Carbonate of Sodium *nine troyounces*; Water *eight pints*. Dissolve the salts separately, each in four pints of the Water; then mix the solutions thoroughly, and set aside the mixture until the precipitate has subsided. Then pour off the supernatant liquid, wash the precipitate with water until the washings pass nearly tasteless, and dry it on bibulous paper without heat." *U. S.* 1870.

When the solutions of sodium carbonate and ferrous sulphate are mixed together, a hydrated ferrous carbonate, of a pale-blue color, is thrown down, and sodium sulphate remains in solution. The precipitate during the washing and drying absorbs oxygen and loses nearly all its carbon dioxide, whereby it is converted almost entirely into ferric oxide. The direction to dry the precipitate without heat is important, as even a moderate elevation of temperature has been shown by the experiments of J. A. Rex to modify the resulting product unfavorably, diminishing its solubility in hydrochloric acid in proportion to the heat employed. (*A. J. P.*, May, 1862, p. 193.)

Properties.—Ferric carbonate is a reddish-brown powder, of a disagreeable, slightly styptic taste, insoluble in water, and not readily dissolved by any acid except hydrochloric, with which it effervesces slightly. When of a bright red color it should be rejected, as this color shows that it has been injured by exposure to heat. After precipitation from its hydrochloric solution by ammonia or potassium hydroxide, either of which throws down ferric oxide, the supernatant liquor should give no indications of containing any metal in solution by the test of hydrogen sulphide or potassium ferrocyanide. It is incompatible with acids and acidulous salts. In composition it is a hydrated ferric oxide containing a little ferrous carbonate. By exposure to a red heat, it absorbs oxygen and loses water and carbon dioxide, being converted into the *astringent saffron of Mars* of the French Codex.

Uses.—Ferric carbonate is a rather feeble ferruginous tonic, nearly free from astringency. It has been especially commended in *neuralgia* in doses of a teaspoonful (3.75 Cc.). Dose, five grains (0.32 Gm.).

* "Solution of Ferric Sulphate, *forty cubic centimeters* [or 1 fluidounce, 169 minims]; Magnesium Oxide, *ten grammes* [or 154 grains]; Water, *a sufficient quantity.* Mix the Solution of Ferric Sulphate with *one hundred and twenty-five cubic centimeters* [or 4 fluidounces, 109 minims] of Water, and keep the liquid in a large, well-stoppered bottle. Rub the Magnesium Oxide with cold Water to a smooth and thin mixture, transfer this to a bottle capable of holding about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and fill it with Water to about three-fourths of its capacity. When the preparation is wanted for use, shake the Magnesium Oxide mixture to a homogeneous, thin magma, add it gradually to the diluted Solution of Ferric Sulphate, and shake them together until a uniform, smooth mixture results.

NOTE.—For the rapid preparation of this antidote to arsenical poisoning, the diluted Solution of Ferric Sulphate, and the mixture of Magnesium Oxide with Water, should always be kept on hand, in separate bottles, ready for immediate use." *U. S.*

This is a preparation which has been introduced for the purpose of furnishing a ready and efficient antidote against arsenic trioxide or arsenous acid. It is almost identical with the *Antidotum Arsenici* of the German Pharmacopœia, and experience has shown its effectiveness. Ferric hydroxide is produced when the mixture of magnesia is added to the diluted solution of ferric sulphate, and, as the magnesia is in excess and acidity thus prevented, no harm can result from not separating the by-products of the reaction. When mixed as officially directed, and ready for use, it contains ferric hydroxide with magnesium sulphate and hydroxide. It has been shown that no soluble compound with arsenic is formed when it is used as an antidote, and the presence of the magnesium salt, from a therapeutical point of view, is not at all objectionable. (See *Arseni Trioxidum,* p. 197.)

Dose, four fluidounces (120 Cc.).

FERRI HYPOPHOSPHIS. U. S.

FERRIC HYPOPHOSPHITE

(fĕr'rī hȳ-pŏ-phŏs'phĭs)

$Fe(PH_2O_2)_3 = 249.09$

"It should contain not less than 98 percent. of pure Ferric Hypophosphite [$(PH_2O.O)_3Fe$], and should be kept in well-stoppered bottles." *U. S.*

Hypophosphite of Iron; Ferrum Hypophosphorosum, Hypophosphis Ferricus; Hypophosphite de Fer, *Fr.;* Unterphosphorigsaures Eisenoxyd, Ferrihypophosphit, *G.*

This is among the hypophosphites brought into notice in consequence of their recommendation by Churchill in the treatment of phthisis, in which they were thought to be useful by the introduction of phosphorus into the system. This particular salt may be considered preferable to others when a marked condition of anæmia indicates a deficiency of iron in the tissues. It may be made by the action of hypophosphorous acid on ferrous carbonate formed by precipitation from the sulphate; but as some difficulty has been found in obtaining this acid perfectly pure, C. H. Wood of London, prefers the plan of double decomposition. He proposes that ferrous sulphate and calcium hypophosphite be made to react on each other in molecular proportions represented by 480 grains of crystallized ferrous sulphate and 326 grains of commercial hypophosphite: in the latter an allowance of 10 per cent. being made for impurities ordinarily found in that salt. These quantities will yield 320 grains of ferric hypophosphite, and the reaction will be represented by the following formula:

$$Ca(H_2PO_2)_2 + FeSO_4 = CaSO_4 + Fe(H_2PO_2)_2$$

Calcium sulphate is precipitated, and ferrous hypophosphite is held in solution. (*P. J.,* 1868, p. 342.) In this condition the salt is a ferrous compound; but on evaporation the ferrous salt becomes ferric, and acquires the properties detailed in the Pharmacopœia. Of this the following description is given in the 8th revision of this work.

Properties.—"A white, or grayish-white powder, odorless and nearly tasteless; permanent in the air. Soluble in 2300 parts of water at 25° C. (77° F.), and in 1200 parts of boiling water; more readily soluble in the presence of hypophosphorous acid, or in a warm, concentrated solution of an alkali citrate, forming with the latter a green solution. When strongly heated in a dry test-tube, the salt evolves spontaneously inflammable hydrogen phosphide gas, and, on complete ignition, leaves a residue of ferric pyrophosphate. Ferric Hypophosphite is readily oxidized by nitric acid or other oxidizing agents. If to 1 Gm. of the salt 10 Cc. of acetic acid be added, no effervescence should occur (absence of *carbonate*), and if the mixture be subsequently heated to boiling, the filtrate should respond to the following tests: The addition of a few drops of silver nitrate T.S. to a portion of the filtrate should, upon warming, cause a brown to black coloration or precipitate. If another portion of the filtrate be added drop by drop to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed upon gently heating. Another portion of the cold filtrate should afford no turbidity with ammonium oxalate T.S. (absence of *calcium*). If 0.5 Gm. of the salt be boiled with 10 Cc. of potassium hydroxide T.S., a reddish-brown precipitate will be produced; and if to the filtrate from the latter, slightly acidulated with hydrochloric acid, magnesia mixture T.S. be added, and subsequently an excess of ammonia water, no crystalline precipitate should be produced (absence of *phosphate*). If 1 Gm. of

the salt be dissolved in about 25 Cc. of boiling water by the aid of sufficient hydrochloric acid, added drop by drop, then a slight excess of ammonia water added, the filtrate from the reddish-brown precipitate should be colorless, and, after acidulating with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121)." *U. S.*

Syrup of ferrous hypophosphite may be prepared by simply adding syrup to the solution of the hypophosphite remaining after the separation of the calcium sulphate in the process of Wood above given. If two and a half ounces of water be used in the process, and the paste resulting from the precipitation of the calcium sulphate be pressed out, the remaining liquid, after filtration, will form with seven times its volume of syrup a liquid containing two grains of the hypophosphite in a fluidrachm. (*P. J.*, April, 1868.) But in this form, if the syrup be not thoroughly protected it quickly absorbs oxygen, and in a few hours begins to exhibit the formation of a precipitate, rendering it in a short time unfit for use. A little phosphoric or citric acid added to the syrup will obviate this result; but it is better perhaps at once to form a syrup from materials which will not be liable to this objection.

Wood employs the following process: "Take of granulated ferrous sulphate 480 gr., calcium hypophosphite 326 gr., diluted phosphoric acid 1 fl. oz., water 1½ fl. oz., syrup, a sufficient quantity. Dissolve, without heat, the ferrous sulphate in the phosphoric acid, previously mixed with the water. Rub the hypophosphite to fine powder, and pour on it the solution of the sulphate. Triturate together for two or three minutes, then pour the mixture on a piece of damp calico, and squeeze out the liquid with the hands. Filter this solution, and add to it seven times its volume of strong syrup. The resulting syrup will contain two grains of ferric hypophosphite in each fluidrachm." The dose may be from two to six fluidrachms (7.5 to 22.50 Cc.).

C. L. Diehl prepares a *syrup of ferric hypophosphite* from a freshly precipitated magma produced by precipitating a solution of calcium hypophosphite with solution of ferric chloride and dissolving the magma by the aid of potassium citrate. (*Proc. A. Ph. A.*, 1882, 71.)

Uses.—Ferric hypophosphite may be given in states of the system where deficient powers of the cerebral centres are attended with an anæmic condition of the blood. It has been especially employed in *phthisis* and allied cachexias. It may be administered in the form of pill or powder, but the syrup is more elegant.

Dose, from five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Syrupus Hypophosphitum Compositus, *U. S.*

FERRI PHOSPHAS. Br.

IRON PHOSPHATE

(fĕr'rī phŏs'phăs)

"A powder containing not less than 47 per cent. of hydrous ferrous phosphate, $Fe_3(PO_4)_2 8H_2O$, with ferric phosphate and some iron oxide." *Br.*

Phosphate of Iron; Phosphas Ferroso-Ferricus; Ferroso-Ferric Phosphate; Phosphate de Fer, Phosphate Ferroso-ferrique, *Fr.*; Ferrum Phosphoricum, *P. G.*; Phosphorsaures Eisenoxydul (Eisenoxydul-Oxyd), *G.*; Fosfata de hierro, *Sp.*

"Ferrous Sulphate, 3 *ounces* (Imperial) or 60 grammes; Sodium Phosphate, 2¾ *ounces* (Imp.) or 55 grammes; Sodium Bicarbonate, ¾ *ounce* (Imp.) or 15 grammes; Distilled Water, boiling, *a sufficient quantity.* Dissolve the Ferrous Sulphate in *thirty fluid ounces* (Imp. meas.) or six hundred cubic centimetres of the Distilled Water, and the Sodium Phosphate in an equal quantity of Distilled Water; when each of the solutions has cooled to between 100° and 130° F. (37.8° and 54.4° C.), add the latter to the former, pouring in also a solution of the Sodium Bicarbonate in a little Distilled Water; mix thoroughly; transfer the precipitate to a calico filter; wash it with hot Distilled Water until the washings no longer afford any reaction with the tests for sulphates; finally dry the precipitate at a temperature not exceeding 120° F. (48.9° C.)." *Br.*

This iron phosphate, which is a slate colored powder, must not be confounded with the soluble ferric phosphate of the U. S. P. (8th Rev.), which is in green transparent scales. As obtained by the present process, this U. S. preparation is not a definite chemical compound, but a mixture, which should probably be called sodio-ferric citro-phosphate, and bears a resemblance to the pyrophosphate, which is now usually made by a similar process. (See *Ferri Phosphas Solubilis.*)

The British iron phosphate is a very different salt. By double decomposition ferrous phosphate and sodium sulphate are produced, the former precipitating as a white bulky powder, which soon changes on exposure to a greenish-blue, and ultimately to a slate color; since the sodium phosphate is chemically an acid salt (Na_2HPO_4) a portion of phosphoric acid is liberated during the reaction, and this, retaining in solution some of the ferrous phosphate, requires the addition of the solution of sodium bicarbonate to neutralize it and set free the remainder of the ferrous phosphate. This salt, when first formed, is represented by the formula $Fe_3(PO_4)_2$; but its strong affinity for oxygen causes the gradual production of sesquisalt, which, therefore, to a certain extent, always exists in the preparation; hence the British authority requires it to contain at least 47 per cent. of ferrous phosphate, $Fe_3(PO_4)_2 8H_2O$. (See *P. J.*, 1897, 141.)

Properties.—"A slate-blue amorphous powder, insoluble in *water,* soluble in *hydrochloric*

acid. The solution yields a precipitate with *solutions of potassium ferrocyanide* and *ferricyanide;* and when treated with *tartaric acid* and an excess of *solution of ammonia,* and subsequently with the *solution of magnesium ammonio-sulphate,* it gives a white granular precipitate. Each gramme dissolved in *hydrochloric acid* should not cease to yield a blue precipitate with *solution of potassium ferricyanide* until at least 28.2 cubic centimetres of the *volumetric solution of potassium bichromate* have been added. It should yield no characteristic reaction with the tests for arsenium." *Br.* This shows the presence of 47 per cent. of ferrous phosphate.

Ferric phosphate, dissolved to saturation in a boiling solution of metaphosphoric acid (HP O_3), under the name of *superphosphate of iron,* was proposed as a remedy, in 1851, by Routh of London. Thomas Greenish of the same city, states that the solution of the salt, on cooling, hardens into a mass of pilular consistence, soluble in water in all proportions, and free from any disagreeable or inky taste.

Uses.—Ferric phosphate possesses the general properties of the ferruginous preparations, and has been given with advantage in *amenorrhœa* and *dyspepsia.*

Dose, from five to ten grains (0.32 to 0.65 Gm.).[1]

[1] *Compound Syrup of Phosphate of Iron. Chemical Food.*—For a formula for a compound syrup of phosphate of iron by Wiegand, made by introducing into it the phosphates of calcium, potassium, and sodium, and for remarks on the pharmacy of the phosphates by Procter, see *A. J. P.,* 1854 (pp. 111 and 112). A formula similar to Wiegand's, communicated by Edward Parrish as probably representing the process for a secret preparation considerably used in Philadelphia may be found in *A. J. P.,* 1857 (p. 573). These formulas are too complicated to have any therapeutic value. Nevertheless, as the preparations have had much vogue, under the name of *chemical food,* we give the formula of Parrish from the journal referred to. "Take of Sulphate of Iron 600 gr.; Phosphate of Soda 720 gr.; Phosphate of Lime 720 gr.; Glacial Phosphoric Acid 1200 gr.; Carbonate of Soda 40 gr.; Carbonate of Potassa 60 gr.; Hydrochloric Acid, Water of Ammonia, each, a sufficient quantity; Powdered Cochineal 120 gr.; Water a sufficient quantity, to make 20 fluidounces; Sugar 36 troyounces; Oil of Orange 10 minims. Dissolve the Sulphate of Iron in 2 fluidounces and the Phosphate of Soda in 4 fluidounces of boiling Water. Mix the solutions, and wash the precipitated phosphate of iron till the washings are tasteless. Dissolve the Phosphate of Lime in 4 fluidounces of boiling Water with sufficient Hydrochloric Acid to make a clear solution, precipitate it with Water of Ammonia, and wash the precipitate. To the freshly precipitated phosphates add the Phosphoric Acid previously dissolved in Water. When clear, add the Carbonates of Soda and Potassa, and afterwards sufficient Hydrochloric Acid to dissolve the precipitate. Now add Cochineal mixed with the Sugar, apply heat, and, when the syrup is formed, strain and flavor it. Each teaspoonful contains about one grain of phosphate of iron and two and a half grains of phosphate of lime, with smaller quantities of the alkaline phosphates, all in perfect solution." The objection to such preparations as this is not that each of the ingredients may not be useful, but that they are so numerous that a morbid state of system in which they can all be indicated must be extremely rare, and every medicine is more or less noxious if given when it is not needed. The probability is that the therapeutic value of the preparation depends mainly on its ferruginous ingredient, and that, as a rule, its therapeutic effects may be equally well if not better obtained from a simple syrup of ferric phosphate. (See *P. J.,* 1893, 795, 797.)

FERRI PHOSPHAS SOLUBILIS. U. S.

SOLUBLE FERRIC PHOSPHATE

(fĕr'rī phŏs'phās sŏ-lū'bĭ-lĭs)

"It should contain Ferric Phosphate corresponding in amount to not less than 12 per cent. of metallic iron, and should be kept in amber-colored, well-stoppered bottles, protected from light." *U. S.*

Ferri et Sodii Citro-phosphas; Ferrum Phosphoricum cum Natrio Citrico; Soluble Phosphate of Iron, Sodio-ferric Citro-phosphate; Citro-phosphate de Fer et de Soude, *Fr.;* Natriumferricitro-phosphat, *G.*

No process is given for this preparation in the U. S. P. (8th Rev.). That of the U. S. P. 1890 is as follows: "Ferric Citrate, *fifty grammes* [or 1 ounce av., 334 grains]; Sodium Phosphate, uneffloresced, *fifty-five grammes* [or 1 ounce av., 411 grains]; Distilled Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Dissolve the Ferric Citrate in the Distilled Water by heating on a water-bath. To this solution add the Sodium Phosphate, and stir constantly until it is dissolved. Evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in dark amber-colored, well-stoppered bottles." *U. S.* 1890. (See preceding article.)

W. A. Puckner (*Proc. A. Ph. A.,* 1897, 231) proposes the following process, preferring potassium chlorate to nitric acid as an oxidizing agent.

Ferrous sulphate, in clear crystals, 156 Gm.; sulphuric acid, 20 Cc.; potassium chlorate, 12 Gm.; ammonia water, 340 Cc.; citric acid, 120 Gm.; sodium phosphate, uneffloresced, 200 Gm.; water, a sufficient quantity. Add the sulphuric acid to 240 Cc. of water, contained in a glass or porcelain vessel, to this add the ferrous sulphate, warm gently until all is dissolved, then add the potassium chlorate and continue the heat for one-half hour, or until a drop of the solution added to potassium ferricyanide test solution no longer produces a distinct green or bluish-green color. Add this solution, slowly and with constant agitation, to the ammonia water contained in a suitable vessel; to this mixture add hot water, 4000 Cc., and allow to subside, and, after one-half hour, decant or siphon off the clear supernatant liquid. To the residue add 2000 Cc. of hot water, allow to subside, and decant; repeat this washing with six portions of hot water, allowing the last portion to subside for at least six hours or overnight. Decant or siphon off the clear liquid as closely as possible, then add to the remaining magma the citric acid and the sodium phosphate, warm gently until solution results, and then evaporate on a water bath at a temperature not exceeding 60° C. until the solution

weighs 500 Gm., and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Solution of Ferric Phosphate (50 per cent.). By evaporating the solution made by Puckner's method (see above) on a water bath until it measures 500 Cc., a solution is made containing 50 per cent. of ferric phosphate.

Properties.—It is officially described as in "thin, bright green, transparent scales, without odor, and having an acidulous, slightly saline taste. The salt is permanent in dry air when excluded from light, but when unprotected, soon becomes dark and discolored. Freely and completely soluble in water; insoluble in alcohol. The aqueous solution of the salt shows a slightly acid reaction with blue litmus paper. The addition of ammonia water to the solution of the salt produces a reddish-brown color. If Soluble Ferric Phosphate be boiled with potassium hydroxide T.S., it affords a brownish-red precipitate without evolving ammonia. Dissolve 0.1 Gm. of the salt in 2 Cc. of warm water, add 5 Cc. of potassium hydroxide T.S., boil and filter. Neutralize the filtrate with hydrochloric acid, add 2 Cc. of magnesia mixture T.S. and ammonia water in slight excess. A white, crystalline precipitate is produced, which, if well washed on a filter, is turned yellow by silver nitrate T.S. To 1 Gm. of the salt dissolved in 10 Cc. of water, add 15 Cc. or a slight excess of boiling potassium hydroxide T.S., and, after thoroughly mixing, filter. The filtrate, after strongly acidulating with hydrochloric acid and adding 10 Cc. of magnesia mixture T.S., followed by a slight excess of ammonia water, will afford an abundant, white, crystalline precipitate. If 0.555 Gm. of the salt be dissolved in 10 Cc. of water, in a glass-stoppered flask having a capacity of about 100 Cc., and 2 Cc. of hydrochloric acid and 40 Cc. of water added, and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 12 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid (each Cc. of tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.*

Uses.—See *Ferri Pyrophosphas Solubilis.*

Off. Prep.—Elixir Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Glyceritum Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Syrupus Ferri, Quininæ et Strychninæ Phosphatum, *U. S.* (from glycerite).

FERRI PYROPHOSPHAS SOLUBILIS. U. S.

SOLUBLE FERRIC PYROPHOSPHATE

(fĕr'rī pȳ-rǫ-phŏs'phăs sǫ-lū'bĭ-lĭs)

"It should contain Ferric Pyrophosphate corresponding in amount to not less than 10 per cent. of metallic iron, and should be kept in amber-colored, well-stoppered bottles, protected from light." *U. S.*

Ferri Pyrophosphas, *U. S.* 1880; Ferric Pyrophosphate; Pyrophosphate of Iron; Ferri et Sodii Citro-pyrophosphas; Ferrum Pyrophosphoricum cum Sodio Citrico; Pyrophosphate of Iron with Sodium Citrate; Sodio-ferric Citro-pyrophosphate; Pyrophosphate de Fer et de Soude, *Fr.;* Pyrophosphorsaures Eisenoxyd mit Citronensaurem Natron, *G.*

"Ferric Citrate, *fifty grammes* [or 1 ounce av., 334 grains]; Sodium Pyrophosphate, uneffloresced, *fifty grammes* [or 1 ounce av., 334 grains]; Distilled Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Dissolve the Ferric Citrate in the Distilled Water, by heating on a water-bath. To this solution add the Sodium Pyrophosphate, and stir constantly, until it is dissolved. Evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in dark amber-colored, well-stoppered bottles." *U. S.* 1890.

There does not seem to be a good reason for appending "Solubilis" to the title of this salt; it is practically the same ferric pyrophosphate as that of the U. S. P. 1880, which had no such addition (see *Ferri Phosphas Solubilis*). The unnecessary lengthening of the official Latin names which must be used in prescription writing is to be strongly deprecated. This formula is based upon a method proposed by M. E. Robiquet to the Academy of Medicine at Paris, in February, 1857, of preparing ferric pyrophosphate for use, by dissolving a gelatinous precipitate of the salt in a solution of ammonium citrate, and forming a syrup with the solution.

The view which obtained when this process was first made official was that a double salt was formed, consisting of ferric pyrophosphate and ammonium citrate, which might be called ammonio-ferric citro-orthophosphate. According to R. Rother (*A. J. P.*, 1876, p. 174), there was an excess of ferric citrate in the pyrophosphate of iron of the U. S. P. 1870, and it was believed to be a complex mixture of the colloid salts ammonio-ferric pyrophosphate, ammonio-ferric citrate, and free ferric citrate, as shown in the reaction:

$$2Fe_4(3P_2O_7) + 6(NH_4)_3C_6H_5O_7 = Fe_4(3P_2O_7).3(NH_4)_4P_2O_7 + 2FeC_6H_5O_7.(NH_4)_3C_6H_5O_7 + 2FeC_6H_5O_7$$

By mixing two molecules of ferric citrate and one of ammonium pyrophosphate a compound analogous to the official preparation was obtained, containing the same proportion of ammonio-ferric pyrophosphate, but mixed with twice as much ammonio-ferric citrate and free ferric citrate. Rother's views were adopted by the Committee of Revision of 1880, as well as the salt which he recommended, in which ammonia was replaced by soda, because of the greater stability of the latter. Soluble Ferric Pyro-

phosphate consists probably of sodio-ferric pyrophosphate, sodio-ferric citrate, and free ferric citrate.

Sodio-ferric pyrophosphate, dried at 100° C., is considered by Flückiger (*Pharm. Chem.*, 2d ed., p. 607, 1888) to have the following composition:

$$Fe_4(P_2O_7)_3 + 3Na_4P_2O_7 + 14H_2O$$

Properties.—It is officially described as in "thin, apple-green, transparent scales, without odor, and having an acidulous, slightly saline taste. The salt is permanent in dry air, when excluded from light, but when unprotected, soon becomes discolored. Freely and completely soluble in water; insoluble in alcohol. The aqueous solution of the salt shows a slightly acid reaction with blue litmus paper. If Soluble Ferric Pyrophosphate be boiled with potassium hydroxide T.S., it affords a brownish-red precipitate without evolving the odor of ammonia. If 0.1 Gm. of the salt be fused with 0.1 Gm. each of potassium nitrate and sodium carbonate, and the residue boiled with 10 Cc. of distilled water and filtered, the filtrate, after being rendered nearly, but not quite neutral with highly diluted nitric acid, should yield a yellow precipitate upon the addition of silver nitrate T.S. If 0.555 Gm. of the salt be dissolved in 10 Cc. of water, in a glass-stoppered flask having a capacity of about 100 Cc., and 2 Cc. of hydrochloric acid and 40 Cc. of water added, and if, after the addition of 1 Gm. of potassium iodide, and securely closing the flask, the mixture be kept for half an hour at 40° C. (104° F.), and then cooled, it should require not less than 10 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 1 percent. of metallic iron)." *U. S.*

Ridenour believed that the presence of orthophosphate in some samples of ferric pyrophosphate is due to the carelessness of the manufacturer and proposed a test for the presence of orthophosphate (*A. J. P.*, 1900, 125).

Uses.—It is a very good chalybeate, mild yet efficient in its action on the system, without disagreeable taste, and, from its solubility, readily administered in any form that may be desirable, whether that of pill, simple solution in water,[1] or syrup.

Dose, two to ten grains (0.13 to 0.65 Gm.).

FERRI SULPHAS. U. S., Br.

FERROUS SULPHATE [Iron Protosulphate]

(fĕr'rī sŭl'phăs)

$FeSO_4 + 7H_2O = 276.01$

"It should contain not less than 99.5 percent. of pure Ferrous Sulphate [$SO_2.O_2Fe + 7H_2O$]; the crystals should not be effloresced, and should be kept in well-stoppered bottles." *U. S.* "Ferrous Sulphate, $FeSO_4,7H_2O$, may be prepared by the interaction of diluted sulphuric acid and iron." *Br.*

Sulphate of Iron, Green Vitriol; Sulfas Ferrosus, Ferrum Vitriolatum Purum, Vitriolum Martis Purum; Sulfate Ferreux Officinal, *Fr. Cod.;* Sulfate (protosulfate) de Fer, *Fr.;* Ferrum Sulfuricum, *P. G.;* Ferrosulfat, Schwefelsaures Eisenoxydul, *G.;* Solfato ferroso, *It.;* Sulfato ferroso, *Sp.*

The British Pharmacopœia (1885) contained the following process for this salt:

"Take of Iron Wire *four ounces* [avoirdupois]; Sulphuric Acid *four fluidounces* [Imperial measure]; Distilled Water *one pint and a half* [Imp. meas.]. Pour the water on the Iron placed in a porcelain dish, add the Sulphuric Acid, and, when the disengagement of gas has nearly ceased, boil for ten minutes. Filter now through paper, and, after the lapse of twenty-four hours, separate the crystals which have been deposited from the solution. Let these be dried on filtering paper placed on porous bricks, and preserved in a stoppered bottle." *Br.* 1885.

The object of this process is to make a pure ferrous sulphate by direct combination. Sulphuric acid, in a concentrated state, acts but imperfectly on iron, but when diluted, a vigorous action takes place. The theoretical quantities for mutual reaction are 56 of iron to 98 of acid. This proportion is one part of iron to one and three-quarters of acid. The British Council uses an excess of acid, the weight of acid being 7.38 avoirdupois ounces, instead of 7. An excess of iron, however, is desirable, as it tends to secure the production of a perfect ferrous sulphate. A process for this salt was given in the U. S. P. 1870, which was based upon the method of Bonsdorff. This chemist found that, when a perfect ferrous sulphate was formed in solution by heating diluted sulphuric acid with an excess of iron, it might be crystallized free from sesquioxide, provided a little excess of sulphuric acid were added to the liquid before filtration, in order to prevent the formation of any sesquioxide during the process, at the same time avoiding, as much as possible, contact with the air. Hence the directions in the former U. S. Pharmacopœia formula to acidulate with sulphuric acid, to cause the funnel to touch the bottom of the receiving vessel, which avoids the dropping of the liquid through the air, and to cover the vessel containing the concentrated liquid when it is set aside to crystallize.

Commercial Ferrous Sulphate or *Copperas* is manufactured on a large scale for the purposes of the arts, from the native ferric sulphide or iron pyrites, by roasting, oxidation by exposure to air and moisture, and lixiviation. The constituents of the mineral become sulphuric acid and ferrous and ferric oxides, which, by their union, form the salt. Ferrous sulphate is also obtained in many chemical processes as a collateral product, as in the manu-

[1] *Liquor Ferri Pyrophosphatis.*—A permanent solution may be made by Rother's process by dissolving 120 grains of iron pyrophosphate in five fluidrachms of water with the aid of heat, filtering while hot, mixing the filtrate with two fluidrachms of glycerin, and adding enough water through the filter to make one fluidounce. (*D. C.*, 1886, p. 99.)

facture of alum, in the precipitation of copper from solutions of copper sulphate by scraps of iron, etc.

Commercial ferrous sulphate is far from being pure. Besides containing some ferric sulphate, it is generally contaminated with metallic and earthy salts, such as those of copper, zinc, aluminum, and magnesium. Two principal kinds occur in the market, one in large grass-green crystals, the surface of which is studded with ochreous spots; the other of a bluish-green color, and ordinarily mixed with the powder of the effloresced salt. Commercial sulphate should never be dispensed by the pharmacist until it has undergone purification by recrystallization from a slightly acid solution.

Properties.—Ferrous sulphate is in the form of "large, pale bluish-green, monoclinic prisms, without odor, and having a saline, styptic taste; efflorescent in dry air. On exposure to moist air, the crystals rapidly oxidize, and become coated with brownish-yellow, basic ferric sulphate. Soluble in 0.9 part of water at 25° C. (77° F.) and in 0.3 part of boiling water; insoluble in alcohol. When slowly heated to 115° C. (239° F.), the crystals disintegrate, and lose 38.87 percent. of their weight (6 molecules of water of crystallization). The aqueous solution of the salt shows an acid reaction with blue litmus paper, and, even when highly diluted, gives with potassium ferricyanide T.S. a blue color or precipitate, and with barium chloride T.S. a white precipitate insoluble in hydrochloric acid. If 1 Gm. of the salt be dissolved in about 25 Cc. of water, containing 1 Cc. of diluted sulphuric acid, the solution heated to boiling, oxidized with nitric acid, and then mixed with a slight excess of ammonia water, the filtrate from the reddish-brown precipitate produced should be colorless, and, after acidulating with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If another portion of the salt be oxidized and precipitated as directed above, the filtrate, on evaporation to dryness and ignition, should not leave any weighable residue (absence of salts of the *alkali metals*). If 1 Gm. of Ferrous Sulphate, in small fragments, be agitated during four or five minutes with 10 Cc. of alcohol, the filtrate should not redden moistened blue litmus paper (absence of *free acid*). If 1.38 Gm. of the salt, in uneffloresced crystals, be dissolved in about 25 Cc. of diluted sulphuric acid, not less than 49.75 Cc. of tenth-normal potassium permanganate V.S. should be required to impart to the liquid a permanent pink color (each Cc. of the tenth-normal potassium permanganate V.S. indicating 2 percent. of crystallized Ferrous Sulphate)." *U. S.* "In oblique rhombic prisms, of a pale bluish-green color and astringent taste; insoluble in *alcohol* (90 per cent.), soluble in less than 2 parts of cold *water* and giving a clear solution (absence of oxysulphate). It affords the reactions characteristic of ferrous salts and of sulphates. Each gramme dissolved in *water* acidulated with *sulphuric acid* should not cease to yield a blue precipitate with *solution of potassium ferricyanide* until 36 cubic centimetres of the *volumetric solution of potassium bichromate* have been added. It should yield no characteristic reaction with the tests for copper, zinc, potassium, sodium, or ammonium. Its solution in *water* should not give any precipitate with *hydrogen sulphide* (absence of ferric compounds, etc.)." *Br.* As prepared by Bonsdorff's method, ferrous sulphate is blue, verging upon green. When it becomes more green than blue, or entirely green, an indication is afforded that it contains some sesquioxide. By exposure to the air the crystals absorb oxygen, and become first green, and ultimately covered with a yellow efflorescence of subsulphate, insoluble in water. Sometimes the crystals are quite permanent when made by Bonsdorff's method, owing to the slight excess of acid which they contain. The aqueous solution is bluish green, but by standing it attracts oxygen, and becomes first green and then reddish, depositing, in the meantime, a portion of sesquisulphate, having the composition:

$$Fe_2(SO_4)_3 + Fe_2O_3 + 8H_2O$$

At a red heat it loses its acid, and is converted into the anhydrous ferric oxide called *colcothar*. It is incompatible with the alkalies and their carbonates, soaps, lime water, calcium and barium chlorides, sodium borate and phosphate, silver nitrate, and lead acetate and subacetate. It is decomposed also by astringent vegetable infusions, the tannic and gallic acids of which form, if any sesquioxide be present, a black compound of the nature of ink. The extent to which this change lessens the activity of the salt is not well ascertained. Ferrous sulphate, as found in commerce, is often the impure commercial sulphate, which is not fit for medicinal use. The perfectly pure salt is precipitated white by potassium ferrocyanide, but that of ordinary purity gives a greenish precipitate, more or less deep, with this test, owing to the presence of some ferric oxide. Copper may be detected by immersing in the solution a bright piece of iron, on which a cuprous film will be deposited. Both copper and zinc may be discovered by oxidizing the iron by boiling the solution of the salt with nitric acid and then precipitating the iron by an excess of ammonia. If the filtered solution be blue, copper is present, and if it contain zinc, this will be separated in flakes of white oxide on expelling the excess of ammonia by ebullition.

It is often desirable to protect ferrous sulphate against the oxidation to which it is liable on exposure. Sugar acts as a preservative in the case of this salt, as in that of ferrous iodide. It may be added to the solution, or incorporated with the sulphate in substance. E. Latour has given a formula for crystallizing the salt with sugar. Geo. Welborn has found that a small lump of camphor, wrapped in tissue

paper, and placed in the bottle with the sulphate, prevents its oxidation. (*P. J.*, May, 1868, p. 537.) Pavesi of Mortara, effects the same object by incorporating it with an equal weight of gum arabic, by evaporating a joint solution of the two substances with a gentle heat. (*J. P. C.*, 4e sér., iii. 49.)

Uses.—Ferrous sulphate is a very astringent chalybeate. In overdoses it produces nausea, vomiting, griping, and purging, and other evidences of gastro-enteric irritation or inflammation. Its astringency fits it especially for use when anæmia is conjoined with marked relaxation or a tendency to immoderate discharges, such as *passive hemorrhages, colliquative sweats, leucorrhœa, gleet,* etc. Externally, the solution has been used in chronic *ophthalmia, leucorrhœa,* and *gleet,* made of various strengths, from one or two to eight or ten grains of the salt to the fluidounce of water. Velpeau has found it an excellent remedy in *erysipelas,* applied topically in the form of solution or ointment. The solution was made of three and a half drachms of the salt to a pint of water, and applied by compresses kept constantly wet. In a few cases convenience required the application of the ointment, made of eight parts of the salt to thirty of lard. An ointment made of one or two parts of the sulphate to sixty of lard was found by Devergie to be particularly efficacious in certain skin diseases, especially in *eczema.* In scaly affections it had no effect. (See *Ferri Sulphas Exsiccatus.*)

Ferrous sulphate, usually in the form of the impure salt or commercial copperas, is a feeble disinfectant. When thrown into a mass of decomposing organic matter, a portion of it is at once precipitated as a sulphide or as an oxide by the hydrogen sulphide and ammonia present. It is asserted that ferric sulphate unites with organic substances to form definite stable compounds, and that animal substances kept in a 3 per cent. solution of neutral ferric sulphate for some time and then removed, mummify without decomposition. (*N. R.*, Dec. 1883, 685.)

Dose, two to five grains (0.13 to 0.32 Gm.).

Off. Prep.—Ferri Arsenas, *Br.;* Ferri Carbonas Saccharatus, *U. S., Br.;* Ferri Phosphas, *Br.;* Ferri Sulphas Exsiccatus, *U. S., Br.;* Ferri Sulphas Granulatus, *U. S.;* Liquor Ferri Subsulphatis, *U. S.;* Liquor Ferri Tersulphatis, *U. S., Br.;* Massa Ferri Carbonatis, *U. S.;* Mistura Ferri Composita, *U. S., Br.*

FERRI SULPHAS EXSICCATUS. U. S., Br.

EXSICCATED FERROUS SULPHATE
[Dried Ferrous Sulphate]

(fĕr'rī sŭl'phăs ĕx-sĭc-cā'tŭs)

Approximately $3FeSO_4.2H_2O = 488.31$

Ferri Sulphas Exsiccata, *Br.* 1885; Dried Sulphate of Iron; Sulfate Ferreux desséché, *Fr.;* Ferrum Sulfuricum Siccum, *P. G.;* Getrochnetes Ferrosulfat, Entwässertes Schwefelsaures Eisenoxydul, *G.;* Sulfato ferroso desecado, *Sp.*

* "Ferrous Sulphate, in coarse powder, *one hundred grammes* [or 3 ounces av., 231 grains]. Allow the salt to effloresce at a temperature of about 40° C. (104° F.), in dry air, and then heat it in a porcelain dish, on a water-bath, constantly stirring, until the product weighs from *sixty-four* to *sixty-five grammes* [or 2 ounces av., 113 grains to 2 ounces av., 128 grains]. Lastly, reduce the residue to a fine powder, and transfer it at once to perfectly dry, well-stoppered bottles." *U. S.*

"Expose Ferrous Sulphate, $FeSO_4,7H_2O$, in a porcelain or iron dish to a temperature of 212° F. (100° C.), stirring occasionally until aqueous vapor ceases to be given off; reduce the residue, which should weigh about 60 per cent. of the original salt, to a fine powder." *Br.*

Properties.—"A grayish-white powder, slowly but completely soluble in water, and conforming to the reactions and tests given under *Ferri Sulphas." U.S.* 100 parts of crystallized ferrous sulphate yield about 65 parts of the exsiccated salt. "A nearly white powder, slowly but entirely soluble in *water.* Each gramme dissolved in *water* acidulated with *sulphuric acid* should not cease to yield a blue precipitate with *solution of potassium ferricyanide* until at least 54.6 cubic centimetres of the *volumetric solution of potassium bichromate* have been added, corresponding to at least 92½ per cent. of Exsiccated Ferrous Sulphate, $FeSO_4,H_2O$." *Br.*

In this process about six molecules out of seven, of the water of crystallization of the salt, are driven off. The heat should not exceed 149° C. (300° F.), otherwise the salt itself would suffer decomposition. If the heat has been excessive, the color of the salt will be brownish instead of grayish white. Dried ferrous sulphate is used for making pills, the crystallized sulphate not being adapted to that purpose. In prescribing the dried sulphate it is necessary to recollect that about three grains of it are equivalent to five grains of the crystallized salt.

Dose, one to three grains (0.065 to 0.2 Gm.).

Off. Prep.—Pilulæ Aloes et Ferri, *U. S.* (*Br.*); Pilula Ferri, *Br.*

FERRI SULPHAS GRANULATUS. U. S.

GRANULATED FERROUS SULPHATE
[Precipitated Ferrous Sulphate]

(fĕr'rī sŭl'phăs grăn-ū-lā'tŭs)

$FeSO_4 + 7H_2O = 276.01$

Granulated Sulphate of Iron; Ferri Sulphas Præcipitatus, *U. S. P.* 1880; Precipitated Sulphate of Iron; Sulfate Ferreux précipité, *Fr.;* Præcipitirtes Ferrosulfat, *G.*

* "Ferrous Sulphate, *one hundred grammes* [or 3 ounces av., 231 grains]; Distilled Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Diluted Sulphuric Acid, *five cubic centimeters* [or 81 minims]; Alcohol, *twenty-five cubic centimeters* [or 406 minims].

Dissolve the Ferrous Sulphate in the Distilled Water previously heated to boiling, add the Diluted Sulphuric Acid, and filter the solution while hot. Evaporate the solution immediately in a tared porcelain dish, on a sand-bath, until it weighs *one hundred and fifty grammes* [or 5 ounces av., 127 grains], and then cool it quickly, with constant stirring. Transfer the product to a glass funnel stopped with a plug of purified cotton, and, when it has thoroughly drained, pour upon it the Alcohol. When this has also drained, spread the crystalline powder on bibulous paper, dry it quickly at the ordinary temperature, and transfer it at once to perfectly dry, well-stoppered bottles." *U. S.*

The process of the U. S. P. (1890), retained by the U. S. P. (8th Rev.), differs radically in manipulation from that of 1880; instead of pouring the filtered solution of ferrous sulphate into alcohol and collecting the precipitate which falls, the solution is granulated by heat with constant stirring (not quite to dryness), and this salt is then washed with alcohol, which displaces impurities and facilitates the rapid drying of the granular powder.

The product is practically identical with the granulated sulphate of iron of the British Pharmacopœia (1885). The British Pharmacopœia (1898) omitted the granulated salt entirely. The process of the U. S. Pharmacopœia of 1880 had the advantage of being more manageable and convenient, ferrous sulphate being used directly instead of being made by the action of sulphuric acid on the metal. The directions given in the first part of the former British process are precisely the same as those laid down by the British Council for making ferrous sulphate; but the hot solution of the iron in the sulphuric acid, instead of being allowed to filter into an empty vessel, is made to drop into a portion of rectified spirit, the mixture being stirred while it cools. The acid directed is in excess, and the filtrate is consequently an acid solution of ferrous sulphate mixed with spirit. The stirring as the mixture cools, finely granulates the salt, which separates perfectly pure, the spirit holding in solution any ferric sulphate which may have been formed, and the excess of acid dissolving any free sesquioxide. This process, in its main features, is that of Berthemot. (See 8th ed., U. S. D.)

Properties.—"Granulated Ferrous Sulphate is a very pale bluish-green, crystalline powder, which should conform in every respect to the reactions and tests given under *Ferri Sulphas.*" *U. S.* Barckhauser, Salzer, and others have stated that ferrous sulphate precipitated by alcohol did not always contain seven molecules of water, and it could not be relied upon for making volumetric solutions because of this lack of uniformity in composition. Caro (*Ann. Ch. Ph.*, clxv. 29) and Schlickum (*Ph. Ztg.*, No. 49), on the other hand, maintain that precipitated ferrous sulphate is constant in composition, and Schlickum proved that if the precipitation took place in the cold it always contained seven molecules of water, but *boiling* with strong alcohol diminished the proportion of water of crystallization. This salt is less liable to oxidation on exposure than is the sulphate in its ordinary form, and experience has shown that it is admirably adapted for dispensing.

Dose, two to five grains (0.13 to 0.32 Gm.).

Off. Prep.—Pilulæ Ferri Carbonatis, *U. S.*

FERRUM. U. S., Br.

IRON

(fĕr'rŭm)

Fe = 55.5

"Metallic iron, in the form of fine, bright, and non-elastic wire." *U. S.* "Annealed iron wire, having a diameter of about 0.005 inch (0.1 millimetre) (about No. 35 wire gauge), or wrought-iron nails, free from oxide." *Br.*

Fer, Mars, Fer métallique, *Fr. Cod.;* Fil de Fer, *Fr.;* Eisen, Eisendraht, *G.;* Ferro, Limatura di ferro, *It.;* Hierro, *Sp.*

In the U. S. Pharmacopœia, this metal is employed in different preparations in the form of wire; it was official in 1850 as *Ferri Ramenta, Iron Filings.*[1]

Iron is the most abundant and useful of the metals, and so interwoven with the wants of mankind that the extent of its consumption by a nation may be taken as an index of progress in civilization. It is universally diffused in nature, not only in the mineral but also in the vegetable and animal kingdoms. There are very few minerals in which traces of it are not to be found, and it is an essential constituent in many parts of animals, but particularly in the blood. It is one of the few metals which are not deleterious to the animal economy. Iron occurs: 1, native (almost exclusively, however, of meteoric origin); 2, sulphuretted, in the minerals *pyrites* (simple ferric

[1] *Iron Wire.*—Ferri Filum, U. S. 1850. Fil de Fer, *Fr.;* Eisendraht, *G.;* Fil di ferro, *It.;* Hilo de hierro, *Sp.*

Iron Filings.—Ferri Ramenta, U. S. 1850. Limatura Ferri; Limailles de Fer, *Fr.;* Eisenfeilicht, *G.;* Limatura di ferro, *It.;* Limatura de hierro, *Sp.* Iron, when employed in pharmaceutical operations, should be of the the purest kind; and hence the Pharmacopœias generally direct it, when wanted in small masses, to be in the form of *iron wire,* which is necessarily made from the purest, because the softest and most ductile iron, and is readily cut into pieces. The wire is very flexible and without elasticity.

Iron filings are usually obtained from the workshops of the blacksmith; but, as furnished from this source, they are generally very impure, and unfit for medicinal use. Gobley, upon examining thirty-six samples of iron filings, found but three exempt from copper; the rest, besides wood, sand, and ferric oxide, contained as high as 2 per cent. of this metal. Iron filings cannot be completely purified by the magnet, as they often have adhering to them bits of foreign matter which are carried up with them. The only way to obtain them pure is to file a piece of pure iron with a clean file. The French Codex directs iron in an *impalpable powder* prepared by porphyrizing bright and clean iron filings without water. A dull black powder is formed, which must be carefully preserved from moisture. An impalpable powder of the metal, *Ferrum Reductum,* is official.

sulphide), *pyrrotine,* or *magnetic pyrites,* and *arsenopyrite* or *mispickel* (a sulph-arsenide of iron); 3, oxidized, embracing the magnetic, specular, red, brown, and argillaceous iron oxides, also *chromite* (mixed iron, chromium, and magnesium oxides) and *franklinite* (mixed iron, manganese, and zinc oxides); 4, in saline combination, forming ferrous carbonate, sulphate, phosphate, and arsenate. Those minerals of iron which admit of being worked to advantage are called *iron ores.* These include the different native oxides, and the carbonate (spathic iron). The best iron is obtained from the ferroso-ferric oxide, usually called magnetic iron ore, and the anhydrous sesquioxide, known as specular iron ore. These occur abundantly in Sweden, and furnish the superior iron of that country. The upper peninsula of Michigan and the borders of Lake Champlain in New York yield similar ores. As a rule, those ores yield the best iron which occur in primitive formations.

Extraction.—The mode of extracting iron from its ores varies somewhat with the nature of the ore; but the general principles of the operation are the same for all. The ore, previously broken into small pieces and roasted, is exposed to the action of an intense heat, urged by an air blast, in contact with carbonaceous matter, such as charcoal, coke, or anthracite, and in connection with some flux capable of fusing with the impurities of the ore. The flux varies with the nature of the ore, and is generally limestone. Fluorspar is occasionally used, but is not often found in sufficiently large deposits to be available. The flux, whatever it may be, enters into fusion with the impurities, and forms what is called the slag, which is a fusible lime silicate chiefly, while the carbon monoxide formed from the carbonaceous matter, acting on the ferric oxide, reduces it to the metallic state. The reduced metal, from its density, occupies the lower part of the furnace, and is protected from the action of the air by the melted slag which floats on its surface. When the reduction is completed, the slag is allowed to run out by a hole in the side of the furnace, and the melted metal by an aperture at the bottom, the latter being received into a series of sand moulds, where it solidifies in masses, known in commerce by the name of *pig* or *cast iron.* In this state the metal is brittle and far from being pure, as it contains from 3 to 6 per cent. of carbon, with silicon, phosphorus, sulphur, and manganese. It is purified, and brought to the state of *malleable iron,* by being fused and subjected, while stirred, to the action of a current of air on its surface. By these means the carbon is nearly burnt out, and the other impurities are oxidized and made to rise to the surface as a slag. Instead of this process, called "refining," usage in this country and in England substitutes what is called "pig boiling,"—that is, the pig iron is at once submitted to the operation of puddling without previous refining. The "puddling" process consists in heating the charge of pig iron on the hearth of a reverberatory furnace in contact with ferric oxide and in a reducing flame. The silicon is first burnt out, and then the carbon gradually disappears; the phosphorus goes into the "tap cinder" as phosphide and phosphate; the sulphur in part disappears as sulphur dioxide and in part remains in the cinder as ferrous sulphide. As the metal approaches to purity, it becomes tough and less liquid, and its particles agglutinate so as to form semi-fused lumps, though the temperature of the furnace continues the same. These lumps are then taken out of the furnace, and their particles, by means of ponderous hammers moved by steam or water power, or by great pressure, are forced together so as to form one tenacious mass. The metal is finally rolled out into bars of a convenient size, when it constitutes the malleable iron of commerce.

The third form of commercial iron, known as "steel," is made either by the *cementation* process, the *Bessemer* process, or the *open hearth* process. In the first case, wrought iron is packed with charcoal and heated until combination takes place, and the resulting steel is cast into ingots. In the second case, cast iron is melted in large vessels called converters, when a blast of air is blown through the mass, burning out the requisite amount of carbon, and then, after addition of a small amount of *spiegeleisen,* or manganiferous cast iron, the finished product is run into moulds; while in the third or open hearth process, a mixture of pig iron and ore is heated with a reverberatory flame, as in the puddling process, or bars and blooms of wrought iron are heated with the pig iron, and steel is made by the combination of the two. Steel contains from ½ to 1 per cent. of carbon.

The production of pig iron in the United States in 1905 was 22,992,380 tons, valued at $379,374,270. The steel production of the United States for 1905, was Bessemer steel, 10,941,375 tons; open hearth steel, 8,971,376 tons; crucible and miscellaneous, 121,000 tons, a total of all kinds of steel, of 20,033,751 tons.

The United States, in 1905, produced 43.2 per cent. of the pig iron of the world, and 46.5 per cent. of the steel, Germany coming second, and Great Britain third, in each case. There was a shrinkage in the production of both iron and steel in the United States in 1904, but in 1905 the production again increased.

Iron mines occur in most countries, but more particularly in northern ones. In Spain the principal mines furnish spathic iron and the red oxide. The chief iron ores of France are the spathic iron, and the specular, brown, and argillaceous oxides; of Germany, the spathic iron and brown oxide. The island of Elba is celebrated for its rich and abundant specular iron ore. In the United States iron is abundant. The principle ores that are worked are the magnetic, red, and brown oxides. The

magnetic oxide is found in large beds in Essex Co., N. Y., on the borders of Lake Champlain, and in the Lake Superior district; the red oxide in New York, New Jersey, Pennsylvania, Alabama, and especially in a very pure state in Missouri, at Iron Mountain and Pilot Knob; the brown oxide in Eastern Pennsylvania.

Properties.—Iron is a hard, malleable, ductile, and tenacious metal, of a grayish-white color and fibrous texture, a characteristic taste, and a sensible odor when rubbed. In tenacity it yields only to nickel and cobalt. (Deville.) Its sp. gr. is about 7.7, and its fusing point very high. It possesses magnetic and welding properties. It is combustible, and, when heated to whiteness, burns in atmospheric air, and with brilliant scintillations in oxygen gas. At a red heat, its surface is converted into black oxide, and at common temperatures, by the combined agency of air and moisture, it becomes covered with a yellowish-brown matter, called *rust*, which is the hydrated sesquioxide. It combines with all the non-metallic elements, except hydrogen and nitrogen, and with most of the metals. It forms three compounds with oxygen, a ferrous oxide and a ferric oxide, which by their union form the native magnetic oxide, hence often termed ferroso-ferric oxide, and a trioxide, which forms an acid called ferric acid. The *monoxide*, or ferrous oxide, is of a dark blue color, attracted by the magnet, and spontaneously combustible in the air, being converted into sesquioxide or ferric oxide. It is the base of ferrous sulphate, and the green salts of iron generally. It is very prone to absorb oxygen, and hence the salts which contain it are soon partially converted, when in solution, into salts of the ferric oxide. Its formula is FeO, consisting of one atom of iron, Fe, and one of oxygen, O. The *sesquioxide*, or ferric oxide, is readily obtained by dissolving iron in nitrohydrochloric acid, precipitating by ammonia, and igniting the precipitate. It is of a red color, not attracted by the magnet, and forms salts which for the most part have a reddish color. Its formula is Fe_2O_3, consisting of two atoms of iron, Fe, and three atoms of oxygen, O. An allotropic variety of the sesquioxide, soluble in water, and not responding to the ordinary tests of iron, has been discovered by Péan de Saint-Gilles. The *native black oxide*, the magnetic oxide of mineralogists, consists of one molecule of FeO and one molecule of Fe_2O_3.

Under the name of *Ferri Oxidum Magneticum*, the British Pharmacopœia had a preparation consisting of this oxide with three molecules of water. *Ferric acid*, discovered by Fremy, may be obtained, in union with potassium hydroxide, by passing chlorine through a very concentrated solution of the alkali, holding the hydrated ferric oxide in suspension, or by fusing iron filings with potassium nitrate. The acid anhydride consists of one atom of iron and three of oxygen, FeO_3. Iron forms a number of important salts.

Iron is readily detected, even in minute quantities, by bringing it to the state of ferric salt in solution, and adding potassium ferrocyanide or tincture of galls, the former of which will strike a deep blue, the latter a black color. Bringing it to the state of a ferric salt is readily effected by boiling the solution containing it with a little nitric acid. The testing of the official scaled salts of iron has attracted the attention of chemists, it being well known that these are not definite chemical compounds. F. B. Power prefers the *iodometric method* for estimating the quantity of iron in scaled salts. It is based on the liberation of iodine by a solution of ferric chloride, and the subsequent estimation of the liberated iodine by a tenth-normal volumetric solution of sodium thiosulphate. (*Ph. Rund.*, 1891, 205.)

Uses.—*General Therapeutic Effects of Iron.* Since iron constitutes an integrant portion of the red blood corpuscles, it is a necessity for their production, and the great indication for its use is lack of hæmoglobin in the blood,—*i. e.*, *anæmia*. It is plain that the lack of hæmoglobin may be due to the lessening of the number of the red blood corpuscles, or it may be the outcome of a lack of the normal amount of hæmoglobin in the individual blood corpuscles. The distinction between these two varieties of anæmia is important, since clinical experience has shown that in anæmia of the first of these classes—the so-called "*pernicious anæmias*," in which there is a marked diminution of the number of the red blood corpuscles—the prognosis is very grave, while in *chlorotic anæmias* in which there is simply poverty of hæmoglobin the prognosis is favorable. In essential anæmias iron may be administered, but is of very little value. In the non-essential or simple anæmias the effect of the administration of iron varies with the cause of the anæmia, but is usually more or less favorable. In the so called *accidental anæmias*, in which the poverty of the blood is due to some temporary, removable, or self-disappearing cause, such as hemorrhage, snake or other poisonings that destroy the red blood corpuscles, iron is of great service in hastening the recovery after the immediate activity of the cause has ceased. In *secondary anæmias*, such as those which follow impaired digestion, diarrhœa, abscesses, and various chronic diseases, iron should be exhibited, provided it has no injurious effect upon the disease which is producing the anæmia. In the class of anæmias typified by *chlorosis*, in which the anæmia is part of a subacute disease of obscure nature, iron is often an extraordinarily effective remedy, evidently doing something more than merely supplying material for the making of the red blood corpuscles. By stimulating the organs which produce the red blood corpuscles, or in some other less direct manner, it evidently increases the manufacture of hæmoglobin in the system.

The old belief that iron is a tonic, independent of its influence upon anæmia, is a mis-

take, there being no sufficient reason for supposing that iron has other therapeutic properties than those of astringency and of chalybeate action, except some special preparations, such as the iodide and the chloride, which are peculiar in their influence by virtue of some substance in them other than the iron.

The question of the selection of a preparation of iron for an individual case is often one of great importance. If it be simply desired to combat anæmia, a preparation should be selected which is free as may be from astringency or peculiar property and is suitable to the individual taste of the patient. Most of the liquid preparations of iron are more or less injurious to the teeth, so that commonly it is preferable to give a solid salt in pill or capsule rather than one of the liquid forms, unless the latter be especially indicated.

The question of the capability of iron preparations of being absorbed is one which has called for an amount of chemical investigation which is so great that even to epitomize it would carry us beyond the proper bounds of an article for a dispensatory, we therefore refer our readers to the last edition of H. C. Wood's *Therapeutics*. It is sufficient to note that many chemists have asserted that most, if not all, of the official preparations of iron are practically not absorbed,—a conclusion which is so at variance with an overwhelming amount of clinical evidence that it could not, under any circumstances, be accepted by clinicians; moreover, it is at present opposed by recent chemical researches, which show many fallacies underlying the older work, and seem to prove the correctness of the position which clinicians have steadily held to,— namely, that the human body is capable of absorbing iron from almost all, if not all, of the official iron preparations. Spurred on by the theory that the inorganic salts of iron are not absorbed, pharmaceutical chemists have devised various organic compounds which will be considered in detail in PART II of this book. There is, however, no sufficient reason for believing that these complicated and costly preparations of iron are in any way superior to the older official forms.

It would probably be much better if the U. S. P. recognized only a fraction of the present official preparations. All that can be accomplished with any preparation in simple anæmia can be done with reduced iron or pill of the carbonate for exhibition in solid form and the ammoniocitrate for liquids. No compounds in which iron is combined with an alkaloid should be recognized by the Pharmacopœia or used by the practitioner. Of course such combinations are to a greater or less extent effective, but the proportionate amount of the alkaloid and the iron required in individual cases varies indefinitely, and the habitual use of a fixed proportion, such as is demanded by the pharmacopœial combinations, strongly inclines the practitioner of medicine to careless and routine practice. The official alkaloidal-ferruginous preparations have no advantage whatever over extemporaneous prescriptions combining iron and the alkaloid.

Certain salts of iron are extremely astringent and more or less irritant. The most important of these are the sulphates and the chlorides. These salts should never be employed as chalybeates, except in those cases in which, for some reason, astringency is desired. Although the mildest of the pure chalybeate preparations are somewhat astringent, and have a tendency to produce constipation, they are also somewhat irritant to the mucous membrane of the gastro-intestinal tract. Such salts as the sulphate or the chloride are very astringent and very irritating. Any functional disarrangement of the digestive organs is a contraindication of greater or less force to the use of iron, and when the loss of functional power depends upon gastric or intestinal catarrh, or upon other organic diseases of the gastro-intestinal mucous membrane, iron is strongly contraindicated. We have often seen great injury done to patients suffering from gastro-intestinal catarrh by the iron given with the hope of relieving the anæmia, which has been secondary to the interference with digestion by the disease. A second contraindication to the use of iron is a rheumatic diathesis, though in rare cases of *chronic rheumatism* in which there is pronounced anæmia iron may do good. In most cases some laxative should be combined with iron to overcome its constipating influence.

Iron has been employed hypodermically to some extent. It has been shown by the chemists working under Kobert of Dorpat, that when a solution of iron and sodium citrate is injected subcutaneously in man, 40 per cent. of the iron escapes in the urine unaltered, the elimination of the iron usually being accompanied by pronounced renal irritation. The hypodermic use of some of the organic compounds of iron has been strongly recommended by investigators. The latest researches seem, however, to show that the iron citrate is as good a preparation for the hypodermic administration of iron as any other, the iron appearing in the urine half an hour after its injection and being present for twenty-four hours. According to Gloevecke, 1 Cc. of a 10 per cent. solution, thrown into the muscles of the back, causes an enduring sharp pain, but Lepine asserts that 2.5 Cc. of a 4 per cent. solution produces little or no disturbance. It is stated that after the hypodermic injection of large doses the irritation of the alimentary canal is more severe than when the drug is given by the mouth,— a statement which finds confirmation in the experiments of Gottlieb, who found that when he injected iron subcutaneously into a dog he was able to obtain nearly 97 per cent. of it from the fæces. The effort at intestinal elimination is evidently accompanied by irritation if the amount of iron to be eliminated is large.

Unsoundness of the kidney is an absolute contraindication to the hypodermic use of iron; hæmaturia and urinary suppression have been produced by the remedy under such circumstances. In ordinary cases of anæmia iron should not be used hypodermically, but when, under the influence of certain poisons, there is very rapid destruction of the hæmoglobin the method may be employed, and trials of it in the essential anæmias are justifiable.

Off. Prep.—Liquor Ferri Chloridi, *U. S.* (*Br.*); Liquor Ferri Pernitratis, *Br.*; Syrupus Ferri Iodidi, *U. S.*, *Br.*; Syrupus Ferri Phosphatis, *Br.*; Syrupus Ferri Phosphatis cum Quinina et Strychnina, *Br.*; Vinum Ferri, *Br.*

FERRUM REDUCTUM. U. S. (Br.)

REDUCED IRON [Iron by Hydrogen, Quevenne's Iron]

(fĕr'rŭm rę-dŭc'tŭm)

"Reduced Iron should contain not less than 90 percent. of pure metallic iron." *U. S.* "A fine powder, containing at least 75 per cent. of metallic iron, with a variable amount of iron oxide; prepared by reducing ferric hydroxide, heated to dull redness, by a stream of dry hydrogen." *Br.*

Ferrum Redactum, *Br.*, *U. S.* 1870; Ferri Pulvis, *U. S.* 1850; Powder of Iron; Ferrum Hydrogenio Reductum, Ferrum Ope Hydrogenii Paratum; Iron reduced by Hydrogen; Fer réduit par l'Hydrogène, *Fr. Cod.*; Ferrum reductum, *P. G.*; Reduzirtes Eisen, *G.*; Ferro ridotto dall' idrogeno, *It.*; Hierro reducido por el hidrogeno, *Sp.*

A process for this form of iron is no longer given in the United States Pharmacopœia.[1]

This preparation was introduced into the United States and Dublin Pharmacopœias of 1850, and is retained in the present edition of our own, although the process for it has been abandoned. It consists of metallic iron in fine powder, obtained by reducing the ferric oxide by hydrogen at a dull red heat. The subcarbonate of the U. S. Pharm. 1870, which is essentially the ferric oxide, is deprived of water by calcination, and then subjected to the reducing influence of a stream of hydrogen, purified from hydrogen sulphide and acid compounds by passing successively through a solution of lead subacetate and milk of lime. The hydrogen unites with the oxygen of the ferric oxide to form water, and leaves the iron in the metallic state. The subcarbonate should be perfectly free from sodium sulphate, which it is likely to contain when imperfectly washed. If this salt be present, it will be reduced by the hydrogen to the state of sodium sulphide, which will contaminate and spoil the metallic iron formed, and cause the preparation, when taken, to give rise to unpleasant eructations. The heat should be carefully regulated, for if it fall below dull redness, part of the oxide will escape reduction, and if it exceed that point considerably, the particles of reduced iron will agglutinate, and the preparation will be heavy and not readily pulverizable. The 1885 British process is not so well fitted for practical purposes as is that of the U. S. Pharm. 1870. In the 1885 revision of the British Pharmacopœia, instead of directing a certain quantity of hydrated ferric oxide, a process is given in the formula for making the ferric oxyhydrate by precipitating a solution of ferric chloride. The direction to dry the hydrogen is unnecessary. On the subject of powder of iron, manufacturing chemists will find it useful to consult the paper of Soubeiran and Dublanc, in which full directions are given for purifying the hydrogen, constructing the furnace, regulating the heat, and avoiding explosions. (*A. J. P.*, xviii. 303.) For improvements by Procter, see *A. J. P.*, xix. 11. The necessity for purification of the hydrogen by passing it successively through concentrated potassium permanganate solution, lead acetate solution, and sulphuric acid has been proved by T. Appel. (*Oest. Zeit. f. Pharm.*, 1892, 395.)

Since the tenth edition of this work was published, several processes have been proposed for obtaining powder of iron. Arthur Morgan of Dublin, recommended the use of dried potassium ferrocyanide, thoroughly mixed with anhydrous ferric oxide, and calcined with pure potassium carbonate at a low red heat. The product contains all the iron in a reduced state, mixed with soluble matters, which are carefully washed away. (See *A. J. P.*, 1854, p. 450.) A similar process to the above has been proposed by a German chemist, named Zängerle, iron oxalate being substituted for the ferric oxide. (See *P. J.*, 1857, p. 565.) Wöhler recommended the use of the same oxalate, not in connection with potassium ferrocyanide, but as a suitable compound of iron for reduction by hydrogen. W. Müller found that ferric

[1] *Ferrum Redactum.*—"Take of Subcarbonate of Iron *thirty troyounces*. Wash the Subcarbonate thoroughly with water until no traces of sulphate of sodium are indicated by the appropriate tests, and calcine it in a shallow vessel until free from moisture. Then spread it upon a tray, made by bending an oblong piece of sheet-iron in the form of an incomplete cylinder, and introduce this into a wrought-iron reduction-tube, of about four inches in diameter. Place the reduction-tube in a charcoal furnace; and, by means of a self-regulating generator of hydrogen, pass through it a stream of that gas, previously purified by bubbling successively through solution of subacetate of lead, diluted with three times its volume of water, and through milk of lime, severally contained in four-pint bottles, about one-third filled. Connect with the further extremity of the reduction-tube a lead tube bent so as to dip into water. Make all the junctions air-tight by appropriate lutes; and, when the hydrogen has passed long enough to fill the whole of the apparatus to the exclusion of atmospheric air, light the fire, and bring that part of the reduction-tube, occupied by the Subcarbonate, to a dull-red heat, which must be kept up so long as the bubbles of hydrogen, breaking from the water covering the orifice of the lead tube, are accompanied by visible aqueous vapor. When the reduction is completed, remove the fire, and allow the whole to cool to the ordinary temperature, keeping up, during the refrigeration, a moderate current of hydrogen through the apparatus. Withdraw the product from the reduction-tube, and, should any portion of it be black instead of iron-gray, separate such portion for use in a subsequent operation. Lastly, having powdered the Reduced Iron, keep it in a well-stoppered bottle. When thirty troyounces of Subcarbonate of Iron are operated on, the process occupies from five to eight hours." *U. S.* 1870.

oxide obtained by heating the metal in the air is reduced when moist at 293° C. (559.4° F.); when quite dry, at 305° to 339° C. (581° to 642.2° F.); the oxalate moist, at 278° C. (532.4° F.). Another eligible compound for reduction is the crystalline powder of ferric oxide, prepared by fusing, in a clay crucible, pure dried ferrous sulphate with three times its weight of sodium chloride, and then washing the melted mass when cold, until everything soluble is removed. (Wöhler.) Crolas prepares a pure ferric oxide by adding barium chloride to the solution of ferric chloride to precipitate the contaminating sulphate, getting rid of the barium chloride by crystallization and precipitating by solution of ammonia. The ammonium chloride is driven off by heat. (*J. P. C.* 4e sér. xx. 30.) The process of Eugène Fegueux consists in reducing the ferric oxide by carbonic oxide, formed by passing a stream of carbon dioxide over red hot charcoal in the reduction tube, before it reaches the ferric oxide. The carbon dioxide, thus reduced to carbonic oxide, is formed again by the deoxidizing of the ferruginous oxide.

Under the name of "*alcoholized iron,*" a powder of iron has been introduced into this country, said to be prepared, in the eastern parts of Germany, by attrition of iron filings with honey, by some cheap method, as by attachment to a saw mill or steam machinery. It has the appearance of powdered plumbago, but under the magnifying glass is seen to contain particles with the metallic lustre and rounded as if by friction. It is soluble in diluted sulphuric acid, with the escape of hydrogen free, or nearly so, from sulphur, but a small quantity of black powder remains undissolved. (*A. J. P.,* 1867, p. 11.) The relation of the epithet "alcoholized" to this powder is not very obvious, as this name was given originally to iron obtained by passing alcohol vapor over ferric oxide. It is not much inferior to reduced iron, and is better than some preparations sold by that name.

Properties.—Powder of iron, called by the French *fer réduit,* is a light, tasteless powder, soft to the touch, of an iron-gray color, and without metallic lustre. If black, the preparation is to be rejected as not being fully deoxidized. When thrown into a diluted acid, it causes a lively effervesence of hydrogen without odor. A small portion of it, struck on an anvil with a smooth hammer, forms a scale having a brilliant metallic lustre. It takes fire upon the application of a burning body. On account of its great liability to oxidation, it should be kept in a dry bottle, well stoppered. A black powder, having a composition corresponding with that of the magnetic oxide of iron, has been sold under the name of Quevenne's iron. The spurious powder may be known by its having a black instead of an iron-gray color, and by its effervescing but slightly with acids. In the process for making reduced iron, part of the sesquioxide almost always escapes full deoxidation, and comes out of the tube having a black color. This part should be rejected, instead of being sold as reduced iron, as appears to have been done by some manufacturing chemists. If the preparation has been very badly made, its solution in diluted sulphuric acid will produce an intensely red color with potassium sulphocyanide. It is officially described as "a very fine, grayish-black, lustreless powder, without odor or taste; permanent in dry air. Insoluble in water or alcohol. One Gm. of Reduced Iron, when treated with 20 Cc. of diluted sulphuric acid, causes the evolution of nearly odorless hydrogen gas, which should not affect, within five minutes, paper moistened with lead acetate T.S. (limit of *sulphide*), and on applying a gentle heat, the Iron should dissolve in the acid without leaving more than 1 percent. of residue. When ignited in contact with air, it glows and is converted into black ferroso-ferric oxide. If 1 Gm. of Reduced Iron be shaken with 5 Cc. of water, the liquid should not change the color of red litmus paper. To 0.5 Gm. of Reduced Iron, contained in a small covered beaker, add 20 Cc. of diluted sulphuric acid; after the reaction has somewhat subsided, warm the liquid on a water-bath until the reaction ceases, then collect any minute undissolved residue of impure iron arsenide upon a very small filter, rinse the beaker with water, add the rinsings to the filter, and wash the residue with water until free from acid reaction. Transfer the residue to the beaker by rinsing it back, and, after adding about 0.25 Gm. of potassium chlorate and 5 Cc. of hydrochloric acid, evaporate the solution slowly to dryness on a water-bath. Dissolve the residue in sufficient water to measure 50 Cc., then add 5 Cc. of this solution to 5 Cc. of a saturated solution of sulphurous acid and heat the liquid on a water-bath for fifteen minutes, until all traces of sulphurous acid have been removed. The resulting solution should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "A fine grayish-black powder, strongly attracted by the magnet, and producing metallic streaks when rubbed with firm pressure in a mortar. It dissolves in *hydrochloric acid* with the evolution of hydrogen, and without any smell of hydrogen sulphide, and the solution gives a light blue precipitate with *solution of potassium ferrocyanide.* If 0.25 gramme be added to a hot solution of 1 gramme of *copper sulphate* in 15 cubic centimetres of *water,* in a flask that can immediately be well corked, and the whole be shaken occasionally during ten minutes, the liquid, after being rapidly filtered with the minimum of exposure to air, and acidulated with sulphuric acid, should not cease to yield a blue precipitate with *solution of potassium ferricyanide* until at least 33.7 cubic centimetres of the *volumetric solution of potassium bichromate* have been added." *Br.*

Assay for Metallic Iron.—"Introduce about 2.6 Gm. of iodine into a 100 Cc. flask and weigh accurately, then add 6 Cc. of water, 2 Gm. of potassium iodide, and 0.555 Gm. of Reduced Iron. Securely stopper the flask, and, after thoroughly mixing the contents by rotating the flask, set it aside for one hour. Then dilute the contents with sufficient distilled water to make the liquid measure exactly 100 Cc., mix well, and to 25 Cc. of this solution slowly add tenth-normal sodium thiosulphate V.S., with constant stirring, until the last trace of brown color has been discharged. Divide the weight of iodine taken, by 0.02518, and subtract from the quotient twice the number of Cc. of tenth-normal sodium thiosulphate V.S. used; the remainder represents the percentage of metallic iron present in the Reduced Iron, and this should not be less than 90 percent.

NOTE.—The percentage purity of the iodine employed should be accurately determined by a previous experiment, and in place of the 2.6 Gm. above directed, its equivalent in pure (100 percent.) iodine may be taken (see PART III, Test No. 137)." *U. S.*

An examination of the commercial *Reduced Iron* has been made and the results given in *Proc. A. Ph. A.*, 1894, 172, 292. O. Wilner (*A. J. P.*, 1881, 15) states that: 1. The amount of metallic iron in reduced iron can be accurately determined by treatment with mercuric chloride and titration with potassium permanganate. 2. If metallic iron be treated by the aid of a gentle heat with an excess of a concentrated solution of mercuric chloride, mercurous chloride and metallic mercury will be separated, and the metallic iron pass as ferrous chloride into solution; the ferrous and ferric oxides which may be present remain undissolved, and therefore do not prevent the estimation of the amount of metallic iron in the reduced iron. 3. The amount of ferrous oxide in the preparation may be estimated by treating the same portion with hydrochloric acid, digesting the mixture in a closed vessel until the finely divided ferrous oxide becomes dissolved, and titrating with potassium permanganate. 4. The ferric chloride which is thus formed at the same time has no appreciable action upon the precipitated metallic mercury and mercurous chloride.

Uses.—Powder of iron, reduced from the oxide by hydrogen, was first prepared for medicinal purposes by Quevenne and Miquelard of Paris. It is one of the best of chalybeate tonics, nearly free from astringency, and according to Quevenne and Costes of Bordeaux, yields the largest proportion of iron to the gastric juice. The chief objection to it is the difficulty of obtaining it well prepared. Much of the powder of iron found in commerce is not to be depended on, in consequence of imperfect reduction. Observations to determine its therapeutic value, compared with that of the other ferruginous preparations, were made by Costes, for nearly four years, at the Saint-André hospital of Bordeaux, with results highly favorable to it. It is sometimes prepared with chocolate in the form of lozenges.

Dose, one to three grains (0.065 to 0.20 Gm.) several times a day, given in powder or in pill.

Off. Prep.—Pilulæ Ferri Iodidi, *U. S.*; Trochiscus Ferri Redacti, *Br.*

FICUS. U. S., Br.

FIG

(fī'cŭs)

"The partially dried fruit of *Ficus Carica* Linné (Fam. *Moraceæ*)." *U. S.* "The dried fleshy receptacles of Ficus Carica, *Linn.*" *Br.*

Caricæ, Ficus Passa, Fici, Fructus Caricæ; Figue, *Fr. Cod.*; Feigen, *G.*; Fichi, *It.*; Higos, *Sp.*

Engler and Prantl divide the Urticaceæ into three distinct orders,—viz., Urticaceæ proper, including Urtica; Ulmaceæ, including Ulmus; and the Moraceæ, including Ficus, Humulus, and Cannabis.

The genus Ficus yields a number of economic products. Many species possess a milky juice containing caoutchouc, as *F. elastica*, Roxb., of Sumatra, etc. Some of the juices are employed externally as well as internally, as that of *F. indica*, L. Some possess anthelmintic properties, as *F. anthelmintica*, Mart. Some yield gum lac or shellac as a result of the puncture of an insect, as *F. religiosa*, L., *F. laccifera*, Roxb.; and some are esteemed for their fruits, as *F. Carica*, L., *F. religiosa*, L., etc.

Ficus Carica, Willd., *Sp. Plant.* iv. 1131; Woodv., *Med. Bot.*, p. 714, t. 244.—The fig tree, though often not more than twelve feet high, sometimes rises in warm climates twenty-five or even thirty feet. Its trunk, which seldom exceeds seven inches in diameter, is divided into numerous spreading branches, covered with a brown or ash-colored bark. Its large, palmate leaves, usually divided into five obtuse lobes, are deep green and shining above, pale green and downy beneath, and stand alternately on strong, round footstalks. The flowers are situated within a common receptacle, placed upon a short peduncle in the axils of the upper leaves. This receptacle, the walls of which become thick and fleshy, constitutes what is commonly called the fruit; though this term is, strictly speaking, applicable to the small seed-like bodies found in great numbers on the internal surface of the receptacle, to which they are attached by fleshy pedicels. Cultivation has produced in the fig, as in the apple and peach, a great diversity in shape, size, color, and taste. It is usually, however, turbinate, or top-shaped, umbilicate at the large extremity, of the size of a small pear, of a whitish, yellowish, or reddish color, and of a mild, mucilaginous, saccharine taste. The dried figs can be partially restored to their original shape by soaking. The fig tree is supposed to have

come originally from the Levant. It was introduced at a very early period into various parts of the south of Europe, and is now very common throughout the whole basin of the Mediterranean, particularly in Italy and France. Large numbers of Syrian fig trees were planted in the Pomona Valley, California, in 1890, and California figs are now commercial articles. To hasten the ripening of the fruit, it is customary to puncture it with a sharp pointed instrument covered with olive oil. *Caprification* consists in attaching branches of the wild fig tree to the cultivated plant. The fruit of the former contains great numbers of the eggs of insects of the genus Cynips, the larvæ of which, as soon as they are hatched, spread themselves over the cultivated fruit, and, by conveying the pollen of the male organs over which they pass to the female florets, hasten the impregnation of the latter, and cause to quickly come to perfection the fig which might otherwise ripen very slowly, or wither and drop off before maturity. In California the great difficulty in cultivating figs was found to be to get a Cynips which would flourish in the climate. According to Landerer, the unripe fig contains an irritant juice, which inflames the skin, and may even disorganize it. (See *A. J. P.*, xxxiii. 215.) The figs, when perfectly ripe, are dried by the heat of the sun, or in ovens. Those imported into this country come chiefly from Smyrna, packed in drums or boxes. They are more or less compressed, and are usually covered in cold weather with a whitish saccharine efflorescence, which softens in the middle of summer and renders them moist. The best are yellowish or brownish, somewhat translucent when held to the light, and filled with a sweet viscid pulp, in which are lodged numerous small yellow seeds. They are much more saccharine than is the fresh fruit. Their chief constituents are grape sugar, and gum or mucilage. An average of several analyses of dried figs as quoted by Königs (*Nahrungs und Genussmittel,* 3te Aufl., Bd. i. 781) gives—water, 31.20; nitrogenous material, 4.01; sugar, 49.79; ash, 2.86. Reckoned on the weight of absolutely dry material, the nitrogenous matter amounted to 5.75 per cent. and the sugar to 72.26 per cent. They are officially described as being "usually compressed, of irregular shape, fleshy, brownish or yellowish, frequently with an efflorescence of sugar; apex with a small scaly orifice; base with a scar or short stalk; internally hollow, with numerous small, brownish-yellow, glossy and hard akenes; odor distinct, fruity; taste sweet, pleasant." *U. S.*

Uses.—Figs are nutritious, laxative, and demulcent. In the fresh state they are considered, in the countries where they grow, a wholesome and agreeable aliment, and have been employed from time immemorial. They are prone, however, when eaten freely, to produce flatulence, pain in the bowels, and diarrhœa. Their chief medicinal use is as a laxative article of diet in constipation. They occasionally enter into demulcent decoctions, and, roasted or boiled, and split open, are sometimes applied as a cataplasm to inflamed gums.

Off. Prep.—Confectio Sennæ, *U. S., Br.*

FLUIDEXTRACTA.[1] U. S. (Br.)

FLUIDEXTRACTS

(flŭ-ĭd-ĕx-trăc'tă)

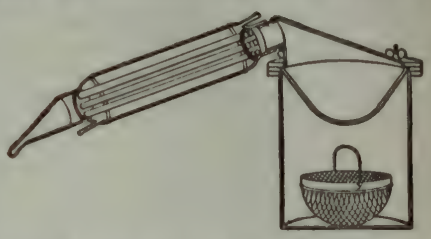
Extracta Liquida, *Br.;* Fluid Extracts; Extraits liquides, *Fr.;* Extracta fluida, *P. G.;* Fluidextrakte, Flüssige Extrakte, *G.*

Fluidextracts were first introduced into the U. S. P. of 1850 as a distinct class of preparations, the fluidextract of sarsaparilla being the only one previously directed, either in our own official code or by the British Colleges. Now we have eighty-five that are official, besides large quantities of non-official fluidextracts annually produced. They are now perhaps the most important class of liquid preparations in use. Their distinctive character is the concentration of the active ingredients of medicinal substances into a small bulk, in the liquid form, a cubic centimeter or fluigramme of any one of them now representing a gramme of the crude drug. In addition to convenience of administration, the advantage of these preparations is that, evaporation not being carried so far as in ordinary extracts, the active principles are less liable to be injured by heat. Formerly their main difficulty was the liability of substances in the liquid state to undergo spontaneous decomposition. In the U. S. P. of 1850 this was counteracted by means of sugar and of alcohol, but in 1865 (*A. J. P.*, 1865, p. 50) Taylor proposed the use of glycerin, which was adopted in the U. S. P. 1870 revision. Glycerin, while it exerts a powerful preservative influence, possesses the valuable property of dissolving matters deposited by some of the fluidextracts when made with sugar, as in the old official recipes. Consequently these fluidextracts were much clearer and better preparations than were the old ones. Subsequent experience with these fluidextracts showed that the use of glycerin should be circumscribed, and that it had been employed too freely in the U. S. P. 1870 formulas. The solvent powers of glycerin are so great that the fluidextracts were frequently loaded with many inert principles, which it dissolved, giving them a dense, rich appearance, without increasing their activity. As the primary object of fluidextracts is concentration, suitable menstrua should in each case be selected with the single object of dissolving and retaining permanently the active constituents of the drug.

[1] The Latin title Extractum —— Fluidum formerly used for Fluid Extracts was dropped by the U. S. P. (8th Rev.) because of the confusion which resulted from the necessary bringing together of the extracts and fluid extracts due to a strict alphabetical arrangement; the name "fluidextractum" is now used for "fluidextract" and the latter made one word; this of course brings the fluidextract under the letter F instead of the letter E under which extracts and fluidextracts were formerly both classed.

The present fluidextracts are of the same strength as those formerly official, and the formulas are based upon the theory that from a given weight of drug an amount of fluidextract shall be made equal in measure to the bulk of the same weight of distilled water; in other words, upon the relation of gramme to cubic centimeter.[1] Although the metric system is admirable in practice, some may prefer to use ordinary weights and measures; in such cases, to make 20 *fluidounces* of a fluidextract 19 *troyounces* of drug will be required, while if avoirdupois weight is preferred, the most convenient relation to recollect will be that 50 *avoirdupois ounces* are required to make 48 *fluidounces,* or *three pints,* of a fluidextract. It has been repeatedly proposed to make 50 *per cent. tinctures* or half-strength fluidextracts, the main object being to secure more representative preparations when made on the small scale. Experiments by Sayre, Gregory, Patch, and others prove that half-strength fluidextracts possess no advantages over those of official strength. (*D. C.,* 1897, 119, 147.) The general formula for the preparation of fluidextracts does not differ materially from that formerly official; the length of time required for maceration has been judiciously reduced, while the quantity reserved has been generally slightly increased, although the formulas are not uniform in this respect. The fact cannot escape observation that there has been a close study of the solubilities, physical properties, and individuality of each drug, while uniformity among the formulas has not been sought for, so much as the best method of producing the fluidextract. The general formula may be expressed as follows. 1000 Gm. of the powdered drug are moistened with a certain quantity of menstruum, packed in a suitable percolator, and enough menstruum added to saturate the powder and leave a stratum above it; the lower orifice of the percolator is closed when the liquid begins to drop, and the percolator is closely covered to prevent evaporation and permit maceration for a specified time; additional menstruum is poured on and percolation continued until the drug is exhausted. Usually from seven hundred to nine hundred cubic centimeters of percolate are reserved, and the remainder evaporated to a soft extract; this is to be dissolved in the reserved portion, and enough menstruum added to make the fluidextract measure 1000 Cc. The precipitation experienced heretofore, when the evaporated weak percolate was added to the reserved portion, is considerably diminished by causing the former to be evaporated to a soft extract. This precipitation, formerly noticed more particularly in alcoholic fluidextracts, was due to the greater volatility of the alcohol in the weak percolates, which, when evaporated, left the residue to a great extent aqueous; when this was added to the strongly alcoholic reserved portion, a precipitation of resinous and frequently active matter took place, which necessitated the storing of the fluidextract until precipitation ceased, and subsequent filtration. This is not altogether avoided by evaporating to a soft extract, but the loss of activity through precipitation is thus greatly diminished. Fluidextracts invariably deposit insoluble matter upon standing, and those made in warm weather, owing to the greater solvent powers of the menstrua (due to the elevated temperature) are found to deposit more freely than the same kind of fluidextracts if made in the winter time with menstrua correspondingly reduced in temperature.

A useful distillatory apparatus has been contrived by Joseph P. Remington for recovering alcohol from weak percolates, and for general pharmaceutical uses. The still shown in the cut is the new form. It is made of tinned copper, the still body holding about three gallons; the condenser has seven straight tubes



surrounded with the cold water introduced by a rubber tube from a hydrant or bucket of water placed higher than the still, and carried off as it becomes warmed by the tube shown at the upper part of the condenser. By a siphon arrangement not shown in the cut, the still can be fed from a reservoir while distillation is in progress, thus using a three gallon still where otherwise a much larger one would have been necessary. The joints are carefully ground, and troublesome lutes and water joints are entirely superseded. The condenser, having straight tubes instead of a spiral one, is easily cleaned, and is powerful enough to condense a gallon of alcohol in thirty minutes. The still may be set into a kettle partly filled with water and thus used as a water bath, or a shallow tinned copper dish with flat rim, which accompanies the still, may be placed between the two brass ring bands and clamped securely. (*A. J. P.,* May, 1879.) Remington's *Practice of Pharmacy,* fourth ed., page 158.

For valuable papers on percolation and fluidextracts, by William Procter, E. R. Squibb,

[1] The following table shows the relation of the crude drug to the fluidextract when made by the process of the U. S. P. 8th Rev. and when made by that of the U. S. P. 1870:

Weight of Drug.	*Measure of Fluidextract.*	
	U. S. P. 8th Rev.	U. S. P. 1870.
100 grammes of drug make	100 Cc.	94.9 Cc.
100 troyounces of drug make	105.4 fluidounces.	100 fluidounces.
100 avoirdupois ounces of drug make	96 fluidounces.	91.1 fluidounces.

Alonzo Robbins, and others, see *Proc. A. Ph. A.*, 1859, p. 265; 1863, p. 222; *A. J. P.*, 1878, pp. 209, 329; 1873, pp. 85, 189.

Several methods have been suggested for preparing fluidextracts more economically. The use of acetic acid as a menstruum to replace alcohol or diluted alcohol has the merit of economy (see *Extracta*, also *A. J. P.*, 1899, 1-14; *Proc. Pennsylvania Pharm. Assoc.*, 1898, 116; *A. J. P.*, 1898, 543; *A. J. P.*, 1899, 67; *Ph. Era*, 1898, 796; *Proc. Minnesota Pharm. Assoc.*, 1902, 103; *West. Drug.*, 1903, 652).

The most important modification is the plan of repercolation, as proposed by E. R. Squibb, for this class of preparations as well as the dry extracts.

Repercolation.—In consequence of the existing high price of alcohol, it is important to adopt some plan by which, while the ends aimed at are attained, the consumption of the menstruum used in percolation may be diminished. This object has been accomplished, to a considerable extent, by E. R. Squibb of Brooklyn, N. Y., by a modification of the process of percolation to which he has given the name at the head of the present paragraph. As defined by the author, repercolation consists in the successive application of the same percolating menstruum to fresh portions of the substances to be percolated. The result is that the same menstruum, acting repeatedly on unexhausted portions of the substance, becomes concentrated to the greatest possible extent, so that much of the menstruum is saved, while subsequent evaporation is avoided, which is itself an object of great importance in the preparation of extracts. It is obvious that repercolation is not applicable to the preparation of infusions, decoctions, tinctures, etc., in which the object in general is less a high degree of concentration than precision in the strength of the preparation, and consequently in the dose. It is to the extracts and fluidextracts that the process is peculiarly adapted, and there now remains no doubt whatever of the great value of the improvement. One of its disadvantages is that the substance treated is less completely exhausted than when the proceeding is inverted, and fresh portions of menstruum are made to act on the same material until the latter is deprived of all its soluble matter. But the loss in this way is trifling, compared with the gain when a menstruum as high-priced as alcohol is employed.

Another practical disadvantage is the inconvenience of keeping the weak percolates, as these have to be labelled, numbered, and stored away for use until the same operation is repeated. In deciding when to adopt it, the operator will of course be influenced by the relative value of the drug and the menstruum. In order to secure the most favorable results in repercolation, certain methods of proceeding are advisable in various steps of the process, differing with the character of the substance to be acted on; and these can be determined only by a careful study, confirmed by repeated experiment. Squibb used repercolation exclusively on the large scale in the manufacture of extracts and fluidextracts, and applied it especially to the preparation of fluidextracts of cinchona; and since his first paper, which was reproduced in the 14th revision of the U. S. Dispensatory, p. 1164, he introduced several improvements, which are intended to make the process useful to the apothecary in his everyday work. By presenting in a note below an abstract of his plan of proceeding in this case, we can impress on the mind of the pharmaceutical student the lessons applicable to the case more forcibly than could be done by a general description.[1].

The plan of N. Spencer Thomas consists in exposing the substance to be acted on to successive expressions, by means of a press, with the menstruum divided into different portions, so that fresh portions of liquid are brought to act on the same solid body in different stages of exhaustion, and then mixing the expressed liquids. The due proportion between the weight of the medicine and the bulk of the ultimate fluidextract is secured by regulating the measure of the last added portion of menstruum, which, in the process as described by Thomas, is the third. Whatever may be the advantages of this method—and it is not with-

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[1] *Squibb's Process for Fluidextract of Cinchona by Repercolation:*—"Take of Yellow Cinchona, in powder No. 50, 32 parts; Stronger Alcohol, sp. gr. .819, 2 parts; Glycerin, sp. gr. 1.250, 1 part; Water, 2 parts. Weigh the Stronger Alcohol, Glycerin, and Water in succession, in any convenient quantity at a time, into a tared bottle, and mix them thoroughly for a menstruum.

"Moisten 8 parts of the Cinchona with eight parts of the menstruum, by thoroughly mixing them, and allow the mixture to stand 8 hours in a closely-covered vessel. Then pass the moist powder through a No. 8 sieve, and pack it firmly in a percolator. Pour menstruum on top until the mass is filled with liquid and a stratum remains on top unabsorbed; cover the percolator closely and macerate for 48 hours. Then arrange the percolator for an automatic supply of menstruum, and start the percolation at such a rate as to give 1 part of percolate in about 4 hours. Reserve the first 6 parts of percolate, and continue the percolation until the Cinchona is exhausted, separating the percolate received after the reserved portion into fractions of about 8 parts each. Moisten a second portion of 8 parts of the Cinchona with 8 parts of the weak percolate,—the first portion that was obtained next after the reserved percolate,—and allow the moist powder to stand for 8 hours in a vessel closely covered. Then pack it moderately in a percolator, and supply the percolator automatically with the remaining fractions of the weak percolate in the order in which they were received, and finally with fresh menstruum until the Cinchona is exhausted. Percolate in the same manner and at the same rate as with the first portion of Cinchona, and, reserving 8 parts of the first percolate, separate the weaker percolate into fractions of about 8 parts each. Percolate the third and fourth portions of 8 parts each of the Cinchona in the same way as the second portion. Finally mix the four reserved percolates together to make 30 parts of finished fluidextract; and having corked, labelled, and numbered the bottles containing the fractions of weak percolate, set them away until the process for Cinchona is to be resumed.

When this fluidextract is to be again made, repeat the process as with the second portion, and reserve 8 parts of the first percolate as finished fluidextract from each 8 parts of Cinchona from that time forward so long as the fractions of weak percolate are carried forward with which to commence each operation." See also Squibb's percolator, 16th edition U. S. D., p. 600.

out its recommendations—it is liable to the objection of loss of alcohol through exposure during expression. Another method of limiting the quantity of alcohol used has been proposed by S. P. Duffield of Detroit. It consists in macerating, for from six to ten days, the medicine to be acted on, previously deprived, by means of a vacuum apparatus, of all the air, and of all readily volatilizable matter contained in its pores, with a certain volume of the menstruum, which is forced through a tube into the vacuum pan by atmospheric pressure, and thus brought into the most intimate contact with all parts of the powder. The process is completed by submitting the mass thus impregnated to hydraulic pressure, and, after allowing the liquid to settle in glass carboys, drawing off the clear liquid into bottles. It is obviously inapplicable to substances whose virtues depend in any considerable degree upon readily volatilizable constituents. Campbell (*A. J. P.*, xlii. 17) proposed a method for doing away with the use of heat, which, however, although in some cases it may do well, cannot be relied upon for the complete exhaustion of all drugs. Sixteen troyounces of the powder are moistened with four to six fluidounces of the menstruum (usually alcohol), and packed in a glass funnel, a piece of sponge having previously been put in the beak of the funnel; the surface of the powder is covered with a disk of paper, and twelve fluidounces of menstruum poured on. When the sponge becomes saturated, the beak of the funnel is corked tightly and the whole set aside for four days, at the end of which time the percolation may be allowed to proceed without further addition of menstruum. J. W. Mill has called attention to the advantage of separating the powder into fine and coarse parts by means of sieves and packing the finer powder at the bottom.

H. Biroth (*Pharm.*, April, 1877) proposes the method which he terms "*insuccation*," for making non-alcoholic fluidextracts; the advantages claimed for it are simplicity and economy. Colaz prepares fluidextracts from fresh plants by bruising and crushing them, and placing the mass in a dialyzer suspended in 90 per cent. alcohol; when the dialysis is completed, the liquid is evaporated to free it from alcohol, the remaining aqueous liquid retaining the active constituents in the proportions in which they are found in the plant. (*Ph. Post*, xxix. 271.) Haussmann (*A. J. P.*, 1895, 291), after examining a large number of commercial fluidextracts, records his results in tabular form, and considers that there is great variation in the quality, due to deviation from pharmacopœial processes.

J. U. Lloyd proposes to recover the alcohol which remains absorbed by the residue after percolation, by mixing the wet residues with an equal bulk or less of dry sawdust, and then percolating this with water. (*A. J. P.*, June, 1877.) Wm. M. Thomson of Philadelphia, devised a very complete method of preparing fluidextracts on a large scale; the principles of his process are maceration and percolation *in vacuo*, and although the principles which have been applied have been long known, and similar apparatus used by Duffield and others, there are many useful practical points which merit a notice in detail. The percolators are egg-shaped, and made of tinned copper; they are capable of being tightly covered, and communicate by means of stopcocks above and below, and iron and stout rubber tubing, with a very efficient double acting air pump. The moistened powder is packed tightly in the percolator, and the cover securely bolted on. The stopcock in the cover is now opened, which communicates with the air pump and a partial vacuum created in the space above the moistened drug; the stopcock is now closed and another stopcock in the cover opened, which communicates by a tube with the reservoir containing the menstruum. The menstruum, of course, quickly penetrates the powder, taking the place of the interstitial air, and when the powder is saturated it is permitted to macerate *in vacuo* a sufficient length of time. To start percolation, a receiver is connected with the beak of the percolator, and, the air being exhausted from it, the percolate at once makes its appearance. When the flow slackens, air may be forced by the pump in the space above the powder, if desired, and the receiver again exhausted below. In this way, it can be seen, entire control of these powerful physical forces may be secured. The advantages are very apparent in preventing the loss of volatile principles and alcohol, while protecting from chemical change caused by exposure to the air. It is quite possible to make official fluidextracts without recourse to subsequent evaporation of weak percolate. For a cut of this apparatus, see *A. J. P.*, 1882.[1]

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[1] The processes for the following Fluidextracts were omitted in the 8th revision of the U. S. P., but as they are still sometimes used we append the processes of the U. S. P. 1890; other fluidextract formulas of the U. S. P. 1890 will be found in PART II under their respective drugs.

Extractum Arnicæ Radicis Fluidum. U. S. (1890). *Fluid Extract of Arnica Root.*—"Arnica Root, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 217 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Arnica Root is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.), to a soft extract: dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]."

Assaying fluidextracts.—The number of assay processes for fluidextracts was materially increased in the U. S. P. (8th Rev.) for preparations made from alkaloidal drugs. The process in each case differs but slightly from the process used for the corresponding drug; they will be found in the succeeding pages under their appropriate headings.

U. S. 1890. This fluidextract is of a clear, reddish-brown color, possessing little odor, and having an acrid taste.

Extractum Colchici Radicis Fluidum. U. S. (1890). *Fluid Extract of Colchicum Root.*—"Colchicum Root, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 400 minims] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Colchicum Root is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]." *U. S.* 1890. This fluidextract is not essentially different from that formerly official. The present menstruum will thoroughly exhaust the root, and this fluidextract is now a good preparation. It is of a reddish-brown color and bitter taste. Dose, from two to eight minims (0.12 to 0.5 Cc.).

Extractum Cusso Fluidum. U. S. (1890). *Fluid Extract of Kousso. Extractum Brayeræ Fluidum, U. S.* 1880; *Fluid Extract of Brayera.*—"Kousso, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Kousso is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion and add enough Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]." *U. S.* 1890. This preparation, although undoubtedly active, was very properly dropped from the U. S. P. because of its containing so large a percentage of alcohol and its extremely disagreeable taste. It may be given in doses of from one-half to one fluidounce (15 to 30 Cc.).

Extractum Gossypii Radicis Fluidum. U. S. (1890). *Fluid Extract of Cotton Root Bark. Extractum Gossypii Radicis Corticis Liquidum,* Br. Add. *Liquid Extract of Cotton Root Bark.*

"Cotton Root Bark, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]. Mix the Glycerin with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol, and, having moistened the powder with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then Alcohol, until the Cotton Root Bark is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]." *U. S.* 1890. "Cotton Root Bark, in No. 30 powder, 20 *ounces* (Imperial) or 1000 grammes; Glycerin, 5 *fl. ounces* (Imp. meas.) or 250 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Glycerin with *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the Alcohol; mix the powder with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of this menstruum; pack firmly in a percolator; add more of the menstruum, and when the liquid begins to drop close the lower orifice of the percolator; set aside for forty-eight hours; then allow percolation to proceed, gradually adding the remainder of the menstruum and then more of the Alcohol until the Cotton Root Bark is exhausted. Reserve the first *fourteen fluid ounces* (Imp. meas.) or seven hundred cubic centimetres of the percolate; remove the alcohol from the remainder by distillation; evaporate the residue to the consistence of a soft extract; dissolve this in the reserved percolate; add enough of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.* This is one of the fluidextracts which is improved by the use of glycerin: the menstruum selected prevents the gelatinization which was a troublesome objection to the fluidextract of the Pharmacopœia of 1870. J. U. Lloyd prefers a menstruum composed of ten fluidounces of alcohol and three fluidounces each of glycerin and water, finishing the percolation with a mixture composed of ten fluidounces of alcohol and six fluidounces of water. It is a deep-reddish liquid, and well represents the root. The dose is from half a fluidrachm to a fluidrachm (1.8 to 3.75 Cc.).

Extractum Scoparii Fluidum. U. S. (1890). *Fluid Extract of Scoparius. Fluid Extract of Broom.* "Scoparius, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 400 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Scoparius is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]." *U. S.* 1890. It is difficult to avoid precipitation in the preparation, but fortunately the precipitate is not active. Dose, from twenty to forty minims (1.3 to 2.5 Cc.).

Extractum Stramonii Seminis Fluidum. U. S. (1890). *Fluid Extract of Stramonium Seed.* [*Extractum Stramonii Fluidum,* U. S. P. 1880.] "Stramonium Seed, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6¾ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Stramonium Seed is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic*

FLUIDEXTRACTUM ACONITI. U. S.

FLUIDEXTRACT OF ACONITE [Extractum Aconiti Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm ăc-ō-nī'tī)

Fluid Extract of Aconite Root; Extrait liquide de Racine d'Aconit, *Fr.;* Flüssiges Eisenhutknollenextrakt, *G.*

• "Aconite, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Aconite is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, mixing thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of aconitine in the remainder of the liquid, add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 0.4 Gm. of aconitine." *U. S.*

Assay. U. S. (8th Rev.)—"Fluidextract of Aconite, *ten cubic centimeters;* Ether, Distilled Water, Ammonia Water, Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Aconite by means of a graduated pipette to a porcelain dish, and evaporate it carefully to dryness on a water-bath at a temperature not exceeding 60° C. (140° F.). Add 5 Cc. of tenth-normal sulphuric acid V.S. and 10 Cc. of distilled water. When the extract is dissolved, filter the liquid into a separator, washing the dish and filter with about 40 Cc. of distilled water; when this has passed through, add 25 Cc. of ether and 2 Cc. of ammonia water to the separator, and agitate for one minute. Draw off the lower layer into a flask and filter the ether-solution into a beaker. Return the contents of the flask to the separator, add 15 Cc. of ether, and agitate for one minute. Draw off the lower layer into the flask and filter the ether-solution into the beaker. Repeat, with two other portions of 10 Cc. each of ether. Evaporate the ether-solution to dryness, and dissolve the residue in 3 Cc. of tenth-normal sulphuric acid V.S. diluted with 20 Cc. of distilled water. Add to the solution 5 drops of hematoxylin T.S., and then carefully run in fiftieth-normal potassium hydroxide V.S. until a violet color is produced, the transition stages being as follows: first yellow, then green, finally passing into violet. Divide the number of Cc. of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 3 (the 3 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.064, and this product by 10, which will give the weight in grammes of aconitine contained in *one hundred cubic centimeters* of the Fluidextract of Aconite."

This preparation of aconite root was found useful by Procter as a basis for making the other preparations of aconite,—the plaster, extract, tincture, or liniment. The fluidextract is of a bright deep reddish-brown color. It will doubtless be frequently employed as an addition to liniments for obtaining the peculiar effects of aconite.

Dose, one-half to one minim (0.03 to 0.06 Cc.), but on account of its very powerful character it should always be used with caution, beginning with the smallest dose.

FLUIDEXTRACTUM APOCYNI. U. S.

FLUIDEXTRACT OF APOCYNUM [Extractum Apocyni Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm ă-pŏç'y-nī)

Fluidextract of Canadian Hemp; Extrait liquide de Chanvre du Canada, *Fr.;* Flüssiges Canadischhanfwurzelextrakt, *G.*

• "Apocynum, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol and *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly,

centimeters [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890. This is a fluidextract the menstruum of which is well adapted for thoroughly exhausting the seed. It is of a dark brown color. The dose is from one to two minims (0.06 to 0.12 Cc.).

gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol to *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water, until the Apocynum is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract represents the activity of apocynum in a very satisfactory manner.

Dose, five to ten minims (0.3 to 0.6 Cc.); as an emetic, fifteen to twenty minims (0.9 to 1.3 Cc.).

FLUIDEXTRACTUM AROMATICUM. U. S.

AROMATIC FLUIDEXTRACT [Extractum Aromaticum Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm ăr-ō-măt'ĭ-cŭm)

Extrait liquide aromatique, *Fr.;* Flüssiges Aromatisches Extrakt, *G.*

* "Aromatic Powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Aromatic Powder is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a valuable fluidextract; it is an excellent aromatic in concentrated form, and will be found very useful not only as an addition to liquids when an aromatic is desired, but its concentrated form permits its use in small quantities with dry powders, like pepsin, bismuth subnitrate, etc., when desired for administration. It is rarely used alone.

Dose, from ten to twenty minims (0.6 to 1.3 Cc.), diluted with water, or dropped on sugar.

FLUIDEXTRACTUM AURANTII AMARI. U. S.

FLUIDEXTRACT OF BITTER ORANGE PEEL [Extractum Aurantii Amari Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm âu-răn'tĭ-ī ą-mā'rī)

Extrait liquide d'Ecorce d'Orange amère, *Fr.;* Flüssiges Pomeranzenschalenextrakt, *G.*

* "Bitter Orange Peel, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it moderately in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Orange Peel is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is useful as a tonic; when dry, the bitter orange peel having very little oil present, there is necessarily little agreeable orange flavor to the fluidextract. Monroe Bond recommends a *Fluidextract of Sweet Orange Peel,* made with a menstruum of seven parts of alcohol and one of glycerin. (*A. J. P.,* 1873, p. 482.)

Dose, fifteen to thirty minims (0.9 to 1.8 Cc.).

FLUIDEXTRACTUM BELLADONNÆ RADICIS. U. S. (Br.)

FLUIDEXTRACT OF BELLADONNA ROOT [Extractum Belladonnæ Radicis Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm bĕl-lą-dŏn'næ rą-dī'cĭs)

"A Liquid Extract containing ¾ grain of the alkaloids of Belladonna Root in 110 minims (0.75 gramme in 100 cubic centimetres)." *Br.*

Extractum Belladonnæ Liquidum, *Br.,* Extract of Belladonna; Extrait liquide de Racine de Belladone, *Fr.;* Flüssiges Tollkirschenwurzelextrakt, *G.*

* "Belladonna Root, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120

grains]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Belladonna Root is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract, dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid; add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 0.5 Gm. of mydriatic alkaloids from Belladonna Root." *U. S.*

Assay of Fluidextract of Belladonna Root. U. S. (8th Rev.)—" Fluidextract of Belladonna Root, *ten cubic centimeters;* Distilled Water, Ammonia Water, Chloroform, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., or Iodeosin T.S., each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Belladonna Root by means of a graduated pipette to a separator, add 10 Cc. of distilled water, 20 Cc. of chloroform, and 2 Cc. of ammonia water. Shake the separator well for one minute, and draw off the lower chloroformic layer into a second separator. Repeat the extraction with two portions of 10 Cc. each of chloroform, and draw the chloroformic solution into the second separator. To the latter add 8 Cc. of normal sulphuric acid V.S. and 20 Cc. of distilled water, shaking well for one minute. When perfectly separated draw off and reject the lower chloroformic layer, and filter the acid aqueous layer into a clean separator. Wash the separator and filter with 10 Cc. of distilled water, adding this to the clean separator. To the latter add 20 Cc. of chloroform and 4 Cc. of ammonia water, and shake well for several minutes. Draw off the lower chloroformic layer into a beaker, and repeat the extraction with two portions of 10 Cc. each of chloroform, adding the chloroformic solution to the beaker. Allow the chloroform in the beaker to evaporate on a water-bath, containing warm water, until the residue is perfectly dry. To the alkaloidal residue add 5 Cc. of tenth-normal sulphuric acid V.S., and when the residual alkaloids have all dissolved, titrate the solution with fiftieth-normal potassium hydroxide V.S., using 5 drops of hematoxylin or iodeosin T.S. as an indicator. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0287, and this product by 10, to obtain the weight in grammes of mydriatic alkaloids contained in *one hundred cubic centimeters* of the Fluidextract of Belladonna Root." *U. S.*

" Moisten *eight ounces* (Imperial) or three hundred and twenty grammes of Belladonna Root, in No. 20 powder, with *six fluid ounces* (Imp. meas.) or two hundred and forty cubic centimetres of a mixture of seven volumes of Alcohol (90 per cent.) and one volume of Distilled Water; set aside for six hours; pack firmly in a percolator; pour over the powder *six fluid ounces* (Imp. meas.) or two hundred and forty cubic centimetres of the same alcoholic menstruum; when the liquid begins to drop, close the lower orifice of the percolator; set aside for twenty-four hours; percolate slowly, adding more of the menstruum as required; collect the percolate in small portions. Moisten a second quantity of *eight ounces* (Imp.) or three hundred and twenty grammes of Belladonna Root, in No. 20 powder, with the first *six fluid ounces* (Imp. meas.) or two hundred and forty cubic centimetres of percolate; proceed to extract this portion of the Belladonna Root in the manner directed for the first portion, but use as the menstruum the liquid collected from the first percolator. This method of percolation is to be carried out through two more quantities each of *eight ounces* (Imp.) or three hundred and twenty grammes of Belladonna Root, the third portion being extracted with the liquid from the second percolator, and the fourth portion with the liquid from the third percolator. Collect *twelve and a half fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the strong percolate from the fourth percolator.

Determine the proportion of alkaloids in the resulting strong percolate by the following analytical process.

Introduce 10 cubic centimetres into a separator, add 10 cubic centimetres of *chloroform,* 50 cubic centimetres of *water,* and a decided excess of *solution of ammonia;* agitate; set aside; separate the chloroformic solution. Twice repeat the agitation with *chloroform* and the separation. Shake the mixed chloroformic solutions with 5 cubic centimetres of *diluted sulphuric acid,* mixed with twice its volume of warm *water;* separate the chloroformic liquid and repeat the agitation with acidulated *water.* Wash the mixed acid liquids with 3 cubic centimetres of *chloroform;* then agitate with 10

cubic centimetres of *chloroform* and an excess of *solution of ammonia.* Separate the chloroformic solution; twice repeat the agitation with *chloroform* and the separation; wash the mixed chloroformic solutions with 5 cubic centimetres of *water* containing one drop of *solution of ammonia;* draw off the chloroformic layer into a counterpoised dish; evaporate on a water-bath; dry the residue below 212° F. (100° C.); weigh. Dissolve the residue in 10 cubic centimetres of a decinormal solution of hydrochloric acid (3.619 grammes of the acid, HCl, per litre) and add centinormal solution of soda (0.3976 gramme of sodium hydroxide, NaOH, per litre) until the liquid is neutral, using Tincture of Cochineal as an indicator. Deduct the measure of soda solution thus required, from 100 cubic centimetres, and multiply the remainder by 0.00287; the product will be the weight in grammes of alkaloids present in the quantity of the percolate operated upon.

From this weight calculate the amount of alkaloids in the bulk of strong percolate, and add to the latter sufficient of the alcoholic menstruum to produce Liquid Extract of Belladonna containing 0.75 gramme of alkaloids in 100 cubic centimetres, or ¾ grain in 110 minims." *Br.*

The British liquid extract represents several radical improvements in British pharmacy,—*i.e.*, the use of repercolation with absence of heat in the process, and standardization, thus making the end product bear a definite relation towards the quantity of active constituents found in the root (0.75 per cent.). It is based upon the formula proposed by R. A. Cripps. (*P. J.*, 1895, 795.) The fluidextract of the root is a good preparation, of reddish-brown color, very different in appearance from the deep-green fluidextract of the leaves which is often seen in the market.

Dose, from one to two minims (0.06 to 0.12 Cc.).

Off. Prep.—Emplastrum Belladonnæ, *Br.;* Extractum Belladonnæ Alcoholicum, *Br.;* Linimentum Belladonnæ, *U. S., Br.;* Tinctura Belladonnæ, *Br.;* Unguentum Belladonnæ, *Br.*

FLUIDEXTRACTUM BERBERIDIS. U. S.

FLUIDEXTRACT OF BERBERIS

(flū-id-ĕx-trăc'tŭm bĕr-bĕr'i-dĭs)

Fluidextract of Oregon Grape (Berberis Aquifolium); Extrait liquide de Berbéris (d'épine-vinette), *Fr.;* Flüssiges Berberitzenextrakt, *G.*

* "Berberis, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol until the Berberis is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was introduced into the U. S. P. (8th Rev.) for the first time. It represents the virtues of berberis.

Dose, half a fluidrachm to a fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM BUCHU. U. S.

FLUIDEXTRACT OF BUCHU [Extractum Buchu Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm bū'chū)

Extrait liquide de Bucco, *Fr.;* Flüssiges Buccoextrakt, *G.*

* "Buchu, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Buchu is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The old menstruum (alcohol 75 per cent.) for this fluidextract has been restored, experience having shown that with the weaker alcohol used in the U. S. P. 1880 formula it was possible to percolate buchu leaves satisfactorily.

In consequence of the peculiar structure of the leaves, it is somewhat difficult to powder them in a mortar, and it will be convenient

to resort to a mill for the purpose. As the most active ingredient of buchu is volatile, the direction in the formula to set aside the first portion of tincture obtained, which is a highly concentrated solution, is peculiarly important; for, if it were subjected to evaporation, much of the volatile oil would necessarily escape. The tincture subsequently obtained probably contains a large proportion of the fixed ingredients of the leaves, and will, therefore, allow of concentration without material loss.

This fluidextract is of a dark green color, and possessed in a high degree of the sensible properties of the leaves. It acquires the odor of mint when long kept, showing that some change takes place in its volatile oil. This fluidextract affords the best means at our command for the exhibition of buchu. It is often combined with solution of potassium hydroxide with excellent results.

Dose, thirty minims to a fluidrachm (1.8 to 3.75 Cc.), three to five times a day.

FLUIDEXTRACTUM CALAMI. U. S.

FLUIDEXTRACT OF CALAMUS [Extractum Calami Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm căl'ă-mī)

Extrait liquide d'Acore vrai, *Fr.;* Flüssiges Kalmuswurzelextrakt, *G.*

* "Calamus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Calamus is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a fluidextract which was introduced with the view of bringing into use an excellent indigenous aromatic stimulant. It will probably be most frequently used in combination with tonics in *dyspepsia* and gastric disorders to relieve *flatulence,* etc.

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

FLUIDEXTRACTUM CALUMBÆ. U. S.

FLUIDEXTRACT OF CALUMBA [Extractum Calumbæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm cą-lŭm'bæ)

Extrait liquide de Colombo, *Fr.;* Flüssiges Kolomboextrakt, *G.*

* "Calumba, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Calumba is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The formula for fluidextract of calumba of the U. S. P. 1870 was faulty, in directing the root to be in fine powder; the large quantity of mucilage present swelled under the influence of the menstruum, and frequently prevented the passage of the percolate; indeed, the powder will probably still be found to give trouble, and there will be some difficulty in thoroughly exhausting it; it should be slowly percolated. This extract is a yellowish-brown liquid, of an intense and purely bitter taste. The absence of tannin makes it a very desirable tonic, in combination with chalybeates.

Dose, fifteen to thirty minims (0.9 to 1.8 Cc.).

FLUIDEXTRACTUM CANNABIS INDICÆ. U. S.

FLUIDEXTRACT OF INDIAN CANNABIS [Extractum Cannabis Indicæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm căn'nă-bĭs ĭn'dĭ-çæ)

Extrait liquide de Chanvre Indien, *Fr.;* Flüssiges Indisch-Hanfextrakt, *G.*

* "Indian Cannabis, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Indian Cannabis is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a fluidextract which has come into use because of its convenience, and probably on account of the impression that heat injures the activity of the drug, and that the extract owes its inactivity sometimes to the influence of heat. (See *Cannabis Indica* and *Extractum Cannabis Indicæ.*) The fluidextract is of a dark green color, having the characteristic odor of the drug.

Dose, from one to two minims (0.06 to 0.12 Cc.).

FLUIDEXTRACTUM CAPSICI. U. S.

FLUIDEXTRACT OF CAPSICUM [Extractum Capsici Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm căp'sĭ-cī)

Fluidextract of Red Pepper; Extrait liquide de Capsique, de Piment des Jardins, *Fr.;* Flüssiges Spanisch-Pfefferextrakt, *G.*

* "Capsicum, in No. 50 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Capsicum is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The necessity for an official fluidextract of capsicum is not apparent, as the oleoresin and tincture are preparations which are well known and established. It will probably be rarely necessary to administer it internally.

Dose, from one-half to one minim (0.03 to 0.06 Cc.).

FLUIDEXTRACTUM CHIMAPHILÆ.

FLUIDEXTRACT OF CHIMAPHILA [Extractum Chimaphilæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm ĉhĭ-măph'ĭ-læ)

Fluidextract of Pipsissewa; Extrait liquide de Pyrole ombellée, *Fr.;* Flüssiges Doldenblüthiges Harnkrautextrakt, *G.*

* "Chimaphila, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Chimaphila is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a rather thick, dark brownish-green fluidextract.

Dose, a fluidrachm (3.75 Cc.).

FLUIDEXTRACTUM CHIRATÆ. U. S.

FLUIDEXTRACT OF CHIRATA [Extractum Chiratæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm ĉhĭ-rā'tæ)

Extrait liquide de Chirette, *Fr.;* Flüssiges Chiretta-extrakt, *G.*

* "Chirata, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Diluted Alcohol, pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above

it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Chirata is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This useful fluidextract is a clear, reddish-brown liquid, of an intensely bitter taste.

Dose, half a fluidrachm (1.8 Cc.).

FLUIDEXTRACTUM CIMICIFUGÆ. U. S. (Br.)

FLUIDEXTRACT OF CIMICIFUGA [Extractum Cimicifugæ Fluidum, Pharm. 1890]

(flû-id-ĕx-trăc'tŭm cim-i-cif'ŭ-gæ)

Extractum Cimicifugæ Liquidum, *Br.*, Liquid Extract of Cimicifuga; Liquid Extract of Actæa Racemosa; Fluidextract of Black Cohosh; Extrait liquide d'Actée à Grappes, *Fr.*; Flüssiges Cimicifugaextrakt, *G.*

• "Cimicifuga, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Cimicifuga is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Cimicifuga, in No. 60 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Cimicifuga with *two pints* (Imp. meas.) or two thousand cubic centimetres of the Alcohol; set aside in a closed vessel for forty-eight hours; transfer to a percolator; when the fluid ceases to pass, continue the percolation with more Alcohol, until the Cimicifuga is exhausted. Reserve the first *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the percolate; evaporate the remainder to the consistence of a soft extract; dissolve this in the reserved portion; add enough of the Alcohol to produce *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.*

This formula does not differ essentially from that of the U. S. Pharm. 1870. The British preparation has been modelled after that of the United States. There probably cannot be two opinions about the menstruum, although it has been asserted that a good fluidextract can be made with a menstruum of three parts alcohol and one part water. The probabilities are, however, that a portion of the resinous principle would precipitate on standing. This fluidextract is of a deep reddish-brown color, and thoroughly represents the drug.

Dose, from fifteen minims to one fluidrachm (0.9 to 3.75 Cc.).

Off. Prep.—Extractum Cimicifugæ, *U. S.*

FLUIDEXTRACTUM CINCHONÆ. U. S. (Br.)

FLUIDEXTRACT OF CINCHONA [Extractum Cinchonæ Fluidum, Pharm. 1890]

(flû-id-ĕx-trăc'tŭm cin-ko'næ)

"A Liquid Extract containing 5 grains of the alkaloids of Red Cinchona Bark in 110 minims (5 grammes in 100 cubic centimetres)." *Br.*

Extractum Cinchonæ Liquidum, *Br.*, Liquid Extract of Cinchona; Extractum Chinæ Callsayæ Fluidum; Extrait liquide de Quinquina jaune, *Fr.*; Flüssiges Kallsayarindenextrakt, Flüssiges Chinaextrakt, *G.*

• "Cinchona, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol and *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, and, when the liquid in the percolator has disappeared from the surface, gradually pour on a mixture of Alcohol and Water, made in the proportion of *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol to *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and continue the percolation slowly until the Cinchona is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly.

Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of anhydrous ether-soluble alkaloids in the remainder of the liquid, and add to this enough of a mixture of Alcohol and Water, using the same proportions as before, to make each *one hundred cubic centimeters* of the Fluidextract contain 4 Gm. of anhydrous ether-soluble alkaloids from Cinchona." *U. S.*

Assay of Fluidextract of Cinchona. U. S. (8th Rev.)—"Fluidextract of Cinchona, *ten cubic centimeters*; Ether, sp. gr. not above 0.720 at 25° C. (77° F.), Normal Sulphuric Acid V.S., Ammonia Water, Chloroform, each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Cinchona by means of a graduated pipette to an Erlenmeyer flask of 200 Cc. capacity, and add a mixture of 100 Cc. of ether, 25 Cc. of chloroform, and 10 Cc. of ammonia water. Insert the stopper securely, and shake the flask vigorously, at intervals, during ten minutes. Allow the liquids to separate, decant into a measuring cylinder exactly 66 Cc. of the supernatant liquid (representing 5 Cc. of the Fluidextract), and transfer this to a separator, rinsing the cylinder with 5 Cc. of ether and adding this to the separator. Add to the latter about 10 Cc. of normal sulphuric acid V.S., or enough to make the solution distinctly acid, and shake the separator vigorously for several minutes, and when the liquids have completely separated, draw off the lower layer into a second separator. To the first separator add 5 Cc. more of normal sulphuric acid V.S., and 5 Cc. of distilled water, shake it for several minutes, and when the liquids have separated, draw off the lower layer into the second separator. Now add 5 Cc. of distilled water to the first separator, shake it, separate as before, and then draw off the lower aqueous layer into the second separator. To the second separator, add 25 Cc. of ether, a small piece of red litmus paper, and then, gradually, ammonia water, keeping the temperature of the liquids below 25° C. (77° F.), until the reaction is alkaline. Then shake the separator vigorously for two minutes, and allow the liquids to stand for ten minutes at a temperature below 15° C. (59° F.). Draw off and reject the lower aqueous layer, and then transfer the ether-layer into a tared beaker. Add 5 Cc. more of ether to the separator, rinse carefully, and add the rinsings to the tared beaker, and entirely evaporate the ether at a moderate heat on a water-bath. Then dry the beaker in an air-bath at 120° C. (248° F.) for half an hour, cool, and weigh. Replace the beaker in the air-bath and heat again at the same temperature for half an hour, cool, and weigh, repeating until the weight is constant. Multiply the weight of the residue by 20, to obtain the weight in grammes of anhydrous ether-soluble alkaloids contained in *one hundred cubic centimeters* of the Fluidextract of Cinchona." *U. S.*

"Red Cinchona Bark, in No. 60 powder, 20 *ounces* (Imperial) or 640 grammes; Hydrochloric Acid, 5 *fl. drachms* (Imp. meas.) or 20 cubic centimetres; Glycerin, 2½ *fl. ounces* (Imp. meas.) or 80 cubic centimetres; Alcohol (90 per cent.), Distilled Water, of each *a sufficient quantity.* Mix the Red Cinchona Bark with *five pints* (Imp. meas.) or three thousand two hundred cubic centimetres of the Distilled Water, to which the Hydrochloric Acid and Glycerin have been added; set aside in a covered vessel for forty-eight hours, stirring frequently; transfer to a percolator; when the liquid ceases to pass, and the contents of the percolator have been properly packed, continue the percolation with Distilled Water until *fifteen pints* (Imp. meas.) or nine thousand six hundred cubic centimetres of liquid have passed, or until that which is passing has ceased to give a precipitate on the addition to it of an excess of *solution of potassium hydroxide.* Evaporate the percolate in a porcelain or enamelled iron vessel at a temperature not exceeding 180° F. (82.2° C.), until it is reduced to *twenty fluid ounces* (Imp. meas.) or six hundred and forty cubic centimetres of liquid.

Determine the proportion of alkaloids in the liquid product by the following analytical process:

Put 5 cubic centimetres of the liquid, together with 25 cubic centimetres of *water,* into a stoppered glass separator; add 30 cubic centimetres of *benzolated amylic alcohol*[1] and 15 cubic centimetres of *solution of potassium hydroxide;* shake them together thoroughly and repeatedly; allow them to remain at rest until the spirituous solution of the alkaloids shall have separated and formed a distinct stratum over the dark-colored alkaline liquid. Run off the latter by the stop-cock into another separator; agitate it thoroughly with 30 cubic centimetres of *benzolated amylic alcohol;* allow the liquids to separate; draw off and reject the lower layer; add the alcoholic layer to the liquid in the first separator; wash the mixture with a little *water;* agitate thoroughly with 30 cubic centimetres of a warm mixture of 1 volume of *diluted hydrochloric acid* and 5 volumes of *water;* allow the liquids to separate; draw off the lower acid layer into another separator; agitate the alcoholic layer with a second quantity of 30 cubic centimetres of the mixture of *water* and *diluted hydrochloric acid;* when separated draw this off into the other portion of acid liquid; to the mixture add 10 cubic centimetres of *chloroform* and sufficient *solution of ammonia* to impart a strongly alkaline reaction; shake thoroughly; allow the liquids to separate; draw off the lower chloroformic layer into a weighed dish; repeat the agitation and separation with two successive quantities of 10 cubic centimetres of *chloroform,* and add the chloroformic liquids to that in the dish. Allow the *chloroform* to evaporate slowly; dry the

[1] Made by mixing together three measures of benzol and one measure of amylic alcohol.

residue in the dish at a temperature of about 230° F. (110° C.). The weight of the dish and its contents, after deducting the known weight of the dish, will give that of the alkaloids.

Having thus ascertained the alkaloidal strength of the *twenty fluid ounces* (Imp. meas.) or 640 cubic centimetres of liquid product, every volume of it containing 5 grammes of total alkaloids is first to be brought to 85 cubic centimetres either by evaporation or, if necessary, by dilution with Distilled Water, then a volume of 12.5 cubic centimetres of the Alcohol is to be added, and the final adjustment of the volume to 100 cubic centimetres is to be effected by the addition of Distilled Water. The finished Liquid Extract will thus contain 5 grammes of the alkaloids of the bark in every 100 cubic centimetres, or 5 grains in 110 minims." *Br.*

Of these two formulas, the first is decidedly preferable. It is based upon that of Alfred B. Taylor of Philadelphia (*A. J. P.*, Jan. 1865). The British Pharmacopœia uses acidulated water with glycerin as a solvent, while it adds alcohol to the liquid to preserve it. In the U. S. process a mixture of alcohol, water and glycerin is used as the menstruum. Now, it is well known that cinchona cannot be properly exhausted by the British solvent; and, though by its use as a menstruum the resin and cinchonic red are mainly left behind, so also is a considerable proportion of the alkaloids. By using alcohol, water and glycerin, the U. S. Pharmacopœia extracts all the virtues of the bark, though it may also take up some of the resin and cinchonic red. The process of the British Pharmacopœia yields a preparation which would be more appropriately termed an "alkaloidal solution of cinchona." The U. S. fluidextract, like others of its class, is a preparation which represents all of the soluble active constituents of cinchona; the British liquid extract, although an improvement on the former process, is simply a "preserved infusion" made by prolonged evaporation; the improvement consists in the addition of acid to the menstruum and the assaying of a portion of the evaporated percolate by a process similar to that adopted by the British Pharmacopœia for cinchona and making the finished product contain 5 per cent. of mixed alkaloids; thus any imperfections in the manipulation are overcome by the check of the assay.[1] The U. S. fluidextract of cinchona is a moderately thin, dark reddish brown, translucent fluid, of a bitter, astringent taste.

Dose, five to twenty minims (0.3 to 1.3 Cc.).

[1] *Liquid Extract of Cinchona* (simplified).—Take of Quinine 75 grains, Cinchonidine 35 grains, Cinchonine 20 grains, Hydrochloric Acid 40 minims, Glycerin 5 fluidrachms, Alcohol 1 fluidrachm. Dissolve the alkaloids in the alcohol and glycerin mixed with 5 fluidounces of water, add the acid, agitate until dissolved, and add sufficient water to make 6 fluidounces. If the color and flavor of the bark are desired, add 60 grains of Red Cinchona in powder to the solution, allow it to stand 24 hours, then filter.

FLUIDEXTRACTUM COCÆ. U. S. (Br.)

FLUIDEXTRACT OF COCA [Extractum Cocæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm cō'çæ)

Extractum Cocæ Liquidum, *Br.;* Liquid Extract of Coca; Fluidextract of Erythroxylon; Extrait liquide de Coca, *Fr.;* Flüssiges Cocablätterextrakt, Flüssiges Cocaextrakt, *G.*

* "Coca, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Coca is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of ether-soluble alkaloids in the remainder of the liquid, and add to this enough Diluted Alcohol to make each *one hundred cubic centimeters* of the Fluidextract contain 0.5 Gm. of ether-soluble alkaloids from Coca." *U. S.*

Assay of Fluidextract of Coca. U. S. (8th Rev.)—"Fluidextract of Coca, *ten cubic centimeters;* Ammonia Water, Ether, Distilled Water, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., or Iodeosin T.S., each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Coca by means of a graduated pipette to a separator, add 25 Cc. of ether, and then 2 Cc. of ammonia water, shaking together for one minute. When the liquids have completely separated, draw off the lower aqueous layer into a second separator, and to this add 20 Cc. more of ether, and repeat the shaking for one minute. Draw off and reject the lower aqueous layer from the second separator, and add the ether-layer to the first separator. To this separator now add 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, and shake it well for one or two minutes. After the liquids have separated, draw off the lower aqueous layer into the other separator, and repeat the extraction in the first separator with 9 Cc. of distilled water and 1 Cc. of normal sulphuric acid V.S., shaking the liquids for one minute, and separating as before. Add the aqueous solution to the other separator, and reject the

ether. Now add to the combined acid liquids 20 Cc. of ether, a small piece of red litmus paper, and sufficient ammonia water to render the mixture distinctly alkaline, and shake the liquids for one or two minutes. Draw off the separated aqueous layer into the other separator and the ether-layer into a beaker. Repeat the extraction of the aqueous layer in the other separator with two portions (15 Cc. each) of ether, and add the resulting ether-solutions to the beaker. Now evaporate the ether from the beaker, and, when dry, add to it 5 Cc. of tenth-normal sulphuric acid V.S., and stir until the alkaloidal residue is dissolved. Then add 5 drops of hematoxylin T.S. or iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.03, and this product by 10, to obtain the weight in grammes of ether-soluble alkaloids contained in *one hundred cubic centimeters* of the Fluidextract of Coca." *U. S.*

"Coca Leaves, in No. 20 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Mix the powdered Coca Leaves with *two pints* (Imp. meas.) or two thousand cubic centimetres of the Alcohol; set aside in a closed vessel for forty-eight hours; transfer to a percolator; when the fluid ceases to pass, continue the percolation with more of the Alcohol until the Coca Leaves are exhausted. Reserve the first *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the percolate; evaporate the remainder, at a temperature below 176° F. (80° C.), to the consistence of a soft extract; dissolve this in the reserved portion; add enough of the Alcohol to produce *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.*

This fluidextract is one of the most useful of the preparations of coca. L. F. Kebler prefers as a menstruum 65 per cent. alcohol and No. 60 powder in making this fluidextract. (*Proc. A. Ph. A.*, 1895, 339; see also *A. J. P.*, 1896, 609; *P. J.*, 1896, 306.) It is of a dark greenish-brown color, of an agreeable tea-like taste, but with little odor.

Dose, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.).

Off. Prep.—Vinum Cocæ, *U. S.*

FLUIDEXTRACTUM COLCHICI SEMINIS. U. S.

FLUIDEXTRACT OF COLCHICUM SEED

[Extractum Colchici Seminis Fluidum, Pharm. 1890]

(flŭ-ĭd-ĕx-trăc'tŭm cŏl'çhĭ-cī sĕm'ĭ-nĭs)

Extrait liquide de Semences de Colchique, *Fr.*; Flüssiges Zeitlosensamenextrakt, *G.*

* "Colchicum Seed, in No. 50 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Colchicum Seed is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of colchicine in the remainder of the liquid, and add to this enough menstruum to make each *one hundred cubic centimeters* of the Fluidextract contain 0.5 Gm. of colchicine." *U. S.*

Assay of Fluidextract of Colchicum Seed. U. S. (8th Rev.)—"Fluidextract of Colchicum Seed, *ten cubic centimeters;* Ether, Chloroform, Alcohol, Ammonia Water, Distilled Water, each, *a sufficient quantity.* Measure into a separator 10 Cc. of Fluidextract of Colchicum Seed, add 1 Cc. of ammonia water, and shake out the alkaloid with three successive portions, 15, 15, and 10 Cc., of chloroform. Collect the chloroformic solutions in a beaker or dish, and evaporate it nearly to dryness by applying a very gentle heat. Dissolve the residue in 10 Cc. of ether, add 5 Cc. of water, stir well, and heat gently until the ether is evaporated. After cooling, filter the aqueous solution into a small separator, retaining the insoluble matter as much as possible in the beaker or dish. Redissolve the residue in a little ether, add 5 Cc. of water, and proceed as before. Wash the container and filter with a little water, and shake the aqueous solution well for one minute with 15 Cc. of chloroform. Draw off the chloroform, after perfect separation, into a tared flask, and again shake out the aqueous liquid, successively, with three portions of 10 Cc. each of chloroform, collecting these solutions in the tared flask. Evaporate the chloroform completely; dissolve the residue in a little alcohol, evaporate the latter, redissolve it in alcohol, evaporate the alcohol as before, and dry the residue at 100° C. (212° F.), until the weight, after cooling in a desiccator, remains constant. Multiply the weight of the residue by 10, to obtain the weight in

grammes of colchicine contained in *one hundred cubic centimeters* of the Fluidextract of Colchicum Seed." *U. S.*

The use of glycerin in this fluidextract (U. S. P. 1870) was even more objectionable than in that of the root, as the fixed oil contained in the seeds was always thrown out of solution, and was usually found floating on the fluidextract, rendering the preparation unsightly. L. I. Morris (*A. J. P.*, 1881, 7) believes that it is unnecessary to grind the colchicum seeds, and that if the whole seeds are digested with diluted alcohol at 80° C. (176° F.) the colchicine is easily extracted.

Dose, from two to eight minims (0.12 to 0.5 Cc.).

Off. Prep.—Vinum Colchici Seminis, *U. S.*

FLUIDEXTRACTUM CONII. U. S.

FLUIDEXTRACT OF CONIUM [Extractum Conii Fluidum, Pharm. 1890]

(flû-ĭd-ĕx-trăc'tŭm cō-nī'ī)

Extractum Conii Fructus Fluidum, *U. S.* 1870; Fluid Extract of Conium Seed, or Hemlock Fruit; Extrait liquide de semence (fruit) de Ciguë, *Fr.*; Flüssiges Schierlingsfruchtextrakt, *G.*

"Conium (fruit) in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, *twenty cubic centimeters* [or 325 minims]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Acetic Acid with *nine hundred and eighty cubic centimeters* [or 33 fluidounces, 66 minims] of Diluted Alcohol, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum and then Diluted Alcohol, until the Conium is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of coniine in the remainder of the liquid, and add to this enough Diluted Alcohol to make each *one hundred cubic centimeters* of the Fluidextract contain 0.45 Gm. of coniine." *U. S.*

Assay of Fluidextract of Conium. U. S. (8th Rev.)—"Fluidextract of Conium, *ten cubic centimeters;* Ether, Alcohol, Absolute Alcohol, Ammonia Water, Normal Sulphuric Acid V.S., Sodium Carbonate T.S., Hydrochloric Acid Solution (5 percent. HCl), Distilled Water, each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Conium by means of a graduated pipette to an evaporating dish containing a little clean sand, and evaporate it to dryness at a gentle heat. Mix the sand uniformly with the extract and transfer it to an Erlenmeyer flask of about 200 Cc. capacity, rinse the dish with 100 Cc. of a mixture of ether 100 Cc., alcohol 7 Cc., and ammonia water 3 Cc., added in portions, and transfer the rinsings to the flask. Insert the stopper securely and shake the flask at intervals during one hour. Decant 50 Cc. of the liquid (representing 5 Cc. of the Fluidextract of Conium) into a beaker, and add sufficient normal sulphuric acid V.S. to produce a distinctly acid reaction. Evaporate the ether at a gentle heat by the aid of a water-bath; then add 15 Cc. of absolute alcohol, and set the beaker aside in a cool place for two hours to allow the ammonium sulphate to deposit. Filter the liquid; wash the residue and filter with a little absolute alcohol, and add the washings to the filtrate; neutralize any excessive amount of acid with sodium carbonate T.S., being careful to retain a slight acidity. Concentrate the liquid to 3 Cc. by the aid of a gentle heat on a water-bath, add 3 Cc. of distilled water and 2 drops of normal sulphuric acid V.S. Add 15 Cc. of ether to remove traces of fatty matter, pour off the ether-solution, and repeat the washing. Then transfer the acid liquid to a separator, introduce a small piece of red litmus paper, and add sufficient sodium carbonate T.S. to render the liquid slightly alkaline; then shake out with successive portions of 15, 10, and 10 Cc. of ether. To the combined ether-solutions in a tared beaker add, drop by drop, sufficient hydrochloric acid solution (5 percent.) to insure an excess of acid, and then evaporate the ether by a gentle heat on a water-bath. Remove the excess of hydrochloric acid by adding to the residue 3 Cc. of alcohol and heating gently to evaporate the liquid, repeat this operation once, and dry the residue at a temperature not exceeding 60° C. (140° F.) until the weight, after cooling in a desiccator, remains constant. Multiply the weight of the residue by 0.777, and the product by 20, to obtain the weight in grammes of coniine contained in *one hundred cubic centimeters* of the Fluidextract of Conium." *U. S.*

The fluidextract of conium of the U. S. Pharmacopœia of 1860 was prepared from the leaves, and was, therefore, of necessity a very uncertain, if not for the most part inert, preparation. The alkaloid coniine is contained in very unequal proportions in the fresh leaves, and is so very volatile and destructible that in the dried leaves it may be altogether wanting. Wm. Manlius Smith (*A. J. P.*, xl. 459), as the result of an elaborate investigation, found that the immature fruits of conium are not only richer in the alkaloids than are the leaves, but are less variable in the proportion they contain,

and have the coniine in them in such form that drying does not dissipate it. The superiority of the fluidextract of conium seed over the same preparation of the leaves was shown by Smith, and has been since abundantly confirmed by experience. The revisers of the U. S. Pharmacopœia of 1870 acted very wisely in abandoning the old for the new preparation.

The present fluidextract is a dark brownish-green liquid having the mouse-urine odor and emitting a still stronger conium odor on the addition of potassium hydroxide; any sample which fails to do this should be rejected as wanting in the alkaloid. Smith found sixteen minims (1 Cc.) of a fluidextract of the seed prepared by Squibb to produce violent symptoms. L. Wheeler, however, took thirty minims (1.8 Cc.) without experiencing any result (*B. M. S. J.*, June, 1870), but dangerous results have followed from the administration of much smaller doses.

Dose, three to five minims (0.2 to 0.3 Cc.), increased *pro re nata.*

FLUIDEXTRACTUM CONVALLARIÆ. U. S.

FLUIDEXTRACT OF CONVALLARIA [Extractum Convallariæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm cŏn-val-lā'rĭ-æ)

Fluidextract of Lily of the Valley; Extrait liquide de Muguet, *Fr.;* Flüssiges Maiblumenwurzelextrakt, *G.*

* " Convallaria, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, until the Convallaria is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract thoroughly represents the activity of convallaria.

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

FLUIDEXTRACTUM CUBEBÆ. U. S.

FLUIDEXTRACT OF CUBEB [Extractum Cubebæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm cū-bē'bæ)

Extrait liquide de Cubèbe, *Fr.;* Flüssiges Kubebenextrakt, *G.*

* " Cubeb, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Cubeb is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

Notwithstanding the fact that the oleoresin of cubeb thoroughly represents in a concentrated liquid form all the virtues of this drug, the alcoholic fluidextract is a useful preparation; it permits the administration of cubeb in aqueous or hydro-alcoholic mixtures where the oleoresin would not be admissible except in emulsion. It is a dark olive, translucent fluid, with the sensible properties of the drug.

Dose, from ten to forty minims (0.6 to 2.5 Cc.).

FLUIDEXTRACTUM CYPRIPEDII. U. S.

FLUIDEXTRACT OF CYPRIPEDIUM [Extractum Cypripedii Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm çÿp-rĭ-pē'dĭ-ī)

Fluidextract of Lady's Slipper; Extrait liquide de Cypripède jaune, *Fr.;* Flüssiges Gelbfrauenschuhextrakt, *G.*

* " Cypripedium, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted

Alcohol, until the Cypripedium is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract well represents the drug, although its use is at present very limited. It is very dark reddish brown in color.

Dose, fifteen minims (0.9 Cc.).

FLUIDEXTRACTUM DIGITALIS. U. S.

FLUIDEXTRACT OF DIGITALIS [Extractum Digitalis Fluidum, Pharm. 1890]

(flŭ-ĭd-ĕx-trăc'tŭm dĭg-ĭ-tā'lĭs)

Extrait liquide de Digitale, *Fr.;* **Flüssiges Fingerhutkrautextrakt, Flüssiges Digitalisextrakt,** *G.*

• "Digitalis, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Digitalis is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is greenish black in color, and represents the drug thoroughly.

Dose, one to two minims (0.06 to 0.12 Cc.).

Off. Prep.—Extractum Digitalis, *U. S.*

FLUIDEXTRACTUM ERGOTÆ. U. S. (Br.)

FLUIDEXTRACT OF ERGOT [Extractum Ergotæ Fluidum, Pharm. 1890]

(flŭ-ĭd-ĕx-trăc'tŭm ĕr'gŏ-tæ)

Extractum Ergotæ Liquidum, *Br.;* **Liquid Extract of Ergot; Extrait liquide de Seigle ergoté,** *Fr.;* **Extractum Secalis Cornuti fluidum,** *P. G.;* **Mutterkorn-Fluidextrakt, Flüssiges Mutterkornextrakt,** *G.*

• "Ergot, recently ground and in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, *twenty cubic centimeters* [or 325 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Acetic Acid with *nine hundred and eighty cubic centimeters* [or 33 fluidounces, 66 minims] of Diluted Alcohol, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding first the remainder of the menstruum and then Diluted Alcohol, until the Ergot is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Ergot, crushed, 20 *ounces* (Imperial) or 400 grammes; Distilled Water, 7½ *pints* (Imp. meas.) or 3000 cubic centimetres; Alcohol (90 per cent.), 7½ *fl. ounces* (Imp. meas.) or 150 cubic centimetres. Digest the crushed Ergot in *five pints* (Imp. meas.) or two thousand cubic centimetres of the Distilled Water for twelve hours; draw off the infusion; repeat the digestion with the remainder of the Distilled Water; press; strain; evaporate the liquid to *fourteen fluid ounces* (Imp. meas.) or two hundred and eighty cubic centimetres; when cold, add the Alcohol; set aside for an hour; filter. The product should measure *twenty fluid ounces* (Imp. meas.) or four hundred cubic centimetres." *Br.*

This fluidextract was first suggested by Joseph Laidley of Richmond, Va., but the process has since been much modified. The improvement first suggested by Procter, of adding an acid to the menstruum to fix the alkaloids, and the selection of the proper menstruum, placed this important preparation at once on a permanent footing, and his original formula, published in 1857, and made official in 1860, is practically that now official, notwithstanding the numerous changes of views concerning the active constituents of ergot. Practical experience has shown that it is not only a reliable preparation, but also, if carefully made, a permanent one. The use of glycerin in the menstruum is of no benefit whatever; as an addition, diluted hydrochloric has been replaced by acetic acid for fixing alkaloids, which makes the present fluidextract identical with Procter's original formula. (See *Ergota.*) Diluted alcohol dissolves all the active matter of ergot, leaving its oil behind, and the tincture first obtained, holding most of the active prin-

ciples, is reserved without concentration. In the British process the prolonged digestion and evaporation must act disadvantageously upon principles which are known to be very easily affected by heat and exposure. Bernagan and Burkhart have devised a process in which the fluidextract contains 5 per cent. of sodium chloride. The advantages are not apparent. (*Ap. Ztg.*, 1895, 309.)

The U. S. fluidextract of ergot is a clear, very dark reddish-brown liquid, having the taste of ergot, but without its fishy odor, owing to the neutralization of the trimethylamine, upon which that odor depends. On the addition, however, of solution of potassium hydroxide, the odor is strongly developed, and the alkaloid escapes so largely that, if hydrochloric acid be held near it, a cloud of trimethylamine chloride will be perceived. This may be considered as a good test of the efficiency of the preparation, for, though the virtues of ergot do not depend on its volatile alkaloid, yet if this be retained in the fluidextract there can be little doubt that the other more fixed principles will be retained also. The preparation is an active one, but in large doses it is more apt to produce nausea than is the simple extract.

Dose, from half a fluidrachm to half a fluidounce (1.8 to 15 Cc.).

Off. Prep.—Vinum Ergotæ, *U. S.*

FLUIDEXTRACTUM ERIODICTYI. U. S.

FLUIDEXTRACT OF ERIODICTYON [Extractum Eriodictyi Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm ĕr-ī-ō-dĭc'tȳ-ī)

Fluidextract of Yerba Santa; Extrait liquide d' Eriodictyon, *Fr.;* Flüssiges Eriodictyonextrakt, *G.*

* "Eriodictyon, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Eriodictyon is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract[1] has a dark brownish-green color, and has proven a valuable addition.

Dose, from fifteen minims to a fluidrachm (0.9 to 3.75 Cc.).

FLUIDEXTRACTUM EUCALYPTI. U. S.

FLUIDEXTRACT OF EUCALYPTUS [Extractum Eucalypti Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm eū-cą-lȳp'tī)

Extrait liquide d'Eucalyptus, *Fr.;* Flüssiges Eucalyptusextrakt, *G.*

* "Eucalyptus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Eucalyptus is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract well represents the drug, and is of a dark greenish-brown color, having the peculiar odor and taste of eucalyptus very strongly developed, but in effectiveness it is much inferior to the volatile oil.

Dose, from ten to thirty minims (0.6 to 1.8 Cc.).

[1] *Aromatic Fluidextract of Yerba Santa* (Edel's process).—Take of fluidextract of yerba santa, 2 fluidounces; oil of cloves, 32 drops; oil of orange, 16 drops; oil of sassafras, 16 drops; alcohol, 3 fluidounces; solution of potassium hydroxide, 12 fluidrachms; compound fluidextract of cardamom, 4 fluidrachms; water, 4 fluidounces; glycerin, purified talc, of each a sufficient quantity. The fluidextracts and oils are mixed, the solution of potassium hydroxide and water added, then some talc, and finally the alcohol, when the mixture is filtered, returning the first filtrate until it passes clear. Sufficient glycerin is then added to the filtrate to make one pint. The preparation is readily miscible with water, elixirs, or syrups. This fluidextract (so called) is intended for making a palatable Aromatic Syrup of Yerba Santa. (*Proc. A. Ph. A.*, 1897, 423.)

FLUIDEXTRACTUM EUONYMI. U. S.

FLUIDEXTRACT OF EUONYMUS

(flū-id-ĕx-trăc'tŭm eū-ōn'y-mī)

Fluidextract of Wahoo; Extrait liquide d'Ecorce de Fusain Americain, *Fr.;* Flüssiges Spillbaumrindenextrakt, *G.*

* "Euonymus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Euonymus is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

Dose, as a laxative, five to fifteen minims (0.3 to 0.9 Cc.); as a purgative, one fluidrachm (3.75 Cc.).

Off. Prep.—Extractum Euonymi, *U. S.*

FLUIDEXTRACTUM EUPATORII. U. S.

FLUIDEXTRACT OF EUPATORIUM [Extractum Eupatorii Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm eū-pā-tō'rĭ-I)

Fluidextract of Boneset, Fluidextract of Thoroughwort; Extrait liquide d'Eupatoire perfoliée, *Fr.;* Flüssiges Durchwachsener-Wasserhanfextrakt, Flüssiges Durchwachsdostenextrakt, *G.*

* "Eupatorium, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Eupatorium is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract will have but a limited use, although it well represents the drug, since boneset is chiefly employed in domestic medicine. It is of a dark greenish-brown color.

Dose, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.).

FLUIDEXTRACTUM FRANGULÆ. U. S.

FLUIDEXTRACT OF FRANGULA [Extractum Frangulæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm frăn'gū-læ)

Extrait liquide d'Ecorce de Bourdaine, *Fr.;* Extractum Frangulæ fluidum, *P. G.;* Faulbaum-Fluidextrakt, Flüssiges Faulbaumrindenextrakt, *G.*

* "Frangula, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol with *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Frangula is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a fluidextract which has been quite largely used in this country. It is intended to be a laxative, but it is frequently disappointing, as the drug is rarely to be obtained of uniformly good quality. The fluidextract is of a dark reddish-brown color.[1]

Dose, ten to twenty minims (0.6 to 1.3 Cc.).

[1] *Sweet Fluid Extract of Buckthorn* (Edel's process).—Fld. extr. buckthorn, 16 fl. oz.; solution of potassa, 1 fl. dr.; solution of liquorice (N. F.), 2 fl. oz.; saccharin, 1 dr. Take 3 fluidounces of the fluidextract, reduce by evaporation to half a fluidounce, dissolve in the rest of the fluidextract, add the solution of potassa, saccharin, and liquorice. The resulting product is a permanent sweet fluidextract. (*Proc. A. Ph. A.*, 1897, 423.)

FLUIDEXTRACTUM GELSEMII. U. S.

FLUIDEXTRACT OF GELSEMIUM [Extractum Gelsemii Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm gĕl-sĕm'ĭ-ī)

Extrait liquide de Jasmin jaune ou Gelsemium, *Fr.;* Flüssiges Gelber Jasminextrakt, Flüssiges Gelsemiumextrakt, *G.*

* "Gelsemium, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Gelsemium is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is identical with the fluidextract formerly official, which has proved very useful. It is of a dark reddish-brown color.

Dose, from two to three minims (0.12 to 0.2 Cc.).

FLUIDEXTRACTUM GENTIANÆ. U. S.

FLUIDEXTRACT OF GENTIAN [Extractum Gentianæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm gĕn-tī-ā'næ)

Extrait liquide de Gentiane, *Fr.;* Flüssiges Enzianextrakt, *G.*

* "Gentian, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Gentian is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a translucent, reddish-brown fluid, with the odor and taste of the root. It may be questionable whether it was needed, though it has the advantage that we may obtain from it the tonic effects of the drug with less alcohol than in an equivalent quantity of the tincture, and pharmaceutically it affords a convenient method of giving to mixtures the tonic properties of gentian when required.

Dose, from ten to thirty minims (0.6 to 1.8 Cc.).

FLUIDEXTRACTUM GERANII. U. S.

FLUIDEXTRACT OF GERANIUM [Extractum Geranii Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm gĕ-rā'nĭ-ī)

Extrait liquide de Géranium maculé, Extrait liquide de Bec de Grue tacheté, *Fr.;* Flüssiges Fleckenstorchschnabelextrakt, *G.*

* "Geranium, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol, and *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol to *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water, until the Geranium is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The quantity of glycerin was greatly diminished in this fluidextract in the U. S. P. 1890, and the process is now unobjectionable. It is a dark reddish-brown liquid, having little odor and a very astringent taste. For *Stolz's process,* see *Registered Pharmacist,* 1893, 253.

Dose, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM GLYCYRRHIZÆ. U. S. (Br.)

FLUIDEXTRACT OF GLYCYRRHIZA [1] **[Extractum Glycyrrhizæ Fluidum, Pharm. 1890]**

(flū-ĭd-ĕx-trăc'tŭm glĭç-ŷr-rhī'zæ)

Extractum Glycyrrhizæ Liquidum, *Br.;* Liquid Extract of Liquorice; Fluidextract of Licorice or Liquorice; Extrait liquide de Réglisse, *Fr.;* Flüssiges Süssholzwurzelextrakt, *G.*

* "Glycyrrhiza, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Ammonia Water, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Pour *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of boiling Water upon the Glycyrrhiza, contained in a suitable vessel, and allow it to stand for one hour. Pack the moistened powder loosely in a metallic percolator, pour boiling Water upon it, and allow the percolation to proceed, supplying boiling Water until the Glycyrrhiza is exhausted. Evaporate the percolate at a moderate heat, until it measures *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims], and, when cool, add *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Alcohol, mix well and set it aside for three days. After filtering the liquid, distil it until *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of distillate have been obtained; transfer the liquid in the still to a suitable container, add the Glycerin, Ammonia Water, and *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol. Finally, add sufficient Water to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Liquorice Root, in No. 20 powder, 20 *ounces* (Imperial) or 1000 grammes; Distilled Water, 5 *pints* (Imp. meas.) or 5 litres; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Liquorice Root with half of the Distilled Water; set aside for twenty-four hours; strain; press; to the pressed marc add the remainder of the Distilled Water and set aside for six hours; strain; press; mix the strained liquids; heat to 212° F. (100° C.); strain through flannel; evaporate until the fluid has acquired, when cold, a specific gravity of 1.200; add to this one-fourth of its volume of the Alcohol; let the mixture stand for twelve hours; filter." *Br.*

[1] *Extractum Glycyrrhizæ Spirituosum,* Br. Add. *Spirituous Extract of Liquorice.*—"Extract of Liquorice, 10 *ounces* (Imperial) or 500 grammes; Alcohol (90 per cent.), 5 *fl. ounces* (Imp. meas.) or 250 cubic centimetres; Distilled Water, a sufficient quantity. Mix the Extract of Liquorice with enough Distilled Water to form a liquid; add the Alcohol; then add enough Distilled Water to produce a well-mixed bulk of one pint (or one thousand cubic centimetres); filter if necessary." *Br. Add.*

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

The process for this fluidextract was materially changed in the U. S. P. (8th Rev.). The former processes, while making stable fluidextracts of good appearance, were deficient in not providing for the removal of the acrid, oily constituent found in licorice root; the present process overcomes this difficulty by exhausting the coarsely powdered root with boiling water, concentrating the infusions, adding alcohol to precipitate inert constituents, and filtering; the filtrate is distilled to recover the excess of alcohol, and glycerin, ammonia water and alcohol added to bring the measure to the required standard. This process is essentially that recommended by A. R. L. Dohme. The British formula for the liquid extract has several inconvenient manipulative features, such as the repeated macerations and expressions, evaporating to a certain specific gravity, etc. (See *Mont. Pharm. Journ.,* 1893, 147; *P. J.,* 1898, 188.) This preparation is now very largely used as an adjuvant, and for disguising the bitter taste of quinine, which should be added to the preparation of licorice just before the dose is taken. It is a very convenient form for using licorice, the objections to the former fluidextracts of the root having been the slight acridity and the presence of too much alcohol. Not only does the ammonia render the glycyrrhizin soluble, thus materially adding to the power and sweetness of the fluidextract, but it also greatly lessens the acridity. It is a very dark reddish-brown liquid, having the well known sweet taste of licorice, and froths when shaken with water. A *syrup of licorice* may be made by adding two parts of fluidextract to fourteen parts of simple syrup. An elixir containing licorice (*Elixir Adjuvans*) was made official in the U. S. P. 8th Rev.

Used as a vehicle only.

Off. Prep.—Elixir Adjuvans, *U. S.;* Mistura Sennæ Composita, *Br.;* Syrupus Sarsaparillæ Compositus, *U. S.;* Tinctura Aloes, *Br.*

FLUIDEXTRACTUM GRANATI. U. S.

FLUIDEXTRACT OF POMEGRANATE

(flū-ĭd-ĕx-trăc'tŭm grą-nā'tī)

Fluidextract of Pomegranate Root Bark; Extrait liquide d'Ecorce de Balaustier, Extrait liquide d'Ecorce de Grenadier, *Fr.;* Flüssiges Granatwurzelrindenextrakt, *G.*

* "Granatum, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Diluted Alcohol, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate

the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Pomegranate is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was admitted to the U. S. Pharmacopœia (8th Revision) for the first time; it well represents the virtues of pomegranate.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM GRINDELIÆ. U. S. (Br. Add.)

FLUIDEXTRACT OF GRINDELIA [Extractum Grindeliæ Fluidum, Pharm. 1890]

(flŭ-ĭd-ĕx-trăc'tŭm grĭn-dē'lĭ-æ)

Extractum Grindeliæ Liquidum, *Br. Add.,* Liquid Extract of Grindelia; Extrait liquide de Grindélia, *Fr.;* Flüssiges Grindelienextrakt, *G.*

* "Grindelia, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, until the Grindelia is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath; and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Grindelia, in No. 40 powder, 20 *ounces* (Imperial) or 1000 grammes; Sodium Bicarbonate, 2 *ounces* (Imp. meas.) or 100 grammes; Distilled Water, 10 *fl. ounces* (Imp. meas.) or 500 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Moisten the Grindelia with *eight fluid ounces* (Imp. meas.) or four hundred cubic centimetres of the Alcohol; macerate in a closed vessel for twenty-four hours; pack the moistened powder in a percolator, and add enough of the Alcohol to saturate it thoroughly; when the liquid begins to drop, close the lower orifice of the percolator; set aside for twenty-four hours, then allow percolation to proceed, gradually adding more of the Alcohol until the Grindelia is exhausted. Remove the alcohol by distillation, and dissolve the residue in the Distilled Water to which the Sodium Bicarbonate has previously been added, and after effervescence ceases add enough Distilled Water to produce *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres and then enough of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br. Add.*

This is a fluidextract which well represents the drug; owing to the large quantity of resinous matter present, it does not mix well with aqueous liquids. The so-called "*alkaline fluid extract of grindelia*" may be made by evaporating one pint of official fluidextract until reduced to twelve fluidounces, making a solution of 180 grains of sodium bicarbonate in four fluidounces of water, adding it slowly to the evaporated fluidextract, and filtering. The fluidextract is a dark brown liquid having the peculiar odor of grindelia.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM GUARANÆ. U. S.

FLUIDEXTRACT OF GUARANA [Extractum Guaranæ Fluidum, Pharm. 1890]

(flŭ-ĭd-ĕx-trăc'tŭm guą-rā'næ)

Extrait liquide de Guarana, *Fr.;* Flüssiges Guaranaextrakt, *G.*

* "Guarana, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Guarana is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *five cubic centimeters* of

this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of alkaloids contained in the remainder of the liquid; add to this enough Diluted Alcohol to make *one hundred cubic centimeters* of the finished Fluidextract contain 3.5 Gm. of the alkaloids from Guarana." *U. S.*

Assay. U. S. (8th Rev.)—"Fluidextract of Guarana, *five cubic centimeters*; Chloroform, Ether, Ammonia Water, Normal Sulphuric Acid V.S., Distilled Water, each, *a sufficient quantity*. Transfer to a separator 5 Cc. of Fluidextract of Guarana, add 15 Cc. of chloroform and 1 Cc. of ammonia water. Shake well and allow the liquid to separate completely. Draw off the chloroform into a beaker. Shake out the fluid remaining in the separator with two additional portions of chloroform of 10 Cc. each, evaporate the combined chloroformic solutions carefully to dryness. Dissolve the alkaloidal residue in a mixture of 2 Cc. of normal sulphuric acid V.S. and 20 Cc. of warm distilled water. Allow it to cool, and filter the solution into a separator, rinse the flask and filter with distilled water, adding the rinsings to the separator, then add 20 Cc. of chloroform and 2 Cc. of ammonia water and shake the separator for one minute. Draw off the chloroform into a tared flask, and repeat the extraction with two portions of 10 Cc. each of chloroform, adding this to the tared flask. Distil off the chloroform, and, when dry, add 2 Cc. of ether, and evaporate this very carefully with the aid of a water-bath (to avoid decrepitation). Dry the residue to a constant weight on the water-bath. Multiply the weight by 20, which will give the weight in grammes of alkaloids contained in *one hundred cubic centimeters* of Fluidextract of Guarana." *U. S.*

This fluidextract is of doubtful utility. The powdered drug itself is portable, not unpleasant to the taste, and is efficient when given diffused in water; nothing is gained by making it into a fluidextract. The fluidextract is of a deep reddish-brown color. (See *Proc. A. Ph. A.*, 1897, 423.)

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

FLUIDEXTRACTUM HAMAMELIDIS FOLIORUM. U. S. (Br.)

FLUIDEXTRACT OF HAMAMELIS LEAVES [Extractum Hamamelidis Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm hăm-ą-mĕl'ĭ-dīs fō-lĭ-ō'rŭm)

Extractum Hamamelidis Liquidum, *Br.;* Liquid Extract of Hamamelis; Fluidextract of Witch-hazel Leaves; Extrait liquide de Hamamélis, *Fr.;* Flüssiges Hamamelisextrakt, *G.;* Extracto fluido de hamamelis, *Sp.*

* "Hamamelis Leaves, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol and *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol to *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, until the Hamamelis Leaves are exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Hamamelis Leaves, in No. 40 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (45 per cent.), *a sufficient quantity*. Moisten the powdered Hamamelis Leaves with about *eight fluid ounces* (Imp. meas.) or four hundred cubic centimetres of the Alcohol; pack the moistened powder in a percolator, and add sufficient menstruum to saturate it thoroughly; when the liquid begins to drop, close the lower orifice of the percolator; set aside for forty-eight hours; then allow percolation to proceed, gradually adding menstruum until the Hamamelis Leaves are exhausted; reserve the first *seventeen fluid ounces* (Imp. meas.) or eight hundred and fifty cubic centimetres of the percolate; remove the alcohol from the remainder by distillation; evaporate the residue to a soft extract; dissolve this in the reserved portion; add sufficient menstruum to produce *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.*

This is a fluidextract which well represents the virtues of witchhazel. It has a dark reddish-brown color.

Dose, half a fluidrachm (1.8 Cc.).

Off. Prep.—Unguentum Hamamelidis, *Br.*

FLUIDEXTRACTUM HYDRASTIS. U. S. (Br.)

FLUIDEXTRACT OF HYDRASTIS [Extractum Hydrastis Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm hȳ-drăs'tĭs)

Extractum Hydrastis Liquidum, *Br.;* Liquid Extract of Hydrastis; Fluidextract of Golden Seal; Extrait liquide de Hydrastis, *Fr.;* Extractum Hydrastis fluidum, *P. G.;* Hydrastis-Fluidextrakt; Flüssiges Hydrastisextrakt, *G.;* Estratto di idraste liquido, *It.;* Extracto fluido de hidrastis, *Sp.*

* "Hydrastis, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol and *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol to *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, until the Hydrastis is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of hydrastine in the remainder of the liquid; add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 2 Gm. of hydrastine." *U. S.*

Assay. U. S. (8th Rev.).—"Fluidextract of Hydrastis, *ten cubic centimeters;* Distilled Water, Potassium Iodide, Ammonia Water, Ether, each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Hydrastis by means of a graduated pipette to a 100 Cc. measuring flask, add 85 Cc. of distilled water in which 2 Gm. of potassium iodide have been previously dissolved, and sufficient water to make 100 Cc., and shake the liquid for several minutes. Then filter 50 Cc. of the liquid into a measuring cylinder and transfer it to a separator. Render the liquid alkaline with ammonia water, add 30 Cc. of ether, and shake the separator at intervals during several minutes. When separated, draw off the aqueous layer into a beaker, and the ether-solution into a tared beaker. Return the aqueous solution to the separator, and shake it with 20 Cc. more of ether for one minute. Draw off and reject the aqueous layer, and run the ether-solution into the tared beaker. Allow the combined ether-solutions to evaporate at a gentle heat, and dry the residue in the beaker to a constant weight on a water-bath. Multiply the weight by 20, which will give the weight in grammes of hydrastine contained in *one hundred cubic centimeters* of Fluidextract of Hydrastis." *U. S.*

"Hydrastis Rhizome, in No. 60 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (45 per cent.), *a sufficient quantity.* Moisten the powdered Hydrastis with about *eight fluid ounces* (Imp. meas.) or four hundred cubic centimetres of the Alcohol; pack the damp powder in a percolator; pour on sufficient menstruum to saturate it thoroughly; when the liquid begins to drop, close the lower orifice of the percolator; set aside for forty-eight hours; then allow percolation to proceed, gradually adding menstruum until the Hydrastis is exhausted; reserve the first *seventeen fluid ounces* (Imp. meas.) or eight hundred and fifty cubic centimetres of the percolate; remove the alcohol from the remainder by distillation; evaporate the residue to a soft extract; dissolve this in the reserved portion; add sufficient menstruum to produce *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.*

The fluidextract thoroughly represents the drug. It is of a deep brownish-yellow color.

Dose, from fifteen minims to one fluidrachm (0.9 to 3.75 Cc.).

FLUIDEXTRACTUM HYOSCYAMI. U. S.

FLUIDEXTRACT OF HYOSCYAMUS [Extractum Hyoscyami Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm hȳ-ŏs-cȳ'ă-mī)

Extrait liquide de Jusquiame, *Fr.;* Flüssiges Bilsenkrautextrakt, *G.*

* "Hyoscyamus, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Hyoscyamus is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *fifty cubic centimeters* of this liquid, as directed below; from the results thus obtained, ascertain by calculation the amount of the alkaloids in the remainder of the liquid; add to this enough menstruum to make each *one hundred cubic centi-*

meters of the finished Fluidextract contain 0.075 Gm. of the alkaloids from Hyoscyamus." *U. S.*

Assay of Fluidextract of Hyoscyamus. U. S. (8th Rev.).—"The method to be employed is identical with that given for Fluidextract of Belladonna Root, using *fifty cubic centimeters* of Fluidextract of Hyoscyamus, instead of the quantity of Fluidextract of Belladonna Root there directed, and multiplying the product by 2 instead of 10." *U. S.*

This fluidextract was improved in the 1880 revision by abandoning the glycerin directed in the former process. It is of a very dark greenish-brown color. For the medicinal properties, see *Hyoscyamus.*

Dose, from five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Extractum Hyoscyami, *U. S.*

FLUIDEXTRACTUM IPECACUANHÆ. U. S. (Br.)

FLUIDEXTRACT OF IPECAC [Extractum Ipecacuanhæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm Ip-ē-căc-ū-ăn'hæ)

"A Liquid Extract containing 2 to 2¼ grains of the alkaloids of Ipecacuanha Root in 110 minims (2 to 2.25 grammes in 100 cubic centimetres)." *Br.*

Extractum Ipecacuanhæ Liquidum, *Br.;* Liquid Extract of Ipecacuanha; Extrait liquide d'Ipécacuanha, *Fr.;* Flüssiges Ipecacuanhaextrakt, *G.*

* "Ipecac, in No. 80 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Ipecac is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of the alkaloids in the remainder of the liquid; add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 1.75 Gm. of the alkaloids from Ipecac." *U. S.*

Assay of Fluidextract of Ipecac. U. S. (8th Rev.)—"Fluidextract of Ipecac, *ten cubic centimeters;* Ammonia Water, Ether, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Ipecac by means of a graduated pipette to a porcelain evaporating dish. Evaporate off the alcohol with the aid of a water-bath, and, when almost cool, add 5 Cc. of normal sulphuric acid V.S., and stir the liquid at intervals for three minutes. Filter the liquid into a separator, rinse the dish, and wash the filter successively with 10 Cc. and 5 Cc. of distilled water, and add these liquids to the separator. To the separator add 20 Cc. of ether and a small piece of red litmus paper; render the liquid alkaline with ammonia water and shake the separator for one minute. Draw off the aqueous layer into a beaker, and the ether-layer into another beaker. Return the aqueous solution to the separator, add 10 Cc. more of ether, and shake the liquid, adding the ether-solution to that already in the beaker, and returning the aqueous solution to the separator; repeat the extraction with 10 Cc. more of ether, and then add the ether-layer to that already in the beaker. Allow the combined ether-solutions to evaporate, either spontaneously or with the aid of a water-bath containing warm water, and then add 10 Cc. of tenth-normal sulphuric acid V.S. Stir the liquid carefully with a glass rod to facilitate the solution of the alkaloids, and when these have all dissolved, add 5 drops of hematoxylin T.S. From a graduated burette, add sufficient fiftieth-normal potassium hydroxide V.S. to just cause the yellow color of the solution to turn purple. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 10 (the 10 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0238, and this product by 10, which will give the weight in grammes of alkaloids contained in each *one hundred cubic centimeters* of Fluidextract of Ipecac." *U. S.*

"Ipecacuanha Root, in No. 20 powder, 1 *pound* (Imperial) or 800 grammes; Calcium Hydroxide, 700 *grains* (Imp.) or 80 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Moisten the powdered Ipecacuanha Root with *six fluid ounces* (Imp. meas.) or three hundred cubic centimetres of the Alcohol; pack firmly in a percolator; add more of the Alcohol, and when the liquid begins to drop, close the lower orifice of the percolator; set aside for twenty-four hours. Then percolate slowly until *thirteen and a half fluid ounces* (Imp. meas.) or six hundred and seventy-five cubic centimetres have been collected; reserve this portion. Continue percolation until nothing more is ex-

tracted; drain well. Mix the Lime with the marc; allow them to remain in contact for twenty-four hours; then continue percolation until exhaustion is complete. Recover the alcohol from the last two percolates by distillation; dissolve the residual extract in the reserved portion of percolate.

Determine the proportion of alkaloids in the resulting strong liquid extract by the following analytical process:

Dilute 20 cubic centimetres with an equal bulk of *water*. Remove the alcohol by the aid of a water-bath; add to the warm solution an excess of *solution of lead subacetate*. Filter; wash the precipitate with water and add the washings to the filtrate. Remove the excess of lead from the filtrate by precipitation with *diluted sulphuric acid;* filter; wash the precipitate with water and add the washings to the filtrate. Transfer the filtrate to a separator; add excess of *solution of ammonia* and agitate with 25 cubic centimetres of *chloroform*. Separate and set aside the chloroformic solution. Twice repeat the agitation with chloroform, and the separation. Mix the chloroformic solutions; evaporate; dry at a temperature below 176° F. (80° C.), and weigh the residue of total alkaloids.

From this weight calculate the amount of alkaloids in the bulk of strong liquid extract, and add to the latter sufficient Alcohol (90 per cent.) to produce Liquid Extract of Ipecacuanha containing not less than 2 and not more than 2.25 grammes of alkaloid in 100 cubic centimetres, or from 2 to 2¼ grains in 110 minims." *Br.*

The menstruum for the U. S. fluidextract was altered in the U. S. P. 1890 and the proportions then adopted are retained in the Eighth Revision; it was proved by J. U. Lloyd that when alcohol alone is used a portion of emetine escapes solution. On the other hand, it is known that when the menstruum is more aqueous large amounts of the pectinous principles are taken up, and it is very desirable to separate these in order to prevent their appearance as a flocculent precipitate in syrup of ipecac; but efficiency is to be sought for as the first desideratum, and hence a menstruum which will extract the activity and make a fluidextract that will not let fall a bulky precipitate of inert matter has been secured; usually this will not mix with syrup without slight precipitation, but the improved official process for syrup of ipecac should effectually separate any precipitate resulting from the presence of apotheme in the fluidextract.[1] The British liquid extract (1898) is a new preparation and is standardized; the excellent researches of Paul and Cownley on ipecac, and the assay work of Kremel, Keller, and others, undoubtedly prompted the introduction of the process for the liquid extract. (See *Ipecacuanha.*) It will probably be found, however, that the U. S. menstruum is preferable. An *acetic extract of ipecac* (*dry*) is used in Great Britain; it has been shown that the heating necessary to dry it is injurious to its emetic properties. (*P. J.*, 1895, 158.)

This fluidextract is a thin, dark reddish-brown, transparent liquid, of a bitterish slightly acrid taste, but without the nauseous flavor of the root. It is a convenient preparation for adding to expectorant and diaphoretic mixtures, and is used officially principally in preparing the syrup of ipecac.[2]

Dose, as emetic, fifteen to thirty minims (0.9 to 1.8 Cc.); as an expectorant, one to two minims (0.06 to 0.12 Cc.).

Off. Prep.—Acetum Ipecacuanhæ, *Br.;* Mistura Rhei et Sodæ, *U. S.;* Syrupus Ipecacuanhæ, *U. S.;* Tinctura Ipecacuanhæ et Opii, *U. S.;* Vinum Ipecacuanhæ, *U. S., Br.*

FLUIDEXTRACTUM KRAMERIÆ. U. S.

FLUIDEXTRACT OF KRAMERIA [Extractum Krameriæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm krą-mē'rĭ-æ)

Fluidextract of Rhatany; Extrait liquide de Ratanhia, *Fr.;* Flüssiges Ratanhiaextrakt, Ratanhiawurzel-fluidextrakt, *G.*

* "Krameria, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical glass percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Krameria is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This process does not differ essentially from that formerly official except in the absence of glycerin from the menstruum; the fluidextract well represents the root, and has a deep red color and a very astringent taste.

Dose, from ten minims to a fluidrachm (0.6 to 3.75 Cc.).

Off. Prep.—Syrupus Krameriæ, *U. S.*

[1] R. Rother recommends alcohol for a menstruum and the use of magnesia, and the percolation of the finely powdered ipecac upon what he calls the disc principle. (*D. C.*, 1886, p. 4.)

[2] For discussion of the alkaloidal strength of ipecac and its fluidextract, by H. W. Snow, see *Ph. Era,* 1887.

FLUIDEXTRACTUM LAPPÆ. U. S.

FLUIDEXTRACT OF LAPPA [Extractum Lappæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm lăp'pæ)

Fluidextrakt of Burdock Root; Extrait liquide de Bardane, *Fr.*; Flüssiges Klettenwurzelextrakt, *G.*

• "Lappa, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Lappa is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The official fluidextract of burdock is of a dark brownish-red color.

Dose, thirty to sixty minims (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM LEPTANDRÆ. U. S.

FLUIDEXTRACT OF LEPTANDRA [Extractum Leptandræ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm lĕp-tăn'dræ)

Fluidextract of Culver's Root; Extrait liquide de Leptandra, *Fr.*; Flüssiges Leptandraextrakt, *G.*

• "Leptandra, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Leptandra is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a fluidextract of a reddish-brown color.

Dose, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.).

Off. Prep.—Extractum Leptandræ, *U. S.*

FLUIDEXTRACTUM LOBELIÆ. U. S.

FLUIDEXTRACT OF LOBELIA

(flū-ĭd-ĕx-trăc'tŭm lo-bē'lĭ-æ)

Extrait liquide de Lobélie enflée, *Fr.*; Flüssiges Lobelienkrautextrakt, Flüssiges Lobelienextrakt, *G.*

• "Lobelia, in No. 50 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *two hundred and seventy-five cubic centimeters* [or 9 fluidounces, 143 minims] of Acetic Acid with *seven hundred and twenty-five cubic centimeters* [or 24 fluidounces, 247 minims] of Water, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Acetic Acid and Water as before, until the Lobelia is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract differs from that of the U. S. P. 1890 [1] in that the menstruum instead

[1] "Lobelia, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 400 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Lobelia is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

of being diluted alcohol, is acetic acid, diluted with 3 volumes of water; the acetic menstruum is well adapted for exhausting the drug.

This is a valuable fluidextract. It is of a dark olive color, having the acrid taste of lobelia very marked.

Dose, as an expectorant, from one to five minims (0.06 to 0.3 Cc.); as an emetic, from ten to twenty minims (0.6 to 1.3 Cc.).

FLUIDEXTRACTUM LUPULINI. U. S.

FLUIDEXTRACT OF LUPULIN [Extractum Lupulini Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm lū-pū-lī'nī)

Extrait liquide de Lupulin, *Fr.;* Flüssiges Lupulinextrakt, *G.*

* "Lupulin, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Pack the Lupulin firmly in a cylindrical percolator; then add enough Alcohol to saturate the Lupulin and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Lupulin is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is of a very dark brown color, having the odor and taste of hops very distinctly. Owing to its resinous character, it is not miscible with aqueous liquids, and if desired in combination it is necessary to use gum arabic or other emulsifying agent.

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

FLUIDEXTRACTUM MATICO. U. S.

FLUIDEXTRACT OF MATICO [Extractum Matico Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm măt'ĭ-cō)

Extrait liquide de Matico, *Fr.;* Flüssiges Maticoblätterextrakt, *G.*

* "Matico, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Matico is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is probably the best liquid preparation of matico; the present formula does not differ materially from that of 1870. It is a greenish-black liquid, which probably contains all of the virtues of matico, and affords an excellent form for internal administration.

Dose, from one-half to one fluidrachm (1.9 to 3.75 Cc.).

FLUIDEXTRACTUM MEZEREI. U. S.

FLUIDEXTRACT OF MEZEREUM [Extractum Mezerei Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm mĕ-zē'rē-ī)

Extrait liquide de Mézéréon (de Garou), *Fr.;* Flüssiges Seidelbastextrakt, *G.*

* "Mezereum, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Mezereum is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is identical with that formerly official. It is too acrid for internal ad-

ministration; its principal use is as the active ingredient in the stimulating ointment of mezereon which is still used.

FLUIDEXTRACTUM NUCIS VOMICÆ. U. S. (Br.)

FLUIDEXTRACT OF NUX VOMICA [Extractum Nucis Vomicæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm nū'cīs vŏm'ĭ-çæ)

"A Liquid Extract containing 1½ grains of Strychnine in 110 minims (1.5 grammes in 100 cubic centimetres)." *Br.*

Extractum Nucis Vomicæ Liquidum, *Br.*; Liquid Extract of Nux Vomica; Extrait liquide de Noix-Vomique, *Fr.*; Flüssiges Krähenaugen-Extrakt, F. Brechnussextrakt, F. Strychnossamenextrakt, *G.*

* "Nux Vomica, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Alcohol, Water, each, *a sufficient quantity*, to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix Alcohol and Water in the proportion of *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol, and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Moisten the powder with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of the mixture, to which the Acetic Acid had previously been added, and let it digest, in a well-covered vessel, in a warm place, during forty-eight hours. Then pack it in a cylindrical glass percolator, gradually pour menstruum upon it, and allow the percolation to proceed slowly until the Nux Vomica is practically exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of strychnine in the remainder of the liquid; add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 1 Gm. of strychnine." *U. S.*

Assay. U. S. (8th Rev.)—"Fluidextract of Nux Vomica, *ten cubic centimeters;* Ammonia Water, Ether, Chloroform, Distilled Water, Normal Sulphuric Acid V.S., Sulphuric Acid Solution (3 percent. H_2SO_4), Sodium Hydroxide Solution (1 in 10), Nitric Acid (sp. gr. 1.40), Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Iodeosin T.S., each, *a sufficient quantity*. Transfer 10 Cc. of Fluidextract of Nux Vomica by means of a graduated pipette to a porcelain dish, evaporate it to dryness with the aid of a water-bath, and dissolve the residue, while warm, in a mixture of 16 Cc. of ether, 5 Cc. of chloroform, and 4 Cc. of ammonia water, and transfer the solution to a separator, rinsing the dish with a little chloroform, which is to be added to the separator, and shake the separator carefully for a few minutes. When the fluids have separated, draw off the aqueous layer into another separator, wash the chloroform-ether liquid and separator with a little water, and add this to the second separator. Then shake the aqueous liquid with two successive portions of 15 and 10 Cc., respectively, of chloroform, and add these to the first separator. If a small portion of the liquid left in the second separator still shows, after acidifying, a reaction with mercuric potassium iodide T.S., repeat the shaking out with 10 Cc. more of chloroform. Now shake the combined liquids in the first separator with three successive portions, respectively, of 15, 10, and 10 Cc. of normal sulphuric acid V.S., and collect the combined acid solutions in another separator.

To this acid solution add a small piece of red litmus paper, and sufficient ammonia water to render it alkaline, then shake out successively with three portions, respectively, of 25, 10, and 10 Cc. of chloroform, and collect the chloroform solutions in a beaker. Evaporate the chloroform with the aid of a water-bath, dissolve the alkaloidal residue in 15 Cc. of 3 percent. sulphuric acid solution, by the aid of a water-bath, and allow the liquid to cool. To this solution add 3 Cc. of a cooled mixture of equal volumes of nitric acid (specific gravity 1.40) and distilled water, and, after rotating the liquid a few times, set it aside for exactly ten minutes, stirring it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10), wash the beaker three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not quite turbid, add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter, wetted with chloroform, into a flask. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the flask, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath, very carefully, to avoid decrepitation. To the alkaloidal residue add 10 Cc. of tenth-normal sulphuric acid V.S., 5 drops of iodeosin T.S., about 80 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., until the aqueous liquid just turns pink. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. taken, by 5, subtract this number from 10 (the 10 Cc.

of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.0332, and this product by 10, which will give the weight in grammes of strychnine contained in *one hundred cubic centimeters* of the Fluidextract of Nux Vomica." *U. S.*

"Moisten *one pound* (Imperial) or five hundred grammes of Nux Vomica, in No. 20 powder, with *eight fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of Alcohol (70 per cent.); set aside in a covered vessel for six hours; pack firmly in a percolator; pour over the powder sufficient of the menstruum to saturate it and to leave a stratum above it; when the liquid begins to flow, close the lower orifice; set aside for twenty-four hours; continue slow percolation, adding more menstruum as required, until *twelve fluid ounces* (Imp. meas.) or three hundred and seventy-five cubic centimetres have been collected; reserve this strong percolate. Change the receiver; continue the percolation until about *sixty fluid ounces* (Imp. meas.) or eighteen hundred and seventy-five cubic centimetres of the menstruum have been employed, or until the powder is exhausted; press the marc; add the expressed liquid to the weaker percolate; remove the alcohol by distillation; evaporate the residue to *one fluid ounce* (Imp. meas.) or thirty-one cubic centimetres; add *three fluid ounces* (Imp. meas.) or ninety-three cubic centimetres of Alcohol (90 per cent.). Add this mixture to the reserved portion; set aside for twenty-four hours; pour off the clear liquid; filter the remainder.

Determine the proportion of Strychnine in the resulting strong liquid extract by the following analytical process:

Evaporate 10 cubic centimetres to a thick syrupy consistence on a water-bath; dissolve the residue in 20 cubic centimetres of *water,* heating if necessary; place the solution in a separator, and add 5 grammes of *sodium carbonate* dissolved in 25 cubic centimetres of *water,* together with 10 cubic centimetres of *chloroform;* agitate thoroughly; set aside; separate the clear chloroformic solution. Twice repeat the agitation with *chloroform,* and the separation. Mix 6 cubic centimetres of *diluted sulphuric acid* with 25 cubic centimetres of *water;* divide this into three parts, and shake the mixed chloroformic solutions with each in turn. Dilute the united acid liquids with *water* to 175 cubic centimetres; transfer to a stoppered flask, adding 25 cubic centimetres of *solution of potassium ferrocyanide;* shake well and frequently during half an hour; allow to stand for 6 hours. Transfer the precipitate to a small filter, rinsing out the last portions with *water* containing one-fortieth of its volume of *diluted sulphuric acid,* and wash until the washings are free from bitterness. Rinse the precipitate into a separator. Add 5 cubic centimetres of *solution of ammonia,* and shake well; then add 15 cubic centimetres of *chloroform* in two successive portions, shaking well after each addition; separate the chloroformic solutions, mix and allow the *chloroform* to evaporate in a counterpoised dish in a current of warm air; dry the residue for 1 hour on a water-bath, covering the dish to avoid loss of Strychnine from decrepitation; weigh.

From this weight calculate the amount of Strychnine in the strong liquid extract, and add to the latter sufficient Alcohol (70 per cent.) to produce a Liquid Extract of Nux Vomica containing 1.5 grammes of Strychnine in 100 cubic centimetres, or 1½ grains in 110 minims." *Br.*

This fluidextract has been retained principally with the view of giving the pharmacist an accurately adjusted liquid preparation of nux vomica which is more concentrated than the tincture. The process of assay is practically the same as that for the extract. The British assay process is based on that recommended by Dunstan and Short (*P. J.,* 1884, 623). The menstruum has been carefully selected so that the alkaloids shall be extracted and as much of the oil left in the residue as possible. In order to make a dry powdered extract it would be necessary to separate the fixed oil before assaying it, and then to make up the weight, if necessary, with sugar of milk or some inert, soluble powder. An important advantage, aside from that of securing uniformity and safety, is that the operator need not carry the percolation beyond the point at which it ceases to be profitable (on account of the waste of alcohol), because the extract must be brought to a definite alkaloidal strength. Such an extract can be used with great advantage to make tincture of nux vomica of definite alkaloidal strength.

Dose, from one to three minims (0.06 to 0.2 Cc.).

Off. Prep.—Tinctura Nucis Vomicæ, *Br.;* Extractum Nucis Vomicæ, *Br.*

FLUIDEXTRACTUM PAREIRÆ. U. S. (Br.)

FLUIDEXTRACT OF PAREIRA [Extractum Pareiræ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm pą-rei'ræ)

Extractum Pareiræ Liquidum, *Br.;* Liquid Extract of Pareira; Extrait liquide de Pareira Brava, *Fr.;* Flüssiges Pareiraextrakt, *G.*

* "Pareira, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol and *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in

a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol to *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water until the Pareira is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Add to Pareira Root, in No. 40 powder, rather more than an equal bulk of boiling Distilled Water and set aside for twenty-four hours; then pack in a percolator and pass boiling Distilled Water slowly until the percolate amounts to about ten times the weight of the Pareira Root, or until the latter is exhausted. Ascertain the proportion of extractive matter in the percolate by evaporating a small weighed quantity in a counterpoised dish on a water-bath to a firm consistence, and weighing the product. Then evaporate the bulk of the percolate until the residual liquid contains one-third of its weight of such extractive matter; mix with this residual liquid sufficient Alcohol (90 per cent.) to produce from three volumes of the evaporated liquid four volumes of Liquid Extract of Pareira. Filter, or otherwise clarify, if necessary." *Br.*

The former British preparation was a concentrated solution of the extract, preserved by adding somewhat less than one-fourth of its measure of alcohol. There must be considerable loss through the action of the heat in evaporating the extract, and again through precipitation, due to attempting to dissolve an aqueous extract in a hydro-alcoholic menstruum. The present liquid extract (1898) is made by percolating the powdered root with boiling water; the process does not state how boiling distilled water is to be passed slowly, and the inference is that it is only intended that boiling water should be poured on the drug; no provision is made to prevent rapid cooling; it would probably be best to use a jacketed percolator, the space being filled with steam or hot water, if hot percolation is intended. The U. S. fluidextract is made directly from the drug, with a mixture of alcohol, water and glycerin, and is undoubtedly the better preparation.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM PHYTOLACCÆ. U. S.

FLUIDEXTRACT OF PHYTOLACCA [Extractum Phytolaccæ Radicis Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm phī-tŏ-lăc'çæ)

Fluidextract of Pokeroot; Extrait liquide de Phytolaque (racine), *Fr.;* Flüssiges Kermesbeerenwurzelextrakt, *G.*

• "Phytolacca, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Phytolacca is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was first made official in the U. S. P. 1890.

Dose, as an alterative, from one to five minims (0.06 to 0.3 Cc.), as an emetic, fifteen to thirty minims (0.9 to 1.8 Cc.).

FLUIDEXTRACTUM PILOCARPI. U. S. (Br.)

FLUIDEXTRACT OF PILOCARPUS [Extractum Pilocarpi Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm pī-lō-cär'pī)

Extractum Jaborandi Liquidum, *Br.,* Liquid Extract of Jaborandi; Fluidextract of Jaborandi; Extrait liquide de Jaborandi, *Fr.;* Flüssiges Jaborandiextrakt, *G.*

• "Pilocarpus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for

forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Pilocarpus is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid by the process given below; from the results thus obtained, ascertain by calculation the amount of alkaloids in the remainder of the liquid; add to this enough menstruum to make each *one hundred cubic centimeters* of Fluidextract contain 0.4 Gm. of the alkaloids from Pilocarpus." *U. S.*

Assay. U. S. (8th Rev.)—"Fluidextract of Pilocarpus, *ten cubic centimeters;* Chloroform, Ammonia Water, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Cochineal T.S. or Iodeosin T.S., each, *a sufficient quantity.* Transfer 10 Cc. of Fluidextract of Pilocarpus by means of a graduated pipette to a porcelain dish containing a little clean sand, and evaporate it to dryness with the aid of a water-bath. Mix the sand uniformly with the extract and transfer the mixture to an Erlenmeyer flask of about 100 Cc. capacity, rinsing the dish with a mixture of 25 Cc. of chloroform and 2.5 Cc. of ammonia water. Transfer the rinsings to the flask, cork it securely, and shake it well at intervals during one hour. Decant the liquid, transfer to a separator, wash the sand with several portions of chloroform, draw off and filter the chloroformic liquid into another separator. Then shake out the chloroform solution with 15 Cc. of normal sulphuric acid V.S., transferring the acid aqueous solution to another separator. Repeat the shaking out with a mixture of 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, collecting the acid solutions in the second separator. Again repeat the shaking out with 10 Cc. of distilled water, and add the aqueous liquid to the second separator. Introduce into the second separator a small piece of red litmus paper, add enough ammonia water to render the liquid alkaline, and shake out the liquid with 20 Cc. of chloroform, drawing off the chloroformic solution into a beaker. Repeat the shaking out with two portions of 15 and 10 Cc. each of chloroform, and add the chloroformic solutions to the beaker. Evaporate the chloroform by means of a water-bath, and dissolve the alkaloidal residue in 8 Cc. of tenth-normal sulphuric acid V.S. Add 5 drops of cochineal T.S. or iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 8 (the 8 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.02, and this product by 10, to obtain the weight in grammes of alkaloids contained in *one hundred cubic centimeters* of the Fluidextract of Pilocarpus." *U. S.*

"Jaborandi Leaves, in No. 20 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (45 per cent.), *a sufficient quantity.* Moisten the powdered Jaborandi Leaves with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; pack the moistened powder in a percolator, and set aside for twelve hours; then percolate with the menstruum, collecting and reserving *seventeen fluid ounces* (Imp. meas.) or eight hundred and fifty cubic centimetres of percolate; continue percolation until an additional quantity of *fifty fluid ounces* (Imp. meas.) or two and a half litres of percolate is obtained; distil the latter so as to recover the alcohol, evaporate the residual aqueous liquid to the consistence of a soft extract, adding it to the reserved percolate; to the product add sufficient of the Alcohol to produce *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.*

This preparation represents jaborandi leaves thoroughly. Of the liquid preparations of the drug, the infusion and tincture are both open to objection, the former on account of the bulkiness of the dose, and the latter because of the amount of alcohol it contains.

Dose, from fifteen minims to half a fluidrachm (0.9 to 1.8 Cc.).

FLUIDEXTRACTUM PODOPHYLLI. U. S.

FLUIDEXTRACT OF PODOPHYLLUM [Extractum Podophylli Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm pŏd-ǫ-phĭl'lī)

Fluidextract of May Apple or Mandrake; Extrait liquide de Podophylle, *Fr.;* Flüssiges Fussblattwurzelextrakt, Flüssiges Podophyllumextrakt, *G.*

* "Podophyllum, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportion of Alcohol and Water as before, until the Podophyllum is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of

the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a fluidextract which well represents the root, but is of very little use, since podophyllum is much better administered in other forms.

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

FLUIDEXTRACTUM PRUNI VIRGINIANÆ. U. S.

FLUIDEXTRACT OF WILD CHERRY [Extractum Pruni Virginianæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm prū'nī vīr-gĭn-ĭ-ā'næ)

Extrait liquide d'Ecorce de Cerisier de Virginie, *Fr.;* Flüssiges Wildkirschenrindenextrakt, *G.*

• "Wild Cherry, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol and *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours; then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol to *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Water, and allow the percolation to proceed very slowly, until the Fluidextract measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This preparation has been practically more troublesome than any of the other fluidextracts. We had first Procter's original process, then his modified one, in which almonds were used to supply emulsin to assist in the development of hydrocyanic acid. (See U. S. D., 15th edition, p. 637.) This was abandoned as too cumbersome in 1870, and we had the glycerin experiment. The fluidextract of 1870 deposited heavily soon after being made. The present formula is the result of much careful work on the part of the Committee, and it is believed to be an improvement over all its predecessors.[1] J. M. Good (*Proc. A. Ph. A.*, 1897, 220) prefers repercolation, with a menstruum composed of one volume each of glycerin and alcohol and three volumes of water; each portion of drug is moistened with a mixture of one part of glycerin and two parts of water. It is of a very dark wine color, of a rough astringent taste, with a decided odor and taste of hydrocyanic acid.

Dose, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM QUASSIÆ. U. S.

FLUIDEXTRACT OF QUASSIA [Extractum Quassiæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm quäs'sĭ-æ)

Extrait liquide de Quassie, *Fr.;* Flüssiges Quassiaextrakt, *G.*

• "Quassia, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Quassia is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is an active preparation. The British "Liquor Quassiæ Concentratus" is

[1] *Fluidextract of Wild Cherry* (Improved).—This process is advocated by Cyrus M. Boger, who states that all of the hydrocyanic acid is developed, tannin is excluded as much as possible, and consequently precipitation is reduced to the lowest point. "Take of Ground Wild Cherry Bark, *ten troyounces;* Water and Alcohol, each, *ten fluidounces;* Glycerin, *four fluidrachms.* Moisten the bark with *ten fluidounces* of water and put loosely in the percolator, close tightly, and allow it to macerate sixty hours; then pack very firmly, mix the *ten fluidounces* of alcohol and *four* of glycerin and pour it upon the bark; now cork up the percolator tightly and macerate twenty-four hours longer; at the expiration of this time remove the cork, and about *twelve fluidounces* of percolate will come through; water should now be poured on to force the other four fluidounces out, when the percolation should be stopped and the product will be finished." (*A. J. P.*, 1887, pp. 231, 232.)

made with alcohol (20 per cent.) as a menstruum and has one-tenth the strength of the U. S. fluidextract.

Dose, from five to ten minims (0.3 to 0.6 Cc.).

FLUIDEXTRACTUM QUERCUS. U. S.

FLUIDEXTRACT OF QUERCUS

(flū-ĭd-ĕx-trăc'tŭm quĕr'cŭs)

Fluidextract of White Oak Bark; Extrait liquide d'Ecorce de Chêne, *Fr.;* Flüssiges Eichenrindenextrakt, *G.*

* "Quercus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Diluted Alcohol, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Quercus is exhausted. Reserve the first *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was admitted to the U. S. P. (8th Rev.) for the first time. It represents the virtues of oak bark.

Dose, fifteen minims to one fluidrachm (0.9 to 3.75 Cc.).

FLUIDEXTRACTUM QUILLAJÆ. U. S.

FLUIDEXTRACT OF QUILLAJA

(flū-ĭd-ĕx-trăc'tŭm quĭl-lā'jæ)

Fluidextract of Soap Bark; Extrait liquide d' Ecorce de Quillaya, *Fr.;* Flüssiges Seifenrindenextrakt, *G.*

* "Quillaja, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Quillaja is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was admitted to the U. S. P. (8th Rev.) for the first time. It represents the soluble principles from quillaja.

Dose, three to ten minims (0.2 Cc. to 0.6 Cc.).

FLUIDEXTRACTUM RHAMNI PURSHIANÆ. U. S. (Br.)

FLUIDEXTRACT OF CASCARA SAGRADA

[Extractum Rhamni Purshianæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm rhăm'nī pür-shī-ā'næ)

Extractum Cascaræ Sagradæ Liquidum, *Br.;* Liquid Extract of Cascara Sagrada; Extrait liquide de Cascara Sagrada, *Fr.;* Flüssiges Cascara-Sagradaextrakt, *G.*

* "Cascara Sagrada, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, until the Cascara Sagrada is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Cascara Sagrada, in No. 20 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (90 per cent.), 4 *fl. ounces* (Imp. meas.) or 200 cubic centimetres; Distilled Water, *a sufficient quantity.* Moisten the Cascara Sagrada with *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the Distilled Water, and set the mixture aside for six hours;

then place it loosely in a percolator and percolate with more of the Distilled Water until the powder is exhausted; evaporate the percolate to *twelve fluid ounces* (Imp. meas.) or six hundred cubic centimetres; add the Alcohol, previously mixed with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of Distilled Water or with sufficient to make up the volume of the mixed liquids to *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Liquid Extract." *Br.* This process has been improved by the adoption of percolation in the Br. Ph. 1898 in place of evaporating decoctions, and preserving the residue with alcohol.

This fluidextract is a good preparation, but the aromatic fluidextract is more largely used.

Dose, fifteen minims to one fluidrachm (0.9 to 3.75 Cc.).

Off. Prep.—Syrupus Cascaræ Aromaticus, *Br.*

FLUIDEXTRACTUM RHAMNI PURSHIANÆ AROMATICUM. U. S.

AROMATIC FLUIDEXTRACT OF CASCARA SAGRADA

(flū-ĭd-ĕx-trăc'tŭm rhăm'nī pŭr-shī-ā'næ ăr-ō-măt'ĭ-cŭm)

Tasteless Fluidextract of Cascara Sagrada; Extrait liquide Aromatique de Cascara Sagrada, *Fr.;* Bitterloses flüssiges Cascara-Sagradaextrakt, *G.*

• "Cascara Sagrada, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycyrrhiza, in No. 30 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Magnesium Oxide, *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]; Glycerin, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Compound Spirit of Orange, *ten cubic centimeters* [or 162 minims]; Alcohol, Diluted Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Cascara Sagrada, Glycyrrhiza, and Magnesium Oxide thoroughly, and, having added *two thousand cubic centimeters* [or 67 fluidounces, 301 minims] of Water, allow the mixture to macerate for twelve hours, and then dry it at a gentle heat. Mix the Glycerin with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the powder is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, add the Compound Spirit of Orange and enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [1] [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This aromatic fluidextract was introduced into the U. S. P. (8th Rev.) for the first time. It is given as a laxative, the object of the addition of magnesium oxide is to destroy the bitter taste of the cascara sagrada. Lime is sometimes used instead of magnesia but it has been shown that lime acts injuriously upon the laxative principles of cascara sagrada. The fluidextract is very largely used.

Dose, fifteen minims to one fluidrachm (0.9 to 3.75 Cc.).

FLUIDEXTRACTUM RHEI. U. S.

FLUIDEXTRACT OF RHUBARB [Extractum Rhei Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm rhē'ī)

Extrait liquide de Rhubarbe, *Fr.;* Flüssiges Rhabarberextrakt, *G.*

• "Rhubarb, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Rhubarb is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and evaporate the remainder, at a temperature not

[1] *Aromatic Fluidextract of Cascara Sagrada* (bitterless).—L. C. Urban prefers lime to magnesia, as suggested by H. B. Gilpin, for making a palatable preparation of cascara. His process is as follows: 1000 Gm. ground cascara sagrada, 150 Gm. ground licorice root, and 100 Gm. freshly slaked lime are kneaded with 1000 Cc. of water, allowed to stand twelve hours, and then dried at 50° C. The dried drugs are moistened with 400 Cc. of a menstruum made by mixing 500 Cc. alcohol and 250 Cc. glycerin with 250 Cc. water, and percolated with sufficient of the menstruum, followed by water, to exhaust the drug. The first 850 Cc. are reserved, then mixed with the balance of the percolate, evaporated to a soft extract, and 12 Cc. of compound spirit of orange added. (*Ph. Rev.,* 1896, 270.)

exceeding 70° C. (158° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

Although the process for the fluidextract of rhubarb of U. S. P. 1870 was an improvement on its predecessors, on the addition of water the fluidextract precipitated heavily, so that syrups or mixtures made with it were very unsightly. As the chief use of the fluidextract is in making such preparations, this was very unfortunate, and constituted sufficient grounds for the abandonment of this formula in favor of one which will exhaust the root of its purgative properties and yet yield a preparation that will remain clear when water is added to it. Geo. Bille claims that all that is necessary is to exhaust the sixteen troyounces of rhubarb with cold water, evaporate, by means of a water-bath, to twelve fluidounces, and add four fluidounces of glycerin. The present process affords a fluidextract which thoroughly represents the root, but it has in a degree the same objection that the former preparation had, immiscibility with syrups and water, with loss of transparency. An alkali or an alkaline carbonate dissolves this precipitate, but the use of the fluidextract is limited. The British "Liquor Rhei Concentratus" is made with alcohol (20 per cent.) as a menstruum and is one-half the strength of the U. S. fluidextract of rhubarb.

Dose, for an adult, as a purgative, twenty to thirty minims (1.3 to 1.8 Cc.); as a laxative, from five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Extractum Rhei, *U. S.;* Mistura Rhei et Sodæ, *U. S.;* Syrupus Rhei, *U. S.*

FLUIDEXTRACTUM RHOIS GLABRÆ. U. S.

FLUIDEXTRACT OF RHUS GLABRA [Extractum Rhois Glabræ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm rhō'ĭs glā'bræ)

Fluidextract of Sumach Berries; Extrait liquide de fruit de Sumac, *Fr.;* Flüssiges Sumachbeerenextrakt, *G.*

* "Rhus Glabra, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Diluted Alcohol, and, having moistened the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Rhus Glabra is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

A formula for this preparation was proposed by J. P. Remington (*A. J. P.,* 1874, p. 7) which differs from that at present official merely in containing a somewhat larger proportion of glycerin in the menstruum. Experience has shown that this is a valuable preparation of sumach berries, and is a useful addition to mouth and throat washes, gargles, etc.

Dose, ten to twenty minims (0.6 to 1.3 Cc.).

FLUIDEXTRACTUM ROSÆ. U. S.

FLUIDEXTRACT OF ROSE [Extractum Rosæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm rō'zæ)

Fluidextract of Red Rose; Extrait liquide de Rose rouge, *Fr.;* Flüssiges Essigrosenblumenblätterextrakt, *G.*

* "Red Rose, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Diluted Alcohol, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and afterwards Diluted Alcohol, until the Red Rose is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and evaporate the remainder, in a porcelain dish, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is a useful adjuvant and an elegant astringent. It is of a deep red color, with the agreeable flavor of rose. Wm.

C. Alpers prefers repercolation for this fluidextract, stating that even a moderate heat imparts an unpleasant odor to the finished product. (*Proc. A. Ph. A.*, 1897, 425.)

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

Off. Prep.—Mel Rosæ, *U. S.*; Syrupus Rosæ, *U. S.*

FLUIDEXTRACTUM RUBI. U. S.

FLUIDEXTRACT OF RUBUS [Extractum Rubi Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm rū'bī)

Fluidextract of Blackberry Bark; Extrait liquide d'Ecorce de Ronce, *Fr.*; Flüssiges Brombeerrindenextrakt, *G.*

• "Rubus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Rubus is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract does not differ essentially from that formerly official. It is a very dark reddish-brown, translucent fluid, having the properties of the root in a marked degree.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Syrupus Rubi, *U. S.*

FLUIDEXTRACTUM SABINÆ. U. S.

FLUIDEXTRACT OF SAVIN [Extractum Sabinæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm sa̤-bī'næ)

Extrait liquide de Sabine, *Fr.*; Flüssiges Sadebaumspitzenextrakt, *G.*

• "Savin, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Savin is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is identical with the fluidextract formerly official. It is a dark greenish-black fluid, not mixing well with aqueous liquids without the use of an emulsifying agent. It is rarely given internally.

Dose, from three to eight minims (0.2 to 0.5 Cc.).

FLUIDEXTRACTUM SANGUINARIÆ. U. S.

FLUIDEXTRACT OF SANGUINARIA

(flū-ĭd-ĕx-trăc'tŭm săn-gŭ̇-nā'rĭ-æ)

Fluid Extract of Bloodroot; Extrait liquide de Sanguinaire, *Fr.*; Flüssiges Blutwurzelextrakt, *G.*

• "Sanguinaria, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *two hundred and seventy-five cubic centimeters* [or 9 fluidounces, 143 minims] of Acetic Acid with *seven hundred and twenty-five cubic centimeters* [or 24 fluidounces, 247 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, allow it to macerate, in a well-covered vessel, during forty-eight hours. Then pack it firmly in a cylindrical glass percolator, gradually pour menstruum upon it, using the same proportions of Acetic Acid and Water as before, and allow the percolation to proceed slowly, until the Sanguinaria is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The liquid preparations of sanguinaria all have an unfortunate tendency to precipitate, and this fluidextract will not prove an exception, although the acetic acid used as a menstruum will have a tendency to prevent pre-

cipitation. It is of a very deep red color. The process for the U. S. P. 1890 fluidextract is appended.[1]

Dose, from one to five minims (0.06 to 0.3 Cc.).

FLUIDEXTRACTUM SARSAPARILLÆ. U. S. (Br.)

FLUIDEXTRACT OF SARSAPARILLA [Extractum Sarsaparillæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm sär-są-pą-rĭl'læ)

Extractum Sarsæ Liquidum, *Br.;* Liquid Extract of Sarsaparilla; Liquor Sarsæ; Extrait liquide de Salsepareille, *Fr.;* Flüssiges Sarsaparillaextrakt, *G.*

* "Sarsaparilla, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Sarsaparilla is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Sarsaparilla, in No. 40 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (20 per cent.), *a sufficient quantity;* Glycerin, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres. Divide the Sarsaparilla into three portions. Moisten one portion with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol; pack in a percolator; set aside for twenty-four hours; percolate with the Alcohol until a quantity of *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres is obtained. Moisten the second portion of the drug with this liquid; pack in a percolator; set aside for twenty-four hours; percolate with a menstruum obtained by further percolation of the first portion; continue until a quantity of *four fluid ounces* (Imp meas.) or two hundred cubic centimetres is obtained. Moisten the third portion of the drug with this liquid; pack in a percolator; set aside for twenty-four hours; percolate with a menstruum obtained by successive percolation through the first and second portions as directed above; collect *eighteen fluid ounces* (Imp. meas.) or nine hundred cubic centimetres from the third percolator; add the Glycerin. The product should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The British Pharm. (1898) has greatly improved the process for this preparation, having abandoned maceration for repercolation; glycerin is used as a preservative, being added to the reserved portion; the reason for not using the glycerin in the first percolate to aid in the extraction is not apparent. The introduction of a simple fluidextract of sarsaparilla into our Pharmacopœias was judicious, as it enables the physician to associate this medicine with others at his pleasure, and in such proportions as he may deem expedient. He may rely upon the efficiency of the preparation, if made with sufficient care and skill and from good parcels of the root. The U. S. fluidextract is a somewhat dense, scarcely translucent liquid, of a very dark reddish-brown color, and of a sweetish and a slightly acrid taste.

Dose, of U. S. fluidextract, from thirty to sixty minims (1.8 to 3.75 Cc.); as given in the British Pharmacopœia, from two to four fluidrachms (7.5 to 15 Cc.).

Off. Prep.—Syrupus Sarsaparillæ Compositus, *U. S.*

FLUIDEXTRACTUM SARSAPARILLÆ COMPOSITUM. U. S.

COMPOUND FLUIDEXTRACT OF SARSAPARILLA [Extractum Sarsaparillæ Fluidum Compositum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm sär-są-pą-rĭl'læ cŏm-pŏs'ĭ-tŭm)

Extrait liquide de Salsepareille composé, *Fr.;* Zusammengesetztes flüssiges Sarsaparillaextrakt, *G.*

* "Sarsaparilla, in No. 30 powder, *seven hundred and fifty grammes* [or 26 ounces av., 199 grains]; Glycyrrhiza, in No. 30 powder, *one hundred and twenty grammes* [or 4 ounces av., 102 grains]; Sassafras, in No. 30 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Mezereum, in No. 30 powder,

[1] "Sanguinaria, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix Alcohol and Water in the proportion of *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, to which the Acetic Acid had previously been added, and let it macerate, in a well-covered vessel, in a warm place, during forty-eight hours. Then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the Sanguinaria is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

thirty grammes [or 1 ounce av., 25 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Diluted Alcohol, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Diluted Alcohol, and, having moistened the mixed powders with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then Diluted Alcohol, until the powder is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

Everything depends in the process upon having the several ingredients equably powdered, mixing them well and duly moistening them, and then packing them properly in the percolator. The moistening of the mixed powders is more easily effected, as they are less disposed to form lumps than is the sarsaparilla powder alone. The preparation is intended to represent, in a concentrated state, the compound decoction of sarsaparilla, having all its ingredients with the exception of the guaiacum wood, which probably adds little to the efficacy of the decoction. It was originally proposed by Wm. Hodgson, Jr. (*A. J. P.*, ii. 285), and the official process differs from his mainly in the omission of the guaiacum wood, the resin of which, separating during the evaporation, somewhat embarrassed the process, without adding to the virtues of the extract. The British "Liquor Sarsæ Compositus Concentratus" is of the same strength as the fluidextract of the U. S. Pharmacopœia, and is made with a menstruum of distilled water with 225 Cc. of alcohol as a preservative in 1000 Cc. of finished solution.

Dose, from thirty minims to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM SCILLÆ. U. S.

FLUIDEXTRACT OF SQUILL

(flū-ĭd-ĕx-trăc'tŭm sçĭl'læ)

Extrait liquide de Scille, *Fr.;* Flüssiges Meerzwiebelextrakt, *G.*

• "Squill, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Acetic Acid, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *two hundred and seventy-five cubic centimeters* [or 9 fluidounces, 143 minims] of Acetic Acid with *seven hundred and twenty-five cubic centimeters* [or 24 fluidounces, 247 minims] of Water, and, having added *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the mixture to the powder, allow it to macerate, in a well-covered glass or porcelain vessel, during forty-eight hours, then transfer it to a conical glass percolator, and allow the percolation to proceed slowly, adding menstruum gradually, using the same proportions of Acetic Acid and Water as before, until the Fluidextract measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* The process of the U. S. P. 1890 is appended.[1]

This fluidextract is made with a diluted acetic acid menstruum (1 to 3). The only objection to the menstruum is that it makes a very thick fluidextract and the percolation is slow, but the solvent powers of the acetic acid are remarkable. J. U. Lloyd recommended diluted acetic acid for a menstruum, and that this fluidextract should be made half strength,—*i.e.*, 2 Cc. represent 1 Gm. (See *Am. Drug.*, 1886, p. 202.)

Dose, from two to three minims (0.12 to 0.2 Cc.).

Off. Prep.—Syrupus Scillæ Compositus, *U. S.*

FLUIDEXTRACTUM SCOPOLÆ. U. S.

FLUIDEXTRACT OF SCOPOLA

(flū-ĭd-ĕx-trăc'tŭm scō-pō'læ)

Extrait liquide de Racine de Scopola, *Fr.;* Flüssiges Skopolawurzelextrakt, *G.*

• "Scopola, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with

[1] "Squill, in No. 20 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of the mixture, pack it in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Squill is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

three hundred and fifty cubic centimeters [or 11 fluidounces, 401 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Scopola is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid as directed below; from the result thus obtained, ascertain by calculation the amount of mydriatic alkaloids in the remainder of the liquid, and add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 0.5 Gm. of the mydriatic alkaloids from Scopola." *U. S.*

Assay. U. S. (8th Rev.)—"The method to be employed is identical with that given for Fluidextract of Belladonna Root, using *ten cubic centimeters* of Fluidextract of Scopola." *U. S.*

This fluidextract was made official for the first time in the U. S. P. (8th Rev.). It may be used for the same purposes as fluidextract of belladonna root.

Dose, from one to three minims (0.06 to 0.2 Cc.).

Off. Prep.—Extractum Scopolæ, *U. S.*

FLUIDEXTRACTUM SCUTELLARIÆ. U. S.

FLUIDEXTRACT OF SCUTELLARIA [Extractum Scutellariæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm scū-tĕl-lā'rĭ-æ)

Fluidextract of Skullcap; Extrait liquide de Scutellaire, *Fr.;* Flüssiges Helmkrautextrakt, *G.*

* "Scutellaria, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Scutellaria is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract thoroughly represents the activity of scutellaria. It is of a dark greenish-brown color.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM SENEGÆ. U. S.

FLUIDEXTRACT OF SENEGA [Extractum Senegæ Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm sĕn'ē-gæ)

Extrait liquide de Polygale de Virginie, Extrait liquide de Sénéca, *Fr.;* Flüssiges Senegaextrakt, *G.*

* "Senega, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Solution of Potassium Hydroxide, *thirty cubic centimeters* [or 1 fluidounce, 7 minims], Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Solution of Potassium Hydroxide with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol and *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol to *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, until the Senega is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, in a porcelain dish, to a soft extract; dissolve this in the reserved portion, and add enough of the last-mentioned mixture of Alcohol and Water to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

Formerly, Fluidextract of Senega was very frequently the cause of annoyance to the pharmacist through gelatinization. This was due to the presence of pectinous bodies in the root. The addition of a fixed alkali to the menstruum effectually prevents this, and in this respect the present preparation is a great improvement over the 1890 fluidextract. It is a blackish-brown, moderately thin liquid. For other processes, see *N. R.,* 1883, pp. 195, 196. The British

"Liquor Senegæ Concentratus" is made half the strength of the U. S. fluidextract with a menstruum composed of 2 parts of 20 per cent. alcohol and 1 part of 45 per cent. alcohol.

Dose, from five to twenty minims (0.3 to 1.3 Cc.).

Off. Prep.—Syrupus Scillæ Compositus, *U. S.;* Syrupus Senegæ, *U. S.*

FLUIDEXTRACTUM SENNÆ. U. S.

FLUIDEXTRACT OF SENNA [Extractum Sennæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm sĕn'næ)

Extrait liquide de Séné, *Fr.;* **Flüssiges Sennaextrakt,** *G.*

* "Senna, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Diluted Alcohol, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Alcohol, pack it firmly in a cylindrical percolator, and percolate it with Alcohol until the Senna is exhausted. The alcoholic percolate thus obtained is to be rejected. Remove the powder from the percolator, dry it, and, having moistened it with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Senna is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The official fluidextract of senna of 1870 differed materially from that of the Pharmacopœias of 1850 and 1860, containing neither sugar, oil of fennel, nor Hoffmann's anodyne. It was deemed better to leave to the prescriber the choice of the volatile oil, and to depend for the preservation of the fluidextract upon the glycerin and what might remain of the alcohol after the evaporation. The U. S. P. 1890 fluidextract, which was practically identical with of the U. S. P. 1880, is very different from that of 1870, which contained 50 per cent. of glycerin. There was no glycerin in the menstruum of 1890, and there really seems to be no occasion for its use. The U. S. P. (8th Rev.) process provides for the elimination of the griping principles by the previous percolation of the powdered senna with alcohol; diluted alcohol is then used to exhaust the drug of the purgative principles. The fluidextract is a dark, blackish, thick, and somewhat turbid liquid, with a strong flavor of senna. It is well adapted for exhibition with saline cathartics, such as Epsom salt or cream of tartar, which also obviate its griping. In this case not more than one-half of the full dose of the fluidextract should be given at once.

The British "Liquor Sennæ Concentratus" is more like a concentrated infusion than a fluidextract, but has the same strength of the latter, the menstruum is distilled water; tincture of ginger and alcohol being added.

Dose, from one-half to two fluidrachms (1.8 to 7.5 Cc.) for an adult.

Off. Prep.—Syrupus Sarsaparillæ Compositus, *U. S.;* Syrupus Sennæ, *U. S.*

FLUIDEXTRACTUM SERPENTARIÆ. U. S.

FLUIDEXTRACT OF SERPENTARIA [Extractum Serpentariæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm sĕr-pĕn-tā'rĭ-æ)

Fluidextract of Virginia Snake Root; Extrait liquide de Serpentaire, *Fr.;* **Flüssiges Schlangenwurzelextrakt,** *G.*

* "Serpentaria, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Serpentaria is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This, though simply a concentrated tincture, is a good preparation, containing the virtues of the root within a small bulk. The fluidextract of serpentaria originated with J. C. Savery, whose formula was published in the eleventh edition of the U. S. Dispensatory (page 713). It was afterwards modified by A. B. Taylor (*A.*

J. P., xxv. 206). In the present preparation the alcoholic strength of menstruum is slightly less than that of the fluidextract of U. S. P. 1870. The fluidextract is thin, reddish brown, and transparent, having the peculiar bitterness and odor of the root in perfection. The British "Liquor Serpentariæ Concentratus" is half the strength of the U. S. fluidextract, the menstruum being alcohol (20 per cent.).

Dose, twenty to thirty minims (1.3 to 1.8 Cc.).

FLUIDEXTRACTUM SPIGELIÆ. U. S.

FLUIDEXTRACT OF SPIGELIA [Extractum Spigeliæ Fluidum, Pharm. 1890]

(flû-ĭd-ĕx-trăc'tŭm spĭ-gē'lĭ-æ)

Fluidextract of Pink Root; Extrait liquide de Spigélie, *Fr.*; Flüssiges Spigelienextrakt, *G.*

* "Spigelia, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Spigelia is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This preparation differs from that official prior to 1890 in having no glycerin in the menstruum; the U. S. P. 1870 fluidextract had 50 per cent.

The fluidextract of spigelia is a dark-brown translucent liquid, with the flavor of the root. The dose may be repeated morning and evening for three or four days, and then followed by a brisk cathartic. It is, however, most used in connection with the fluidextract of senna, the fluidextract of spigelia and senna formerly official being an excellent combination, which should not have been dropped from the Pharmacopœia.[1]

[1] *Extractum Spigeliæ et Sennæ Fluidum*, U. S. 1870. *Fluid Extract of Spigelia and Senna.*—"Take of Fluid Extract of Spigelia *ten fluidounces;* Fluid Extract of Senna, *six fluidounces;* Oil of Anise, Oil of Caraway, each, *twenty minims.* Mix the Fluid Extracts, and dissolve the Oils in the mixture." *U. S.* 1870.

It combines the cathartic property of senna with the anthelmintic virtues of pinkroot, and is a very good vermifuge, being generally acceptable to the stomach, and not offensive to the taste. The dose is from two fluidrachms to half a fluidounce (7.5 to 15 Cc.) for an adult, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.) for a child two years old.

Dose, for an adult, from one to two fluidrachms (3.75 to 7.5 Cc.); for a child of two or three years, from ten to twenty minims (0.6 to 1.3 Cc.).

FLUIDEXTRACTUM STAPHISAGRIÆ. U. S.

FLUIDEXTRACT OF STAPHISAGRIA

(flû-ĭd-ĕx-trăc'tŭm stăph-ĭ-să'grĭ-æ)

Fluidextract of Stavesacre Seed; Extrait liquide des Semences de Staphisaigre, *Fr.*; Flüssiges Stephanskörnerextrakt, *G.*

* "Staphisagria, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Staphisagria is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was first made official in the U. S. P. (8th Rev.). Mixed with alcohol and ether, it is used as an external application to destroy lice.

FLUIDEXTRACTUM STILLINGIÆ. U. S.

FLUIDEXTRACT OF STILLINGIA [Extractum Stillingiæ Fluidum, Pharm. 1890]

(flû-ĭd-ĕx-trăc'tŭm stĭl-lĭn'gĭ-æ)

Extrait liquide de Stillingie, *Fr.*; Flüssiges Stillingiaextrakt, *G.*

* "Stillingia, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid

begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Stillingia is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The glycerin in the menstruum has been abandoned in this fluidextract, which is of a dark reddish-brown color.

Dose, from fifteen to forty-five minims (0.9 to 2.8 Cc.).

FLUIDEXTRACTUM STRAMONII. U. S.

FLUIDEXTRACT OF STRAMONIUM

(flū-ĭd-ĕx-trăc'tŭm strā-mō'nĭ-ī)

Extrait liquide de Feuilles de Stramoine, *Fr.;* Flüssiges Stechapfelblätterextrakt, *G.*

• "Stramonium, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Stramonium is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and mix thoroughly. Assay *ten cubic centimeters* of this liquid, as directed below; from the results thus obtained, ascertain by calculation the amount of mydriatic alkaloids in the remainder of the liquid, and add to this enough menstruum to make each *one hundred cubic centimeters* of the finished Fluidextract contain 0.35 Gm. of the mydriatic alkaloids from Stramonium." *U. S.*

Assay. U. S. (8th Rev.)—"The method to be employed is identical with that given for Fluidextract of Belladonna Root, using *ten cubic centimeters* of Fluidextract of Stramonium." *U. S.*

This is a fluidextract the menstruum of which is well adapted for thoroughly exhausting the drug. Stramonium leaves are now used instead of stramonium seed, for making the fluidextract, which is of a dark brown color.

Dose, from one to two minims (0.06 to 0.12 Cc.).

Off. Prep.—Extractum Stramonii, *U. S.*

FLUIDEXTRACTUM SUMBUL. U. S.

FLUIDEXTRACT OF SUMBUL

(flū-ĭd-ĕx-trăc'tŭm sŭm'bŭl)

Fluidextract of Muskroot; Extrait liquide de Sumbul, *Fr.;* Flüssiges Sumbulwurzelextrakt oder Moschuswurzelextrakt, *G.*

• "Sumbul, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Sumbul is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was made official for the first time in the U. S. P. (8th Rev.), superseding the tincture of sumbul, to which it is superior.

Dose, half a fluidrachm to one fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Extractum Sumbul, *U. S.*

FLUIDEXTRACTUM TARAXACI. U. S. (Br.)

FLUIDEXTRACT OF TARAXACUM [Extractum Taraxaci Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm tă-răx'ă-cī)

Extractum Taraxaci Liquidum, *Br.;* Liquid Extract of Taraxacum; Fluidextract of Dandelion; Extrait liquide de Pissenlit, *Fr.;* Flüssiges Löwenzahnwurzelextrakt, *G.*

• "Taraxacum, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Solution of Sodium Hydroxide, *fifty cubic*

centimeters [or 1 fluidounce, 331 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol, until the Taraxacum is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, add the Solution of Sodium Hydroxide, and enough Diluted Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Taraxacum Root, dried, in No. 20 powder, 20 *ounces* (Imperial) or 1000 grammes; Alcohol (60 per cent.), 2 *pints* (Imp. meas.) or 2000 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the powdered Taraxacum Root with the Alcohol; set aside in a closed vessel for forty-eight hours; press out *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of liquid; set the latter aside; mix the pressed residue with *two pints* (Imp. meas.) or two thousand cubic centimetres of the Distilled Water; set aside for forty-eight hours; press out and strain the liquid; evaporate to about *ten* [*fluid*] *ounces* (Imp. meas.) or five hundred cubic centimetres; mix the two liquids; if necessary make up the volume to *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres by the addition of Distilled Water; filter." *Br.* It is to be regretted that the Br. Pharm. (1898) did not adopt percolation for this preparation, as it can be practiced here with great success.

The activity depends more upon the proper selection of the root than upon anything else. The addition of a small quantity of solution of sodium hydroxide increases the efficiency of the fluidextract. The process of exhausting the drug is not difficult, and one of the best tests of this fluidextract is its bitter taste. It is a blackish, moderately thick liquid.

Dose, from one to three fluidrachms (3.75 to 11.25 Cc.).

FLUIDEXTRACTUM TRITICI. U. S.

FLUIDEXTRACT OF TRITICUM [Extractum Tritici Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm trĭt'ĭ-cī)

Fluidextract of Couch-grass Root; Extrait liquide de petit Chiendent, *Fr.;* Flüssiges Queckenwurzelextrakt, *G.*

* "Triticum, finely cut, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Pack the Triticum in a cylindrical metallic percolator, pour boiling Water upon it, and allow the percolation to proceed, supplying boiling Water, as required, until the Triticum is exhausted. Evaporate the percolate to *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims], and, having added to it *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Alcohol, mix well and set it aside for forty-eight hours. Then filter the liquid and add to the filtrate enough of a mixture of Alcohol and Water made in the proportion of *one volume* of Alcohol to *three volumes* of Water to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

In making this fluidextract in warm weather, it is advisable to *commence* evaporating the percolate before the drug is exhausted, or fermentation may set in; triticum contains fermentable sugars, and diluted aqueous solutions do not keep well.

This fluidextract is a valuable preparation. The German Pharmacopœia directed an *Extractum Graminis,* by digesting 1 part of Triticum with 6 parts of hot water, for six hours, straining, evaporating to a syrup, mixing 1 part of this extract with 4 parts of cold distilled water, filtering, and evaporating to an extract. The fluidextract is preferable, as the excessive use of heat is avoided.

Dose, from three to six fluidrachms (11.25 to 22.5 Cc.).

FLUIDEXTRACTUM UVÆ URSI. U. S.

FLUIDEXTRACT OF UVA URSI [Extractum Uvæ Ursi Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm ū'væ ür'sī)

Extrait liquide de Busserole, *Fr.;* Flüssiges Bärentraubenblätterextrakt, *G.*

* "Uva Ursi, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *three hundred cubic centimeters* [or 10 fluidounces, 69 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol and *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding, first, the remainder

of the menstruum, and afterwards a mixture of Alcohol and Water, made in the proportion of *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol to *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water, until the Uva Ursi is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough of the mixture of Alcohol and Water to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This preparation is a dense, black liquid, of a sweet, bitterish, astringent, but not very disagreeable taste.

Dose, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM VALERIANÆ. U. S.

FLUIDEXTRACT OF VALERIAN [Extractum Valerianæ Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm vă-lē-rĭ-ā'næ)

Extrait liquide de Valériane, *Fr.;* Flüssiges Baldrianextrakt, *G.*

* "Valerian, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it firmly in a cylindrical percolator, then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Valerian is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a concentrated tincture, strong both in alcohol and in the virtues of valerian. It is probable that all or nearly all the volatile ingredients of the root are extracted by the reserved portion which first passes, and which, not being exposed to evaporation, loses none of the volatile oil and acid that have been dissolved, while the soluble matter subsequently extracted, consisting chiefly of the fixed principles, will not be dissipated by the concentration ordered. The fluidextract may therefore be considered as fully representing the virtues of the root. The formula is, with some modification, that of Grahame (*A. J. P.,* xxi. 379). The preparation is a dark brownish-red liquid, transparent in thin layers, with the odor and taste of valerian.

Dose, thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM VERATRI. U. S.

FLUIDEXTRACT OF VERATRUM [Extractum Veratri Viridis Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm vĕ-rā'trī)

Fluidextract of American Hellebore; Extrait liquide de Vératre américain, *Fr.;* Flüssiges Grüngermerextrakt, *G.*

* "Veratrum, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Veratrum is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is the best preparation of veratrum and thoroughly represents the drug.

Dose, one to two minims (0.06 to 0.12 Cc.).

FLUIDEXTRACTUM VIBURNI OPULI. U. S.

FLUIDEXTRACT OF VIBURNUM OPULUS [Extractum Viburni Opuli Fluidum, Pharm. 1890]

(flū-ĭd-ĕx-trăc'tŭm vī-bŭr'nī ŏp'ū-lī)

Fluidextract of Cramp Bark; Flüssiges Schneeballrindenextrakt, *G.*

* "Viburnum Opulus, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms].

Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Viburnum Opulus is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract was first introduced into the U. S. P. 1890: there seems to be little necessity for two fluidextracts of viburnum.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM VIBURNI PRUNIFOLII. U. S.

FLUIDEXTRACT OF VIBURNUM PRUNIFOLIUM [Extractum Viburni Prunifolii Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm vī-bŭr'nī prū-nĭ-fō'lī-ī)

Fluidextract of Black Haw; Extrait liquide de Viburne, *Fr.;* Flüssiges Viburnumextrakt, *G.*

* "Viburnum Prunifolium, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Viburnum Prunifolium is exhausted. Reserve the first *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a fluidextract which well represents the drug. It is of a dark reddish-brown color.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM XANTHOXYLI. U. S.

FLUIDEXTRACT OF XANTHOXYLUM [Extractum Xanthoxyli Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm xăn-thŏx'y-lī)

Fluidextract of Prickly Ash; Extrait liquide d'Ecorce de Clavalier, *Fr.;* Flüssiges Zahnwehrindenextrakt, *G.*

* "Xanthoxylum, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, and, having moistened the powder with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Xanthoxylum is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract thoroughly represents the virtues of the drug.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

FLUIDEXTRACTUM ZINGIBERIS. U. S.

FLUIDEXTRACT OF GINGER [Extractum Zingiberis Fluidum, Pharm. 1890]

(flū-id-ĕx-trăc'tŭm zĭn-gĭb'ĕ-rĭs)

Extrait liquide de Gingembre, *Fr.;* Flüssiges Ingwerextrakt, *G.*

* "Ginger, in No. 50 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *two hundred and fifty cubic centimeters* [or 8 fluid-

ounces, 218 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Ginger is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This fluidextract is a highly concentrated alcoholic solution of the active principles of ginger. It is transparent, and of a reddish color.

Dose, from ten to twenty minims (0.6 to 1.3 Cc.).

Off. Prep.—Syrupus Zingiberis, *U. S.*

FŒNICULUM. U. S. (Br.)

FENNEL

(fœ-nĭc'ŭ-lŭm)

"The dried, nearly ripe fruit of *Fœniculum vulgare* Miller (Fam. *Umbelliferæ*)." *U. S.* "The dried ripe fruit of Fœniculum capillaceum, *Gilib.*, collected from cultivated plants." *Br.*

Fœniculi Fructus, *Br.;* Semen Fœniculi, Fennel Fruit (Seed), Sweet Fennel Fruit; Fenouill doux (Fruit), *Fr. Cod.;* Fruits (Semences) de Fenouil, *Fr.;* Fructus Fœniculi, *P. G.;* Fenchel, Fenchelsamen, *G.;* Finocchio, *It.;* Hinojo, *Sp.*

The plant producing fennel seed was attached by Linnæus to the genus *Anethum,* but was separated from it by De Candolle, and placed, with three or four others, in a new genus styled *Fœniculum,* which has been generally adopted by botanists. The *Anethum Fœniculum* of Linnæus embraced two varieties, the *common* or *wild fennel,* and the *sweet fennel,* the latter being the plant usually cultivated in the gardens of Europe. These are considered by De Candolle as distinct species, and named respectively *Fœniculum vulgare* and *Fœniculum dulce,* but the correctness of the opinion of the great Swedish botanist is now generally admitted.

Fœniculum vulgare, De Cand., *Prodrom.* iv. 142.—*F. capillaceum,* Gilib., *Fl. Lithuan.* iv. 1782.—*Anethum Fœniculum,* Linn.—*Fœniculum Fœniculum* (L.), Karst., Britton and Brown.—*F. officinale,* All.—*Meum Fœniculum,* Spreng.—*Common Fennel* has a biennial or perennial tapering root, and an annual, erect, round, striated, smooth, green, and copiously branching stem, which usually rises three or four feet in height. The leaves, which stand alternately at the joints of the stem, upon membranous striated sheaths, are many times pinnate, with long, linear, pointed, smooth, deep-green leaflets. The flowers are in large, flat, terminal umbels, with from thirteen to twenty rays, and destitute both of general and partial involucres. The corolla consists of five petals, which, as well as the stamens, are golden yellow. The fruit is ovate, rather less than two lines in length by about a line in breadth, and of a dark color, especially in the channels. The plant is a native of Europe, growing wild upon sandy and chalky ground throughout the continent, and is also abundant in Asia, possibly extending as far as China. The variety *F. officinale* of Mérat and De Lens is chiefly characterized by its fruit being twice as long as is that of the ordinary plant, and also a little curved, of a less dark color, with prominent ridges, and a persistent peduncle. It is sweeter and more aromatic than is common fennel seed. In India fennel is said to be obtained from *F. panmorium,* D.C., which is probably, however, only a variety of the official plant. Sicilian fennel is affirmed to be the fruit of *F. piperitum.*

F. dulce, De Cand., *Prodrom.* iv. 142.—*Sweet Fennel* bears a general resemblance to *F. vulgare,* but differs in having its stem somewhat compressed at the base, its radical leaves somewhat distichous, and the number of rays in the umbel only from 6 to 8. It is also a much smaller plant, being only about a foot high; its flowers appear earlier, and its young sweet shoots or turiones are eaten in Italy boiled or as a salad. According to Index Kewensis it is identical with *F. vulgare.*

The roots of fennel were formerly employed in medicine, but are generally inferior in virtues to the fruit, which is now the only portion recognized by either the U. S. or British Pharm. It is stated that manufacturers of the oil usually distil the whole plant. Commerce is partly supplied from the product of our own gardens; but much the larger portion of the medicine is imported from Europe, and chiefly, we have been informed, from Germany. During the winter of 1879 much of the seed in the German market was adulterated with fennel seed partially deprived of its oil. The fennel seed cultivated here is sweeter and more aromatic than that from abroad, probably in consequence of its greater freshness. Fennel seeds[1] (half fruits) are oblong oval, from one to three or four lines in length, flat on one side, convex on the other, not infrequently connected by their flat surfaces, straight or slightly curved, brownish or of a dark grayish-green color, with five prominent, obtuse, yellowish

[1] L. R. Stowell states that the centres of the prominent ridges of fennel fruit are small vascular bundles, surrounded by large clear cells, of which those near the vascular bundles are elongated and narrow, while those more distant are irregular in shape and have large oval communicating openings.

ribs or ridges on the convex surface. On section the vittæ, or oil tubes, are seen to be very well developed and to be situated one between each pair of ridges and two upon the flat face of each mericarp. "Mericarps usually separated, each 4 to 10 Mm. long, and 2 to 3 Mm. broad, more or less curved, with five prominent, light-colored primary ribs, otherwise smooth, yellowish- or brownish-green; pericarp containing an oil-tube between each two ribs, and two upon the flat side; odor and taste aromatic, anise-like." *U. S.* There are eight chief varieties of fennel known to European commerce, the fruits differing very much in size and considerably in taste. The table below, which was originally compiled by J. C. Umney, is sufficiently complete for the purposes of identification of these different varieties.

Schimmel & Co.'s Semi-Annual Report for April, 1897, gives as additional varieties of fennel—Aleppo, oil amounting to 0.75 per cent.; Macedonian, 3.4 to 3.8 per cent.; Moravian, 3 per cent.; Milanese, 4.2 per cent.; Roumanian, 4.6 per cent.; Spanish, amount not stated; and Syrian (Damascus), 1.6 per cent. Of these, the Syrian may be the same as that called Persian by Umney, and the Roumanian the same as that called Russian. Several additional varieties are also mentioned by Umney (*P. J.*, 58 (1897), p. 226), who states that the European varieties were almost entirely displaced by the East Indian seed and that the latter would probably be supplanted by the Japanese variety.

The odor of fennel seed is fragrant, its taste warm, sweet, and agreeably aromatic. It yields its virtues to hot water, but more freely to alcohol. The essential oil may be separated by distillation with water. (See *Oleum Fœniculi.*) From 960 parts of the seed Neumann obtained 20 parts of volatile and 120 of fixed oil.

Uses.—Fennel seed was used by the ancients. It is one of our most grateful aromatics, and in this country is much employed as a carminative, and as a corrigent of other less pleasant medicines, particularly senna and rhubarb. It is recommended for these purposes by the absence of any highly excitant property. An infusion may be prepared by introducing two or three drachms of the seeds into a pint of boiling water. In infants the infusion is frequently employed as an enema for the expulsion of flatus.

Dose, of the bruised or powdered seeds, twenty grains to half a drachm (1.3 to 2.0 Gm.).

Off. Prep.—Aqua Fœniculi, *U. S.* (from oil), *Br.;* Infusum Sennæ Compositum, *U. S.;* Pulvis Glycyrrhizæ Compositus, *Br.*

FRANGULA. U. S.

FRANGULA [Buckthorn]

(frăn'gŭ-lą)

"The dried bark of *Rhamnus Frangula* Linné (Fam. *Rhamnaceæ*), collected at least one year before being used." *U. S.*

Rhamni Frangulæ Cortex, *Br.* (1885); Frangula Bark; Alder Buckthorn; Ecorce de Bourdaine, Bourgène, *Fr.;* Cortex Frangulæ, *P. G.;* Faulbaumrinde, *G.;* Corteccia di frangola, *It.*

R. Frangula, Linn., *B. & T.* 65.—*Frangula vulgaris,* Reichb.—*F. Alnus,* Mill.—The *Alder Buckthorn* is an erect glabrous shrub from ten to fifteen feet high, without thorns, with broadly ovate obtuse leaves, with the margins entire or slightly sinuate, the under side sometimes slightly downy, and the rather numerous lateral veins diverging equally almost from the whole length of the midrib. Flowers all hermaphrodite, two or three together in each axil, with the calyx teeth, petals, and stamens in fives. Fruit dark purple, the size of a pea. This plant grows in hedges and bushy places throughout Europe and Russian Asia, except in the far north.

It is probable that most of the species of the genus Rhamnus have cathartic properties. An article upon *R. Purshiana* will be found elsewhere, as it is official in both of the Pharmacopœias. The *R. catharticus,* Linn., or common buckthorn, grows in Europe along with the official species, and has become naturalized in this country. Its bark is probably often sold for the official article. It is distinguished by its more spreading, thorny habit, and its diœcious flowers, which are thickly clustered in the axils and have their parts in fours. The leaves also are more acute, have their margins

Fennel Fruits.

Variety.	Average Length.	Average Length of Vittæ in Transverse Section.	Average Breadth of Vittæ in Transverse Section.	Percentage of Oil.	Odor and Taste of Oil.
	Mm.	Mm.	Mm.		
1. French (sweet) . . .	7 to 8	.11	.04 to .05	2.1	Sweet, anise-like, and fatty.
2. French (bitter) . . .	4 to 5	.18 to .2	.07 to .08	Not distilled	. . . . .
3. German (Saxon) . . .	8 to 10	.2 to .22	.07 to .08	4.7	Sweet and very camphoraceous.
4. Indian	6 to 7	.1	.03 to .04	.72	Sweet and anise-like.
5. Russian	4 to 5	.2	.04 to .05	4.8	Very camphoraceous.
6. Galician	5 to 6	.2 to .22	.08 to .10	4.4	Very camphoraceous.
7. Persian	6 to 7	.15	.05	1.7	Sweet and anise-like.
8. Japanese	3 to 4	.15 to .16	.07 to .08	2.7	Very sweet and camphoraceous.

finely serrate and their lateral veins mostly proceeding from the proximal half of the midrib. The fruit is black.[1]

Properties.—This bark is officially described as "in quills of variable length, frequently flattened or crushed; bark 0.3 to 1 Mm. thick, externally grayish-brown to purplish-black, with numerous lenticels and occasional patches of foliaceous lichens; inner surface smooth, minutely striated, brownish-yellow to deep brown; fracture short and of a purplish tint in the outer layer, fibrous and pale yellow in the inner layer; odor distinct; taste somewhat aromatic, sweetish, and bitter; when chewed, imparting to the saliva a yellow color. The powder should be free from stone cells, and the fragments are colored reddish by sodium hydroxide T.S." *U. S.*

According to Schrenk (*Am. Drug.*, April, 1887), the bark of *Rhamnus Frangula* can be distinguished from that of *R. Purshiana* (*Cascara Sagrada*) by the absence of the irregular angular sclerenchymatous cells, which in *R. Purshiana* are wedged together in large compact groups, increasing in size and number towards the surface, and causing the short fracture of the outer bark.

It is not certainly known which of the several bodies isolated from frangula bark is the purgative principle. The most important body, *frangulin*, the *rhamnoxanthin* ($C_{20}H_{20}O_{10}$) of Buchner and Binswanger, may be obtained by Phipson's process by macerating the bark for three or four days in carbon disulphide, then permitting the liquid to evaporate, exhausting the residue with alcohol, which leaves the fatty matter behind, evaporating the alcoholic liquid to dryness, and recrystallizing from ether. As thus obtained it is in fine yellow crystals, melting at about 226° C. (438.8° F.), and subliming in golden-yellow needles. It is insoluble in water, soluble in 160 parts of warm 80 per cent. alcohol, nearly insoluble in cold alcohol, soluble in hot fixed oils, petroleum benzin, and oil of turpentine. It communicates its color to cotton, silk, and wool. Faust (*A. Pharm.*, 187, 8) first proved the glucosidal character of frangulin by boiling it in alcoholic solution with hydrochloric acid, obtaining glucose and *frangulinic acid*, $C_{14}H_8O_4$. This forms fine microscopic needles of reddish color, fusing at 248° to 250° C. Liebermann and Waldheim (*Ber. d. Chem. Ges.*, 9, p. 1775) obtained in this decomposition instead of frangulinic acid *emodin*, $C_{15}H_{10}O_5$, which they consider to be trioxymethylanthraquinone. Frangulinic acid, on the other hand, would be a dioxyanthraquinone and an isomer of alizarin. Schwabe, in 1888, also found that *emodin* and *rhamnodulcite* were the decomposition products of *frangulin*, to which latter he gave the formula $C_{21}H_{20}O_9$, instead of that given above by Buchner. (Planchon et Collin, *Drogues Simples* (1896), vol. ii. 590.) E. Amweg has devised a method of separating the glucosides from frangula, cascara and rhubarb by extraction with solvents; he uses, 1, benzene; 2, a mixture of two parts of benzene, and one part of absolute alcohol, and 3, alcohol (60 per cent.) (*Ap. Ztg.*, 1897, 747). Kubly isolated a crude acid which, when purified, he termed *frangulic acid;* Amweg regards this acid as a decomposition product and calls it *pseudo-frangulin*, this when hydrolyzed becomes *pseudo-emodin*. The emetic action of the green bark is attributed to a hydrolytic ferment, which is destroyed by heating. (*P. J.*, 1898, 24.)

Uses.—In its fresh state this drug is very irritant to the gastro-intestinal mucous membrane, producing, when taken in sufficient quantity, violent catharsis, accompanied by vomiting and much pain. During drying it is said to lose much of its irritant power, and the dried bark is affirmed to resemble rhubarb in its action; hence the direction that the bark should be at least one year old. A *decoction* (an ounce to the pint) may be used in tablespoonful doses, or a dessertspoonful of an *elixir*, made by mixing four fluidounces of the fluidextract with twelve of elixir of orange may be employed.

[1] The berries, which are ripened in September, are of the size of a pea, round, somewhat flattened at top, black, smooth, shining, with four seeds in a green, juicy parenchyma. Their odor is unpleasant, their taste bitterish, acrid, and nauseous. Their blackish, expressed juice was formerly recognized in the Br. Ph. under the name of *Rhamni Succus*. It has the color, odor, and taste of the parenchyma, is reddened by the acids, and from deep green is rendered light green by the alkalies. Upon standing it soon begins to ferment, and becomes red in consequence of the formation of acetic acid. Evaporated to dryness, with the addition of lime or an alkali, it forms the color called by painters *sap-green*. The dried fruit of another species, *R. infectoria*, yields a rich yellow color, and is employed in the arts under the name of *French berries*. Fleury obtained a peculiar crystallizable principle, *rhamnin;* but he did not ascertain whether it possessed cathartic properties. (See *J. P. C.*, xxvii, 666.) Winckler obtained from the ripe fruit a principle which he called *cathartin*, and believes that the rhamnin of Fleury, which was obtained from the unripe berries, is converted into that principle and grape sugar as the fruit matures. (*Chem. Gaz.*, viii. 232.) Lefort (*J. P. C.*, 1866, p. 420) studied Fleury's rhamnin, and describes it as forming pale yellow, translucent tables. It is scarcely soluble in cold water, soluble in hot alcohol, insoluble in ether or carbon disulphide. It is very soluble in caustic alkalies, from which it is precipitated by mineral acids. He gives it the formula $C_{12}H_{12}O_8 + 2H_2O$. Lefort also found a principle, *rhamnegin*, soluble in cold water, but otherwise agreeing in properties with rhamnin. Schützenberger (1868) decomposed rhamnegin, proving it to be a glucoside, having the formula $C_{24}H_{32}O_{14}$, and yielding *rhamnetin*, $C_{12}H_{10}O_5$, and a sugar isomeric with mannite. Schützenberger also found a body isomeric with rhamnegin, and distinguished the two as *α rhamnegin* and *β rhamnegin*, which, with Lefort's rhamnin, are present in buckthorn juice. Liebermann and Hörmann (*Ber. d. Chem. Ges.*, xi. (1878), pp. 952, 1618) confirm Schützenberger's results, and give the name of *xanthorhamnin* to his *α* rhamnegin. They find his formula $C_{12}H_{10}O_5$ for rhamnetin to be correct, but get results that give for xanthorhamnin rather the formula $C_{48}H_{58}O_{29}$. Both the berries and their expressed juice are active hydragogue cathartics, apt to cause nausea and severe griping, and at one time much used in dropsy and also in rheumatism and gout. The dose of the recent berry is said to be about twenty grains (1.3 Gm.), of the dried, a drachm (3.9 Gm.), and of the expressed juice, a fluidounce (30 Cc.).

Among other species of Rhamnus which have claimed attention are *R. Wightii*, W. & A., a common shrub of Madras and Bombay (*P. J.*, Feb. 1888), and *R. californica*, Eschsch. (*R. humboldtiana*, Roem. and Schult.), of Mexico, which S. E. Sosa states sometimes produces paralysis in children (*El Estudio*, 1890). (See also *Rhamnus Purshiana.*)

Dose, of frangula, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Fluidextractum Frangulæ, *U. S.*

GALBANUM. Br.

GALBANUM

(găl'bą-nŭm)

"A gum-resin obtained from Ferula galbaniflua, *Boiss.* and *Buhse,* and probably from other species." *Br.*

Gummi-Resina Galbanum; Galbanum, *Fr. Cod.;* Galbanum, *P. G.;* Galban, Mutterharz, *G.;* Galbano, *It., Sp.*

It is uncertain from what plant galbanum is derived. At one time it was supposed to be the product of *Bubon Galbanum,* an umbelliferous plant of the eastern coast of Africa. It has also been referred to the *Ferula ferulago* of Linnæus, the *Ferula galbanifera* of Lobel, which inhabits the coast of the Mediterranean and is found also in Transylvania and the Caucasus. But no part of either of these plants has the odor of galbanum, and it is, therefore, scarcely probable that they yield the drug. Don, having found the seeds taken from a parcel of galbanum to belong to an undescribed genus of umbelliferous plants, and concluding that they came from the same source as the gum-resin itself, gave the title of Galbanum to the new genus, and named the species *Galbanum officinale.* This was rather hastily adopted by the London College; it is by no means certain that the same plant produced the seeds and the gum-resin. Specimens of a plant were received in England from Persia having a concrete juice adhering to them, which was taken by Lindley for galbanum, and that botanist, finding that the plant belonged to an undescribed genus, named it *Opoïdia,* with the specific name *galbanifera.* Pereira, however, found the substance not to be galbanum, and this supposed origin of the drug, therefore, must be considered as extremely doubtful. A German traveller, F. A. Buhse, who has resided in Persia, stated that in 1848 he met with the *galbanum* plant on the declivities of the Demavend, near the southern coast of the Caspian. He saw the gum-resin exuding spontaneously from the plant, and was informed by the natives that the drug was collected from it. The plant is a Ferula, and has received the name of *F. galbaniflua,* Boissier and Buhse. Buhse also stated that the Persian galbanum is yielded by a second plant, which is doubtfully distinct from *F. galbaniflua;* this is the *F. rubricaulis,* Boissier (*F. erubescens,* Berg). Holmes is of the opinion (*P. J.,* 1891, 194) that "Levant" galbanum is yielded by *Ferula galbaniflua* and its variety *β-Ancheri;* that *solid* "Persian" comes possibly from *F. Schair,* Borscz.; while the *liquid* "Persian," judging from the fruits found in it, is derived from an undescribed species allied to *F. galbaniflua.* It would also appear that the *F. Galbanum* of Aitchison is not identical with that of Boissier, and that neither this species nor *F. rubricaulis* yields galbanum, and that, further, all the varieties of galbanum of commerce come through Persia. Galbanum is said to be obtained by making incisions into the stem, or cutting it off a short distance above the root. A cream-colored juice exudes, which concretes upon exposure to the air. A portion of juice also exudes spontaneously from the joints, and hardens in the shape of tears. It was formerly official in the U. S. Pharmacopœia, but was dropped in the 1890 revision.

Properties.—Galbanum usually appears in the form of masses composed of whitish, reddish, or yellowish tears, from the size of a pin's head to that of a pea and larger, irregularly agglutinated by a darker colored yellowish-brown or greenish substance, more or less translucent, and generally mixed with pieces of stalk, seeds, or other foreign matters. It is also found, though rarely, in our markets, in the state of distinct roundish tears, about as large as a pea, of a yellowish-white or pale brownish-yellow color, shining externally as if varnished, translucent, and often adhering together. Galbanum has in cool weather the consistence of firm wax, but softens in summer, and by the heat of the hand is rendered ductile and adhesive. At 100° C. (212° F.) it is sufficiently liquid to admit of straining, and it generally requires to be strained before it can be used. A dark-brown or blackish color, a consistence always soft, the absence of whitish grains, a deficiency in the characteristic odor and taste, and the intermixture of earthy impurities are signs of inferiority. According to Hirschsohn (*Ph. Z. R.,* 1893, 353), galbanum of commerce differs from that formerly found in the market; its consistence is now like that of white turpentine, although the odor is still that of Levant galbanum; the greatest difference is shown in the action of strong acids and solvents on it. (See *A. J. P.,* 1893, 384.)

The odor of galbanum is peculiar and disagreeable; its taste bitterish, warm, and acrid; its sp. gr. 1.212. Triturated with water, it forms an imperfect milky solution, which on standing deposits the greater portion of what was taken up. Wine and vinegar act upon it in a similar manner. Alcohol dissolves a considerable proportion, forming a yellow tincture, which has the odor and taste of galbanum, and becomes milky with water, but affords no precipitate. In diluted alcohol it is wholly soluble, with the exception of impurities. Ether dissolves the greater portion. "When moistened with alcohol, galbanum acquires a purple color on the addition of a little hydrochloric acid." *U. S.* 1880. According to Conrady, the composition of galbanum is as follows: ethereal oil, 9.5 per cent.; resin, soluble in alcohol, 63.5 per cent.; and gum and impurities, 27 per cent. The purified resin was found by Conrady to

contain about 20 per cent. of combined *umbelliferone,* about 0.25 per cent. of free umbelliferone, and about 50 per cent. of *galbaresinotannol.* This latter representative of the class of resino-tannols first established by Tschirch was proved to have the alcohol character by forming the acetyl and benzoyl derivatives. Conrady also considers that the umbelliferone is combined with this galbaresino-tannol in the form of an ester. The volatile oil he found to consist essentially of a hydrocarbon of the formula $C_{10}H_{16}$, with small amounts of a sesquiterpene, $C_{15}H_{24}$. The terpene has been identified as *d-pinene* by the terpin hydrate formation, while the sesqui-terpene, according to Wallach, is *cadinene,* identified by the formation of its chlorhydrate fusing at 117° to 118° C. (Gildemeister and Hoffman, *Aetherische Oele,* p. 753). When the oil is extracted by solvents it is free from acid reaction, but when distilled with steam it acquires an acid reaction, and notable quantities of isovaleric acid are developed. These fatty acids are probably bound up as esters in the cold extracted oil. (*A. Pharm.,* 232 (1894), 98.) The crude oil is dextrogyrate. The resin, constituting about 60 per cent., is very soft, and dissolves in ether or in alkaline liquids, even in milk of lime, but only partially in carbon disulphide. When heated with hydrochloric acid for some time, it yields *umbelliferone,* $C_9H_6O_3$, which may be dissolved from the acid liquid by means of ether or chloroform, and obtained on evaporation in colorless acicular crystals. The aqueous solution of umbelliferone exhibits, especially on addition of an alkali, a brilliant blue fluorescence, which is destroyed by an acid. If a small fragment of galbanum be immersed in water, a fluorescence will be produced by a drop of ammonia. Asafetida shows the same reaction, but ammoniac does not.

Galbanum submitted to dry distillation yields a thick oil of brilliant blue color. This oil on rectification yields a greenish portion, and then a superb blue oil. Kachler (*Ber. d. Chem. Ges.,* 1871, p. 36) found a colorless oil, $C_{10}H_{16}$, and a blue oil, $C_{10}H_{16}O$, boiling at 289° C. The blue oil, according to Kachler, after purification, agrees with the blue oil of the flowers of *Matricaria Chamomilla.* By fusing galbanum resin with potassium hydroxide, Hlasiwetz and Barth (*Ann. Ch. Ph.,* 130, p. 354) obtained *resorcinol,* together with acetic and volatile fatty acids.

According to Ludewig, a gum-resin, designated as *Persian galbanum,* is received in Russia by the way of Astrakhan or Orenburg, and is the kind used in that country. It comes enclosed in skins, and is in masses of a reddish-brown color with whitish streaks, of a disagreeable odor, somewhat like that of asafetida, and of an unpleasant, bitter, resinous taste. It is so soft as to melt with a slight elevation of temperature. It differs from common galbanum in its odor, in its color, which is never greenish, and in the absence of tears, and is probably derived from a different plant. It abounds in impurities. This variety of galbanum is probably the same as that obtained by Aitchison in Afghanistan, which on chemical examination yielded—volatile oil, 3.108 per cent.; resin (ether extractive, 61.2, alcohol extractive, 7.576), 68.776; water extractive (gum), 17.028; insoluble matter, 10.56. (*P. J.,* Dec. 11, 1886.)

Uses.—Galbanum was known to the ancients. It is stimulant, expectorant, and antispasmodic, and is considered as intermediate in power between ammoniac and asafetida. It has chiefly been used in chronic affections of the bronchial mucous membrane, *amenorrhœa,* and chronic *rheumatism.* It is occasionally applied externally as a plaster to *indolent swellings,* with the view of promoting resolution or suppuration.

Dose, from ten to twenty grains (0.65 to 1.3 Gm.), given in pill, or triturated with gum arabic, sugar and water, so as to form an emulsion.

Off. Prep.—Pilula Galbani Composita, *Br.*

GALLA. U. S., Br.

NUTGALL

(găl'la)

"An excrescence on *Quercus infectoria* Olivier (Fam. *Cupuliferæ*), caused by the punctures and deposited ova of *Cynips tinctoria* Olivier." *U. S.* "Excrescences on Quercus infectoria, *Olivier,* resulting from the puncture and deposition of an egg or eggs of Cynips Gallæ tinctoriæ." *Br.*

Galls, Aleppo or Syrian Galls; Galla Halepensis, s. Turcica, s. Levantica, s. Tinctoria, s. Quercina; Galle de Chêne, d'Alep, *Fr. Cod.;* Noix de Galle, *Fr.;* Gallæ, *P. G.;* Galläpfel, Gallen, *G.;* Noce di galla, *It.;* Agalla, *Sp.*

Many plants, when pierced by certain insects, particularly those of the genus *Cynips,* are affected at the points of puncture with a morbid action, resulting in excrescences, which, as they are derived from the juices of the plant, partake more or less of its chemical character. Most of the oaks are occasionally thus affected, and the resulting excrescences, having in a high degree the astringency of the plant, have been employed for various practical purposes. They are known by the name of *galls,* a term which, as well as their use in medicine, has been handed down from the ancients. *Quercus infectoria, Q. ægilops, Q. excelsa, Q. Ilex, Q. Cerris,* and *Q. Robur* have been particularized as affording this product; but it is now generally admitted, on the authority of Olivier, that the official galls are derived chiefly, if not exclusively, from *Q. infectoria.*[1]

[1] Under the name of *Chinese galls,* a product has been brought from China, supposed to be caused by an insect allied to the aphis, as such an insect has been found in the interior of them. They are irregularly spindle-shaped, often more or less bent, with obtusely pointed protuberances, about two inches long by an inch in diameter at the central thickest part,

Quercus infectoria, Willd., *Sp. Plant.* iv. 436; Olivier, *Voy. Orient.* t. 14 *et* 15; Carson, *Illust. of Med. Bot.,* ii. 40, pl. 85.—*Q. lusitanica,* Lam., *Encyc.* i. 719.—*Q. leptocarpus,* Kotschy. —*Q. rigida,* Koch.—*Q. petiolaris,* Boiss.—The *dyer's oak* is a small tree or shrub, with a crooked stem, seldom exceeding six feet in height. The leaves are obtusely toothed, smooth, of a bright-green color on both sides, and stand on short footstalks. The acorn is elongated, smooth, two or three times longer than the cup, which is sessile, somewhat downy, and scaly. This species of Quercus grows, according to Olivier, throughout Asia Minor, from the Archipelago to the confines of Persia. M. Kinnier found it also in Armenia and Kurdistan; Hardwicke observed it growing in the neighborhood of Adwanie, and it probably pervades the middle latitudes of Asia.

The gall originates from the puncture of the *Cynips quercûsfolii* of Linnæus, the *Diplolepis gallæ tinctoriæ* of Geoffroy, a hymenopterous insect or fly, with a fawn-colored body, dark antennæ, and the upper part of its abdomen shining brown. The insect pierces the shoots and young boughs, and deposits its egg in the wound. This irritates the part, and a small tumor quickly rises, which is the result of a morbid growth, exhibiting various cells under the microscope, but no proper vegetable fibre. The egg grows with the gall, and is soon converted into a larva, which feeds upon the vegetable matter around it, and thus forms a cavity in the centre of the excrescence. The insect at length becomes a fly, and escapes by eating its way out. The galls are in perfection when fully developed, before the egg has been hatched or the fly has escaped. Collected at this period, they are called, from their dark color, *blue, green,* or *black galls,* and are most highly esteemed. Those which are gathered later and have been injured by the insect are *white galls.* They are usually larger, less heavy and compact, and of a lighter color than the former.

The galls collected in Syria and Asia Minor are brought to this country chiefly from the ports of Smyrna and Trieste, or from London. As they are produced abundantly near Aleppo, it has been customary to designate them by the name of that town, though the designation, however correct it may formerly have been, is now wholly inapplicable, as they are obtained from many other places, and the produce of different parts of Asiatic Turkey is not capable of being discriminated, at least in our markets. Great quantities of galls, very closely resembling those from the Mediterranean, have been brought to the United States from Calcutta. Royle states that they are taken to Bombay from Bussorah through the Persian Gulf. We are, nevertheless, informed that galls are among the products of Moultan. Those of France and other southern countries of Europe have a smooth, shining reddish surface, are little esteemed, on account of their small yield of tannin, and are seldom brought to the United States.

Properties.—Galls are "subglobular, 1 to 2 Cm. in diameter, externally blackish olive-green or blackish-gray, more or less tuberculated above, the basal portion nearly smooth and contracted into a short stalk, sometimes with a perforation on one side; heavy; fracture horny, yellowish or grayish; in the centre a cavity containing either the partly developed insect, or pulverulent remains left by it; nearly inodorous; taste strongly astringent." *U. S.* The best are externally of a dark bluish or lead color, sometimes with a greenish tinge, internally whitish or brownish, hard, solid, brittle, with a flinty fracture, a striated texture, and a small spot or cavity in the centre, indicating the presence of the undeveloped or decayed insect. Their powder is of a light yellowish gray. Those of inferior quality are of a lighter color, sometimes reddish or nearly white, of a loose texture, with a large cavity in the centre, communicating externally by a small hole through which the fly has escaped. The U. S. P. 1890 directed that "light, spongy, and whitish-colored Nutgalls should be rejected." Galls have a bitter, very astringent taste, and when whole are inodorous or nearly so, but bruised or in powder they have a decided and peculiar though not very strong odor. The tannin of galls, usually known as *gallo-tannic acid,* appears to exist in the galls, in part at least, as a glucoside, but one very easily broken up by ferments like pectase into glucose and *di-gallic acid,* $C_{14}H_{10}O_9$, which is the material, therefore, extracted from the galls. This di-gallic acid may be considered as the anhydride of *gallic acid,* $C_7H_6O_5$, formed from two molecules of this latter by the elimination of one molecule of water. Commercial tannin yields from 0 to 22 per cent. of glucose, showing the presence of varying amounts of the unaltered

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of an ash color and a soft velvety feel, very light, hollow, with translucent walls about a line in thickness, of a slight odor recalling that of ipecac, and a bitter astringent taste. From an examination of fragments of leaves and petioles found among these galls, Schenck concluded that the tree on which they are found is a species of Rhus; but according to Decaisne, their true source is probably the *Distylium racemosum* of Zuccarini (*Flor. Japon.,* i. p. 178, t. 94), a large tree of Japan, the leaves of which produce a velvety gall, resembling the one in question. (Guibourt, *Hist. Nat. des Drogues,* 1850, iii. 703.) More recently, however, it has been asserted by Daniel Hanbury that this opinion of Decaisne is erroneous (*P. J.,* Feb. 1862, p. 421), as in his examination of the packages imported from China and Japan he has found remains of different parts of a species of Rhus, but never any of a Distylium. Besides, the form of the galls of the Distylium, as figured by Siebold and Zuccarini, is entirely different. The species of Rhus which yields the commercial Chinese galls is the *R. semialata,* Murray. The Chinese make great use of this product both in dyeing and as a medicine. L. A. Buchner, Jr., has found it to contain 65 per cent. of tannic acid identical with that of the official galls. (*Ph. Cb.,* July, 1851, p. 526.) It is recommended by Stenhouse for the manufacture of gallic acid, being preferable for this purpose to the official galls, in consequence of its less amount of coloring matter. (*P. J.,* Dec. 1862.) An inferior kind of galls is produced in great quantities in England, by the attack of the *Cynips kollari* of Hartig, upon the common English oak; but they have been ascertained to contain little tannic acid, and are of little value.

glucoside. Galls yield, on an average, from 65 to 77 per cent. of tannin. (See *Acidum Tannicum* and *Acidum Gallicum*, see also "The Tannins," by Henry Trimble, J. B. Lippincott Co., 1892.) All the soluble matter of galls is taken up by forty times their weight of boiling water, and the residue is tasteless. Alcohol dissolves seven parts in ten, ether five parts. (*Thomson's Dispensatory.*) A saturated decoction deposits upon cooling a copious pale-yellow precipitate. The infusion or tincture affords precipitates with sulphuric and hydrochloric acids, lime water, and ammonium and potassium carbonates, with solutions of lead acetate and subacetate, copper and iron sulphates, silver and mercury nitrates, and potassio-antimonyl tartrate; with solution of gelatin; and with the infusions of Peruvian bark, calumba, opium, and many other vegetables, especially those containing alkaloids, with most of which tannic acid forms insoluble compounds. The infusion of galls reddens litmus paper, is rendered orange by nitric acid, milky by mercuric chloride, and has its color deepened by ammonia, but yields no precipitate with either of these reagents. Zinc sulphate was said by A. T. Thomson to slowly occasion a precipitate, but this result was not obtained by Duncan. Infusion of galls is rendered more permanent by the addition of 10 per cent. of glycerin.

A variety of galls was imported into Germany, which was said to be derived from Central Asia, especially from the provinces of Khokan, Khiva, and Bokhara, where they are used in dyeing. They are of various forms, some being long, others round, cylindrical, or angular, and sometimes they are grouped upon a single stalk, and covered with little elevations. They differ from all other galls by their color, being on one side yellow, and on the other of a fine red. Most of them present a little opening, and in the interior are eggs and larvæ of a peculiar species of aphis. They have yielded, on analysis, 43.10 per cent. of tannin, 3.03 of a green wax, 16 of cellulose, and an undetermined quantity of fecula and volatile oil. (R. Palne, *J. P. C.*, Avril, 1873.)

Uses.—Galls have a powerfully astringent action, but are no longer prescribed internally.[1]

Off. Prep.—Tinctura Gallæ, *U. S.*; Unguentum Gallæ, *U. S.*, *Br.*; Unguentum Gallæ cum Opio, *Br.*

[1] *Aromatic Syrup of Galls.*—The following old formula, based upon one of Physick's, is still sometimes employed. Macerate for twenty-four hours half an ounce of powdered galls, two drachms of bruised cinnamon, and two drachms of bruised nutmeg, in half a pint of brandy; then percolate, and, when the liquor has ceased to pass, add enough diluted alcohol to yield half a pint of filtered liquor. Put this into a shallow capsule, suspend over it two ounces of sugar on a slip of wire gauze, and set the tincture on fire. The sugar melts with the flame, and falls into the liquid beneath. When the combustion ceases, agitate and filter. A highly astringent aromatic syrup is obtained, a fluidrachm of which may be given in diarrhœa. (*A. J. P.*, xxvii. 416.)

GAMBIR. U. S. (Br.)

GAMBIR [Pale Catechu]
[To replace Catechu, Pharm. 1890]

(găm'bĭr)

"An extract prepared from the leaves and twigs of *Ourouparia Gambir* (Hunter) Baillon (Fam. *Rubiaceæ*)." *U. S.* "An extract of the leaves and young shoots of the Uncaria Gambier, *Roxb.*" *Br.*

Catechu, *Br.*; Catechu Pallidum, Terra Japonica, Gambier, Cutch; Gambir Cubique, *Fr.*; Catechu, *P. G.*; Katechu, Gambir-Catechu, *G.*; Catechu, *It.*, *Sp.*

Ourouparia Gambir (Hunter), Baillon; *Uncaria Gambier*, Roxb.; *Nauclea Gambir*, Hunter.[2] This is a climbing shrub with slender stems somewhat thickened at the nodes, cylindrical or occasionally slightly angular; leaves ovate or oblong, entire, three to four inches long, rounded at the base but abruptly attenuated at the apex, opposite and stipulated, smooth on both sides. The flowers are small, crowded into a dense globular head on a hairy receptacle; the flower heads are borne on long axillary peduncles which bear in the middle a whorl of bracts. At the point where these bracts occur the peduncle breaks after the falling of the inflorescence and the remainder of the peduncle becomes elongated and curved into hooks by means of which the plant climbs. Corolla gamopetalous, trumpet-shaped, tube slender, ½ inch long, flaring and five-lobed at the summit; stamens five, inserted on the throat of the corolla; ovary inferior, 2-celled; style long, protruding beyond the corolla; calyx 5-lobed, woolly; fruit one inch long, pericarp dry, dehiscing vertically into two valves; seeds very numerous.

It is a native of Malacca, Sumatra, Cochin-China, and other parts of Eastern Asia, and is largely cultivated in the islands of Bintang, Singapore, and Prince of Wales. The gambir is prepared by lopping off the leaves, shoots, and twigs of the plant, chopping them into pieces, and throwing them into an iron pot filled with boiling water. When the leaves are exhausted and the liquid sufficiently thick, it is poured into small wooden tubs, and so soon as sufficiently cool, a half closed hand is plunged into the semi-fluid mass and a piece of light wood shaped like an elongated dice box rapidly worked up and down in the hollow formed by the hand. The extract begins to thicken by a process which is compared to crystallization. The mass is finally turned out, and cut into cubes, which are put upon trays and smoke-dried. (See also *P. J.*, 1892, 1003.) This extract, which is known by the native Malays as *pinang* or *siren* was first brought to the attention of the profession by Campbell.

[2] The full synonymy of this plant is exceedingly complex. The *Index Kewensis* makes the genera *Ourouparia*, *Agylophora*, *Uncinaria*, all synonyms of *Uncaria*. The British Pharmacopœia follows the Index Kewensis, but the Ouraparia of Aublet antedates the Uncaria of Schreber by fourteen years.

Properties.—Gambir is in "irregular masses, or cubes about 25 Mm. in diameter; externally reddish-brown, pale brownish-gray, or light brown; fracture dull-earthy, friable, crystalline; inodorous, bitterish, very astringent, with a sweetish after-taste; free from starch. Not less than 70 percent. should be soluble in alcohol; when incinerated, Gambir should not yield more than 5 percent. of ash." *U. S.* "Catechu should not afford any characteristic reaction with the tests for starch, and should not yield more than 5 per cent. of ash when incinerated." *Br.* It is light and porous, so that it floats when thrown in water. It is partially soluble in cold water, and almost wholly so in boiling water, which deposits a portion upon cooling. Duhamel, Ecky, and Procter dissolved 87.5 per cent. of it in cold water by means of percolation. (*A. J. P.*, xvi. 166.) Nees von Esenbeck found it to consist of from 36 to 40 per cent. of *catechutannic acid,* a peculiar principle called *catechuin, catechin,* or *catechuic acid,* gum or gummy extractive, a deposit like cinchonic red, and 2.5 per cent. of lignin. *Catechin,* when perfectly pure, is snow-white, of a silky appearance, crystallizable in fine needles, melting at 217° C., unalterable in the air if dry, fusible by heat, very slightly soluble in cold water, with which it softens and swells up, soluble in boiling water, which deposits it on cooling, and soluble also in alcohol and ether. It very slightly reddens litmus paper, and, though coloring solution of chloride of iron green, and producing with it a grayish green precipitate, differs from tannic acid in not affecting a solution of gelatin. The very great discordance of different authors as to its formula seems to be explained by some experiments of Etti (*Ann. Ch. Ph.*, 186, p. 327), who showed that *catechin,* $C_{19}H_{18}O_8$, readily gives at 100° C. (212° F.), or even when kept for some time over sulphuric acid, an anhydride, $C_{38}H_{34}O_{15}$, and at 160° C. (320° F.) a second anhydride, $C_{38}H_{32}O_{14}$, which, mixed in varying proportions, explain the varying results. Gautier (*Bull. Soc. Chim.*, 30, 567) finds three different catechins separable by their different solubility in water, all of them crystallizable. These are: *a-catechin,* $C_{40}H_{38}O_{18} + 2H_2O$, melting at from 204° to 205° C., and present in gambir to the amount of 12 per cent.; *b-catechin,* $C_{47}H_{38}O_{16} + H_2O$, melting at from 176° to 177° C., and 2 per cent. present in gambir; and *c-catechin,* $C_{40}H_{38}O_{16} + H_2O$, melting at 163° C., and present in gambir to the amount of 6.5 per cent.

Perkin and Yoshitako (*P. J.*, 1902, p. 530) have made an elaborate investigation of gambir and acacia catechus. They find three catechins, designated respectively as (*a*), (*b*), and (*c*). Catechin (*b*), $C_{15}H_{14}O_6 + 4H_2O$, occurs in air dried, colorless needles, melting at 175° to 177° C., and gives on fusion with alkali, phloroglucinol, protocatechuic acid, and an acid resembling acetic acid. Catechin (*c*), $C_{15}H_{14}O_6$, air dried, contains no water of crystallization and forms colorless prisms, melting at 235° to 237° C. Catechin (*a*), $C_{15}H_{14}O_6 + 3H_2O$ (or less probably $C_{14}H_{14}O_6 + 3H_2O$), air dried, forms colorless needles, melting at 204° to 205° C.

Good gambir should occur in a hard compact mass, breaking up, when the adhering mat is removed, into distinct cubes of a brownish-black color externally, and a deep mahogany-red with an occasional streak of yellow internally. It should not steam when the mat is opened. From this quality it grades down to a stuff which has been prepared by mixing the material obtained by reboiling the exhausted leaves with various mixtures. This lowest grade is not in cubes, steams when opened, frequently shows large patches of black or dirty blue color, and often has a sour fetid odor; its color varies from black to light-brown.

The varieties between the two extremes are very great; sometimes gambir occurs in solid mass of fair quality; sometimes the cubes are of extraordinary size, and of a color varying from a dirty white to very pale yellow. The finer varieties of gambir vary in physical characteristics; sometimes it is in oblong instead of cubical pieces, without differing in other respects from the ordinary kind; sometimes in small circular cakes, or short cylindrical pieces, heavier than water, of a pale reddish-yellow color, moderately astringent, gritty under the teeth, and quite impure; sometimes in very small cubes, distinguishable by the black color they afford with tincture of iodine, indicating the admixture of sago or other amylaceous matter; and, finally, in circular cakes of the size of a small lozenge flat on one side and somewhat convex on the other, of a pale pinkish yellowish-white color, and chalky to the touch. This is most highly esteemed by the natives in India. (Pereira.) At the Edinburgh Forestry Exhibition in 1885 the Maharajah of Johore exhibited specimens labelled "gambir produced in Johore." The first quality, which was "*makan*" (for eating), was in regular cubes, externally cassia-brown color, internally pale cinnamon brown, and yielded 32 per cent. of tannic acid; the second quality was in badly formed cubes, externally brown and black, internally cinnamon, and yielded 30 per cent. of tannic acid; the third quality was in dull-brown, well-shaped cubes, internally pale brown, and yielded 19 per cent. of tannic acid. The oblong or *parallelopiped gambir* was of a uniform dull brown, very hard and strong, and yielded only 2 per cent. of tannic acid. MacEwan believes that the low percentage of tannin was due to the decoction not having been subjected to prolonged boiling, which favors the decomposition of catechin, with the formation of catechutannic acid. None of the finest varieties of gambir, such as are used by the natives for chewing, occur to any extent in American commerce. Prebble records his examination of a cube gambir of fine appearance which contained a large percentage of starch. (*P. J.*, 1893, 21.)

Enormous quantities of gambir are used both in Europe and America in tanning, calico printing, dyeing, and other art processes requiring tannic acid.

Uses.—Gambir is a serviceable remedy in those cases where astringents are indicated. The complaints to which it is best adapted are *diarrhœa* dependent on debility or relaxation of the intestinal mucous membrane, and *passive hemorrhages*, particularly from the uterus. A small piece held in the mouth and allowed slowly to dissolve is an excellent remedy in *relaxation of the uvula* and the *irritation of the fauces* and *troublesome cough* which depend upon it. Applied to *spongy gums*, in the state of powder, it sometimes proves useful; and it has been recommended as a dentifrice in combination with powdered charcoal, Peruvian bark, myrrh, etc.

Dose, from ten grains to half a drachm (0.65 to 2.0 Gm.), which should be frequently repeated, and is best given with sugar, gum arabic, and water.

Off. Prep.—Pulvis Catechu Compositus, *Br.*; Tinctura Gambir Composita, *U. S.* (*Br.*); Trochisci Gambir, *U. S.* (*Br.*).

GELATINUM. U. S., Br.

GELATIN

(ję-lăt'ĭ-nŭm)

"The purified air-dried product of the hydrolysis of certain animal tissues, as skin, ligaments, and bones, by treatment with boiling water." *U. S.* "The air-dried product of the action of boiling water on such animal tissues as skin, tendons, ligaments, and bones." *Br.*

Gelatine; Gélatine animale, *Fr. Cod.*; Colle de Flandre purifée, *Fr.*; Gelatina alba, *P. G.*; Weisser Leim, Gelatine, Gallerte, *G.*; Gelatina, *Sp.*

Gelatin is the term applied to purified forms of the substance ordinarily known as glue, and the bones and animal matter from which the best qualities of gelatin are prepared are carefully selected so as to be free from decomposed products and odorous substances. The hot solution of gelatin must be thoroughly clarified if the so-called sparkling gelatin is to be made. The surface of sheet gelatin is covered with lozenge-shaped marks, due to impressions left by the knotted netting upon which it is dried. Shred gelatin is made by cutting sheet gelatin into very narrow shreds by a shearing-machine. (See *Nat. Drug.*, 1894, 134.) *Gelatose* and *paragelatose* are terms used by Dastre and Floresco to define gelatin which has lost its power of "gelatinization" through the action of ferments or microbes, saline solutions, or the prolonged action of boiling water. (*P. J.*, 1895, 454.)

Properties.—It is officially described as "an amorphous, more or less transparent solid, usually shredded or in thin sheets; colorless or with a slight yellowish tint, inodorous, and having a slight, characteristic, almost insipid taste. Unalterable in the air when dry, but putrefying rapidly when moist or in solution. When incinerated, Gelatin is decomposed, leaving a slight mineral residue, which should not exceed 2 percent. of the original weight. Gelatin is insoluble in cold water, but swells and softens when immersed in it, gradually absorbing from 5 to 10 times its weight of water. It is soluble in boiling water, acetic acid, and glycerin; insoluble in alcohol, ether, chloroform, benzene, carbon disulphide, and fixed and volatile oils. When dissolved in boiling water (1 in 50), it should solidify upon cooling, and form a transparent jelly. An aqueous solution of Gelatin (1 in 5000) is at once rendered turbid on the addition of tannic acid T.S., the precipitate being insoluble in the presence of an excess of the reagent. Gelatin is precipitated from its aqueous solution by mercuric chloride T.S. in excess; it is not precipitated by a solution of alum, by ferric chloride T.S., or by lead acetate T.S. If potassium dichromate T.S. be added to a solution of Gelatin in hot water, the jelly which forms on cooling becomes insoluble in warm water after exposure to light." *U. S.* "In translucent and almost colorless sheets or shreds. A solution in 50 parts of hot *water* is inodorous, and solidifies to a jelly on cooling. Gelatin is insoluble in *alcohol* (90 per cent.) and *ether*. It dissolves in *acetic acid*. Its aqueous solution yields a precipitate with *solution of tannic acid*, but not with solutions of other acids, nor with *solution of alum, solution of lead acetate*, or *test-solution of ferric chloride*." *Br.*

Gelatin is largely used for making *capsules*. Certain medicines are so offensive to the taste, and consequently so likely to cause nausea, that it is highly desirable to administer them in such a way as to prevent their contact with the tongue and palate. This object is fully accomplished, so far as regards many disagreeable liquid medicines, by the use of the capsules of gelatin. A polished bulb of iron, ivory, or bone, of the size and shape of the capsules required, and connected by a slender rod with a handle, is first greased by rubbing with an oiled cloth, and then dipped into a solution of gelatin made by heating six parts of pure gelatin with one of sweetened water. Upon being withdrawn, it is held for a short time so as to allow the excess of the solution to run off, and then fixed with the handle in a board, the coated bulb being upward, until the coating becomes cold and firm. The capsule is now removed by the fingers, and further dried by exposure on a tray. A number of capsules having been prepared, they are placed each in a small cell upon a board, with their mouths upward, and the liquid they are to contain is introduced by means of a syringe with a fine point. Their mouths are then closed with a drop of the solution of gelatin applied by means of a stick or glass rod, which is afterwards strengthened by an additional coating, given by

dipping the mouth of the capsule into the solution diluted with a little water. (*Redwood's Supplement,* p. 664.) The capsules may be made of such a capacity as to contain from ten to fifteen grains of copaiba or other liquid. Capsules are now largely used for enclosing dry powders like quinine, etc. These are ovoid in shape, and after being filled with the powder by the pharmacist, are closed by putting upon the open end a rounded gelatin cap and pressing it down tightly. When so-called *soft capsules* are desired, a small quantity of glycerin is introduced into the gelatin mass; this makes the film elastic by preventing its drying completely.

Uses.—The experiments of Dastre and Floresco (*C. R. S. B.*, 1896, ii.; iii.), which have been confirmed by a number of observers, show that gelatin has the power of greatly increasing the coagulability of the blood. According to H. C. Wood, Jr. (*Am. Med.*, 1902, iii.), this property is not destroyed by digestion. This coagulating action has been taken advantage of in the treatment of *aneurism* and *hemorrhage.* The results in aneurism have, however, not been entirely encouraging. In hemorrhages not too acute, as *menorrhagia* or moderate *hemoptysis,* the gelatin may be successfully given by mouth in the form of a 10 per cent. jelly. In severe types of bleeding, as *hematemesis,* it may be given hypodermically in warm physiological salt solution. Great care must be observed in its hypodermic use, as several cases of fatal tetanus have followed this treatment. For hypodermic use only the especially prepared *Gelatinum Sterilizatum pro injectione,* which is now marketed by several manufacturing houses, should be employed. It is asserted that the remedy is useful also as a local styptic in *epistaxis.*

Dose, one-half to one ounce (15.5 to 31 Gm.).

Off. Prep.—Gelatinum Glycerinatum, *U. S.;* Suppositoria Glycerini, *Br.* (Vehicle for lamellæ in Br.)

GELATINUM GLYCERINATUM. U. S.

GLYCERINATED GELATIN

(ǧe-lăt'i-nŭm glĭç-e-ri-nā'tŭm)

Gelatina Glycerinata, Gelatinum Glycerini; Glycerin Jelly; Gelée Glycérinée, *Fr.;* Glycerinleim, *G.*

* "Gelatin, *one hundred grammes* [or 3 ounces av., 231 grains]; Glycerin, *one hundred grammes* [or 3 ounces av., 231 grains], Water, *a sufficient quantity,* to make *two hundred grammes* [or 7 ounces av., 24 grains]. Pour upon the Gelatin sufficient Water, which has been previously boiled and cooled, to cover it; allow it to stand one hour; pour off the Water and allow the Gelatin to drain for a few minutes; then transfer it to a tared dish, add the Glycerin, and heat it on a water-bath until the gelatin is dissolved. Strain the solution while hot, and continue to heat on the water-bath until the product weighs *two hundred grammes* [or 7 ounces av., 24 grains]. When cold, cut the mass into pieces, and preserve these in suitable containers." *U. S.*

This preparation was made official for the first time in the U. S. Pharm. (8th Rev.).

Uses.—Glycerinated gelatin is used solely as a vehicle in making gelatin suppositories, bougies, etc. (See *Suppositoria.*)

GELSEMIUM. U. S. (Br.)

GELSEMIUM

(ǧel-sĕm'i-ŭm)

"The dried rhizome and roots of *Gelsemium sempervirens* (Linné) Aiton filius (Fam. *Loganiaceæ*)." *U. S.* "The dried rhizome and roots of Gelsemium nitidum, *Michaux.*" *Br.*

Gelsemii Radix, *Br.,* Gelsemium Root, Yellow Jasmine, Yellow Jessamine, Carolina or American Yellow Jessamine, Yellow or Evening Trumpet Flower; Gelsemium, *Fr. Cod.;* Jasmin sauvage, *Fr.;* Gelsemie, Giftjasmin, *G.;* Gelsemio, *Sp.*

Gelsemium sempervirens (L), Ait. f., Britton and Brown; also Ait. f. (1211).—*Bignonia sempervirens,* L. (1753).—*Gelsemium nitidum,* Michx. (1803).—*G. lucidum,* Poiv.—The *yellow* or *Carolina jasmine* is one of the most beautiful climbing plants of our Southern States,[1] ascending lofty trees, and forming festoons from one tree to another, and during its flowering season, in the early spring, scenting the atmosphere with its delicious odor. The stem is twining, smooth, and shining; the leaves perennial, opposite, shortly petiolate, lanceolate, entire, dark green above, and paler beneath; the flowers in axillary clusters, large, of a deep-yellow color, and fragrant, with a very small, five-leaved calyx, and a funnel-shaped corolla, having a spreading, five-lobed, nearly equal border. The fruit is a flat, compressed capsule, divisible into two parts, two-celled, and furnished with flat seeds, which adhere to the margins of the valves. The plant grows in rich, moist soils along the sea-coast from Virginia to the south of Florida. The flowers are said to be poisonous. *Gelsemium elegans,* Benth., of upper Burma is an extremely poisonous creeper which contains gelsemine or an allied alkaloid.

Properties.—As we have seen it in commerce, the rhizome is sliced into pieces, about an inch in length, cylindrical or split, very light and fibrous, of a dirty yellowish-white color, but darker where the epidermis remains, of a slight, feebly narcotic odor, and a bitterish, not unpleasant taste. It is officially described as "cylindrical, usually in cut pieces of variable length, from 5 to 20, or even 30 Mm. in diameter; externally light yellowish-brown, with purplish-brown longitudinal lines; fracture of the rhizome splintery, the roots breaking with one-half the fracture transverse, the other half

[1] This official plant must not be confounded with the true yellow jasmine of Madeira, often planted in the Southern States, which is the *Jasminum odoratissimum,* L., which also has very fragrant yellow flowers.

oblique or short-splintery; bark about 1 Mm. thick; wood pale yellow, porous, but tough, with numerous distinct medullary rays, in the rhizome excentric, and with four groups of internal phloem; odor pronounced, characteristic; taste slightly aromatic, bitter." *U. S.* A microscopic character, said by Rothrock to be diagnostic, is the more or less complete division of the pith into four parts by plates of large, thin-walled cells. (*A. J. P.*, 1884.) For elaborate study of structure of gelsemium, see *A. J. P.*, 1898, 398; *A. J. P.*, 1899, 422; *D. C.*, 1901, 244. Sayre (*A. J. P.*, 1897, 8) found specimens of the root mixed with considerable proportions of the stem. Ingham (*A. J. P.*, 1897, 234) found that there was not much difference between the root and rhizome in alkaloidal value, but the stem does not appear to contain either gelsemine or gelsemic acid. (See also *A. J. P.*, 1897, 140.) Gelsemium yields its virtues to water, and readily to diluted alcohol. Analyzed by Henry Kollock, it was found to contain gum, starch, pectic acid, albumen, gallic acid, fixed oil, a fatty resin, a dry acrid resin, yellow coloring matter, volatile oil, extractive, lignin, a peculiar alkaloid called *gelsemine*, potassium, calcium, and magnesium salts, iron, and silica. The alkaloid, however, was not obtained sufficiently pure to admit of a full investigation of its properties. (*A. J. P.*, xxvii.) After Kollock's experiments, the alkaloid was obtained in a crystalline form, but still impure, by Maisch, from a tincture of the root, by a process of which a very brief abstract is given in *A. J. P.*, 1869, by C. L. Eberle, who in the same paper publishes the results of his own investigation. Eberle not only extracted gelsemine, but also satisfactorily established its alkaline properties, and proved that it was not contained in the wood of the root. Soon afterwards, the chemistry of yellow jasmine was more thoroughly investigated by Theo. G. Wormley. (*A. J. P.*, 1870.) He obtained pure gelsemine from the root and a peculiar acid, which he called *gelseminic* (gelsemic) *acid*.

Gelsemic or *Gelseminic Acid.*—Wormley obtained the acid from a fluidextract of the root, which is actually a concentrated tincture, by evaporating it on a water bath to about one-eighth of its volume, adding to the residue several times its bulk of pure water, allowing the mixture to stand until the supernatant liquid is nearly or quite clear, then transferring to a filter, washing the solids well with water, and reducing the filtrate thus obtained, together with the washings, on a water bath, to about the volume of the concentrated fluidextract. To this, filtered if necessary, hydrochloric acid is added in the proportion of a drop of the pure acid to each fluidounce of the original fluidextract; the acidulated liquid is then agitated with twice its volume of ether; and, after the liquids have separated, the ethereal portion is decanted, the aqueous liquid again agitated with a similar quantity of ether, which is in its turn decanted, and the aqueous part finally washed with about its volume of ether. On mixing the ethereal liquids thus obtained, and allowing them to evaporate spontaneously, the gelsemic acid is left, chiefly in the form of nearly colorless groups of crystals, together with more or less yellowish or brownish resinous matter. From this the crystals are separated by washing with a little cold absolute alcohol, which dissolves the resin, with but a little of the crystals.

To purify the crystals further, they are mixed with a little hot water, and extracted from the mixture when cool by chloroform, which, on spontaneous evaporation, yields them nearly if not quite colorless. The acid, when pure, is colorless, inodorous, almost tasteless, and readily crystallizable, usually in groups or tufts of fine needles. The action of concentrated nitric acid may be considered as a test. If a drop of this acid be added to gelsemic acid or any of its salts, it forms a yellow, reddish, or red solution, which, if treated with ammonia in excess becomes of a deep blood-red color, lasting for hours. The one-thousandth of a grain will exhibit these changes. Potassium, sodium, or ammonium hydroxide, added to the acid, cause it to become intensely yellow, and form with it highly fluorescent solutions. The acid is fusible, and, at a high heat, volatilizable without change. Robbins (*Deut. Chem. Ges.*, 1876, 1182), who has also investigated gelsemic acid, states that it is identical with *æsculin* (the glucoside of the horse-chestnut), and gives it the formula $C_{15}H_{16}O_9 + 1\frac{1}{2}H_2O$. Dragendorff and Schwartz both believed with Robbins that gelsemic acid was identical with æsculin.

The subject was (*A. J. P.*, July, 1882) re-investigated by Wormley, who found that gelsemic acid differs from æsculin in the following well-marked particulars: 1, in crystallization, the gelsemic acid crystallizing much more readily; 2, in solubility, the gelsemic acid being more soluble in ether and less soluble in water than æsculin; 3, gelsemic acid is not soluble in hydrochloric acid, while æsculin is; 4, corrosive sublimate gives a copious yellow precipitate with gelsemic acid, while it gives no result with æsculin; 5, copper sulphate and lead acetate yield precipitates with gelsemic acid differing from those of the same reagents with æsculin. The conclusion of Wormley, that they are "very different substances," has been confirmed by Coblentz. (*Proc. A. Ph. A.*, 1897, 225.) He found that gelsemic acid was not a glucoside, as it remained unchanged after prolonged boiling with diluted acids, no reaction with phenylhydrazine being obtainable. Coblentz explains Robbins' reaction with Fehling's solution by showing that gelsemic acid has active reducing powers upon copper, silver, mercury, and other similar metallic salts. The differences between it and æsculin may be thus summarized: Æsculin, formula $C_{15}H_{16}O_9 + 1\frac{1}{2}H_2O$, melts at 160° C.; gelsemic acid, formula $C_{13}H_{11}O_5$, melts at 206° C.; æsculin forms a penta-acetyl derivative melting at from 203° to 206° C.; gel-

semic acid forms a diacetyl derivative melting at 180° C.; æsculin splits up into sugar and æsculetin; gelsemic acid does not hydrolyze; æsculin forms a bromine derivative melting at from 193° to 195° C.; gelsemic acid forms a bromine derivative melting at 250° C.

E. Schmidt believes that Wormley's gelsemic acid is identical with *scopoletin* derived from scopola root, and gives the name as *β-methylæsculetin*, $C_9H_5(CH_3)O_4$.

Coblentz found that one part of gelsemic acid was soluble in 1490 parts of distilled water at 30° C., in 415 parts of absolute ether at 22° C., in 135 parts of chloroform at 24° C., and readily soluble in hot alcohol and glacial acetic acid.

Gelsemine.—This may be obtained, according to Wormley, from the concentrated extract from which gelsemic acid has been separated by ether, by rendering it slightly alkaline with potassium hydroxide (Schwartz prefers sodium hydroxide solution on account of the too great energy of the potassium hydroxide), then agitating repeatedly with chloroform, which dissolves the alkaloid with some impurities, and yields it, when evaporated at a very moderate heat, in the form of a hard, gum-like, yellowish or brownish-yellow solid. If this be treated with a little water, and acidulated with hydrochloric acid, it yields the alkaloid with some impurities to the liquid, which, if now filtered, evaporated to about one-sixteenth by volume of the original fluidextract employed, and then treated with a slight excess of potassium hydroxide, will give up the alkaloid in the form of a more or less white precipitate. This, upon being separated, and allowed to dry, shrinks greatly, and becomes dark. To purify it, the dry mass is powdered, and dissolved, with the aid of a few drops of hydrochloric acid, in a little water, from which the alkaloid is precipitated by a slight excess of potassium hydroxide, and then taken up by ether, which leaves it, on spontaneous evaporation, in the state of a very hard, brittle, and transparent mass, strongly adhering to the surface of the vessel employed. If now detached and pulverized, it forms a powder nearly or quite colorless. If still colored, it may be again treated with ether. Gelsemine was obtained in a much purer state than had been previously made by A. W. Gerrard. (*A. J. P.*, 1883, p. 258.) It is a brittle, transparent solid, crystallizing with difficulty from alcohol. Boiling water sparingly dissolves it. It softens at 38° C., and fuses at 45° C. The pure base gives no color reaction with strong nitric acid, and the mixture is scarcely changed in color by heating. Strong sulphuric acid has no apparent action upon it; but if to the mixture a little manganic oxide be added and then rubbed with a glass rod, a deep crimson-red is obtained, passing to green. This reaction is so delicate that it can be demonstrated with a solution of 1 in 100,000. If this reaction be performed upon the pure alkaloid, the color may be sufficiently intense to cause it to be mistaken for strychnine, but if a parallel experiment be carried on with strychnine, the two alkaloids cannot be mistaken, for the strychnine gives an intense purple, passing to red. Gerrard analyzed the alkaloid with care, and gives the formula $C_{12}H_{14}NO_2$ as its correct composition. F. A. Thompson (*Ph. Era*, 1887, p. 3) announced the presence of a second alkaloid, which he called *gelseminine*. After obtaining a solution of the alkaloids as sulphates he agitates it with an alkali and ether; the ethereal solution is shaken with water acidulated with hydrochloric acid, and the alkaloids are converted into hydrochlorides; gelseminine hydrochloride being easily soluble, and gelsemine hydrochloride less soluble, the latter is deposited on standing, and may be obtained pure by repeated crystallizations. He asserts that gelseminine differs greatly in physical and chemical properties from gelsemine, but, as he did not succeed in obtaining it absolutely pure, did not give the differences.

According to Cushny "*Gelsemine* is only slightly active, inducing the same symptoms in frogs as strychnine, but having no effect on mammals, even when injected into a vein in very large quantity. *Gelseminine*, on the other hand, is a powerful poison which resembles coniine in most of its effects. The action of gelsemium is undoubtedly due to gelseminine and not to gelsemine, as far as mammals are concerned.

The pupils are very widely dilated by gelseminine when a solution is applied locally to the eye, much less so in general poisoning, in which the respiration generally fails before the pupil is fully dilated. The power of accommodation is also entirely lost when gelseminine or gelsemium tincture is applied to the eye."

Uses.—Gelsemium [1] produces in the healthy adult agreeable sensations of languor, with muscular relaxation, so that the subject finds some difficulty in moving the eyelids and keeping the jaws closed. More largely taken, it occasions dizziness, dimness of vision, dilated pupil, general muscular debility, and universal prostration, reducing the frequency and force of the pulse, and the frequency of respiration. After very pronounced poisonous doses the symptoms which have just been enumerated are intensified: double or impaired vision, ptosis,

[1] Gelsemium is said to have been long popularly employed as a vermifuge in the Southern and Southwestern States; but its more valuable properties have been known but a few years. Their discovery was accidental. A planter of Mississippi, laboring under an obstinate bilious fever, directed his servant to get a particular root from the garden and prepare a tea from it. The tea was prepared accordingly, and drunk by the invalid, who was soon afterwards affected with great prostration, and especially muscular debility, so that he could not raise a limb, but without stupor. These effects gradually passed off, and with them the fever. The servant had made a mistake in the root, and dug that of the gelsemium instead of the one intended. The planter, having made this discovery, employed the root afterwards with success upon his own plantation and in the neighborhood. The remedy passed into the hands of irregular practitioners, and was used by the "eclectic physicians" before its virtues came to the knowledge of the profession.

dilated insensible pupils, falling of the lower jaw, loss of power of enunciation, and excessive muscular relaxation are associated with slow, labored breathing, which in some cases is interrupted by violent spells of dyspnœa; consciousness is long unimpaired, but is apt to be lost before death, and in rare cases unconsciousness has been present, even although recovery followed. Of the various symptoms of gelsemium poisoning the most characteristic are the dropping of the jaw and the ocular manifestations, combined with general muscular relaxation. The effects usually begin in half an hour, but sometimes almost immediately. According to Wormley, death has occurred at periods which vary from one to seven and a half hours. Twelve minims of the fluidextract are said to have proved fatal to a boy three years old, and thirty-five drops of a tincture of the bark have caused death in one hour and a half. In several instances a drachm of the fluidextract has, under treatment, been recovered from. M. P. Hatfield has recorded a case in which fifteen grains of a resinoid extract of gelsemium caused the death of a woman in one hour.

The treatment of poisoning by gelsemium should consist in evacuating the stomach, maintaining absolute rest in the horizontal position, keeping up the bodily temperature, if required, by external warmth, and administering spinal and arterial stimulants. We have very little experimental data as to the physiological antidotes to gelsemium. Our general knowledge indicates that morphine, atropine, strychnine, and digitalis given hypodermically should be of service in the treatment of the poisoning, and Courtright (quoted by Wormley) narrates a case in which the hypodermic injection of three grains of morphine, in divided doses, within a few moments was followed by marked improvement and recovery, although the patient had taken between one and two teaspoonfuls of the tincture of gelsemium. The combined injection of atropine and morphine probably affords the best available treatment.

Physiological studies, while by no means complete, have thrown much light upon the action of gelsemium. The muscular weakness which it causes is always associated with a depression of reflex activity, and is the result of a direct paralyzing influence upon the spinal cord, as probably is also the diminution of sensibility, the nerves and muscles not being sensibly affected by the poison. The action upon the circulation is less marked than upon the nervous system, the heart and arterial pressure not being much affected by therapeutic doses. After toxic amounts there is great depression of the circulation, which has been shown by I. Ott to be at least in part due to a direct action upon the heart. The dilatation of the pupil which is present in poisoning with the drug, and which is also produced by its local application to the eye, is probably due to a paralysis of the oculomotor nerve, to which also may be ascribed the palsy of accommodation and of the external rectus muscle. The diseases in which the medicine has been prescribed are *intermittent, remittent, typhoid,* and *yellow fevers, inflammation* of the *lungs* and *pleura, dysentery, rheumatism, neuralgia, dysmenorrhœa, delirium tremens, trismus nascentium, chorea, hysteria,* and *epilepsy.* The drug is, however, not applicable to the treatment of low fevers, and is not sufficiently powerful as a cardiac depressant to be relied upon in very sthenic inflammations; its use should be chiefly restricted to spasmodic and neuralgic affections. In supraorbital *neuralgia, dysmenorrhea,* and in *odontalgia* it has been especially commended.

There is much testimony as to its antiperiodic properties, and it may be used as an adjuvant to quinine in the treatment of *remittent fever.* James D. McGarghey praises it especially in cases of *intermittent fever,* when the attacks are disposed to return obstinately and irregularly. (*P. M. T.,* March 7, 1874.) It has also been employed with a measure of success in controlling *cardiac palpitations.* The gelsemine of Wormley included gelseminine and was consequently powerful. Until both alkaloids are found in commerce in a state of purity it would be unwise to state the dose of either.

Gelsemium should be administered in the form either of the tincture or of the fluidextract, the dose of the tincture being ten minims (0.6 Cc.), that of the fluidextract two minims (0.12 Cc.); to be repeated, if necessary, every 2, 4, or 6 hours, and gradually increased until the object is obtained, or some obvious effect is produced on the system.

Dose, of gelsemium, one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Fluidextractum Gelsemii, *U. S.;* Tinctura Gelsemii, *U. S., Br.*

GENTIANA. U. S. (Br.)

GENTIAN

(gĕn-tī-ā'nạ)

"The dried rhizome and roots of *Gentiana lutea* Linné (Fam. *Gentianaceæ*)." *U. S.* "The dried rhizome and roots of Gentiana lutea, *Linn.*" *Br.*

Gentianæ Radix, *Br.,* Gentian Root, Bitter Root, Fel Root; Radix Gentianæ Rubræ (vel Luteæ vel Majoris); Gentiane (Racine), *Fr. Cod.;* Racine de Gentiane (de Gentiane jaune), Gentiane jaune, *Fr.;* Radix Gentianæ, *P. G.;* Enzian, Enzianwurzel, Bitterwurzel, Rother Enzian, *G.;* Genziana, *It.;* Genciana (Raiz de), *Sp.*

Gentiana lutea, Willd., *Sp. Plant.* i. 1331; Woodv., *Med. Bot.,* p. 273, t. 95; Carson, *Illust. of Med. Bot.,* ii. 12, pl. 60—*Yellow Gentian* is among the most remarkable of the species which compose this genus, both for its beauty and great comparative size. From its thick, long, branching, perennial root, an erect, round stem rises to the height of three or four feet, bearing opposite, sessile, ovate, acute, five-nerved leaves of a bright-green color, and somewhat glaucous. The lower leaves, which spring from the root,

are narrowed at their base into the form of a petiole. The flowers are large and beautiful, of a yellow color, peduncled, and placed in whorls at the axils of the upper leaves. The calyx is monophyllous, membranous, yellowish, and semi-transparent, splitting when the flower opens, and reflected when it is fully expanded; the corolla is rotate, and deeply divided into five or six lanceolate, acute segments; the stamens are five or six, and shorter than the corolla. The plant grows among the Apennines, the Alps, the Pyrenees, and in other mountainous or elevated regions of Europe. It is stated by Bourquelot and Hérissey that in order to develop the deep colored fracture preferred by many druggists the root is frequently submitted to fermentation by heaping it up into a mass which becomes heated. Gentian root which has thus been treated is said to yield 27 per cent. less extractive than does that which has been properly dried. Further, even in the best commercial dried root the *sucrose, gentianose* and *gentiopicrin* of the fresh root are present only in extremely small amounts. (*J. P. C.*, 6, 16, 513.)

Several other species possess analogous virtues, and are used for similar purposes. The roots of *G. purpurea* and *G. punctata,* inhabiting the same regions as *G. lutea,* and of *G. pannonica,* growing in Austria, are said to be often mingled with the official, from which they are scarcely distinguishable. The *G. macrophylla* of Pallas is used in Siberia; one indigenous species, *G. Catesbæi* (now *G. Elliottii,* Chapm.),[1] growing in the Southern States, formerly had a place in the secondary catalogue of the U. S. Pharmacopœia, and is reputed to be but little inferior to the official species. *G. quinquefolia,* L. (*G. quinqueflora,* Lam.), growing throughout the Northern and Northwestern States, is said to be much used in domestic practice. In Europe the rhizome of the *G. asclepiadea* and *G. lutea* are often admixed with the official rhizome. According to Vogl they can be detected by the abundance of lignified prosenchymatous elements and stone cells, the genuine powder containing scarcely any lignified elements other than large reticulated vessels. (*O. Z.*, 1903, 141.)

Properties.—As found in commerce, gentian is in pieces of various dimensions and shapes, usually of considerable length, consisting sometimes of longitudinal slices, sometimes of the root cut transversely, twisted, wrinkled externally, sometimes marked with close transverse rings of a grayish-brown color on the outside, yellowish or reddish within, and of a soft, spongy texture. It is officially described as occurring "in nearly cylindrical pieces or longitudinal slices, of variable length and from 5 to 35 Mm. thick; externally yellowish-brown, the rhizome annulate, the roots longitudinally wrinkled; fracture short but uneven, the bark rather thick, separated from the somewhat spongy, reddish-yellow or brownish inner portion by a dark brown cambium zone; odor strong, characteristic; taste slightly sweetish, strongly and persistently bitter. The powder is free from starch grains and sclerenchymatic tissues." *U. S.* No distinct pith, liber cells, starch granules, or raphides are found in gentian. (See *P. J.*, 1872, 42.) The odor is feeble, but decided and peculiar. The taste is slightly sweetish and intensely bitter, without being nauseous. The powder is yellowish. Water and alcohol extract the taste and virtues of the root. "Gentian Root should not yield any definite reactions with the tests for starch." *Br.*

Kromayer, in 1862, first obtained the bitter principle of gentian in a state of purity, and gave it the name of *gentiopicrin,* and the formula $C_{20}H_{30}O_{12}$. It is a neutral body, crystallizing in colorless needles, which readily dissolve in water. It is soluble in spirit of wine, but in absolute alcohol only when aided by heat; it does not dissolve in ether. A solution of sodium hydroxide forms with it a yellow solution. Under the influence of diluted acids, gentiopicrin is resolved into glucose and an amorphous yellowish-brown neutral substance named *gentiogenin.* Fresh gentian roots yield about one-tenth per cent. of gentiopicrin. Another constituent is *gentianin* or *gentisin,* $C_{14}H_{10}O_5$. It forms tasteless, yellowish prisms, subliming with partial decomposition at a temperature over 300° C., sparingly soluble in alcohol, and with alkalies yields intensely yellow, crystallizable compounds, easily decomposed by carbon dioxide. Von Kostanecki (*A. J. P.*, 1891, p. 192), by boiling gentisin with hydriodic acid, succeeded in demethylating it, and so obtained *gentisein,* $C_{13}H_8O_5$, which crystallizes with $2H_2O$ in fine straw-colored needles; these become anhydrous at 100° C. A triacetyl derivative was then formed from this gentisein. Gentisin is therefore the methyl ether of gentisein, and can be written

$$C_{13}H_5O_2\begin{cases}OCH_3\\OH\\OH\end{cases}.$$

Hlasiwetz and Habermann showed, in 1875, that when *gentianin* was melted with potassium hydroxide it yielded *phloroglucin,* $C_6H_3(OH)_3$, and *dioxybenzoic acid,* $C_6H_3.(OH)_2COOH$. The latter was at first called *gentianic* or *gentisinic acid.* Maisch believed that tannin is absent from gentian root, and states that the dark olive-green coloration

[1] *Gentiana Elliottii,* Chapm.—The blue gentian has a perennial, branching, somewhat fleshy root, and a simple, erect, rough stem, rising eight or ten inches in height, and bearing opposite leaves, which are ovate-lanceolate, acute, and rough on their margin. The flowers are of a palish-blue color, crowded, nearly sessile, and axillary or terminal. The divisions of the calyx are linear-lanceolate, and longer than the tube. The corolla is large, ventricose, plaited, and divided at its border into ten segments, of which the five outer are more or less acute, the five inner bifid and fringed. The number of stamens is five, and the two stigmas are seated on the germ. The capsule is oblong, acuminate, with two valves, and a single cell. *G. Elliottii,* Chapm. grows in the grassy swamps from Virginia to Florida, where it flowers from September to December. It was named by Elliott (1817) in honor of Catesby. It may be given in powder in the dose of from fifteen to thirty grains, or in the form of extract, infusion, wine or tincture.

observed when ferric chloride is added to its preparations is due to gentisic acid (*A. J. P.*, 1876). Ville (*A. J. P.*, 1877) and Davies (*P. J.*, 1879) maintain that there is a small quantity of tannin in gentian root. Patch (*A. J. P.*, 1876) found that an alcoholic solution of an ethereal extract of gentian yielded a dark-green coloration with ferric salts, but if the alcoholic solution were diluted with water it yielded no precipitate with gelatin. Subsequently (*Proc. A. Ph. A.*, 1881) he showed that there was a principle associated with the resinous matter in gentian (but which was not isolated in a state of purity) that produced the reactions of a tannin, viz., a greenish-black color with ferric chloride, and precipitated by tartar emetic, cinchonidine sulphate, and gelatin. Louis Magnes found in the root, when perfectly dried at 100° C. (212° F.), 15 per cent. of glucose, and 12 per cent. in the root in its ordinary state. (*A. J. P.*, pp. 333-4.) When gentian is macerated in cold water, it undergoes the vinous fermentation, in consequence of the presence of this saccharine principle. From the fermented infusion a spirituous liquor is obtained by distillation, which, though bitter, and having an unpleasant odor, is said to be relished by the Swiss and Tyrolese. A. Meyer (*Ph. Cb.*, 1882, May) obtained a sweet principle, which he called *gentianose*, $C_{18}H_{36}O_{31}$, by precipitation of the filtered juice with alcohol, treatment with ether, and crystallization from alcohol. It does not reduce Fehling's solution. Infusion of gentian is precipitated by tannic acid and the soluble salts of lead, but is compatible with the salts of iron. Pectin, so frequently found in fleshy roots, exists in gentian. (Bourquelot and Herissey, *Répert. de Pharm.*, 1898.) The yellow coloring matter of the root was investigated by E. V. Howell, who concludes that it is quercitrin.

Uses.—Gentian possesses in a high degree the tonic powers of the simple bitters. It excites the appetite and invigorates digestion. In very large doses, however, it is apt to oppress the stomach, to irritate the bowels, and even to occasion nausea and vomiting. It has been known from the highest antiquity, and is said to have derived its name from Gentius, a king of Illyria. Many of the complex preparations handed down from the Greeks and Arabians contain it among their ingredients; and it enters into most of the stomachic combinations employed in modern practice. It may be used in all cases of pure debility of the digestive organs, or where a general tonic impression is required. *Dyspepsia, atonic gout, amenorrhœa, hysteria, scrofula,* and *intermittent fever* are among the many affections in which it has proved useful, but it is the condition of the stomach and of the system generally, not the name of the disease, which must be taken into consideration in prescribing it, and there is scarcely a complaint in which it can be advantageously given under all circumstances. The porous property of the root causes it to expand with moisture, and it has been employed as a substitute for sponge tent in the enlargement of strictured passages.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Extractum Gentianæ, *U. S.*, *Br.;* Fluidextractum Gentianæ, *U. S.;* Infusum Gentianæ Compositum, *Br.;* Tinctura Gentianæ Composita, *U. S.*, *Br.*

GERANIUM. U. S.

GERANIUM [Cranesbill]

(ge-rā'nĭ-ŭm)

"The dried rhizome of *Geranium maculatum* Linné (Fam. *Geraniaceæ*)." *U. S.*

Cranesbill Root, Spotted or Wild Cranesbill, or Storksbill, Alum Root; Racine de Bec-de-Grue tacheté, Racine de Pied-de-Corneille, *Fr.;* Fleckstorchschnabelwurzel, *G.*

Geranium maculatum, L., *Sp. Pl.* (1753), 681; Willd., *Sp. Plant.* iii. 705; Bigelow, *Am. Med. Bot.*, i. 84; Barton, *Med. Bot.*, i. 149.—This plant has a perennial, horizontal, fleshy rhizome, which is furnished with short fibres, and sends up annually an herbaceous stem, with several radical leaves. The stem is erect, round, dichotomously branched, from one to two feet high, of a grayish-green color, and thickly covered, in common with the petioles and peduncles, with reflexed hairs. The leaves are deeply divided into three, five, or seven lobes, which are variously incised at their extremities, hairy, and of a pale green color, mottled with still paler spots. Those which rise from the root are supported on footstalks eight or ten inches long; those of the stem are opposite, the lower petiolate, the upper nearly sessile, with lanceolate or linear stipules. The flowers are large, and usually of a rose-purple color. The peduncles spring from the forks of the stem, and severally support two flowers upon short pedicels. The calyx is composed of five oblong, ribbed, cuspidate leaves; the petals are five, obovate, and entire; the stamens ten, with oblong, deciduous anthers, the five alternate filaments being longer than the others, and having glands at their base; the ovary is ovate, supporting a straight style as long as the stamens, and surmounted by five stigmas. The fruit consists of five aggregate, one-seeded capsules, attached by a beak to the persistent style, curling up and scattering the seeds when ripe. The plant is indigenous, growing throughout the United States in moist woods, thickets, and hedges, and generally in low grounds. It flowers from May to July. The root should be collected in autumn.

Properties.—Geranium occurs in pieces from one to three inches long, from a quarter to half an inch in thickness, somewhat flattened, contorted, wrinkled, tuberculated, and beset with slender fibres. It is externally of an umber-brown color, internally reddish gray, compact, inodorous, and of an astringent taste, without bitterness or other unpleasant flavor. "Of horizontal growth, cylindraceous, somewhat flattened and rather sharply tuberculated,

2.5 to 10 Cm. long and 3 to 15 Mm. in diameter; longitudinally wrinkled, dark brown; fracture short, light reddish brown or purplish; bark thin; wood indistinct; central pith large; odor slight; taste strongly astringent." *U. S.* Water and alcohol extract the virtues of geranium. According to Edward Staples, it contains tannic and gallic acids, mucilage, red coloring matter, resin, and a crystallizable vegetable principle. (*A. J. P.*, 1829, p. 171.) Tilden found, besides tannic and gallic acids, gum, pectin, sugar, starch, albumen, resin soluble in alcohol, oleoresin soluble in ether only, coloring matter, chlorophyll, lignin, and various salts. (*P. J.*, 1863, p. 22.) Tannic and gallic acids are probably the sole active ingredients. Henry Trimble and J. C. Peacock (*A. J. P.*, 1891, p. 265) collected the plant at periods of the year ranging from January to October, and determined the percentage of tannin as calculated for the perfectly dry drug to vary from 9.72 to 27.85 per cent. They also determined that it belonged to the class of tannins analogous to gallo-tannic acid, yielding pyrogallol on heating. They decomposed the tannin by the action of hydrochloric acid, obtaining gallic acid, glucose, and geranium red as products.

Uses.—Geranium is one of our best indigenous astringents, and may be employed for all the purposes to which these medicines are applicable. The absence of unpleasant taste and of other offensive qualities renders it peculiarly serviceable in the case of infants and of persons of very delicate stomach. *Diarrhœa, chronic dysentery, cholera infantum* in the later stages, and the various hemorrhages, are the forms of disease in which it is most commonly used and with greatest advantage; but care should be taken, before it is administered, that the condition of the system and of the part affected is such as not to contra-indicate the use of astringents. As an application to *indolent ulcers,* an injection in *gleet* and *leucorrhœa,* and a gargle in *relaxation of the uvula* and *aphthous ulcerations* of the throat, it answers the same purpose as kino, catechu, and other medicines of the same class. It is a popular domestic remedy in various parts of the United States, and is said to be employed by the Indians. It may be given in substance, decoction, tincture, or extract.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Fluidextractum Geranii, *U. S.*

GLANDULÆ SUPRARENALES SICCÆ. U. S.

DESICCATED SUPRARENAL GLANDS

(glăn'dŭ-læ sū-prą-rę-nā'lęs sĭc'çæ)

"The suprarenal glands of the sheep (*Ovis aries* Linné) or ox (*Bos taurus* Linné), freed from fat, and cleaned, dried, and powdered." *U. S.*

Glandes Surrénales desséchées, *Fr.;* Getrocknete Nebennieren, *G.*

This powder was introduced into the U. S. Pharm. (8th Rev.) for the first time.

Properties.—It is officially described as "a light yellowish-brown, amorphous powder, having a slight, characteristic odor; partially soluble in water. One part of Desiccated Suprarenal Glands represents approximately 6 parts of fresh glands, free from fat. Upon incineration it should not yield more than 7 per cent. of ash. If 0.5 Gm. of Dessicated Suprarenal Glands be macerated with 25 Cc. of water for fifteen minutes, and filtered, the filtrate should give an emerald-green color upon the addition of a few drops of ferric chloride T.S. The green color disappears quite rapidly." *U. S.* In no portion of physiology is there at present more uncertainty of knowledge and activity of research than in regard to the functions of the suprarenal bodies. Two theories have been strenuously upheld,—one that these bodies have for their function the destruction of certain poisons, and that the substances found in them have been gathered out from the blood for the purposes of removal; the other that the suprarenal bodies produce a very active substance necessary for the health of the organism.

Whichever of these theories be correct, it is established that the suprarenal bodies do contain in them a substance of remarkable physiological activity. This principle was first isolated in the form of its benzoyl compound by John J. Abel of Johns Hopkins University, and called *epinephrin.* Later it was obtained in the crystalline state by Takamine and by Aldrich, the former giving it the formula $C_{10}H_{15}NO_3$, while the latter found the formula $C_9H_{13}NO_3$. Takamine gave his preparation the name *adrenalin,* and its commercial manufacture was begun under this name. Abel (*A. J. P.*, 1903, p. 309) considered that neither the Takamine nor the Aldrich preparations were pure, and for the pure product, which he calls *epinephrin hydrate,* he gives the formula $C_{10}H_{13}NO_3 + \frac{1}{2}H_2O$. Jowett (*C. D.*, 1904, p. 276), as the result of a study of the subject, declares for the formula $C_9H_{13}NO_3$, proposed by Aldrich.

Uses.—It is probable that the suprarenal glands or so-called capsules have two functions; one the destruction of poisons in the blood and second the secretion of a substance which has a powerfully stimulating effect on the general circulation, acting at the same time upon the heart itself and upon the muscular coats of the arterioles. The intravenous injection of the extract of the glands produces an enormous rise in the arterial pressure, which, however, is extremely transitory, probably on account of the destruction of the active principle in the system. Both Gottlieb and Langlois failed to prolong the action of the extract by ligating the renal arteries. When given hypodermically the action of the glands upon the circulation is very feeble and when administered by the mouth it produces no sensible effect. According to Lewandowsky it acts as a stimulant, not only to the vascular muscle fibres, but to all

the involuntary muscles, including those of the intestines and to the erector pilæ. In the rabbit the repeated injection of the active principle of suprarenal glands has led to pulmonary œdema and extreme atheroma of the arteries.

On account of the feebleness of its influence when given by the mouth the suprarenal extract is of very little practical use as a general stimulant to the circulation, but its active principle or the thoroughly aseptic extract given intravenously may be of service in *shock* and sudden *cardiac collapse* such as sometimes occurs during anæsthesia and under other conditions. The repeated use of the substance would seem, however, interdicted on account of the danger of causing œdema of the lungs.

As a local stimulant to the vessels the extract is an extremely valuable remedy in the treatment of inflammations of the mucous membrane as *conjunctivitis, rhinitis, pharyngitis, hay fever* and the like. Owing to its vaso-constrictor effect it has also been found of service in local hemorrhages as *epistaxis, hematemesis, intestinal bleeding* and *operative hemorrhage.*

Internally it is of value in *Addison's disease.* It has been recommended by Cohen in *asthma,* and by Huchard in *neurasthenia.* The proprietary preparation of the adrenals known as *rachitol,* supposed to be of value in *rickets,* appears to be useless.

Locally, the suprarenal may be used in solutions of the extract in the proportion of 5 to 25 per cent. As these solutions form excellent culture media for bacteria they are not permanent unless an antiseptic is added. The solution of the alkaloid, which is marketed under various trade names in the form of a 1 to 1000 solution, may be used as a hemostatic or in the treatment of congestions and inflammations in a 1 to 10,000 solution. Internally the dried extract is given in doses of five to ten grains (0.3 to 0.6 Gm.).

Dose, five to twenty grains (0.32 to 1.3 Gm.).

GLANDULÆ THYROIDEÆ SICCÆ.
U. S. (Br.)

DESICCATED THYROID GLANDS

(glăn'dŭ-læ thī'röĭ'dę-æ sĭc'çæ)

"The thyroid glands of the sheep (*Ovis aries* Linné), freed from fat, and cleaned, dried, and powdered." *U. S.*

"A powder prepared from the fresh and healthy thyroid gland of the sheep. Remove the external fat and connective tissue from thyroid glands taken from sheep immediately after killing. Cut the glands across, and reject any which contain cysts, are hypertrophied, or otherwise abnormal. Mince finely the healthy glands, and dry at a temperature of 90° to 100° F. (32.2° to 37.8° C.); powder the dried product; remove all fat from it by treatment with *petroleum spirit;* and again dry the residue." *Br.*

Thyroideum Siccum, *Br.;* **Dry Thyroid; Getrocknete Schilddrüsen,** *G.*

Desiccated thyroid glands were introduced into the U. S. P. (8th Rev.) for the first time; the British Pharmacopœia introduced this preparation in the 1898 edition (see also *Liquor Thyroidei*). The process for dry thyroid is given above; the objection to its use is that the powder may contain bacteria, or even ptomaines, if great care is not used in its preparation; it is also stated that glycerin does not dissolve all of the thyroiodin which is the principal active constituent, and "Thyroid Solution" cannot be thoroughly representative.

Properties.—Dry thyroid is officially described as "a yellowish, amorphous powder, having a slight, peculiar odor, and containing the active ingredients of the thyroid tissue; partially soluble in water. One part of Desiccated Thyroid Glands represents approximately 5 parts of the fresh glands. Upon incineration it should yield not more than 6 percent. of ash. If 1 Gm. of Desiccated Thyroid Glands be mixed with an equal weight of pure sodium hydroxide and carefully fused in a silver dish, and oxidized by adding potassium nitrate while fusing, until a white mass remains, and if the fused mass be dissolved in a small quantity of water, the solution treated with 2 Gm. of sodium nitrite, acidified with concentrated nitric acid, and then shaken with 5 Cc. of chloroform, a decided pink to violet coloration should be imparted to the latter (presence of *iodine compounds*). A cold extract of Desiccated Thyroid Glands treated with 2 Gm. of sodium nitrite and acidified with strong nitric acid should not give the iodine test on shaking with chloroform." *U. S.* "A light dull-brown powder, with a very faint meat-like odor and taste, and free from any flavor of putrescence. It is liable to become damp on exposure to the air, and then deteriorates." *Br.* Many preparations of the thyroid glands are upon the market, most of which are powders or so-called standardized extracts. The active principles have not been isolated in such a state of purity as to admit of accurate description.

In 1895 Baumann (*Zeits. f. Phys. Chemie,* Bd. xxi.) announced the discovery in the thyroid body of *thyroiodin,* and his allegation that it is the active principle of the thyroid gland has been confirmed by E. Roos, Arthur Hennig, Truebel, Ewall, E. Levy, and others, so that its remedial activity seems to be established, although it is probable that there is a second active substance in the gland. *Thyreoantitoxin* of Fränkel (*Aerztl. Central Anzeiger,* 1895) contains no iodine and appears not to be active. Luiffet (*P. J.,* 1900, 440) confirms the results of Baumann that the iodine content of the glands varies in animals, and that the thyroids

of sheep fed on salt marshes are richer in iodine than those grazed on pastures not abnormally saline. The U. S. P. test for iodine content has been criticised, some chemists asserting that desiccated thyroid glands are effective when they do not respond to this test. See also *P. J.*, 1898, 482.

Iodo-globulin, which is believed to be active, is destroyed by boiling in acid or alkaline solutions, but may be extracted by macerating the glands in cold water and evaporating the solution at 100° C. (212° F.). Thyroiodin exists in small proportion (1 in 333). E. C. C. Stanford has furnished the following process for the mixed powder termed *thyroglandin.* "The thyroid glands, freed from fat and minced, are first macerated in four to five times their weight of cold water, using ice if necessary in summer to keep down the temperature to 50° F., for twenty-four hours, and this maceration is repeated. The solutions are filtered off and evaporated to dryness at a temperature not exceeding 212° F. The extract is powdered, and represents the iodo-globulin and a small proportion of saline matter. The residue from the cold water maceration is boiled for one hour with a 1 per cent. solution of sodium hydroxide (in the proportion of 1 per cent. of sodium hydroxide to the original weight of the glands). The solution is allowed to cool to deposit the fat, and filtered off. This solution is then carefully neutralized with hydrochloric acid and evaporated to dryness at 212° F.; the residue, which contains all the thyroiodin, is then powdered and mixed with the iodo-globulin obtained in the first process. The resulting powder is thyroglandin." (*Y. B. P.*, 1898, 354.)

Uses.—It has been proved upon the human being by Kocher of Berne, and upon monkeys by Horsley of London, that the removal of the thyroid body is followed by the production of increasing weakness, associated with swelling of the body, enlargement and thickening of the skin, mucoid exudation into the subcellular tissue, and a very extraordinary slowing of all functions,—a condition which progresses until the subject sinks into a state of complete apathy, with subnormal temperature and failure of all vital functions. This congeries of symptoms is the same as that previously described under the name of *myxœdema* by Ord. Both surgical and idiopathic myxœdema have in a large number of cases been treated by the use of the thyroid extract, with such extraordinary results as to leave no doubt but that this extract is a specific in myxœdematous diseases, and is also an extremely valuable remedy in *cretinism,* a condition very closely allied to myxœdema.

In a number of cases the free continuous exhibition of the thyroid gland has been followed by progressive loss of weight, shortness of breath, weak and rapid pulse, and great nervousness, constituting the condition known as *thyroidism.* The loss of weight, which is very marked, appears to be in part accounted for by an increased destruction of the nitrogenous substances of the body, with a corresponding increase in the output of urea, but in chief part to the result of the destruction of fat. From studies on the lower animals and upon man it is plain that the thyroid gland contains in it some substance which pronouncedly affects nutrition, a fact the recognition of which by the profession has led to the experimental use of the thyroid body in a very large number of conditions connected with disturbed nutrition. It seems well established that the drug is valuable in that form of *goitre* which is indigenous to Switzerland, but is much more likely to do harm than good in *exophthalmic goitre* or *Basedow's disease.* Also, that it is often of great service in the treatment of *obesity.* It has been widely used in various forms of *insanity* and in various diseases of the skin, with, on the whole, not satisfactory results, so that its employment in these affections may be said to be already passing out of vogue. Great advantage, however, is asserted to have followed its use in cases of *keloidal scars* where there has been excessive formation of fibrous tissue.

In all these cases the thyroid preparation acts simply by supplying to the system an organic principle which the thyroid body in the patient has failed to produce in sufficient quantity. The thyroid body is, therefore, in most cases a palliative, so that its continuous administration is necessary, large doses being first given until the evils wrought by the absence of the thyroid gland have been overcome, and smaller doses being afterwards exhibited to maintain the bodily health which has been restored by the larger doses. The raw or slightly boiled thyroid gland may be used to the amount of from a quarter to half of the gland of the sheep daily, but the preparations are perhaps equally efficacious and certainly much better taken by patients. Under the name of *iodothyrin* there is sold commercially a substance claiming to be thyroiodin with sugar; it is said to be of such strength that one gramme of it contains 0.3 milligramme of iodine and is equivalent to one gramme of the fresh gland. A dose of from one to two grammes a day may be given to an adult. The rule is, in all cases in which the thyroid body is used, to increase the dose until a satisfactory result is obtained or slight evidences of thyroidism appear. In an elaborate series of experiments, R. H. Cunningham believed that he had proved that the symptoms of thyroidism are simply produced by secondary products of decomposition in the thyroid body during the making of these preparations, and may be caused by extracts from almost any kind of animal tissues, and reached other conclusions gainsaying the value of the thyroid body as a therapeutic agent. A discussion of this matter would require too much space to be entered into here. Suffice it at present to state that the clinical and experi-

mental evidences of the value of the thyroid gland in the conditions spoken of seem to us unimpugnable.

Of the dried extract the *dose* is from one to three grains (0.065 to 0.2 Gm.), three times a day, in capsules.

Dose, two to five grains (0.13 to 0.32 Gm.).

Off. Prep.—Liquor Thyroidei, *Br.*

GLYCERINUM. U. S., Br.

GLYCERIN GLYCEROL

(glĭç-ẹ-rĭ'nŭm)

"A liquid obtained by the decomposition of vegetable or animal fats, or fixed oils, and containing not less than 95 percent. of absolute Glycerol, a triatomic alcohol [$CH_2OH.CHOH.CH_2OH = 91.37$]." *U. S.* "Glycerin, or glycerol, is a trihydric alcohol, $C_3H_5(OH)_3$, associated with a small percentage of water; it is obtained by the interaction of alkalies, or of superheated steam, with fats and fixed oils." *Br.*

Glycerina, *U. S.* 1870; Glycerine; Glycerine officinale, *Fr. Cod.;* Glycerinum, *P. G.;* Glycerin, Glyceryloxyhydrat, Oelsüss, Scheelesches Süss, *G.;* Glicerina, *It., Sp.*

Litharge, olive oil, and water are boiled together in the 1890 process for making lead plaster; the olein of the oil is decomposed by the lead oxide, according to the following reaction:

$$2(C_3H_5(OC_{18}H_{33}O)_3) + 3PbO + 3H_2O = 2(C_3H_5(OH)_3) + 3(Pb(OC_{18}H_{33}O)_2)$$

by which lead oleate or plaster and free glycerin are obtained. (See *Emplastrum Plumbi.*) It follows, therefore, that the plaster, while still hot and in the liquid state, contained glycerin diffused through it. It was this process that was used for preparing glycerin in the formula of U. S. P. 1850. In accordance with this, when the liquid plaster is mixed with an equal measure of boiling water, and the mixture stirred briskly, a solution of glycerin is obtained, which, after having been decanted, and evaporated to a limited extent, is freed from lead by hydrogen sulphide. The liquid is then filtered to separate lead sulphide, heated to free it from hydrogen sulphide, and finally evaporated to expel the water, which is known to be all removed when the mass ceases to lose weight.

Glycerin was discovered in 1789 by Scheele, by whom it was called the *sweet principle of oils.* It is produced not only during the saponification of the fats and oils by lead oxide in forming lead plaster, but also during the same process when effected by potassium and sodium hydroxides in the manufacture of soap, the alkalies uniting with the fatty acids and setting the glycerin free. Soap-maker's waste is an abundant source of glycerin; but when thus obtained it is apt to have more or less odor, which even percolation through animal charcoal does not always remove. The recovery of glycerin from spent soap lyes is now effected very generally by the Van Ruymbeke process. The lye is settled and drawn off from the sludge, treated with a "persulphate of iron" containing about 50 per cent. of sulphuric acid, which forms a copious precipitate of ferric hydroxide and iron soaps and carries down all other insoluble impurities. After filtration, the lye, which is nearly water-white, is evaporated in vacuo. Some sodium sulphate and sodium chloride crystallize out, after which the glycerin is concentrated and distilled under a high vacuum. The two methods of saponification by which glycerin has been obtained on a large scale are the process of Wilson and Payne, of decomposing the fats by superheated steam and subsequent distillation, and the lime autoclave process of Milly. The process of Richard A. Tilghman of Philadelphia (the patent for which was obtained in 1854, and, after years of litigation, was at last sustained in 1888), consists in subjecting fatty bodies to the action of water at a high temperature under pressure, whereby the fats, which are *glycerides* or *esters* of the fatty acids, are broken up into free glycerin and free fatty acids, the water supplying the elements of hydrogen and oxygen necessary for that change. The reaction is as follows for the case of a fat like stearin:

$$C_3H_5(OC_{18}H_{35}O)_3 + 3H.OH = C_3H_5(OH)_3 + 3C_{18}H_{35}O.OH$$

(See *A. J. P.,* March, 1855, p. 121.) Through a distillatory apparatus containing palm oil, heated steam between 550° and 600° F. is passed. The oil is decomposed into free acids and glycerin, which, together with water, distil over, and, condensing in the receiver, separate into two layers, the lower of which is glycerin. If this, as first procured, contains too much water, it must be concentrated; if discolored, it must be redistilled with steam. (*P. J.,* 1861, p. 350.) Ordinary impure glycerin may be purified by distillation with steam under pressure. Though, when distilled alone, it is partially decomposed, giving off pungent vapors of *acrolein,* yet in a current of superheated steam it passes over unchanged at temperatures between 204.4° and 260° C. (400° and 500° F.). Very pure glycerin is now produced in this country in immense quantities. The United States also imports considerable quantities of glycerin, the amounts for the last three years having been—for 1902, 28,576,400 lbs., valued at $2,358,325; 1903, 35,295,575 lbs., valued at $2,937,802; and for 1904, 31,078,455 lbs., valued at $2,583,270.

Properties.—Glycerin is "a clear, colorless liquid, of a thick, syrupy consistence, smooth to the touch, odorless, sweet to the taste, and producing a sensation of warmth upon the mouth and lips; when exposed to the air, it absorbs moisture. Specific gravity: not less than 1.246 at 25° C. (77° F.). Soluble in all proportions in water and alcohol; also soluble in a mixture of 3 parts of alcohol and 1 part of ether, but insoluble in ether, chlo-

roform, carbon disulphide, petroleum benzin, benzene, and fixed and volatile oils. Glycerin is slowly volatilized from weak aqueous solutions, at or above 100° C. (212° F.), with the vapor of water. At boiling temperatures 70 percent. to 100 percent. Glycerin rapidly volatilizes; 95 percent. Glycerin boils at 165° C. (329° F.); anhydrous Glycerin boils at 290° C. (554° F.) without decomposition; under continued heat it is finally entirely decomposed and dissipated. An aqueous solution of Glycerin is neutral to litmus paper. If a fused bead of borax, on a loop of platinum wire, be moistened with Glycerin, and then held in the edge of a non-luminous flame, the latter will be transiently tinted a vivid green." *U. S.*

as a means of concentrating and purifying glycerin. According to G. F. Wilson, glycerin, when of the density 1.24, contains 94 per cent. of anhydrous glycerin; when of the density 1.26, 98 per cent. A table by Wilhelm Lenz (*Zeit. An. Chem.*, 1880), showing the percentage of absolute glycerin in mixtures of glycerin and water, which was obtained by a quantitative determination of the carbon in the various dilutions by ultimate analysis, will be found in the U. S. D., 15th ed., p. 712. The table below by W. W. J. Nicol of England, has been constructed after careful determinations, aided by A. B. Lyons's data on expansion of glycerin solutions. (*Ph. Era*, 1888.)

Per cent. Glycerin.	Sp. Gr. at 15° C. = 59° F.	Per cent. Glycerin.	Sp. Gr. at 15° C. = 59° F.	Per cent. Glycerin.	Sp. Gr. at 15° C. = 59° F.	Per cent. Glycerin.	Sp. Gr. at 15° C. = 59° F.
1	1.00236	26	1.06500	51	1.13265	76	1.20131
2	1.00473	27	1.06765	52	1.13539	77	1.20404
3	1.00711	28	1.07031	53	1.13814	78	1.20677
4	1.00949	29	1.07297	54	1.14088	79	1.20949
5	1.01189	30	1.07564	55	1.14362	80	1.21221
6	1.01430	31	1.07832	56	1.14637	81	1.21493
7	1.01673	32	1.08100	57	1.14912	82	1.21766
8	1.01917	33	1.08370	58	1.15187	83	1.22038
9	1.02163	34	1.08639	59	1.15462	84	1.22310
10	1.02409	35	1.08908	60	1.15737	85	1.22583
11	1.02656	36	1.09176	61	1.16011	86	1.22855
12	1.02904	37	1.09445	62	1.16286	87	1.23128
13	1.03153	38	1.09713	63	1.16561	88	1.23400
14	1.03403	39	1.09983	64	1.16837	89	1.23673
15	1.03653	40	1.10253	65	1.17113	90	1.23945
16	1.03905	41	1.10525	66	1.17387	91	1.24217
17	1.04160	42	1.10798	67	1.17662	92	1.24487
18	1.04416	43	1.11071	68	1.17937	93	1.24756
19	1.04672	44	1.11345	69	1.18212	94	1.25021
20	1.04930	45	1.11618	70	1.18487	95	1.25285
21	1.05189	46	1.11893	71	1.18761	96	1.25547
22	1.05449	47	1.12167	72	1.19035	97	1.25809
23	1.05712	48	1.12441	73	1.19309	98	1.26072
24	1.05978	49	1.12716	74	1.19583	99	1.26335
25	1.06236	50	1.12990	75	1.19857	100	1.26596

In properties, glycerin is intermediate between water and the oils. When exposed to the air it gradually absorbs moisture. As already stated, though decomposed by a high heat in its unmixed state, yet with water under pressure it is volatilizable unchanged at a temperature between 204.4° and 260° C. (400° and 500° F.). Cooled down rapidly, it only becomes more viscid, without congealing, even when a temperature of —40° C. is attained; but, if kept for some time at a temperature of about 0° C. (32° F.), it gradually forms hard but deliquescent crystals, which melt only at about 22° C. (71.6° F.).[1] This fact is now utilized

Glycerin possesses extensive powers as a solvent, and is an excellent excipient for many medicinal substances. It dissolves bromine and iodine, sulphur iodide, potassium and sodium chlorides, the fixed alkalies, some of the alkaline earths, lime, for example, for which it increases the solvent powers of water (*J. P. C.*, Juin, 1874), and a large number of neutral salts. It also dissolves the vegetable acids, particularly tannic acid. It is a good solvent of pepsin, and is used for the extraction of this principle from the mucus of the stomach. Two parts and a half of glycerin dissolve one of sugar, and three and a half parts, one of gum. When starch paste and glycerin are heated together, a turbid liquid is formed, which deposits on cooling, the supernatant liquid holding starch in solution. (*J. P. C.*, Nov. 1868, pp. 361-2.) J. S. Blockley of London, has ascertained that certain glucosides are far more soluble in glycerin than in water. Thus, salicin dissolves in eight parts of cold glycerin, and santonin in eighteen parts when boiling. The latter solution, when of half this strength, forms on cooling an almost solid mass. It is not always a good solvent for alkaloids

[1] Wm. Crookes gives an account, in the *Chem. News*, of Jan. 18, 1867, of 5 tons of glycerin imported into London from Germany in casks of 8 cwt. each, which, though when it left the Continent was in its ordinary state of a viscid liquid, was found, on reaching London, to have become solidified into a mass of very hard, brilliant crystals. The same result has been noticed in Vienna, in a mass of glycerin which had been in an iron tank more than a year. (*Chem. News*, April 5, 1867.) The crystalline mass noticed by Crookes yielded pure glycerin when melted. Frozen glycerin has been examined by Wallace Procter and Henry Trimble (*A. J. P.*, 1885, p. 273); the crystals had the sp. gr. 1.2618, and the portion which had not been solidified had the sp. gr. 1.235.

or their salts, and will *sometimes precipitate the latter even from their aqueous or acidulated solutions.* Glycerin, next to alcohol, is the best solvent of iodine. Iodine and potassium iodide, when dissolved in it, form *iodized glycerin,* the medicinal applications of which are given under iodine. (See *Iodum.*)[1] It combines with potassa and baryta, and also with sulphuric acid. Glycerin does not evaporate when exposed to the air, nor can it be distilled without decomposition, unless in the presence of water or steam. When decomposed by heat, it emits extremely irritating vapors of acrolein. At a full red heat it takes fire, and burns with a blue flame. In consequence of the high temperature required for its volatilization, it has been proposed to use it for an evaporating bath, in which a heat beyond that of boiling water is required. Glycerin is antiseptic, and has been recommended by Warington and Demarquay to preserve alimentary substances and objects of natural history, and to inject bodies for dissection. According to W. Frazer, it does not answer for preserving pathological preparations, as they are completely softened by its action. Berthelot of Paris, succeeded in combining glycerin with a number of acids, both mineral and organic, forming three distinct series of neutral compounds. Among others, he has united it with the fatty acids, producing, by synthesis, the organic fatty substances stearin, palmitin, olein, etc. Glycerin has been formed artificially from tribromallyl, by Wurtz, and from trichlorhydrin, by Friedel and Silva. Synthesis is, however, not practicable on a large scale, no method having yet been discovered to compete successfully with its preparation from natural fats. By Pasteur it was ascertained to be one of the products of the vinous fermentation. Glycerin is a triatomic alcohol, being a compound of the triad radical (C_3H_5) with 3(OH) groups. In the natural fats, the three H atoms of these OH groups are replaced by fatty acid radicals like stearyl, $C_{18}H_{35}O$, palmityl, $C_{16}H_{33}O$, and oleyl, $C_{18}H_{33}O$. The natural fats are, therefore, compounds of an alcohol radical with an organic acid, and are true esters, which are known as *glycerides.*

The solvent and preservative properties as well as agreeable taste and permanent consistence of glycerin render it very useful as a menstruum in pharmacy, and a class of preparations consisting of medicinal substances dissolved in it has come into extensive use. The British Pharmacopœia has adopted such a class, under the name of *Glycerina,* or *glycerines.* This title "glycerines" is not now available because the termination "ine" is reserved for alkaloids, while the term *glyceroles,* adopted from the French, is objectionable, as the termination "ole" has been used to designate certain proximate principles; but the U. S. Pharmacopœia title, *Glycerita,* or *glycerites,* is satisfactory.

Impurities and Tests.—Glycerin is occasionally deficient in density and consistency. According to Dalpiaz, it is sometimes perfectly colorless from being bleached by chlorine, when it is apt to contain calcium chloride, as well as free chlorine. The latter may be detected by rendering the suspected sample slightly blue by a few drops of an acid solution of indigo in sulphuric acid, when, if free chlorine be present the blue color will disappear. Starch paste containing a little potassium iodide is a better test, however; if a blue color appears when this is added to glycerin, free chlorine is indicated.

The U. S. P. (8th Rev.) furnishes the following tests: "Five Cc. of Glycerin, heated to boiling in an open porcelain or platinum dish, and then gently ignited, should vaporize, burn, and leave not more than a dark stain, which on stronger heating should disappear entirely (absence of *mineral impurities*). If 5 Cc. of Glycerin be mixed with 50 Cc. of water and 10 drops of hydrochloric acid in a small flask, and heated for half an hour on a water-bath, then 10 Cc. of the hot liquid, mixed with 2 Cc. of sodium hydroxide T.S. and 1 Cc. of alkaline cupric tartrate V.S., should show no yellowish-red cloudiness or precipitate within six hours (absence of *sugars*). If 5 Cc. of Glycerin be mixed with an equal volume of concentrated sulphuric acid in a test-tube, the liquid should acquire, on standing for one hour, a color not darker than yellow (absence of *readily carbonizable impurities*). If 5 Cc. of Glycerin be mixed with the same volume of a mixture of equal parts of alcohol and diluted sulphuric acid, and gently heated, a fruity odor should not be recognizable (absence of *butyric acid*). No color, cloudiness, or precipitate should appear when separate portions of its aqueous solution (1 in 10) are treated with barium

[1] The following table, by Klever, gives a general view of the solvent powers of glycerin,—100 parts of glycerin dissolving the annexed quantities of substances:

	PARTS.
Acidum arsenicum	20
" arsenosum	20
" benzoicum	10
" boricum	10
" oxalicum	15
" tannicum	50
Alumen	40
Ammonii carbonas	20
" chloridum	20
Antimon. et pot. tart.	5.50
Atropina	3
Atropinæ sulphas	33
Barii chloridum	10
Brucina	2.25
Calcii sulphidum	5
Cinchonina	0.30
Cinch. sulphas	6.70
Cupri acetas	10
" sulphas	30
Ferr. et potas. tart.	8
" lactas	16
" sulphas	25
Hydrarg. chlorid. corrosiv.	7.50
" cyanidum	27
Iodum	1.90
Morphina	0.45
Morphinæ acetas	20
" hydrochloridum	20
Phosphorus	0.20
Plumbi acetas	20
Potassii arsenas	50
" bromidum	25
" chloras	3.50
" cyanidum	32
" iodidum	40
Quinina	0.50
Quininæ tannas	0.25
Sodii arsenas	50
Sodii bicarbonas	8
" boras	60
" carbonas	98
" chloras	20
Sulphur	0.10
Strychnina	0.25
Strychninæ nitras	4
" sulphas	22.50
Urea	50
Veratrina	1
Zinci chloridum	50
" iodidum	40
" sulphas	35

(*Neues Jahrb. für Pharm.*, 1869, Mai u. Juni, 315.)

chloride T.S. (*sulphuric acid*), calcium chloride T.S. (*oxalic acid*), ammonium oxalate T.S. (*calcium salts*), silver nitrate T.S. (*chlorides*), or silver ammonium nitrate T.S. (*acrolein*); in the last-mentioned case, the test-tube, loosely stoppered to protect it from impurities, should be allowed to stand, protected from light, for at least five minutes. The aqueous solution (1 in 20), when acidified with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Five Cc. of the aqueous solution (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (See PART III, Test No. 17)." *U. S.* The Br. Pharm. furnishes the following tests: "Sp. gr. 1.260. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, calcium, potassium, sodium, ammonium, chlorides, or sulphates; and no red precipitate with excess of *solution of potassio-cupric tartrate* on boiling, even when previously acidified and boiled (absence of grape and cane sugars). It should undergo no darkening in color at ordinary temperatures when mixed with an equal volume of *solution of ammonia* and a few drops of *solution of silver nitrate;* and when shaken with an equal volume of *sulphuric acid,* the mixture being kept cool, no coloration, or only a very slight straw coloration, should result (absence of foreign organic matter). When gently heated with a mixture, in equal volumes, of *alcohol* (90 per cent.) and *diluted sulphuric acid,* a fruity odor should not be produced (absence of butyric acid). 2 cubic centimetres diluted with 5 cubic centimetres of a mixture of 1 part of *hydrochloric acid* and 7 parts of *water,* 1 gramme of pure *zinc* being added, and the whole placed in a long test-tube, the mouth of which is covered by a piece of filter-paper moistened with a drop or two of *test-solution of mercuric chloride* and dried, should not afford a yellow stain on the paper even after 15 minutes (limit of arsenium). When heated in an open capsule it yields acrid vapors; and is finally dissipated, leaving no ash (absence of fixed mineral matter)." *Br.*

Arsenic has been shown to exist in small quantities as an impurity in some glycerins; its presence may be suspected whenever sulphuric acid (made from pyrites) has been used in the manufacture of the glycerin, as in the Wilson and Payne process for the decomposition of the fats (see page 586). Lime may be detected by ammonium oxalate; lead, by ammonium sulphide, and sulphuric acid, by a soluble salt of barium. Diluted, and boiled with a solution of potassium hydroxide, it is not altered in color, showing the absence of glucose. Trommer's test is probably more effectual. The presence of even a small proportion of sugar is shown by the following test: Dilute the glycerin with an equal volume of water and introduce 2 Cc. of the mixture into a test tube; pour carefully down the side of the test tube 2 Cc. of a reagent made by dissolving 0.010 Gm. of morphine sulphate in 5 Cc. of sulphuric acid (U. S. P.) and adding 1 drop of tincture of ferric chloride (freshly prepared). If sugar is present a band of color will appear at the plane of contact of the two fluids, violet-blue below, orange-yellow above; sulphuric acid alone will produce a yellow to brown zone. (A. B. Lyons, *Proc. A. Ph. A.,* 1905, 331.) According to Hager, sugar or dextrin may be detected in the following manner. Dilute the glycerin with water, add ammonium molybdate and some drops of nitric acid, and boil. If these impurities are present, a blue color is produced; if not, it remains colorless. (*Ibid.,* May, 1869.) Among the most injurious impurities of glycerin are thought to be oxalic and formic acids, the latter of which, being especially irritating to the skin, unfits glycerin for some of the purposes for which it is most employed. The oxalic acid is said to result from the action of sulphuric acid employed in purifying glycerin; the formic, from the reaction between glycerin and oxalic acid. They may be detected by the U. S. P. tests. Henry Bower of Philadelphia, who manufactured very pure glycerin, claimed that silver nitrate is the most reliable test. Glycerin which shows no reaction with this salt he considers suitable for all uses. (*A. J. P.,* 1868.) See improved U. S. P. test above. For a method of extracting glycerin from mixtures containing sugar and glucose, see a paper by Prescott, *N. R.,* 1878. For methods of determining glycerin in mixtures or its detection in wines, etc., see *Chem. News,* 1882; *A. J. P.,* 1882; *S. W. P.,* 1881; *Chem. News,* 1886; *Am. Drug.,* 1886.[1]

Uses.—The uses of glycerin as a vehicle for other medicines have been already given. When given internally, it is laxative, and it has also been suggested as a substitute for cod liver oil in *phthisis,* etc. R. P. Cotton, however, has tried it in the Consumption Hospital at Brompton, and shown that it has generally but little influence, and that as a remedial agent it will bear no comparison with cod liver oil. When injected directly into the blood, glycerin produces in the lower animals violent nervous symptoms and death, but this action is probably due to the mechanical alteration of the viscidity of the vital fluid. All our physiological evidence goes to show that glycerin has, unless in very immoderate quantities, no distinct physiological or therapeutic properties other than those of a feeble laxative. It has recently been extensively employed in habitual constipation in the form of suppositories. (See *Suppositoria Glycerini.*) Although at various times much lauded in tuberculous diseases and in *diabetes,* it has entirely failed to gain the confidence of the profession, and is now very rarely employed.

[1] *Glycero-alcohol,* a valuable solvent made by mixing glycerin, 333; distilled water, 146; and alcohol sufficient to measure 1000 parts. Its specific gravity is about 1; it is a good solvent for alkaloids, keeps indefinitely, and does not evaporate readily.

Glycerin is extensively used *externally* as a softening, emollient application in various conditions of the skin. Its affinity for water is such that it sometimes acts as an irritant upon the mucous membrane, unless diluted. It appears to have been first employed externally in 1846, by Thomas De la Rue of London. Added to poultices, in a proportion varying from one-fourth to one-sixteenth, it has the effect of keeping them soft for a long time. To collodion it gives a valuable plasticity. Incorporated in very small proportion with extracts and pills, it keeps them soft and free from mouldiness. In cases of *deafness*, from deficiency, accumulation, or hardness of the cerumen, and attended with dryness of the meatus, glycerin is an excellent remedy, introduced into the canal by means of raw cotton saturated with it. Glycerin may be used in the form of an ointment,[1] and is also used in the menstruum of official extracts, fluidextracts, glycerites, infusions, syrups, tinctures, etc., and in making pills.

Off. Prep.—Cataplasma Kaolini, *U. S.;* Gelatinum Glycerinatum, *U. S.;* Suppositoria Glycerini, *U. S., Br.*

GLYCERINUM ALUMINIS. Br.

GLYCERIN OF ALUM

(glĭç-ẹ-rī′nŭm ą-lū′mį-nīs)

Glycéré d'Alun, *Fr.;* Alaun-Glycerit, *G.*

"Alum, in powder, 1 *ounce* (Imperial) or 20 grammes; Distilled Water, 3 *fl. drachms* (Imp. meas.) or 7.5 cubic centimetres; Glycerin, sufficient to produce 6 *fl. ounces* (Imp. meas.) or 120 cubic centimetres. Triturate until solution is effected, warming slightly if necessary; set aside; pour off the clear liquid from any deposited matter that may be present." *Br.*

This has the astringency of the glycerite of tannin without the tendency to soil the linen or blacken in contact with iron, but is much more irritating.

GLYCERINUM BORACIS. Br.

GLYCERIN OF BORAX

(glĭç-ẹ-rī′nŭm bọ-rā′cīs)

Glycéré de Borax, *Fr.;* Borax-Glycerit, *G.*

"Borax, 1 *ounce* (Imperial) or 20 grammes; Glycerin, 6 *fl. ounces* (Imp. meas.) or 120 cubic centimetres. Triturate the Borax with the Glycerin until solution is effected." *Br.*

[1] Ecky's *glycerin ointment* is made as follows. Take of spermaceti *half an ounce;* white wax *a drachm;* oil of almonds *two fluidounces;* glycerin *a fluidounce.* Melt the spermaceti and wax with the oil of almonds by a moderate heat. Then, having poured the melted liquid into a Wedgwood mortar, add the glycerin, and rub until the ingredients are thoroughly mixed and cool. This ointment may be used with advantage in chaps and excoriations.

The *Glyceritum Sodii Boratis* of U. S. P. 1870 was of the strength of *one troyounce* to *four fluidounces.* Otherwise it did not differ from the British preparation.

The demulcent properties and sweet taste of this preparation render it a useful and convenient method of applying borax to the infantile *thrush* and other forms of sore mouth in children. It has been highly commended in *erysipelas* by D. M. Salazar of Madrid. The part should be freely painted with it and then covered with raw cotton. (*N. Y. M. R.,* viii. 311.)

GLYCERINUM PEPSINI. Br.

GLYCERIN OF PEPSIN

(glĭç-ẹ-rī′nŭm pĕp-sī′nī)

Glycéré de Pepsine, *Fr.;* Pepsin-Glycerit, *G.*

"Pepsin, 800 *grains* (Imperial) or 80 grammes; Hydrochloric Acid, 110 *minims* (Imp. meas.) or 10 cubic centimetres; Glycerin, 12 *fl. ounces* (Imp. meas.) or 525 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Hydrochloric Acid, Glycerin, and *six fluid ounces* (Imp. meas.) or two hundred and sixty cubic centimetres of the Distilled Water; then add the Pepsin; after one week, pour off the clear liquid, or filter; add sufficient Distilled Water to produce *one pint* (Imp. meas.) or eight hundred and seventy-five cubic centimetres. 1 fluidrachm of this preparation represents 5 grains of Pepsin." *Br.*

This preparation is apparently identical with the glycerite of pepsin of the National Formulary, but the pepsin of the British Pharmacopœia is supposed to be five times as strong as that of the N. F.

Dose, one fluidrachm (3.75 Cc.), equivalent to five grains of pepsin.

GLYCERINUM PLUMBI SUBACETATIS. Br.

GLYCERIN OF SUBACETATE OF LEAD

(glĭç-ẹ-rī′nŭm plŭm′bī sŭb-ăç-ẹ-tā′tīs)

Glycéré de Sousacétate de Plomb, *Fr.;* Bleiessigglycerit, *G.*

"Lead Acetate, 5 *ounces* (Imperial) or 100 grammes; Lead Oxide, in powder, 3½ *ounces* (Imp.) or 70 grammes; Glycerin, 1 *pint* (Imp. meas.) or 400 cubic centimetres; Distilled Water, 12 *fl. ounces* (Imp. meas.) or 240 cubic centimetres. Mix; boil for a quarter of an hour; filter; evaporate at a temperature not exceeding 222° F. (105.5° C.) until the product weighs *thirty-two and three-quarters ounces* (Imp.) or six hundred and fifty-five grammes, and has a specific gravity of 1.48." *Br.*

This glycerite originated with Balmanno Squire of London, but the process made official is that recommended by R. W. Parker.

(See *A. J. P.*, 1886, 296.) It is a powerful sedative astringent, and may be employed as a local application in external inflammations.

Off. Prep.—Unguentum Glycerini Plumbi Subacetatis, *Br.*

GLYCERINUM TRAGACANTHÆ. Br.

GLYCERIN OF TRAGACANTH

(glĭç-ẹ-rī'nŭm trăg-ạ-căn'thæ)

Glycéré de Gomme Adragante, *Fr.*; Traganth-Glycerit, *G.*

"Tragacanth, in powder, ½ *ounce* (Imperial) or 10 grammes; Glycerin, 1½ *fl. ounces* (Imp. meas.) or 30 cubic centimetres; Distilled Water, ½ *fl. ounce* (Imp. meas.) or 10 cubic centimetres. Mix the Glycerin with the Tragacanth; add the Distilled Water; triturate until a homogeneous paste is produced." *Br.*

This preparation has been introduced into the British Pharmacopœia mainly to serve as an excipient for pills.

GLYCERITA.

GLYCERITES

(glĭç-ẹ-rī'tạ)

Glycerina, *Br.*; Glycerines; Glycerata, Glycerolata, Glycerols; Glycérés, *Fr. Cod.*; Glycérats, Glycérolés, *Fr.*; Glycerit, Glycerolat, *G.*

These are solutions of medicinal substances in glycerin. In the thirteenth edition of the Dispensatory various reasons were adduced for preferring the name glycerates for these preparations, but, as the revisers of the U. S. Pharmacopœia have adopted that of glycerites, these reasons are omitted. The U. S. name is certainly much better than the British name glycerin (*Glycerinum*) for this does not distinguish a *class* of preparations from the *solvent* used in making them. (See preceding articles.)

Glycerin has valuable properties as a solvent and vehicle for medicinal substances. Such are its not unpleasant taste and bland character, its wide range of solvent power, which adapts it sometimes as a menstruum where neither water nor alcohol could be advantageously used, and enables it to retain in solution otherwise insoluble substances so frequently found in infusions and decoctions, and its preservative influence, which often protects against oxidation, and, by a destructive agency upon all of the lowest forms of vegetable and animal life, prevents the various fermentative processes so destructive to organic bodies. Another important property, as a vehicle for external remedies, is the permanence of its liquid character, so that it does not, like water and alcohol, dry up when applied to the skin, resembling in this respect, as well as in its demulcent quality, the fixed oils, without their tendency to rancidity. Hence it has of late come into extensive use in the preparation of medicinal solutions, which under the name of *Glycérés* found admission into the French Codex of 1866, and are now recognized by both the United States and British Pharmacopœias.[1]

GLYCERITUM ACIDI TANNICI. U. S. (Br.)

GLYCERITE OF TANNIC ACID

(glĭç-ẹ-rī'tŭm ăç'ĭ-dī tăn'nĭ-cī)

Glycerinum Acidi Tannici, *Br.*; Glycerin of Tannic Acid (of Tannin); Glycéré de Tannin, *Fr. Cod.*; Glycérole de Tannin, Glycérine tannique, *Fr.*; Tannin-Glycerit, Tannin-Glycerol, *G.*

* "Tannic Acid, *twenty grammes* [or 309 grains]; Glycerin, *eighty grammes* [or 2 ounces av., 360 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Tannic Acid with the Glycerin to a smooth paste, transfer this to a porcelain dish, avoiding contact with metallic utensils, and apply the heat of a water-bath, until the Tannic Acid is completely dissolved. Then transfer the solution to a bottle." *U. S.*

"Tannic Acid, 1 *ounce* (Imperial) or 20 grammes; Glycerin, sufficient to produce 5 *fl. ounces* (Imp. meas.) or 100 cubic centimetres. Triturate the Tannic Acid with the Glycerin until solution is effected." *Br.*

The U. S. preparation is a 20 per cent. solution by weight; the strength of the British preparation is somewhat weaker, being a 20 per cent. solution by measure. H. F. Meier found that the greenish scum usually seen on the surface of the preparation is chlorophyll from the tannin.

This preparation may be used, both internally and externally, for most of the purposes to which tannic acid is applied. On the whole, it is the most useful preparation of tannic acid for external use; as circumstances require it the official strength may be altered by direction of the physician; a very concentrated solution, two parts of glycerin to one of tannin, may be made by the aid of a moderate heat. This applied daily to nipples,

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[1] *Glyceritum Picis Liquidæ*, U. S. 1870. *Glycerite of Tar.*—"Take of Tar *a troyounce*; Carbonate of Magnesium, in powder, *two troyounces*; Glycerin *four fluidounces*; Alcohol *two fluidounces*; Water *ten fluidounces*. Having mixed the Glycerin, Alcohol, and Water, rub the Tar in a mortar, first with the Carbonate of Magnesium, and then with six fluidounces of the mixed liquids gradually added, and strain with expression. Rub the residue in like manner with half the remaining liquid, and strain as before. Repeat the process again with the remaining liquid. Put the residue into a percolator, add gradually the expressed liquids previously mixed, and afterwards a sufficient quantity of water to make the liquid which passes measure a pint." *U. S.* 1870.

This is a very excellent preparation of tar, which may be used either externally or internally. The formula is essentially the same as that proposed by J. B. Moore, although employing one-third less of the magnesium salt (*A. J. P.*, 1869, p. 115). As first made it is of a reddish-brown color; after a time it is apt to deposit a dark sediment, which should be separated by filtration. An ounce of it represents half a fluidrachm of tar. The dose is from a drachm to a half-ounce (3.75 to 15 Cc.).

during the later months of pregnancy, will usually prevent the occurrence of *sore nipples* during suckling.

Dose, from ten to forty minims (0.6 to 2.5 Cc.). (See *Acidum Tannicum.*)

GLYCERITUM AMYLI. U. S. (Br.)

GLYCERITE OF STARCH

(glĭç-ẹ-rī′tŭm ăm′y-lī)

Glycerinum Amyli, *Br.,* Glycerin of Starch, Glycamyl, Plasma: Glycéré d'Amidon, *Fr. Cod.;* Glycérate simple (d'Amidon), *Fr.;* Unguentum Glycerini, *P. G.;* Glycerinsalbe, Stärke-Glycerit, *G.;* Glicerolato di amido, *It.;* Glicerolado de almidon, *Sp.*

* "Starch, *ten grammes* [or 154 grains]; Water, *ten cubic centimeters* [or 162 minims]; Glycerin, *eighty grammes* [or 2 ounces av., 360 grains]. Triturate the Starch with the Water, until a homogeneous mixture is produced. Then gradually add this to the Glycerin, contained in a porcelain dish, and heated to about 140° C. (284° F.). Continue the heat, with constant stirring, keeping it below 144° C. (291.2° F.), until a translucent jelly is formed. Transfer the product to suitable vessels, provided with well-fitting covers." *U. S.*

"Starch, 1 *ounce* (Imperial) or 20 grammes; Glycerin, 6½ *fl. ounces* (Imp. meas.) or 130 cubic centimetres; Distilled Water, 1½ *fl. ounces* (Imp. meas.) or 30 cubic centimetres. Mix; heat them together, stirring constantly, until a translucent jelly is formed." *Br.*

Of these preparations it is only necessary to say that, with the exception of an inconsiderable difference in the proportions, they are the same as that brought into notice in 1858 by G. F. Schacht under the name of *plasma,* as a substitute for ointments, the emollient and demulcent properties of which they possess, without their inconvenience, whether used simply, or as a vehicle for other substances to be employed locally. Schacht prepared plasma by mixing 70 grains of starch in powder, and a fluidounce of glycerin, heating to 240° F. until the union is effected, and stirring constantly. The stirring should be continued moderately, during the cooling, to secure a proper consistence. As the plasma is liable to absorb moisture, it should be kept in well closed vessels. (*P. J.,* Oct. 1866, 210.) J. H. Pearson (*P. J.,* 1897, 201) recommends the addition of one grain of powdered tragacanth to the ounce of finished product, to prevent the separation of the glycerin and water from the mass, on standing.

GLYCERITUM BOROGLYCERINI. U. S. (Br.)

GLYCERITE OF BOROGLYCERIN
[Solution of Boroglyceride]

(glĭç-ẹ-rī′tŭm bō-rọ-glĭç-ẹ-rī′nī)

Glycerinum Acidi Borici, *Br.;* Glycerin of Boric Acid; Glycerite of Glyceryl Borate; Glycéré de boroglycéride, *Fr.;* Boroglyceridlösung, *G.*

* "Boric Acid, in fine powder, *three hundred and ten grammes* [or 10 ounces av., 409 grains]; Glycerin, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Heat *four hundred and sixty grammes* [or 16 ounces av., 99 grains] of Glycerin, in a tared porcelain dish, to a temperature not exceeding 150° C. (302° F.), and add the Boric Acid in portions, constantly stirring. When all is added and dissolved, continue the heat at the same temperature, frequently stirring, and breaking up the film which forms on the surface. When the mixture has been reduced to the weight of *five hundred grammes* [or 17 ounces av., 279 grains], add to it *five hundred grammes* [or 17 ounces av., 279 grains] of Glycerin, mix thoroughly, and transfer it to suitable vessels." *U. S.*

"Boric Acid, in fine powder, 6 *ounces* (Imperial) or 300 grammes; Glycerin, *a sufficient quantity.* Heat *nine ounces* (Imp.) or four hundred and fifty grammes of Glycerin, in a weighed porcelain dish, to a temperature not exceeding 302° F. (150° C.), and add the Boric Acid in portions, constantly stirring. When all is dissolved maintain the temperature of the liquid, frequently stirring and breaking up the film which forms on the surface, until the mixture has been reduced to the weight of *ten ounces* [Imp.] or five hundred grammes; then add *ten ounces* (Imp.) or five hundred grammes of Glycerin; mix thoroughly. The product should weigh *twenty ounces* (Imp.) or one thousand grammes." *Br.*

This solution was first introduced into the U. S. P. 1890 from the National Formulary. It is a thick, sweet, viscid, colorless liquid, and has the advantage of offering the antiseptic, boric acid, in a very soluble form. It may be made more rapidly than by the above process if one ounce av. of boroglyceride be dissolved in one ounce av. of glycerin with the aid of a gentle heat. (See *Boroglyceride,* PART II.)

GLYCERITUM FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U. S.

GLYCERITE OF THE PHOSPHATES OF IRON, QUININE AND STRYCHNINE

(glĭç-ẹ-rī′tŭm fĕr′rī quĭ-nī′næ ĕt strĭçh-nī′næ phŏs-phā′tŭm)

Glycéré des Phosphates de Fer, de Quinine et de Strychnine, *Fr.;* Eisen-, Chinin- und Strychninphosphat-Glycerit, *G.*

* "Soluble Ferric Phosphate, *eighty grammes* [or 2 ounces av., 360 grains]; Quinine, *one hundred and four grammes* [or 3 ounces av., 293 grains]; Strychnine, *eight-tenths of a gramme* [or 12⅓ grains]; Phosphoric Acid, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Glycerin, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Heat the Soluble

Ferric Phosphate with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, in a porcelain dish, at a temperature not exceeding 70° C. (158° F.), until it is dissolved. Then add the Phosphoric Acid with the Strychnine and Quinine and sufficient Water to make the product measure *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] and stir until solution is effected. Mix the solution with the Glycerin, and filter if necessary." *U. S.*

This glycerite was made official in the U. S. P. (8th Rev.) for the first time. It is intended solely for use in making the syrup of the phosphates of iron, quinine and strychnine by diluting 1 volume of the glycerite with 3 volumes of syrup.

Dose, fifteen minims (0.9 Cc.).

Off. Prep.—Syrupus Ferri, Quininæ et Strychninæ Phosphatum, *U. S.*

GLYCERITUM HYDRASTIS. U. S.

GLYCERITE OF HYDRASTIS

(glĭç-ę-rī'tŭm hȳ-drăs'tĭs)

Glycéré d'Hydrastis du Canada, *Fr.;* Gelbwurzel-Glycerit, *G.*

* "Hydrastis, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Hydrastis with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until the Hydrastis is practically exhausted. Remove nearly all of the Alcohol, by distillation or evaporation, pour the thick concentrated liquid into *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]of ice-cold Water, and set it aside, in a cold place, for twenty-four hours. Then filter, pass enough cold Water through the filter to make the filtrate measure *five hundred cubic* centimeters [or 16 fluidounces, 435 minims], add the Glycerin, and mix thoroughly." *U. S.*

This preparation was transferred to the U. S. P. 1890 from the National Formulary. It is intended to take the place of the various preparations which are in vogue and which go under the names of *Fluid Hydrastis, Colorless Hydrastis,* etc.[1] The process for this glycerite has been improved by adopting J. U. Lloyd's suggestion to concentrate the alcoholic tincture by distillation or evaporation and pouring the thick liquid into ice-cold water, for the purpose of separating the oily and resinous matter which is useless. F. A. Sieker found that glycerite of hydrastis as made by the former U. S. process varies greatly in strength. (See *Proc. A. Ph. A.,* 1893, 691; also *Ph. Rund.,* 1895, 236, and *Proc. A. Ph. A.,* 1894, 668.) Its medicinal properties are those of hydrastis.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

GLYCERITUM PHENOLIS. U. S. (Br.)

GLYCERITE OF PHENOL [Glyceritum Acidi Carbolici, Pharm. 1890, Glycerite of Carbolic Acid]

(glĭç-ę-rī'tŭm phęn-ō'lĭs)

Glycerinum Acidi Carbolici, *Br.;* Glycerin of Phenol; Glycérole d'Acide Phénique, Glycéré de Phenol, Glycérine Phénique, *Fr.;* Phenol-Glycerit, *G.;* Glycerina con acido fenico, *Sp.*

* "Liquefied Phenol, *twenty cubic centimeters* [or 325 minims]; Glycerin, *eighty cubic centimeters* [or 2 fluidounces, 338 minims], to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Add the Liquefied Phenol to the Glycerin, and stir until thoroughly mixed." *U. S.*

"Phenol, 1 *ounce* (Imperial) or 20 grammes; Glycerin, sufficient to produce 5 *fl. ounces* (Imp. meas.) or 100 cubic centimetres. Triturate the Phenol with the Glycerin until solution is effected." *Br.*

Uses.—For the uses of this preparation, see *Phenol.* The U. S. (8th Rev.) glycerite is a 20 per cent. by volume solution of liquefied phenol; the British preparation is slightly stronger, being a 20 per cent. by volume solution of crystallized phenol. It may be used internally or locally, and for both purposes should in general be diluted with water at the time of application.

Dose, from five to ten minims (0.3 to 0.6 Cc.).

GLYCYRRHIZA. U. S. (Br.)

GLYCYRRHIZA LICORICE ROOT

(glĭç-ŷr-rhī'zą)

"The dried rhizome and root of *Glycyrrhiza glabra* Linné (Spanish Licorice), or of *Glycyrrhiza glandulifera* Waldstein and Kitaibel (Russian Licorice) (Fam. *Leguminosæ*)." *U. S.* "The peeled root and peeled subterranean stem of Glycyrrhiza glabra, *Linn.,* and other species." *Br.*

Glycyrrhizæ Radix, *Br.;* Radix Glycyrrhizæ Hispanicæ; Liquorice Root, Spanish Licorice Root; Réglisse, *Fr. Cod.;* Racine de Réglisse, Bois doux, Racine douce, Bois de Réglisse, *Fr.;* Radix Liquiritiæ, *P. G.;* Spanisches Süssholz, Spanische Süssholzwurzel, Süssholzwurzel, *G.;* Liquirizia, *It.;* Regaliz (Raiz de), Orozuz, Palo dulce, *Sp.*

Glycyrrhiza glabra, Willd., *Sp. Plant.* iii. 1144; Woodv., *Med. Bot.* p. 420, t. 152; Carson, *Illust. of Med. Bot.,* i. 38, pl. 32.—The licorice

[1] *Fluid Hydrastis.*—H. C. Bradford gives the following formula: Hydrastine hydrochloride, 20 gr.; Glycerin, 6 fl. oz.; Distilled Water, 10 fl. oz. Mix and filter. It is advisable to keep this preparation in amber bottles. (*West. Drug.,* 1902, 59.)

plant has a perennial root, which is round, succulent, tough, and pliable, furnished with sparse fibres, rapid in its growth, and in a sandy soil penetrates deeply into the ground. The stems are herbaceous, erect, and usually four or five feet in height, have few branches, and are garnished with alternate, pinnate leaves, consisting of several pairs of ovate, blunt, petiolate leaflets, with a single leaflet at the end, of a pale-green color, and clammy on their under surface. The flowers are violet or purple, formed like those of the pea, and arranged in axillary spikes supported on long peduncles. The calyx is tubular and persistent. The fruit is a compressed, smooth, acute, one-celled legume, containing from one to six small kidney-shaped seeds. There are two very distinct varieties of the plant yielding the root: the typical form, which is smooth throughout, and the variety, now recognized by the U. S. Pharmacopœia as a distinct species, *G. glandulifera,* W. K., in which the stem, leaves, and pods are more or less roughly glandular or pubescent.

The habitat of the plant is wide-spread, extending from the shores of the Mediterranean to Siberia as far north as latitude 55°, and southward through Asia Minor and Persia to Farther India. The licorice plant is cultivated in England,[1] the north of France, and Germany. It is also largely produced in the north of Spain, where it is an important article of commerce, and in Asia along the banks of the Tigris and Euphrates. It is probable that a portion of the root from Italy and Sicily is the product of *G. echinata,* which grows wild in Apulia. This species is also abundant in the south of Russia, where, according to Hayne, sufficient extract is prepared from it to supply the whole Russian empire. Large quantities of licorice root are now imported for the purpose of making the extract, the imports for 1902 having been 109,077,323 lbs., valued at $1,926,903; for 1903, 88,580,611 lbs. valued at $1,545,167; and for 1904, 89,463,182 lbs., valued at $1,472,323.

A species of Glycyrrhiza, *G. lepidota,* grows abundantly about St. Louis, in the State of Missouri, and flourishes along the banks of the Missouri River to its source. It is probably the same as the licorice plant mentioned by Mackenzie as growing on the northern coast of this continent. Nuttall states that its root possesses in no inconsiderable degree the taste of licorice, and M. L. McCullough found it to contain 6.39 per cent. of crude glycyrrhizin, in contrast with 7.18 per cent. in the official species. (*A. J. P.,* 1890.)

[1] Most of the licorice root of commerce appears to be the product of wild plants, but it has been successfully cultivated in England (*A. J. P.,* 1874, 473) and in Syria. (*P. J.,* xvi. 647.) Although the attempts to produce it in the United States have hithero met with no great success, we can see no reason why in some of the lowlands of the Southeastern States it should not flourish. An interesting report upon the production of licorice root in Spain was made by H. C. Marsten, United States consul, and may be found abstracted in *N. R.,* Jan. 1882.

Properties.—The licorice root of commerce is in long pieces, varying in thickness from a few lines to two inches, fibrous; when not peeled, externally grayish brown and longitudinally wrinkled by desiccation, often warty, internally yellowish, pliable, tough, without odor, and of a sweet characteristic taste, mingled with a slight degree of acrimony. The two varieties are described in the U. S. Pharmacopœia as follows:

"*Spanish Licorice.*—Cylindrical, usually cut into pieces 14 to 20 Cm. or more long, 5 to 15 Mm. thick; longitudinally wrinkled, grayish-brown or dark-brown, pliable; fracture coarsely fibrous; internally tawny-yellow; bark 1 to 3 Mm. thick; wood porous, in narrow wedges; odor slight; taste sweetish and slightly acrid.

Russian Licorice.—Somewhat tapering, frequently 1 M. or more in length, 1 to 5 Cm. in diameter, deprived of the outer corky layer, when it is externally pale yellow; internally of a lighter yellow; wood rather soft; taste less sweet than that of the Spanish Licorice. Any blackened, knotty, bitter portions should be removed." *U. S.*

Formerly commerce was chiefly supplied with licorice root by Italy and Spain, but the amount coming from these sources is at present probably not more than 10 per cent. of the whole, the greater portion coming from Southern Russia, a large amount from Anatolia and Syria, and a little from Turkey and Persia. The Spanish variety has been most esteemed, but, according to H. N. Rittenhouse, the peeled Russian licorice is richer in glycyrrhizin and extractives than is any other variety, and is in fact the most valuable. Russian licorice is usually very large, quite sweet, but at the same time rather more bitter and acrid than is the Spanish variety. Licorice root is often worm eaten and more or less decayed; such root should be rejected, as should also the small fibrous roots often shipped from Spain. The best pieces are large, bright yellow internally, and have the layers and the bark distinct. The bark is chiefly liber, consisting of parenchymatous tissue with bast-cells (which are stained yellow by iodine), and arranged so as to make ordinary liber bundles, and also a sort of network.

A character said by Rothrock (*A. J. P.,* 1884) to be diagnostic is the occurrence in the wood and parenchyma of bundles composed of numerous bast-cells, surrounded by a sheath of large cells containing crystals of calcium oxalate. In the Russian root the parenchymatous wood-cells are larger than in the Spanish. The powder is of a grayish-yellow color, when the root is pulverized without being deprived of its epidermis; of a pale sulphur-yellow, when the epidermis has been removed. Robiquet found the following ingredients in licorice root: 1, a peculiar transparent yellow substance, called *glycyrrhizin,* of a sweet taste, scarcely soluble in cold water, very soluble in boiling water, with which it gelatinizes on cooling,

thrown down from its aqueous solution by acids, readily soluble in cold alcohol, insusceptible of the vinous fermentation, yielding no oxalic acid by the action of nitric acid, and therefore wholly distinct from sugar; 2, a crystallizable principle named *agedoïte* by Robiquet, but subsequently proved to be identical with *asparagin;* 3, starch; 4, albumen; 5, a brown acrid resin; 6, a brown nitrogenous extractive matter; 7, lignin; 8, salts of calcium and magnesium, with phosphoric, sulphuric, and malic acids. Flückiger states that a small amount of tannin is also always contained in the root, or rather its bark. The chief constituent, *glycyrrhizin,* Gorup-Besanez (*Ann. Ch. Ph.,* 118) considered to be a glucoside, as on boiling with diluted acids it breaks up into *glycyrrhetin* and an uncrystallizable sugar capable of fermentation. Roussin (*J. P. C.,* July, 1875) found that the sweet taste of the root was not owing to the free glucoside, but to its compound with ammonia.

Habermann (*Ann. Ch. Ph.,* 197) found that glycyrrhizin-ammonia was the acid ammonium salt of glycyrrhizic acid, a nitrogenous acid, and gave the formula $C_{44}H_{62}NO_{18}.NH_4$ for it. (See *Glycyrrhizinum Ammoniatum.*) He succeeded in extracting from the commercial "ammoniacal glycyrrhizin," *glycyrrhizic acid,* which may be considered to be the active constituent of licorice. It was obtained by dissolving the crude glycyrrhizin in glacial acetic acid at a boiling temperature, rapidly filtering, again treating the crystalline parts of the filtrate in the same manner, and finally purifying by repeated crystallizations from 90 per cent. alcohol. Its properties are peculiar, and account to a great extent for the singular behavior of liquid licorice preparations. With water, in which the substance is but little soluble at ordinary temperature, it forms a transparent, faintly yellow jelly. On mixing 1 Gm. of the body with 100 Cc. of water, the mixture after a few hours becomes so jelly-like that the open vessel may be inverted without losing any substance. It is insoluble in ether, but slightly soluble in absolute alcohol (even boiling), more so in alcohol of 90 per cent., and especially so when hot. Its solubility increases with the decrease of the percentage of alcohol. The apparent glucosidal character of glycyrrhizic acid Habermann explains by the fact that it breaks up on boiling with diluted sulphuric acid into *glycyrrhetin* and *parasaccharic acid,* according to the reaction:

$$C_{44}H_{68}NO_{18} + 2H_2O = C_{32}H_{47}NO_4 + 2C_6H_{10}O_5$$

(*Ann. Ch. Ph.,* 197; *N. R.,* Sept. 1879.) By fusing glycyrrhizin with potassium hydroxide, Weselsky and Benedikt (*Ber. d. Chem. Ges.,* 1876) obtained *paraoxybenzoic acid.*

Uses.—Glycyrrhiza is an excellent demulcent, well adapted to *pulmonic catarrhs,* and even to irritations of the mucous membrane of the bowels and urinary passages; but it is chiefly used for the purpose of concealing the taste or of covering the acrimony of various drugs, such as ammonium chloride or quinine. A decoction may be prepared by boiling an ounce of the bruised root, for a few minutes, in a pint of water, but at present the extract is almost universally preferred. The powder is used in the preparation of pills, either to give due consistence or to cover their surface and prevent them from cohering, and as a diluent in powdered extracts.

Off. Prep.—Extractum Glycyrrhizæ, *U. S., Br.;* Extractum Glycyrrhizæ Purum, *U. S.;* Fluidextractum Glycyrrhizæ, *U. S.* (*Br.*); Fluidextractum Rhamni Purshianæ Aromaticum, *U. S.;* Fluidextractum Sarsaparillæ Compositum, *U. S.;* Glycyrrhizinum Ammoniatum, *U. S.;* Liquor Sarsæ Compositus Concentratus, *Br.;* Mistura Glycyrrhizæ Compositus, *U. S.* (from extract); Pulvis Glycyrrhizæ Compositus, *U. S., Br.;* Pulvis Morphinæ Compositus, *U. S.;* Tinctura Aloes, *U. S.;* Tinctura Aloes et Myrrhæ, *U. S.;* Trochisci Glycyrrhizæ et Opii, *U. S.* (from extract).

GLYCYRRHIZINUM AMMONIATUM. U. S.

AMMONIATED GLYCYRRHIZIN

(glĭç-yr-rhĭ-zī'nŭm ăm-mō-nī-ā'tŭm)

Glycyrrhizine Ammoniacale, *Fr. Cod.;* Glyzina, Glyzine, *Fr.;* Ammoniak-Glycyrrhizin, *G.*

• "Glycyrrhiza, in No. 20 powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Water, Ammonia Water, Sulphuric Acid, each, *a sufficient quantity.* Mix *four hundred and seventy-five cubic centimeters* [or 16 fluidounces, 30 minims] of Water with *twenty-five cubic centimeters* [or 406 minims] of Ammonia Water, and, having moistened the powder with the mixture, macerate for twenty-four hours. Then pack it moderately in a conical glass percolator, and gradually pour water upon it until *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of percolate are obtained. Add Sulphuric Acid slowly to the percolate, with constant stirring, so long as a precipitate is produced. Collect this on a strainer, wash it with cold Water until the washings no longer have an acid reaction, redissolve it in Water with the aid of Ammonia Water, filter, if necessary, and again add Sulphuric Acid so long as a precipitate is produced. Collect this, wash it, dissolve it in a sufficient quantity of Ammonia Water previously diluted with an equal volume of Water, and spread the clear solution upon plates of glass, so that, when dry, the product may be obtained in scales." *U. S.*

This is a preparation whose introduction is a result of the very important researches of Z. Roussin, communicated to the Société de Pharmacie of Paris, June 2, 1875. This investigator noticed that *glycyrrhizin,* the sweet principle of licorice root, is insipid when compared with

the root itself, and suspected that it existed in a modified form in the root. Experiment showed that alkalies developed the sweet taste, and he ultimately proved that the alkali with which it was combined in the root was ammonia, and that glycyrrhizin played the part of an acid. He named the compound *ammonium glycyrrhizate,* and called attention to the fact that licorice root which had lost a portion of its sweetness through fermentation and the development of acetic acid and precipitation of insoluble glycyrrhizin could be restored to its former sweetness if allowed to remain a sufficient length of time in an ammoniacal atmosphere. The official process for ammoniated glycyrrhizin is closely modelled after Roussin's, with the exception of the substitution of percolation by a slightly ammoniated menstruum for maceration and expression with cold water. Roussin purified his product by redissolving it in alcohol and precipitating with ether; this is deemed unnecessary for a preparation which is intended to be useful without being expensive. (See *Proc. A. Ph. A.,* 1876, p. 544.)

Connerade has proposed some modification of Roussin's method; his process is as follows: "Macerate ground liquorice root with one and a half parts by weight of water, strain, wash the residue with a very small quantity of water, heat the mixed liquids to boiling to coagulate albumen, strain again, and then add diluted sulphuric acid (1 in 10), as long as a precipitate is produced. Let this settle, decant the liquid, and dissolve the precipitate in solution of ammonia, diluted with nine parts of water. Filter the latter and evaporate it to dryness. The compound then remains as a brown, friable varnish, unaltered by air, of a pure, sweet taste, easily soluble in cold water, and imparting to the latter, even when diluted to 1 in 1000 parts, an amber color. The yield is about 10 per cent. of the weight of the root." (*N. R.,* March, 1881.)

Properties.—The following is the description given in the U. S. Pharmacopœia: "Dark brown or brownish-red scales, without odor, and having a very sweet taste. Readily soluble in water and in alcohol. The aqueous solution, when heated with potassium hydroxide T.S., evolves ammonia. If the aqueous solution be supersaturated with an acid, there will be produced a precipitate (glycyrrhizin) which, when dissolved in hot water, forms a jelly on cooling. This substance, after being washed with diluted alcohol and dried, appears as an amorphous, yellow powder, having a strong, bitter-sweet taste, and an acid reaction. Upon incineration, Ammoniated Glycyrrhizin should not leave more than a trace of ash." *U. S.*

Uses.—This substance appears to possess the medicinal properties of licorice, and may be used as an elegant substitute for it in mixtures which are neither acid nor alkaline.

Dose, from five to fifteen grains (0.32 to 1.0 Gm.).

GOSSYPII CORTEX. U. S. (Br. Add.)

COTTON ROOT BARK [Gossypii Radicis Cortex, Pharm. 1890]

(gŏs-sȳp'ĭ-ī cŏr'tĕx)

"The dried bark of the root of *Gossypium herbaceum* Linné, or of other cultivated species of *Gossypium* (Fam. *Malvaceæ*)." *U. S.*

Gossypii Radicis Cortex, *Br. Add.;* Ecorce de la Racine de Cotonnier, *Fr.;* Baumwoll-Wurzelrinde, *G.;* Corteza de la raiz d'algodon, *Sp.*

In consequence of changes produced in the plants of this genus by cultivation, botanists have found great difficulty in determining which are distinct species and which are merely varieties. De Candolle describes thirteen species in his Prodromus, and mentions six others, but considers them all uncertain. Royle describes eight and admits others. Schwartz thinks that they may all be referred to one original species. Engler and Prantl recognize six species, three of these being cultivated. The plants inhabit different parts of tropical Asia and Africa, and many of them are cultivated for their cotton in climates adapted to their growth. The species from which most of the cotton of commerce has been thought to be obtained is the one specially indicated by the U. S. Pharmacopœia. According to Royle, it is the India cotton which is produced by *G. herbaceum,* while *G. barbadense* furnishes all the cotton of North America, and *G. peruvianum* that produced in Brazil, Peru, and other parts of South America. (See *A. J. P.,* 1858, 339.) A. W. Chapman, however, in his *Flora of the Southern United States* (New York, 1860, 58,), states that the numerous varieties of the cotton plant are now referred to two species, the *long staple,* or *sea island,* to *G. album* (Haw.), and the *short staple,* or *upland,* to *G. nigrum* (Haw.). For an account of a microscopical and microchemical examination of cotton root bark by F. W. Morgan, see *A. J. P.,* 1898, 427.

Gossypium herbaceum, Linn., *Sp. Plant.* 975; De Cand., *Prodrom.* i. 456.—This is a biennial or triennial plant, with a branching stem from two to six feet high, and palmate hoary leaves, the lobes of which are somewhat lanceolate and acute. The flowers are pretty, with yellow petals, having a purple spot near the claw. The leaves of the involucre or outer calyx are serrate. The capsule opens when ripe, and displays a loose white tuft of long slender filaments, which surround the seeds and adhere firmly to the outer coating. The plant is a native of Asia, but is cultivated in most tropical countries. It requires a certain duration of warm weather to perfect its seeds, and, in the United States, does not mature north of Virginia.

The herbaceous part of the plant contains much mucilage, and has been used as a demulcent. The seeds yield by expression a fixed oil of the drying kind, which is employed for making soap and for other purposes. (See

Oleum Gossypii.) The bark of the root has been supposed to possess medicinal virtues, and is recognized by the U. S. Pharmacopœia. Another official portion, and that for which the plant is cultivated, is the filamentous substance surrounding the seeds. This when separated constitutes the cotton of commerce. Cotton seeds have been employed in our Southern States with great asserted success in the treatment of intermittents, but are at present seldom, if ever, used. (For details, see U. S. D., 16th ed.)

Properties.—Cotton Root Bark is officially described as "in thin, flexible bands or quilled pieces, the bark 0.2 to 1 Mm. thick; outer surface yellowish-brown, longitudinally wrinkled, with small lenticels, the periderm frequently exfoliated and somewhat fuzzy from partly detached bast fibres; inner surface whitish, longitudinally striate; fracture tough, fibrous, the bast-layer separable into thin laminæ; odor faint; taste slightly astringent and acrid." *U. S.* E. S. Wayne of Cincinnati, found in it a peculiar acid resin, colorless and soluble in water, when pure, but absorbing oxygen on exposure, and then becoming red and insoluble in water. It is deposited by the fluidextract on standing. He suggests that this may be the active principle of the root; but the fact has not been determined. (*A. J. P.*, 1872.) William C. Staehle (*A. J. P.*, 1875) made an examination of this resin, and obtained results somewhat different from those of Wayne. Staehle's percolate was of a dark reddish-brown color, while Wayne's was pale amber. This is accounted for, however, by the presence of a principle which is colorless in the fresh bark, but of a dark red in bark which has been exposed to air and light. W. A. Taylor noticed that the change in color from pale amber to dark red took place in an alcoholic tincture. (*A. J. P.*, 1876.) Staehle found the resin soluble in 14 parts of alcohol, 15 parts of chloroform, 23 parts of ether, and 122 parts of benzene.

Uses.—Bouchelle of Mississippi, first stated that cotton root is an excellent emmenagogue, and was habitually resorted to by the slaves of the South for producing abortion. To assist *labor,* he employed a decoction made by boiling four ounces of the inner bark of the root in a quart of water to a pint, and gave a wineglassful (60 Cc.) every twenty or thirty minutes. (*W. J. M. S.*, Aug. 1840.) These opinions of Bouchelle have been confirmed by various Southern medical practitioners, and H. I. Garrigues asserts that the cotton root has great powers in arresting hemorrhage and ameliorating the other symptoms of *uterine fibroids,* but, for some reason, the drug failed to come into general use. Bellany of Columbus, Georgia, found that the root should be gathered as late as possible in the fall before frost. The fluidextract official in the U. S. P. 1890 (see page 525) may be used in doses of from one-half to one fluidrachm (1.8 to 3.75 Cc.), repeated at short intervals if necessary. The British Addendum recognizes a decoction of Cotton Root Bark.[1]

Dose, thirty to sixty grains (2 to 3.9 Gm.).

GOSSYPIUM PURIFICATUM. U. S. (Br.)

PURIFIED COTTON [Absorbent Cotton]

(gŏs-sȳp'ĭ-ŭm pū-rĭ-fĭ-cā'tŭm)

"The hairs of the seed of *Gossypium herbaceum* Linné, or of other cultivated species of Gossypium (Fam. *Malvaceæ*) freed from adhering impurities and deprived of fatty matter." *U. S.* "The hairs of the seed of Gossypium barbadense, *Linn.,* and of other species of Gossypium, freed from fatty matter." *Br.*

Gossypium, *Br.;* Cotton Wool; Lana (Lanugo, s. Pili) Gossypii; Coton Hydrophile, *Fr. Cod.;* Coton absorbant, Xylum præparatum, *Fr.;* Gossypium depuratum, *P. G.;* Gereinigte Baumwolle, Baumwolle, *G.;* Cotone assorbente, C. idrofilo, *It.;* Algodon hidrofilo, Algodon absorbente, *Sp.*

Cotton consists of "white, soft, fine filaments, appearing under the microscope as hollow, flattened and twisted bands, spirally striate, and slightly thickened at the edges; inodorous and tasteless; insoluble in ordinary solvents, but soluble in an ammoniacal solution of cupric oxide." *U. S.* It is without odor or taste, soluble in strong alkaline solutions, and decomposed by the concentrated mineral acids. In chemical character it is related to but not identical with lignin, the latter being an alteration product and sometimes called oxycellulose. By nitric acid it is converted into that remarkable explosive substance denominated gun cotton, for an account of which see *Pyroxylinum* and *Collodium. Mercerized cotton* (imitation of silk) is made by boiling the raw cotton in a diluted alkaline solution.

In the process of purifying cotton a soap is formed through the union of the fatty matter with the alkali, and this is subsequently dissolved out by repeated washings. F. L. Slocum published in 1881 a process for preparing it. For details see the foot-note.[2] The U. S. P.

[1] *Decoctum Gossypii Radicis Corticis,* Br. Add., *Decoction of Cotton Root Bark.*—Cotton Root Bark, bruised, 4 *ounces* (Imperial) [200 grammes]; Distilled Water, *a sufficient quantity.* Boil the Cotton Root Bark with two pints (Imp. Meas.) [or two litres] of the Distilled Water, in a suitable vessel, until the volume is reduced to one pint (Imp. Meas.) [or one thousand cubic centimetres], strain, if necessary pour more Distilled Water over the contents of the strainer, so as to produce one pint (Imp. Meas.) [or one thousand cubic centimetres] of the strained Decoction.

[2] *Purified Cotton.*—Take of the best quality of carded cotton batting any desired quantity, and boil it with a 5 per cent. solution of potassium or sodium hydroxide for one-half hour, or until the cotton is entirely saturated with the solution, and the alkali has saponified all oily matter. Then wash thoroughly, to remove all soap, and nearly all alkali; press out the excess of water, and immerse in a 5 per cent. solution of chlorinated lime for 15 or 20 minutes; again wash, first with a little water, then dip in water acidulated with hydrochloric acid, and thoroughly wash with water; press out the excess of water, and again boil for 15 or 20 minutes in a 5 per cent. solution of potassium or sodium hydroxide; now wash well,

tests are as follows: "When Purified Cotton, previously compressed in the hand, is thrown on the surface of cold water, it should readily absorb the latter and sink, and the water should not acquire either an acid or an alkaline reaction (evidence of *proper purification* and absence of *fatty matter*). Purified Cotton should be perfectly free from all visible impurities, and on combustion should not leave more than 0.3 percent. of ash." *U. S.* The first test proves the absence of fatty matter, for if even a small quantity be present the cotton will float in water. Repeated experiments have proved that cotton will take fire and burn spontaneously if impregnated with linseed oil, or some of the other fixed oils, and allowed to stand, whereby the heat of the oxidation of the oil suffices to ignite the matted fibres of the cotton. (*P. J.*, 1872, p. 225.) Cotton, analyzed by M. Schunck, was found, independently of cellulose $(C_6H_{10}O_5)_n$, of which it chiefly consists, to contain vegetable wax, a fatty acid, coloring matter, pectic acid, and a little of an albuminoid substance. (*J. P. C.*, Sept. 1868, 233.) For medicinal use it should be carded into thin sheets.[1] It is said that air passed through cotton loses the property of inducing fermentation, on account of the microscopic organisms being strained out of it; and this fact has been utilized in preserving infusions by placing them in bottles containing corks armed with tubes loosely filled with cotton, and drawing the infusion from a stopcock near the bottom.

Uses.—The use of cotton as a filtering medium and in the preparation of medicated waters has already been alluded to. It is much used in surgery as a dressing for burns, scalds, blisters, and wounds, in order to prevent the access of pathogenetic germs.[2] Cotton batting is often employed to maintain a uniform temperature in parts affected with acute rheumatic inflammation.

Off. Prep.—Pyroxylinum, *Br.*

dipping in the acidulated water and washing thoroughly with pure water. Afterwards press out and dry quickly.

The amount of loss by this process is practically 10 per cent. A sample of 360 gr. lost, on boiling with alkali and bleaching, 15 gr., or 4.17 per cent., and 270 gr. of this bleached sample lost, on again boiling with an alkali, 14 gr., or 5.18 per cent., a total loss of 9.35 per cent. (*A. J. P.*, 1881, p. 53. See also *Ph. Era*, 1890, 22.)

[1] *Wood Wool.*—Under this name Bruns has introduced finely grained, purified wood fibre, such as is used in making paper. It may be medicated like cotton. (*N. R.*, 1883, p. 361.)

[2] Absorbent cotton has been medicated in various ways and come largely into use. (See *Iodized Cotton*, under *Iodum.*) *Picric Cotton* is prepared by dissolving 0.25 Gm. of picric acid in 25 Gm. of ether, or of 94 per cent. alcohol, and immersing in the solution 10 Gm. of clean cotton, and drying. *Salicylic Cotton* (5 per cent.) may be prepared by Bruns's process, by saturating one kilogramme of cotton with 4 liters of a solution of 50 Gm. of salicylic acid, and 20 Gm. of castor oil in 3.930 liters of alcohol. *Benzoic Cotton* is made in the same way, substituting benzoic for salicylic acid. (*A. J. P.*, Dec. 1878.) *Chlorinated Cotton.* Pavesi subjects cotton moistened with glycerin, and suspended at the top of a large wide-mouthed bottle, to the action of chlorine vapor, generated by adding sulphuric acid to chlorinated lime. (*N. R.*, July, 1880.) Joseph W. England communicates in *A. J. P.*, 1887, p. 173, practical formulas for preparing the following medicated cottons and gauzes: *Borated Cotton, Benzoated Cotton, Salicylated Cotton, Naphthalinated Cotton, Iodoformized Cotton, Carbolized Cotton, Sublimated Cotton, Carbolized Gauze, Sublimated Gauze, Absorbent Canton Flannel.* For methods of assay of medicated cottons, gauzes, etc., see *Proc. A. Ph. A.*, 1897, 457, 458, 459.

GRANATUM. U. S. (Br.)

POMEGRANATE

(grą-nā'tŭm)

"The bark of the stem and root of *Punica Granatum* Linné (Fam. *Punicaceæ*)." *U. S.* "The dried bark of the stem and root of Punica Granatum, *Linn.*" *Br.*

Granati Cortex, *Br.*, Pomegranate Bark; Grenadier, *Fr. Cod.;* Ecorce de la Racine de Grenadier (de Balaustier), Ecorce de Granade, *Fr.;* Cortex Granati, *P. G.;* Granatrinde, Granatwurzelrinde, *G.;* Melograno, Malicorio, Scorza del Melograno, *It.;* Granada (Corteza de), *Sp.*

Punica Granatum, Willd., *Sp. Plant.* ii. 981; Woodv., *Med. Bot.* p. 531, t. 190; Carson, *Illust. of Med. Bot.*, i. 45, pl. 38.—The pomegranate is a small shrubby tree, attaining in favorable situations the height of twenty feet, with a very unequal trunk, and numerous branches which sometimes bear thorns. The leaves are opposite, entire, oblong or lance-shaped, pointed at each end, smooth, shining, of a bright-green color, and placed on short footstalks. The flowers are large, of a rich scarlet color, and stand at the end of the young branches. The petals are roundish and wrinkled, and are inserted into the upper part of the tube of the calyx, which is red, thick, and fleshy. The fruit is a globular berry, about the size of an orange, crowned with the calyx, covered with a reddish-yellow, thick, coriaceous rind, and divided internally into many cells, which contain an acidulous pulp, and numerous oblong, angular seeds.

This tree grows wild upon both shores of the Mediterranean, in Arabia, Persia, Bengal, China, and Japan, has been introduced into the East and West Indies, and is cultivated in all civilized countries where the climate is sufficiently warm to allow the fruit to ripen. In higher latitudes, where it does not bear fruit, it is raised in gardens and hot houses for the beauty of its flowers, which become double and acquire increased splendor of coloring by cultivation. Doubts have been entertained as to its original country. The name of *Punicum Malum*, applied by the ancients to its fruit, implies that it was abundant at an early age in the vicinity of Carthage. The fruit, for which the plant is cultivated, varies much in size and flavor. It is said to attain greater perfection in the West Indies than in its native country. The edible pulp is red, succulent, pleasantly acid, and sweetish. The flowers were recognized by the Dublin College, and the seeds are official in France. See a paper by J. U. Lloyd in *West. Drug.*, 1897, 202.

Rind of the Fruit.—This is presented in commerce under the form of irregular fragments,

hard, dry, brittle, of a yellowish or reddish-brown color externally, paler within, without odor, and of an astringent, slightly bitter taste. It contains a large proportion of tannin, and in countries where the tree abounds, has been employed for tanning leather.

Flowers.—The flowers, sometimes called *balaustines,* are inodorous, have a bitterish, astringent taste, and impart a violet-red color to the saliva. They contain tannic and gallic acids, and were used by the ancients in dyeing.

Bark.—The stem bark is officially described as "in single quills or transversely curved pieces, mostly 2 to 10 Cm. long, 5 to 20 Mm. in diameter; bark 0.5 to 3 Mm. thick; outer surface yellowish- to brownish-gray, with brownish-black fruit-heads of a lichen and small lenticels; inner surface grayish-yellow to brownish, finely striate; fracture short, smooth, the phelloderm layer dark green, the inner bark dull greenish-yellow; odor distinct; taste astringent, somewhat bitter." *U. S.* The roots of the pomegranate are hard, heavy, knotty, ligneous, and covered with a bark which is yellowish-gray or ash-gray on the outer surface, and yellow on the inner. The *root bark* occurs in quills or fragments similar to but differing from those of the stem as shown in the official characterization.[1] "Dark brown, with more or less longitudinal patches and scales of cork; green phelloderm layer absent; medullary rays extending nearly to the periderm." *U. S.* "The transverse section exhibits numerous fine radial and tangential lines." *Br.* It has little or no odor, colors the saliva yellow when chewed, and leaves in the mouth an astringent taste without disagreeable bitterness. The infusion of the bark yields a deep-blue precipitate with salts of iron, and a yellowish-white precipitate with solution of gelatin. The inner surface of the bark, steeped in water and then rubbed on paper, produces a yellow stain, which by the contact of ferrous sulphate is rendered blue, and by that of nitric acid acquires a slight rose tint, which soon vanishes. These properties serve to distinguish this bark from those of the box root and barberry, with which it is said to be sometimes adulterated. When used, it should be separated from the ligneous portion of the root, as the latter is inert. The bark contains more than 22 per cent. of tannic acid, which Rembold (*Ann. Ch. Ph.,* 143, 285) found to consist for the most part of a peculiar variety, *punico-tannic acid,* $C_{20}H_{16}O_{13}$; when boiled with diluted sulphuric acid it is resolved into *ellagic acid,* $C_{14}H_8O_9$, and sugar. Punico-tannic acid is accompanied by common tannic acid, yielding by means of sulphuric acid, gallic acid, which appears sometimes to pre-exist in the bark. Henry Trimble, however, (*A. J. P.,* 1897, 636), as the result of an ultimate analysis of the purified tannin and a study of its reactions, pronounced it to be identical with gallotannic acid. Pomegranate bark also yields a considerable quantity of *mannite,* which was formerly described under the names of *punicin* or *granatin.* The active power of the root, however, is due, according to Tanret (*C. R. A. S.,* 86, 1270, and 87, 358), to an alkaloid *pelletierine,* $C_8H_{15}NO$, a dextrogyrate liquid boiling at 195° C., easily soluble in water, alcohol, and ether, and specially so in chloroform. It has strong basic properties and precipitates many metallic salts: 1000 parts of dry bark yielded 4 parts of it.

In a later communication (*C. R. A. S.,* 88, p. 716), Tanret announced that he had found three additional volatile bases in the bark, a liquid left-rotating one, a liquid optically inactive one, and a crystallizable inactive one, which latter has the formula $C_9H_{15}NO + 2H_2O$, fuses at 46° C., and boils at 246° C. His process for obtaining these alkaloids is as follows. A mixture of the salts of the alkaloids is prepared by mixing the powdered bark with a milk of lime, exhausting with water, shaking the resulting liquor with chloroform, and neutralizing the latter with diluted acid. A solution of the mixed alkaloids is thus obtained in which one or other of them predominates, according to the source of the bark. Two of the four alkaloids are displaced from their salts by sodium bicarbonate, and two are not. The solution is therefore treated with an excess of sodium bicarbonate and shaken with chloroform, and this in its turn is agitated with diluted sulphuric acid. The resulting solution contains the sulphates of two alkaloids, to which the names of *methylpelletierine,* $C_9H_{17}NO$, and *pseudopelletierine,* $C_9H_{15}NO$, have been given. Potassium hydroxide is then added to the first liquor, and upon repeating the treatment with chloroform and acid there is obtained a solution of *pelletierine* and *isopelletierine* sulphates. (*P. J.,* 1880.) Carl J. Bender (*Ph. Centralh.,* 1885, p. 6) found three bases in pomegranate bark, one crystallizable and two amorphous. He objects to the name pelletierine, and substitutes *punicine.* Wm. F. Junkunz analyzed pomegranate bark, and believed that the alkaloid exists in the bark as a tannate. (*A. J. P.,* 1884.) The old idea that the bark loses activity when kept seems to be negatived by the analysis of De Vrij. (*P. J.,* xxi.) Piccinni isolated a tertiary alkaloid, $C_{10}H_{18}NO$, from pomegranate root bark (*P. J.,* 1900, 249). For Leger's method of determining total alkaloids see *P. J.,* 1904, 581.

[1] The bark of the stem of the pomegranate is sold as root bark: for microscopic diagnosis, see *P. J.,* 1873. As the activity of the barks of different portions of the plant is important, represented by the alkaloids the analyses of Stoeder are of interest. His results are: stem and branch bark, in thin quills, 0.612 per cent.; average quills, 0.350 per cent.; thick quills, 0.498 per cent.; root bark from south of Europe, in thick quills, 1.010 per cent.; shaved root bark from Java, 1.326 per cent.; exfoliated bark from dry thick roots of unknown age, 1.240 per cent.; finely rasped wood from these roots, 0.218 per cent. According to the same authority (*Nederl. Tijd. Pharm.,* 1890), of the bark of three varieties of the wild pomegranate recognized and used by the natives of Java, the red-flowered "merah," yielded 2.43 per cent.; the white-flowered, "poetih," yielded 3.75 per cent.; the black-flowered, "hitam," yielded 1.71 per cent.

Uses.—The rind of the pomegranate fruit was formerly recognized by the U. S. Pharmacopœia. It is astringent, and in the form of decoction is sometimes employed in *diarrhœa* and *colliquative sweats*, and, more frequently, as an injection in *leucorrhœa*, and as a gargle in *sore throat* in the earlier stages, or after the inflammatory action has in some measure subsided. The powdered rind has also been recommended in *intermittent fever*. The flowers have the same medicinal properties and are used for the same purposes. The bark of the root was used by the ancients as a vermifuge, and is recommended in the writings of Avicenna, but was unknown in modern practice until brought into notice by F. Buchanan, who learned its powers in India. The Mahometan physicians of Hindostan consider it a specific against *tænia*. One of these practitioners, having relieved an English gentleman in 1804, was induced to disclose his secret, which was then made public. The French writers prefer the product of the wild pomegranate, growing on the borders of the Mediterranean, to that of the plant cultivated in gardens for ornamental purposes. The bark may be administered in powder or decoction, but the latter form is usually preferred. The decoction is prepared by macerating two ounces of the bruised bark in two pints of water for twenty-four hours, and then boiling to a pint. Of this a wineglassful may be given every half hour, hour, or two hours, until the whole is taken. It often nauseates and vomits, and usually purges. Portions of the worm often come away soon after the last dose. It is recommended to give a dose of castor oil and to diet the patient strictly on the day preceding the administration of the remedy, and, if it should not operate on the bowels, to follow it by castor oil, or an enema. If not successful on the first trial, it should be repeated daily for three or four days, until the worm is discharged. It appears to have been used by the negroes of San Domingo before its introduction into Europe.

The efficacy of pelletierine as a tænicide has been abundantly confirmed, and it appears to be established that the tannate is the most effective and the least dangerous form of the remedy,—probably because its insolubility prevents its rapid absorption and enables it to come in prolonged contact with the worm. The experiments of Dujardin-Beaumetz have shown that the alkaloids from pomegranate act upon the higher animals like curare, causing paralysis of the motor nerves without affecting sensation or muscular contractility. The same authority asserts that hypodermic injections of six grains produce in man severe vertigo, muscular weakness, and great retinal congestion. Double vision has also been noted, and Galezowski has been led by it to prescribe pelletierine in paralysis of the third and sixth pairs of nerves; he affirms that he has succeeded in affording relief after the failure of potassium iodide and blisters. The proper dose of pelletierine tannate is variously given by authorities. It has been stated to be from one-half to three-quarters of a grain (0.032 to 0.048 Gm.) (*B. G. T.*, xcvi., xcvii.), but others place it as high as eight grains (0.5 Gm.). Commercially, it occurs almost exclusively as a syrupy solution, put up, we believe, under the supervision of its discoverer, each bottle containing a single dose, it is stated, of about five grains (0.32 Gm.). We have seen pronounced temporary general palsy produced in a female adult by this dose. The dose of pomegranate rind and flowers in powder is from twenty to thirty grains (1.3 to 2.0 Gm.). A decoction may be prepared in the proportion of an ounce of the bark to a pint of water, and given in the dose of a fluidounce (30 Cc.). The remedy should always be given after a twelve hours' fast, and be followed in two hours by a brisk cathartic. The seeds are demulcent.

Dose, twenty to thirty grains (1.3 to 2 Gm.).

Off. Prep.—Decoctum Granati Corticis, *Br.;* Fluidextractum Granati, *U. S.*

GRINDELIA. U. S., Br. Add.

GRINDELIA

(grĭn-dē'lĭ-ą)

"The dried leaves and flowering tops of *Grindelia robusta* Nuttall, or of *Grindelia squarrosa* (Pursh) Dunal (Fam. *Compositæ*)." *U. S.*

California Gum-plant; Grindelia, *Fr.;* Grindelie, *G.*

This genus inhabits the western side of both North and South America. Most if not all of the species produce a resinous exudation, especially from the flower-heads, and it is probable that medicinal properties are common to the genus.

G. robusta, Nuttall, is an herbaceous plant, from one to three feet high, very glabrous, with leaves varying from broadly spatulate or oblong to lanceolate, or the upper cordate and clasping, commonly obtuse, sharply more or less serrate; the scales of the involucre are produced into long circinate, squarrose, awn-like tips; the pappus of two to three, rarely five, nearly smooth, flattish awns; akenes mostly one- to three-toothed at the apex.

G. squarrosa (Pursh), Dunal (Syn. *Donia squarrosa*, Pursh (1814), *G. squarrosa*, Dunal 1836), is in general a less leafy and bushy plant than is *G. robusta*, but so closely resembles some varieties of the latter that, after a careful study of various published descriptions and of the specimens in the herbarium of the Philadelphia Academy of Natural Sciences, we are not satisfied of the specific distinctness. The character pointed out by Torrey and Gray, that in *robusta* the leaves are broader at the base than above does not hold, for in a specimen in the herbarium of the Academy of Natural Sciences labelled in

Nuttall's handwriting, and, therefore, probably the type of *G. robusta,* the leaves are not broader at the base; while in various specimens of *G. squarrosa* they are not narrowed at the base. The most constant distinctive characters in the specimens at hand are that *G. robusta* has a more leafy involucre and its leaves usually are more coarsely serrate; but Watson describes a variety of *G. robusta* in which the upper leaves are entire. There is no constant difference in the scales of the involucre. According to Joseph Beauvais (*A. J. P.,* Feb. 1889), the resin of the leaf of *G. robusta* is contained in epidermal glands, and also in rather large resin-ducts situated in an interior collenchymatous layer.

Properties.—The official description of grindelia is as follows: "Leaves about 5 Cm. or less long, varying from broadly spatulate or oblong to lanceolate, sessile or clasping, obtuse, more or less sharply serrate, often spinosely toothed, or even laciniate-pinnatifid, pale green, smooth, finely dotted, somewhat coriaceous, brittle; heads more or less resinous-viscid, many-flowered, either conical-urceolate (*G. squarrosa*), or depressed-urceolate (*G. robusta*); the involucre hemispherical, about 10 Mm. broad, composed of numerous imbricated, squarrosely tipped or spreading scales; ray-florets yellow, ligulate, pistillate, sometimes absent; disk-florets yellow, tubular, perfect; pappus of two or three mostly unequal awns about the length of the disk-florets; odor balsamic; taste pungently aromatic and bitter." *U. S.*

As it occurs in commerce, grindelia is in the form of the whole dried herb; the stems are about eighteen inches in length, light brownish, very frequently stripped of their leaves, but with some of the floral heads adherent. The brittle leaves are much broken, and with separated floral heads are mixed with the stem. The taste is warmish, peculiar, and very persistent. The specimens we have examined seemed to contain numerous floral heads, some according with those of the typical *G. robusta,* others without trace of involucre leaves. Some of the latter may have been removed, it is true, by accidents of carriage; but if *G. squarrosa* and *G. robusta* be distinct species, it would appear that they are indiscriminately collected. The activity of the drug probably resides in the resinous exudation. C. J. Rademaker obtained from it an oil, the odor of which closely resembled that of oil of turpentine, resin, and a crystalline body having an alkaline reaction. (*N. R.,* 1876, p. 205.) W. H. Clark and John L. Fischer (*A. J. P.,* 1888, p. 433) failed to verify all of Rademaker's results, but obtained an alkaline principle to which the name of *grindeline* was given. A. Schneegans (*A. J. P.,* 1892, 369) found in *Grindelia robusta, saponin,* which, he states, is composed of two glucosides; he also found indications of an alkaloid, but believes that its presence is not yet certainly proved. See also *M. R.,* 1898, 394. *Grindelia robusta* is said to contain 0.28 per cent. of a dark-brown essential oil, having a specific gravity of 0.9582 at 15° C., and the optical rotation in alcoholic solution of —8° 08′. It is soluble in ether, amyl alcohol, and chloroform. (*Ph. Ztg.,* 48, 574.)

Uses.—According to Buffington, when given to the lower animals in very large doses grindelia produces narcosis, with dilated pupils, slowing of the action of the heart from stimulation of the inhibitory nerves, and elevation of the blood pressure from stimulation of the vasomotor centre. Dobroklowsky has found that on the isolated frog's heart it acts in small doses as a stimulant and in large doses as a paralyzant; he further states that it acts chiefly upon the motor nerves and muscles, but Buffington asserts that it paralyzes first the sensory nerve-trunks, then the sensory side of the spinal cord, and afterwards involves the motor nerve-trunks and cord. Grindelia is not used in practical medicine for its influence upon the circulation, but as an antispasmodic, especially in *asthma,* and in *bronchitis* when there is a distinct tendency to dyspnœa and bronchial spasm. It seems probable that it not only exerts an antispasmodic influence, but also stimulates the bronchial mucous membrane, and it may be confidently exhibited in chronic bronchitis, especially of the aged. It has been employed with asserted success in *whooping cough.* Its active principles appear to be excreted from the kidneys; hence after large doses there are sometimes evidences of renal irritation, and in chronic *catarrh* of the *bladder* good has been effected by its stimulant influence upon the mucous membrane of the viscus. As a local application, grindelia has been employed with asserted advantage in *burns, vaginitis, genito-urinary catarrh,* etc., applied either in the form of a poultice or in solution.

Dose, thirty to forty grains (2 to 2.6 Gm.).

Off. Prep.—Fluidextractum Grindeliæ, *U. S.*

GUAIACI LIGNUM. Br.

GUAIACUM WOOD

(guaĭ′ą-cī lĭg′nŭm)

"The heart-wood of Guaiacum officinale, *Linn.,* or of Guaiacum sanctum, *Linn.*" *Br.*

Lignum Sanctum (vel Benedictum); Lignum Vitæ; Gayac, *Fr. Cod.;* Bois de Gayac, *Fr.;* Lignum Guajaci, *P. G.;* Guajakholz, Franzosenholz, Pockholz, *G.;* Guajaco, Legno guajaco, *It.;* Guayaco (Leño de), *Sp.*

Guaiacum officinale, Willd., *Sp. Plant.* ii. 538; Woodv., *Med. Bot.* 557, t. 200; Carson, *Illust. of Med. Bot.,* i. 25, pl. 17.—This is a large tree, of a very slow growth. When of full size it is from forty to sixty feet high, with a trunk four or five feet in circumference. The branches are knotted, and covered with an ash-colored striated bark. That of the stem is of a dark-gray color, variegated with greenish or purplish spots. The leaves are opposite, and abruptly pinnate, consisting of two, three, and sometimes four pairs of leaflets, which are

obovate, veined, smooth, shining, dark green, from an inch to an inch and a half long, and almost sessile. The flowers are of a rich blue color, stand on long peduncles, and grow to the number of eight or ten at the axils of the upper leaves. The seeds are solitary, hard, and of an oblong shape.

G. sanctum, L., is distinguished from *G. officinale* by its five-celled fruit and its oblong or obliquely obovate or sometimes rhomboid-ovate leaflets, six to eight to each leaf. It grows in Cuba and some other of the West India Islands, and in the Bahama Islands. Its wood is smaller than that of *G. officinale*, and is said by Fée to be paler and less dense.

G. officinale grows in the West Indies, particularly in Hayti and Jamaica, and is found also in the warmer parts of the neighboring continent. All parts of the tree are possessed of medicinal properties, but the wood and the concrete juice only are official. The bark, though much more efficacious than the wood, does not enter commerce. *G. arboreum* of De Candolle has been said to furnish some of the guaiacum wood of commerce.

Guaiacum wood is imported from Hayti and other West India islands, in the shape of logs or billets, covered with thick gray bark, which presents on its inner surface, and upon its edges when broken, numerous shining crystalline points. These were supposed by Guibourt to be benzoic acid, by others a resinous exudation from the vessels of the plant; but Otto Berg has determined that they are crystals of calcium sulphate. The billets are used by turners for the fabrication of various instruments and utensils, for which the wood is well adapted by its extreme hardness and density. It is kept by the druggists and apothecaries in the state of shavings or raspings, which they obtain from the turners. It is commonly called *lignum vitæ*, a name which obviously originated from the supposition that the wood was possessed of extraordinary remedial powers.

Properties.—Guaiacum wood is hard and heavy. The color of the sap-wood is yellow, that of the older and central layers greenish brown, that of the shavings a mixture of the two. It is said that when the wood is brought into a state of minute division its color is rendered green by exposure to the air, and bluish green by the action of nitric acid fumes, and the latter change may be considered as a test of its genuineness. (Duncan.) An easier test is a solution of corrosive sublimate, which, added to the shavings and slightly heated, causes a bluish-green color in the genuine wood. Guaiacum wood is almost without odor unless rubbed or heated, when it becomes odorous. When burned, it emits an agreeable odor. It is bitterish and slightly pungent, but requires to be chewed for some time before the taste is developed. It contains, according to Trommsdorf, 26 per cent. of resin, and 0.8 of a bitter pungent extractive, upon both of which, probably, though chiefly on the former, its medicinal virtues depend. (See *Guaiacum.*) Paetzold (*Schim. Rep.*, 1902, 43) states that the bark of the guaiac tree yields 1 per cent. of a volatile oil, having an exquisite odor. The wood yields its virtues but partially to water. One pound of the wood afforded to Geiger two ounces of extract. "Guaiacum Wood is generally used in the form of raspings or turnings, which should be greenish-brown, containing few particles of a whitish color, and should acquire a dark-bluish-green color on the addition of nitric acid." *U. S.* 1890.

Uses.—Guaiacum wood ranks among the stimulant diaphoretics. It is said to have been introduced to the notice of European practitioners by the natives of Hispaniola soon after the discovery of America. It was used in Europe so early as 1508, and attained great celebrity as a remedy for *lues venerea;* but the general professional verdict is that it has no distinct influence in *syphilis*, nor yet in chronic *rheumatism* and *gout*, *scrofula*, or *cutaneous eruptions*, against which it was formerly much used. It is usually exhibited in decoction, and in combination with other medicines, as in the compound decoction of sarsaparilla.

Dose, thirty to sixty grains (2.0 to 3.9 Gm.).

Off. Prep.—Liquor Sarsæ Compositus Concentratus, *Br.*

GUAIACOL. U. S.

GUAIACOL

(guaĭ'ą-cŏl)

$C_7H_8O_2 = 123.13$

"One of the chief constituents [$C_6H_4(OH)(OCH_3)$ 1 : 2] of creosote, the product from beechwood-tar, obtained by collecting and purifying the fraction of creosote boiling between 200° and 205° C. (392° and 401° F.); or prepared synthetically from either catechol by methylating, or from ortho-anisidin by diazotizing and boiling. Guaiacol should be preserved in amber-colored bottles, protected from light." *U. S.*

Ortho-dioxybenzene-methyl-ester, Methyl-orthodioxybenzene, Methyl-pyrocatechin, Catechol-monomethyl-ether; Gaïacol, *Fr. Cod.;* Guajakol, Brenzcatechin-monomethyl-ester, *G.;* Guajacolo, *It.;* Guayacol, *Sp.*

Preparation.—Guaiacol is the monomethyl ester of the ortho-dioxybenzene known as catechol (pyrocatechin), and can be readily made from this diatomic phenol by methylating with the aid of methyl-sulphuric acid. It is, however, largely obtained from beechwood creosote, of which it constitutes from 60 to 90 per cent. The separation of the diatomic phenols and phenol-ethers from monatomic phenols in a mixture like creosote, is effected in several ways. The compounds formed by baryta with the former are much less soluble that those with the latter, and this is also true of magnesia compounds. Another method is to rub up the creosote with potassium carbonate. Guaiacol and creosote combine to form

solid addition compounds, from which the other phenols are washed out with ether or petroleum benzin, when the crystalline mass is decomposed with water and the phenols separated.

Properties.—It is officially described as "a colorless, crystalline solid, melting at 28.5° C. (83.3° F.), or a colorless, refractive liquid, boiling at 205° C. (401° F.), having an agreeable aromatic odor. Specific gravity of liquid: 1.140 at 25° C. (77° F.). Soluble in 53 parts of water at 25° C. (77° F.), and in alcohol and ether in all proportions; soluble in acetic acid and in 1 part of glycerin. The addition of ferric chloride T.S. to an alcoholic solution of Guaiacol (1 in 100) causes an immediate blue color, changing to emerald green, and finally becoming yellowish. If 2 Cc. of Guaiacol be shaken with 4 Cc. of petroleum benzin, the mixture should separate, on standing, into two distinct layers. Turbidity or failure to separate into layers indicates the presence of impurities. One Cc. of Guaiacol should dissolve in 7 Cc of sodium hydroxide T.S., when heated, and, on cooling, the mixture should congeal to a white mass. Coloration or failure to congeal indicates the presence of impurities. The white mass thus obtained should form a clear solution with 20 volumes of water (turbidity indicates *oily hydrocarbons*). One Cc. of Guaiacol, when added to 10 Cc. of concentrated sulphuric acid, should develop a pure yellowish color in the liquid (a reddish color indicating *creosote*)." *U. S.* S. Vreven recommended the following method for distinguishing between guaiacol and creosote: A drop of the liquid to be examined, 2 to 3 drops of ether, and 1 or 2 drops each of concentrated nitric and hydrochloric acids are well shaken together in a test tube. The mixture assumes at first a red-brown color, which is particularly evident in the ether layer; but upon spontaneous evaporation, well-formed needle-shaped crystals will separate out if guaiacol is present, the formation of these crystals being facilitated by occasional shaking, whereas in the presence of creosote oily globules only separate. While phenol gives a reaction similar to that of guaiacol, the crystals formed are easily distinguished from the needles produced by the latter. (*Zeit. Oest. Apoth. Ver.*, 1896, 711.)

Uses.—Locally, guaiacol is an irritant with some anæsthetic property. It is germicidal but, according to the experiments of Kuprianow, is distinctly less active than creosote or phenol. It is absorbed rapidly, not only from the alimentary canal but also through the skin. It is eliminated through the kidney, partly as a compound with sulphuric acid, partly as glycuronic acid and probably to some extent as guaiacol. Its general action, so far as known, resembles that of creosote but it affects temperature much more powerfully. The use of it as an antipyretic, in large doses, applied externally, which has been practised to some extent is, however, distinctly dangerous. Its range of usefulness as an internal drug is that of creosote, as a substitute for which it has largely been used in *phthisis* and *bronchitis*. It has been considerably employed locally in *lupus, tubercular cystitis,* and in other forms of *surgical tuberculosis*. Inhalations of the aqueous solution (1 to 600) have been much used in phthisis.

Dose, five to ten minims (0.3 to 0.6 Cc.).

GUAIACOLIS CARBONAS. U. S.

GUAIACOL CARBONATE

(guaĭ'ą-cō-lĭs cär'bo-nās)

$(C_7H_7O)_2CO_3 = 272.05$

"A guaiacol derivative $[(C_6H_4(OCH_3)O)_2.CO]$, obtained by the action of carbonyl chloride upon sodium-guaiacolate." *U. S.*

Duotal; Carbonate de Gaïacol, *Fr.;* Guajacolkarbonat, Kohlensaure-Guajacyläther, *G.;* Carbonato de guayacol, *Sp.*

Properties.—It is officially described as in "white, crystalline powder, of neutral reaction, almost tasteless and odorless. Insoluble in water; soluble in 48 parts of alcohol, 1.5 parts of chloroform, and 13 parts of ether at 25° C. (77° F.); readily soluble in hot alcohol and benzene; slightly soluble in glycerin and fatty oils. When heated between 84° and 87° C. (183.2° and 188.6° F.), it fuses. Guaiacol Carbonate is at once decomposed when treated with alcoholic potassium hydroxide T.S., and from the solution so obtained guaiacol may be separated on the addition of an acid. An alcoholic solution of Guaiacol Carbonate should not yield a bluish-green color on the addition of ferric chloride T.S. (absence of *free guaiacol*)." *U. S.* It is known commercially as *duotal*.

Uses.—Guaiacol carbonate is much used as a substitute for guaiacol on account of its tastelessness and its lack of irritant properties. It is however much less active and less effective than is guaiacol both as a local and systemic drug. The experiments of W. Hesse indicate that when taken internally much of it passes through the alimentary canal unabsorbed.

Dose, fifteen to twenty grains (1 to 1.3 Gm.).

GUAIACUM. U. S. (Br.)

GUAIAC [Guaiaci Resina, Pharm. 1890, Guaiac Resin]

(guaĭ'ą-cŭm)

"The resin of the wood of *Guaiacum officinale* Linné, or of *Guaiacum sanctum* Linné (Fam. *Zygophyllaceæ*)." *U. S.* "The resin obtained from the stem of Guaiacum officinale, *Linn.*, or Guaiacum sanctum, *Linn.*" *Br.*

Guaiaci Resina, *Br.,* Guaiacum; Guaiacum Resin; Résine de Gayac, *Fr. Cod.;* Resina Guajaci, *P. G.;* Guajak, Guajakharz, *G.;* Resina de guajaco, *It.;* Resina de guayaco, *Sp.*

For a description of *Guaiacum officinale,* see *Guaiaci Lignum,* p. 602.

Guaiac is the concrete juice of this tree. It is obtained in several different modes. The most simple is by spontaneous exudation, or by incisions made into the trunk. Another method is by sawing the wood into billets about three feet long, boring them longitudinally with an auger, then placing one end of the billet on the fire, and receiving in a calabash the melted guaiac, which flows out through the hole at the opposite extremity. But the plan probably most frequently pursued is to boil the wood, in the state of chips or sawdust, in a solution of common salt, and skim off the substance which arises to the surface. Guaiac is brought to this market from the West Indies. It is usually in large irregular pieces of various sizes, in which small fragments of bark, sand, and other impurities are mixed with the genuine guaiac, so as to give to the mass a diversified appearance. Sometimes it is found in small roundish homogeneous portions, separate or agglutinated; sometimes in homogeneous masses, prepared by melting and straining the drug in its impure state. It is probable that the guaiac obtained from the billets in the manner above described is of uniform consistence.[1]

Properties.—The masses are irregular or somewhat globular, of a glassy lustre and resinous fracture. They are of a deep greenish-brown or dark-olive color on their external surface, and internally wherever the air can penetrate. The predominant hue of those parts not exposed to the air is reddish brown or hyacinthine, diversified, however, with shades of various colors. The odor is feeble but fragrant, and is rendered stronger by heat. The taste, which is at first scarcely perceptible, becomes acrid after a short period, and a permanent sense of heat and pungency is left in the mouth and fauces. Guaiac is brittle, and when broken presents a shining glass-like surface, conchoidal or splintery, with smaller fragments more or less translucent. It is readily pulverized, and the powder, at first of a light-gray color, becomes green on exposure to the light. Its sp. gr. varies from 1.2 to 1.23. It softens in the mouth, and melts with a moderate heat. Water dissolves a small proportion of guaiac, not exceeding nine parts in 100, forming an infusion of a greenish-brown color and sweetish taste, which upon evaporation yields a brown substance soluble in hot water and alcohol, but scarcely so in ether. Alcohol takes up the whole, with the exception of impurities. The official requirements as are follows: "Not more than 15 percent. of Guaiac is insoluble in alcohol, and the alcoholic solution becomes blue on the addition of tincture of ferric chloride; acid number not less than 70 nor more than 80; ash not more than 4 percent. The filtrate obtained on macerating the powder with 4 or 5 times its weight of petroleum benzin should be colorless, and should not give a green color on the addition of an equal volume of solution (1 in 1000) of cupric acetate (absence of *rosin*)." *U. S.* The tincture is of a deep-brown color, is decomposed by water, and affords blue, green, and brown precipitates with the mineral acids. It is colored blue by nitric acid, by chlorine, and by tincture of ferric chloride, and usually by spirit of nitrous ether, and is similarly changed when treated successively by diluted hydrocyanic acid and solution of copper sulphate. Either in substance or tincture, guaiac gives a blue color to gluten and substances containing it, to mucilage of gum arabic, to milk, and to various freshly cut roots, as to the potato, carrot, and horseradish. It is soluble also in ether, alkaline solutions, and sulphuric acid. The solution in sulphuric acid is of a rich claret color, deposits, when diluted with water, a lilac precipitate, and, when heated, evolves charcoal. Exposed to air and light, guaiac absorbs oxygen and becomes green, and the change takes place rapidly in the sunshine. Tincture of guaiac has been used for the detection of blood stains, which it does by the blue color produced by it, when in contact with the red coloring matter of blood, in connection with some ozonized substance, especially hydrogen dioxide. (*Guy's Hospital Reports*, 3d ser., xiii. 432.) It may be used also to distinguish the blood of man and other mammals, in which the corpuscles are non-nucleated, from that of other classes, as birds, fishes, and reptiles, which have nucleated corpuscles. The method of R. M. Bertolet may sometimes be advantageously used in jury trials. A microscopic preparation, duly mounted, is carefully irrigated with a simple tincture of guaiac resin, and then, under glass, exposed to the action of a very small quantity of an ethereal solution of hydrogen dioxide. The mammalian corpuscles will exhibit a uniform blue coloration throughout, of different shades in the different corpuscles, while, if the blood corpuscle is nucleate, the nucleus is seen as a well defined and deep blue body, with a delicate violet colored medium around it. (*Am. J. M. S.*, Jan. 1874.)

Lücker (*Proc. A. Ph. A.*, 1894, 953), having reinvestigated guaiacum, stated that it consists chiefly of three acids,—viz., *guaiacic*, $C_{20}H_{24}O_4$, occurring in crystals melting at 86° C.; *guaiaconic*, $C_{20}H_{24}O_5$, an amorphous body melting at from 81° to 83° C.; and *guaiacinic*, $C_{21}H_{22}O_7$. He considers all three of them to be probably condensation products from tiglic aldehyde with creosol and guaiacol. Döbner has also determined that these three acids form a series of hydroxyl containing acids which may be represented by the formulas: $C_{20}H_{23}O_3(OH)$, $C_{20}H_{22}O_3(OH)_2$ and $C_{21}H_{19}O_4(OH)_3$. (Tschirch, *Harze und Harzbehälter*, 1900, p. 300.) *Guaiac yellow*, the coloring matter of guaiac resin, was first observed by Pelletier.

[1] Under the name of *Resina Guaiaci Peruviana Aromatica* there is a substance known in European commerce which probably has no relation to guaiac. For a summary of our knowledge concerning it, see *A. J. P.*, 1877, p. 18.

It crystallizes in pale yellow quadratic octahedra having a bitter taste, but is not a glucoside. Guaiac resin also yields interesting products on dry distillation. First, according to Hlasiwetz, is obtained *guaiacene,* C_5H_8O, at 118° C., next *guaiacol,* $C_6H_4\begin{cases}OCH_3\\OH\end{cases}$, being the methyl ether of pyrocatechin, at 205° to 210° C., and with it *kreosol,* $C_6H_3(CH_3)_2OH$, and finally *pyroguaiacin,* $C_{38}H_{44}O_6$ (according to Wiesner, $C_{18}H_{18}O_3$), in pearly scales, melting at 180° C. According to Lieben and Zeisel (*Ber. d. Chem. Ges.,* xiv. p. 932), guaiacene is the aldehyde of tiglic acid, $C_5H_8O_2$, and can be made synthetically from a mixture of acetaldehyde and propionaldehyde. When distilled with zinc dust there is obtained *creosol* (50 per cent. in the case of resin purified by alcohol) and 30 per cent. of a mixture of *toluene, meta-* and *paraxylene,* with a little *pseudocumene* and *guaion,* $C_{12}H_{12}$. (Bötsch, *M. Chem.,* 1880, 615.)

Saponin has been found by E. Paetzold in the bark, the wood, and the natural resin of guaiacum. (*Bull. des Sciences Pharm.,* iii. 407.) According to the experiments of W. Frieboes (*In. Dis.,* Rostock, 1903), this saponin (1 to 1000) forms a frothing solution which is persistent, is an excellent emulsifier, has the power to maintain in solution large proportions of sparingly soluble substances and is innocuous and non-irritant.

The mineral acids are incompatible with the solutions of guaiac.

Adulterations.—This drug is sometimes adulterated with the rosin of the pine. The fraud may be detected by the terebinthinate odor exhaled when the sophisticated guaiac is thrown upon burning coals, as well as by its partial solubility in hot oil of turpentine. This liquid dissolves rosin, but leaves pure guaiac untouched. Amber is said to be another adulterant. Nitric acid affords an excellent test of guaiac. If paper moistened with the tincture be exposed to the fumes of this acid, it speedily becomes blue. Purgotti proposed guaiac resin as a test for copper. (See *A. J. P.,* June, 1880.)

Uses.—Guaiac is stimulant and alterative. If given to a patient when covered warm in bed, especially if accompanied with opium and ipecac or the antimonials, and assisted by warm drinks, it often excites profuse perspiration, and hence it has been usually ranked among the diaphoretics. In large doses it purges, and it has been especially commended as a laxative in chronic rheumatism, and it is thought by some practitioners to be possessed of emmenagogue powers. It has been given with asserted advantage in *chronic rheumatism, gouty affections,* secondary *syphilis, scrofulous diseases,* and *cutaneous eruptions.* The medicine is given in substance or tincture. The dose of the powder is from ten to thirty grains (0.65 to 2.0 Gm.), which may be exhibited in pill or bolus, in the shape of an emulsion formed with gum arabic, sugar, and water, or as a syrup.[1] An objection to the form of powder is that it quickly aggregates. Guaiac is sometimes administered in combination with alkalies, with which it readily unites. Several European Pharmacopœias direct a *soap of guaiac,* under the name of *sapo guaiacinus,* to be prepared by diluting solution of potassium hydroxide with twice its weight of water, boiling lightly, then adding guaiac gradually, with continued agitation, so long as it continues to be dissolved, and finally filtering, which was followed by evaporating to the pilular consistence.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Mistura Guaiaci, *Br.;* Pilula Hydrargyri Subchloridi Composita, *Br.;* Tinctura Guaiaci, *U. S.;* Tinctura Guaiaci Ammoniata, *U. S., Br.;* Trochiscus Guaiaci Resinæ, *Br.*

GUARANA. U. S.

GUARANA

(guą-rā′ną)

"A dried paste consisting chiefly of the crushed seeds of *Paullinia Cupana* Kunth (Fam. *Sapindaceæ*), yielding, when assayed by the process given below, not less than 3.5 per cent. of its alkaloidal principles." *U. S.*

Paullinia, Brazilian Cocoa, Guarana Bread; Guarana, *Fr. Cod.;* Pasta Guaranæ; Guarana, *G., It.;* Paullnia, Guarana, *Sp.*

There are described of the genus Paullinia 121 species, all of them confined in their geographical range to tropical and subtropical South America, except one, which has strayed to Eastern and Western Africa, and two others which are found in Mexico and in the gardens of the Sandwich Islands. The name of the genus was given in honor of Christ. Fred. Paullini, a German medico-botanical writer, who died in 1712.

P. sorbilis, Martius, *Reise in Brasil,* vol. iii. 1098; *B. & T.* 67.—*Guarana üva.*—This woody climber grows in the northern and western provinces of Brazil, ripening its seeds in October and November. The leaves are alternate, on long stalks, impari-pinnate, with five oblong, oval, coarsely irregularly sinuate-dentate leaflets, five to six inches long by two to three broad, contracted into a shortly attenuated blunt point. The flowers are arranged in axillary, spicate panicles, four inches or more in length. The fruit is about the size of a grape, ovoid or pyriform, on a short peduncle, with a short

[1] *Syrup of Guaiac.* T. C. Craig. (*A. J. P.,* July, 1880.)—Powd. Guaiac Resin, 640 grains; Caustic Potassa, 58 grains; White Sugar, ℔j (av.); Water, q. s. Dissolve the Potassa in 8 fluidounces of water; moisten the Guaiac with this solution; pack it in a percolator, and gradually pour on the remainder of the solution; when this ceases dropping, add sufficient water to make the percolate measure 8 fluidounces; add the sugar, and dissolve.

strong beak, glabrous, with six longitudinal ribs. The three-valved pericarp is thin, tough, and strongly hairy within.

Preparation and Properties.—The seeds, which look like small horse-chestnuts, are contained in a three-celled, three-valved, coriaceous capsule, are lenticular and almost thorny, and invested with a flesh-colored arillus, which is easily separable when dry. Guarana is made exclusively by the Guaranis, a tribe of South America Indians, and probably varies in the details of its preparation, as it certainly does in appearance and quality. The drug appears to be produced almost exclusively from plants cultivated in the region of the lower Madeira and southward. After the seeds are shelled and thoroughly washed they are roasted for about six hours, and their external papery shells are then removed by placing them in sacks and beating them with clubs; or, after the seeds have been broken in a mortar, the coarse powder is mixed with a little water, and then kneaded into a paste, which is shaped into cylindrical or globular masses. According to Rusby, the common belief that at this stage various foreign bodies are added to the paste is incorrect. The masses are dried, sometimes in the sun, or more usually by the heat of a slow fire so arranged as to avoid smoke. When finished, the masses are of a reddish-brown color, rugose on the surface, very hard, with an irregular fracture, and of a marbled appearance when broken, due to the fragments of the seeds and their black testa embedded in the mass.

Properties.—It is officially described as follows: "Usually in cylindrical sticks, about 3 to 5 Cm. in diameter, hard and heavy, dark reddish-brown; fracture uneven, often fissured in the centre, pale reddish-brown, showing numerous coarse fragments of seeds and their blackish-brown integuments; odor slight; taste astringent, somewhat smoky and unpleasantly bitter, then sweetish." *U. S.*

Guarana is of a somewhat astringent and bitterish taste, and in this, as well as in its odor, bears some resemblance to chocolate, though not oleaginous. It swells up and softens in water, which partially dissolves it. It is also partly soluble in alcohol. Martius found in it a crystallizable principle, which he named *guaranine*, but which has been proved by Berthemot and Dechastelus to be identical with *caffeine*. Alexander Bennett, in an elaborate series of physiological experiments, has confirmed this identity.[1] The discovery of caffeine in plants belonging to distinct natural families, namely, the coffee and tea plants, the Paraguay tea, and the Paullinia, is a highly interesting result of recent chemical investigations. It is said to be more abundant in the Paullinia than in either of the other vegetables, 5.07 per cent. having been found by Stenhouse in Paullinia, while he obtained only 2.13 per cent. from good black tea, 1.00 from coffee, and 1.2 from Paraguay tea. (*P. J.*, xvi. 213.) According to Berthemot and Dechastelus, it exists in the seeds united with tannic acid, with which it appears to form two compounds, one crystallizable and soluble in water, the other of a resinoid appearance and insoluble. Besides these ingredients the seeds contain free tannic acid, gum, albumen, starch, and a greenish fixed oil. (*J. P. C.*, xxvi. 514.) For a method of preparing guaranine, see *J. P. C.*, 4e sér., xviii. 224.

Rochefontaine and Gusset prepared guaranine by mixing one part of calcined magnesia with five parts of powdered guarana, moistening with water, and, after standing twenty-four hours, exhausting the mass with boiling chloroform, evaporating the chloroform, treating the residue with boiling water, filtering, and evaporating over sulphuric acid. (*A. J. P.*, 1886, p. 248.) F. V. Greene (United States Navy) prefers a process for obtaining caffeine from guarana similar to one proposed by Wayne for its extraction from tea and coffee. The details of the method are as follows: The powdered guarana is intimately mixed with three times its weight of finely divided litharge, and the mixture boiled in distilled water, until, on allowing the temperature to fall below the boiling point, the insoluble portion is found to subside rapidly, leaving the supernatant liquid clear and without color. When cool, the clear liquid is filtered, and the precipitate is transferred to the filter and washed with boiling water, the washing to be continued as long as yellowish precipitates are produced with either phosphomolybdic acid solution, auric or platinic chloride. A stream of hydrogen sulphide gas is now passed through the filtrate, and the lead sulphide thus formed separated by filtration. The solution is evaporated on a water bath to expel the excess of hydrogen sulphide, filtered to remove a trace of sulphur, finally evaporated to the crystallizing point, and the caffeine, which crystallizes out on cooling, removed from the mother liquor and pressed between folds of bibulous paper. After being thus treated, the crystals will be found to be perfectly white. A shorter process for the assay of guarana is given by C. H. LaWall. (*A. J. P.*, 1897, 350.) It is as follows:

Five Gm. of the drug and 5 Cc. of 16 per cent. ammonia water are placed in a separatory funnel. After allowing the mixture to stand for thirty minutes, the alkaloid is shaken out with chloroform, using three portions of 20 Cc. each. F. V. Greene has shown that the tannic acid from guarana has different properties from that found in other plants, and proposes to call it *paullinitannic acid.* (*A. J. P.*, 1877, 390.) Fournier has found in paullinia, besides caffeine tannate, the following principles: gum, starch, an acrid green fixed oil, a concrete volatile oil, an aromatic liquid volatile oil soluble in water with a little alcohol,

[1] This identity has been denied by T. J. Mays. (See H. C. Wood's *Therapeutics.*)

another liquid volatile oil scarcely soluble in water, a peculiar principle not precisely determined, and tannic acid. (*J. P. C.*, Avril, 1861, 291.) E. R. Squibb examined commercial guarana, and obtained 4.38 per cent. of alkaloid from good specimens. On account of the uncertainty of the composition of guarana, he recommended physicians to prescribe fluidextract of green coffee in its place. (See *Ephem.*, 1884, 612.)

Assay. U. S. (8th Rev.).—"Guarana, in No. 60 powder, *six grammes;* Chloroform, Ether, Ammonia Water, Normal Sulphuric Acid V.S., Distilled Water, each, *a sufficient quantity.* Introduce the Guarana into an Erlenmeyer flask, and pour upon it 120 Cc. of chloroform and 6 Cc. of ammonia water, and insert the stopper securely. Shake the flask at intervals for half an hour, and allow it to stand for four hours. Filter a sufficient quantity of the liquid into a measuring cylinder until 100 Cc. (representing 5 Gm. of Guarana) have been obtained, then transfer the filtrate to a flask, and distil off all of the chloroform by means of a water-bath. Dissolve the alkaloidal residue in a mixture of 2 Cc. of normal sulphuric acid V.S. and 20 Cc. of warm distilled water. Allow the liquid to cool, and filter it into a separator, rinse the flask and filter with several small portions of distilled water, add 20 Cc. of chloroform and 2 Cc. of ammonia water to the separator, and shake it for one minute. Draw off the chloroform into a tared flask and repeat the extraction with two portions of 10 Cc. each of chloroform. Distil off the chloroform from the combined liquids, and when the residue is dry, add 2 Cc. of ether and evaporate on a water-bath very carefully to avoid decrepitation; continue the heating until the weight of the residue after cooling remains constant. This weight multiplied by 20 will give the percentage of the alkaloidal principles contained in the Guarana." *U. S.*

Uses.—The effects of guarana upon the system are chiefly those of its alkaloid, although it contains enough tannin to have an appreciable influence. It is habitually employed by the Indians, either mixed with articles of diet, as with cassava or chocolate, or in the form of drink, prepared by scraping it, and suspending the powder in sweetened water, precisely as other nations use teas, coffees, etc. It is also considered by the Indians useful in the prevention and cure of bowel complaints. Gavrelle, who was at one time physician to Dom Pedro, in Brazil, and there became acquainted with the virtues of this medicine, called the attention of the profession to it some years since in France. It is now used in medicine almost exclusively to give relief during the paroxysm of *migraine,* and in atonic *chronic diarrhœa,* taken three or four times a day.

Dose, of the powder, twenty to sixty grains (1.3 to 3.9 Gm.); of the fluidextract, twenty to sixty minims (1.3 to 3.75 Cc.).

Off. Prep.—Fluidextractum Guaranæ, *U. S.*

HÆMATOXYLON. U. S. (Br.)

HEMATOXYLON [Logwood]

(hæ-ma-tŏx'y-lŏn)

"The heart-wood of *Hæmatoxylon campechianum* Linné (Fam. *Leguminosæ*)." *U. S.* "The heart-wood of Hæmatoxylon campechianum, *Linn.*" *Br.*

Hæmatoxyli Lignum, *Br.;* Lignum Campechianum, Lignum Cœruleum; Bois de Campêche ou Bois d'Inde, *Fr. Cod.;* Bois de Sang, *Fr.;* Blauholz, Campecheholz, Blutholz, Kampeschenholz, *G.*

Hæmatoxylon campechianum, Willd., *Sp. Plant.* ii. 547; Woodv., *Med. Bot.* 455, t. 163; Carson, *Illust. of Med. Bot.,* i. 33, pl. 25.—This is a tree of middle size, usually not more than twenty-four feet high, though, under favorable circumstances, it sometimes rises forty or fifty feet. The trunk, seldom exceeding twenty inches in diameter, is often very crooked, and is covered with a dark rough bark. The branches are also crooked, with numerous smaller ramifications, which are beset with sharp spines. The sap-wood is yellowish, but the interior layers are of a deep-red color. The leaves are alternate, abruptly pinnate, and composed of three or four pairs of sessile, nearly obcordate, obliquely nerved leaflets. The flowers, which are in axillary spikes or racemes near the ends of the branches, have a brownish-purple calyx and lemon-yellow petals. They exhale an agreeable odor, said to resemble that of the jonquil.

The tree is a native of Campeche, the shores of Honduras Bay, and other parts of tropical America, and has become naturalized in Jamaica. The wood, which is the part used in medicine, is a valuable article of commerce, and largely employed in dyeing. It comes to us in logs deprived of the sap-wood and having a blackish-brown color externally. According to Louis Siebold, the ground or chipped logwood of commerce is unfit for use as a medicinal agent, because it has been prepared as a dyestuff by being exposed in large moist heaps until its hematoxylin has been converted by oxidation into hematein. As a coloring agent, for commercial purposes, this fermented logwood, according to Siebold, is much superior to the natural wood. An inferior variety of logwood which contains little or no hematoxylin, but a pure yellowish-gray dye is that known as *bastard logwood.* According to the researches of E. S. Earl this bastard logwood is produced by a variety of the species, which, when growing, cannot be distinguished from the ordinary form. (*B. D. A. J.*, i. 31.)

Properties.—Logwood is hard, compact, heavy, of a deep-red color, becoming purplish black by exposure, internally brown-red, and marked with irregular, concentric circles, splitting irregularly, of a slight peculiar odor, and a sweet, somewhat astringent taste. Logwood is officially described as "usually in small chips, reddish-brown, the freshly cut surface

dark yellowish-red; on transverse section the wood showing medullary rays which are four cells wide; odor faint, agreeable; taste sweetish, astringent. Hematoxylon imparts to water containing a little acid a yellowish color, which is changed to purple or violet-red by alkalies. When the surface has a greenish metallic lustre, the wood has undergone fermentation and should be rejected." *U. S.* It imparts its color to water and alcohol. Its solution affords precipitates with sulphuric, nitric, hydrochloric, and acetic acids, alum, copper sulphate, lead acetate, and ferrous sulphate, striking a bluish-black color with the last mentioned salt. Precipitates are also produced with it by lime water and gelatin. Chevreul found in logwood a volatile oil, an oleaginous or resinous matter, a brown substance the solution of which is precipitated by gelatin (*tannin*), another brown substance soluble in alcohol but insoluble in water or ether, a nitrogenous substance resembling gluten, free acetic acid, various salts, and a peculiar principle called *hematoxylin* or *hematin*, on which the coloring properties of the wood depend. This is obtained by digesting the aqueous extract in alcohol, evaporating the tincture until it thickens, then adding a little water, and submitting the liquid to a new but gentle evaporation. Upon allowing it to rest, hematoxylin is deposited in crystals, which may be purified by washing with alcohol and drying. Thus procured, the crystals are shining, of a yellowish-rose color, bitterish, acrid, and slightly astringent to the taste, readily soluble in boiling water, forming an orange-red solution which becomes yellow on cooling, and soluble also in alcohol and ether. According to Erdmann, who obtained hematoxylin by the process of Chevreul, substituting ether for alcohol, its crystals, when quite pure, are colorless, without a tinge of redness; its taste is sweet, like that of licorice, without bitterness or astringency; and it is not of itself a coloring substance, but affords beautiful red, blue, and purple colors, by the joint action of an alkaline base and the oxygen of the air. He obtained from logwood 9 to 12 per cent. of crystallized hematoxylin, to which he gave the formula $C_{16}H_{14}O_6$. It crystallizes with 1 or with 3 molecules of water, and is readily soluble in hot water or alcohol, but sparingly in cold water or in ether. (*J. Pr. Chem.*, 36, p. 205.) By the combined action of ammonia and oxygen dark violet crystalline scales of *hematein*, $C_{16}H_{12}O_6 + 3H_2O$, are produced. They show a fine green hue, which is also very commonly observable on the surface of the logwood chips of commerce. Hematein may again be transformed into hematoxylin by means of nascent hydrogen or of sulphurous acid. Commercial extract of logwood extracted from the wood by boiling water contains both hematoxylin and hematein. Hematoxylin, in alcoholic solution, is used as an indicator in the U. S. P. (8th Rev.). (See Test-solution No. 127, PART III.)

Uses.—Logwood is a mild astringent, devoid of irritating properties, and well adapted to the treatment of that relaxed condition of bowels which is apt to succeed *cholera infantum*. It is also occasionally used with advantage in ordinary *chronic diarrhœa* and *chronic dysentery*. The only U. S. official preparation is the extract. *Hematoxylin* was found by Combemale (*B. M. N.*, xxxiii. 1894) to be very feebly antiseptic, but capable in large doses of producing fatal gastro-enteritis in the lower animals.

Dose, from ten to twenty grains (0.65 to 1.3 Gm.).

Off. Prep.—Decoctum Hæmatoxyli, *Br.*; Extractum Hæmatoxyli, *U. S.*

HAMAMELIDIS CORTEX. U. S., Br.

HAMAMELIS BARK [Witchhazel Bark]

(hăm-ą-mĕl'ĭ-dĭs cŏr'tĕx)

"The bark and twigs of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*)." *U. S.* "The dried bark of Hamamelis virginiana, *Linn.*" *Br.*

Witchhazel, Spotted Hazel, Snapping Hazel, Winterbloom; Ecorce de Hamamelis, *Fr. Cod.*; Hamamelis, Zauberhasel, *G.*; Hamamelis, *Sp.*

H. virginiana, L.—*Witchhazel* is an indigenous shrub, from five to fifteen feet high, growing in almost all sections of the United States, usually on hills or in stony places, and often on the banks of streams. It is the only species of the genus found in Eastern North America, and is specifically characterized by its leaves being obovate or oval, wavy-toothed, and somewhat downy when young. The seeds are black and shining externally, white, oily, and farinaceous within, and edible like the hazelnut. It is remarkable for the late appearance of its yellow flowers, which expand in September or October, and continue until the weather becomes very cold in winter. The fruit, which is a nut-like capsule not unlike the hazelnut, ripens in the following autumn, and is often mingled on the same plant with the new blossoms.

Properties.—The bark occurs "in irregularly quilled or bent pieces, 1 to 2 Mm. thick; outer surface grayish-brown, with numerous lenticels, or reddish-brown, with short transverse ridges or scars, or somewhat scaly in older bark; the thin, corky layer easily removed from the pale cinnamon-colored middle bark; inner surface pale cinnamon-colored, or sometimes yellowish, smooth, or finely striate; fracture of young bark short, of old bark tough in the bast layer; odor faint; taste astringent, somewhat bitter and pungent. Twigs flexible and tough, of irregular length, not more than 6 Mm. in diameter, branching, or bearing nodes at intervals of 2 to 5 Cm.; externally varying from yellowish-brown to deep purplish-brown, lightly longitudinally wrinkled, and having scattered

small circular whitish or pale lenticels; bark occupying about one-fifth of the radius; wood greenish-white, lightly radiate, and exhibiting one to three annual rings; pith centric, small." *U. S.* In the Br. Pharm. it is characterized as "usually in curved pieces about one-sixteenth of an inch (one and a half millimetres) thick, and varying from two to eight inches (one-half to two decimetres) in length, sometimes covered with a silvery-gray or dark-gray scaly cork marked with transverse lenticels, but frequently freed from the cork, and then exhibiting a nearly smooth reddish brown outer surface. The inner surface is pale reddish pink in color, and finely striated longitudinally; the fracture is laminated and coarsely fibrous. The bark has an astringent taste, but no marked odor. The transverse section exhibits a complete ring of sclerenchymatous cells and numerous tangentially elongated groups of bast fibres." *Br.*

Walter B. Cheney examined witchhazel bark, and found tannin, resin, extractive, but no indication of an alkaloid or other crystalline principle. (*A. J. P.*, 1886, p. 418.) It contains a trace of volatile oil, however. John Marshall of the University of Pennsylvania, also found that hamamelis root contains tannic acid and a trace of volatile oil, but no other active substance. (*T. G.*, ii. 295.)

Uses.—The bark of the witchhazel is said to have first attracted attention on account of its use by the North American Indians as a sedative application to external inflammations. It was many years ago strongly recommended by James Fountain and N. S. Davis (*N. Y. M. J.*, x. 208; *Trans. Amer. Med. Assoc.*, i. 350) in *hemorrhage* of the *lungs* and *stomach*. Fountain also used with alleged great advantage, an ointment prepared from lard and the decoction of equal parts of hamamelis, white oak bark, and apple tree bark. Of late years professional attention has been very strongly directed to the remedy on account of the enormous sale of a much vaunted proprietary remedy said to be made by distilling the bark with very dilute alcohol (six per cent.), and used externally for *sprains* and *bruises*, and internally for most of the diseases to which flesh is heir. The pecuniary success of this remedy probably has depended in very small part upon the virtues of the witchhazel, which seems to possess no active physiological properties. At least we have injected a very concentrated distillate in large quantities into frogs and into mammals without perceiving any more effects than would be produced by the injection of similar quantities of distilled water, and Guy, in Paris, has reached similar conclusions. The fluidextract of the drug has been used as a remedy in various forms of venous dilatation and engorgement. It was very strongly recommended by John H. Musser in *varicose veins* (*P. M. T.*, vol. xiii.), and has been used by some practitioners with good results in cases of *hemorrhoids*, but has failed to yield in other hands corresponding advantage. (See *B. M. S. J.*, April 16, May, 1885; also *B. G. T.*, vol. cvi.) The dose of the fluidextract given by Musser was a teaspoonful (3.75 Cc.) four times a day. It may, however, be given in double the quantity with impunity and probably in such doses is an advantageous astringent.

Dose, of leaves or of bark, thirty grains (2 Gm.).

Off. Prep.—Aqua Hamamelidis, *U. S.*; Tinctura Hamamelidis, *Br.*

HAMAMELIDIS FOLIA. U. S., Br.

HAMAMELIS LEAVES [Hamamelis, Pharm. 1890 Witchhazel Leaves]

(hăm-ą-měl'ĭ-dĭs fō'lĭ-ą)

"The dried leaves of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*), collected in autumn." *U. S.* "The leaves, fresh and dried, of Hamamelis virginiana, *Linn.*" *Br.*

Feuilles de Hamamelis, *Fr. Cod.*; Witchhazel.

Hamamelis leaves are officially described as "short-petiolate; blade inequilaterally obovate or oval, about 10 Cm. long; base slightly heart-shaped and oblique, margin coarsely sinuate; upper surface pale or brownish-green; under surface light green, with a satiny lustre, the midrib and veins prominent, the few hairs having much thickened walls and a very small lumen; petiole short, stout; odor slight; taste astringent, slightly aromatic and bitter." *U. S.*

See *Hamamelidis Cortex*.

Off. Prep.—Fluidextractum Hamamelidis Foliorum, *U. S.* (*Br.*); Liquor Hamamelidis, *Br.*; Unguentum Hamamelidis, *Br.* (from liquid extract).

HEDEOMA. U. S.

HEDEOMA [Pennyroyal]

(hĕd-ę-ō'mą)

"The dried leaves and flowering tops of *Hedeoma pulegioides* (Linné) Persoon (Fam. *Labiatæ*)." *U. S.*

American or Mock Pennyroyal, Squawmint, Mosquito Plant; Herbe de Pouliot américaine, *Fr.*; Amerikanischer Polei, *G.*

This plant is entirely distinct from *Mentha Pulegium*, or European pennyroyal. It is probable that various other species of the genus are used in the localities in which they grow. Thus, *H. piperita*, Bentham, is said to be used in Mexico as a substitute for peppermint, and *H. thymoides*, Gray, in Texas as an aromatic diaphoretic.

Hedeoma pulegioides (L.), Pers. (1807); *Cunila pulegioides*, L. (1762); *Melissa pulegioides*, L. (1753).—This is an indigenous annual plant, from nine to fifteen inches high, with a small, branching, fibrous, yellowish root, and a pubescent, quadrangular stem, which

sends off numerous slender erect branches. The leaves are opposite, having short petioles, about half an inch long, oblong-lanceolate or oval, nearly acute, attenuated at the base, remotely serrate, rough or pubescent, and prominently veined and glandular on the under surface. The flowers are very small, pale blue, supported on short peduncles, and arranged in axillary whorls along the whole length of the branches. They have a tubular-ovoid, two-lipped and five-toothed calyx, and a pale blue, spotted, two-lipped corolla, containing two sterile and two fertile exserted stamens. The plant is common in the Eastern and Middle Western United States, preferring dry grounds. Hedeoma is officially described as "branchlets quadrangular, with numerous spreading hairs; leaves opposite, short-petioled, oblong, 15 to 35 Mm. long, thin, obtuse, obscurely serrate, glandular-hairy beneath; flowers in axillary fascicles, with a tubular-ovoid, bilabiate and 5-toothed calyx, and a pale blue, spotted, bilabiate corolla containing two sterile and two fertile, exserted stamens; odor strong, somewhat mint-like; taste aromatic and pungent." *U. S.* The activity of hedeoma depends upon a volatile oil. (See *Oleum Hedeomæ.*)

Uses.—American pennyroyal is a gently stimulant aromatic, and may be given in flatulent *colic* and *sick stomach,* or to qualify the action of other medicines. Like most of the aromatic herbs, it possesses the property, when administered in warm infusion, of promoting perspiration, and of exciting the menstrual flux when the system is predisposed to the effort. A large draught of the warm tea is in popular practice often given at bedtime, in recent cases of *suppression* of the *menses,* the feet having been previously bathed in warm water.

Dose, two drachms (7.7 Gm.).

HEMIDESMI RADIX. Br.

HEMIDESMUS ROOT

(hĕm-ĭ-dĕs'mī rā'dĭx)

"The dried root of Hemidesmus indicus, *R. Br.*" *Br.*

Indian Sarsaparilla: Nunnari; Racine de Hemidesmus, *Fr.;* Hemidesmus-Wurzel, *G.*

Hemidesmus indicus (Willd.), R. Br., Engler and Prantl; *H. indicus,* R. Br., *Hort. Kew.* ii. 75; Lindley, *Flor. Med.* p. 543.—*Periploca indica,* Willd., *Sp. Plant.* i. 1251; Fam. *Asclepiadaceæ.*—This is a climbing plant, with twining, woody, slender stems, and opposite petiolate leaves, which are entire, smooth, shining, and of a firm consistence. The leaves vary much in size and shape, some being linear and acute, others broad-lanceolate, and others again oval or ovate. The flowers are small, green on the outside, purple within, and disposed in axillary racemes. The calyx is five-parted, with acute divisions; the corolla flat, with oblong, pointed divisions. The fruit consists of two long, slender, spreading follicles.

This plant is common over the whole peninsula of Hindostan. The official portion is the root, which has long been used in India as a substitute for sarsaparilla. It is long, rarely more than one-quarter of an inch in diameter, rigid, tortuous, cylindrical, and little branched, consisting of a ligneous centre, and a brownish, corky bark, marked with longitudinal furrows and transverse fissures. The odor is aromatic, the taste sweetish. On one side of the root the cork is frequently separated from and raised above the cortex, and is transversely fissured. The transverse section exhibits numerous laticiferous cells in the cortex. For details of microscopic structure, see *P. J.,* 1872, 62. Garden obtained from hemidesmus a peculiar, volatilizable acid principle, which he named *smilasperic acid,* under the erroneous impression that the root was derived from *Smilax aspera.* Pereira proposed to call it *hemidesmic acid.* Scott also obtained a stearopten by distillation with water, presumably the same material. It has not been further investigated.

Uses.—Hemidesmus root is said to be tonic, diuretic, and alterative. It was introduced into Great Britain from India, and was employed for some time under the name of *Smilax aspera.* It is used for the same purposes as sarsaparilla, and in some instances it is said to have proved successful in *syphilis* when that medicine had failed, but it cannot be relied upon. The native practitioners in India are said to employ it in nephritic complaints, and in the sore mouth of children. It is used in the form of infusion or decoction, made in the proportion of two ounces of the root to a pint of water. A pint may be given in wineglassful doses in the course of the day.

Off. Prep.—Syrupus Hemidesmi, *Br.*

HEXAMETHYLENAMINA. U. S.

HEXAMETHYLENAMINE

(hĕx-ă-mē-thȳl-ēn-ă-mī'nă)

$C_6H_{12}N_4 = 139.18$

"A condensation product [Hexamethylenetetramine, $(CH_2)_6N_4$], obtained by the action of ammonia upon formaldehyde. It should be kept in well-stoppered bottles." *U. S.*

Urotropine, Urotropin, Cystogen, Formin, Aminoform.

The full name of this compound is hexamethylenetetramine, which was originally used by Nicolaier; the Latin title was shortened upon its admission to the U. S. P. (8th Rev.) to *Hexamethylenamina.*

Preparation.—Hexamethylenamine may be made by the gradual addition of 70 parts of stronger ammonia water to 100 parts of a forty per cent. solution of formaldehyde which must be kept well cooled. The ammonia water

must be added carefully in small quantities until in slight excess, which is indicated by its odor remaining after the liquid has stood several hours; then 10 parts of ammonia water are added and the solution allowed to stand until crystallization is completed. The hexamethylenamine is purified by treatment with animal charcoal and recrystallization.

Properties.—It is officially described as in "colorless, lustrous, odorless crystals, having, when in aqueous solution, an alkaline reaction upon red litmus paper. Soluble in about 1.5 parts of water, 10 parts of alcohol, and in 228 parts of ether at 25° C. (77° F.); in 1.5 parts of water at 100° C. (212° F.), and in about 8 parts of hot alcohol. When heated to 263° C. (505.4° F.) it sublimes without melting and with partial decomposition. If 0.1 Gm. of Hexamethylenamine be mixed with 0.1 Gm. of salicylic acid and 5 Cc. of sulphuric acid, and then heated moderately, a carmine-red color should be produced. If an aqueous solution of Hexamethylenamine (1 in 10) be heated with diluted sulphuric acid, it is decomposed with the liberation of formaldehyde (recognized by its odor or by its darkening paper moistened with silver ammonium nitrate T.S.). If an aqueous solution (1 in 10) be heated with diluted sulphuric acid and then supersaturated with solution of sodium hydroxide, ammonia is liberated. If to an aqueous solution (1 in 10) tannic acid T.S. be added, a precipitate is formed. If mercuric chloride T.S. be added to an aqueous solution (1 in 10), a precipitate is produced which on standing forms crystalline needles." *U. S.* [1]

Uses.—Hexamethylenamine is distinctly but not violently a local irritant: taken internally it is eliminated with great rapidity generally unchanged, its presence often being detected in the urine in one half hour, and as long as 24 hours, after its ingestion. The former belief that it was largely decomposed with the liberation of formaldehyde in the kidney is probably not correct, although frequently formaldehyde may be detected in the urine after its ingestion. The change appears to occur after the excretion from the kidney, and probably takes place only when there is an excess of acid in the urine. Suder having demonstrated that hexamethylenamine mixed outside of the body with acid urine undergoes decomposition and fails to do so when the urine is alkaline shows the necessity, when hexamethylenamine is exhibited, that care should be taken to maintain the acidity of the urine. Upon the general system hexamethylenamine exerts no perceptible influence. When given in overdose it causes irritation of the kidney with burning pain in the bladder and urethra, and, it may be, an acute nephritis. A measles-like rash with much itching has been noticed after its continuous use. Hexamethylenamine probably is itself possessed of marked bactericidal powers, and it probably achieves good in urinary diseases by virtue of its own inherent properties. Originally suggested as a uric acid solvent, clinical experience has shown that it is about equivalent to piperazine in this respect and really is of no value for the solution of formed *renal calculi.* It is of great value in *pyelitis, cystitis,* also in *phosphaturia.* In *gonorrhea* it seems to be of no service. It is also stated by various authorities to be a very serviceable intestinal antiseptic. Hexamethylenamine should be administered in at least a half a pint of water.

Dose, five to fifteen grains (0.32 to 1.0 Gm.), three to six times a day.

[1] Hexamethylenamine may be detected in the urine by adding bromine water, which precipitates the orange yellow hexamethylenamine dibromide. Citron's test is as follows (*M. H. S. A.,* 1898): Acidify the urine slightly, boil in a flask or test tube, in the mouth of which has been placed a cotton plug soaked with solution of resorcinol in sodium hydroxide, when a brilliant red color will develop. This test depends on the liberation of formaldehyde due to the decomposition of the hexamethylenamine in acid solution. The reaction with the resorcinol is the same as is described in the test for methyl alcohol (see *Alcohol,* p. 105).

HIRUDO. Br.

LEECHES

(hĭ-rū'dō)

"1. Sanguisuga medicinalis, *Savigny,* the Speckled Leech; and 2. Sanguisuga officinalis, *Savigny,* the Green Leech." *Br.*

Sangsue médicinale, *Fr. Cod.;* Hirudines, *P. G.;* Blutegel, *G.;* Sanguisuga, Mignatta, *It.;* Sanguijuela, *Sp.*

HIRUDO.—*Class* 1, Annelides. *Order* 3, Abranchiatæ. *Family* 2, Asetigeræ. Cuvier.

The leech belongs to that class of invertebrated articulated animals called *Annelides.* This class contains the worms with red blood, having soft retractile bodies composed of numerous segments or rings, breathing generally by means of branchiæ, with a nervous system consisting in a double knotted cord, destitute of feet, and supplying their place by the contractile power of their segments or rings. The third order of this class—*Abranchiatæ*—comprehends those worms which have no apparent external organ of respiration. This order is again divided into two families, to the second of which—the *Asetigeræ,* or those not having setæ to enable them to crawl—the leech belongs.

It is an aquatic worm with a flattened body, tapering towards each end, and terminating in circular flattened disks, the hinder one being the larger of the two. It swims with a vertical undulating motion, and moves when out of the water by means of these disks or suckers, fastening itself first by one and then by the other, and alternately stretching out and contracting its body. The mouth is placed in the centre of the anterior disk, and is furnished with three cartilaginous jaws at the entrance of the alimentary canal. These jaws are lined at their edges with fine sharp teeth, and

meet so as to make a triangular incision in the flesh. The head is furnished with small raised points, supposed by some to be eyes. Respiration is carried on through small apertures ranged along the inferior surface. The nervous system consists of a cord extending the whole length, furnished with numerous ganglions. The intestinal canal is straight, and terminates in the anus, near the posterior disk. Leeches are hermaphrodite, and mutually impregnate each other. They are oviparous; and the eggs, varying from six to fifteen, are contained in a sort of spongy, slimy cocoon, from half an inch to an inch in diameter. These are deposited near the edge of the water, and hatched by the heat of the sun. The leech is torpid during the winter, and casts off from time to time a thick slimy coating from its skin. It can live a considerable time in sphagnous moss or in moistened earth, and is frequently transported in this manner to great distances without injury.

Savigny has divided the genus Hirudo of Linnæus into several genera. The true leech is the Sanguisuga of this author, and is characterized by its three lenticular jaws, each armed with two rows of teeth, and by having ten ocular points. Several species are used for medicinal purposes, of which the most common are the gray and the green leech of Europe, both of which are varieties of the *Hirudo medicinalis* of Linnæus, and the *Hirudo decora* of this country.

1. *Hirudo medicinalis,* Linn., *Ed. Gmel.* i. 3095. *The green leech—Sanguisuga officinalis,* Savigny, *Mon. Hir.* p. 112, t. 5, f. 1. *The gray leech—Sanguisuga medicinalis,* Savigny, *Mon. Hir.* p. 114, t. 5, f. 2.—Many of the best zoologists regard the *Sanguisuga officinalis* and *S. medicinalis* of Savigny as mere varieties. They are both marked with six longitudinal dorsal ferruginous stripes, the four lateral ones being interrupted or tessellated with black spots. The color of the black varies from a blackish to a grayish green. The belly in the first variety is of a yellowish-green color, free from spots, and bordered with longitudinal black stripes. In the second it is of a green color, bordered and maculated with black. This leech varies from two to four inches in length. It inhabits marshes and running streams, and is abundant throughout Europe.[1]

The great use made of leeches in the modern practice of medicine has occasioned them to become a considerable article of commerce. They are collected in Spain, France, Italy, Germany, and Sweden, and carried in large numbers to London and Paris. They are also frequently brought to this country, as the practitioners in some of our large cities use only the foreign leech, although our own waters furnish an inexhaustible supply of this useful worm.[2] The indigenous leech was formerly much used in the city of Philadelphia.

2. *Hirudo decora,* Say, *Colonel Long's Second Expedition,* ii. 268.—The medicinal leech of America has been described by Say under the name of *Hirudo decora,* in the Appendix to the Second Expedition of Colonel Long. Its back is of a deep pistachio-green color, with three longitudinal rows of square spots. These spots are placed on every fifth ring, and are twenty-two in number. The lateral rows of spots are black, and the middle range of a light brownish-orange color. The belly is of the latter color, variously and irregularly spotted with black. The American leech sometimes attains the length of four or five inches, although its usual length is from two to three. It does not make so large and deep an incision as the European leech, and draws less blood. Under the name of *Hirudo australis, Australian leeches,* the British Addendum recognizes *Hirudo quinquestriata,* Schmarda (*Hirudo australis,* Bosisto; *Limnobdella quinquestriata,* R. Blanch), the *five-striped* or Australian leech, whose dorsal surface is greenish-yellow-brown, with five longitudinal stripes, the ventral surface being greenish-yellow and not spotted. The jaws are large, with forty-eight to fifty teeth, the inner being the larger.

The proper preservation of leeches is an object of importance to the practitioner, as they are liable to a great and sudden mortality. They are usually kept in jars, in clear, soft water, which should be changed twice a week in winter and every other day in summer. The jar must be covered with a linen cloth, and placed in a situation not liable to sudden changes of temperature. They will live a long time and continue active and healthy without any other attention than that of frequently changing the water in which they are kept. Derheims has proposed the following excellent method of preserving them. In the bottom of a large basin or trough of marble he places a bed, six or seven inches deep, of a

[1] A variety of the leech has come into use in Europe, called in commerce *African leeches.* They are of a beautiful light-green color, varying to a deep green, and often inclining to red, with black points on the back, and broad streaks of a bright orange yellow, which are black towards the abdomen. They correspond perfectly with the *Sanguisuga interrupta* of Moquin-Tandon. These leeches draw very well. (*P. J.,* x. 38.) The leeches from Algiers, called in French commerce *dragons* (*Sanguisuga troctena* of Moquin-Tandon), of which considerable numbers have been taken to France, are said by M. A. de Quatrefages, contrary to former opinion, to be quite equal to the European. (*J. P. C.,* 3e sér., xxxiii.) It is stated (*P. J.,* June, 1867) that great numbers of leeches are collected in Australia and sent to Melbourne, whence a large proportion are exported to Europe and America. This leech is said to differ from the ordinary English leech only in that the olive streaks are much lighter in the former.

[2] Attempts have been made, in France, on a large scale, to propagate leeches for sale. This is done by means of natural meadows, in which numerous small ponds are made, where the leeches, with certain cautions as to nourishment and preservation, multiply and grow so rapidly as to become a source of profit. In order that they may propagate, it is necessary that they should be fed on blood, which is given them either by causing animals, as horses, cows, etc., to be driven into the meadows, or by obtaining blood from slaughter houses, and, after depriving it of fibrin by agitation, immersing the animals for a time in it while yet warm. (See *J. P. C.,* Jan. and Mai, 1854.)

mixture of moss, turf, and fragments of wood. He strews pebbles above, so as to retain them in their place without compressing them too much or preventing the water from freely penetrating them. At one end of the trough, and about midway of its height, is placed a thin slab of marble or earthenware, pierced with numerous holes, and covered with a bed of moss, which is compressed by a thick layer of pebbles. The reservoir being thus disposed is half filled with water, so that the moss and pebbles on the shelf shall be kept constantly moist. The basin is protected from the light by a linen cover stretched over it. By this arrangement the natural habits of the leech are not counteracted. One of these habits, essential to its health, is that of drawing itself through the moss and roots to clear its body from the slimy coat which forms on its skin and is a principal cause of its disease and death. James Banes recommends that when kept in jars they should be cleansed by means of a whisk of very fine broom or willow, when the water is changed. Lahache, an apothecary at Bruyères, strongly recommends carrageen, or Irish moss (*Chondrus crispus*), as admirably adapted to the habits and wants of the leech, furnishing the animal, he supposes, with nutriment, as it does not die of inanition when thus kept. The water should be renewed in the jars daily. (*J. P. C.*, 4e sér., iii. 128.) Alfred Allchin keeps them in aquaria with growing water-plants and snails, which keep the water pure.[1] (*A. J. P.*, xxviii. 222.)

Uses.—Leeches afford the least painful and in many instances the most effectual means for the local abstraction of blood. They are often applicable to parts which, either from their situation or from their great tenderness when inflamed, do not admit of the use of cups, and in the case of infants are under all circumstances preferable to that instrument. They are indeed a powerful therapeutic agent, and give to the physician, in many instances, a control over disease which he could obtain in no other way.

Franz (*P. J.*, lxxiii. 347) has used *hirudine*, a principle discovered by Haycraft, which it is asserted increases the coagulability of the blood, as an antihemorrhagic. Extract of leeches, however, has the property of lessening or entirely preventing the coagulation of the blood. According to Haycraft, the substance which acts as an anti-coagulant is found in the buccal secretion (*P. J.*, 1891). Landois Schultze has shown that this principle is extracted by water (*Th. M.*, 1892, 140). According to Franz, the active anti-coagulation principle of the leech occurs chiefly in the salivary glands anterior to the tenth ring, but is to some extent diffused throughout the whole body. We have been unable to buy leech extract in the American market, but have found that by means of the following process, which is a modification of that used by Franz, entirely satisfactory results can be obtained in the laboratory. Cut off the leech heads, mince them, rub up with a very fine sand and add to the mass 5 Cc. of seven-tenths per cent. normal sodium chloride solution for each leech head, and heat for twenty minutes over a water bath at 100° C. (212° F.). Treat the bodies of the leeches in a similar manner. Allow the masses from the heads and bodies to stand separately in a cool room for twelve hours; centrifuge the leechhead mass for twenty minutes, then wash the sand in the lower part of the centrifuge, centrifuging the resulting liquid, and mixing the two fluids obtained. Filter the mass containing the bodies of the leeches through cheese cloth under pressure; centrifuge the filtrate; wash the mass with the salt solution, centrifuge the resulting liquid, and add it to the previously centrifuged filtrate. Mix the liquids obtained from the heads with that derived from the bodies, and an active solution is obtained. When using either solution in the laboratory do not estimate by the number of cubic centimeters of the solution, but by the number of leeches represented. According to Franz, in a dog, three leeches per kilo will prevent coagulation of the blood, but we have found that three and one-half leeches per kilo are necessary in America, the difference being probably due to the condition of the leeches, Franz having used the fresh European leeches, and we the leech after transportation and probably deterioration.

In applying leeches to the skin, care should be taken to shave off the hair, if there be any, and to have the part well cleansed with soap and water, and afterwards with pure water. If the leech does not bite readily, the skin should be moistened with a little blood, or milk and water. It is said to bite more freely if the skin has been previously reddened by a sinapism and then washed perfectly clean. Sometimes the leech is put into a large quill open at both ends, and applied with the head to the skin until it fastens itself, when the quill is withdrawn. If it be desirable that the leech shall bite in a particular spot, this end may be attained by cutting a small hole in a piece of blotting paper, and then applying this moistened to the skin, so that the hole shall be immediately over the spot from which the blood is to be taken. Leeches continue to draw blood until they are gorged, when they drop off.[1] The quantity of blood which they draw varies with the part to which they are applied, and the degree of inflammation existing in it. From the loose and vascular textures they will abstract more

[1] For other methods of keeping leeches, also of raising them, see U. S. D., 14th ed., 472.

[1] As a very efficient mode of applying leeches, it is recommended, after having moistened the skin with pure warm water, to put the leeches into a tumbler half full of cold water, and by an adroit movement invert it upon the part. The leeches are said to attach themselves so rapidly that it seems to the patient as though they made but a single bite. When they are all attached, the glass is to be carefully removed, the water being absorbed, as it runs off on one side, by a sponge or linen cloths.

than from those which are firm and compact, and more from an inflamed than from a healthy part. As a rule, our leechers apply six for every fluidounce of blood. A single European leech will draw from half an ounce to an ounce. The quantity may often be much increased by bathing the wound with warm water. Leeches will continue to suck after their tails are cut off, which is sometimes done, although it is a barbarous practice.[1] It is said that they will draw better if put into cold beer, or diluted wine, and allowed to remain until they become very lively. They may be separated from the skin at any time by sprinkling a little salt upon them. After they drop off, the same application will make them disgorge the blood they have swallowed. Some leechers draw the leeches from the tail to the head through their fingers, and thus squeeze out the blood, after which all that is necessary is to put them in clean water, and change it frequently.[2] Leeches which are gorged with blood should be kept in a vessel by themselves, as they are more subject to disease, and often occasion a great mortality among the others. They should not be again used until they have recovered their activity. In cases where the bleeding from leech bites continues longer than is desirable, it may be stopped by continued pressure, with the application of lint, by the use of collodium, or by touching the wounds with lunar caustic. A little cotton, impregnated with a saturated solution of alum in boiling hot water, and, after it has become sufficiently cool, but before the alum has begun to crystallize, pressed upon the wound, will often prove effectual. Another mode of repressing the hemorrhage is to press upon the bite a piece of thin caoutchouc, previously softened upon one side by heat, so as to become adhesive. If lunar caustic be applied, the stick must first be brought to a fine point, which is to be inserted in the wound. Some have even recommended the use of a fine wire made red hot. When the part wounded is without a bony basis, pressure may be made by pinching the wound between the fingers. It may sometimes be necessary, in the case of a deep bite, to sew the wound, which is readily done with a single stitch of the needle, that need not penetrate deeper than the cutis.

[1] Under the name of *bdellotomy*, a practice has been introduced into Germany, of making a small incision in the side of the leech while drawing. The blood escapes through the wound, and the animal will continue to suck for a long time, so that one will perform the office of many in the quantity of blood taken.

[2] Soubeiran and Bouchardat, after numerous experiments upon the different modes of fitting the gorged leeches for use again, came to the conclusion that a carefully managed pressure is the best. Two conditions, however, are necessary to success; one that they should be disposed to disgorge the blood, and the other that they should be immersed in warm water previously to the stripping. The first object is effected by common salt. The following plan is recommended. The leeches are to be thrown into a solution of 16 parts of common salt in 100 of water, from which they are to be taken out one by one, and, being held by the tail, are to be dipped into water which feels hot to the hand, but yet can be borne by it, and then passed lightly between the fingers. Thus treated, they easily give up the blood. After being stripped, they should be placed in vessels containing fresh water, which should be renewed once a day. At the end of eight or ten days they are fit for reapplication. (*J. P. C.*, 3e sér., xi. 343 and 350.) It is said that in the French military hospitals a mixture of one part of vinegar with eight parts of water is preferred to salt water for promoting disgorgement. (*M. T. G.*, Oct., 1856, p. 375.) It has been stated that if the leeches, after being stripped, be put into water sweetened with a little white sugar, and the solution be renewed several times, at intervals of six or twelve hours, they will speedily recover their activity, and may be reapplied two or three times in the course of a few days. Immersion in camphor water for a few moments is said by Boyce to cause them to vomit the blood. They should afterwards be put into clean water, to be changed in half an hour. Frodsham, of England, has found camphor water preferable to either salt water or diluted vinegar, for disposing the gorged leech to part with blood. Grannat, a French military pharmaceutist, has found the natural process of disgorging preferable to all others. He placed some gorged leeches in wooden tubs containing at the bottoms a little clay and water, and renewed the water every forty-eight hours. After eight days, the leeches, now in good health, were transferred to a pond prepared for the purpose, where they propagated. He put 1000 leeches in the pond, and at the end of a year had taken out 850 fit for service, without interfering with the reproduction. (*J. P. C.*, 3e sér., xx. 186.) Vayson's plan of preserving leeches has been highly recommended. It consists simply in putting them, after stripping, if they have been used, in an earthenware vessel of the shape of an inverted truncated cone, with holes in the bottom so small as to prevent the escape of the leech, and filled with turfy earth. After the introduction of the leech, the opening to be closed with a coarse cloth. The vessel is then placed in a tub containing water four inches deep. If to be sent to a distance, the earth in the vessel should be moistened throughout.

HOMATROPINÆ HYDROBROMIDUM.
U. S., Br.

HOMATROPINE HYDROBROMIDE
[Homatropine Hydrobromate]

(hō-măt-rō-pī′næ hȳ-drō-brō′mī-dŭm)

$C_{16}H_{21}NO_3.HBr = 353.49$

"The hydrobromide [HBr.$C_{16}H_{21}NO_3$] of an alkaloid obtained by the condensation of tropine and mandelic acid. It should be kept in well-stoppered vials, protected from light." *U. S.* "The hydrobromide, $C_{16}H_{21}NO_3$,HBr, of an alkaloid prepared from tropine." *Br.*

Bromhydrate d'Homatropine, *Fr. Cod.*; Homatropinum hydrobromicum, *P. G.*; Homatropinhydrobromid, Bromwasserstoffsaures Homatropin, Bromwasserstoffsaures Oxytoluyltropein, *G.*

Preparation.—This alkaloidal salt was first admitted to the British Pharmacopœia in the additions of 1890. Homatropine, $C_{16}H_{21}NO_3$, is prepared by evaporating a mixture of tropine, $C_8H_{15}NO$ (obtained through the saponification of hyoscyamine), and *mandelic acid* (phenyl-glycollic), $C_6H_5.CH(OH)COOH$, with diluted hydrochloric acid; mandelic acid may be produced by acting on amygdalin with hydrochloric acid, or synthetically from benzaldehyde and hydrogen cyanide.

Properties.—Homatropine hydrobromide is officially described as follows: "A white, odorless, crystalline powder, or rhombic prisms, having a bitter taste. Soluble in 5.7 parts of water, 32.5 parts of alcohol, and in 620 parts of chloroform at 25° C. (77° F.); soluble in

8.7 parts of alcohol at 60° C. (140° F.); insoluble in ether. At 213.8° C. (417° F.) it melts. It leaves no residue upon incineration. Its aqueous solution is neutral to litmus paper, and is not precipitated by tannic acid T.S. or platinic chloride T.S. It contains no water of crystallization. If 2 Cc. of chloroform be shaken with 1 Cc. of an aqueous solution of the salt (1 in 10) to which a few drops of chlorine water have been cautiously added, the chloroform should assume a brownish color. Iodine T.S., when added to solutions of Homatropine Hydrobromide, produces a brown precipitate; silver nitrate T.S., a creamy white precipitate. If to an aqueous solution containing 0.1 Gm. of the salt an excess of potassium hydroxide T.S. be added, this liquid shaken out with ether, and the ether allowed to evaporate spontaneously, the crystals which form should have a melting point of 96° C. (204.8° F.). If 1 Cc. of an aqueous solution of the salt (1 in 100) be made alkaline with ammonia water, shaken out with chloroform, and the chloroformic solution evaporated to dryness, the residue should turn yellow and finally brick-red when warmed with about 1.5 Cc. of a solution made by dissolving 1 part of mercuric chloride in 50 parts of a mixture of alcohol 5 volumes and water 3 volumes (absence of *most other alkaloids* except *atropine* and *hyoscyamine*). If sulphuric acid containing a trace of potassium dichromate be added to a crystal of the salt, an evanescent pink color will be produced, which changes rapidly to green. If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should not acquire a violet color upon the addition of a few drops of alcoholic potassium hydroxide T.S. (absence of *atropine, hyoscyamine,* or *hyoscine*)." *U. S.* "A white crystalline powder or aggregation of minute trimetric crystals, soluble in 6 parts of cold *water,* and in 133 parts of *absolute alcohol.* The solutions should be neutral to *litmus.* A dilute aqueous solution, when applied to the eye, powerfully dilates the pupil. Heated on platinum foil it fuses and burns without leaving an appreciable residue. If 0.2 cubic centimetre of *chloroform* be shaken with 1 cubic centimetre of a 10 per cent. aqueous solution, to which *solution of chlorine* has been cautiously added, the *chloroform* will assume a brownish color. A 2 per cent. aqueous solution yields no precipitate on the cautious addition of *solution of ammonia* previously diluted with twice its volume of *water,* but dilute *solution of potassium hydroxide* produces in it a white precipitate, soluble in excess of the reagent. *Solution of iodine* causes a brown and *test-solution of mercuric chloride* a white precipitate. If about 0.01 gramme be dissolved in a little *water* and the solution rendered alkaline with *solution of ammonia* and shaken with *chloroform,* the separated *chloroform* will leave on evaporation a residue which will turn yellow, and finally brick-red, when warmed with about 1.5 cubic centimetres of a 2 per cent. solution of *mercuric chloride* in a mixture of five volumes of *alcohol* (90 per cent.) and three volumes of *water.* When treated with *fuming nitric acid* and *potassium hydroxide,* as described under 'Atropina,' no reddish-violet coloration is developed (distinction from atropine), the residue becoming reddish yellow. It affords the reactions characteristic of hydrobromides." *Br.*

Uses.—Homatropine hydrobromide is stated to produce, when taken internally, symptoms somewhat similar to those caused by atropine, except that the pulse rate is rendered slower instead of more rapid. Experiments made upon the reptilian heart indicate that the slowness of the pulse and the fall of the arterial pressure which has been found to accompany it are due in large part or altogether to direct action upon the heart itself. No cases of fatal poisoning are, so far as we know, on record, but in experiments made upon the lower animals death has been found to be due to a centric respiratory paralysis.

Homatropine hydrobromide has not been used internally to any extent, but is largely employed as a local mydriatic, having the advantage over atropine of being much less irritating to the conjunctiva and much less prone to produce serious systemic disturbance. The pupil begins to dilate in from seven to twenty minutes after the instillation; accommodation fails in from forty to ninety minutes, while usually the recovery is complete in from one to three days. For simple dilatation of the pupil, a solution of the strength of four grains to the ounce is sufficient. When it is desired to paralyze accommodation completely, the 2 per cent. solution may be employed.

Dose, internal, from one one-hundred and fiftieth to one-sixtieth of a grain (0.0004 to 0.001 Gm.).

Off. Prep.—Lamellæ Homatropinæ, *Br.*

HUMULUS. U. S. (Br.)

HOPS

(hū'mŭ-lŭs)

"The carefully dried strobiles of *Humulus Lupulus* Linné (Fam. *Moraceæ*), bearing their natural glandular trichomes." *U. S.* "The dried strobiles of Humulus Lupulus, *Linn.,* from cultivated plants." *Br.*

Lupulus, *Br.;* Hop; Strobili Humuli, s. Lupuli; Houblon, *Fr. Cod.;* Hopfen, *G.;* Luppolo, *It.;* Lupulo (Fruto de), Hombrecillo, *Sp.*

Humulus Lupulus, L., *Sp. Pl.* (1753), 1028; Willd., *Sp. Plant.* iv. 769; Bigelow, *Am. Med. Bot.,* iii. 163.—The root of the hop is perennial, and sends up numerous annual, angular, rough, flexible stems, which twine around neighboring objects in a spiral direction from left to right, and climb to a great height. The leaves are

opposite, and stand upon long footstalks. The smaller are sometimes cordate; the larger have three or five lobes; all are serrate, of a deep green color on the upper surface, and, together with the petioles, extremely rough, with minute prickles. At the base of the footstalks are two to four smooth, ovate, reflexed stipules. The flowers are numerous, axillary, and furnished with bracts. The male flowers are a yellowish white, and arranged in panicles; the female, which grow on a separate plant, are pale green, and disposed in solitary, peduncled aments, composed of membranous scales, ovate, acute, and tubular at the base. Each scale bears near its base, on its inner surface, two flowers, consisting of a roundish compressed germ, and two styles, with long filiform stigmas. The aments are converted into ovate membranous cones or strobiles, the scales of which contain, each, at its base, two small seeds, surrounded by a yellow, granular powder. The genus *Humulus* is placed with *Morus* and *Cannabis* in a separate family, *Moraceæ*, by Engler and Prantl.

The hop plant is a native of North America and Europe. In parts of New England, New York, and Michigan it is extensively cultivated, and most of the hops consumed in the United States are supplied by those districts. England probably produces the largest quantity of hops in the world, with Germany next in order. The part of the plant used is the fruit or strobiles. These, when fully ripe, are picked, dried by artificial heat, packed in bales, and sent into the market under the name of hops.

Hops consist of numerous thin, translucent, veined, leaf-like scales, which are of a pale greenish-yellow color, and contain near the base two small, round, black seeds. They are officially described as "ovoid-cylindrical, about 3 Cm. long, consisting of a thin, hairy flexuous rachis and numerous yellowish-green to pale brown obliquely ovate, membranaceous scales with a glandular-hairy base, frequently infolded on one side, enclosing a subglobular, light brown, very glandular akene; odor strong and agreeable; taste aromatic and bitter." *U. S.* Though brittle when quite dry, they are pulverized with great difficulty. Their odor is strong, peculiar, somewhat narcotic, and fragrant; their taste very bitter, aromatic, and slightly astringent. Their aroma, bitterness, and astringency are imparted to water by decoction, but the first mentioned property is dissipated by long boiling. The most active part of hops is a substance formed on the surface of the scales, and, in the dried fruit, existing in the state of very small granules. This substance was called *lupulin* by A. W. Ives of New York, by whom its properties were first investigated and made generally known, though it was previously noticed by Sir J. E. Smith of England, and Planche of France. The scales themselves, however, are not destitute of virtues, and contain, as shown by Payen and Chevallier, the same active principles as does lupulin, though in less proportion.[1]

LUPULINUM. U. S. *Lupulin.*—Although lupulin is official (see *Lupulinum*), its characteristics are described here in order that the constituents of hops may be all considered together. Lupulin is obtained by rubbing or threshing and sifting the strobiles, of which it constitutes from one-sixth to one-tenth by weight. It is in the state of a yellowish powder, mixed with minute particles of the scales, from which it cannot be entirely freed when procured by a mechanical process. It has the peculiar flavor of hops, and appeared to Lebaillif and Raspail, when examined by the microscope, to consist of globules filled with a yellow matter, resembling in this respect the pollen of vegetables; but from the investigations of Personne it would seem to be of the nature of a gland, commencing in a cell formed among those of the epidermis, and, when fully developed, secreting a resinous matter. (*J. P. C.*, 3e sér., xxvi.) It is inflammable, and when moderately heated becomes somewhat adhesive. The odor of lupulinic grains resides in the essential oil. This is obtained to the extent of 0.9 per cent. by distilling hops with water. When distilled from the fresh strobiles the oil has a greenish color, but a reddish brown when old hops have been employed. It is devoid of rotatory power, neutral to litmus paper, and

[1] Hops are often subjected in Germany to the fumes of burning sulphur, because of the supposition that they keep better when thus treated. Besides, by being partially bleached by the process, old hops, which have suffered from time, having become darker, generally spotted, and weaker, assume a brighter appearance, as if fresher, and generally command a better price in the market. To detect the consequent presence of sulphurous acid, the brewers put a silver spoon in a mixture of hops and water, under the impression that it will produce a black stain upon the silver. But this test will answer only when applied within a fortnight after the use of the sulphur. A more delicate method is that of Heidenreich, who puts 20 or 30 cones of the hops in a flask with zinc and hydrochloric acid, and passes the hydrogen evolved through solution of lead acetate. If sulphurous acid be present, hydrogen sulphide will be produced, which will occasion a dark precipitate with the solution. But even this plan often fails when the hops have been kept more than three or four weeks. A modification of this test has been proposed by R. Wagner. For the solution of lead acetate used in Heidenreich's method there is to be substituted a solution of sodium nitroprusside, so weak as to have a very light brown color, to which have been added a few drops of solution of potassium hydroxide. If the gas evolved contain the minutest proportion of sulphur, a violet color will be produced when the first bubble passes into the solution; and this will by a continuance of the process become a magnificent purple. The least trace of sulphurous acid may thus be found, but a few months after the sulphuring of hops none at all can be detected.

Hops are said to be sometimes threshed in order to separate the lupulin, which is sold separately. Their efficiency is thus, no doubt, greatly impaired. Hops thus treated have the scales more or less broken; and any parcel presenting this appearance is to be suspected. Hops often contain a variable quantity of lupulin in consequence of the granules of this substance separating, especially on agitation, and seeking the lower portion of the mass, which thus becomes richer, while the upper is poorer. They should always be examined in reference to the lupulin they contain, and, if nearly or quite destitute of it, should be deemed of inferior value and not be used medicinally.

gives no remarkable coloration with concentrated sulphuric acid. According to Chapman (*J. Chem. S.*, 1895, 54, 780) the essential oil consists of two terpenes, one $C_{10}H_{16}$, and the other $C_{10}H_{18}$, boiling between 160° and 171°, and a sesquiterpene called *humulene*, boiling at 263° to 266°. This latter makes up almost two-thirds of the oil. There is also a small amount of an oxygenated constituent, probably $C_{10}H_{18}O$. The bitter principle formerly called *lupulin* or *lupulite* was first isolated by Lermer (*J. Pr. Chem.*, 101), who called it the *bitter acid of hops* (*Hopfenbittersaure*). It crystallizes in large brittle rhombic prisms, and possesses the peculiar bitter taste of beer. Its composition is $C_{32}H_{50}O_7$. The main contents of the hop gland consist of wax (*myricyl palmitate*, according to Lermer) and resins, one of which is crystalline and unites with bases. Besides the constituents of the glands, hops contain, according to Etti, *lupulo-tannic acid* and *phlobaphene*. The former is a whitish, amorphous mass, soluble in alcohol, hot water, or acetic ether, but not in ether. By heating the *humulo-tannic acid* to 130° C., or by boiling its aqueous or alcoholic solution, it gives off water and is transformed into phlobaphene, a dark-red amorphous substance,

$$2C_{25}H_{24}O_{13} - H_2O = C_{50}H_{46}O_{25}$$

The latter substance, on boiling it with diluted mineral acids, becomes hydrolized, and furnishes glucose and *hop-red*, according to the reaction:

$$C_{50}H_{46}O_{25} + 2H_2O = C_{38}H_{26}O_{15} + 2C_6H_{12}O_6$$

From raw phlobaphene, ether removes the bitter principles of hops, a colorless crystallizable and a brown amorphous resin, besides chlorophyll and essential oil. (*Pharmacographia*, 2d ed.) The existence of a peculiar alkaloid in hops, suggested by Lermer in 1863, has been determined by Griessmayer. A concentrated decoction of hops was distilled with potassium or magnesium hydroxide, the distillate neutralized with hydrochloric acid, evaporated to dryness, and treated with cold absolute alcohol to remove ammonium chloride; the alcoholic liquid was heated to boiling and cooled, when much trimethylamine chloride crystallized. The residuary liquid was filtered, the filtrate evaporated, first by a water bath and then spontaneously, the residue was redissolved in water in a narrow cylinder, agitated with potassium hydroxide and ether, and the ethereal liquid allowed to evaporate spontaneously. The remaining alkaline liquid had a peculiar odor recalling that of coniine, and a cooling but not bitter taste. It soon exhibited small crystals, and finally solidified completely. The author supposed that these crystals were impurities, and that the pure alkaloid is liquid or gaseous. He proposed for it the name of *lupuline*. (*A. J. P.*, 1874.) Lastly, Etti found arabic (pectic) acid, phosphates, nitrates, malates, citrates, and also sulphates, chiefly of potassium, to occur in hops. The amount of ash afforded by hops dried at 100° C. would appear to be on an average about 6 to 7 per cent. H. Bungener has isolated from hops a bitter crystalline substance, $C_{25}H_{35}O_4$, which is insoluble in water, but soluble in alcohol and alkaline solutions. He believes it to be identical with Lermer's hop-bitter acid, to be feebly acid, and to possess the character of an aldehyde. (*P. J.*, 1884.)

Uses.—Hops are tonic and have been esteemed a narcotic. The complaints in which they have been used are *dyspepsia*, and the nervous tremors, *wakefulness*, and *delirium of drunkards*, but their medicinal properties are so feeble as rarely, in practice, to be perceptible.

An *infusion* prepared with half an ounce of hops and a pint of boiling water may be given in the dose of four fluidounces (120 Cc.) three or four times a day. The tincture is a British official preparation of hops, but the alcohol probably acts more decidedly upon the system than the hops. (See *Tinctura Lupuli.*) A pillow of hops has proved useful in allaying restlessness and producing sleep in nervous disorders. They should be moistened with water containing a trace of glycerin previously to being placed under the head of the patient, in order to prevent rustling. Fomentations with hops, and cataplasms made by mixing them with some emollient substance, are often beneficial in local pains and tumefactions.

The effects of hops may be obtained most conveniently by the use of *lupulin* (see *Lupulinum*), which, although at one time much employed as an anaphrodisiac, has fallen into deserved desuetude.

Dose, thirty to ninety grains (2.0 to 5.8 Gm.).

Off. Prep.—Infusum Lupuli, *Br.*; Tinctura Lupuli, *Br.*

HYDRARGYRI CHLORIDUM CORROSIVUM. U. S. (Br.)

CORROSIVE MERCURIC CHLORIDE [Bichloride of Mercury, Corrosive Sublimate, Mercuric Chloride]

(hȳ-drär′gy-rī ȼhlō′rı̣-dŭm cōr-rǫ-sī′vŭm)

$HgCl_2 = 268.86$

"It should contain not less than 99.5 percent of pure Mercuric Chloride, and be kept in well-stoppered bottles." *U. S.* "A salt, $HgCl_2$, obtained as a sublimate by heating a mixture of mercuric sulphate, sodium chloride, and a little black oxide of manganese." *Br.*

Hydrargyri Perchloridum, *Br.*, Sublimatus Corrosivus, Chloruretum (Chloretum) Hydrargyricum, Hydrargyrum Corrosivum Sublimatum, Hydrargyri Bichloridum; Hydrargyrum Muriaticum Corrosivum, Sublimatus Corrosivus, Sublimatum corrosivum, Mercurius Sublimatus Corrosivus; Corrosive Chloride of Mercury, Perchloride of Mercury; Sublimé corrosif, Chlorure mercurique, *Fr. Cod.*; Deutochlorure de Mercure, *Fr.*; Hydrargyrum Bichloratum, *P. G.*; Quecksilberchlorid, Aetzender Quecksilbersublimat, *G.*; Bicloruro di mercurio, *It.*; Cloruro mercurio, *Sp.*

The former official processes for this salt will be found in the foot-note.[1]

[1] "Take of Mercury *twenty-four troyounces;* Sulphuric Acid *thirty-six troyounces;* Chloride of Sodium

The names given in the two Pharmacopœias to this important chloride do not exactly correspond. It is called *Hydrargyri Chloridum Corrosivum* in the U. S. Pharmacopœia, and *Hydrargyri Perchloridum* in the British. We prefer the former, as indicating, beyond any possibility of mistake, the article intended, as well as its corrosive property. Perchloride and subchloride are hardly sufficiently distinctive, when a mistake may be so serious as that of confounding corrosive sublimate and calomel. In the first British Pharmacopœia corrosive sublimate was recognized as the official title, which was a sufficient guarantee of security; but, unfortunately, it was deemed proper, immediately after the official title, and in close connection with it, to define the salt as chloride of mercury, in conformity with the view, adopted in that work, of the atomic weight of mercury. With many persons calomel is still the chloride of mercury, so that there is some risk that, should calomel be prescribed by this title, corrosive sublimate may be dispensed for it, with dangerous if not fatal effects to the patient. Indeed, death has at least in one recorded instance occurred in consequence of this confusion of nomenclature, and our official guides should take especial care to guard against such mistakes, instead of contributing to them. The British Pharmacopœia (1898) uses for the English names mercuric chloride for corrosive sublimate and mercurous chloride for calomel, but these names are not used in prescription writing.

Preparation.—The first step in making corrosive sublimate is to form mercuric sulphate, by heating sulphuric acid and the metal together in an iron pot so arranged as to carry off the unwholesome fumes of sulphurous oxide, which are copiously generated. The dry salt obtained is then mixed with sodium chloride, and the mixture sublimed in an iron pot lined with clay and covered by an inverted earthen pan. A. T. Thomson of London, England took out a patent for forming corrosive sublimate on the large scale, by the direct combination, by combustion, of gaseous chlorine with heated mercury. The product is stated to be perfectly pure, and to be afforded at a lower price than the sublimate made in the usual way. In order that the combination may take place, the mercury need not be heated to its boiling point, but only to a temperature between 149° and 204° C. (300° and 400° F.). According to Maclagan, corrosive sublimate made by this process is liable to the objection that a proportion of calomel is always formed, occasionally amounting to 10 per cent. It may sometimes be useful to know how to make a small quantity of corrosive sublimate in an emergency. This may be done by dissolving mercuric oxide (red precipitate) in hydrochloric acid, evaporating the solution to dryness, dissolving the dry mass in water, and crystallizing. Here a double decomposition takes place, resulting in the formation of water and the chloride.

Properties.—Corrosive mercuric chloride is officially described as in "heavy, colorless, rhombic crystals, or crystalline masses, odorless, and having an acrid and persistent metallic taste; permanent in the air. When in fine powder, it is soluble in 13 parts of water, 3 parts of alcohol, and in about 14 parts of glycerin at 25° C. (77° F.); soluble in 2 parts of boiling water, and in 1.2 parts of boiling alcohol. If 1 Gm. of finely powdered Mercuric Chloride be dissolved in 10 Cc. of alcohol or 20 Cc. of water, it should leave not more than 0.005 Gm. of residue. It fuses at 265° C. (509° F.) to a colorless liquid, and at about 300° C. (572° F.) it volatilizes in dense, white vapors, leaving no appreciable residue. The aqueous solution reddens blue litmus paper, but becomes neutral to litmus paper upon the addition of sodium chloride. With ammonia water the aqueous solution of the salt yields a white precipitate; with an excess of hydrogen sulphide a black one; with potassium iodide T.S. a red one, soluble in an excess of the reagent; and with silver nitrate T.S. a white precipitate, insoluble in nitric acid. If to 0.5 Gm. of Mercuric Chloride, dissolved in 20 Cc. of water, 5 Cc. of hydrochloric acid be added, and the solution be completely saturated with hydrogen sulphide, allowed to stand for several hours in a well-corked flask until the precipitate has subsided, and then filtered, the filtrate should be colorless and leave no weighable residue upon evaporation (absence of many *foreign salts*). If the precipitate obtained in the preceding test, after washing with about 100 Cc. of water and draining, be rinsed into a beaker with about 20 Cc. of water, and then

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eighteen troyounces. Boil the Mercury with the Sulphuric Acid, by means of a sand-bath, until a dry white mass is left. Rub this, when cold, with the Chloride of Sodium in an earthenware mortar; then sublime with a gradually increasing heat." *U. S.* 1870. "Take of Persulphate of Mercury *twenty ounces* [avoirdupois]; Chloride of Sodium, dried, *sixteen ounces* [av.]; Black Oxide of Manganese, in fine powder, *one ounce* [av.]. Reduce the Persulphate of Mercury, and the Chloride of Sodium each to fine powder, and, having mixed them and the Oxide of Manganese thoroughly by trituration in a mortar, put the mixture into an apparatus adapted for sublimation, and apply sufficient heat to cause vapors of perchloride of mercury to rise into the less heated part of the apparatus which has been arranged for their condensation." *Br.* 1885.

In order to understand the above processes, which are the same in principle, it is necessary to premise that corrosive sublimate is mercuric chloride, consisting of two atoms of chlorine and one atom of mercury. By boiling sulphuric acid in excess with mercury to dryness, a white salt (mercuric sulphate) is formed, according to the reaction:

$$2H_2SO_4 + Hg = HgSO_4 + SO_2 + 2H_2O$$

(See *Hydrargyri Persulphas.*) When this is mixed with sodium chloride (common salt), and the mixture exposed to a subliming heat, a mutual decomposition takes place, according to the reaction:

$$HgSO_4 + 2NaCl = Na_2SO_4 + HgCl_2$$

The mercuric chloride thus formed sublimes, and the sodium sulphate remains behind. The quantities for mutual decomposition are two molecules of sodium chloride and one molecule of mercuric sulphate. The British formula differs from that of the U. S. P. 1870 in ordering mercuric sulphate ready formed, instead of preparing it as the first step of the process, and in the use of a small proportion of manganese dioxide, intended to convert into mercuric any mercurous salt that may be in the sulphate, and thus prevent the formation of mercurous chloride. (See *Hydrargyri Persulphas.*)

5 Cc. of stronger ammonia water added, and if after covering and digesting the mixture for about 15 minutes on a bath of boiling water, it be rinsed upon a filter and washed with a little water, the filtrate and washings after evaporating to dryness, moistening with 6 drops of nitric acid, and again drying, should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If the precipitated sulphide remaining upon the filter be treated with diluted nitric acid (1 in 4), warmed, and then filtered, the filtrate should leave no weighable residue upon evaporation and gentle ignition (limit of *foreign metals*)." *U. S.* "Heavy colorless masses of prismatic crystals, possessing a highly acrid metallic taste. Soluble in 16 parts of cold and 2 parts of boiling *water*, 3 parts of *alcohol* (90 per cent.), 4 parts of *ether*, and, on trituration, in 2 parts of cold *glycerin*. It affords the reactions characteristic of mercuric salts and of chlorides. When heated it sublimes without decomposition, leaving only a trace of fixed residue. When heated with excess of *lime* it yields 72.8 to 73.8 per cent. of metallic mercury." *Br.*

Ether is capable of removing corrosive sublimate, to a considerable extent, from its aqueous solution when agitated with it. According to Mialhe, ether will not dissolve it when accompanied by a considerable quantity of mercuric oxide and a chloride of an alkalifiable metal. Sulphuric, nitric, and hydrochloric acids dissolve it without alteration. When heated it melts, and readily sublimes in dense, white, acrid vapors, which condense, on cool surfaces, in white, shining needles. Its aqueous solution renders green the syrup of violets, and is precipitated brick-red, becoming yellow, by the fixed alkalies and alkaline earths, and white by ammonia. (See *Hydrargyrum Ammoniatum.*) The former precipitate is mercuric oxide, which has the property of evolving oxygen and of being reduced to metallic globules when exposed to heat. This oxide is formed in the process for preparing *aqua phagedænica*, called also *lotio flava*, or *yellow wash*, which is obtained by mixing half a drachm of corrosive sublimate with a pint of lime water. (See *Lotio Flava.*) Corrosive sublimate forms, with ammonium chloride and sodium chloride, compounds which are more soluble than the uncombined mercurial salt. It is on this account that aqueous solutions of sal ammoniac or of sodium chloride dissolve much more corrosive sublimate than simple water. The combination of corrosive sublimate with ammonium chloride was formerly called *sal alembroth*, or *salt of wisdom*. According to F. Hinterberger, corrosive sublimate is capable of combining with quinine and cinchonine. (*Chem. Gaz.*, ix. 211.) By dissolving one part of corrosive sublimate and a hundred parts of sodium chloride in distilled water and evaporating to dryness, a soluble preparation is obtained which does not coagulate albumen. (*A. J. P.*, xliv. 11.) J. F. Brown (*C. D.*, 1896, 425) recommended for dispensing purposes a solution of mercuric chloride of such strength that ten minims contain one grain, made by dissolving ninety-six grains of corrosive sublimate in one and a half ounces avoirdupois of glycerin and six fluidrachms of distilled water by the aid of heat, then cooling the solution and adding distilled water until the solution measures two fluidounces.

Tests.—Pure corrosive chloride of mercury sublimes, when heated, without residue, and its powder is entirely and readily soluble in ether. Consequently, if a portion of any sample should not wholly dissolve in ether, or if it should not evaporate entirely, the presence of some impurity is proved. If calomel be present, and it frequently is, it will not be wholly soluble in water.[1] Arsenic is reported to be a frequent impurity in corrosive sublimate. (See paper by J. Granville Smith, *A. J. P.*, 1877, p. 397.) It can be readily detected by the test of U. S. P. (8th Rev.). (See above.) Corrosive sublimate is incompatible with many of the metals, the alkalies and their carbonates, soap, lime water, tartar emetic, silver nitrate, the lead acetates, the potassium and sodium sulphides, the soluble iodides, and all the sulphydrates. It is decomposed by many vegetable and some animal substances. According to A. T. Thomson, it produces precipitates in infusions or decoctions of chamomile, horseradish, calumba, cinchona, gambir, rhubarb, senna, simaruba, and oak bark. Mialhe and Lepage have shown that corrosive sublimate is slowly converted into calomel by syrup of sarsaparilla and syrup of honey, but is not changed by contact with pure syrup. Samuel Kennedy (*Ph. Rec.*, 1888, p. 201) proved conclusively that when corrosive sublimate was dissolved in compound syrup of sarsaparilla, as frequently prescribed, precipitation invariably occurred. He found that if sodium chloride in quantity equalling that of the mercurial used were added, precipitation was greatly retarded.

Uses.—Corrosive sublimate is a very powerful preparation, operating quickly, and, if not properly regulated, producing violent effects. It is less likely to salivate than most other mercurials. In doses of one-hundredth to one-sixtieth of a grain (0.0006 to 0.0011 Gm.) it often seems to act as a tonic to the general nutrition, and even in somewhat larger dose it may exert its peculiar influence without any obvious alteration of the vital functions, except, perhaps, a slight increase in the frequency of the pulse, and in the secretions from the skin and kidneys. Sometimes, however, it purges, but this effect may be obviated by combining it with a little opium. In larger doses it occa-

[1] Bullot, having noticed in some corrosive sublimate an insoluble portion consisting of minute yellowish granules, found on examination that it was an aniline product. He surmised that the drug had been thrown into commerce after having been used in the preparation of aniline dyes. (*J. P. C.*, 4e sér., xviii. 414.)

sions nausea, vomiting, griping pain in the bowels, diarrhœa, and other symptoms of gastric and intestinal irritation, and in still larger quantities produces all the effects of a violent corrosive poison. It has long been used as a remedy in *syphilis*, in all stages of which it has been highly recommended. It is especially valuable in the advanced stages of the disorder, when there is no cachexia. When a very rapid impression is desired it is not as useful as calomel. It is the best of all the preparations of mercury for hypodermic use in syphilitic diseases. From one-twentieth to one-tenth of a grain (0.003 to 0.006 Gm.) dissolved in ten minims of water may be thrown deeply into the muscles, preferably of the back. If it produces much smarting one-fourth of a grain of cocaine should be injected and immediately followed, without removal of the needle, by the corrosive sublimate. Corrosive sublimate has been used with more or less lack of success in most chronic diseases involving wide spread nutritive changes, such as *chronic rheumatism*, *cutaneous diseases*, etc.

Externally employed, corrosive sublimate is stimulant, escharotic, and germicidal. A solution in water, containing one-eighth grain in the fluidounce, is employed as an injection in *gleet*, and as a collyrium in chronic *venereal ophthalmia*. A stronger solution, containing one or two grains in the fluidounce, is an efficacious wash in *lepra* and other scaly eruptions. Dissolved in water, in the proportion of five to ten grains to the fluidounce, it may be used with much benefit in *venereal ulcers* of the throat, to which it should be applied by means of a camel's-hair pencil. With lime water it forms the *aqua phagedænica* of the older writers, employed as a wash for ill-conditioned *ulcers*. The powdered chloride has been used as an escharotic, but is, in general, inferior to silver nitrate or potassium hydroxide. In *onychia maligna*, however, it is employed with great advantage, mixed with an equal weight of zinc sulphate, and sprinkled thickly upon the surface of the ulcer, which is then to be covered with a pledget of lint saturated with tincture of myrrh. The whole diseased surface is thus removed, and the ulcer heals.[1] This practice originated, we believe, with Perkins of Philadelphia, and was highly recommended by Physick. Geo. B. Wood often employed it with success. A solution of corrosive sublimate in collodion (four parts to thirty) has been used as a caustic, for the destruction of *nævi materni*, and for other purposes. It can be very accurately applied, but its use requires care, as fatal poisoning has followed a single application of the alcoholic solution of corrosive sublimate to a moderate surface of *ringworm*. (*L. L.*, 1871, ii. 413.) It is applied by means of a camel's-hair pencil.

Corrosive sublimate is one of the most powerful of known germicides, a solution of one part of it in twenty thousand of water being sufficient to kill micrococci and bacilli in active growth, while a solution of one in one thousand will rapidly destroy bacterial spores. According to Koch, as little as one part of corrosive sublimate in three hundred thousand of a proteid solution will prevent the germination of the spores of the bacillus of anthrax. As, however, ammonia and several other chemical substances habitually found in masses of filth rapidly decompose mercuric chloride, the latter is scarcely available for most disinfectant purposes on a large scale. For the purposes of antisepsis in surgery, however, corrosive sublimate is probably the most generally useful and effective of the known germicides. The solution of one in one thousand may be used for washing the hands, disinfecting furniture, etc., and is even employed in the disinfecting of wounds; usually, however, a much weaker solution than that just mentioned is employed by the surgeon. It is rarely if ever justifiable to use upon a mucous surface or a wound a solution stronger than one in two thousand, and if the solution is to be used freely and continuously, as in washing out the vagina, etc., one in ten thousand is as strong as should be employed; indeed, the employment of a vaginal wash of this strength has been followed by violent poisoning. As long ago as 1891 Sebillotte collected 148 cases of poisoning by vaginal injections. (See H. C. Wood, Jr., *Am. Med.*, Dec. 1902.) In a number of cases a solution of one part in fifteen hundred used locally by the surgeon has produced death, preceded by constitutional symptoms.

For the purpose of convenience of surgeons, *corrosive sublimate tablets* are now largely prepared and used. The amount of corrosive sublimate in these tablets should be so calculated as to yield, with the measures of water ordinarily used, solutions of convenient strength. Thus, if each tablet contains 7.3 grains of corrosive sublimate, one tablet dis-

[1] *Antiseptic Dressings.*—The following directions are given in *Ph. Rund.*, Prague, for antiseptic dressings to be used in the German army:

Corrosive Sublimate Gauze.—Dissolve 50 Gm. mercuric chloride in 5000 Gm. alcohol and add 7500 Gm. distilled water, 2500 Gm. glycerin, and 0.5 Gm. fuchsin, the latter being added for the purpose of readily distinguishing the corrosive sublimate gauze from others. Four hundred metres of gauze are well kneaded in this solution and allowed to soak for fifteen minutes; the gauze is then strongly pressed and well dried on wash-lines, being protected from light and dust.

Corrosive Sublimate Cotton.—Absorbent cotton is soaked in the above solution and dried in loose layers. It has been stated that the cotton has a dissociating effect upon the mercuric chloride, mercury being fixed upon the cotton as oxide, a certain proportion of mercurous chloride being formed at the same time. (*A. J. P.*, 1893, 451.)

Corrosive Sublimate Catgut.—A 5 per cent. aqueous solution of corrosive sublimate is prepared, in which thin catgut is soaked for about eight hours, and the thicker kinds for ten or twelve hours. The catgut is subsequently kept in vials with alcohol.

Corrosive Sublimate Silk is prepared by soaking well washed ligature silk in a solution of 5 parts of corrosive sublimate in 100 parts of water and 20 parts of glycerin. After drying it is wrapped in oiled silk or other water-proof material, and, before using, it is dipped into a 3 per cent. phenol solution, or a 1 per cent. solution of corrosive sublimate.

solved in a pint of water will yield a solution of one in one thousand. Tablets are found in the market one-half this strength, one tablet making only half a pint of 1-1000 solution. In order to make the tablets readily soluble, the corrosive sublimate is usually compressed with some powdered ammonium chloride or tartaric acid; it is asserted of the latter addition, upon the authority of Laplace, that tartaric acid prevents the precipitation of the mercury as an insoluble albuminate. The proportions used by the manufacturers are as follows: 7.7 grains of corrosive sublimate and 7.3 grains of ammonium chloride in each tablet, one tablet making one pint of 1-1000 solution. The tablets containing tartaric acid are usually made one-half this strength, as follows: 3.85 grains of corrosive sublimate and 19.25 grains of tartaric acid in each tablet. It is essential that the tablets be colored or in some way marked so that the attention may be drawn to their nature, and accidental poisoning prevented.

Dose, of corrosive sublimate, from the one-hundredth to an eighth of a grain (0.0006 to 0.008 Gm.), preferably given after meals, in pill or solution. The pill is usually prepared with crumb of bread; care should be taken that the medicine be equally diffused through the pilular mass before it is divided.

Toxicological Properties.—Swallowed in poisonous doses, it produces burning heat in the throat, excruciating pain in the stomach and bowels, excessive thirst, anxiety, nausea and frequent retching with vomiting of bloody mucus, diarrhœa and sometimes bloody stools, small and frequent pulse, cold sweats, general debility, difficult respiration, cramps in the extremities, faintings, insensibility, convulsions, and death. The mucous membrane of the stomach exhibits, on dissection, signs of the operation of a violent corrosive poison. These symptoms are sometimes followed or conjoined with others indicating an excessive mercurial action upon the system, such as inflammation of the mouth and salivary glands, profuse salivation, fetid breath, etc. The chief symptom of corrosive sublimate poisoning which distinguishes it from poisoning by antimony, arsenic, or other corrosive metallic irritant is the fact that the stools are very frequent, smallish, and composed chiefly of mucus and blood. A case is on record of death, in an infant, from the constitutional effects of corrosive sublimate sprinkled upon an excoriated surface, and in two instances of children, the one seven and the other nine years old, death with all the symptoms of internal poisoning, followed the application to the scalp of an ointment said to consist of one part of the corrosive chloride to four parts of tallow. (*Dublin Q. J.,* Aug. 1854.) In the inferior animals, in whatever mode introduced into the system, it produces symptoms and lesions similar to those which it causes in man. In the treatment of poisoning by corrosive sublimate, Orfila recommends the free use of the white of eggs beaten up with water. The albumin forms an insoluble and comparatively innocent compound with the corrosive sublimate, and the liquid by its bulk dilutes the poison, and distends the stomach so as to produce vomiting.

It is, however, asserted by Lassaigne that this compound of albumin and corrosive sublimate, when recently precipitated, is soluble in acid and alkaline liquids, and in solutions of potassium, sodium, and calcium chlorides. (See *J. P. C.,* xxiii.) It is also soluble in an excess of albumin, whether introduced into the stomach or previously existing there. It is, therefore, important, at the same time that the antidote is used, to evacuate the stomach before the newly formed compound can be dissolved. If eggs cannot be procured, wheat flour may be substituted, gluten having, according to Taddei, the same effect as albumin. Milk also has been recommended, in consequence of the insoluble compound which casein forms with the poison. Besides the antidotes mentioned, Peruvian bark, meconic acid, ferrous sulphide, and iron filings have been proposed, all of which have the property of decomposing corrosive sublimate. The ferrous sulphide was found quite successful by Mialhe in experiments upon dogs, if given immediately after the poison was swallowed, but failed when delayed for ten minutes.

Buckler made some successful experiments on lower animals upon the antidotal properties of a mixture of gold dust and iron filings (*Med. and Surg. Journ.,* 1843), and a case of poisoning by corrosive sublimate has been recorded by C. Johnston of Baltimore, in which this antidote was employed with the apparent result of saving life, after albumin had been used without effect. Johnston, however, employed the reduced iron of the Pharmacopœia, and gold leaf, arranging them in alternate layers, so as to make boluses of convenient size (*Am. J. M. S.,* April, 1863). The method of operation of this antidote will be understood when the action of gold and iron as a test for corrosive sublimate is explained in the succeeding paragraph. It is of the utmost importance that whatever antidote is used should be given without delay, and in this respect the one nearest at hand may be considered the best. Under all circumstances the stomach should be rapidly and thoroughly washed out by abundance of mucilaginous fluids, the stomach tube being used if necessary. The after effects should be treated like other forms of toxic gastro-enteritis, *i.e.,* by local bloodletting or counter-irritation, demulcent drinks, opiates, etc.

Tests for Corrosive Sublimate.—On account of the extreme virulence of this chloride as a poison, the reagents by which it may be detected form a subject of study of the utmost importance, as connected with medico-legal investigations. The best tests for determining its mercurial nature, mentioned in the order

of their delicacy, are potassium ferrocyanide, lime water, potassium carbonate, potassium iodide, ammonia, hydrogen sulphide, and stannous chloride. *Potassium ferrocyanide* gives rise to a white precipitate (mercuric ferrocyanide), becoming slowly yellowish, and at length pale blue. *Lime water* throws down a yellow precipitate of hydrated mercuric oxide. *Potassium carbonate* causes a brick-red precipitate of mercuric carbonate. *Potassium iodide* produces a very characteristic pale scarlet precipitate of mercuric iodide. This precipitate frequently appears at first yellow, especially if the corrosive sublimate be present in minute proportion. *Ammonia* gives rise to a white, flocculent precipitate, the official ammoniated mercury, or white precipitate. *Hydrogen sulphide* occasions a black precipitate of mercuric sulphide; and the same precipitate is thrown down by ammonium sulphydrate. Finally, *tin protochloride* (stannous chloride) causes a grayish-black precipitate (mercury in a finely divided state). Taking the results of Devergie, the relative delicacy of these tests may be expressed on the basis of 100 as follows: potassium ferrocyanide 1½; lime water 4; potassium carbonate 7; potassium iodide 8; ammonia 36; hydrogen sulphide or ammonium sulphydrate 60; and stannous chloride 80.

Wormley (*Micro-Chemistry of Poisons*, 2d ed. p. 348) states that the reaction of stannous chloride is retarded or entirely prevented by alkaline chlorates, and by free nitric acid. He highly commends, however, the following copper test: *a bright copper plate*, immersed in a solution containing corrosive sublimate, is instantly tarnished, and, after half an hour, becomes covered with a grayish-white powder; conclusive proof of mercury is obtained by heating the well-dried coated copper plate in an ignition tube, whereby the mercury is volatilized and collects in globules. *A polished piece of gold*, moistened with the *clear* mercurial solution, and touched through the liquid with a piece of iron, contracts a white stain. This test, proposed by Sylvester and simplified by Paris, is conveniently applied by moistening with the suspected solution a gold coin or ring, and touching it through the moistened spot with the point of a penknife. The iron forms with the gold a simple galvanic couple, which enables the latter to precipitate mercury on its surface. Nearly all the above tests merely prove the presence of mercury. To determine whether the metal is united with chlorine, the mercurial liquid may be precipitated by lime water, and the filtered solution, acidulated with nitric acid, then tested with silver nitrate. If the mercury is in the state of chloride, the filtered solution will be one of calcium chloride, which with silver nitrate will yield a heavy, white precipitate (silver chloride), insoluble in nitric acid, but soluble in ammonia; the silver nitrate may be added directly to the mercurial liquid, and, if it contains corrosive sublimate, silver chloride will fall, but probably mixed with calomel.

By the combined indications of the foregoing tests, corrosive sublimate may be infallibly detected, unless it exists in very minute quantity, associated with organic substances, by which its presence is often greatly obscured. When it exists in organic mixtures, made by boiling the contents or substance of the stomach in distilled water, Christison recommends that a preliminary trial be made with stannous chloride on a small portion filtered for the purpose. If this causes a grayish-black color, he shakes the mixture, as recommended by Orfila, with a fourth of its bulk of cold ether, which dissolves the corrosive sublimate and rises to the surface. The ethereal solution is then evaporated to dryness, and the dry salt obtained is dissolved in hot water, whereby a pure solution is procured, in which the poison may be readily detected by the ordinary tests.

In using ether, however, it must be borne in mind that, as ascertained by Mialhe, the presence of a considerable quantity of mercuric oxide, and of a chloride of an alkaline metal, prevents the solvent power of ether. If the trial test should produce a light-gray color, the corrosive sublimate is indicated in still less quantity, and Christison recommends to proceed in the following manner. Treat the unfiltered mixture with stannous chloride, as long as any precipitate is formed, which will have a slate-gray color. Collect, wash, and drain it on a filter, and, having removed it without being dried, boil it, in a glass flask, with a moderately strong solution of potassium hydroxide, until all the lumps disappear. The alkali will dissolve all animal and vegetable matter; and, on allowing the solution to remain at rest, a heavy grayish-black powder will subside, which consists chiefly of metallic mercury, and in which small globules of the metal may sometimes be seen with the naked eye, or by the aid of a magnifier. Wormley (*loc. cit.*) suggests boiling the organic mixture with water acidulated with hydrochloric acid, and testing the filtered solution with a strip of copper foil. Probably advantage might be derived from the process of dialysis, in separating corrosive sublimate, among other crystallizable substances, from the colloidal matters, contained in organic mixtures. (See *Dialysis.*)

Off. Prep.—Hydrargyri Iodidum Rubrum, *U. S.;* Hydrargyri Oleas, *Br.;* Hydrargyri Oxidum Flavum, *U. S.;* Hydrargyrum Ammoniatum, *U. S., Br.;* Liquor Hydrargyri Perchloridi, *Br.;* Lotio Hydrargyri Flava, *Br.*

HYDRARGYRI CHLORIDUM MITE. U. S. (Br.)

MILD MERCUROUS CHLORIDE [Calomel, Mercurous Chloride, Protochloride of Mercury, Subchloride of Mercury]

(hȳ-drär′gy-rī ȼhlō′rī-dŭm mī′tē)

$HgCl = 233.68$

"It should contain not less than 99.5 percent. of pure Mercurous Chloride, and be kept

in dark amber-colored bottles." *U. S.* "A salt, Hg_2Cl_2, obtained as a sublimate when a mixture of mercurous sulphate and sodium chloride is heated." *Br.*

Hydrargyri Subchloridum, *Br.,* Calomelas; Hydrargyri Chloridum, Hydrargyrum Chloratum (Muriaticum), Mercurius Dulcis, Chloruretum Hydrargyrosum; Mild Chloride of Mercury, Submuriate of Mercury; Chlorure Mercureux, *Fr. Cod.;* Protochlorure ou Sous-muriate de Mercure, Calomel, *Fr.;* Hydrargyrum Chloratum, *P. G.;* Quecksilberchlorür, *G.;* Protocloruro di mercurio, *It.;* Cloruro mercurioso sublimado, *Sp.*

Very properly, processes for this compound have been omitted from the Pharmacopœias, as it cannot be made by the pharmacist conveniently. For processes of the U. S. P. 1870 and of the Br. Pharm. 1885, with remarks, see foot-note.[1]

Preparation on the Large Scale.—The process for making calomel by means of mercuric sulphate was originally practised at Apothecaries' Hall, London. The proportions taken and the mode of proceeding in that establishment were, according to Brande, as follows: 50 lbs. of mercury are boiled to dryness with 70 lbs. of sulphuric acid, in a cast iron vessel; and 62 lbs. of the dry salt formed are triturated with 40½ lbs. of mercury until the globules disappear, and the whole is mixed with 34 lbs. of sodium chloride. The mixture is sublimed from an earthenware retort into an earthenware receiver, and the product is from 95 to 100 lbs. of calomel in mass. This is then ground to an impalpable powder, and washed with a large quantity of distilled water.

To bring the calomel into a state of minute division the method of Joseph Jewell of London, improved by Ossian Henry, is employed. It consists in causing the calomel in vapor to come in contact with steam in a large receiver, whereby it is condensed into an impalpable powder, and perfectly washed from corrosive sublimate in the same operation. Calomel made by this process, sometimes called Jewell's or Howard's *hydrosublimate of mercury,* is free from all suspicion of containing corrosive sublimate, is much finer than when obtained by levigation and elutriation, and possesses more activity as a medicine. This kind of calomel is included in the French Codex under a distinct name (*Mercure doux à la vapeur*). Soubeiran of Paris, has perfected a process for obtaining calomel as an impalpable powder, by substituting the agency of cold air for that of steam for the purpose of condensing it; this process he believes to be precisely the same as that pursued by the English manufacturers, producing a calomel equal to the best English. A description of his apparatus may be found in the *J. P. C.* (3e sér., ii.), and of the English apparatus, as described by F. C. Calvert, in the same journal (3e sér., iii.). Both these papers are copied into the *A. J. P.* (xv.).

Calomel may also be prepared in the dry way by taking four parts of corrosive sublimate and rubbing it up in a mortar with three parts of mercury, after moistening the mass with alcohol. The powder is then dried and sublimed in glass flasks. The powder should be dried quickly before sublimation, so as to drive off any trace of uncombined mercury. A comparative examination of English and American calomel was undertaken separately in 1885 by Bedford and Patch. (See *Proc. A. Ph. A.,* 1885.) While there was no reason for preferring English calomel, none of the samples exhibited more than traces of mercuric chloride. Wöhler has proposed to obtain calomel, in the humid way, by precipitating a solution of corrosive sublimate by a stream of sulphurous acid, taking advantage of a reaction first observed by Vogel. Calomel obtained in the humid way, called *precipitated calomel,* was formerly official with the Dublin College, and was adopted in the French Codex. This form of calomel is of doubtful utility, and when

[1] "Take of Mercury *forty-eight troyounces;* Sulphuric Acid *thirty-six troyounces;* Chloride of Sodium *eighteen troyounces;* Distilled Water, *a sufficient quantity.* Boil, by means of a sand-bath, twenty-four troyounces of the Mercury with the Sulphuric Acid, until a dry white mass is left. Rub this, when cold, with the remainder of the Mercury, in an earthenware mortar, until they are thoroughly mixed. Then add the Chloride of Sodium, and, having rubbed it with the other ingredients until globules of Mercury cease to be visible, sublime the mixture into a large chamber so that the sublimate may fall in powder. Wash the sublimed matter with boiling Distilled Water, until the washings afford no precipitate with water of ammonia, and dry it." *U. S.* 1870.

"Take of Persulphate of Mercury *ten ounces* [avoirdupois]; Mercury *seven ounces* [av.]; Chloride of Sodium, dried, *five ounces* [av.]; Boiling Distilled Water *a sufficiency.* Moisten the Persulphate of Mercury with some of the Water, and rub it and the mercury together until globules are no longer visible; add the Chloride of Sodium, and thoroughly mix the whole by continued trituration. Sublime by a suitable apparatus into a chamber of such size that the Calomel, instead of adhering to its sides as a crystalline crust, shall fall as a fine powder on its floor. Wash this powder with boiling Distilled Water, until the washings cease to be darkened by a drop of sulphydrate of ammonium. Finally, dry at a temperature not exceeding 212° F. (100° C.)." *Br.* 1885.

In the U. S. process, 1870, as in the case of corrosive sublimate, mercuric sulphate is first formed; but, instead of being immediately sublimed with the sodium chloride, it undergoes a preparatory trituration with a quantity of mercury equal to that employed in forming it. The residue of this process and of that for corrosive sublimate are the same. The calomel, as sublimed, is liable to contain a little corrosive sublimate; and hence the direction of the U. S. Pharmacopœia of 1870 to wash it with boiling distilled water until ammonia produces no precipitate with the washings. According to Berthé, calomel in contact with hot water is converted, to a small extent, into corrosive sublimate; hence he recommends that the portion of water to be tested should be cold when passed through the calomel. The British process (1885) is a modification of that of the old Dublin Pharmacopœia, including, like that, no directions for making the mercuric sulphate, because this salt is made by a separate formula, being designated as *persulphate of mercury.* It omits, however, as unnecessary, a partial preliminary sublimation, to test the production of corrosive sublimate, and, immediately after a thorough mixture of the materials, proceeds to the final sublimation. An improvement was to cause the vapors to enter for condensation a chamber of considerable size, so that they might fall in powder, instead of condensing on the sides of the receiver in a crystalline mass. The necessity of pulverizing the calomel is thus avoided. The Br. Pharmacopœia (1885) directs the powder to be washed, but, instead of using ammonia as a test of the absence of corrosive sublimate in the washings, directs for the purpose ammonium sulphide, which throws down a black precipitate if corrosive sublimate be present.

obtained by Wöhler's process it is a crystalline powder, which is unfit for use unless after elaborate levigation and elutriation.

Properties.—When in mass, its form and appearance depend on the shape and temperature of the subliming vessel. In this state it is generally in the form of a white, fibrous, crystalline cake, the interior of which is often studded with shining transparent crystals, having the shape of quadrangular prisms, and a texture somewhat horny and elastic. When the mass is scratched it yields a yellow streak, which is very characteristic. Its sp. gr. is 7.2. Patch found (*Proc. A. Ph. A.*, 1885, p. 477) the sp. gr. of calomel to vary from 6.94 to 7.93, the standard being water at 39° F. Powder is the official form of this chloride, in which state it is always kept by pharmacists. The powder has a light buff or ivory color, if obtained by the levigation of sublimed masses; but if condensed at once in the form of an impalpable powder, as is the case with Jewell's calomel and in the official processes, it is perfectly white. To protect it from the action of the light, it should be kept in a dark place, or in bottles painted black or covered with black paper. By the action of the fixed alkalies or alkaline earths it immediately becomes black, in consequence of the formation of mercurous oxide, reducible by heat to the metallic state. The preparation employed under the name of *lotio nigra*, or *black wash*, as a local application to syphilitic *ulcers*, etc., is made by adding a *drachm* of calomel to *a pint* of lime water. (See *Lotio Nigra.*) By double decomposition between the calomel and lime, the black suboxide precipitates, and calcium chloride remains in solution, indicated by yielding a copious white precipitate with silver nitrate. The oxide, however, is not pure, but associated with undecomposed calomel. Before being applied, the wash should be well shaken.

It is officially described as "a white, impalpable powder, becoming yellowish-white on being triturated with strong pressure, and showing only small, isolated crystals when viewed under a lens having a magnifying power of one hundred diameters. It is odorless and tasteless, and permanent in the air. Insoluble in water, alcohol, or ether, and also in cold dilute acids. When strongly heated, Mercurous Chloride is volatilized without fusion or the evolution of brown vapors, leaving no appreciable residue. In contact with calcium hydroxide T.S., or with solutions of alkali hydroxides, or with ammonia water, the salt is blackened. When heated with dried sodium carbonate in a dry glass tube, it yields a sublimate of metallic mercury." *U. S.*

Tests.—Calomel, when pure, completely sublimes on the application of heat, a property which detects all fixed impurities, such as calcium carbonate, sulphate, and phosphate, barium sulphate, and lead carbonate. Under the influence of an elevated temperature, especially in the presence of alcohol or water, it gives rise to a small quantity of corrosive sublimate. (Berthé.) Calomel strikes a black color, free from reddish tinge, by the action of the fixed alkalies, and the black oxide thus produced is brought by heat to the metallic state. The buff color indicates the absence of corrosive sublimate, but whiteness by no means shows the presence of this impurity. Its freedom from the corrosive chloride may be determined by washing a portion of it in warm distilled water, and then testing the water with ammonia, which will cause a white precipitate (ammoniated mercury) should the water have taken up any of the poisonous chloride.

The official tests are as follows: "If 1 Gm. of the salt be shaken with 10 Cc. of water or alcohol, and the mixture filtered, neither of the filtrates should respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121), nor should any appreciable residue be left on evaporation (absence of *soluble impurities*). If 2 Gm. of the salt be shaken with 20 Cc. of ether, filtered, the filtrate evaporated, and 10 Cc. of distilled water added, not more than a slight opalescence should result upon the addition of silver nitrate T.S. to 5 Cc. of the filtrate, and no change in color should be produced upon adding a few drops of ammonium sulphide T.S. to the remainder (absence of *mercuric chloride*). On heating a portion of the salt in a test-tube with potassium hydroxide T.S., it should not evolve ammonia; and if another portion be shaken with acetic acid, and filtered, the filtrate should not be affected by hydrogen sulphide T.S., nor by silver nitrate T.S. (distinction from, and absence of, *ammoniated mercury*). If to 0.5 Gm. of Mercurous Chloride contained in a small beaker, 5 Cc. of nitric acid be added, and the mixture evaporated to dryness on a water-bath, and if, after dissolving the residue in about 25 Cc. of distilled water and 5 Cc. of hydrochloric acid, the solution be completely saturated with hydrogen sulphide, and allowed to stand for several hours in a well-corked flask, until the precipitate has subsided, and then filtered, the filtrate should be colorless and leave no weighable residue upon evaporation (absence of many *foreign salts*). If the precipitate obtained in the preceding test, after washing with about 100 Cc. of water, and draining, be rinsed into a beaker with about 20 Cc. of water and then 5 Cc. of stronger ammonia water added, and if, after covering and digesting the mixture for about 15 minutes on a water-bath, it be rinsed upon a filter and washed with a little water, the filtrate and washings, after evaporating to dryness, moistening with 6 drops of nitric acid, and again drying, should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If the precipitated sulphide remaining upon the filter be treated with diluted nitric acid (1 in 4), warmed, and then filtered, the filtrate should leave no weighable residue upon evaporation and gentle ignition (limit of *foreign*

metals)." *U. S.* "A dull-white heavy and nearly tasteless powder, sometimes rendered yellowish by prolonged trituration; insoluble in *water, alcohol* (90 per cent.), or *ether*. It affords the reactions characteristic of mercurous salts and of chlorides. Hydrocyanic acid converts it into mercuric salt and a black powder readily yielding metallic mercury. It volatilizes when sufficiently heated, leaving only a trace of fixed residue. Warm *ether* with which it has been shaken leaves, on evaporation, no residue (absence of mercuric chloride). Warmed with *solution of potassium hydroxide* it becomes black and does not evolve ammonia (absence of mercuric-ammonium chloride). When heated with excess of *lime* it should yield 84.4 to 84.9 per cent. of metallic mercury." *Br.*

An easy method of detecting corrosive sublimate, proposed by Bonnewyn, is to put some of the suspected powder upon a well polished surface of iron, and then moisten it with a drop of alcohol or ether. If the calomel be pure the surface will remain quite unaffected, while it will be blackened by corrosive sublimate if present in the proportion of only one to 50,000 (*J. P. C.*, 4e sér., ii. 79). The presence of any soluble chloride whatever in the calomel would be detected by the production of a precipitate with the washing by silver nitrate. Soluble salts of mercury may be detected by rubbing the suspected calomel with ether on a bright surface of copper, when the metal will become amalgamated and exhibit a white stain. When this test shows impurity, the soluble salt present is probably corrosive sublimate. Calomel containing corrosive sublimate acts violently on the bowels, and, when the impurity has been present in considerable amount, has been known to cause death. Besides being incompatible with the alkalies and alkaline earths, calomel is also decomposed by the alkaline carbonates, soaps, sulphydrates, and, according to some authorities, by iron, lead, and copper. By boiling with the alkaline formiates it is decomposed, and metallic mercury liberated. (H. Rose, *Annal. der Physik und Chem.*, cvi. 500.)

According to Lebeaux, calomel should not be prescribed with iodine, unless the prescriber intends to give mercuric iodide (red iodide), when the dose must be reduced accordingly. (*Ann. Thér.*, 1857, p. 180.) It should not be given at the same time with nitrohydrochloric acid, for fear of generating corrosive sublimate. One of the authors has been informed of a case in which death, with symptoms of violent gastro-intestinal irritation, followed their joint use. According to the experiments of Deschamps, calomel is decomposed by bitter almonds and by hydrocyanic acid. In the former case corrosive sublimate, mercuric cyanide, and ammonium chloride are formed; in the latter, corrosive sublimate and mercuric cyanide only; hence this writer considers it very dangerous to associate calomel with bitter almonds or hydrocyanic acid in prescription. This conclusion has been confirmed by Mialhe and Prenleloup, and more recently it has been shown by E. Riegel that cherry-laurel water has the power of converting calomel into corrosive sublimate. According to Mialhe, calomel is in part converted into corrosive sublimate and metallic mercury by ammonium chloride and by sodium and potassium chlorides, even at the temperature of the body; hence he believes that the conversion may take place in the primæ viæ. Popular belief coincides with Mialhe's views in regard to the power of common salt to increase the activity of calomel.

Uses.—Calomel unites to the general properties of the mercurials those of a purgative and anthelmintic. It is the most valuable of the mercurial preparations. Whether the object is to bring the system under the general influence of mercury, or to produce its alterative action upon the hepatic or other secretory function, calomel, on account both of its certainty and of its mildness, is preferred to all other preparations, with the single exception of the blue pill, which, though less certain, is still milder, and is sometimes preferably employed. When used with the above objects, the tendency to purge which it sometimes evinces, even in very small doses, must be restrained by combining it with opium. As a purgative, calomel owes its chief value to its tendency to act on the liver, the secretory function of which it stimulates. It is usually slow and somewhat uncertain in its cathartic effect, and, though itself but slightly irritating, sometimes occasions severe griping pain with bilious vomiting, attributable to the acrid character of the bile which it causes the liver to secrete.

It is peculiarly useful in the commencement of *bilious fevers*, in *hepatitis, jaundice, bilious* and *painter's colic, dysentery*, especially that of tropical climates, and all other affections attended with congestion of the portal system or torpidity of the hepatic function. The difficulty with which it is thrown from the stomach renders it highly useful in some cases of obstinate vomiting, when other remedies are rejected. In the case of children it is peculiarly valuable from the facility of its administration. In the treatment of *worms* it is often useful as an aid to other remedies, acting probably not only as a purgative, but also as an irritant to the worms, either by its immediate influence or that of the acrid bile which it causes to flow. The slowness and uncertainty of its action, and its liability to salivate if too long retained in the bowels, render it proper either to follow or combine it with other cathartics, in order to insure its purgative effect. When given alone, it should be followed, if it does not operate in six or seven hours, by a dose of castor oil or magnesium citrate. The cathartics with which it is most frequently combined are jalap, rhubarb, aloes, scammony, colocynth, and gamboge. It is often added in small quantities to purgative combinations, with a view to its influence on the liver.

In very large doses, calomel is supposed by some to act directly as a sedative, and with this view has been given in *yellow* and *malignant bilious fevers,* violent *dysentery,* malignant *cholera,* etc. The quantities which have been administered in such affections, with asserted impunity and even advantage, are almost incredible. A common dose is twenty or forty grains, repeated every half hour, or hour, or less frequently, according to the circumstances of the case. It is unquestionable that the effects obtained from calomel are not at all proportionate to the size of the dose. This is evidently due to the peculiarities of its absorption. It seems to be established that it is not, as was at one time supposed, converted in the stomach into corrosive sublimate, but is precipitated by the alkaline juices of the intestine in the form of black oxide, which black oxide is itself soluble in alkaline liquors and also in fatty matters. A small quantity of calomel coming into the intestines is, therefore, at once converted into black oxide and fully exhausts all the solvent power of the alkaline juices, which may therefore be unable to take up any more rapidly a large than a small amount of the drug. It is possible that in some cases in which minute doses of calomel are given in powdered form, the excessive action of the drug is due to the conversion of part of the calomel into corrosive sublimate.[1]

Externally applied, calomel is often used as an efficient alterative and desiccant in venereal and other *ulcers,* herpetic eruptions, etc.

In *syphilis,* calomel vapor baths once or twice a week are often of service. They may be made extemporaneously by pouring an ounce and a half of water into a dish, putting twenty grains of calomel in it, and heating by means of a spirit lamp, the patient being seated on a chair over the dish, and surrounded by blankets closely wrapped around the neck, spread out below.

Dose, as an alterative, in functional derangement of the liver, is from half a grain to a grain (0.032 to 0.065 Gm.) every night, or every other night, followed in the morning, if the bowels are not opened, by a gentle saline laxative. When the stomach or bowels are very irritable, as in cholera and diarrhœa, from an eighth to a quarter of a grain (0.008 to 0.016 Gm.) may be given every hour or two, so as to amount to one or two grains (0.065 to 0.13 Gm.) in the course of the day. With a view to salivation, the dose is from half a grain to a grain (0.032 to 0.065 Gm.) three or four times a day, to be increased considerably in urgent cases. Sometimes very minute doses, as the twelfth of a grain (0.005 Gm.) or less, given very frequently, so as to amount to the ordinary quantity in twenty-four hours, will operate more effectually as a sialagogue than larger doses. When large doses are given with this view, it is often necessary to combine them with opium. As a purgative, from five to fifteen grains (0.32 to 1 Gm.) or more may be exhibited. The cathartic action is not increased in proportion to the dose, and enormous quantities have been given with impunity. On the other hand, the most effective method of influencing the liver and other intestinal glands, is the exhibition of one-fourth to one-half grain (0.016 to 0.032 Gm.) doses every hour, until the effect is produced or five or six grains (0.32 or 0.4 Gm.) have been taken. Even in very small single doses of not more than one, two, or three grains (0.065, 0.13, or 0.20 Gm.), calomel purges some individuals briskly. In these persons, large doses, though they do not proportionally increase the evacuation, often occasion spasmodic pain in the stomach and bowels. For children larger doses are generally required in proportion than for adults. Not less than from two to three grains (0.13 to 0.20 Gm.) should be given as a purge to a child two or three years old, and this quantity often fails to act, unless assisted by castor oil or some other cathartic. Calomel may be given in pill made with gum arabic and syrup, or in powder mixed with syrup or molasses.

Off. Prep.—Lotio Hydrargyri Nigra, *Br.;* Pilulæ Catharticæ Compositæ, *U. S.;* Pilula Hydrargyri Subchloridi Composita, *Br.;* Unguentum Hydrargyri Subchloridi, *Br.*

[1] G. Vulpius has investigated the conditions which favor the formation of corrosive sublimate in calomel mixtures, and reaches the following conclusions:

1. No sublimate forms in the course of twenty-four hours in mixtures of calomel with white sugar, milk sugar, magnesia, magnesium carbonate, and sodium bicarbonate.
2. No such formation takes place in three months in mixtures of calomel with magnesia, magnesium carbonate, and sugar.
3. Minute traces of corrosive sublimate are found at the expiration of the same time in a mixture of calomel, sodium bicarbonate, and sugar of milk.
4. A large quantity of corrosive sublimate forms in the same time in a mixture of calomel, sodium bicarbonate, and cane sugar.
5. Calomel powders containing magnesia or sodium bicarbonate alone will contain corrosive sublimate if digested with water.
6. The formation of corrosive sublimate in mixtures of calomel and alkalies digested in water for a short time is not favored, but, on the contrary, prevented, by the presence of hydrochloric acid in the water, the acid neutralizing, to a certain extent, the alkalies which cause the formation. (*A. J. P.,* July, 1879.)

HYDRARGYRI IODIDUM FLAVUM. U. S.

YELLOW MERCUROUS IODIDE [Green Iodide of Mercury, Mercurous Iodide, Protiodide of Mercury, Yellow Iodide of Mercury]

(hȳ-drär′gy-rī ī-ōd′ī-dŭm flā′vŭm)

$HgI = 324.40$

"It should contain not less than 99.5 percent. of pure Mercurous Iodide." *U. S.*

Hydrargyri Iodidum Viride, U. S. P. 1880; Hydrargyri Iodidum, U. S. P. 1850; Iodide of Mercury, Yellow Iodide of Mercury, Hydrargyrum Iodatum Flavum, Hydrargyri Proto-ioduretum, Ioduretum Hydrargyrosum; Protiodure de Mercure, Iodure mercureux. *Fr. Cod.;* Hydrargyri bijodatum, *P. G.;* Quecksilberjodid, Gelbes Jodquecksilber, *G.;* Protojoduro di mercurio, *It.;* Yoduro mercurioso, *Sp.*

* "Mercury, *fifty grammes* [or 1 ounce av., 334 grains]; Nitric Acid, Potassium Iodide, Distilled Water, each, *a sufficient quantity*. Mix *twenty cubic centimeters* [or 325 minims], each, of Nitric Acid and Distilled Water, and, when the liquid is cold, pour it upon the Mercury contained in a glass beaker. Set the mixture aside in a dark place, and keep it at a temperature between 25° and 30° C. (77° and 86° F.), with occasional agitation, until the reaction ceases and a little mercury still remains undissolved. Separate the crystals of mercurous nitrate, which will have formed, from the mother-liquid, allow them to drain in a glass funnel, and dry them on bibulous paper, in a dark place. When the salt is dry dissolve *forty grammes* [or 1 ounce av., 180 grains] of it in *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Distilled Water to which *six cubic centimeters* [or 97 minims] of Nitric Acid have previously been added. Having prepared a solution of *sixteen grammes* [or 247 grains] of Potassium Iodide in *thirty-two cubic centimeters* [or 1 fluidounce, 39 minims] of Distilled Water, slowly pour the solution of Potassium Iodide into the solution of Mercurous Nitrate, with constant stirring, which should be continued for fifteen minutes, allow the precipitate to subside, decant the supernatant liquid, and wash the precipitate by decantation with ten successive portions of *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] each of Distilled Water. Finally, transfer the precipitate to a filter, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 40° C. (104° F.), and keep it in dark amber-colored vials, with the least possible exposure to light. Instead of weighing off *forty grammes* [or 1 ounce av., 180 grains] of the Mercurous Nitrate as above directed, the whole of the crystallized salt may be taken and the amount of Potassium Iodide, etc., adjusted to the proportions given above." *U. S.*

The Br. Pharm. dropped this salt at its 1885 revision, and did not restore it in 1898, and the omission has been rather severely criticised.

The process of the U. S. P. (8th Rev.) for this salt differs from that official in 1880 [1] for green iodide of mercury; it is essentially the process recommended by Edward Soetje (*Proc. A. Ph. A.*, 1888, p. 167), the product is the result of double decomposition between mercurous nitrate and potassium iodide, in solution, *yellow* mercurous iodide and potassium nitrate being formed. This method of making mercurous iodide has long been known, but the disadvantage heretofore has been that some mercuric iodide was formed, which contaminated the product; the thorough washing by ten successive portions of distilled water should remove all traces of this impurity. Several other methods of making mercurous iodide have been proposed. Roland Seeger suggests double decomposition between mercurous acetate and potassium iodide. (*A. J. P.*, 1859, p. 204.) Boutigny proposes to decompose calomel by potassium iodide, and gives the following formula. Twenty-nine drachms of calomel are mixed with twenty drachms of pulverized potassium iodide in a glass mortar, and twelve ounces of boiling distilled water poured upon the mixture. After cooling the liquid is decanted, and the precipitate washed on a filter with distilled water, and dried in the shade. (See *A. J. P.*, viii. 326.) This process was not successful with Charles Bullock, when he used the reacting ingredients in quantities six times those recommended by Boutigny. John Canavan of New York, ascribes the failure to insufficient trituration, which, to insure complete reaction, must be long continued. If the reaction be imperfect, the water washes away not only potassium chloride, but also potassium iodide, holding in solution a part of mercurous iodide formed, which is ultimately decomposed into mercuric iodide and metallic mercury. The experiments of Maisch tend to confirm this view. He further found that a boiling temperature enables potassium chloride to decompose the mercurous iodide perceptibly, and infers that the use of cold water would give a purer product. He therefore concludes that the process of Boutigny cannot be depended upon for giving a pure mercurous iodide.

P. Yvon has prepared mercurous iodide by subliming iodine with an excess of mercury, and subsequently washing it with diluted nitric acid. (*J. P. C.*, 4e sér., xviii. p. 167.) George A. Haffa precipitated a solution of mercurous nitrate with potassium iodide, and obtained mercurous iodide of a yellow or green color according to the density of the solution. The solution of mercurous nitrate is prepared by acting upon 15,000 gr. of mercury with a cold mixture of nitric acid (6000 gr.) and water (4000 gr.), placing the vessel in cold water, and stirring the contents constantly until the reaction has entirely ceased; the white crystalline mass, without being separated from

[1] *Hydrargyri Iodidum Viride*, U. S. 1880.—"Mercury, *eight parts* [or one ounce av.]; Iodine, *five parts* [or two hundred and seventy-four grains]; Alcohol, *a sufficient quantity*. Pour about *three parts* [or half a fluidounce] of Alcohol into a mortar containing the Mercury, add the Iodine in several successive portions, and triturate the mixture, adding sufficient Alcohol from time to time to keep the mass constantly moist, and taking care that it shall neither become too hot, nor be exposed to light during the various steps of the process. Continue the trituration until all globules of Mercury have disappeared and the mixture has become nearly dry and has acquired a greenish-yellow color. Then add sufficient Alcohol to reduce the whole to a thin paste, pour this into a bottle, let it stand for several days, and then wash the Iodide twice with about *fifty parts* [or half a pint] of Alcohol each time, and decant the washings. Transfer the Iodide to a filter and continue washing with Alcohol until the washings are no longer affected by hydrosulphuric acid. Lastly, dry the product in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles, protected from light." *U. S.* 1880. This process for forming the mercurous iodide is a case of simple combination, the alcohol facilitating the union by dissolving the iodine.

the excess of metallic mercury, is then dissolved in water acidulated with nitric acid (1 oz. to the gallon) until the solution measures four pints. For preparing *green mercurous iodide*, six ounces of a solution of mercurous nitrate are mixed with six pints of water, and there is added in a continuous stream, and with constant stirring, a solution of potassium iodide (3 oz. in 54 oz. of water); the precipitate is washed with water, and dried without the aid of heat. *Yellow mercurous iodide* is prepared in the same manner, except that two ounces of solution of mercurous nitrate diluted with water (8 pints) are used with a solution of potassium iodide (1 oz. in 4 pints of water). This salt darkens much more quickly when exposed to the light than that made by the U. S. P. 1880 process. (*A. J. P.*, 1886.) Stomen practically confirms these results. (*Ber. d. Chem. Ges.*, 1887; see also *Ph. Era*, 1888.) From experiments by C. H. Wood, it appears that the green iodide is a mixture of yellow iodide and metallic mercury. By continuing the trituration, the powders become more and more yellow, and at length have only a tinge of green. He infers that pure mercurous iodide is yellow, and that the green color is owing to an admixture of the blue of the mercury with the yellow of the mercurous iodide.[1] (*P. J.*, 1868.) Flückiger (*Pharmaceutische Chemie*, 2d ed., 1888) agrees with this view, and says that by slow sublimation, at a very gentle heat, the true mercurous iodide can be obtained in small transparent yellow crystals of the quadratic system which are related to the forms of calomel. (See *J. P. C.*, 1894, 67.) Francois' process is essentially the result of the reducing action of aldehyde on iodomercurammonium iodide. (*J. P. C.*, 1894, 67.)

Properties.—It is officially described as "a bright yellow, amorphous powder, odorless and tasteless. By exposure to light it becomes darker, in proportion as it undergoes decomposition into metallic mercury and mercuric iodide. Almost insoluble in water, and wholly insoluble in alcohol or ether. When slowly and moderately heated, it assumes at first an orange and then a red color, becoming yellow again on cooling. When quickly and strongly heated, it is at first partially decomposed into mercury and mercuric iodide, and finally is volatilized, leaving not more than 0.05 percent. of residue. When Mercurous Iodide is heated with sulphuric acid and a little manganese dioxide, vapor of iodine is evolved. In contact with a solution of potassium iodide, the salt is decomposed into mercuric iodide, which dissolves, and metallic mercury, which remains undissolved. If 0.5 Gm. of the salt be shaken with 10 Cc. of alcohol and the mixture allowed to stand and then filtered, a portion of the perfectly clear filtrate should be scarcely affected by hydrogen sulphide T.S., nor should it produce more than a very faint, transient opalescence when dropped into water; and if 5 Cc. of the filtrate be evaporated on a white porcelain surface, not more than a very faint, red stain should remain (absence of more than traces of *mercuric iodide*)." *U. S.* Its sp. gr. is 7.75. If quickly and cautiously heated, it sublimes in red crystals, which afterwards become yellow. "Gradually heated in a test-tube, it yields a yellow sublimate, which, upon friction, or after cooling, becomes red, while globules of metallic mercury are left in the bottom of the tube." *Br.* 1867. It is sometimes considered to be composed of two atoms of mercury united with two atoms of iodine, Hg_2I_2, $397 + 251.8 = 648.8$, although most chemists and the present U. S. P. make its formula HgI, consisting of one atom of mercury 198.50, and one of iodine $125.9 = 324.40$. (See *Chem. News*, 1896, 12, 95, 306.)

Uses.—Mercurous iodide is used in advanced *syphilis*. The dose is one-fifth of a grain (0.012 Gm.), gradually increased to two grains (0.13 Gm.). It should never be given at the same time with potassium iodide, which converts it into mercuric iodide and metallic mercury.

Dose, one-fifth of a grain (0.012 Gm.).

HYDRARGYRI IODIDUM RUBRUM.

U. S., Br.

RED MERCURIC IODIDE [Biniodide of Mercury, Mercuric Iodide, Red Iodide of Mercury]

(hȳ-drär′gy-rī ī-ŏd′ī-dŭm rū′brŭm)

$HgI_2 = 450.30$

"It should contain not less than 99.5 percent. of pure Mercuric Iodide." *U. S.* "Precipitated Mercuric Iodide, HgI_2, formed by the interaction of mercuric chloride and potassium iodide." *Br.*

Mercurius Iodatus Ruber, Deutoioduretum Hydrargyri, Hydrargyrum Iodatum Rubrum, Ioduretum Hydrargyricum; Deutoiodide of Mercury; Iodure mercurique, *Fr. Cod.*; Deuto-iodure (Bi-iodure) de Mercure, *Fr.*; Hydrargyrum Bijodatum, *P. G.*; Quecksilberjodid, Rothes Jodquecksilber, *G.*; Bijoduro di mercurio, *It.*; Yoduro mercurico, *Sp.*

* "Corrosive Mercuric Chloride, *forty grammes* [or 1 ounce av., 180 grains]; Potassium Iodide, *fifty grammes* [or 1 ounce av., 334 grains]; Distilled Water, *a sufficient quantity*. Dissolve the Corrosive Mercuric Chloride and the Potassium Iodide, each, in *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Distilled Water, and filter the solutions separately. Pour both solutions, simultaneously and in a thin stream, with constant and very active stirring, into *two thousand*

[1] Patrouillard recommends Dublanc's process, which consists in triturating together a mixture of mercuric (red) iodide and of metallic mercury, in the following proportions: mercuric iodide 227 parts; mercury 100 parts. The mercuric iodide may easily be obtained of absolute purity and in a state of perfect dryness; besides, during the trituration there is no risk of loss by volatilization. The mixture should merely be moistened with alcohol of eighty per cent., so as to form a thin paste, and well triturated; the reaction takes place in a very short time, and the product is of a dark greenish-yellow color. By way of precaution, it should be washed with boiling alcohol. (*Rép. de Pharm.*, 1877, 549; *N. R.*, Nov. 1877.)

cubic centimeters [or 67 fluidounces, 5 fluidrachms] of Distilled Water. When the precipitate has subsided, decant the supernatant liquid, collect the precipitate on a filter, and wash it with cold Distilled Water, until the washings give not more than a slight opalescence with silver nitrate test solution. Finally, dry it in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.), and keep it in well-stoppered bottles, protected from light." *U. S.*

In the above process for forming mercuric iodide a double decomposition takes place between corrosive sublimate and potassium iodide, resulting in the formation of potassium chloride which remains in solution, and mercuric iodide which precipitates. The precipitate is soluble in the reacting salts, and hence a loss of part of it is incurred by an excess of either. It is best, however, to have a slight excess of the potassium iodide, which is furnished by the proportion taken in the formula, as then decomposition of the whole of the corrosive sublimate is insured, and any contamination of the mercuric iodide by it prevented; loss by solution in the supernatant liquid is largely obviated by the improvement which was first introduced in the U. S. P. 1890, whereby separate solutions are poured simultaneously into a large volume of water. The process of the Edinburgh College consisted in a combination of the ingredients by trituration in due proportion with the aid of alcohol; but after the red powder was obtained it was treated with a boiling solution of sodium chloride, which dissolved the mercuric iodide to the exclusion of any contaminating mercurous iodide, and the solution thus obtained, on cooling, deposited the pure mercuric salt in crystals. F. R. Williams states that in the manufacture of the red iodide on a large scale the amount of water required by the official processes is very troublesome. He remedies it by using ammonium chloride, so as to get a very concentrated solution of corrosive sublimate, which he adds to a concentrated solution of the iodide. The addition of the ammonium chloride does not interfere with the reaction, but is of material service in assisting in the solution of the corrosive sublimate. (*P. J.*, June, 1873.)

Chas. L. Mitchell has improved upon the process of Williams; see foot-note.[1]

Properties.—As obtained by the late Edinburgh process, it is in splendid crimson acicular crystals. Köhler has found, however, that it crystallizes better from boiling hydrochloric acid. (*Ber. d. Chem. Ges.*, 1879, p. 608.) It also crystallizes well from hot saturated solutions in acetone, glacial acetic acid, absolute alcohol, amyl alcohol, and nitric acid of 1.2 sp. gr., see also *Chem. News*, 1900, 24. When heated the mass becomes yellow at about 150° C. (302° F.), melting at 254° C. (489.2° F.) to a dark yellow liquid, and sublimes at 349° C. in yellow rhombic scales, which become red on cooling. Mercuric iodide is a dimorphous substance, having a different crystalline form in its red and yellow states. According to Schiff, it is only in its yellow form that it is soluble in alcohol; hence it is that, when separated by water from its alcoholic solution, it falls in this condition. (*Ann. Ch. Ph.*, cix. 371.) It forms definite compounds with the iodides of the alkali metals. The compound formed with potassium iodide has been used as a medicine. (See *Potassium Iodohydrargyrate*, in PART II.) "When digested with solution of soda it assumes a reddish-brown color, and the fluid, cleared by filtration and mixed with solution of starch, gives a blue precipitate on being acidulated with nitric acid," showing that it is an iodide. Mercuric iodide consists of one atom of mercury 198.5, and two atoms of iodine 251.80 = 450.30, and its formula is HgI_2. It combines with mercurous iodide, so as to form a yellow *sesqui-iodide*, represented by the formula $HgI + HgI_2$, or Hg_2I_3.

"A scarlet-red, amorphous powder, odorless and tasteless; permanent in the air. Almost insoluble in water; soluble in 116 parts of alcohol, 85 parts of ether, and 1340 parts of chloroform at 25° C. (77° F.); soluble in 15 parts of boiling alcohol; also soluble in solutions of the soluble iodides, mercuric chloride, sodium thiosulphate, and hot solutions of the alkali chlorides. When heated to about 150° C. (302° F.), the salt becomes yellow, but again assumes a red color on cooling; at 253° C. (487.4° F.) it fuses to a dark yellow liquid, which, on cooling, forms a yellow, crystalline mass, and at higher temperatures is finally volatilized, leaving no appreciable residue. On heating the salt with potassium hydroxide T.S., and adding a little sugar of milk, metallic mercury is precipitated. A saturated solution of Mercuric Iodide in hot alcohol should, after cooling, be colorless; and when diluted with an equal volume of water, the solution should not redden blue litmus paper (absence of *mercuric chloride*). If about 0.5 Gm. of Mercuric Iodide be thoroughly agitated with 10 Cc. of distilled water, the filtered liquid should not become more than slightly colored by hydrogen sulphide T.S., nor give more than a slight opalescence with silver nitrate T.S. (limit of soluble *chlorides* or *iodides*)." *U. S.* "A crystalline powder of a vermilion color, becoming yellow when a film of it spread on a sheet of paper is gently heated over a lamp. It is almost insoluble in *water*, dissolves sparingly

[1] *Hydrargyri Iodidum Rubrum, Mitchell's Process.* Mercury, 1000 gr.; Nitric Acid, 1700 gr.; Potassium Iodide, 1662 gr. or q. s.; Distilled Water, q. s. (Instead of the mercury and nitric acid, 2500 gr. of solution of mercuric nitrate can be used.) Dissolve the mercury in the nitric acid by the aid of a little heat (in large quantities this is not necessary, as the reaction between the acid and the mercury generates sufficient heat), and dilute with an equal bulk of water. Then add the potassium iodide, dissolved in eight fluidounces of water, until no further precipitation ensues, being careful towards the last to add the solution very gradually, so as to avoid dissolving the mercuric iodide in an excess of the liquid. Collect the precipitate on a filter, wash well with distilled water, drain and dry. (*A. J. P.*, 1876, 116.)

in *alcohol* (90 per cent.), but freely and entirely in *ether* (absence of mercurous iodide), or in *solution of potassium iodide.* It affords the reactions characteristic of mercuric compounds and of iodides. It volatilizes at a temperature under redness, leaving not more than a trace of fixed matter. When heated with excess of *copper* it should yield 43.5 to 44 per cent. of metallic mercury." *Br.*

Uses.—Mercuric iodide is a powerful irritant poison. It has been used in similar diseases with the mercurous iodide, namely, in *scrofula* and *syphilis,* but is much more active. It is especially valuable in old, obstinate cases of syphilis, as in syphilitic rheumatic pains and diseases of the bones, thickening of the dura mater, etc. There seems to be in these cases no practical difference between its action and that of corrosive sublimate, although sometimes it is better borne by the stomach than is the latter preparation. The dose is one-twentieth of a grain (0.003 Gm.), gradually increased to one-fourth of a grain (0.016 Gm.), given in pill. It is sometimes administered in water with potassium iodide so as to make a solution of potassio-mercuric iodide.[1] Cazenave considers mercuric iodide to be the best topical application in *lupus.* He applies it in thin layers, every six or eight days, to small portions of the ulcerated surface at a time, in the form of a caustic ointment, made of equal parts of the iodide, oil, and lard. The application produces severe pain, and gives rise to a sharp inflammation, which soon terminates, leaving the ulcer in an improved condition, with a tendency to cicatrize smoothly and on a level with the surrounding skin. A solution of mercuric iodide in olive oil (1 in 5000), which is to be prescribed as an external application, has been prepared by Delacour. (See *J. P. C.,* 1903, 603; 1904, No. 2.)

Dose, one-twentieth of a grain (0.003 Gm.).

Off. Prep.—Liquor Arseni et Hydrargyri Iodidi, *U. S.* (*Br.*); Unguentum Hydrargyri Iodidi Rubri, *Br.*

HYDRARGYRI OXIDUM FLAVUM.
U. S., Br.

YELLOW MERCURIC OXIDE

(hȳ-drär'ǧy-rī ŏx'ĭ-dŭm flā'vŭm)

HgO = 214.38

"It should contain not less than 99.5 per cent. of pure Yellow Mercuric Oxide." *U. S.*

"Precipitated Mercuric Oxide, HgO, obtained by the interaction of mercuric chloride and sodium hydroxide." *Br.*

Yellow Oxide of Mercury; Hydrargyrum Oxidatum Flavum vel Præcipitatum; Precipitated Oxide of Mercury, Mercuric Oxide; Oxyde Mercurique jaune, *Fr. Cod.;* Oxide de Mercure jaune ou précipité, *Fr.;* Hydrargyrum oxydatum via humida paratum, *P. G.;* Praecipitirtes (Gelbes) Quecksilberoxyd, *G.;* Ossido mercurico giallo, *It.;* Oxido mercurico amarillo, *Sp.*

* "Corrosive Mercuric Chloride, *one hundred grammes* [or 3 ounces av., 231 grains]; Sodium Hydroxide, *forty grammes* [or 1 ounce av., 180 grains]; Distilled Water, *a sufficient quantity.* Dissolve the Corrosive Mercuric Chloride in *one thousand cubic centimeters* [or 33 fluidounces 6½ fluidrachms] of warm Distilled Water, and filter the solution. Dissolve the Sodium Hydroxide (which should contain at least 90 percent. of pure, anhydrous sodium hydroxide) in *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of cold Distilled Water, and into this solution pour gradually, and with constant stirring, the solution of Corrosive Mercuric Chloride. Allow the mixture to stand for an hour at a temperature of about 30° C. (86° F.), stirring frequently. Then decant the supernatant, clear liquid from the precipitate, and wash the latter repeatedly by the addition and decantation of portions of Distilled Water, using *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water each time. Collect the precipitate on a strainer, and continue the washing with warm Distilled Water, until a small portion of the washings, when poured on a little mercuric chloride test solution, no longer produces a yellowish turbidity at the line of contact of the two liquids. Then allow the precipitate to drain, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.), and keep it in well-stoppered bottles, protected from light." *U. S.*

The process adopted for this preparation is that of Hoffmann. The United States Pharmacopœia directs the alkaline solution in excess, and the addition of the corrosive sublimate to the alkali. Both these points are important, for if the corrosive sublimate be in excess, brown oxychloride will be formed towards the last of the decomposition, and when the alkali is added to the solution of corrosive sublimate, the same compound will be formed from the first, and is with difficulty decomposed by an excess of alkali. The solution of sodium hydroxide should be as free as possible from carbonate, to prevent the formation of brown mercuric carbonate. The mercuric chloride is precipitated by the sodium hydroxide, sodium chloride being left in solution. The object of the subsequent washing is to remove the sodium chloride and the excess of the alkali.[1]

[1] *Sirop Gibert. Gibert's Syrup.*—A syrup has been largely used in the French hospitals and in this country which has received this name. It is made by dissolving *three grains of mercuric iodide* and *one hundred and two grains* of *potassium iodide* in *three fluidrachms* of water, filtering, and adding sufficient simple syrup to make *ten fluidounces.* Each tablespoonful contains about one-seventh of a grain of mercuric iodide and five grains of potassium iodide.

[1] Charles L. Mitchell proposes an improvement on the official process, which avoids the use of large vessels when it is made on a large scale. He takes of solution of mercuric nitrate (prepared by dis-

The process was improved in the 1890 revision (and the improvement retained in the 8th Rev.) through the use of a freshly made solution of sodium hydroxide; the official "solution of potassa" used in the U. S. P. 1880 process invariably contained potassium carbonate, except when it was freshly made, and the presence of carbonate gave the mercuric oxide a reddish-brown tint which was very objectionable.

Properties.—The official mercuric oxide is of a yellow color similar to that of the yolk of egg, and is a completely amorphous powder, exhibiting no evidence of crystalline particles even under the microscope. Yellow mercuric oxide differs from the red only by being amorphous and in a much more minute state of division, the red oxide by trituration acquiring an orange and finally a yellow color. In consequence of its different state of aggregation, it is much more quickly acted on by reagents than is the red oxide. Thus, oxalic acid, which acts on the red oxide only with the aid of heat, immediately combines with the yellow oxide at ordinary temperatures, producing the white oxalate, and while the latter oxide, in contact with chlorine, gives up oxygen to that element, forming hypochlorous acid and corrosive sublimate, the former exercises scarcely any influence on the gas at common temperatures. It is described in the U. S. Pharmacopœia as "a light orange-yellow, amorphous, heavy, impalpable powder; odorless, and having a somewhat metallic taste; permanent in the air, but turning darker on exposure to light. Almost insoluble in water, insoluble in alcohol, but readily and completely soluble in diluted hydrochloric or nitric acid, forming colorless solutions. When moderately heated, Yellow Mercuric Oxide assumes a red color. At a red heat it is completely decomposed into oxygen and metallic mercury, and is finally volatilized, leaving not more than 0.1 percent. of residue. When moistened with hot water, Yellow Mercuric Oxide should not turn red litmus paper blue. If 0.5 Gm. of Yellow Mercuric Oxide be digested on a water-bath, for fifteen minutes, with a solution of 1 Gm. of oxalic acid in 10 Cc. of water, it will be converted into white mercuric oxalate (distinction from *red mercuric oxide*). On dissolving 0.1 Gm. of the Oxide in 10 Cc. of diluted nitric acid, the resulting solution should be clear, and should not afford more than a slight opalescence with silver nitrate T.S. (limit of *chlorides*). The solution of 0.5 Gm. of the Oxide in a mixture of 2 Cc. of hydrochloric acid and 25 Cc. of water, should not respond to the tests for *foreign salts, metals,* or *arsenic,* as described under *Hydrargyri Chloridum Mite.*"

solving mercury in an excess of nitric acid), any convenient quantity; solution of sodium hydroxide, U. S. P., a sufficient quantity. The solution of mercuric nitrate is diluted with an equal bulk of water, and added to the solution of sodium hydroxide; the latter should be in slight excess. The yellow precipitate is collected, washed well, and dried.

U. S. "A yellow powder yielding nothing to *water,* but being readily dissolved by *hydrochloric acid,* the solution affording the reactions characteristic of mercuric salts. Gently heated it assumes a red color. Heated to incipient redness it is resolved into oxygen and the vapor of mercury, leaving only an insignificant amount of fixed residue; the proportion of metallic mercury obtained being 92 to 92.5 per cent." *Br.* I. Comere explains in a paper in *Répert. de Pharm.,* 1881, 199, the various conditions and modifications in the process necessary to make the oxide vary in color. (*N. R.,* 1882, 149.)

Uses.—The attention which has been recently paid to the yellow oxide is owing to its peculiar applicability to the local treatment of diseases of the eye, in consequence of its amorphous character. B. Squire of England, was the first to notice publicly this use of the oxide (*P. J.,* 2d ser., vi. 512). At present the yellow oxide is very largely used by oculists throughout the world. The red oxide, however carefully it may be triturated, even though in a perfectly impalpable state, still shows under the microscope crystalline particles, which in contact with the conjunctiva cause more or less irritation; it can, therefore, be readily understood that, in the ordinary mode of preparing it for use as an ointment, it may sometimes be productive of serious annoyance. From this objection the yellow oxide is exempt.

Off. Prep.—Oleatum Hydrargyri, *U. S.;* Unguentum Hydrargyri Oxidi Flavi, *U. S., Br.*

HYDRARGYRI OXIDUM RUBRUM.
U. S., Br.

RED MERCURIC OXIDE [Red Precipitate]

(hȳ-drär′ǧy-rī ŏx′ĭ-dŭm rū′brŭm)

$HgO = 214.38$

"It should contain not less than 99.5 percent. of pure Red Mercuric Oxide, and should be kept in well-stoppered bottles, protected from light." *U. S.* "Red Mercuric Oxide, HgO, is obtained by heating mercurous nitrate until acid vapors cease to be evolved." *Br.*

Peroxide of Mercury, Red Oxide of Mercury; Hydrargyri Nitrico-oxydum, Mercurius Corrosivus Ruber vel Præcipitatus, Oxydum Hydrargyricum; Oxyde mercurique rouge, *Fr. Cod.;* Deutoxyde ou Péroxyde de Mercure, Précipité rouge, Poudre de Jean de Vigo, *Fr.;* Hydrargyrum Oxydatum, *P. G.;* Quecksilberoxyd, Rother Praecipitat, Quecksilber Præcipitat, Rothes Quecksilberoxyd, *G.;* Ossido mercurico rosso, *It.;* Oxido mercurico rojo, *Sp.*

Neither Pharmacopœia gives at present an official process for this oxide. For former processes, see below.[1]

[1] "Take of Mercury *thirty-six troyounces;* Nitric Acid *twenty-four troyounces;* Water *two pints.* Dissolve the Mercury, with the aid of a gentle heat, in the Acid and Water previously mixed, and evaporate to dryness. Rub the dry mass into powder, and heat it in a very shallow vessel until red vapors cease to rise." *U. S.* 1870. "Take of Mercury, by weight, *eight ounces* [avoirdupois]; Nitric Acid *four*

The preparation is still frequently called by its older name, *red precipitate.* The name of *red mercuric oxide* is appropriate, as mercuric nitrate exists in it merely as an accidental impurity, and there is no occasion to distinguish the preparation from the oxide obtained by calcining mercury, the latter not being official, and perhaps never employed.

In the preparation of this mercurial, various circumstances influence the nature of the product, and must be attended to, if it is desired to procure the oxide with that fine bright orange-red color, and shining scaly appearance, usually considered desirable. Among these circumstances is the condition of the mercuric nitrate submitted to calcination. According to Gay-Lussac, it should be employed in the form of small crystalline grains. If previously pulverized, as directed in some of the official processes, it will yield an orange-yellow powder; if it be in the state of large and dense crystals, the oxide will have a deep orange color. Care must be taken that the mercury and acid be free from impurities. It is highly important that sufficient nitric acid be employed fully to saturate the mercury. According to R. Dufass a mercuric oxide which combines the good properties of both red and yellow oxides, without any of their disadvantages, is obtained as follows: 125 Gm. of potassium carbonate and 500 Gm. of water are heated to boiling, and a solution of 100 Gm. of mercuric chloride in 1875 Gm. of water is slowly added under continued boiling. The resultant precipitate, after washing and drying, is obtained as an orange-yellow crystalline powder. (*Süddeut. Apoth. Ztg.,* 1902, 836.) Payssé, who paid great attention to the manufacture of red precipitate, recommended 70 parts of nitric acid from 34° to 38° Baumé, to 50 parts of mercury. This, however, is an excess of acid. We have been told by a skilful practical chemist of Philadelphia that he has found, by repeated experiment, 7 parts of nitric acid of 35° Baumé to be sufficient fully to saturate 6 parts of mercury. Less will not answer, and more will be useless. It is not necessary that the salt should be removed from the vessel in which it is formed; it is even asserted that the product is always more beautiful when the calcination is performed in the same vessel. A glass flask may be used with a large flat bottom, so that an extended surface may be exposed and all parts heated equally. The metal and acid having been introduced, the flask should be placed in a sand bath, and covered with sand up to the neck. The solution of the mercury should be favored by a gentle heat, which should afterwards be gradually increased till red vapors appear, then maintained as equably as possible until these vapors cease and at last slightly elevated until oxygen gas begins to escape. This may be known by the increased brilliancy with which a taper will burn if placed in the mouth of the flask, or by its rekindling if partially extinguished. Too high a temperature must be carefully avoided, as it decomposes the oxide and volatilizes the mercury. At the close of the operation, the mouth of the vessel should be stopped, and the heat gradually diminished, the flask being still allowed to remain in the sand bath. These last precautions are said to be essential to the fine red color of the preparation. It is best to operate upon a large quantity of materials, as the heat may be thus more uniformly maintained. The former direction of the Br. Ph., to rub a portion of mercury with the nitrate before decomposing it, renders the process more economical, as the nitric acid, which would otherwise be dissipated, is thus employed in oxidizing an additional quantity of the metal. As the process is ordinarily conducted in laboratories, the mercuric nitrate is decomposed in shallow earthen vessels, several of which are placed upon a bed of sand, in the chamber of an oven or furnace, provided with a flue for the escape of the vapors. Each vessel may conveniently contain ten pounds of the nitrate. There is always loss in the operation thus conducted.[1] Egeling states that this oxide can be prepared by precipitation so that the resulting product cannot be distinguished from that made by ignition. Into a boiling solution of mercuric chloride (1 : 5) a boiling concentrated solution of potassium hydroxide is poured, until the dark brown color of the oxychloride is changed to a bright red, and the liquid reacts faintly alkaline; this is poured into 20 volumes of boiling water, and the precipitate collected, washed and drained. (*Ph. Ztg.,* 92, 517.)

Properties.—Red precipitate, well prepared, has a brilliant red color, with a shade of orange, a shining scaly appearance, and an acrid taste. It is very slightly soluble in water, of which Barker found 1000 parts to take up 0.62 of the oxide. Christison found 1 part of the oxide to be dissolved by about 7000 parts of boiling water, and the solution to give a black

fluidounces and a half [Imperial measure]; Water *two fluidounces* [Imp. meas.]. Dissolve half the Mercury in the Nitric Acid diluted with the Water, evaporate the solution to dryness, and with the dry salt thus obtained, triturate the remainder of the Mercury until the two are uniformly blended together. Heat the mixture in a porcelain dish, with repeated stirring, until acid vapors cease to be evolved." *Br.* 1885.

In this process the mercury is dissolved by the nitric acid, forming either mercuric nitrate, or a mixture of this with mercurous nitrate. The resulting mass when exposed to a strong heat is decomposed, giving out red nitrous fumes, and assuming successively a yellow, an orange, and a brilliant purple-red color, which becomes orange-red on cooling. These changes are owing to the gradual separation and decomposition of the nitric acid, by the oxygen of which the mercurous oxide, if any be present, is converted into mercuric oxide, while nitrogen dioxide gas escapes, and becomes nitrogen tetroxide on contact with the air. The mercuric oxide is left behind, but in general not quite free from the nitrate, which cannot be wholly decomposed by heat without endangering the decomposition of the oxide itself, and the volatilization of the metal.

[1] For a process for *Hydrargyrum præcipitatum per se, precipitate per se,* or *calcined mercury,* all practically identical with red mercuric oxide, see U. S. D., 17th ed., 704.

precipitate with hydrogen sulphide. Tannic acid precipitates metallic mercury from an aqueous solution of the oxide, especially when heated. (Bullock, *Proc. A. Ph. A.*, 1858, p. 306.) It is insoluble in cold alcohol and ether. (*Ibid.*) Nitric and hydrochloric acids dissolve it without effervescence. "Heavy, orange-red, crystalline scales, or a crystalline powder, becoming more yellow the finer it is divided; odorless, and having a somewhat metallic taste; permanent in the air. Almost insoluble in water, insoluble in alcohol, but readily and completely soluble in diluted hydrochloric or nitric acid, forming colorless solutions. When heated to about 400° C. (752° F.), Red Mercuric Oxide becomes dark violet or almost black, but assumes its original color on cooling. At a red heat it is completely decomposed into oxygen and metallic mercury, and is finally volatilized, leaving no appreciable residue. If 0.5 Gm. be digested on a water-bath with a solution of 1 Gm. of oxalic acid in 10 Cc. of water, it will not change color within two hours (distinction from *yellow mercuric oxide*). If 1 Gm. of Red Mercuric Oxide be mixed with 5 Cc. of water, and 2 Cc. of sulphuric acid added, the mixture cooled, and 2 Cc. of ferrous sulphate T.S. be carefully poured upon it, no brown zone should be developed at the line of contact upon standing (absence of *nitrate*). On dissolving 0.1 Gm. of the Oxide in 10 Cc. of diluted nitric acid, the resulting solution should be clear, and should not produce more than a slight opalescence with silver nitrate T.S. (limit of *chlorides*). The solution of 0.5 Gm. of the Oxide in a mixture of 2 Cc. of hydrochloric acid and 25 Cc. of water, should not respond to the tests for *foreign salts, metals,* or *arsenic,* as described under *Hydrargyri Chloridum Mite.*" *U. S.* "Orange-red crystalline scales or powder answering to the tests given under 'Hydrargyri Oxidum Flavum.' When gently heated it becomes dark violet, but resumes its orange-red color on cooling. When heated in a dry test-tube it should not evolve orange fumes (absence of nitrates)." *Br.* It is essentially mercuric oxide, consisting of one atom of the metal 198.5, and one of oxygen 15.88 = 214.38; but in its ordinary state it always contains a minute proportion of nitric acid, probably in the state of subnitrate. According to Brande, when rubbed and washed first with a solution of potassium hydroxide, and then with distilled water, and carefully dried, it may be regarded as nearly pure mercuric oxide. It is said to be sometimes adulterated with brickdust, red lead, etc., but these may be readily detected, as mercuric oxide is wholly dissipated if thrown upon red hot iron. The disengagement of red vapors when it is heated indicates the presence of mercuric nitrate.

Uses.—This preparation is too harsh and irregular in its operation for internal use, but is still employed externally as a stimulant and escharotic in the state either of powder or of ointment, although to a great extent supplanted by the yellow oxide. The powder is sprinkled on the surface of *chancres,* and *indolent, flabby,* or *fungous ulcers.* The powder should be finely levigated.[1]

Off. Prep.—Liquor Hydrargyri Nitratis, *U. S.;* Unguentum Hydrargyri Oxidi Rubri, *U. S., Br.*

HYDRARGYRUM. U. S., Br.

MERCURY [Quicksilver]

(hȳ-drär′gy-rŭm)

Hg = 198.50

"It should contain not less than 99.9 per cent. of pure metallic Mercury, and should be kept in strong, well-stoppered bottles." *U. S.* "A metal obtained from native mercuric sulphide." *Br.*

Hydrargyrum Vivum, Mercurius Vivus, Argentum Vivum; Mercure Purifié, *Fr. Cod.;* Vif Argent, *Fr.;* Hydrargyrum, *P. G.;* Quecksilber, *G.;* Mercurio, *It., Sp.*

Mercury is found pure, forming an amalgam with silver, in the form of chloride (native calomel), but most abundantly as the sulphide or native cinnabar. Mines of this metal are found at Almaden in Spain, at Idria in Carniola, in the former duchy of Deux-Ponts, in Belluno, a province of Venetia, in Corsica, in the Philippine Islands and China, near Huancavelica in Peru, near Azogue in Colombia, at Durango in Mexico, at Yulgilbar, New South Wales, at New Almaden, New Idria, and other localities in Santa Clara County, California, about sixty-six miles from San Francisco, and in Brewster and other counties in Texas. The most ancient mine is that of Almaden in Spain, which was worked before the Christian era. This mine, and the mines of California, are the most productive at the present day, the Spanish mine yielding about three and a quarter millions of pounds, and the California mines about two-thirds of this amount annually. The ore in all the mines mentioned is cinnabar. The cinnabar from old Almaden is of a dull-red color in mass, of a dull brick-red color when in fine powder, and of the sp. gr. 3.6. That from New Almaden is of a bright-red color, slightly inclining to purple, not so hard as the Spanish ore, of a brilliant vermilion color in powder, and of the sp. gr. 4.4. The California cinnabar is richer in mercury, because purer, than the Spanish, the former yielding about 70 and the latter about 38 per cent. of mercury, according to the analysis of Adam Bealey. The California mine had been long known to the Indians, but its commercial value was first made known about 1843, by a Mexican, named Castillero, who became its first owner. At present it is in the hand of Americans. Ruschenberger has detected selenium in California cinnabar.

[1] *Hydrargyri Oxidum Nigrum,* U. S. 1850. *Black Mercurous Oxide.*—This preparation has been dropped from both Pharmacopœias, and is now very rarely used. For a full account of its preparation, uses, and properties, see U. S. D., 14th ed., 1256.

Extraction.—Mercury is obtained almost exclusively from the sulphide or native cinnabar. It is extracted by two principal processes. According to one process, the mineral is picked, pounded, and mixed with lime. The mixture is then introduced into cast iron retorts, which are placed in rows, one above the other, in an oblong furnace, and connected with earthenware receivers one-third full of water. Heat being applied, the lime combines with the sulphur, so as to form calcium sulphide and sulphate, while the mercury distils over, and is condensed in the receivers. The other process is practised at Almaden in Spain. Here a square furnace is employed, the floor of which is pierced with many holes, for the passage of the flame from the fireplace beneath. In the upper and lateral part of the furnace, holes are made, communicating with several rows of *aludels,* formed of adapters passing into one another, which terminate in a small chamber that serves both as condenser and receiver. The mineral, having been picked by hand and pulverized, is kneaded with clay, and formed into small masses, which are placed on the floor of the furnace. Heat being applied, the sulphur burns, and the volatilized mercury passes through the aludels to be condensed in the chamber.

Mercury, as found in commerce, is contained in cylindrical wrought iron bottles, called flasks, each containing 76½ pounds.[1] Since the regular working of the California mine of New Almaden, the importation of the metal from Spain and Austria has gradually diminished, and at present the domestic production is sufficient not only to supply the home consumption, but to give an excess for exportation. In the year 1862 the different mines of California were said to be yielding mercury at the rate of four millions of pounds per annum (*A. J. P.*, Sept. 1862, 410), which had increased in 1877 to over six million pounds, but then fell off again. The production for 1903 was 35,620 flasks, of which California produced 30,591 and Texas 5029; for 1904, 34,570 flasks, of which California produced 29,234 and Texas 5336. The world's production at present is about 7,000,000 lbs. The exports are made principally to China, Mexico, Chili, and Peru. The chief uses of the metal are in mining silver and gold, in preparing vermilion, in making thermometers and barometers, in silvering looking glasses, and in forming various pharmaceutical compounds.

Properties.—Mercury is "a shining, silver-white metal, without odor or taste. It is liquid at ordinary temperatures and easily divisible into spherical globules; but when cooled to —39.38° C. (—38.88° F.), it forms a ductile, malleable mass. Specific gravity: 13.535 at 25° C. (77° F.). Insoluble in the ordinary solvents, also in concentrated hydrochloric acid, and, at ordinary temperatures, in sulphuric acid; but it dissolves in the latter when boiled with it, and is readily and completely soluble in nitric acid. At ordinary temperatures it volatilizes very slowly, more rapidly as the temperature increases, and at 357.25° C. (675.05° F.), it boils and is completely volatilized, yielding a colorless, very poisonous vapor, and no appreciable residue. When globules of Mercury are dropped upon white paper, they should roll about freely, retaining their globular form, and leaving no streaks or traces. It should be perfectly dry and present a bright surface even after agitation in contact with air. On boiling 5 Gm. of Mercury with 5 Cc. of water and 4.5 Gm. of sodium thiosulphate, in a test-tube for about one minute, the Mercury should not lose its lustre, and should not acquire more than a slightly yellowish shade (absence of more than *slight traces of foreign metals*)." *U. S.* When perfectly pure it undergoes no alteration by the action of air or water, but in its ordinary state suffers a slight tarnish. When heated to near the boiling point, it gradually combines with oyxgen, and is converted into mercuric oxide; but at the temperature of ebullition it parts with the oxygen with which it had combined, and is reduced again to the metallic state. It boils at 357.25° C. (675.05° F.), yielding a colorless vapor, and congeals at —39.4° C. (—39° F.), forming a malleable solid of tin-white color. It is a good conductor of heat, and its specific heat is small. It is not attacked by hydrochloric acid, nor by cold sulphuric acid; but boiling sulphuric acid or cold nitric acid dissolves it, producing mercurous sulphate and mercurous nitrate, respectively, with the extrication, in the former case, of sulphurous acid; in the latter, of nitrogen dioxide, becoming hyponitric acid fumes. Its combinations are numerous, and several of them constitute important medicines. It forms two series of compounds, the *mercurous* compounds containing the atom Hg^{I}, and the *mercuric* compounds containing the atom Hg^{II}.

Mercury, as it occurs in commerce, is in general sufficiently pure for pharmaceutical purposes. Occasionally it contains foreign metals, as lead, tin, zinc, and bismuth. Brande informs us that in examining large quantities of this metal in the London market he found it in only one instance intentionally adulterated. When impure, the metal has a dull appearance, leaves a trace on white paper, is deficient in due fluidity and mobility, as shown by its not forming perfect globules, is not totally dissipated by heat, and when shaken in a glass bottle coats its sides with a pellicle, or, if very impure, deposits a black powder. If agitated with strong sulphuric acid, the adulterating metals become oxidized and dissolved, and thus the mercury may to a limited extent be purified. Lead is detected by shaking the suspected metal with equal parts of acetic acid and water, and then testing the acid by sodium sulphate or potassium iodide. The former will

[1] Since June 1st, 1904, the flasks have contained uniformly 75 lbs.

produce a white, the latter a yellow, precipitate, if lead be present. Bismuth is discovered by dropping a nitric solution of the mercury, prepared without heat, into distilled water, when bismuth subnitrate will be precipitated. The complete solubility of the metal in nitric acid shows that tin is not present, and, if hydrogen sulphide does not act upon hydrochloric acid previously boiled upon the metal, the absence of contaminating metals is shown. Mercury may be purified by digesting it with a small portion of weak nitric acid, or with a solution of mercuric chloride, whereby all the ordinary contaminating metals will be removed. The purification by nitric acid is, according to L. Meyer (*Zeit. An. Chem.*, ii. 241), best effected as follows: The metal is allowed to flow in a very thin stream from a small opening in a glass funnel into a wide glass tube 1.25 M. high and 5 cm. in diameter, which contains a dilute mixture of water and nitric acid. A narrow tube is fastened to the bottom of this, curved upward so as to discharge the mercury at a height of 10 cm. above the lower end of the wide tube; from this the pure metal flows; it has then only to be washed with water and dried. The above operation may have to be repeated several times, and the metal if pure must leave no residue when dissolved in pure nitric acid, evaporated to dryness, and ignited. To separate mechanical impurities, moisture, or small quantities of oxide, mercury may be filtered by collecting it in a sound piece of chamois leather and gathering the corners together, forcibly squeezing the particles through the pores of the leather. Mercury, however, is usually purified by distillation.[1] Being much more volatile than the contaminating metals, it rises first in distillation, while they are left behind. But it is necessary to avoid pushing the distillation too far, for in that event some of the foreign metals are apt to be carried over. The British Council, on account of this danger, directed only five-sixths of the mercury to be distilled. The distilled product is boiled for a few minutes with diluted hydrochloric acid, which, while it does not attack the mercury, dissolves any contaminating metals which may have passed over. The distillation is directed to be performed from a glass retort or iron bottle; but it is more conveniently conducted from the latter, over a common fire, into water contained in a receiver. In small operations a wash hand basin will answer for a receiver. Millon has ascertained the curious fact that the presence of so small a quantity as one ten-thousandth of lead or zinc in mercury raises its boiling point. Violette has made known a method of distilling mercury, or amalgamated silver, which presents many advantages. It consists in subjecting the metal, in iron vessels, to a current of high pressure steam, which serves the double purpose of imparting the necessary heat, and carrying over the mercurial vapor by a mechanical agency. (*Philos. Mag.*, Dec. 1850.) As it is difficult and troublesome to purify mercury by distillation, it is better to purchase pure samples of the metal, which may always be found in the market.[1]

Mercury is detected with great delicacy by Smithson's process, which consists in the use of a plate of tin, lined with one of gold, in the form of a spiral. When immersed in a mercurial solution, this galvanic combination causes the precipitation of the mercury on the gold, which consequently contracts a white stain. In order to be sure that the stain is caused by mercury, the metal must be volatilized in a small tube, so as to obtain a characteristic globule. Danger and Flandin have improved on Smithson's process. (See *Chem. Gaz.*, No. 61, p. 191.) A minute portion of any of the preparations of mercury, either in the solid state or in concentrated solution, being placed on a bright plate of copper, and a drop of a strong solution of potassium iodide added, a silvery characteristic stain will immediately appear on the copper.

Uses.—Mercury in its uncombined state is inert, but in combination acts as a peculiar and universal stimulant. When exhibited in minute division, as it exists in several preparations, it produces its peculiar effects, but this does not prove that the uncombined metal is active, but only that the condition of minute division is favorable to chemical combination, and consequently to its solution in the stomach. Its compounds exhibit certain general medicinal properties and effects which belong to the whole as a class, while each individual preparation is characterized by some peculiarity in its operation. In this place we shall consider the physiological action of mercury, and the principles by which its administration should be regulated; its effects as modified in its different combinations will be noticed under the head of the several preparations. Of the modus operandi of mercury we know nothing, except that it possesses a peculiar alterative power over the vital functions. This alterative power

[1] The British Pharmacopœia of 1864 gave the following process for the purification of mercury, using for this purpose an impure form of the metal, under the name of *Commercial Mercury* or *Quicksilver:*

"Take of Mercury of Commerce *three pounds* [avoirdupois]; Hydrochloric Acid *three fluidrachms;* Distilled Water *a sufficiency.* Place the Commercial Mercury in a glass retort or iron bottle, and applying heat cause two pounds and a half of the metal to distil over into a flask employed as a receiver. Boil on this for five minutes the Hydrochloric Acid diluted with nine fluidrachms of Distillled Water, and having, by repeated affusions of Distilled Water and decantations, removed every trace of acid, let the mercury be transferred to a porcelain capsule, and dried first by filtering paper, and finally on a water-bath." *Br.* 1864.

[1] *Measuring Definite Quantities of Mercury.*—H. Kral calls attention to a simple method for measuring mercury in operations in which approximately identical quantities of the metal are required. It consists of using a goose quill, into which the necessary quantity of mercury has been weighed. A small hole is then cut immediately above the surface of mercury, and the apparatus is ready for use. By simply immersing it into the bottle containing the mercury, it is filled through the opening, and uniform quantities, sufficiently accurate for practical purposes, are thus easily measured.—*Ph. Centralh.*, 1895, 422, 423.

is sometimes exerted without being attended with any other vital phenomenon than the removal of disease, while at other times it is accompanied with certain obvious effects, such as a quickened circulation, a frequent jerking pulse, and increased activity of all the secretory functions, particularly those of the salivary glands and the liver. When mercury acts slowly as an alterative, there is not the least apparent disturbance of the circulation. When it operates decidedly and obviously, it is very prone to cause an immoderate flow of saliva and produce the condition denominated ptyalism or salivation. Mercury has been detected in most of the solids and fluids of the body, including the blood. When in the blood it cannot be detected by the ordinary tests, on account of its intimate union with the organic matter of that liquid. To discover it, the blood must be subjected to destructive distillation. The liver is the organ which retains mercury the longest. It has been detected in that viscus though absent in the lungs, heart, bile, and spinal marrow.[1] Mercury has been used in almost every disease, but too often with evil results. In functional derangement of the digestive organs, mercurials in minute doses often exert a salutary operation, subverting the morbid action, and that, too, by their slow, alterative effects, without affecting the mouth. In these cases, no decided disturbance of the vital function takes place, but the alvine discharges, if clay-colored, are generally restored to their natural hue; whether the liver be torpid and obstructed as in *jaundice*, or pouring out a redundancy of morbid bile as in *melæna*, the judicious use of mercury seems equally efficacious in unloading the viscus, or restoring its secretion to a healthy state. In chronic inflammation of the mucous and serous membranes, the alterative effects of mercury are sometimes attended with much benefit. In many of these cases effusion has taken place, and under these circumstances the mercury often proves useful as well by promoting absorption as by removing the chronic inflammation on which the effusion depends. Hence it is often given with advantage in chronic forms of *meningitis, bronchitis, pleuritis, pneumonitis, dysentery, rheumatism*, etc., and in *hydrocephalus, hydrothorax, ascites*, and *general dropsy*. Mercury may also be advantageously resorted to in certain states of febrile disease. In some forms of *remittent* and *typhoid fever*, a particular stage is marked by a parched tongue, torpor of the bowels, scanty urine, and dryness of the surface. Here the very cautious employment of mercury is sometimes serviceable. It acts in such cases by increasing the secretions.

In syphilitic affections, mercury, until of late years, was held to be indispensable. Of its mode of action in these affections we know nothing. Without entering into the question of the necessity of mercury in venereal complaints, we are free to admit that the discussion which has grown out of it has shown that this remedy has frequently been unnecessarily resorted to in *syphilis*. For inducing the specific effects of mercury on the constitution, blue pill or calomel is generally resorted to. In order to procure what has been called the slow alterative effects of the metal, from half a grain to a grain (0.032 to 0.065 Gm.) of blue pill may be given in the twenty-four hours, or from a sixth to a fourth of a grain (0.01 to 0.016 Gm.) of calomel; or, if a gentle ptyalism be desired, two or three grains (0.13 or 0.20 Gm.) of the former, or a grain of the latter (0.065 Gm.) may be given two or three times a day. Where the bowels are peculiarly irritable, it is often necessary to introduce the metal by means of friction with mercurial ointment. Where a speedy effect is desired, the metal may be advantageously given hypodermically.

The first observable effects of mercury in inducing ptyalism are a coppery taste in the mouth, a slight soreness of the gums, and an unpleasant sensation in the sockets of the teeth when the jaws are firmly closed. Shortly afterwards the gums begin to swell, a line of whitish matter is seen along their edges, and the breath is infected with a peculiar and very disagreeable odor, called the mercurial fetor. The saliva at the same time begins to flow, and, if the affection proceed, the gums, tongue, throat, and face become much swollen; ulcerations attack the lining membrane of the mouth and fauces; the jaws become excessively painful; the tongue is coated with a thick whitish fur, and the saliva flows in streams from the mouth. It occasionally happens that the affection of the mouth proceeds to a dangerous extent, inducing extensive ulceration, gangrene, and even hemorrhage. The best remedies are astringent and detergent gargles, used weak at first, as the parts are extremely tender. In cases attended with swelling and protrusion of the tongue, the wash is best applied by injection by means of a large syringe. We have found lead water among the best applications in these cases, and diluted solutions of chlorinated soda or of chlorinated lime, while they correct the fetor, will be found to exert a curative influence on the ulcerated surfaces. A wash of silver nitrate, made by dissolving eight grains (0.5 Gm.) in a fluidounce (30 Cc.) of water, has also been used with benefit. While the system is under the action of mercury the blood is more watery than in health, less charged with albumin, fibrin, and red globules.

In the foregoing observations we have described the ordinary effects of mercury, but occasionally, in peculiar constitutions, its operation is quite different, being productive of a dangerous disturbance of the vital functions. Pearson gave a detailed account of this occasional peculiarity in the operation of mercury, in his work on venereal diseases. The symp-

[1] For a method of detecting mercury in the urine, see *P. J.*, Aug. 1873, 145.

toms which characterize it are a small and frequent pulse, anxiety about the præcordia, pale and contracted countenance, great nervous agitation, and alarming debility. Their appearance is the signal for discontinuing the mercury, as a further perseverance with it might be attended with fatal consequences. Mercury also produces a peculiar eruption of the skin, which is described by writers under the various names of *hydrargyria, eczema mercuriale,* and *lepra mercurialis.* Those who work in mercury, and are, therefore, exposed to its vapor, such as looking-glass silverers, and quicksilver miners, are injured seriously in their health, and not unfrequently affected with shaking palsy, attended with vertigo and other cerebral disorders. The miners are often salivated.

Many plants, exposed to the influence of the vapor spontaneously rising from mercury in confined air, perish in a few days, while if sulphur be placed by the side of the metal no effect of the kind is experienced. (Boussingault, *J. P. C.,* Sept. 1867, p. 176.) A probable inference from this fact is that workmen necessarily exposed to the vapor of mercury might be protected by the presence of sulphur in sufficient quantity.

Mercury is sometimes given in the metallic state, in the quantity of a pound or two, in *obstruction of the bowels,* to act by its weight; but the practice is of doubtful advantage.

Off. Prep.—Emplastrum Ammoniaci cum Hydrargyro, *Br.;* Emplastrum Hydrargyri, *U. S., Br.;* Hydrargyri Iodidum Flavum, *U. S.;* Hydrargyrum cum Creta, *U. S., Br.;* Linimentum Hydrargyri, *Br.* (from ointment); Massa Hydrargyri, *U. S.* (*Br.*); Unguentum Hydrargyri, *U. S., Br.;* Unguentum Hydrargyri Compositum, *Br.;* Unguentum Hydrargyri Dilutum, *U. S.;* Unguentum Hydrargyri Nitratis, *U. S., Br.;* Unguentum Hydrargyri Nitratis Dilutum, *Br.*

HYDRARGYRUM AMMONIATUM. U. S., Br.

AMMONIATED MERCURY [White Precipitate]

(hȳ-drär′gy-rŭm ạm-mō-nī-ā′tŭm)

$HgNH_2Cl = 249.61$

"It should contain not less than 78 percent. nor more than 80 percent. of metallic mercury." *U. S.*

Hydrargyri Præcipitatum Album; Hydrargyrum Amidato-bichloratum (ammoniato-muriaticum), Mercurius Præcipitatus Albus; Hydrargyri Ammonio-Chloridum; Ammonio-chloride of Mercury, Mercuric Ammonium Chloride; Mercuric amido-chloride; Chloramidure de Mercure, Oxychlorure Ammoniacal de Mercure, Lait Mercuriel, Mercure Précipité Blanc, *Fr.;* Hydrargyrum praecipitatum album, *P. G.;* Weisser Quecksilberpräcipitat, Quecksilber-Chloridamid, *G.;* Cloramiduro di mercurio, *It.*

* "Corrosive Mercuric Chloride, in powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Ammonia Water, Distilled Water, each, *a sufficient quantity.* Dissolve the Corrosive Mercuric Chloride in *two thousand cubic centimeters* [or 67 fluidounces, 5 fluidrachms] of warm Distilled Water, filter the solution, and allow it to cool. Pour the filtered liquid gradually, and with constant stirring, into *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of Ammonia Water, taking care that the latter shall remain in slight excess. Collect the precipitate on a filter, and, when the liquid has drained from it as much as possible, wash it with a mixture of *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Distilled Water and *twenty cubic centimeters* [325 minims] of Ammonia Water. Finally, dry the precipitate between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.), and keep it in well-stoppered bottles, protected from light." *U. S.*

"Mercuric Chloride, 3 *ounces* (Imperial) or 60 grammes; Solution of Ammonia, 4 *fl. ounces* (Imp. meas.) or 80 cubic centimetres; Distilled Water, *a sufficient quantity.* Dissolve the Mercuric Chloride in *three pints* (Imp. meas.) or twelve hundred cubic centimetres of the Distilled Water with the aid of heat; pour the liquid into the Solution of Ammonia diluted with *one pint* (Imp. meas.) or four hundred cubic centimetres of Distilled Water, constantly stirring; collect the precipitate on a filter; wash it well with cold Distilled Water until the liquid which passes through is free from chloride; dry the product at a temperature not exceeding 212° F. (100° C.)." *Br.*

The Pharmacopœias now agree in obtaining white precipitate by precipitating a solution of mercuric chloride by ammonia. When ammonia, in slight excess, is added to a cold solution of mercuric chloride, ammonium chloride is formed in solution, and the white precipitate of the Pharmacopœias thrown down. The precipitate is washed with a diluted solution of ammonia, according to the U. S. formula, according to the British, with greater precision, until the washings cease to give evidence of the presence of a chloride by producing a precipitate with silver nitrate acidulated with nitric acid. Power states that washing to this extent results in a considerable degree of decomposition. The substance washed away is ammonium chloride with the excess of ammonia employed; hence the washings, agreeably to the directions of the British formula, are tested with an acid solution of silver nitrate. The white precipitate forms according to the following reaction:

$$HgCl_2 + 2NH_3 = NH_4CL + NH_2HgCl$$

In other words, one molecule of the mercuric chloride reacts with two of the ammonia, and yields one molecule of ammonium chloride and one of *mercur-ammonium chloride,* or white precipitate. A method of making white precipitate, said to be employed by large manufacturers, substitutes ammonium chloride and sodium carbonate for ammonia. As the product contains less mercury than the official preparation, and is in commerce, it is important to be able to distinguish the two. According

to Redwood, this can be done by heating, the official preparation volatilizing without fusing, the unauthorized fusing before volatilizing. Attfield has, however, shown that fusibility does not necessarily indicate that the specimen contains 65 per cent. of mercury, nor infusibility demonstrate that it contains the official proportion of 79½ per cent. The commercial variety differs somewhat from the present official preparation in composition, its formula being $N_2H_6HgCl_2$ (or *mercur-diammonium chloride*). (See paper by F. X. Moerk, *A. J. P.*, 1888.)

Properties.—"White, pulverulent pieces, or a white, amorphous powder, without odor, and having an earthy, afterwards styptic and metallic taste; permanent in the air. Insoluble in water or in alcohol. By prolonged washing with water it is gradually decomposed, assuming a yellow color, and becoming converted into a basic salt. Readily soluble in warm hydrochloric, nitric, or acetic acid, and in a cold solution of ammonium carbonate. Also completely soluble in a cold solution of sodium thiosulphate, with the evolution of ammonia; when this solution is heated for a short time, red mercuric sulphide is separated, which, on protracted boiling, turns black. At a temperature below a red heat Ammoniated Mercury is decomposed without fusion, and at a red heat it is wholly volatilized. When heated with potassium hydroxide T.S., the salt turns yellow, and evolves vapor of ammonia. The solution of the salt in diluted nitric acid gives with potassium iodide T.S. a red precipitate and with silver nitrate T.S. a white precipitate. The salt should be soluble in hydrochloric acid without effervescence (absence of *carbonate*), and without leaving a residue (absence of *mercurous salt*). The solution of 0.5 Gm. of Ammoniated Mercury in 2 Cc. of hydrochloric acid diluted with water to 25 Cc. should not respond to the tests for *foreign salts, metals*, and *arsenic*, as described under *Hydrargyri Chloridum Mite.*" *U. S.* "A white powder on which *water* has but little action, and *alcohol* (90 per cent.) or *ether* no action. Digested with *solution of potassium hydroxide*, it evolves ammonia, acquiring a pale yellow color, and the liquid, filtered and acidulated with *nitric acid*, gives a white precipitate with *solution of silver nitrate*. Boiled with *solution of stannous chloride* it becomes gray, and yields globules of metallic mercury. It volatilizes at a temperature under redness, without fusing, leaving only an insignificant amount of fixed residue. When heated with excess of *lime* it should yield 78 to 79 per cent. of metallic mercury." *Br.*

Adulteration with white lead, chalk, or calcium sulphate may be detected by exposing a sample to a strong red heat, when these impurities will remain. Should starch be mixed with it, a charred residue will be obtained on the application of heat. Lead or starch may be found by digesting it with acetic acid, and testing the acetic solution with the compound solution of iodine, which will give a yellow precipitate if lead and a blue one if starch be present. The absence of mercurous oxide is shown by its not being blackened when rubbed with lime water.

Uses.—Ammoniated mercury is used only as an external application. Mercur-diammonium chloride is said to produce an ointment more translucent and less white than the genuine, and more apt to become yellow on being kept. (J. Borland, *P. J.*, Dec. 1867, p. 262.)

Ammoniated mercury has been swallowed by mistake. It is highly poisonous, producing gastric pain, nausea, and purging. For recovery after taking half a drachm, see *L. L.*, July 4, 1857. The remedies employed were an emetic of zinc sulphate and milk.

Off. Prep.—Unguentum Hydrargyri Ammoniati, *U. S., Br.*

HYDRARGYRUM CUM CRETA.
U. S., Br.

MERCURY WITH CHALK

(hȳ-drär′ǧy-rŭm cŭm crē′tą)

Gray Powder; Æthiops Cretaceus; Mercure avec la Craie, Poudre de Mercure crayeux, *Fr.*; Quecksilber mit Kreide, *G.*

* "Mercury, *thirty-eight grammes* [or 1 ounce av., 150 grains]; Clarified Honey, *ten grammes* [or 154 grains]; Prepared Chalk, *fifty-seven grammes* [or 2 ounces av., 5 grains]; Water, *a sufficient quantity*, to make *one hundred grammes* [or 3 ounces av., 231 grains]. Weigh the Mercury and Clarified Honey successively into a strong bottle of the capacity of *one hundred cubic centimeters* [or 3 fluidounces, 183 minims], and add *two cubic centimeters* [or 32 minims] of Water. Cork the bottle, and shake it for about half an hour at a time, until the aggregate time of shaking reaches ten hours, or until the globules of Mercury are no longer visible under a lens magnifying *four diameters*. The shaking may be more conveniently performed by mechanical means. Rub the Prepared Chalk with Water, in a mortar, to a thick, creamy paste, and, having added the contents of the bottle, washing the last portions in with a little Water, triturate the whole to a uniform mixture. Finally, dry the mixture, first between ample layers of bibulous paper, and afterwards in a dish at the ordinary temperature, until it weighs *one hundred grammes* [or 3 ounces av., 231 grains]. Then reduce it to a uniform powder, without trituration, and keep it in well-stoppered bottles, protected from light." *U. S.*

"Mercury, 1 *ounce* (Imperial) or 20 grammes; Prepared Chalk, 2 *ounces* (Imp.) or 40 grammes. Rub the Mercury and Prepared Chalk in a porcelain mortar until the metallic globules cease to be visible to the naked eye, and the mixture acquires a uniform grey color." *Br.*

The method of making this mercurial directed by the U. S. P. 1880 was so faulty as to be inoperative, and it has been abandoned; the U. S. P. 1890 process for making mercury with chalk was based upon Squibb's method of succussion, which was retained and is described at length farther on. When mercury is triturated with certain dry and pulverulent substances, such as chalk or magnesia, it gradually loses its fluidity and metallic lustre and becomes a blackish or dark-gray powder. A similar change takes place when it is rubbed with viscid or greasy substances, such as honey or lard. The globules disappear, so as in some instances not to be visible even through a good lens, and the mercury is said to be extinguished. It was formerly thought that the metal was oxidized in the process. At present the change is generally ascribed to the mechanical division of the metal, which in this state is supposed to be capable of acting on the system. There is good reason, however, to believe that in this, as in all the analogous preparations of mercury in which the metal is extinguished by trituration, a very small portion is converted into mercurous oxide, while by far the greater part remains in the metallic state.

Mercury with chalk is officially described as "a light gray, rather damp powder, free from grittiness, without odor, and having a slightly sweetish taste. If a portion of the powder be digested with warm acetic acid, the chalk is dissolved with effervescence, leaving a residue of finely divided mercury. The filtrate should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of *mercurous oxide*). If another portion of the powder be digested with warm, diluted hydrochloric acid, the filtrate should not be affected by hydrogen sulphide T.S., or by stannous chloride T.S. (absence of *mercuric oxide*)." *U. S.* "A powder of a light grey color; free from grittiness; insoluble in *water;* partly dissolved by *diluted hydrochloric acid,* leaving the mercury in a finely divided state. The solution formed with *hydrochloric acid* does not yield any white or grey precipitate on the addition of *solution of stannous chloride* (absence of mercuric compounds)." *Br.* Robert B. Matter suggests an improved process for its preparation whereby labor and time are saved; it is as follows. Mix twelve parts of finely powdered gum arabic with twelve parts of prepared chalk, triturate with sufficient water to form a rather thin paste, add thirty-eight parts of mercury, and continue the trituration until the globules of mercury have disappeared. Now add thirty-eight parts of finely powdered prepared chalk and sufficient water to form a thin paste, triturate, and when all the globules of mercury have disappeared, place the mortar in a hot water bath. The mixture distributed around the sides of the mortar will dry rapidly, when it can be easily scraped out, powdered in a clean mortar, passed through bolting cloth, or a fine sieve, and finally rubbed lightly in a clean dry mortar; 8 ounces may be made by this process in an hour. (*A. J. P.,* 1886, 119.)

Mercury with chalk is a smooth, grayish powder, insoluble in water. Globules of mercury can generally be seen in it by the aid of a microscope, as the metal can scarcely be completely extinguished with chalk alone by any length of trituration. Jacob Bell found that by powerfully pressing it a considerable quantity of metal was separated in the form of globules. Phillips states that the extinguishment of the mercury is greatly accelerated by the addition of a little water. Stewart of Baltimore proposed the following process, by which he stated that the preparation might be completed in a short time, so that no globules should be visible with a powerful lens. Three ounces of mercury and six ounces of rosin are to be rubbed together for three hours; five ounces of chalk are to be added, and the trituration continued for an hour; the mixture is then to be heated with alcohol so as to dissolve the rosin; and the remaining powder is to be dried on bibulous paper and well rubbed in a mortar. (*A. J. P.,* xv. 162.) But Procter showed that the preparation thus made contains mercuric oxide, and is, therefore, injuriously harsh in its operation. (*Ibid.,* xxii. 113.) It is said that the precipitated black oxide is sometimes added with a view to save time in the trituration; but this must be considered as an adulteration, until it can be shown that the same oxide exists in the same proportion in the preparation made according to the official directions. Ed. Jenner Coxe of New Orleans, found that the extinguishment of the mercury may be effected much more speedily than in the ordinary manner, by putting the ingredients into a quart bottle, to be well corked, and kept in constant agitation until the object is attained. A portion of chalk may be thus shaken with the metal until no globules can be seen, and the process completed by trituration with the remainder of the chalk in a mortar. This mode of proceeding was suggested to Coxe by W. Hewson of Augusta, Ga. (*Ibid.,* xxii. 317.) Squibb, having ascertained that the preparation cannot be satisfactorily made in this way on a large scale (*Proc. A. Ph. A.,* 1858, p. 424), invented a machine for accomplishing the same object, by which the requisite motion is imparted to the materials contained in two large bottles, and which is said to answer the purpose well. By means of this apparatus, E. R. Squibb prepared mercury with chalk on a large scale, mixing the materials in the official proportions, but aiding the extinguishment of the metal by mixing with it about one-seventh of its weight of honey, and adding this to the chalk made into a paste with water, and afterwards drying. (*Ibid.,* 1859, p. 359.) It has been shown that the preparation thus made resists oxidation most effectually, owing probably to the presence

of saccharine matter. (J. P. Remington, *A. J. P.*, Jan. 1869.) W. E. Bibby (*A. J. P.*, 1876, p. 269) recommends the rubbing of 3 troyounces of mercury, 4 troyounces of prepared chalk, and 1 troyounce of sugar of milk together in a mortar into an impalpable powder and passing the powder through a fine sieve. As found in commerce, mercury with chalk, instead of being the mild preparation intended, sometimes acts very harshly, causing vomiting, gastric pains, etc. This has been ascribed to the presence of antimony or arsenic, which, however, must be rare; the ordinary cause of the harshness is no doubt mercuric oxide, produced in minute proportion either during the trituration, or by the spontaneous change which occurs with time, mercurous oxide becoming mercuric oxide by the influence of light. The only sure method to guard against such results is to test the preparation carefully before dispensing it. (See *A. J. P.*, 1878, p. 325.) If the mercury contained in it be volatilized by heat, and the remaining chalk be dissolved by diluted acetic acid, the solution should not be colored by hydrogen sulphide. The presence of any probable metallic impurity may be detected in this way. To detect mercuric oxide, a portion of the powder may be treated with diluted hydrochloric acid with a moderate heat, and the solution tested by stannous chloride, which, if there be any mercuric oxide present, will cause a precipitation of metallic mercury as a black powder.

Uses.—Mercury with chalk is a very mild mercurial, similar in its properties to the blue mass, but much weaker. It is sometimes used as an alterative, particularly in the complaints of children attended with deficient biliary secretion, indicated by white or clay-colored stools. The chalk is antacid, and, though in small quantity, may sometimes be a useful accompaniment of the mercury in *diarrhœa*. Eight grains of the U. S. preparation contain about three grains of mercury. It should not be given in pill with substances which become hard on keeping, as the contraction of the mass presses together the particles of mercury, which in time appear in globules in the interior of the pill.

Dose, one to thirty grains (0.065 to 2 Gm.).

HYDRASTINA. U. S.

HYDRASTINE

(hȳ-drăs-tĭ′nạ)

$C_{21}H_{21}NO_6 = 380.32$

"An alkaloid obtained from Hydrastis. It should be kept in well-stoppered bottles." *U. S.*

Hydrastine, *Fr. Cod.*; Hydrastin, *G.*

Hydrastine may be obtained by exhausting the powdered root as far as possible with water by percolation, adding hydrochloric acid to the infusion so as to precipitate the berberine in the form of hydrochloride, and treating the mother liquor with solution of ammonia in slight excess. The hydrastine is precipitated, in an impure state, and may be purified by repeated solution in boiling alcohol, which deposits it in crystals on cooling. A little animal charcoal may be used towards the close of the process, in order to deprive the crystals completely of color. To Mahla of Chicago, and Perrins of London, is due the credit of having investigated this alkaloid.

Properties.—"White to creamy white, glistening prisms, sometimes of large size, possessing a bitter taste, and permanent in the air. It contains no water of crystallization. Almost insoluble in water at 25° C. (77° F.); soluble in 135 parts of alcohol, 124 parts of ether, and in 2 parts of chloroform at 25° C. (77° F.); soluble in 4000 parts of water at 80° C. (176° F.), and in 17 parts of alcohol at 60° C. (140° F.); easily soluble in benzene. Hydrastine melts at 131° C. (267.8° F.). It shows an alkaline reaction to moistened litmus paper, and is lævogyrate. Sulphuric acid produces a yellow color when added to Hydrastine, and on heating, a purple color is developed. Sulphuric acid containing a trace of molybdic acid gives a green color, changing to olive-green and then to brown; nitric acid yields a reddish-yellow color; sulphuric acid containing a trace of selenous acid gives a yellowish-red color, changing to brown. Sulphuric acid containing a trace of potassium dichromate produces a red color, changing to brown. If a crystal of Hydrastine be dissolved in diluted sulphuric acid and a solution of potassium permanganate (1 in 10) be added, a blue fluorescence will be developed (distinction from *hydrastinine*)." *U. S.*

Uses.—Hydrastine is an active alkaloid, which is slowly absorbed and probably eliminated by the kidneys and lower bowel unchanged. When given to the lower animals it primarily stimulates the spinal motor cord, causing tetanic convulsions, with heightened reflexes, followed, if the dose has been large enough, by loss of reflex activity, and motor paralysis, which are probably in part due to depression of the motor centres, and are certainly, at least in part, the outcome of depression of the motor nerves and also of the muscles themselves. Death may occur in a convulsion from cramp-asphyxia, or later from simultaneous paralysis of the respiratory centre and of the peripheral apparatus. The arterial pressure is first elevated and secondarily depressed; the first rise of pressure is probably due to the stimulation of the heart muscle, increasing the output of force, and of both the vasomotor centres and the muscle fibres in the arteriole coats, causing contraction of the blood vessels; the fall of pressure is the result of a direct paralytic action exerted upon the muscle fibres in the heart and in the arterioles. Hydrastine notably increases intestinal peristalsis, and probably uterine contractions. It would seem to be a universal muscle poison, which

acts upon both striated and non-striated muscle fibres in heart, arterioles, intestines, uterus, and generally throughout the body, its first stimulant action being followed by marked depression. Hydrastine has been shown by Fellner and Slavatinski to have a distinct ecbolic action, and premature labor is asserted to have been caused by its hypodermic administration. In practical medicine it is chiefly employed for the arrest of uterine hemorrhage, and in ordinary *menorrhagia.* When a prompt action is desired, a soluble salt like the hydrochloride should be administered hypodermically.

Locally, commercial hydrastin (a mixture of the alkaloids of hydrastis) is a valuable remedy in the treatment of *gonorrhœa, chronic gastric* and *intestinal catarrhs, otorrhœa, vaginitis, rhinitis,* and other forms of catarrhal inflammation of the mucous membrane. For such purposes the impure mixture is probably superior to the pure alkaloid. From five to ten grains of commercial hydrastin or from fifteen to thirty minims of the fluidextract of hydrastis may be used in an ounce of diluent.

Dose, of pure hydrastine, one-sixth to one-half grain (0.01 to 0.032 Gm.).

HYDRASTININÆ HYDROCHLORIDUM. U. S.

HYDRASTININE HYDROCHLORIDE [Hydrastininæ Hydrochloras, Pharm. 1890, Hydrastinine Hydrochlorate]

(hȳ-drăs-tĭ-nī'næ hȳ-drǫ-ȼhlō'rĭ-dŭm)

$C_{11}H_{11}NO_2.HCl = 223.88$

"The hydrochloride [$HCl.C_{11}H_{11}NO_2$] of an artificial alkaloid derived from hydrastine. It should be kept in well-stoppered bottles." *U. S.*

Hydrastininum hydrochloridum, *P. G.;* Hydrastininhydrochlorid, Salzsaures Hydrastinin, *G.*

Preparation.—Hydrastinine is an artificial alkaloid, produced by acting on hydrastine, the alkaloid from hydrastis, with oxidizing agents. When manganese dioxide and sulphuric acid are used together, or when platinic chloride is employed, hydrastinine and *opianic acid* are the products.[1] (See *Hydrastis.*)

Properties.—Hydrastinine hydrochloride is officially described as in "light yellowish needles, or a yellowish-white, crystalline powder; odorless, and having a bitter taste. Very soluble in cold and hot water, and in alcohol; soluble in 286 parts of chloroform and 1300 parts of ether at 25° C. (77° F.). Hydrastinine Hydrochloride melts at 212° C. (413.6° F.). Its aqueous solution, especially when highly diluted, shows a blue fluorescence, and is neutral to litmus paper. On ignition the salt should be completely consumed. In an aqueous solution of the salt (1 in 20), bromine T.S. produces a yellow precipitate, which should be perfectly soluble in ammonia water, forming an almost colorless solution. In an aqueous solution of the salt, potassium dichromate T.S. produces a precipitate which redissolves if gently heated, but on cooling the solution, it separates in glistening needles. If ammonia water be added to an aqueous solution of Hydrastinine Hydrochloride (1 in 20), no turbidity should be produced. On slowly adding to a solution of 0.2 Gm. of the salt in 3 Cc. of water 4 to 5 drops of solution of sodium hydroxide (1 in 7), each drop will cause a milky turbidity, which disappears again on shaking. From this solution, after standing for some time, pure white hydrastinine should separate, and the supernatant fluid should be almost colorless. With a crystal of the salt, sulphuric acid or nitric acid produces a deep yellow color; sulphuric acid with a trace of nitric acid, a reddish-brown color; sulphuric acid with a crystal of ammonium vanadate, a light brown color changing to dark brown." *U. S.*

Uses.—Hydrastinine is, when given in large enough amount, a powerful depressant to the whole motor tract, affecting the psycho-motor centres of the cerebral cortex, the motor nerve, and the muscle itself. In the present state of our knowledge it is uncertain whether the depression is or is not preceded by a brief period of excitation, but it is almost certain that there is a primary stimulation of the muscles. The alkaloid slows the action of the heart but increases the force of the beat, and markedly augments the blood pressure, contracting actively the blood vessels by stimulating both the vasomotor centres and the muscles in the walls of the arterioles. In the toxic dose it finally paralyzes respiration, although there is reason for believing that in the beginning it stimulates the function. Death occurs from asphyxia, to which is usually ascribed the final fall of the arterial pressure. Although there has been some conflict of evidence, it seems finally established that hydrastinine is a powerful oxytocic. According to experiments of Archangelsky, its administration to pregnant animals is very commonly followed by abortion. According to Faber, when given hypodermically during human parturition, it very notably increases the force and length of the uterine contraction, and is capable, in sufficient dose, of causing a tonic spasm of the uterus similar to that produced by ergot. Its action upon the uterus appears to be independent of any other of its influences, and to be direct. It would seem that it is a universal muscle poison,

[1] E. Schmidt, in studying this production of hydrastinine by oxidation from hydrastine, was led to make some interesting comparisons between hydrastine and narcotine. The latter of these he considers to contain three methyl groups, thus, $C_{19}H_{14}(OMe)_3NO_4$, while the former contains only two, thus, $C_{19}H_{15}(OMe)_2NO_4$. Since the oxidation of narcotine with manganese dioxide and sulphuric acid yields opianic acid and cotarnine, and under the same conditions hydrastine gives opianic acid and hydrastinine, and, further, as opianic acid contains two methyl groups and cotarnine one of these groups, as shown by Wright, it follows that hydrastinine contains no methyl group, and cotarnine may prove to be a methylated hydrastinine. The author hoped later to succeed in converting hydrastine into narcotine. (*A. J. P.,* 1888, p. 635.)

primarily stimulant in its action, and that in this way it affects the heart, the arterioles, and the uterus. According to von Bunge, it markedly increases peristalsis, so that even the intestines do not escape its muscular action.

Hydrastinine was originally recommended by Falck in the treatment of *menorrhagia, metrorrhagia, dysmenorrhœa,* and even *endometritis.* The testimony as to its value in all forms of uterine hemorrhage seems to be conclusive, and it is affirmed by many gynæcologists that it has a pronounced alterative influence upon the mucous membrane of the uterus. From our own experience we are convinced that it has value as a cardiac tonic, not equal in power or certainty of action to digitalis, but often useful as a substitute for that drug, especially in minor cases of heart failure. Its sedative action on the centric nervous system, conjoined with its stimulating influence upon the circulation and its pronounced effects upon the genital system, make it a very valuable remedy in the treatment of feeble women of hysterical temperament, with tendency to uterine fluxes.

Dose, usually employed, from three-fourths of a grain to one and a half grains (0.048 to 0.096 Gm.) every three to six hours, but probably larger doses might often be used with advantage, since no ill effects have been as yet recorded as being produced by it. The salt may be given hypodermically.

HYDRASTIS. U. S. (Br.)

HYDRASTIS [Golden Seal]

(hȳ-drăs'tĭs)

"The dried rhizome and roots of *Hydrastis canadensis* Linné (Fam. *Ranunculaceæ*), yielding, when assayed by the process given below, not less than 2.5 percent. of hydrastine." *U. S.* "The dried rhizome and roots of Hydrastis canadensis, *Linn.*" *Br.*

Hydrastis Rhizoma, *Br.;* Hydrastis Rhizome; Rhizoma Hydrastis; Golden Seal, Yellow Root, Yellow Puccoon, Orange Root, Indian Dye, Indian Turmeric, Yellow Eye, Jaundice Root; Hydrastis, *Fr. Cod.;* Racine d'Hydrastis du Canada, Sceau d'or, *Fr.;* Canadische Gelbwurzel, Gelbes Blutkraut, *G.;* Idraste, *It.;* Hidrastis del Canada (Rizoma de), *Sp.*

Hydrastis canadensis, Gray, *Manual of Bot.,* 14; figured in Griffith's *Med. Bot.,* 82.—This is a small, herbaceous, perennial plant, with a thick, fleshy, yellow rhizome, from which numerous long roots arise, and an erect, simple, pubescent stem, from six inches to a foot in height. There are usually but two leaves, which are unequal, one sessile at the top of the stem, the other attached to the stem a short distance below by a thick roundish footstalk, causing the stem to appear as if bifurcate near the summit. The leaves are pubescent, roundish-cordate, with from three to seven, but generally five, lobes, which are pointed and unequally serrate. A solitary flower stands upon a peduncle rising from the basis of the upper leaf. It is whitish, rose-colored, or purplish, without corolla, but with a colored calyx, the sepals of which closely resemble petals, and are very caducous, falling very soon after the flower has expanded. The fruit is a globose, compound, red or purple berry, half an inch or more in diameter, composed of many fleshy carpels, each tipped with a short curved beak, and containing one or rarely two seeds. The plant grows in moist, rich woodlands in most parts of the United States, and at one time abundantly in the North and West. The fruit bears a close resemblance to the raspberry, but is not edible. The root is the part used. The Indians employed it for staining and dyeing yellow, and it is said to impart a rich and permanent yellow, and with indigo a fine green, to wool, silk, and cotton. There is but one other species of Hydrastis known,—viz., *H. jezoensis,* Sieb. et Zucc., which is found in Northern Japan. For morphology of hydrastis see *Chem. Zeit.,* 1894, 134, and for botanical description by J. U. Lloyd, see *West. Drug.,* 1897, 59.

Properties.—The fresh root is juicy, and loses much of its weight in drying. The dried caudex is officially described as a "rhizome of oblique growth, subcylindrical, straight or somewhat tortuous, 2 to 5 Cm. long, and 3 to 6 Mm. in diameter, with short stem remnants, or stem scars, and slightly annulate; externally brownish-gray to yellowish-brown; fracture short, waxy, deep yellow; bark about 0.5 Mm. thick, wood wedges bright yellow, pith large, light yellow; the roots thin, brittle, with a thick yellow bark and a somewhat quadrangular wood; odor distinct; taste bitter. Sections of Hydrastis treated with sulphuric acid show under the microscope the separation of the alkaloids in prismatic, tabular, and acicular crystals." *U. S.* The rhizome breaks with a clean resinous fracture, leaving a smooth brownish-yellow or greenish-yellow surface, exhibiting a ring of bright yellow with somewhat distant narrow wood-bundles. Many of the detached rootlets are mixed with the rhizomes in mass. The color of the rhizome, though yellow in the recent root, becomes a dark yellowish brown by age; that of the rootlets and the interior of the root is yellow, and that of the powder still more so. The odor is sweetish, and somewhat narcotic, the taste bitter and peculiar. The medicine imparts its virtues and coloring matters to water and alcohol. Examined by Alfred B. Durand of Philadelphia, it was found to contain albumen, starch, fatty matter, resin, yellow coloring matter, sugar, lignin, and various salts. He also discovered a peculiar nitrogenous, crystallizable substance, for which he proposed the name of *hydrastine.* (*A. J. P.,* 1851, p. 112.) It has also been determined that the root contains another alkaloid, to which it owes its yellow color, and which is probably identical with the yellow coloring matter of Durand. F. Mahla first ascertained that this

new alkaloid of hydrastis is *berberine.*[1] (*Am. J. S.,* Jan. 1862, p. 43.) It exists in large proportion in hydrastis, constituting, according to Perrins, nearly 4 per cent. There can be no doubt that this medicine owes much of its virtue to berberine. For a valuable paper by J. U. Lloyd on the preparation of salts of berberine, see *A. J. P.,* 1879, p. 11. Lerre's process based on Lloyd's for preparing hydrastine and berberine is as follows:

First Process.—Two thousand pounds of golden seal in No. 40 powder is exhausted with 80 per cent. boiling alcohol in a hot extraction apparatus, careful recovery leaving a dark syrup containing the total active ingredients. This is withdrawn and immediately added to five times its volume of warm water, and the whole allowed to stand 24 hours, by which time the resinoids have separated. The bright chocolate liquid is now acidified with sulphuric or hydrochloric acid in excess, and allowed to stand 24 hours, when most of the liquor may be decanted; the residual berberine salt is easily strained off, washed, and is then ready for purification. To the combined liquors an excess of alkali is added which throws out the impure hydrastine, which after washing and drying is ready for purification. All liquors are rejected. The berberine salts are purified by repeated crystallizations from boiling water, and finally in alcohol. Fair samples of drug yield about 3½ per cent. The crude hydrastine is dissolved in boiling alcohol or chloroform, filtered and recrystallized. The yield is about 1¾ per cent.

Second Process.—The above quantity of crude drug may be macerated with a 2 per cent. solution of acetic acid, and this at first sight would seem the better process; practice, however, leads to an opposite deduction, as the quantities of liquid to be handled are greater and the troubles in purifying multiplied. (*D. C.,* 1897, 34.) A substance obtained by the precipitation of an infusion of the root by hydrochloric acid has been for some time known and used by the "Eclectics," under the name of *hydrastin;* it consists of a small proportion of hydrastine, with berberine and resin (*A. J. P.,* 1876, p. 386), and the reader must be cautious not to confound this substance with the alkaloid to which the name properly belongs.[2] Perrins obtained 1.5 per cent. of it

[1] *Berberine.*—This alkaloid appears to have been first discovered, in 1826, in a species of Xanthoxylum, by Chevallier and Pelletan, who, from its color and taste, named it *xanthopicrite;* Buchner and Herberger, in 1835, found it in *Berberis vulgaris,* and named it berberine; but none of these chemists were aware of its alkaline properties. Indeed, the substance obtained by them, at least the berberine of Buchner, must have been a native salt of the proper alkaloid, which was not, therefore, procured in a pure state. Subsequently Fleitmann demonstrated its basic character, and published an account of several of its salts. It is not confined to the barberry, but has been found, by several chemists, in several other plants, particularly those products combining bitterness and a yellow color, as in *Cocculus palmatus, Hydrastis canadensis, Xanthorrhiza apiifolia, Coptis teeta, Fagara Clava-Herculis, Cossinium fenestratum,* and others belonging to the natural families of Berberidaceæ, Menispermaceæ, and Ranunculaceæ. Indeed, few if any of the known alkaloids are so widely diffused as this appears to be in the vegetable kingdom. A list of the plants from which it has been obtained is contained in *A. J. P.,* Sept. 1863, p. 456.

Berberine may be obtained most readily from its sulphate. Proctor has given the following process for preparing it, based upon a suggestion of Merrill, of Cincinnati. The coarsely powdered root is to be exhausted by repeated decoction with boiling water, and the mixed liquids, after filtration, are to be evaporated to a soft extract. This is to be digested several times with stronger alcohol, in the proportion of a pint to half a pound of the root, until exhausted, one-fourth of its bulk of water is to be added to the tincture, and five-sixths of the alcohol to be distilled off. To the residue, while still hot, sulphuric acid is to be added in excess, and the liquid allowed to cool. The berberine sulphate is deposited in crystals, and, having been purified by recrystallization, is to be decomposed by the addition, in excess, to its solution in boiling water, of freshly precipitated lead monoxide, the solution being kept hot until the decomposition is completed. This may be known by the absence of a precipitate when lead acetate is added to a drop of the clear liquid. The liquid is then to be filtered, and set aside to crystallize. The berberine sulphate may be decomposed by treatment with barium hydroxide, removing excess of barium by carbon dioxide, concentrating and crystallizing. It may also be made by precipitating a concentrated aqueous extract of any drug containing berberine by excess of sulphuric acid. Thus obtained, berberine is in the form of a yellow powder, which, under the microscope, appears to consist of groups of minute, acicular crystals. It has a bitter taste, is soluble in about 100 parts of cold water, still less soluble in cold alcohol, freely soluble in both these liquids when hot, and insoluble in ether. It forms salts of difficult solubility with hydrochloric and sulphuric acids, and is distinguished by being copiously precipitated by the former acid from its cold water solution in the form of crystals of the hydrochloride. It is freely dissolved by acetic acid, which forms with it a readily soluble salt. (*A. J. P.,* Jan. 1864, 10.) Its formula is, on the authority of Perrins, $C_{20}H_{17}NO_4$. (*P. J.,* April, 1863, 464.) Hlasiwetz (*Ann. Ch. Ph.,* 115, 45) also confirms this formula, which may therefore be assumed as correct. Gaze's method consists of the preparation of an insoluble compound of berberine with acetone, and then liberating the berberine by boiling the compound with a mixture of alcohol and chloroform for 12 hours under a reflux condenser. This method has been criticized by Gordin, who found that Gaze's product was not pure berberine. (*Proc. A. Ph. A.,* 1901, 228.) *Berberine hydrochloride,* which is the salt that has attracted most notice, may be readily obtained by using hydrochloric instead of sulphuric acid in the above process, and purifying the precipitate by solution in hot alcohol, and subsequent refrigeration. It is in fine acicular crystals of a bright yellow color and intensely bitter taste, very slightly soluble in cold water, to which, however, it imparts a deep yellow color, slightly soluble in cold alcohol, but dissolved in large proportion by both liquids when hot. By concentrated nitric acid both this salt and its base are decomposed, with the production of a dark red color and the escape of nitrous fumes. A process for *berberine hypophosphite,* by J. U. Lloyd, may be found in *A. J. P.,* July, 1877. Parsons (*N. R.,* 1879, 109) analyzed *berberine phosphate,* and believes the formula to be $C_{20}H_{17}NO_4.2H_3PO_4$.

According to the studies of Falck and Guenste, berberine causes in dogs and rabbits restlessness, convulsive tremblings, hurried respiration, and diarrhœa, followed, if the dose has been large enough, by decrease of the breathing rate, wide-spread paralysis, dyspnœa, convulsions, and death. In man as yet no serious symptoms have been recorded as produced by it. Buchner is stated to have taken nearly twenty grains without causing anything more serious than a loose stool. It has been employed in internal medicine as a simple bitter, in doses of from two to five grains (0.13 to 0.32 Gm.).

[2] Wilhelm (*P. J.,* 1888, 325) furnishes a process for obtaining the alkaloids from hydrastis as follows. The extract obtained by treating the coarsely powdered root with water acidified with acetic acid at 100° F. is evaporated to a syrup and excess of diluted sulphuric acid added, when berberine sulphate separates. The filtrate neutralized with ammonia water gives a precipitate containing much hydrastine; this is separated, and on adding ammonia

from the root, and, having given five grains of it to a rabbit without any other effect than a slight uneasiness which soon ceased, concluded justly that it was not poisonous.

Canadine ($C_{20}H_{21}NO_4$) was extracted by E. Schmidt; it occurs in the form of brilliant, small, white nodules, melting at 134° C. (273.2° F.). When canadine is dissolved in alcohol and treated with iodine, berberine hydriodide (which is yellow in color) is formed. Canadine was believed to be identical with dihydromethylberberine (*Ph. Post,* 1892, 230), and the formula $C_{21}H_{21}NO_4$ was given to it. E. Schmidt, however (*A. Pharm.,* 1894, 136 to 154), has found that its true formula is $C_{20}H_{21}NO_4$, and, owing to the fact that iodine forms with it berberine hydriodide, he believes that canadine is a tetrahydroberberine. Schmidt also obtained, as an additional product of the iodine reaction, the hydriodide of another base, which he believes is intermediate between berberine and canadine. For a process for isolating canadine, see *Proc. A. Ph. A.,* 1894, 1103. The alkaloid discovered by A. K. Hale, and obtained later by Burt and by Lerchen, and which was named *xanthopuccine,* is now considered to be identical with canadine. For processes for making hydrastine and berberine, see *D. C.,* 1897, 34. It is probable, from the odor of hydrastis, that besides the two alkaloids here mentioned it contains also an active volatile principle, but this has not yet been isolated.

Assay.—"Hydrastis, in No. 60 powder, *fifteen grammes;* Ether, Ammonia Water, Distilled Water, Normal Sulphuric Acid V.S., each, *a sufficient quantity.* Introduce the Hydrastis into an Erlenmeyer flask of 250 Cc. capacity, add 150 Cc. of ether, shake the flask occasionally during ten minutes, and add 5 Cc. of ammonia water, again shaking the flask at intervals during half an hour. Then add 15 Cc. of distilled water to the mixture in the flask and shake it until the drug collects in masses, and at once pour off, into a measuring cylinder, 100 Cc. of the supernatant ether-solution and transfer it to a separator. Add 15 Cc. of normal sulphuric acid V.S. to the separator, and shake it moderately during one minute. Allow the liquids to separate, and draw off the lower acid liquid into a second separator. Again shake out the ether-solution with 5 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, and shake the separator for one minute. After the liquids have separated, draw off the acid solution as before into the second separator. Repeat the same process with 5 Cc. of distilled water, drawing this also into the second separator. Introduce a small piece of red litmus paper into the second separator, add enough ammonia water to render the liquid alkaline, and then 25 Cc. of ether, and shake the separator moderately during one minute, and when the liquids have separated, draw off the lower alkaline liquid into another separator, and the ether-solution into a tared beaker. Again shake out the alkaline liquid, using 20 Cc. of ether, shake the separator for one minute, and when the liquids have separated, draw off the alkaline liquid into the other separator, and the ether-solution into the tared beaker. Finally, again shake out the alkaline liquid, using 15 Cc. of ether, proceeding as before, and adding the ether-solution to the liquid in the tared beaker. Evaporate the ether carefully with the aid of a water-bath, and dry the alkaloidal residue in the beaker to a constant weight at 100° C. (212° F.). The weight found, multiplied by 10, will give the percentage of hydrastine in the Hydrastis." *U. S.*

Uses.—As a local remedy hydrastis has a very decided effect upon the mucous membrane. It has been used with asserted remarkable results in chronic *gastro-intestinal catarrhs,* especially those due to alcoholic excess, and as the commercial hydrastin is one of the drugs that was found in the experiments of Rutherford to notably increase the biliary secretion in the lower animals, it is probable that in gastric diseases attended by *hepatic congestion* and lack of functional activity it exerts an almost specific influence. It has been strongly recommended in *dyspepsia* and the *vomiting of pregnancy.* It is much used by specialists as a local remedy in the treatment of *otorrhœa, nasal, vaginal,* and other *catarrhs.* In the second stage of *gonorrhœa,* as an addition to injection mixtures, it may be of great service. In chronic or subacute *inflammations* of the *colon* and *rectum* injections of hydrastis are often of great service, and it has been used in *hemorrhoids* with asserted excellent results.

The strength of the local application of hydrastis to be used in various diseases of the mucous membrane varies from half a fluidrachm to two drachms of the fluidextract to one ounce of diluent. In *gonorrhœa* from five to ten grains (0.32 to 0.65 Gm.) of commercial hydrastin, or forty to eighty minims (2.5 to 5 Cc.) of the fluidextract, may be used to the fluidounce. In *hemorrhoids* from two to four drachms to the fluidounce may be used. The glycerite [1] is not so useful a local preparation

water in excess to the filtrate a further precipitate is produced, which contains *canadine.* Both precipitates, boiled with ethyl acetate, give solutions which on cooling deposit hydrastine in large crystals, somewhat colored, but rendered pure by recrystallization. The crystals from the second ammonia precipitate are much purer than those from the first; by slow evaporation of the ethyl acetate solution they can be obtained as large as walnuts.

Hydroberberine (Canadine), whose molecule contains four atoms of hydrogen more than the molecule of berberine, is said by Marfori to differ from berberine physiologically: it produces in moderate dose an increase in the blood pressure by stimulating the vasomotor centre in the medulla. *Opianic, hydrastinic,* and *berberinic acids* are said by the same authority to be almost inert physiologically, except that they are feebly antiseptic. (*T. G.,* 1890.)

For a physiological study of the *methylamine* derivatives of hydrastine (*hydrastine methylamine*), see *V. A. P. A.,* cxlii., 1895.

[1] *Liquor Hydrastinæ.*—Under the names of *Liquid Hydrastis, Fluid Hydrastis, Colorless Hydrastis,* etc.,

as the fluidextract diluted with water, a deposit of the insoluble resinous substance upon the mucous membrane and its constant prolonged influence being important.

The general action of hydrastis upon the system is probably chiefly due to its hydrastine (see p. 640).

It is essential to recognize the differences, medicinally, between the preparations of hydrastis. The so-called *hydrastin* of commerce is really an impure body, containing berberine, canadine, hydrastine, and probably some resin. It is this mixture which Rutherford found to have a pronounced influence upon the biliary secretion in the lower animals. Whether this action is or is not dependent upon the presence of berberine or other impurities is as yet uncertain. The practical deduction is, however, that when hydrastis is to be used in chronic gastro-intestinal catarrh, or as a local application to the mucous membrane, it is better to use hydrastin or the fluidextract rather than the pure alkaloid. The *dose* of this hydrastin is from five to ten grains (0.32 to 0.65 Gm.).

There is some reason for believing that *berberine* has a special action upon the gastro-intestinal tract. Marfori has, however, found that even in large therapeutic dose it is without perceptible influence upon the circulation or the nervous system. When, therefore, a preparation of hydrastis is to be used for effects other than a local action on the gastro-intestinal or other mucous membrane, a salt of the pure alkaloid hydrastine should be used. There is abundant clinical testimony to the great value of hydrastine in the treatment of *uterine hemorrhages,* whether occurring in the non-parturient or in the parturient woman.

Dose, of hydrastis, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Fluidextractum Hydrastis, *U. S.* (*Br.*); Glyceritum Hydrastis, *U. S.;* Tinctura Hydrastis, *U. S., Br.*

HYOSCINÆ HYDROBROMIDUM. U. S., Br.

HYOSCINE HYDROBROMIDE [Hyoscinæ Hydrobromas, Pharm. 1890, Hyoscine Hydrobromate]

(hȳ-ǫs-cī'næ hȳ-drǫ-brō'mi-dŭm)

$C_{17}H_{21}NO_4.HBr + 3H_2O = 434.92$

"The hydrobromide [$HBr.C_{17}H_{21}NO_4 + 3H_2O$] of an alkaloid, chemically identical with scopolamine, obtained from Hyoscyamus and other plants of the *Solanaceæ.* It should be kept in well-stoppered, amber-colored vials." *U. S.* "The hydrobromide, $C_{17}H_{21}NO_4$,HBr, $3H_2O$, of an alkaloid contained in Hyoscyamus Leaves, different species of Scopola, and possibly other solanaceous plants." *Br.*

Hyoscinum Hydrobromicum; Hydrobromate of Hyoscine, Scopolamine Hydrobromide; Bromhydrate d'Hyoscine, *Fr.;* Scopolaminum hydrobromicum, *P. G.;* Scopolaminhydrobromid, Hyoscinhydrobromid, Bromwasserstoffsaures Hyoscin, *G.*

This salt was introduced for the first time in the U. S. P. 1890. *Hyoscine,* $C_{17}H_{21}NO_4$, is found in the leaves and seeds of *Hyoscyamus niger, Duboisia myropoides, Scopola japonica, Atropa Belladonna* and other solanaceous plants. Pure hyoscine forms a syrupy liquid. The best salt for practical use is the hydrobromide, which is in "colorless, transparent, rhombic crystals, sometimes of large size, odorless, having an acrid, slightly bitter taste; slightly efflorescent. Soluble in 1.5 parts of water, 16 parts of alcohol, and in 750 parts of chloroform at 25° C. (77° F.); soluble in 1.33 parts of alcohol at 60° C. (140° F.); insoluble in ether. Its aqueous solution shows a slightly acid reaction to blue litmus paper. Hyoscine Hydrobromide, when heated, softens at about 100° C. (212° F.); it first melts and then loses its water of crystallization at 110° C. (230° F.). If dried over sulphuric acid until deprived of its water of crystallization, it melts at 179.7° C. (355.5° F.). When ignited, it leaves no residue. Hyoscine chloraurate crystallizes in yellow prisms and melts at 197° C. (386.6° F.). Hyoscyamine chloraurate crystallizes in yellow leaflets and melts at 160° C. (320° F.). Atropine chloraurate crystallizes in dull yellow grains and melts at 136° C. (276.8° F.). If 2 Cc. of chloroform be shaken with 1 Cc. of solution of Hyoscine Hydrobromide (1 in 10), to which a few drops of chlorine water have been cautiously added, it should assume a brownish color. If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide T.S. Silver nitrate T.S., when added to a solution of the salt, affords a yellowish-white precipitate insoluble in nitric acid, but the washed precipitate is soluble in an excess of ammonia water. Mercuric potassium iodide T.S., in aqueous solutions of the salt acidified with hydrochloric acid, yields a yellowish-white precipitate. Mercuric chloride T.S. and solution of phosphotungstic acid give a white precipitate when added to an aqueous solution of the salt. Picric acid T.S. and platinic chloride T.S. yield yellow precipitates when added to a concentrated solution of the salt. Sulphuric acid should give no color when added to Hyoscine Hydrobromide (absence of *carbonizable impurities*); nor should any color be developed on the subsequent addition of a drop of nitric acid (absence of *morphine*)." *U. S.* "It

preparations of the alkaloids of hydrastis have been largely used. In some cases these solutions have been made directly from the drug by depriving a fluidextract of coloring matter (see *Glyceritum Hydrastis*), in others the alkaloid has been dissolved in a suitable liquid. Gust. Steinman (*A. J. P.*, 1887, 296) examined several samples and found hydrastine in each, combined with either sulphuric or hydrochloric acid, besides aluminum, potassium, boric acid, etc., in small proportion; by dissolving 20 grains of hydrastine sulphate or hydrochloride in a pint of a solution of glycerin and water (sp. gr. 1.15), a liquid is produced from which the asserted good results can be obtained.

has an acrid, slightly bitter taste, and is odorless. It is soluble in 1 part of cold *water* and in 13 parts of *alcohol* (90 per cent.), very slightly soluble in *ether* or *chloroform*. When heated to 212° F. (100° C.) it loses rather more than 12 per cent. of its weight and fuses to a viscid mass which becomes liquid at a temperature of 379.4° to 381.2° F. (193° to 194° C.). An aqueous solution yields a precipitate with *test-solution of mercuric chloride, solution of iodine,* or *solution of potassium hydroxide,* but not with *solution of ammonia* or *solution of potassium bichromate.* It forms with *auric chloride* a crystalline salt having a melting point of 388.4° F. (198° C.). It affords the reactions characteristic of hydrobromides. Its aqueous solution slightly reddens *litmus.* Heated to redness with access of air it leaves no residue." *Br.*

E. Schmidt (*Ap. Ztg.,* 1891, 522) believes that the hyoscine hydrobromide of commerce is essentially hydrobromide of *scopolamine,* $C_{17}H_{21}NO_4$. This view has been confirmed by O. Hesse (*Ann. Ch. Ph.,* 1893, 304), and the British Pharmacopœia defines hyoscine as an alkaloid contained in hyoscyamus, different species of Scopola, and possibly other solanaceous plants, while the German Pharmacopœia changed the title to "Scopolaminum Hydrobromicum." The U. S. Pharmacopœia (8th Rev.) introduced Scopolaminæ Hydrobromidum as a separate title, but referred to Hyoscinæ Hydrobromidum for the description and tests, declaring them to be identical substances. *Atroscine* was found by Hesse in variable amount in the hyoscine hydrobromide of commerce. It is a mydriatic equal in power to atropine or scopolamine.

Uses.—Various observers have noted that the impure amorphous hyoscyamine is more powerful than the crystallized alkaloid. These observations, with the chemical fact that amorphous hyoscyamine is chiefly hyoscine, in 1884 led H. C. Wood to make a careful physiological study of that alkaloid upon the lower animals and to apply it to clinical medicine. It was found that the pure hyoscine produced in the frog, motor reflex paralysis, due to a depression of the spinal cord, and that in mammals it caused disturbance of respiration, loss of muscular power, pronounced tendency to stupor, and, finally, death by asphyxia. It exerts very little influence upon the circulation even when in toxic doses. It became evident that the drug was a depressant of the principal cerebral centres, of the respiratory centres, and also of the lower motor centres of the spinal cord. In man, the ingestion of hyoscine in decided doses is followed in a very short time by dryness of the mouth, flushings of the face, great sleepiness, associated in some cases with delirious mutterings, and giddiness akin to that of alcoholic intoxication. The respirations are usually lessened in frequency, and the pulse rate is also somewhat diminished. Dilatation of the pupils is usually, but not invariably, produced. After toxic doses these symptoms are intensified, while the frequent loss or impairment of the power of swallowing, and a peculiar hoarseness of the voice, with, in some cases, laryngeal dyspnœa, indicate that the muscles of the larynx, as well as those of the pharynx, have a special tendency to be paralyzed by the alkaloid; the respiration not only becomes slow and full, but sometimes takes on a distinctly Cheyne-Stokes character; the skin is not dry, as in atropine poisoning, but is frequently covered with sweat. No cases of fatal poisoning are on record. One-fourth of a grain (0.016 Gm.) of very impure hyoscine produced in the case of Hutchinson profound muscular relaxation, with quiet coma lasting for eleven hours. In applying hyoscine to the treatment of disease, H. C. Wood found that it is a valuable soporific, especially useful in those cases in which the wakefulness is complicated with or due to cerebral excitement. In *insomnia* produced by overwork, when the brain seems to lose the capability of ceasing its action, hyoscine is of service; but it is especially valuable in actively delirious conditions, such as occur in *acute mania* or in exacerbations in the course of *chronic mania.* In those cases in which morphine increases the cerebral excitement hyoscine usually acts most happily. According to the statements of Bruce and Tirard, it is an entirely safe remedy in cases of severe kidney disease when morphine is contra-indicated. H. C. Wood has found that it is an efficient remedy in the treatment of sexual excitement, such as *nymphomania, spermatorrhœa,* and allied affections, and that it will almost invariably control *excessive seminal emissions.* Hyoscine rarely, if ever, produces much more serious after effects than a little dryness of the throat and headache, and does not disturb the alimentary canal. The reports of later clinicians indicate that excessive susceptibility to its influence is a not infrequent idiosyncrasy, and it is even affirmed that one two-hundredth of a grain has caused alarming symptoms. It is probable, however, that much larger doses were taken in these cases than is alleged. On account of its tendency to produce pharyngeal and laryngeal paralysis, it should not be employed in such diseases as scarlet fever or diphtheria when there is a tendency to throat difficulties. Being practically tasteless, hyoscine is readily given in food or drink without the knowledge of the patient. It acts well when taken by the mouth, but is especially efficient and prompt when administered hypodermically, and never produces local irritation. The effects of a hypodermic dose are usually manifested inside of ten minutes, and persist for six or eight hours.

The dose by the mouth is from one one-hundred and twentieth to one-sixtieth of a grain (0.0005 to 0.001 Gm.); for hypodermic injections one one-hundred and fiftieth to one one-hundredth of a grain (0.0004 to 0.0006 Gm.). On account of the susceptibility of some persons to it, the commencing dose by the mouth

should not be over one one-hundred and twentieth of a grain (0.0005 Gm.), by injection one one-hundred and fiftieth of a grain (0.0004 Gm.); after cautious trial, doses larger than the maximum just given may be employed.

Dose, one one-hundred and fiftieth to one eightieth of a grain (0.0004 to 0.0008 Gm.).

HYOSCYAMINÆ HYDROBROMIDUM. U. S.

HYOSCYAMINE HYDROBROMIDE [Hyoscyaminæ Hydrobromas, Pharm. 1890, Hyoscyamine Hydrobromate]

(hȳ-ǫs-cȳ-ą-mī'næ hȳ-drǫ-brō'mį-dŭm)

$C_{17}H_{23}NO_3.HBr = 367.40$

"The hydrobromide [HBr.$C_{17}H_{23}NO_3$] of an alkaloid obtained from hyoscyamus and other plants of the *Solanaceæ*. It should be kept in amber-colored, well-stoppered vials." *U. S.*

Hyoscyaminum Hydrobromicum; Bromhydrate d'Hyoscyamine, *Fr.*; Hyoscyaminhydrobromid, Bromwasserstoffsaures Hyoscyamin, *G.*

Preparation.—This salt may be made by dissolving 10 Gm. of hyoscyamine in 11 Gm. of hydrobromic acid (25 per cent.), evaporating and crystallizing.

Properties.—Hyoscyamine hydrobromide is officially described as in "white, prismatic crystals, or a yellowish, amorphous, resin-like mass, having, particularly when damp, a tobacco-like odor, and an acrid, nauseous, and bitter taste; deliquescent on exposure to the air. Very soluble in water; soluble in 2 parts of alcohol, 1600 parts of ether, and in 2.5 parts of chloroform at 25° C. (77° F.). Its aqueous solution is neutral to litmus paper, and is strongly lævogyrate. It melts at 151.8° C. (305.3° F.). It leaves no residue on incineration. Hyoscyamine chloraurate melts at 160° C. (320° F.). Atropine chloraurate melts at 136° C. (276.8° F.). Hyoscine chloraurate melts at 197° C. (386.6° F.). Hyoscyamine picrate melts at 162° C. (323.6° F.). Atropine picrate melts at 175° C. (347° F.). Silver nitrate T.S., when added to a solution of the salt, yields a yellowish-white precipitate which is insoluble in nitric acid, but the washed precipitate is soluble in an excess of ammonia water. Gold chloride T.S., when added to a solution of the salt, yields a precipitate which, when recrystallized from a small quantity of boiling water acidulated with hydrochloric acid, is deposited, on cooling, in minute, lustrous, golden-yellow scales (difference from *atropine*). Platinic chloride T.S. does not form a precipitate with solutions of the salt (difference from *most alkaloids*). If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide T.S. Sulphuric acid should produce no color when added to Hyoscyamine Hydrobromide (absence of *carbonizable impurities*), nor should any color be developed upon the subsequent addition of a drop of nitric acid (absence of *morphine*)." *U. S.*

Uses.—The medicinal properties and the dose of this salt of hyoscyamine are precisely those of the sulphate, to which it is preferred by some.

Dose, one one-hundred and twentieth to one one-hundredth of a grain (0.0005 to 0.0006 Gm.).

HYOSCYAMINÆ SULPHAS. U. S., Br.

HYOSCYAMINE SULPHATE

(hȳ-ǫs-cȳ-ą-mī'næ sŭl'phăs)

$(C_{17}H_{23}NO_3)_2.H_2SO_4 = 671.43$

"The neutral sulphate [$SO_2(OH)_2.(C_{17}H_{23}NO_3)_2$] of an alkaloid obtained from Hyoscyamus and other plants of the *Solanaceæ*. It should be kept in amber-colored, well-stoppered vials." *U. S.* "The sulphate, $(C_{17}H_{23}NO_3)_2$, H_2SO_4,$2H_2O$, of an alkaloid contained in Hyoscyamus Leaves and possibly other solanaceous plants." *Br.*

Sulfate d'Hyoscyamine, *Fr.*; Hyoscyaminum Sulfuricum, Schwefelsaures Hyoscyamin, Hyoscyaminsulfat, *G.*

Although Brandes announced the existence of an alkaloid in the seeds of *Hyoscyamus niger*, the process which he used to obtain it was not successful in other hands. The credit of first isolating the alkaloid *hyoscyamine* or *hyoscyamia* from the plant must be given to Geiger and Hesse, who obtained it as long ago as 1833. Höhn and Reichardt's process, in which the seed is used as the source, is as follows. They treat hyoscyamus seed first with ether to separate fatty matter, then with alcohol acidulated with a few drops of sulphuric acid, and afterwards distil the alcoholic solution. The aqueous residue is to be neutralized with sodium hydroxide, and the liquid precipitated by a solution of tannin. The precipitate, having been placed on a porcelain plate to dry, is mixed while yet moist with an excess of lime, and then exhausted by strong alcohol. The alcoholic solution is treated with sulphuric acid, then with sodium hydroxide, and finally with ether, which dissolves the liberated hyoscyamine. By distilling off the ether a colorless oleaginous liquid is left, which at length concretes. (*J. P. C.*, Mai, 1872, p. 385.)

These investigators gave to hyoscyamine the formula $C_{15}H_{23}NO_3$, but Ladenburg has shown by a study of its decomposition products that it is isomeric with atropine, $C_{17}H_{23}NO_3$. Ladenburg made the most complete study of atropine and hyoscyamine that we have, and has established their relations to each other in a clear light. According to him (*Ber. d. Chem. Ges.*, xiii. pp. 251, 909, and 1549), hyoscyamus contains two alkaloids, a crystalline one, to which the name of *hyoscyamine* is given, and which

is the one hitherto studied under that name, and an amorphous one, which remains in the mother liquor after the removal of the crystallizable alkaloid. It can be extracted by the formation of the gold salt, which is less soluble than hyoscyamine gold chloride. This alkaloid, for which he proposed the name *hyoscine,* and to which he gave the same formula ($C_{17}H_{23}NO_3$) as hyoscyamine, yields different decomposition products upon decomposition by baryta water. Hyoscyamine treated with boiling baryta water assimilates a molecule of water and splits up into what were called *hyoscinic acid,* $C_9H_{10}O_3$, and *hyoscine,* $C_8H_{15}NO$, but which Ladenburg shows to be simply identical with the decomposition products of atropine, *tropic acid* and *tropine.* The nonexistence of Ladenburg's hyoscine of the formula $C_{17}H_{23}NO_3$ and the truth of the statement that commercial hyoscine is identical with scopolamine (see p. 645) is strongly supported upon large experience in manufacturing these bases by L. Merck. Inasmuch as Ladenburg (*Ber. d. Chem. Ges.,* xii. 941) has succeeded in effecting the synthesis of *atropine* by the combination of tropic acid and tropine (the two decomposition products which are common to the two alkaloids *atropine* and *hyoscyamine*), we must look for the differences between these two to physical and molecular sources rather than chemical.

Hyoscyamine crystallizes in colorless, transparent, silky needles, fusing at 108.5° C., is inodorous, of an acrid, disagreeable taste, slightly soluble in water, very soluble in alcohol and ether, and volatilizable with little change if carefully distilled. It is quickly altered by contact with water and an alkali, and when heated with potassium or sodium hydroxide is completely decomposed, with the disengagement of ammonia. It neutralizes the acids, forming crystallizable salts, and is precipitated by infusion of galls. The alkaloid and its salts are very poisonous, and the smallest quantity, introduced into the eye, produces dilatation of the pupil, which continues long.

Hyoscine has been known in commerce as *amorphous hyoscyamine.* The best salts, according to Edlefsen, to prepare and dispense are the *hydrobromide* and *hydriodide.* Hyoscine hydriodide crystallizes from water, in which it is only moderately soluble, in small, hemihedral prisms, which mostly have a slight yellowish color. (See *Hyoscinæ Hydrobromidum.*)

The double gold chloride, $C_{17}H_{21}NO_4HCl + AuCl_3$, is less soluble than the corresponding gold salt of hyoscyamine, and so serves to separate them when together.

Properties.—The U. S. Pharmacopœia describes hyoscyamine sulphate as "white, indistinct crystals, or a white powder; odorless, having a bitter, acrid taste; deliquescent when exposed to the air. Very soluble in water; soluble in 6.4 parts of alcohol, 2500 parts of ether, and in 2300 parts of chloroform at 25° C. (77° F.). Its aqueous solution is lævogyrate, and neutral to litmus paper. It melts at 198.9° C. (390.1° F.). Upon ignition it is rapidly consumed without residue. Hyoscyamine chloraurate melts at 160° C. (320° F.). Atropine chloraurate melts at 136° C. (276.8° F.). Hyoscine chloraurate melts at 197° C. 386.6° F.). Hyoscyamine picrate melts at 162° C. (323.6° F.). Atropine picrate melts at 175° C. (347° F.). Barium chloride T.S., when added to an aqueous solution, yields a white precipitate, insoluble in hydrochloric acid. Gold chloride T.S., when added to an aqueous solution, yields a precipitate which, when recrystallized from a small quantity of boiling water, acidulated with hydrochloric acid, is deposited on cooling in minute, lustrous, golden-yellow scales (difference from *atropine*). Platinic chloride T.S. does not form a precipitate with solutions of the salt (difference from *most alkaloids*). If 0.01 Gm. of the salt be added to 5 drops of nitric acid, and evaporated to dryness in a porcelain dish, the residue should yield a violet color upon the addition of alcoholic potassium hydroxide T.S. Sulphuric acid should produce no color when added to Hyoscyamine Sulphate (absence of *carbonizable impurities*)." *U. S.* "A crystalline powder, deliquescent, odorless, having a bitter acrid taste. Melting point 402.8° F. (206° C.). Soluble in 0.5 part of *water,* 2.5 parts of *alcohol* (90 per cent.), very slightly soluble in *ether* or *chloroform.* It affords the reactions characteristic of sulphates. A solution in *water* acidulated with *hydrochloric acid* yields no precipitate with *solution of platinic chloride,* but affords with *solution of auric chloride* a yellow precipitate soluble in boiling *water* acidulated with *hydrochloric acid,* and again deposited, as the solution cools, in brilliant, golden-yellow scales (distinction from atropine). Heated to redness with access of air it leaves no residue." *Br.*

Uses.—Owing to the facts that until very recently commercial hyoscyamine has usually been contaminated with hyoscine, and that few careful studies of a chemically pure hyoscyamine have been made, its exact influence upon the human system is not positively determined. The studies of J. C. Shaw appear, however, to prove that hyoscyamine acts upon the nervous system and the circulation, including the heart and the vasomotor system, precisely as does atropine, except as regards respiration, which appears in most cases to have been slowed rather than increased in rapidity, an indication that hyoscyamine, unlike atropine, is not a respiratory stimulant. Shaw also found that hyoscyamine is less powerful as a mydriatic and more powerful as a soporific than is atropine. On the other hand, in studies upon normal men, Richter could not perceive that hyoscyamine had a tendency to produce sleep. Sydney Ringer, in a careful comparative study of hyoscyamine and atropine in acute

mania, was unable to detect any important differences in the action of the two substances. The dose of commercial hyoscyamine varies greatly according to its purity, but one-fortieth of a grain (0.0016 Gm.) of the pure alkaloid has produced violent poisoning, with symptoms similar to those caused by atropine; not more than one-eightieth of a grain (0.0008 Gm.) should be given as a commencing dose.

Dose, one one-hundred and twentieth to one one-hundredth of a grain (0.0005 to 0.0006 Gm.).

HYOSCYAMUS. U. S. (Br.)

HYOSCYAMUS [Henbane]

(hȳ-ǫs-cȳ′ą-mŭs)

"The dried leaves and flowering tops of *Hyoscyamus niger* Linné (Fam. *Solanaceæ*), collected from plants of the second year's growth, and yielding, when assayed as directed below, not less than 0.08 percent. of mydriatic alkaloids." *U. S.* "The fresh leaves and flowers, with the branches to which they are attached, of Hyoscyamus niger, *Linn.;* also the leaves and the flowering tops, separated from the branches and carefully dried. Collected from the flowering biennial plants." *Br.*

Hyoscyami Folia, *Br.;* Black Henbane, Stinking Nightshade, Insane Root, Poison Tobacco; Jusquiame noire, *Fr. Cod.;* Belene, Chenile, *Fr.;* Herba Hyoscyami, *P. G.;* Bilsenkraut, Bilsenkrautblätter, *G.;* Giusquiamo, *It.;* Beleno, *Sp.*

There are about eleven species of the genus Hyoscyamus known; these are distributed from the Canary Islands over Europe and Northern Africa to Asia.

Hyoscyamus niger, L., *Sp. Pl.* (1753) 179; Willd., *Sp. Plant.* i. 1010; Woodv., *Med. Bot.,* 204, t. 76; Carson, *Illust. of Med. Bot.,* ii. 19, pl. 66.—Henbane is usually a biennial plant, with a long, tapering, whitish, fleshy, somewhat branching root, not unlike that of parsley, for which it has been eaten by mistake, with poisonous effects. The stem, which rises in the second year, is erect, round, branching, from one to four feet high, and thickly furnished with leaves. These are large, oblong-ovate, deeply sinuated with pointed segments, undulated, soft to the touch, and at their base embrace the stem. The upper leaves are generally entire. Both the stem and leaves are hairy, viscid, and of a sea-green color. The flowers form long, one-sided, leafy spikes, which terminate the branches, and hang downward. They are composed of a calyx with five pointed divisions, a funnel-shaped corolla, with five unequal, obtuse segments at the border, five stamens inserted into the tube of the corolla, and a pistil with a blunt, round stigma. The corolla is of an obscure yellow color, beautifully variegated with purple veins. The fruit is a globular two-celled capsule, covered with a lid, invested with the persistent calyx, and numerous small seeds, which are discharged by the horizontal separation of the lid. The whole plant has a rank, offensive odor.

H. niger is susceptible of considerable diversity of character, causing varieties which have by some been considered as distinct species. Thus, the plant is sometimes annual, the stem simple, smaller, and less downy than in the biennial plant, the leaves shorter and less hairy and viscid, and the flowers often yellow without the purple streaks. It has been ascertained that much difference of medicinal properties is connected with these diversities of character, and the Pharmacopœias direct the biennial variety as the most efficient.

The plant is found in the northern and eastern sections of the United States, occupying waste grounds in the older settlements, particularly cemeteries, old gardens, and the foundations of ruined houses. It is not, however, a native of this country, having been introduced from Europe. In Great Britain, and on the continent of Europe, it grows abundantly along the roads, around villages, amidst rubbish, and in uncultivated places. Both varieties were formerly cultivated in England, but at present the biennial is chiefly or solely grown. The annual plant flowers in July or August, the biennial in May or June. For an account of the cultivation of the biennial variety at Hitchin, England, see *P. J.,* Feb. 1860.

H. albus, so named from the whiteness of its flowers, is used in France indiscriminately with the former species, with which it appears to be identical in medicinal properties. *Hyoscyamus muticus,* L., of Egypt is said to grow luxuriantly in the temperate zone and to produce a very much larger proportion of alkaloid than does the official English plant. It appeared in the London market in the form of broken stalks with a few capsular fruits and traces of leaves and may become an important source of the alkaloids to the manufacturers.

All parts of *Hyoscyamus niger* are active. The official description of the plant is as follows: "Leaves ovate or ovate-oblong, the lower with a short petiole, the upper sessile, 5 to 25 Cm. long, 2 to 10 Cm. broad, acute, coarsely and angularly toothed or lobed, grayish-green, glandular-hairy, particularly on the lower surface; flowers nearly sessile, with an urn-shaped, unequally 5-toothed calyx and a campanulate, purple-veined corolla, which in the fresh state is yellowish; fruit capsular, 2-celled, and enclosed in the calyx; odor heavy, narcotic; taste somewhat bitter and nauseous. The powder is grayish-green and contains calcium oxalate in single or twin monoclinic prisms about 0.010 Mm. in diameter." *U. S.*

The mesophyll of the leaf contains small prisms of calcium oxalate. Much of the efficacy of hyoscyamus depends upon the time at which it is gathered. The leaves should be collected soon after the plant has flowered. In the biennial plant, those of the second year are preferred to those of the first. The latter, ac-

cording to Houlton, are less clammy and fetid, yield less extractive, and are medicinally much less efficient. It is said that the plant is sometimes destroyed by severe winters in England, and that no leaves of the second year's growth are then obtainable. This is, perhaps, one of the causes of the great uncertainty of the medicine as found in commerce. The root also is said to be much more poisonous in the second year than in the first.[1]

Assay. U. S. (8th Rev.)—"The method to be employed is identical with that given on page 228, with the exception that *twenty-five grammes* of Hyoscyamus in No. 60 powder are to be used, the quantity of chloroform-ether mixture which is added at first increased from 50 Cc. to 100 Cc., and the product at the end of the assay multiplied by 4 instead of 10." *U. S.*

Properties.—The recent leaves have, when bruised, a strong, disagreeable, narcotic odor, somewhat like that of tobacco. Their taste is mucilaginous and very slightly acrid. When dried, they have little odor or taste. Thrown upon the fire, they burn with a crackling noise, as if they contained a nitrate, and at the same time emit a strong odor. Their virtues are completely extracted by diluted alcohol. The aqueous infusion is of a pale-yellow color, insipid, with the narcotic odor of the plant. The leaves were analyzed by Lindbergsen, who obtained from them a narcotic principle. They contain a large proportion of potassium nitrate, F. Mahla having obtained, as nearly as he could estimate from his experiments, 2 per cent. of that salt. (*A. J. P.*, 1859, p. 402.) The seeds are very small, roundish, compressed, somewhat kidney-shaped, a little wrinkled, of a gray or yellowish-gray color, of the odor of the plant, and of an oleaginous, bitterish taste. Geiger and Hesse (1833) were the first to demonstrate the existence of an alkaloid in hyoscyamus. Ladenburg stated in 1880 that there are two alkaloids in the plant, —one crystallizable, *hyoscyamine,* and the other amorphous, *hyoscine* (scopolamine, p. 645). (See *Hyoscyaminæ Sulphas,* p. 647, and *Hyoscinæ Hydrobromidum,* p. 645.) Höhn (*Ann. Ch. Ph.*, 157, 98) obtained from the seeds a bitter principle which proved to be a glucoside. He calls it *hyoscypicrin,* and gives it the formula $C_{27}H_{52}O_{14}$.

From experiments made by Hirtz upon the relative medicinal power of extracts from the seeds and from the leaves, he inferred that the former had ten times the strength of the latter. Henbane leaves yield, by destructive distillation, a very poisonous empyreumatic oil.

Uses.—Hyoscyamus was known to the ancients, and was employed by some of the earlier modern practitioners, but had fallen into disuse, and was almost forgotten, when Baron Störck again introduced it into notice. By this physician and some of his successors it was prescribed in numerous diseases, and, if we may credit their testimony, with the happiest effects; but subsequent experience of its operation has greatly narrowed the extent of its application. It is at present used almost exclusively to relieve *pain,* procure sleep, or quiet irregular nervous action, and is not supposed to exercise any specific curative influence over particular diseases. It is similar in its physiological action to belladonna, and in poisonous doses produces similar symptoms; but it is more of a hypnotic and much feebler. It is chiefly employed to allay nervous irritation, in *hysteria,* and in various pectoral diseases with *cough,* also to prevent griping by the vegetable cathartics. In Europe, where the fresh leaves are readily obtained, it is often applied externally in the shape of lotion, cataplasm, or fomentation, to allay pain and irritation, in *scrofulous* or *cancerous ulcers, scirrhous, hemorrhoidal,* or other painful *tumors, gouty* and *rheumatic swellings,* and *nervous headaches.* The treatment of hyoscyamus poisoning is identical with that of belladonna poisoning. (See *Belladonna,* p. 228.)

Hyoscyamus may be given in fluidextract, solid extract or in tincture. The dose of the leaves is from five to ten grains (0.32 to 0.65 Gm.), that of the seeds somewhat smaller. The extract, or inspissated juice of the fresh leaves (*Extractum Hyoscyami Viride, Br.*), is exceedingly variable in its operation, being sometimes active, sometimes almost inert. The usual dose is from two to three grains (0.13 to 0.20 Gm.), repeated and gradually increased until its effects are obtained. The alcoholic extract (*Extractum Hyoscyami, U. S.*) is more certain. The dose of the extract is from one to two grains (0.065 to 0.13 Gm.), increased *pro re nata.*

Dose, of the leaves, two to five grains (0.13 to 0.32 Gm.).

Off. Prep.—Extractum Hyoscyami, *U. S.* (from fluidextract) (*Br.*); Fluidextractum Hyoscyami, *U. S.;* Pilula Colocynthidis et Hyoscyami, *Br.* (from extract); Succus Hyoscyami, *Br.;* Tinctura Hyoscyami, *U. S., Br.*

INFUSA. U. S.

INFUSIONS

(ĭn-fu'zə)

Apozèmes, Tisanes, Infusions, *Fr.;* Infusa, *P. G.;* Infusionen, Aufgüsse, *G.;* Infusi, *It.;* Infusiones, *Sp.*

These are aqueous solutions obtained by treating with water, without the aid of ebulli-

[1] The several products of the hyoscyamus plants are placed by R. Usher (*P. J.*, Aug. 1867) in the following order, as to efficiency; 1, the leaves of the biennial plant of the second year's growth; 2, the biennial plant of the first year; 3, the British annual henbane; 4, the German annual henbane. The last two, though most extensively used, are really nearly valueless, and should always be rejected. The British annual so nearly resembles the biennial of the second year, having flowers, that the two may be easily mistaken for each other; but a sufficient distinction is that the annual plant "possesses no flavor or odor." Besides, the leaves are much shorter, and occasionally there is a pure primrose blossom, which never happens with the biennial, which is beautifully streaked. The biennial plant is so liable to the attacks of worms that at one time little of the second year's growth was collected, and the market was supplied with a very inferior article.

tion, vegetable products only partially soluble in that liquid. The water employed may be hot or cold, according to the objects to be accomplished. Infusions are generally prepared by pouring boiling water upon the vegetable substance and macerating the mixture in a tightly closed vessel until the liquid cools. The soluble principles are thus extracted more rapidly, and, as a rule, in a larger proportion, than at a lower temperature. Some principles, moreover, are dissolved in this manner which are nearly or quite insoluble in cold water. A prolonged application of heat is in some instances desirable, and this may be effected by placing the vessel near the fire. Cold water is preferred when the active principle is highly volatile, when it is injured by heat, or when any substance of difficult solubility at a low temperature exists in the vegetable, which it is desirable to avoid in the infusion. A longer continuance of the maceration is necessary in this case, and in warm weather there is sometimes danger that spontaneous decomposition may commence before the process is completed. When a strong infusion is required, the process of *percolation* may be advantageously resorted to. The water employed should be free from saline impurities, which frequently produce precipitates and render the infusion turbid. Fresh river, rain, or distilled water is usually preferable to water pumped from wells or obtained from springs, except when the latter are known to produce water which will not react with any of the constituents of the infusion.

The substance to be acted on should be sliced or bruised, or in the state of powder, but this last condition is seldom requisite, unless when percolation is employed, and is always inconvenient, as it requires that the infusion should be filtered through paper in order completely to separate the undissolved portion. In other cases it is sufficient to strain it through fine linen or muslin. When percolation is resorted to, the substance should be more or less finely powdered. The United States Pharmacopœia furnishes a general formula for infusions, which is to be used when the proportions are not specified. In the U. S. P. 1880 the strength of such infusions was fixed at 10 per cent. Experience has shown, however, that this was too strong for general purposes, and in the U. S. Pharmacopœia of 1890 and the Eighth Revision, 5 per cent. has been chosen as the limit.

General Formula for Infusions, U. S. P.

"An ordinary Infusion, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula:" *U. S.* "Take of The Substance, coarsely comminuted, *fifty grammes* [or 1 ounce av., 334 grains]; Boiling Water, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Introduce the Substance into a suitable vessel provided with a cover, pour upon it the Boiling Water, cover the vessel tightly, and let it stand for half an hour in a warm place. Then strain with expression, and pass enough Water through the strainer to make the Infusion measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"*Caution.*—The strength of Infusions of energetic or powerful substances should be specially prescribed by the physician." *U. S.*

Infusions are usually prepared in glazed earthenware or porcelain vessels fitted with covers. Brande suggests the use of clean metallic vessels, which, when finely polished, retain the heat for a longer time, but they are more liable to chemical alterations, and may sometimes injuriously affect the preparation. Vessels of block-tin are generally well adapted for the purpose.

As infusions do not keep well, especially in warm weather, they should be made extemporaneously and in small quantities. In this country they are usually prepared in the patient's home, and the propriety of their introduction into the Pharmacopœia has been doubted, but it is desirable to have certain fixed standards for the regulation of the medical practitioner, and it is always preferable to direct infusions from the apothecary, for whose guidance official formulas are necessary. Physicians would, indeed, find an advantage in more frequently directing them to be prepared by the pharmacist, instead of leaving their preparation to the carelessness or want of skill of attendants upon the sick. Infusions may be kept during hot weather, and for many months, by straining them *while hot*, and pouring them at once into bottles provided with accurately ground stoppers. The bottle must be brim-full, the stopper being made to displace its bulk of the fluid. A common bottle with a cork stopper may be used, if the softened cork be forced into the full bottle, tied down, and at once dipped into hot sealing wax. The hotter the liquid and the freer from air the better will the infusion keep. Sterilization of infusions by heating them to the boiling point, then preserving in bottles which have been kept hot to destroy germs, and stoppered with sterilized cotton, is effective, particularly if the bottles have a stopcock near the bottom to draw the infusion when wanted. Alméns has proposed a very efficient method of preserving infusions. (*A. J. P.*, April, 1875.) It is as follows: The infusion or decoction is heated for some time in a water bath at 100° C. (212° F.), and the bottle is then fitted with a tight cork, through which a glass tube passes, lightly filled with cotton wool. The cork has a second opening, through which a glass tube passes nearly to the bottom of the bottle; this tube is bent at a sharp angle and has fitted to it a piece of india rubber tubing, to which a pinchcock is attached, by means of

which the contents may be drawn as wanted. By making very concentrated infusions, as suggested by Donovan, with a mixture of three parts of water and one part of alcohol, they may be long kept, and when used can be diluted with water to the proper strength. Thus, if made four times as strong as the official infusion, they may be diluted with three measures of water. The proportion of alcohol would thus be very small, but it might still be medicinally injurious, and infusions should not be prepared in this way unless with the cognizance of the prescriber.

Battley of London introduced a set of preparations, which he called *inspissated infusions,* the advantages of which are that the virtues are extracted by cold water, are not injured by heat used in the evaporation, are in a concentrated state, and are not impaired by time. To prepare them he macerated the material, coarsely powdered, bruised, or finely sliced, in twice its weight of cold distilled water, pressing the solid matter into the liquid repeatedly by a rammer or the hand; then allowed the liquid to drain out, or expressed it in the case of highly absorbent substances, and repeated the process, with an amount of water equal to that which had been separated, until the strength was exhausted. Four or six hours of maceration were usually sufficient. The infusion is then to be concentrated by evaporation, at a temperature not exceeding 71.1° C. (160° F.) to the sp. gr. 1.200, and as much alcohol is to be added as will make its sp. gr. 1.100. These preparations are very analogous to the *fluidextracts* already considered. As a rule, it would probably be preferable to prepare infusions by the process of percolation.

The inspissated infusions must be diluted when administered. The presence of alcohol, though in small quantity, would sometimes be a serious objection. (*P. J.*, x. 129.) *Concentrated infusions* of the strength of 50 per cent. were introduced into the British Pharmacopœia (1898); they are mostly made by percolation, and are termed "Liquors." (See *Liquor Chiratæ Concentratus.*) This certainly leads to confusion in nomenclature, and it is difficult to understand why they were not called concentrated infusions, particularly as their almost universal use is for making ordinary infusions by diluting with water.

As we have already treated of the chemical relations and medicinal properties of the substances used in infusion, it would be useless repetition to enlarge upon these points in the following details. We shall touch upon them only in cases of peculiar interest, or where changes requiring particular notice may grow out of the nature of the process.[1]

INFUSUM AURANTII. Br.

INFUSION OF ORANGE PEEL

(ĭn-fū'zŭm âu-răn'tĭ-ī)

Tisane d'Ecorce d'Orange, *Fr.;* Pomeranzenschalenaufguss, *G.*

"Dried Bitter-Orange Peel, cut small, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

A grateful stomachic.

Dose, from one-half to one fluidounce (15 to 30 Cc.).

INFUSUM AURANTII COMPOSITUM. Br.

COMPOUND INFUSION OF ORANGE PEEL

(ĭn-fū'zŭm âu-răn'tĭ-ī cŏm-pŏz'ĭ-tŭm)

Tisane d'Ecorce d'Orange composée, *Fr.;* Pomeranzen- und Citronenschalenaufguss, *G.*

"Dried Bitter-Orange Peel, cut small, ½ *ounce* (Imperial) or 25 grammes; Fresh Lemon Peel, cut small, ¼ *ounce* (Imp.) or 12.5 grammes; Cloves, bruised, 55 *grains* (Imp.) or 6.25 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

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[1] At the several revisions of the Pharmacopœias the following Infusions have been dropped from the official lists. We give the former official formulæ.

Infusum Catechu. Br. 1885. *Infusion of Catechu.* "Take of Catechu, in coarse powder, *one hundred and sixty grains;* Cinnamon Bark, bruised, *thirty grains;* Boiling Distilled Water, *ten fluidounces* [Imp. meas.]. Infuse in a covered vessel, for half an hour, and strain." *Br.* 1885. *Dose,* from one to three fluidounces (30 to 90 Cc.).

Infusum Cusso. Br. 1885. *Infusion of Kousso.* "Take of Kousso, in coarse powder, *one-half an ounce* [avoirdupois]; Boiling Distilled Water *eight fluidounces* [Imp. meas.]. Infuse in a covered vessel, for fifteen minutes. Not to be strained." *Br.* 1885. The whole may be taken for a dose. The *infusion of brayera* (kousso) was very properly dropped at the 1890 revision of the U. S. P. The old formula is as follows: "Brayera, in No. 20 powder, *six parts* [or one ounce avoirdupois]; Boiling Water, *one hundred parts* [or one pint]. Pour the Boiling Water upon the Brayera, and let it macerate in a covered vessel until cool. This infusion should be dispensed without straining it." *U. S.* 1880.

Infusum Jaborandi. Br. 1885. *Infusion of Jaborandi.*—"Take of Jaborandi, cut small, *half an ounce* [avoirdupois]; Boiling Distilled Water *ten fluidounces* [Imp. meas.]. Infuse in a covered vessel, for half an hour, and strain." *Br.* 1885. This preparation is efficient, but from its nauseousness and tendency to sicken the stomach is inferior to the alkaloid or even the fluidextract. *Dose,* from one to two fluidounces (30 to 60 Cc.).

Infusum Lini. Br. 1885. *Infusion of Linseed.* "Take of Linseed *one hundred and fifty grains;* Dried Liquorice Root, in No. 20 powder, *fifty grains;* Boiling Distilled Water *ten fluidounces.* Infuse in a covered vessel, for two hours, and strain." *Br.* 1885. This is nearly identical with the *Compound Infusion of Flaxseed* of the U. S. P. 1870. It is a useful demulcent drink in inflammatory affections of the mucous membrane of the lungs and urinary passages. It may be taken *ad libitum.*

Infusum Maticæ. Br. 1885. *Infusion of Matico.* "Take of Matico Leaves, cut small, *half an ounce* [avoirdupois]; Boiling Distilled Water, *ten fluidounces* [Imp. meas.]. Infuse in a covered vessel, for half an hour, and strain." *Br.* 1885. The dose of this infusion is two fluidounces (60 Cc.).

Infusum Valerianæ. Br. 1885. *Infusion of Valerian.*—"Take of Valerian Rhizome, bruised, *a quarter of an ounce* [avoirdupois]; Boiling Distilled Water *ten fluidounces* [Imp. meas.]. Infuse in a covered vessel, for one hour, and strain." *Br.* 1885. The dose of this infusion is two fluidounces (60 Cc.), repeated three or four times a day, or more frequently.

A grateful stomachic in the *dose* of from one-half to one fluidounce (15 to 30 Cc.).

INFUSUM BUCHU. Br.

INFUSION OF BUCHU

(ĭn-fū'zŭm bū'çhū)

Infusum Diosmæ, s. Barosmæ; Tisane de Buchu, *Fr. Cod.;* Buchuaufguss, *G.*

"Buchu Leaves, freshly broken, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

It has the odor, taste, and medicinal virtues of the leaves, and affords a convenient method of administering the medicine.

Dose, from one to two fluidounces (30 to 60 Cc.).

INFUSUM CALUMBÆ. Br.

INFUSION OF CALUMBA

(ĭn-fū'zŭm cą-lŭm'bæ)

Infusion of Columbo; Tisane de Columbo, *Fr.;* Kolombo-Infusion, Kolomboaufguss, *G.;* Infusion de Colombo, *Sp.*

"Calumba Root, thinly sliced, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, cold, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse for half an hour; strain." *Br.*

The infusion of calumba is likely to spoil very quickly, especially in warm weather. It has been generally supposed that the cold infusion would keep better than the hot, because it contains no starch. Thomas Greenish, however, upon comparing specimens of the two infusions, found that the spontaneous change began sooner in the cold than in the hot, though the former was clearer. Calumba contains starch and albumen. Cold water extracts the latter without the former; hot water the former with comparatively little of the latter, which is partially coagulated by the heat. Both starch and albumen are liable to spontaneous change, but the former is much the more permanent of the two. Hence it is, according to Greenish, that the hot infusion keeps best. Indeed, he ascribes the change which takes place in the starch of the hot infusion chiefly to the agency of a little albumen which has escaped coagulation. According to these views, the best plan of preparing infusion of calumba is to exhaust the root with cold water, by which the starch is left behind, and then to heat the infusion to the boiling point in order to coagulate the albumen. (*A. J. P.,* xviii. 141; from *P. J.*) Upon comparing specimens of the cold and hot infusion, we have not found the results of Greenish fully confirmed. The cold infusion appeared to keep better than the hot. Nevertheless the plan of preparing the infusion above proposed is probably the best. The infusion of calumba is not colored by salts of iron, and may be conveniently administered in connection with them.

Dose, one fluidounce (30 Cc.), three or four times a day.

INFUSUM CARYOPHYLLI. Br.

INFUSION OF CLOVES

(ĭn-fū'zŭm căr-ĭ-ǫ-phĭl'lī)

Tisane de Girofle, *Fr.;* Gewürznelken-Infusion, Gewürznelkenaufguss, *G.*

"Cloves, bruised, ½ *ounce* (Imperial) or 25 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

The infusion of cloves affords precipitates with lime water, and with the soluble salts of iron, zinc, lead, silver, and antimony. (Phillips.)

Dose, one fluidounce (30 Cc.).

INFUSUM CASCARILLÆ. Br.

INFUSION OF CASCARILLA

(ĭn-fū'zŭm căs-cą-rĭl'læ)

Tisane de Cascarille, *Fr.;* Kaskarillaufguss, *G.*

"Cascarilla, in No. 10 powder, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

This infusion affords precipitates with lime water, infusion of galls, silver nitrate, lead acetate and subacetate, zinc sulphate, and ferrous sulphate.

Dose, one fluidounce (30 Cc.).

INFUSUM CHIRATÆ. Br.

INFUSION OF CHIRETTA

(ĭn-fū'zŭm çhĭ-rā'tæ)

Tisane de Chirette, *Fr.;* Chirettaufguss, *G.*

"Chiretta, cut small, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

Dose, from one-half to one fluidounce (15 to 30 Cc.).

INFUSUM CINCHONÆ ACIDUM. Br.

ACID INFUSION OF CINCHONA

(ĭn-fū'zŭm cĭn-çhō'næ ăç'ĭ-dŭm)

Infusion of Yellow Bark; Infusion of Calisaya Bark; Tisane de Quinquina jaune, *Fr.;* Kalisaya-Rindenaufguss, *G.*

"Red Cinchona Bark, in No. 40 powder, 1 *ounce* (Imperial) or 50 grammes; Aromatic Sulphuric Acid, 2 *fl. drachms* (Imp. meas.) or

12.5 cubic centimetres; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Mix the Red Cinchona Bark with the Distilled Water in a covered vessel; add the Aromatic Sulphuric Acid; infuse for one hour; strain." *Br.*

Though the infusion with boiling water is more quickly prepared than the cold infusion, and therefore better adapted to cases of emergency, yet the former is a more elegant preparation, not turbid like the latter, and at least equally efficient. We therefore prefer the process of the U. S. Pharmacopœia 1890, provided it be skilfully conducted.

The U. S. 1890 infusion [1] is an efficient preparation. Water extracts from bark quinine and cinchonine kinates, but leaves behind the compounds which these principles form with the cincho-tannic acid. The simple infusion, therefore, is rather feeble. But the addition of the acid insures the solution of all or nearly all the active matter. Geo. B. Wood placed much reliance on this infusion. It would be best to macerate the bark with the acidulated water some time before it is introduced into the percolator. The infusion of cinchona, made without acid, affords precipitates with the alkalies, alkaline carbonates, and alkaline earths; the soluble salts of iron, zinc, and silver; corrosive mercuric chloride, arsenic trioxide, and tartar emetic; gelatinous solutions; and various vegetable infusions and decoctions, as those of galls, chamomile, calumba, cascarilla, horseradish, cloves, catechu, orange peel, digitalis, senna, rhubarb, valerian, and simaruba. In some instances the precipitate occurs immediately, in others not for several hours. The loss of few, however, of these substances by precipitation diminishes the efficacy of the infusion, as they do not affect the active principles. The alkalies, alkaline earths, and vegetable astringents are really incompatible. As gallic, tartaric, and oxalic acids form salts with quinine of somewhat difficult solubility, the neutral and soluble gallates, tartrates, and oxalates produce in the infusion slight precipitates of corresponding salts of the alkaloids, but these are redissolved by an excess of the acid. Antimony and potassium tartrate does not precipitate the alkaloids. Solutions of iodine are incompatible, forming with the alkaloids insoluble compounds. For an account of the chemical reactions of the infusions of different varieties of cinchona bark, see *A. J. P.*, ix. 128. The simple infusion of cinchona may be advantageously administered in cases which require tonic treatment but do not call for the full powers of the bark. The acid infusion has all the powers of cinchona itself.

Dose, one fluidounce (30 Cc.).

[1] *Infusum Cinchonæ.* U. S. 1890. *Infusion of Cinchona.*—"Cinchona, in No. 40 powder, *sixty grammes* [or 2 ounces av., 51 grains]; Aromatic Sulphuric Acid, *ten cubic centimeters* [or 162 minims]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 391 minims]. Mix the Acid with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water, and moisten the powder with *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it, first, the remainder of the mixture, and afterwards Water, until the Infusion measures *one thousand cubic centimeters* [or 33 fluidounces, 391 minims]." *U. S.* 1890.

INFUSUM CUSPARIÆ. Br.

INFUSION OF CUSPARIA

(ịn-fū'ṣŭm cŭs-pā'rī-æ)

Infusion of Angustura; Tisane d'Angusture, *Fr.*; Angusturaaufguss, *G.*

"Cusparia Bark, in No. 20 powder, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

Under the name of *Infusum Angusturæ* this preparation was official in the U. S. Pharm. 1870, made in the proportion of half a troy-ounce of Angustura bark in a pint of water.

Dose, two fluidounces (60 Cc.), repeated every two, three, or four hours.

INFUSUM DIGITALIS. U. S., Br.

INFUSION OF DIGITALIS

(ịn-fū'ṣŭm dĭg-ị-tā'lĭs)

Infusion of Foxglove; Tisane de Digitale, *Fr.*; Fingerhutaufguss, Digitalisaufguss, *G.*; Infusion de digital, *Sp.*

* "Digitalis, bruised, *fifteen grammes* [or 231 grains]; Alcohol, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Cinnamon Water, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; Boiling Water, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Cold Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Upon the Digitalis, contained in a suitable vessel, pour the Boiling Water, and allow it to macerate for one hour. Then strain, add the Alcohol and Cinnamon Water to the strained liquid, and pass enough Cold Water through the residue on the strainer to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix well." *U. S.*

"Digitalis Leaves, in No. 20 powder, 60 *grains* (Imperial) or 6.8 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 100 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

The U. S. P. infusion was improved in the 1890 revision. Cinnamon is used solely as a flavoring ingredient, as it has never been present in sufficient quantity to serve any other purpose. When either the tincture or the aromatic itself is used, precipitation is sure to take place. Cinnamon water is unobjectionable. The present process, which is modelled after the formula of L. G. Blakeslee (*Ph. Era*, 1887, p. 228), yields a preparation which, while not differing essentially in strength from the

former official infusion, keeps better and does not deposit to any extent. The addition of 10 per cent. of glycerin would be a still greater improvement. D. E. Prall (*A. J. P.*, 1878, p. 423) proved that the abundant precipitate in the old infusion was caused by the tincture of cinnamon, and recommended a simple infusion without any aromatic. J. W. England (*A. J. P.*, 1892, 361) prefers to omit cinnamon entirely from the preparation and add ammonia water (90 minims in a pint). G. L. Humphreys suggests the addition of 8 grammes of powdered cinnamon to the official ingredients, pouring the boiling water upon the digitalis and cinnamon and macerating until the mixture is cold, then following the official directions, and finally filtering the infusion through *unwetted* filtering paper. (See *West. Drug.*, 1897, 162.)

The U. S. infusion is essentially the same as that employed by Withering. It affords precipitates with ferrous sulphate, lead acetate, tannic acid, and infusion of cinchona. The proportion of digitalis is less than half as great in the British preparation, and the dose should be proportionately larger. It will not escape the close observer that the stated dose of digitalis in infusion is much larger than in substance, for which there does not appear to be a good reason, but which accounts for the fact that many physicians assert that they get better results from the infusion than from the digitalis itself.

Dose, of U. S. infusion, two to four fluidrachms (7.5 to 15 Cc.). The British Pharmacopœia, though its infusion has only about half the strength of ours, gives its dose as from two to four fluidrachms (7.5 to 15 Cc.).

INFUSUM ERGOTÆ. Br.

INFUSION OF ERGOT

(ĭn-fū′zŭm ĕr′gŏ-tæ)

Tisane de Seigle ergoté, *Fr.;* Mutterkornaufguss, *G.*

"Ergot, freshly crushed, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

Dose, two fluidounces (60 Cc.).

INFUSUM GENTIANÆ COMPOSITUM. Br.

COMPOUND INFUSION OF GENTIAN

(ĭn-fū′zŭm jĕn-tī-ā′næ cŏm-pŏz′ĭ-tŭm)

Tisane de Gentiane composée, *Fr.;* Enzianaufguss, *G.*

"Gentian Root, thinly sliced, ¼ *ounce* (Imperial) or 12.5 grammes; Dried Bitter-Orange Peel, cut small, ¼ *ounce* (Imp.) or 12.5 grammes; Fresh Lemon Peel, cut small, ½ *ounce* (Imp.) or 25 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

"Take of Gentian, in moderately coarse powder, *half a troyounce;* Bitter Orange Peel, in moderately coarse powder, Coriander, in moderately coarse powder, each, *sixty grains;* Alcohol *two fluidounces;* Water *a sufficient quantity.* Mix the Alcohol with fourteen fluidounces of Water, and, having moistened the mixed powders with three fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them first the remainder of the menstruum, and afterwards Water, until the filtered liquid measures a pint." *U. S.* 1870.

It is, in our opinion, unfortunate that this, the most esteemed of all infusions, should not have been reinstated in the U. S. P. 8th Revision. We have inserted the formula of U. S. P. 1870, as it will doubtless continue to be largely prescribed. It should be designated, however, as U. S. P. 1870. It has been the custom with some physicians to prescribe a concentrated infusion made with one-fourth the quantity of menstruum directed by the formula of U. S. P. 1870. This permits the use of a valuable tonic with the presence of but a trifling amount of alcohol. This concentrated preparation keeps well, and it may be diluted with the right quantity of the proper menstruum by the pharmacist to make the infusion of U. S. P. 1870. The use of the alcohol is to assist in dissolving the bitter principle, and at the same time to contribute towards the preservation of the infusion, which, without this addition, is very prone to spoil. It has, however, been abandoned by the British Pharmacopœia, and lemon peel substituted.

Dose, one fluidounce (30 Cc.), repeated three or four times a day.

INFUSUM KRAMERIÆ. Br.

INFUSION OF KRAMERIA

(ĭn-fū′zŭm krą-mē′rĭ-æ)

Infusion of Rhatany; Tisane de Ratanhia, *Fr.;* Ratanhiawurzelaufguss, *G.*

"Krameria Root, bruised, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

The infusion of rhatany is undoubtedly most efficient when prepared from the root in a state of moderately coarse powder by the mode of percolation with cold water, as directed in the U. S. process of 1870.

Dose, of the infusion, from one to two fluidounces (30 to 60 Cc.).

INFUSUM LUPULI. Br.

INFUSION OF HOPS

(ĭn-fū′zŭm lū′pū-lī)

Infusum Humuli, *U. S.* 1870; Tisane de Houblon, *Fr.;* Hopfenaufguss, *G.*

"Hops, freshly broken, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

The infusion of hops of the U. S. P. 1870 was made exactly like the above, except that the strength was half a troyounce to a pint.

Dose, of the British infusion, from one to two fluidounces (30 to 60 Cc.).

INFUSUM PRUNI VIRGINIANÆ. U. S.

INFUSION OF WILD CHERRY

(ĭn-fū'zŭm prū'nī vīr-jĭn-ī-ā'næ)

Tisane d'Ecorce de Cerisier sauvage, *Fr.;* Wildkirschenrindeaufguss, *G.*

• "Wild Cherry, in No. 20 powder, *forty grammes* [or 1 ounce av., 180 grains]; Glycerin, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of Water, and allow it to macerate for one hour; then pack it firmly in a conical glass percolator, and, having placed the Glycerin in the receiving bottle, gradually pour Water upon the powder and continue percolation until the Infusion measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix well." *U. S.*

This is a peculiarly suitable object for official direction, as, in consequence of the volatile nature of one of its active ingredients, and for another reason (see *Prunus Virginiana*), it is better prepared with cold water than in the ordinary mode. The infusion of wild cherry bark is one of the preparations to which the process of percolation or displacement is well adapted. In this way the virtues of the bark can be more rapidly and thoroughly exhausted than by maceration alone. In order to allow time for the reaction necessary to the production of the hydrocyanic acid, an hour's preliminary maceration is directed, which might perhaps be advantageously somewhat lengthened. If kept in a warm place this preparation undergoes a rapid alteration, and even under the best of circumstances it is unstable. According to the experiments of J. B. Moore (*A. J. P.,* 1873, p. 242), confirmed by our own experience, the addition of two fluidounces of glycerin to the pint of menstruum is of great advantage in delaying the change. The U. S. (8th Rev.) has introduced glycerin into the process, but does not add the glycerin to the menstruum, placing it in the receiving bottle. By this method the infusion is not made unnecessarily astringent and the preservative power of the glycerin is retained. When properly made, infusion of wild cherry bark is beautifully transparent, has the color of sherry wine, and the agreeable bitterness and peculiar flavor of the bark.

Dose, from two to three fluidounces (60 to 90 Cc.), from three to six times a day.

INFUSUM QUASSIÆ. Br.

INFUSION OF QUASSIA

(ĭn-fū'zŭm quäs'sī-æ)

Tisane de Quassie, *Fr.;* Quassiaaufguss, *G.;* Infusion de cuasia amarga, *Sp.*

"Quassia Wood, finely rasped, 88 *grains* (Imperial) or 10 grammes; Distilled Water, cold, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

Boiling water may be employed when it is desirable to obtain the preparation quickly, but cold water affords a clearer infusion. The fifteen minutes maceration directed in the British Pharmacopœia, considering that cold water is used, appears to us to be too short for the exhaustion of the wood.

Dose, two fluidounces (60 Cc.), three or four times a day.

INFUSUM RHEI. Br.

INFUSION OF RHUBARB

(ĭn-fū'zŭm rhē'ī)

Tisane de Rhubarbe, *Fr.;* Rhabarberaufguss, *G.;* Infuso di rabarbaro, *It.;* Infusion de ruibarbo, *Sp.*

"Rhubarb Root, in thin slices, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

In order that the rhubarb may be exhausted, it should be digested with the water near the fire, at a temperature somewhat less than that of boiling water. It is customary to add some aromatic, such as cardamom, fennel seed, or nutmeg, which improves the taste of the infusion and renders it more acceptable to the stomach. One drachm of either of these spices may be digested in connection with the rhubarb.

This infusion may be given as a laxative, and is occasionally used as a vehicle for tonic, antacid, or more active cathartic medicines. The stronger acids and most metallic solutions are incompatible with it.

Dose, one to two fluidounces (30 to 60 Cc.).

INFUSUM ROSÆ ACIDUM. Br.

ACID INFUSION OF ROSES

(ĭn-fū'zŭm rō'zæ ăç'ĭ-dŭm)

Infusum Rosæ Compositum, *U. S.* 1870; Compound Infusion of Rose; Acid Infusion of Rose; Tisane de Rose composée, *Fr.;* Saurer Rosenaufguss, *G.*

"Red-Rose Petals, dried and broken, ½ *ounce* (Imperial) or 25 grammes; Diluted Sulphuric Acid, 2 *fl. drachms* (Imp. meas.) or 12.5 cubic centimetres; Distilled Water, boiling, 1

pint (Imp. meas.) or 1000 cubic centimetres. Add the Diluted Sulphuric Acid to the Distilled Water; infuse the Red-Rose Petals in the mixture in a covered vessel for fifteen minutes; strain." *Br.*

The formula of the U. S. P. 1870 is preferable to that of the Br. Pharm. on account of the presence of sugar. It is unfortunate, in our opinion, that this elegant infusion was not reinstated at the last revision of the U. S. Pharmacopœia. We append the formula of the U. S. P. 1870: "Take of Red Rose [dried petals] *half a troyounce;* Diluted Sulphuric Acid *three fluidrachms;* Sugar [refined], in coarse powder, *a troyounce and a half;* Boiling Water *two pints and a half.* Pour the Water upon the Rose in a covered glass or porcelain vessel; add the Acid, and macerate for half an hour. Lastly, dissolve the Sugar in the liquid, and strain." *U. S.*

The red rose serves little other purpose than to impart a fine red color and a slight rose and astringent flavor to the preparation, which owes its medicinal virtues almost exclusively to the sulphuric acid. According to J. B. Barnes, one part of glycerin added to eight or nine parts of infusion of rose increases greatly its brightness and transparency. It is refrigerant and astringent, and affords a useful and not unpleasant drink in *hemorrhages* and *colliquative sweats.* It is much used by British practitioners as a vehicle for saline medicines, particularly magnesium sulphate, the taste of which it serves to cover. It is also employed as a gargle, usually in connection with acids, nitre, alum, or tincture of Cayenne pepper.

Dose, two fluidounces (60 Cc.).

INFUSUM SCOPARII. Br.

INFUSION OF BROOM

(ĭn-fū'zŭm scō-pā'rĭ-ī)

Tisane de Genêt à balais, *Fr.;* **Besenginsteraufguss,** *G.*

"Broom Tops, dried and bruised, 2 *ounces* (Imperial) or 100 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

This preparation has been introduced in place of the Decoction of Broom of the British Pharmacopœia of 1885. Water thoroughly extracts the virtues of broom, and the large quantity of water in each dose aids the diuretic action.

Dose, from one to two fluidounces (30 to 60 Cc.).

INFUSUM SENEGÆ. Br.

INFUSION OF SENEGA

(ĭn-fū'zŭm sĕn'ē-gæ)

Tisane de Polygale de Virginie, *Fr.;* **Senegaaufguss,** *G.*

"Senega Root, in No. 10 powder, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for half an hour; strain." *Br.*

Dose, one fluidounce (30 Cc.).

INFUSUM SENNÆ. Br.

INFUSION OF SENNA

(ĭn-fū'zŭm sĕn'næ)

Senna Tea; Tisane de Séné, *Fr.;* **Sennaaufguss,** *G.*

"Senna, 2 *ounces* (Imperial) or 100 grammes; Ginger, sliced, 55 *grains* (Imp.) or 6.25 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

"Take of Senna *a troyounce;* Coriander, bruised, *sixty grains;* Boiling Water *a pint.* Macerate for an hour in a covered vessel, and strain." *U. S.* 1870.

We prefer the coriander of the U. S. P. 1870 to the ginger of the British. The strength of the British preparation has been increased in the present edition of the Br. Pharm., and is now nearly one and a half times as great as that of the U. S. infusion. The infusion deposits, on exposure to the air, a yellowish precipitate, which is said to aggravate its griping tendency; it should, therefore, not be made in large quantities. It is customary to prescribe with it manna and some one of the saline cathartics, which increase its efficacy and render it less painful in its operation. (See *Infusum Sennæ Compositum.*) The cold infusion, especially if made by percolation from the coarsely powdered leaves, while probably not inferior in strength to that prepared with boiling water, is said to be less unpleasant to the taste.

Dose, two fluidounces (60 Cc.).

Off. Prep.—Mistura Sennæ Composita, *Br.*

INFUSUM SENNÆ COMPOSITUM. U. S.

COMPOUND INFUSION OF SENNA [Black Draught]

(ĭn-fū'zŭm sĕn'næ cŏm-pŏs'ĭ-tŭm)

Tisane de Séné composée, *Fr.;* **Infusum Sennæ Compositum,** *P. G.;* **Wiener Trank, Sennaaufguss,** *G.;* **Infuso di sena con manna,** *It.*

* "Senna, *sixty grammes* [or 2 ounces av., 51 grains]; Manna, *one hundred and twenty grammes* [or 4 ounces av., 102 grains]; Magnesium Sulphate, *one hundred and twenty grammes* [or 4 ounces av., 102 grains]; Fennel, bruised, *twenty grammes* [or 309 grains]; Boiling Water, *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims]; Cold Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Upon the Senna, Manna, and Fen-

nel, contained in a suitable vessel, pour the Boiling Water, and allow it to macerate for half an hour. Then strain with expression, dissolve the Magnesium Sulphate in the infusion, and again strain. Lastly, add enough Cold Water through the strainer to make the Infusion measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This preparation is the Black Draught of European pharmacy, and it is an excellent form of administering these cathartics in a liquid condition.

Dose, four fluidounces (120 Cc.).

INFUSUM SERPENTARIÆ. Br.

INFUSION OF SERPENTARY

(ĭn-fū'zŭm sĕr-pĕn-tā'rĭ-æ)

Tisane de Serpentaire, *Fr.;* Schlangenwurzelaufguss, *G.*

"Serpentary Rhizome, in No. 10 powder, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

Dose, one fluidounce (30 Cc.) every two hours in low forms of fever, but less frequently in chronic affections.

INFUSUM UVÆ URSI. Br.

INFUSION OF BEARBERRY

(ĭn-fū'zŭm ū'væ ûr'sī)

Tisane d'Uva Ursi, *Fr.;* Bärentraubenblätteraufguss, *G.*

"Bearberry Leaves, bruised, 1 *ounce* (Imperial) or 50 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Infuse in a covered vessel for fifteen minutes; strain." *Br.*

Dose, from one to two fluidounces (30 to 60 Cc.), three or four times a day.

INJECTIO APOMORPHINÆ HYPODERMICA. Br.

HYPODERMIC INJECTION OF APOMORPHINE

(ĭn-jĕc'tĭ-ō ăp-o-mör-phī'næ hȳ-po-dĕr'mĭ-cæ)

Injection hypodermique d'Apomorphine, *Fr.;* Subcutane Apomorphineinspritzung, *G.*

"Apomorphine Hydrochloride, 1 *grain* (Imperial) or 0.1 gramme; Diluted Hydrochloric Acid, 1 *minim* (Imp. meas.) or 0.1 cubic centimetre; Distilled Water, 110 *minims* (Imp. meas.) or 10 cubic centimetres or a sufficient quantity. Boil the Distilled Water for a few minutes; cool; add the Diluted Hydrochloric Acid; dissolve the Apomorphine Hydrochloride in the resulting liquid; add, if necessary, sufficient recently boiled and cooled Distilled Water to produce *one hundred and ten minims* (Imp. meas.) or ten cubic centimetres of the Injection. This Injection should be recently prepared. 110 minims contain 1 grain of Apomorphine Hydrochloride; 100 cubic centimetres contain 1 gramme." *Br.*

Dose, by subcutaneous injection, from two to eight minims (0.12 to 0.5 Cc.).

INJECTIO COCAINÆ HYPODERMICA. Br.

HYPODERMIC INJECTION OF COCAINE

(ĭn-jĕc'tĭ-ō cō-cæ-ī'næ hȳ-po-dĕr'mĭ-cæ)

Injection hypodermique de Cocaine, *Fr.;* Subcutane Cocaineinspritzung, *G.*

"Cocaine Hydrochloride, 33 *grains* (Imperial) or 1 gramme; Salicylic Acid, ½ *grain* (Imp.) or 0.015 gramme; Distilled Water, 6 *fl. drachms* (Imp. meas.) or 10 cubic centimetres or a sufficient quantity. Boil the Distilled Water; add the Salicylic Acid; dissolve the Cocaine Hydrochloride in the solution when cool; add, if necessary, sufficient recently boiled and cooled Distilled Water to produce *six fluid drachms* (Imp. meas.) or ten cubic centimetres of the Injection. 110 minims contain about 10 grains of Cocaine Hydrochloride; 100 cubic centimetres contain 10 grammes." *Br.*

Dose, by subcutaneous injection, from two to five minims (0.12 to 0.3 Cc.).

INJECTIO ERGOTÆ HYPODERMICA. Br.

HYPODERMIC INJECTION OF ERGOT

(ĭn-jĕc'tĭ-ō ĕr'gŏ-tæ hȳ-po-dĕr'mĭ-cæ)

Hypodermic Injection of Ergotin; Injection hypodermique d'Ergot de Seigle, *Fr.;* Subcutane Mutterkorneinspritzung, *G.*

"Extract of Ergot, 100 *grains* (Imperial) or 10 grammes; Phenol 3 *grains* (Imp.) or 0.3 gramme; Distilled Water, 220 *minims* (Imp. meas.) or 20 cubic centimetres or a sufficient quantity. Mix the Phenol with the Distilled Water; boil for a few minutes; cool; add the Extract of Ergot, and, if necessary, sufficient recently boiled and cooled Distilled Water to produce *three hundred and thirty minims* (Imp. meas.) or thirty cubic centimetres of the Injection. This Injection should be recently prepared. 110 minims contain about 33 grains of Extract of Ergot; 100 cubic centimetres contain about 33 grammes." *Br.*

Dose, by subcutaneous injection, from three to ten minims (0.2 to 0.6 Cc.).

INJECTIO MORPHINÆ HYPODERMICA. Br.

HYPODERMIC INJECTION OF MORPHINE

(ĭn-jĕc'tĭ-ō mör-phī'næ hȳ-po-dĕr'mĭ-cæ)

Injection hypodermique de Morphine, *Fr.;* Subcutane Morphineinspritzung, *G.*

"Morphine Tartrate, 50 *grains* (Imperial) or 5 grammes; Distilled Water, *a sufficient*

quantity. Dissolve the Morphine Tartrate in sufficient recently boiled and cooled Distilled Water to produce *eleven hundred minims* (Imp. meas.) or one hundred cubic centimetres of the Injection." *Br.*

This solution is made from morphine tartrate in place of the morphine acetate formerly used; this is a great improvement, as the acetate is the most unstable of all morphine salts. The morphine strength of this injection is slightly less than one-half that of the Hypodermic Injection of Morphine of the British Pharmacopœia of 1885. 110 minims contain 5 grains of Morphine Tartrate; 100 cubic centimeters contain 5 grammes.

Dose, by subcutaneous injection, from two to five minims (0.12 to 0.3 Cc.).

INJECTIONES HYPODERMICÆ.

HYPODERMIC INJECTIONS

Under this head are classed preparations which are recognized in the British Pharmacopœia for hypodermic application. These preparations are really of very little value, on account of their proneness to undergo decomposition, and are greatly inferior to the *hypodermic tablets* of various strengths which are now supplied by manufacturing pharmacists—the size of the tablets not varying with the strength, because it is always necessary to use so much diluent in order to make the tablet of sufficient size to handle conveniently. The tablets most used contain apomorphine, morphine, morphine and atropine, atropine, strychnine, pilocarpine, cocaine, hyoscyamine, physostigmine, hyoscine, nitroglycerin, or caffeine; each should be readily soluble in fifteen minims of water. These tablets should be made official, since their convenience, permanence, and accuracy in weight have caused them to come into universal use. The selection of the diluent is an important question; very finely powdered cane sugar has been employed, but is apt to produce local irritation and even abscesses. Sodium chloride has also been recommended, but the best diluent seems to be dried neutral sodium sulphate.

IODOFORMUM. U. S., Br.

IODOFORM

(ī-ō-dō-för'mŭm)

$CHI_3 = 390.61$

"Triiodomethane, usually obtained by the action of iodine upon alcohol, in the presence of an alkali or alkali carbonate. Iodoform should be kept in well-stoppered bottles, in a cool and dark place." *U. S.* "Iodoform, or tri-iodomethane, CHI_3, is a product of the action of iodine on ethylic alcohol in the presence of solution of potassium carbonate." *Br.*

Triiodomethane, Formyltriiodide; Iodoforme, *Fr. Cod.;* Iodure de formyle, *Fr.;* Iodoformium, *P. G.;* Jodoform, Carboneum jodatum, Trijodmethan, *G.;* Jodoformio, Trijodometano, *It.;* Yodoformo, *Sp.*

This compound, discovered by Sérullas in 1822, was introduced as a remedy, about the year 1837, by R. M. Glover of London, and Bouchardat of Paris, and was first adopted as official in the U. S. Pharmacopœia of 1870.

Preparation.—Cornélis and Gille published a process in *J. P. C.,* 1852, p. 196. (See U. S. D., 14th ed., 511.) Wittstein's process is an improvement on this, and is as follows: Take two parts of potassium carbonate, two of iodine, one of 95 per cent. alcohol, and five of water, mix them in a retort, and heat the mixture, by means of a water bath, until perfectly colorless; then, after the cooling of the liquid, pour it into a suitable vessel, and allow it to settle. The yellow scaly mass deposited is collected on a filter, washed thoroughly with water, and dried between folds of bibulous paper. As iodoform is very volatile, it must be prepared in closed vessels. The liquid remaining after the deposition of iodoform contains potassium iodate and iodide, which may be decomposed with renewed formation of iodoform by adding potassium dichromate 2 to 3 parts, and hydrochloric acid 16 to 24 parts; this liberates iodine. 32 parts of sodium carbonate, 6 parts of iodine, and 16 parts of alcohol are now added, the liquid is again poured off from the iodoform produced, and the operation repeated if necessary. The formation of the iodoform is represented by the following equation:

$$C_2H_5.OH + 4I_2 + 3K_2CO_3 = CHI_3 + CHKO_2 + 5KI + 2H_2O + 3CO_2$$

Other products, such as potassium iodate, are, however, formed. G. R. Bell (*N. R.,* March, 1882) has practically tried nearly all the processes for the preparation of iodoform, and recommends Filhol's, which is as follows. Put into a long-necked matrass or flask which is supplied with a perforated cork and long supply tube a solution of 200 parts of crystallized sodium carbonate and 1000 parts of distilled water, and add 100 parts of alcohol, heat in a water bath from 60° to 71.1° C. (140° to 160° F.), then gradually add 100 parts of iodine, about ten parts at a time. When the liquid has become colorless, remove the flask from the water bath, and allow it to cool three or four hours, then pour out on a filter; return the filtrate to the flask, add 200 parts of sodium carbonate, 100 parts of alcohol, heat to 71.1° C. (160° F.), and pass a slow current of chlorine gas through the mixture as long as iodine is separated, continuing until the brown liquid is again decolorized. A small excess of chlorine is of no consequence (Hager states that for every 100 parts of iodine it requires the chlorine which can be evolved from about 200 parts of hydrochloric acid by means of manganese dioxide). Let the flask stand twenty-four hours, then throw the contents on a filter and examine the filtrate with chlorine water to see whether it still contains an appreciable amount of iodine compounds, then if necessary subject the filtrate to a second treatment of chlo-

rine gas, adding previously only 20 parts of sodium carbonate and 10 parts of alcohol. Collect the iodoform after twenty-four hours. The filtrate may be concentrated and decomposed by excess of nitric acid, according to the method recommended in Bouchardat's process. The collected crystals of iodoform are now well washed with the smallest quantity of cold distilled water, spread out on bibulous paper, and dried in the open air.

Sulliot and Raynaud have devised a process for making iodoform from kelp ash. (*Bull. Soc. Chim.*, 1889, 3.) S. R. Boyce (*Proc. A. Ph. A.*, 1890, 220) details a process which is essentially that of Sulliot and Raynaud. The advantages claimed for this method are that 98 per cent. of the iodine used is converted into iodoform, and the use of the nitric acid in Filhol's process is obviated. Solution of chlorinated soda is added by drops to a solution of fifty grammes of potassium iodide, five grammes of sodium hydroxide, and forty grammes of acetone in one liter of water. The iodoform, which crystallizes out, should be protected from the light.

Iodoform is now made by electrolysis. An alkaline solution of sodium iodide is electrolyzed in the presence of alcohol, when, iodine being liberated at the anode, iodoform is obtained by the following reaction:

$$CH_3.CH_2OH + 10I + H_2O = CHI_3 + CO_2 + 7HI$$

The hydriodic acid formed combines with the sodium hydroxide present, to make sodium iodate, which, with the carbon dioxide, forms the side products. The temperature is kept at about 70° C. during the reaction and a diaphragm is used. The yield of iodoform is about 70 per cent. M. Otto produces iodoform industrially, direct from alkaline iodides, as follows: 100 kg. of water, 300 kg. of alcohol, 10 kg. of sodium carbonate and 55 kg. of potassium iodide are heated to 50° C. in a suitable vessel, and a current of ozone is passed through the mixture. Iodoform is deposited and crystallizes in a pure condition on the sides of the vessel and throughout the fluid itself. The alcohol may be replaced by acetaldehyde, acetone, etc. (*Ap. Ztg.*, 1900, 166.)

The fact, noticed by Lieben in 1870, that many other compounds besides ethyl alcohol yield iodoform when treated with iodine and alkali, led Krämer (*Ber. d. Chem. Ges.*, 1880, p. 1000) to propose the iodoform formation as an exact quantitative test for the presence of acetone in methyl alcohol. This "iodoform test" is now used in testing the purity of methyl alcohol for use in the manufacture of aniline dye colors, as well as the purity of acetone itself. (See *Acetonum.*) Heinrich Spindler proposes to make iodoform from the chlorides, bromides, or chloro-bromides of the paraffin series by reaction with an inorganic iodide; thus, if chloroform and *anhydrous* calcium iodide are heated to 120° C. iodoform is produced. (*Am. Drug.*, 1886, p. 67.) F. Günther recommends mixing alcohol containing 25 per cent. of aldehyde with ten times its weight of solution of sodium hydroxide, adding the iodine, and passing a current of carbon dioxide through the mixture. (*A. Pharm.*, 1887, p. 373.)

Properties.—It is in the form of "a fine, lemon-yellow powder or lustrous crystals of the hexagonal system, having a peculiar, very penetrating and persistent odor, and an unpleasant, slightly sweetish, and iodine-like taste. Soluble in 9391 parts of water, to which it imparts its odor and taste, in 46.7 parts of alcohol, and in 5.2 parts of ether at 25° C. (77° F.); soluble in about 12 parts of boiling alcohol; soluble in chloroform and fixed and volatile oils; slightly soluble in petroleum benzin. Digest in a porcelain dish 0.1 Gm. of Iodoform with 5 Cc. of an alcoholic solution of potassium hydroxide (1 in 20) until it is dissolved, evaporate to dryness on a water-bath, dissolve the residue in 5 Cc. of distilled water, add 2 Cc. of chloroform and an excess of nitric acid, and shake the mixture; the chloroform will assume an intense violet color. Its solutions in neutral solvents are neutral to litmus paper. Iodoform is slightly volatile, even at ordinary temperatures, and in boiling water distils slowly with the vapor of water. At about 115° C. (239° F.) it melts to a brown liquid, and at a higher temperature emits vapors of iodine, leaving behind a carbonaceous mass, which, upon full combustion, should leave not more than 0.1 percent. of residue (limit of *fixed impurities*). On being dried over sulphuric acid, the loss in weight should not exceed 1 percent. If 2 Gm. of Iodoform be thoroughly shaken with 10 Cc. of water, the filtrate should be colorless and free from bitter taste (absence of *soluble yellow coloring matters, picric acid,* etc.); it should not affect the color of litmus paper (absence of *free acids*), nor should it be rendered more than faintly opalescent by silver nitrate T.S. (absence of *soluble iodides*)." *U. S.* "Very slightly soluble in cold *water,* soluble in 80 parts of cold or 10 parts of boiling *alcohol* (90 per cent.), in 5 parts of cold *ether,* soluble also in *chloroform, carbon bisulphide,* or fixed and volatile oils, and, sparingly, in *benzol;* the solutions do not affect *litmus.* When heated it first melts to a brown liquid, then gives off brown and violet vapors, leaving a black residue which entirely disappears on continued incineration. When warmed with an alcoholic solution of *potassium hydroxide* and the resulting liquid acidulated with *nitric acid,* iodine is liberated, the mixture becoming brown, and, when cold, blue on the addition of *mucilage of starch. Water* with which Iodoform has been shaken should be colorless and not bitter (absence of soluble yellow coloring matters, picric acid, etc.), and should not yield any reaction with the tests for iodides." *Br.* Iodoform is a volatile substance, soft to the touch, and totally devoid of corrosive properties. With potassium hydroxide in

solution, it is decomposed, yielding potassium formate and iodide. Hence these two principles are incompatible in prescriptions. The specific gravity of iodoform, about which there has been a controversy, was determined by J. Percy Remington to be 4.000; the specific gravity of 2.000 as given in the U. S. P. 1890 was undoubtedly due to the operator taking the specific gravity of iodoform in water, and when this is done it is practically impossible to free the crystals from admixed air; the result was reached by using a saturated solution of iodoform in pure kerosene as the liquid, and by a simple calculation obtaining the equivalent in water. Iodoform is sometimes met with in commerce adulterated with water; Vulpius (*Ph. Cb.,* 1894) on examination detected 13 per cent. in one specimen.

Uses.—Maitre, who has studied the physiological effects of iodoform on men, states that from a dose of 30 or 40 centigrammes (about 5 or 6 grains) no effects are observed except a slight increase of appetite. Two hours after it has been taken, the presence of iodine can be detected in the urine and the saliva, and nearly three days elapse before the whole is eliminated. (See also Höyges, *J. P. C.,* Juillet, 1867.) It passes off also with the lacteal secretion. Given to dogs in much larger doses, several grammes for example, it produces narcotic effects, and two stages in its operation have been noticed; the first is marked with more or less prostration, with symptoms of intoxication, the animal tottering, inclining to one side with the head falling, with loss of appetite, but without vomiting. The next day, unless a very large dose has been given, complete recovery takes place. A still larger dose induces the second stage, characterized by a remarkably intense excitation, with anxious breathing, strong and short pulse, a true opisthotonos, sometimes very striking, and convulsive movements of the paws, especially the hinder ones. After death fatty degeneration of the heart, liver, and kidneys may be found. (A. Höyges.) The very free use of iodoform in Germany as an antiseptic dressing to wounds, ulcers, etc., has led to many cases of poisoning. In the most characteristic and severe cases the phenomena of iodoform poisoning resemble somewhat those of meningitis; they are headache, somnolence deepening into stupor, contracted, motionless pupils, abnormal quiet or restlessness ending in active delirium, with, however, a normal temperature and an exceedingly rapid pulse.[1] In cases of this character death almost always follows, although the symptoms may have developed abruptly and the dressing has at once been removed. In other cases the principal symptoms are general malaise and depression, faintness, headache, loss of appetite, and a persistent iodoform taste in the mouth. In some cases there is a slight temporary increase of temperature. Mental depression or excitement is especially noticed. Finally the pulse becomes accelerated, soft, and feeble; in some cases the pulse is very rapid,—from 150 to 180,—while the temperature remains normal, or only slightly elevated. It is asserted by Samter and Retzlaff (*T. G.,* 1889) that potassium bromide is an antidote in poisoning with iodoform, its antidotal powers being due to the fact that it exceeds all other salts in its power of dissolving iodine compounds.

Iodoform, though containing 29 parts in 30 of its weight of iodine, is not locally irritant, but anæsthetic and antiseptic. It is said, when employed as a suppository, to produce unconsciousness of the act of defecation. In the form of vapor, it possesses anæsthetic properties, but inferior to those of chloroform. On account of its large proportion of iodine, it was supposed to be capable of replacing that element and the iodides as a remedy, with the advantages of being non-irritant, and of having an organic nature, qualities which favor its absorption and assimilation. The principal diseases in which it has been tried are *goitre, rickets, scrofula, phthisis, syphilis,* and *glandular tumors.* It may be given in doses of from one to three grains (0.065 to 0.2 Gm), three or four times a day, in pill form, but it has not met the expectation of its early advocates, and is not much used internally. The chief value of iodoform in practical medicine is as an external application. It has long been used in cases of painful *ulcers,* especially when of syphilitic origin, but has been found to act almost equally well in indolent leg ulcers and other non-specific abrasions, and will even produce marked relief in open *cancers.*[2] Within the last few years it has been freely employed as an antiseptic dressing to *wounds,* and the testimony from surgeons is so strong that it is difficult to avoid believing that it is one of the most certain remedies of the class. The good results which have been achieved have led to a series of studies of its action upon septic organisms, with results which are apparently at variance with practical surgical teachings,[3] and which seem to prove that iodoform itself has little power as a bactericide. When, however, it is brought in contact with the living surface of a wound it undergoes

[1] *Diagnostic Sign of Iodic Poisoning.*—Burlureaux affirms that if a piece of silver be placed in the mouth of a person suffering from iodoform poisoning, immediately the taste of garlic will be perceived, and if some of the saliva be mixed with calomel, a canary-yellow precipitate of mercurial iodide will be obtained. The most that such a test can accomplish is to show that the patient is under the influence of some compound of iodine.

[2] *Iodoform in Burns.*—At a discussion of the International Congress of Dermatology, in 1889, the conclusion was reached that the best treatment of *burns* in the beginning is to cut the bullæ, wash the part with a very weak solution of salt, and then dress with iodoform gauze or a pomade of iodoform, and cover with oil silk. In the later stages, after the separation of the eschars, according to Hebra, iodoform retards cicatrization, while a one or two per cent. solution of resorcinol hastens epithelium formation.

[3] For a more elaborate discussion of these investigations, the reader is referred to H. C. Wood's *Treatise on Therapeutics,* 12th edition.

a slow chemical change, resulting in the liberation of iodine, which element has a distinct influence upon the development of septic organisms. Moreover, iodoform appears to have a specific influence upon human tissue, by which it prevents the formation of purulent or serous exudations, and greatly diminishes the soil in which the bacteria develop. The local application of iodoform in surgical tuberculosis has received the highest commendation from numerous surgeons. In the treatment of tuberculous *abscesses,* in tuberculous *empyema,* in tubercular joints, in non-suppurating tuberculous glands, and even in tuberculous *peritonitis,* numerous cures have been claimed. That iodoform has a specific influence upon the *tubercle bacillus* would seem to follow from the experiments of Gosselin of Caen, who found that guinea pigs saturated with iodoform are incapable of contracting tuberculosis.

The manner of application varies with different surgeons. Verneuil, who has had an enormous experience, prefers in the treatment of abscesses and of tuberculous glands, and in most other cases, the injection of a 5 per cent. ether solution. Others prefer glycerin as a vehicle, especially in empyema cases, while others, especially in peritonitis, dust the dry powder over the surface which has been laid open. In uterine affections, vaginal suppositories made by incorporating 5.5 grains of iodoform with 2.5 drachms of cacao butter have been largely used, and similar rectal suppositories have been employed with asserted advantage in *hemorrhoids, prostatic enlargement,* and in *fissures of the anus.* In surgical dressings with iodoform the powder is usually sprinkled freely upon the wounds and secured in place by a dry dressing. *Iodoform gauze,* or *iodoform cotton wool,* may be made by saturating suitable material with a concentrated ethereal solution and afterwards drying.

The maximum amount of iodoform which may be used with safety as an external application is uncertain. Langenstein attributes a fatal result to one drachm, while one hundred and twenty grains have certainly caused death. Not more than half a drachm of iodoform should be ordinarily applied to a wound, although in cases of tuberculosis the surgeon is warranted in taking the risk of larger amounts. Verneuil sometimes injects at one sitting 75 grains of the iodoform.

One of the principle obstacles to its employment is the odor, which, to some patients, is unbearable. Many methods of disguising the odor have been recommended, but in our experience the large quantity required of each deodorizing agent would preclude its employment. Tannin has been recommended, but, as this operates by decomposing the iodoform, it is not to be thought of in this connection. Probably the best class of substances to use are the volatile oils, such as anise, peppermint, fennel, bergamot, almond, etc., tonka, coffee, and balsam of Peru, although the latter acts by forming a compound, and the aim should be not to destroy the odor, but so to modify it as to remove its objectionable features. Olive oil saturated with camphor is said to dissolve 6 per cent. of iodoform, and is preferred by some surgeons.

Dose, one to five grains (0.065 to 0.32 Gm.).

Off. Prep.—Suppositoria Iodoformi, *Br.;* Unguentum Iodoformi, *U. S., Br.*

IODOLUM. U. S.

IODOL

(ī-ŏd'o-lŭm)

$C_4I_4.NH = 566.17$

"Tetraiodopyrrol, a derivative of the base pyrrol, obtained by the direct action of iodine upon the base in the presence of alcohol. Iodol should be preserved in amber-colored bottles, protected from light." *U. S.*

Tetraiodopyrrol, Pyrrol Tetraiodide; Jodol, Tetrajodpyrrol, *G.;* Jodolo, *It.;* Yodol, *Sp.*

Preparation.—Iodol was discovered by Silber and Ciamician, and is made from the pyrrol obtained in Dippel's oil (bone oil), which, after purifying, is treated with a solution of iodine in potassium iodide, when the tetraiodide (iodol) precipitates. It is purified by redissolving in hot alcohol, and again precipitated by the addition of water. It contains nearly 89 per cent. of iodine.

Properties.—It is officially described as "a light grayish-brown, crystalline powder, without odor or taste. It is soluble in about 4900 parts of water, 9 parts of alcohol, 1.5 parts of ether, and 105 parts of chloroform at 25° C. (77° F.); soluble in fixed oils. It is soluble in concentrated sulphuric acid, producing a green solution gradually changing to brown. When heated to 100° C. (212° F.) it remains unchanged, but at a temperature of 140° to 150° C. (284° to 302° F.) it is decomposed with the liberation of violet iodine vapors. When ignited it should leave not more than 0.1 percent. of residue (limit of *inorganic impurities*). If 0.5 Gm. of Iodol be shaken with 100 Cc. of water and filtered, the filtrate should not be made more than slightly opalescent by silver nitrate T.S. (absence of *hydriodic acid* or soluble metallic *iodides*). If 0.5 Gm. of Iodol be shaken with 100 Cc. of water and filtered, the filtrate should not communicate more than a light yellowish tinge to chloroform (absence of appreciable amount of *free iodine*)." *U. S.*

Uses.—When given in sufficient dose to animals, iodol causes emaciation, albuminous urine, fall of temperature, general loss of muscular power, and finally death from fatty degeneration of the liver and kidneys and other tissues. That iodol applied externally is capable of producing constitutional symptoms is shown by C. Lauenstein (*T. G.,* 1887, 768), in a case in which

the surgical use of the drug caused dizziness, marked rise in the temperature, vomiting, small irregular pulse of 136, albuminous urine, and apathy which did not subside for four days. Iodine was found in the urine for twelve days. Pallin also reports a case with similar symptoms. That iodol is a less dangerous topical application than iodoform is due to its slower absorption. Iodol may be employed for all purposes for which iodoform has been used. It has been found very valuable in the treatment of *tuberculous laryngitis,* and may be blown into the larynx directly upon the ulcers without causing irritation. It has been used with asserted great success in the treatment of blennorrhagic and simple *vaginitis,* in *chancres* and other *ulcers,* in suppurative *adenitis,* and as an antiseptic dressing to *wounds.* Mazzoni's original solution was: iodol, one part; alcohol, sixteen parts; glycerin, thirty-four parts. One drachm of iodol forms with one ounce of ether a clear brown solution, which may be applied by the spray or brush to the nasal and other mucous membranes, on which it leaves a coating of iodol. Iodol pastilles are prepared by Wolfenden from one grain of iodol, one minim of glycerin, and eighteen grains of glyco-gelatin, and are by him strongly recommended for *laryngitis.* Iodol has also been used as an internal remedy. Assaky states that its effects in *tertiary syphilis* and in *scrofula* are extraordinary. Good effects have also been claimed for it in *diabetes.* Assaky and Reck have given thirty grains (1.9 Gm.) a day with asserted good results.

Dose, two to four grains (0.13 to 0.26 Gm.).

IODUM. U. S., Br.

IODINE

(ī-ō′dŭm)

I = 125.90

"It should contain not less than 99 percent. of pure Iodine, and be kept in glass-stoppered bottles, in a cool place." *U. S.* "A solid non-metallic element obtained from the ashes of sea-weeds and from native iodides and iodates." *Br.*

Iodinium, *U. S.* 1870; Iode sublimé, *Fr. Cod.;* Iode, *Fr.;* Jodum, *P. G.;* Jod, *G.;* Jodo, *It.;* Yodo, *Sp.*

Iodine is a non-metallic element, discovered in 1812 by Courtois, a soda manufacturer of Paris. It exists in certain marine vegetables, particularly the fuci or common sea weeds, which have long been its most abundant natural source. It has been detected in some fresh water plants, among which are the water cress, brooklime, and fine-leaved water hemlock; also in the ashes of tobacco, and of Honduras sarsaparilla. (Chatin.) It has been found in the beet-root of the grand duchy of Baden. (Lamy.) Macadam detected a trace of iodine in 100 gallons of water used for domestic purposes in Edinburgh, in several of the domestic animals, and in man. He detected it also in potatoes, beans, peas, wheat, barley, and oats. (*P. J.,* Nov. 1854, p. 235.) Iodine is, moreover, found in the animal kingdom, as in the sponge, the oyster, various polypi, cod liver oil, and eggs, and, in the mineral kingdom, in sea water in minute quantity, in certain salt springs, as silver iodide in a rare Mexican mineral, in a zinc ore of Silesia, in native sodium nitrate, and in some kinds of rock salt. It is now obtained commercially from one of these sources—viz., from the native sodium nitrate, or Chili saltpetre, with which it occurs as sodium iodate. The production of the province of Tarapaca (Chili) has assumed large dimensions within recent years, as a result of higher prices established by a combination of Scotch, French, and South American producers. The exportations of iodine from Chili amounted in 1904 to 458,206 kilos, while the stock on hand at the beginning of that year in London, was 713,690 kilos. Bussy has obtained iodine, in the proportion of one part in five thousand, from the coal gas liquor of the gas works of Paris. It was first discovered in the United States in the water of the Congress Spring, at Saratoga, by William Usher. It was detected in the Kanawha saline waters by Emmet, and it occurs in the bittern of the salt works of Western Pennsylvania, in the amount of about eight grains to the gallon. In sea weeds the iodine exists in the state probably of sodium iodide. In different countries sea weeds are burned for the sake of their ashes, the product being a dark-colored fused mass called *kelp.* This substance, besides sodium carbonate and iodide, contains more or less sodium chloride, potassium chloride, sodium sulphate, etc. The deep sea fuci contain the most iodine, and when these are burned at a low temperature for fuel, as is the case in the island of Guernsey, their ashes furnish more iodine than does ordinary kelp. (Graham.) According to Geo. Kemp, the laminarian species, especially *Laminaria digitata, L. saccharina,* and *L. bulbosa,* which are deep water sea weeds, and contain more potassium than sodium, are particularly rich in iodine.

Preparation.—Although most largely produced in South America, iodine is still obtained from kelp, and in Great Britain is manufactured chiefly at Glasgow. The kelp, which on an average contains 1-224th part of iodine, is lixiviated with water, in which about half dissolves. The solution is concentrated until a pellicle forms and allowed to cool, whereby nearly all the salts, except sodium iodide, are separated, they being less soluble than the iodide. The remaining liquor, which is dense and dark-colored, is made very sour by sulphuric acid, which causes the evolution of carbon dioxide, hydrogen sulphide and sulphurous acid, and the deposition of sulphur. The liquor is then introduced into a leaden still, and distilled with manganese dioxide into a

series of glass receivers, inserted into one another, in which the iodine is condensed. In this process the sodium iodide is decomposed, and the iodine evolved according to the reaction:

$$2NaI + 2H_2SO_4 + MnO_2 = MnSO_4 + Na_2SO_4 + 2H_2O + I_2$$

which leaves as residue manganous sulphate and sodium sulphate.[1] In this treatment much care is needed to avoid the liberation of chlorine from chlorides present, which will form volatile iodine trichloride and so occasion loss. This can be avoided by heating the acidified iodide solution with ferric chloride, when iodine is liberated according to the reaction:

$$2NaI + 2FeCl_3 = 2FeCl_2 + 2NaCl + I_2$$

The methods for the separation of the iodine from its combinations in the mother liquors as practised in South America may be divided essentially into three classes. 1. The mother liquors after the crystallization of the saltpetre without further concentration are treated with a solution of sodium sulphite of strength corresponding to the amount of iodine present; the iodine is liberated according to the reaction:

$$2NaIO_3 + 4HNaSO_3 + SO_2 = Na_2SO_4 + 4HNaSO_4 + I_2$$

the iodine thus separated from the sodium iodate is filtered through linen cloth, washed, pressed, and sublimed. 2. The mother liquors are treated with sodium sulphite or bisulphite until the precipitated iodine is converted into HI, and this is precipitated as cuprous iodide by a solution of copper sulphate and sodium sulphite. 3. The amount of iodine is increased by fractional evaporation and crystallization of the mother liquors, and then, after adding the calculated amount of sodium bisulphite, the iodine is distilled off from the acidified liquor. (*Dingler's Polytech. Journ.*, 231, p. 375.)

[1] The methods formerly practised for obtaining iodine from sea weeds were accompanied with great loss. A notable improvement over the old kelp processes are the "char" and "wet" processes of E. C. C. Stanford (*J. Soc. Chem. Ind.*, 1885, p. 518), which show the following results when compared with the old processes. *Kelp process;* per cent. utilized, 18; kelp, 18 tons, yield salts 9 tons and iodine 270 lbs.; residues, kelp waste 18 tons, valueless. *Char process;* per cent. utilized, 36; char, 36 tons, yield salts 15 tons and iodine 600 lbs.; residues, charcoal 36 tons, tar, and ammonia. *Wet process;* per cent. utilized, 70; water extract, 33 tons, yield salts 20 tons and iodine 600 lbs.; residues, algin 20 tons, cellulose 15 tons, dextrin, etc.

Still another improvement was made in Germany (A. James, German Patent No. 95,063, of March 17, 1897), whereby over 91 per cent. of the iodine present in the sea weed has been recovered. Sea weed either wet or dry is immersed in sea water that has previously been treated with quicklime to precipitate the magnesia and give a distinctly alkaline reaction. The sea weed in the proportion of about one ton to the cubic meter of water is left immersed for twelve hours, during which time about 60 per cent. of the iodine is dissolved. It is then leached for six hours, each time in a second and third portion of prepared sea water. The combined extraction waters are then treated with ferrous sulphate, to coagulate mucilaginous matter, neutralized with sulphuric or hydrochloric acid, and the iodine then set free with an oxidizing agent like nitric acid or persulphate of ammonium, 1.5 kilos of nitric acid being required per cubic meter of solution. Iodine thus freed is extracted with petroleum naphtha, this solution being agitated with caustic alkali to form iodide and iodate, which are then treated in the usual manner.

The British Pharmacopœia of 1864 purified iodine as follows: Take of Iodine of Commerce *one ounce.* Introduce the Commercial Iodine into a porcelain capsule of a circular shape, cover this as accurately as possible with a glass flask filled with cold water, and apply to the capsule the heat of boiling water for twenty minutes. Let the flask be now removed, and should colorless acicular prisms of a pungent odor be found attached to its bottom, let them be separated from it. This being done, the flask is to be restored to its previous position, and a gentle and steady heat (that of a gas-lamp answers well) applied, so as to sublime the whole of the iodine. Upon now allowing the capsule to cool, and lifting off the flask, the purified product will be found attached to the bottom of the latter. When separated it should be immediately enclosed in a bottle furnished with an accurately ground stopper. In this process a short preliminary sublimation by the heat of a water bath is ordered, in which the bottom of a glass flask filled with cold water is the refrigerator. The object of this is to separate any cyanogen iodide that may happen to be present. Should the flask, upon its removal, have attached to its bottom white acicular crystals, these will be the iodide in question, and must be rejected. The flask having been replaced, heat is again applied until the whole of the iodine has sublimed and attaches itself to the cool bottom of the flask.

Water has sometimes been found in iodine to the extent of 15 or 20 per cent. If considerable, it is easily discovered by the iodine adhering to the inside of the bottle. Bolley estimates its amount by rubbing together, until the odor of iodine disappears, 30 grains of iodine with about 240 of mercury, in a small weighed porcelain dish, using a small weighed agate pestle. When complete combination has been effected, the whole is placed in a water bath to dissipate the water. The loss of weight gives the amount of water in the iodine. (*Chem. Gaz.*, March 15, 1853, p. 118.) The presence of water is injurious only as it renders all the preparations of iodine weaker than they should be. In the former Ed. Pharmacopœia, directions were given to dry it, by placing it "in a shallow basin of earthenware, in a small confined space of air, with ten or twelve times its weight of fresh-burnt lime, till it scarcely adheres to the inside of a dry bottle."

Properties.—Iodine is described by the U. S. Pharmacopœia as "heavy, bluish-black, dry and friable, rhombic plates, having a metallic lustre, a distinctive odor, and a sharp and acrid taste. Specific gravity: 4.948 at 17° C. (62.6° F.). Iodine imparts a deep brown, evanescent stain to the skin, and slowly destroys vegetable colors. Soluble in about 5000 parts of water, and in 10 parts of alcohol at 25° C. (77° F.); freely soluble in ether, chloroform, or carbon disulphide; its solution in alcohol or in an aqueous solution of potassium

iodide has a reddish color; its solution in chloroform or carbon disulphide has a violet color. It volatilizes slowly at ordinary temperatures. When heated to about 114° C. (237.2° F.), it fuses, and is gradually dissipated in the form of a purple vapor, leaving no residue. With starch T.S. a dark blue color is produced." *U. S.* "Soluble in about 5000 parts of *water,* but freely dissolved by *alcohol* (90 per cent.), *ether, chloroform,* or *solution of potassium iodide.* The aqueous solution strikes a deep blue color with *mucilage of starch.* It sublimes without residue, and the portion that first comes over does not include any slender colorless prisms emitting a pungent odor (absence of iodine cyanide)." *Br.* It is a volatile substance, and evaporates even at common temperatures. Its vapor has the sp. gr. 8.7, being the heaviest aëriform substance known. If inhaled mixed with air, it excites cough and irritates the nostrils. When it comes in contact with cool surfaces, it condenses in brilliant steel-gray crystals. Iodine is freely soluble in alcohol and ether, but requires 5000 times its weight of water to dissolve it. If water stands on iodine for some time, especially in a strong light, it apparently dissolves more iodine, but the result depends upon the formation of hydriodic acid, in a solution of which iodine is more soluble than in water. The solution of iodine in water has no taste, a feeble odor, and a light-brown color; its solution in alcohol or ether is nearly black. Its solubility in water is very much increased by the addition of certain salts, as sodium chloride, ammonium nitrate, or potassium iodide, and the same effect is produced, to some extent, by tannic acid. Its solution in tannic acid is called *iodo-tannin,* of which Socquet and Guillermond made a syrup for internal and an aqueous solution for external use. For the formulas, see *B. F. M. R.,* 1854, p. 181. It is also soluble in glycerin, as ascertained by Cap in 1854. According to I. Walz, glacial acetic acid is an excellent solvent of iodine, at least equal to alcohol. When the acid is heated to boiling with excess of iodine, and then allowed to cool slowly, it deposits iodine in beautiful large slender crystals, sometimes half an inch long, much larger and more abundant than those formed from other solutions. (*Chem. News,* 1873, p. 233.) In chemical characters iodine resembles chlorine, but its affinities are weaker. It combines with most of the non-metallic and nearly all the metallic elements, forming a class of compounds called iodides. Some of these are official, as the iron, mercury, lead, potassium, sodium, strontium, and sulphur iodides. It forms with oxygen one oxide, *iodic oxide,* I_2O_5 and two acids, *iodic*[1] and *periodic,* and with hydrogen a gaseous acid, called *hydriodic acid.*

Tests.—Iodine, in most cases, may be recognized by its characteristic purple vapor; but, where this cannot be made evident it is detected unerringly by starch, which produces with it a deep-blue color. The test was discovered by Colin and Gaultier de Claubry, and is so delicate that it will indicate the presence of iodine in 450,000 times its weight of water. In order that the test may succeed, the iodine must be free, and the solutions cold. To render it free when in combination, as it always is in the animal fluids, a little nitric acid, free from iodine, must be added to the solution suspected to contain it. Thus, in testing urine for iodine, the secretion is mixed with starch, and acidulated with a drop or two of nitric acid, when, if iodine be present, the color produced will vary from a light purple to a deep indigo blue, according to the amount of the element present. Sometimes in mineral waters the proportion of iodine is so minute that the starch test, in connection with nitric acid, gives a doubtful coloration. In such cases, Liebig recommends the addition to the water of a very small quantity of potassium iodate, followed by a little starch and hydrochloric acid. Assuming the iodine to be present as hydriodic acid, the liberated iodic acid sets free the iodine of the mineral water, and becomes itself deoxidized, thus increasing the amount of the free iodine:

$$HIO_3 + 5HI = 3I_2 + 3H_2O$$

This test would be fallacious if iodic acid, mixed with hydrochloric acid, colored the starch, but this is not the case. Still, Liebig's test is inapplicable in the presence of reducing agents, such as sulphurous acid, which would give rise to free iodine from the test itself, independently of the presence of the element in the water tested. (W. Knop.) The U. S. P. gives the following tests: "A solution of iodine in chloroform should be perfectly clear and limpid (absence of *moisture*). To determine the presence of cyanogen, chlorine, or bromine, proceed as follows: Triturate 0.5 Gm. of finely powdered Iodine with 20 Cc. of water, and filter the solution. To one-half of this solution, in a test-tube, carefully add tenth-normal sodium thiosulphate V.S., until the solution is just decolorized. Then add a few drops of ferrous sulphate T.S., and subsequently a little sodium hydroxide T.S., and heat the mixture gently. On now adding a slight excess of hydrochloric acid, the liquid should not assume a blue color (absence of *iodine cyanide*). To the other half of the aqueous filtrate, in a test-tube, add a slight excess of silver nitrate T.S., shake the liquid actively, allow the precipitate to subside, and, having poured off the clear, supernatant liquid completely, shake the precipitate with a mixture of 1 Cc. of ammonia water and 9 Cc. of water, and filter. Upon the addition of a

[1] R. H. Brett of Liverpool, has found that when a small portion of the alkaloids, or their salts, is mixed with about an equal portion of iodic acid and a few drops of water, and the mixture gently heated, a succession of distinct explosions, attended by the evolution of gas, takes place. Brett finds that this phenomenon does not occur with other organic substances, and suggests it as a general test for alkaloids. (*P. J.,* Nov. 1854.)

slight excess of nitric acid to the filtrate, not more than a slight opalescence should make its appearance (limit of *chlorine* or *bromine*).

Assay.—Place about 0.5 Gm. of Iodine in a tightly stoppered weighing-bottle and weigh accurately; add 1 Gm. of potassium iodide and dissolve in 50 Cc. of water, then add tenth-normal sodium thiosulphate V.S. until the liquid is decolorized. The number of Cc. of tenth-normal sodium thiosulphate V.S. consumed, when multiplied by 1.259, and divided by the weight of the Iodine taken, gives the percentage of pure Iodine present." *U. S.* The British Pharmacopœia states that "a solution of Iodine in *chloroform* should be perfectly clear (absence of moisture). Each gramme, dissolved in 50 cubic centimetres of *water* containing 2 grammes of *potassium iodide*, should require for decoloration at least 78.4 cubic centimetres of the *volumetric solution of sodium thiosulphate*." Carey Lea proposes chromium trioxide as a substitute for the nitric acid for the liberation of iodine, as a more delicate test. It may be most conveniently applied by first adding starch to the liquid to be tested, and then a little diluted solution of potassium dichromate, enough to cause a pale yellow color, followed by a few drops of hydrochloric acid. (*Am. J. Sci.*, xlii. 109.) Another test for iodine, proposed by Rabourdin, is chloroform, by the use of which he supposes that the element may be not only detected in organic substances, but approximately estimated. Thus, if 150 grains of a solution, containing one part in one hundred thousand of potassium iodide, be treated with 2 drops of nitric and 15 or 20 of sulphuric acid, and afterwards shaken with 15 grains of chloroform, the latter acquires a distinct violet tint. Rabourdin applies his test to the detection of iodine in the several varieties of cod liver oil. For this purpose he incinerates, in an iron spoon, 50 parts of the specimen of oil with 5 of *pure* potassium hydroxide, dissolved in 15 of water, and exhausts the cinder with the smallest possible quantity of water. The solution is filtered, acidulated with nitric and sulphuric acids, and agitated with 4 parts of chloroform. After a time the chloroform subsides, of a violet color more or less deep according to the proportion of iodine present. Lassaigne considers the starch test more delicate than that of chloroform. For detecting iodine in the iodides of the metals of the alkalies, he considers palladium bichloride as extremely delicate, producing brownish flocks of palladium biniodide. According to Moride, petroleum benzin is a good test for free iodine, which it readily dissolves, forming a solution of a bright-red color, deeper in proportion to the amount of iodine taken up. As petroleum benzin does not dissolve chlorine or bromine, it furnishes the means of separating iodine from these elements. D. S. Price has pointed out the nitrites as exceedingly sensitive tests of iodine combined as an iodide. The suspected liquid is mixed with starch paste, acidulated with hydrochloric acid, and treated with solution of potassium nitrite. The iodine is set free, and a blue color appears, more or less deep, according to the proportion of iodine present. By this test, iodine may be detected in an aqueous solution containing only one in 400,000 parts. A similar test had been previously proposed by Grange.

It has been long known that when a mixture of iodine and starch in water is subjected to heat the blue color disappears, and that, if the heat be not too long continued, so as to volatilize the iodine or convert it into hydriodic acid, the color will return on the cooling of the liquid. Various explanations have been given of this curious fact by Personne and others, but the only one that is quite satisfactory is that by Magnes-Lahens, which he supports by experiment, that during the continuance of the heat the particles of starch and iodine separate, to unite again on refrigeration. (*J. P. C.*, 4e sér., iii. 405.) [1]

Adulterations.—Iodine is said to be occasionally adulterated with mineral coal, charcoal, plumbago, and black manganese oxide. These are easily detected by their fixed nature, while pure iodine is wholly volatilized by heat. Herberger found native antimony sulphide in one sample, and plumbago in another, and Righini has detected as much as 25 per cent. of calcium chloride. The presence of cyanogen iodide and of water has already been referred to, and the modes of detecting and separating them pointed out. (See page 664.) Besides the test given on page 665, the British Pharmacopœia directs that the official iodine should be soluble in alcohol, ether, and a solution of potassium iodide, and should sublime without residue, and that the part which first comes over should contain no colorless prisms of a pungent odor.

Uses.—Iodine was first employed as a medicine in 1819, by Coindet, Sr., of Geneva. It operates as a general excitant of the vital actions, especially of the absorbent and glandular systems. Its effects are varied by its degree of concentration, state of combination, dose, etc., and hence under different circum-

[1] *Amylum Iodatum.* U. S. 1880. *Iodized Starch* (*Amyli Iodidum, Iodide of Starch; Iodure d'Amidon*, Fr.; *Jodstärke*, G.).—"Starch, *ninety-five parts* [or four hundred and eighteen grains]; Iodine, *five parts* [or twenty-two grains]; Distilled Water, *a sufficient quantity*, to make *one hundred parts* [or one ounce av.]. Triturate the Iodine with a little Distilled Water; add the Starch gradually, and continue triturating until the compound assumes a uniform blue color, approaching black. Dry it at a temperature not exceeding 40° C. (104° F.), and rub it to a fine powder. Iodide of Starch should be preserved in glass-stoppered vials." *U. S.* This preparation has been highly recommended as free from local irritant properties. Dalton of New York, found that nearly all the animal fluids decompose starch iodide and destroy its blue color. (*Am. J. M. S.*, April, 1856, p. 327.) This result is owing, no doubt, to the alkaline nature of most of the animal fluids, especially those of the duodenum, alkaline iodides being formed at the expense of the starch. The dose is a heaped teaspoonful, given in water gruel, three times a day, and afterwards increased to a tablespoonful. No nicety is necessary in apportioning the dose. In some cases Buchanan has given half-ounce (15.5 Gm.) doses, increased to an ounce (31 Gm.).

stances it may prove corrosive, irritant, or simply alterative. It is absorbed into the circulation, and may be found in all the secretions, but is chiefly eliminated by the kidneys, not, however, uncombined, but in the state of hydriodic acid or an iodide. Cantu detected it not only in the urine and saliva, but also in the sweat, milk, and blood. According to Gleg and Bourcet (*C. R. A. S.*, 130, 1721) it is a normal constituent of the blood.

In an overdose iodine acts as an irritant poison. From four to six grains (0.26 to 0.4 Gm.), in man, cause a sense of constriction in the throat, sickness and pain at the stomach, and at length vomiting and colic. Even in medicinal doses it sometimes causes alarming symptoms, such as fever, restlessness, disturbed sleep, palpitations, excessive thirst, acute pain in the stomach, vomiting and purging, violent cramps, frequent pulse, and, finally, progressive emaciation if the medicine be not laid aside. Such violent symptoms are, however, very rare, but where iodine or potassium iodide is given freely a mild *iodism* is not unfrequent. It is usually characterized by pain or heaviness in the region of the frontal sinuses, with or without coryza; in some instances soreness of the mucous membrane of the mouth and throat, or a mild ptyalism, is the prominent symptom, or a papular eruption may be the first manifestation of the constitutional action of the remedy. Absorption of the mammæ and wasting of the testicles have been reported as caused by the long-continued use of the drug, but such results are extremely rare. Lebert noted that these accidents produced by iodine, with scarcely an exception, were in those cases of goitre in which the remedy acted rapidly in removing the tumor, and believed that the bad effects arose from the too prompt absorption of the abnormal material of the tumor, and not from iodine itself. (*Ann. Thér.*, 1855, 228.) The modern discovery that the active principle of the thyroid body can produce rapid wasting singularly confirms the old observation and theory of Lebert.

Iodine has been principally employed in diseases of the glandular system. It has been used with success in *ascites*, especially when connected with diseased liver. It acts most efficiently immediately after tapping. In *glandular enlargements* and chronic indurations it is often of great service. Coindet discovered its extraordinary power in curing *goitre*,[1] and it has been used with more or less advantage in enlargements and indurations of the liver, spleen, mammæ, testes, and uterus. In hepatic affections of this kind, where mercury has failed or is inadmissible, iodine is our best resource. In chronic diseases of the uterus, with induration and enlargement, and in hard tumors of the cervix and indurated puckerings of the edges of the os tincæ, iodine has occasionally effected cures, when administered internally and locally applied. In the form of potassium iodide in *advanced syphilis, mercurial cachexia,* and *lead poisoning,* it is one of our best remedies. It is habitually employed in *scaly skin affections* and in *chronic rheumatism.* Coindet first directed attention to its effects in *scrofula,* but Lugol, by numerous trials in the Hôpital Saint-Louis, extending from 1827 to 1831, first established the value of the remedy.

The most eligible form of iodine for internal administration is its solution in water, aided by potassium iodide. (See *Liquor Iodi Compositus.*) The solutions employed by Lugol contained one part of iodine and two parts of potassium iodide, and the doses given by him were equivlent to half a grain (0.032 Gm.) of iodine daily for the first fortnight, three-quarters of a grain (0.048 Gm.) daily for the second and third fortnights, one grain (0.065 Gm.) daily during the fourth and fifth fortnights, and, in some cases, a grain and a quarter (0.081 Gm.) daily for the remainder of the treatment, always largely diluted. The tincture of iodine is not as eligible for internal use.

According to Hutet, one grain of iodine is deprived entirely of taste and odor by one teaspoonful of a strong infusion of coffee. (*P. J.*, Dec. 1870.)

The external employment of iodine may be divided into general and topical. By its use externally it does not create a merely local effect, but, by its absorption, produces its peculiar constitutional impression. The external treatment, when general, consists in the use of the *iodine bath.* This for adults should contain from two to four drachms of iodine, with double that quantity of potassium iodide, dissolved in water, in a *wooden* bath tub, the proportion of the water being about a gallon for every three grains of iodine employed. The quantity of ingredients for the baths of children is one-third as much as for adults, but dissolved in about the same quantity of water. The quantity of iodine and iodide for a bath having been determined upon, it is best to dissolve them in a small quantity of water (half a pint, for example) before they are added to the water of the bath, as this mode of proceeding facilitates their thorough diffusion. The iodine baths, which may be directed three or four times a week, usually produce a slight rubefacient effect, but occasionally a stronger impression, causing the epidermis to peel off, particularly from the arms and legs. The skin at the same time acquires a deep yellow tinge, which usually disappears between the baths.

[1] Chatin, finding, according to his observations, a great variation in the amount of iodine in the air, water, and soil of different localities, has founded on this supposed fact an explanation of the prevalence of goitre and cretinism in some places and their absence in others. Thus, in certain parts of France, near Paris, which he calls the Paris zone, the amount of iodine thus distributed is comparatively large, and goitre and cretinism are unknown, while in the Alpine valleys, where only one-tenth the amount of iodine is found, these affections are endemic. These conclusions are controverted by Lohmeyer of Göttingen, and Kletzinsky of Vienna, who failed to detect iodine in the air of those cities the inhabitants of which are free from goitre. Nicholas Senn (*J. A. M. A.*, 1905) likewise attributes the freedom of the Esquimaux from similar diseases to the large amount of iodine salts consumed by them.

The topical application of iodine is made by means of several official preparations. (See *Unguentum Iodi* and *Tinctura Iodi.*) Besides these, several others have been employed topically. Lugol's *iodine lotion* consists of from two to four grains of iodine, and double that quantity of potassium iodide, dissolved in a pint of water. It is used as a wash or an injection in scrofulous *ophthalmia, ozæna,* and *fistulous ulcers.* His *rubefacient iodine solution* is formed by dissolving half an ounce of iodine and an ounce of potassium iodide in six fluidounces of water. This is useful for exciting scrofulous ulcers, for touching the eyelids, and as an application to recent scrofulous cicatrices, to render them smooth. The rubefacient solution, added to warm water in the proportion of about a fluidrachm to the gallon, makes a convenient local bath for the arms, legs, feet, or hands, and, mixed with linseed meal or some similar substance, it forms a cataplasm useful in certain eruptions, especially where the object is to promote the falling off of scabs. External applications of iodine have been recommended for the removal even of internal plastic exudations, as to the side, for example, in protracted pleurisy. The rubefacient preparation of iodine at present most commonly employed is the tincture. (See *Tinctura Iodi.*) The preparation called *iodine paint* is a tincture twice as strong as the official tincture, and is made by dissolving a drachm of iodine and half a drachm of potassium iodide in a fluidounce of alcohol, and allowing the mixture to stand in a glass-stoppered bottle until solution is effected. It is applied with a glass or a camel's hair brush, in one or more coatings, according to the degree of effect desired. Iodine paint is used as a counter-irritant, with advantage, in almost all forms of deep-seated chronic inflammation. When thus used, it must be borne in mind that the iodine acts also by being absorbed. Another valuable application of it is for the removal of *nævi.* Lugol's *caustic iodine solution* is made of iodine and potassium iodide, each, an ounce, dissolved in two fluidounces of water. This is used to destroy soft and fungous granulations, and has been employed with decided benefit in *lupus.*

The *Strong Solution of Iodine* of the British Pharmacopœia is intermediate in strength between the two solutions last mentioned. (See *Liquor Iodi Fortis,* Br.) Another caustic solution of iodine, under the name of *iodized glycerin,* is made by dissolving one part of potassium iodide in two parts of glycerin, and adding the solution to one part of iodine, which it completely dissolves. Max Richter of Vienna, to whom belongs the credit of having introduced into practice the solution of iodine in glycerin, found this caustic particularly useful in *lupus,* non-vascular *goitre,* and scrofulous and constitutional syphilitic *ulcers.* The solution is applied by means of a hair-pencil to the diseased surface, which must then be covered with gutta-percha paper, fixed at the edges by strips of adhesive plaster, in order to prevent the evaporation of the iodine. The application produces burning pain, which rarely lasts for more than two hours. The dressing is removed in twenty-four hours, and pledgets dipped in cold water applied. This iodine caustic is too strong for ordinary local use. A weaker solution is recommended by Szukits, formed of one part of iodine to five parts of glycerin, for application to the neck, female breast, abdomen etc. After four or five paintings it causes excoriation, which requires its discontinuance and the use of cold applications.[1] A mode of applying iodine locally has been suggested by R. Greenhalgh of London, which consists in thoroughly impregnating raw cotton with a solution in glycerin of potassium iodide and of iodine, in the proportion of two ounces of the former and one ounce of the latter to eight ounces of the menstruum, and then drying the "*iodized cotton.*" It is intended for application to the cervix or os uteri, which is effected through a speculum. (*L. L.,* May 26, 1866, p. 582.) Méhu's method of making iodized cotton is as follows. Finely divided iodine (5 to 10 parts) is sprinkled between layers of loose cotton (100 parts) introduced

[1] *Iodized Oil.*—The following is the original process of Personne. Five parts of iodine are mixed with a thousand parts of almond oil, and the mixture is subjected to a jet of steam, until decolorized. The same operation is repeated with five additional parts of iodine. The oil is then washed with a weak alkaline solution, to remove the hydriodic acid developed in the process. By this mode of proceeding it may be presumed that the iodine is intimately united with the oil, along with which it would find an easy entrance into the system, and that, while about half of the iodine is lost as hydriodic acid, the remainder takes the place of the hydrogen eliminated from the oil. In 1851 the French Academy appointed Guibourt, Soubeiran, Gibert, and Ricord to report upon the therapeutic value of a definite combination of iodine and oil. The reporter (Guibourt) approved of Personne's process, and Gibert and Ricord reported favorably of the therapeutic effects of the preparation. Personne's iodized oil differs little in appearance and taste from almond oil, and is easily taken alone or in emulsion. The dose is two fluidounces (60 Cc.) daily, which may be increased to three fluidounces (90 Cc.) or more. (*Am. J. M. S.,* xxiii. 502.)

Berthé and Lepage have objected to Personne's iodized oil, that it is of variable iodine strength, and that it is liable to become rancid, in consequence of the use of steam in its preparation. Berthé makes an iodized oil which he alleges to be free from these objections, by heating to about 176° F. five parts of iodine with a thousand parts of almond oil, in a water bath, until decoloration has taken place. The resulting oil is colorless, perfectly transparent, without odor or rancidity, not acted on by starch, and of a constant composition. To shorten the time in preparing the oil, Lepage dissolves the iodine in three times its weight of ether, before adding it to the oil, and briskly shakes the mixture for eight or ten minutes. The preparation is then heated in a water bath, to decolorize it and drive off the ether. Hugounenq objects to this process, for if the oil be completely deprived of the odor of ether, the heating must be continued for several hours. He also objects to any process which requires the continued application of heat, as rendering the oil liable to become quickly rancid. His plan is to rub up the iodine, for five or six minutes, in a porcelain mortar, with a small portion of the oil, and then gradually to add the remainder. A red limpid liquor is obtained, which may be completely decolorized by exposure for fifteen minutes to the sun's rays. Iodized oil, thus prepared, has the odor and taste of almond oil, is not more liable to become rancid than the pure oil, and is free from hydriodic acid. (*J. P. C.,* Mars, 1856.)

into a tall glass vessel, and the latter placed horizontally on a water or sand bath. As soon as vapors of iodine are seen to rise, and the air has been expelled from the vessel, the latter is tightly stoppered. On continuing to apply a moderate and uniform heat, the iodine vapors penetrate the cotton, and color it yellow. After about two hours, the cotton will have assumed the color of burnt coffee, and the operation is finished. Cotton iodized in other ways, as by immersion in concentrated solutions of iodine in ether or carbon disulphide, retains merely traces of iodine. (*N. R.*, April, 1867.)

Iodine is used by injection into various cavities. It has been employed in this way for the cure or relief of *hydrocephalus, pleuritic effusion, hydropericardium, ascites, ovarian dropsy, hernia, hydrocele, spina bifida, dropsy of the joints, large cystic bronchocele,* and *chronic abscesses.* The discussion of the indications for the use of the injections in these cases, and of the precautions and the methods to be adopted, belongs rather to treatises upon the practice of medicine and surgery than to a work like the present. To such treatises, therefore, the reader is referred.

Enemata containing iodine have been used by several practitioners, in the *chronic dysentery* and *diarrhœa* of both adults and children, with decided benefit, a prominent effect being the relief of tenesmus. They are supposed to act locally on ulcers in the colon and rectum, and generally by absorption. The injection should be made of Lugol's solution, one to ten fluidrachms in one or two quarts of water. It should be preceded by an emollient enema to empty the intestine, and should be repeated once or twice daily, gradually increasing its strength. If the pain is severe, a laudanum injection will bring immediate relief.

Iodine, in the state of vapor, has been employed by inhalation, and the experiments as yet tried have been in the treatment chiefly of *phthisis* and *chronic bronchitis.* Although very extraordinary results were claimed for the method, yet it has entirely failed to fulfil expectations, and is at present very rarely practised. For details as to methods, the reader is referred to the 14th edition of the U. S. D.[1]

Iodine or an iodide should not be given in solution with an alkaloid, as it forms insoluble compounds, and in Philadelphia death has been produced by the strychnine iodide which had crystallized out of a mixture; the patient taking in the last dose in the bottle the precipitated strychnine salt. It has even been suggested by R. F. Fairthorne (*A. J. P.*, 1856) and H. W. Fuller (*L. L.*, March 21, 1868, p. 373) as an antidote to alkaloids, but the insoluble compounds of these substances would by no means be inert in the stomach.

In cases of poisoning by iodine, the stomach must be evacuated, and drinks administered containing an amylaceous substance, such as flour, starch, or arrow-root.

Off. Prep.—Liquor Iodi Compositus, *U. S.* (*Br.*); Pilulæ Ferri Iodidi, *U. S.;* Sulphuris Iodidum, *U. S., Br.;* Syrupus Ferri Iodidi, *U. S., Br.;* Tinctura Iodi, *U. S., Br.;* Unguentum Iodi, *U. S., Br.*

IPECACUANHA. U. S. (Br.)

IPECAC

(Ĭp-ẹ-căc-ū-ăn'hạ)

"The dried root, to which may be attached a portion of the stem not exceeding 7 Cm. in length, of *Cephaëlis Ipecacuanha* (Brotero) A. Richard (Fam. *Rubiaceæ*), known commercially as *Rio, Brazilian,* or *Para ipecac,* or the corresponding portion of *C. acuminata* Karsten, known commercially as *Carthagena ipecac,* yielding, when assayed by the process given below, not less than 2 percent. of ipecac alkaloids." *U. S.* "The dried root of Psychotria Ipecacuanha, *Stokes.*" *Br.*

Ipecacuanhæ Radix, *Br.*, Ipecacuanha Root; Ipécacuanha annelé ou officinale, *Fr. Cod.;* Racine brésilienne, *Fr.;* Radix Ipecacuanhæ, *P. G.;* Ruhrwurzel, Brechwurzel, Ipecacuanha, *G.;* Ipecacuana, *It.;* Ipecacuana (Raiz de), *Sp.*

The term *ipecacuanha,* derived from the language of the aborigines of Brazil, has been applied to various emetic roots of South American origin.[2] The botanical character of the ipecac plant of commerce was long unknown. Piso and Marcgraf, who were the first to treat of this medicine, in their work on the Natural History of Brazil, published at Amsterdam in 1648, described in general terms two plants,—one producing a whitish root, distinguished by the name of white ipecac, the other a brown root, which answers in their description precisely to the official drug. But their account was not sufficiently definite to enable botanists to decide upon the character of the plants. The medicine was generally thought to be derived from a species of *Viola,* which Linnæus des-

[1] Barrère has proposed the use, for inhalations, of *iodized camphor,* which is to be taken like snuff. This is prepared by putting powdered camphor in a snuff-box, with a hundredth part in bulk of iodine, contained in a muslin bag. In the course of a few hours the substances, by occasional shaking, unite, forming a powder resembling iodine in color. The difficulty in practising ordinary iodine inhalation depends chiefly on the irritation caused by the vapor, which excites cough and fatigues the patient. According to Barrère, this inconvenience is avoided by the use of the iodized camphor. A pinch of it produces sneezing and some smarting in the nostrils, but when the vapor reaches the lungs it causes a refreshing sensation, which induces the patient to draw a long and deep breath. (*Ann. Thér.*, 1855, p. 232.) Hutet recommends the inhalation of hydriodic ether in affections of the lungs.

Brainard employs the vapor of iodine, with great advantage, in the treatment of *indolent ulcers,* first dressing the ulcer with simple cerate spread on lint, then applying over this several layers of lint in which from one to four grains of iodine have been folded, and covering the whole with oiled silk and tin foil, secured by a bandage, so as to prevent the escape of the iodine, which is vaporized by the heat of the body. (*Chicago Med. Journ.*, Jan. 1860.)

[2] Weddell states that the word ipecacuanha is nowhere in Brazil used to designate the Cephaëlis, which is generally called *poaya.* (*J. P. C.*, 3e sér., xvi. 34.)

ignated as *V. Ipecacuanha.* Opinion afterwards turned in favor of a plant sent to Linnæus by Mutis from Colombia, as affording the ipecac of that country and of Peru. This was described in the *Supplementum* of the younger Linnæus, 1781, under the name of *Psychotria emetica,* and was long erroneously considered as the source of the true ipecac. Gomez of Lisbon, was the first who accurately described and figured the genuine plant, which he had seen in Brazil, and specimens of which he took with him to Portugal, but Brotero, professor of botany at Coimbra, with whom he had left specimens, having drawn up a description and inserted it with a figure in the Linnæan Transactions without acknowledgment, enjoyed for a time the credit due to his countryman. In the paper of Brotero (1802) the plant is named *Callicocca ipecacuanha,* but the term *Callicocca,* having been applied by Schreber (1789), without sufficient reason, to a genus already named, the name of Cephaëlis, Swartz (1788) has been largely used. According to Engler and Prantl, the principal synonyms of the ipecac plant are, besides the official botanical names, *Cephaëlis Ipecacuanha,* Willd., *Psychotria Ipecacuanha,* Müll.-Arg., and *Uragoga Ipecacuanha,* Baill. 150 species of the genus Uragoga, according to Engler and Prantl, are to be found in the tropics, of which 100 grow in Brazil. The genus is divided into 4 sections, of which the Euragoga (Cephaëlis) comprises 73 species, most of which are found in Brazil.

In recognizing *Cephaëlis acuminata,* Karsten, the U. S. Pharmacopœia has followed a very uncertain lead. This species was originally described in literature in Karsten's *Deutsche Flora,* published in 1883, and the only characters given are "leaves elliptical, pointed, stipules separated often almost to their base into a subulate fringe," and that the bark of the root is not separated cylindrically as in the older ipecac, is not uniform in constitution, but formed of radially arranged, vertically directed, parenchymatous cells separated by radii from the inner bark (bast-cells). The differences between elliptical and pointed, and oblong ovate and pointed, are very slight. The leaves of the Brazilian ipecac appear to vary very much in their outlines. Further, Karsten himself states that the stipules of the true ipecac plant are furnished with a subulate fringe of the length or longer than their full surface, so that the difference between the stipules of the alleged species is very slight. Again, the characteristics drawn from the structure of the root do not seem to us of specific value. Carthagena ipecac of the American market does not have the structure spoken of by Karsten, but agrees entirely with ordinary ipecac. Finally, the description by Karsten of *C. acuminata* indicates that he has probably never seen a flowering specimen of the plant. Humboldt, who was evidently familiar with the Colombian plant in its native woods, perceived no difference between it and the Brazilian form, and the highest botanical authorities do not acknowledge Karsten's species, as C. acuminata, though characterized as long ago as 1883, is not in the Index Kewensis nor in Engler and Prantl. The matter is one of some practical importance from the fact that at one time the United States custom authorities objected to the entry of Carthagena ipecac on the ground that it was not ipecac at all, but an adulterant, and gave way largely because it was affirmed that it was the product of *Cephaëlis Ipecacuanha.*

Cephaëlis Ipecacuanha, Richard, *Hist. Ipecac.* p. 21, t. i.; Martius, *Spec. Mat. Med. Brazil,* t. i. p. 4; *Curtis's Bot. Mag.,* N. S., vol. xvii. pl. 4083, 1844.—*Callicocca Ipecacuanha,* Brotero, *Linn. Trans.* vi. 137.—This is a small shrubby plant, with a root from four to six inches long, about as thick as a goose quill, marked with annular rugæ, simple or somewhat branched, descending obliquely into the ground, and here and there sending forth slender fibrils. The stem is two or three feet long, but, being partly under ground, and often procumbent at the base, usually rises less than a foot in height. It is slender; in the lower portion leafless, smooth, brown or ash-colored, and knotted, with radicles frequently proceeding from the knots; near the summit, pubescent, green, and furnished with leaves seldom exceeding six in number. These are opposite, petiolate, oblong-obovate, acute, entire, from three to four inches long, from one to two broad, obscurely green and somewhat rough on their upper surface, pale, downy, and veined on the under. At the insertion of each pair of leaves are deciduous stipules, embracing the stem, membranous at the base, and separated above into numerous bristle-like divisions. The flowers are very small, white, and collected to the number of eight, twelve, or more, each accompanied with a green bract, into a semi-globular head, supported upon a round, solitary, axillary footstalk, and embraced by a monophyllous involucre, deeply divided into four, sometimes five or six, obovate, pointed segments. The fruit is an ovate, obtuse berry, which is at first purple, but becomes almost black when ripe, and contains two small plano-convex seeds.[1]

The ipecac plant of Brazil flourishes in moist, thick, and shady woods, being most abundant within the limits of the eighth and twentieth degrees of south latitude. It flowers in January and February, and ripens its fruit in May. The root is active in all seasons, but, as it has to be dried rapidly, collection during the rainy season is relaxed. The native collector, or *poayero,* seizes all the stems of a clump, loosens them by a zigzag motion, and then, thrusting a pointed stick under the roots, tears up the

[1] *Cephaëlis tomentosa,* of Trinidad, has been studied by Francis Ransom, who finds that it contains emetine, but in too small quantity for commercial purposes. For description of the root, etc., see *P. J.,* xix. p. 258.

whole mass. The roots, freed from dirt by shaking, are then dried. The amount gathered daily varies from 8 to 30 pounds, according to skill and locality. Extirpation does not take place, because, as shown by the Edinburgh gardeners McNab and Lindsay, a very small fragment of the root, or even a petiole of a leaf, will rapidly produce a new plant. Weddell, indeed, many years since, stated that the remains of the root, often purposely left in the ground, serve the purpose of propagation, each fragment giving rise to a new plant. Ipecac of commerce comes chiefly from the interior province of Matto-Grosso, upon the upper waters of the Paraguay (from which in some years as much as 450,000 kilos are shipped), although some is said to be gathered near Philadelphia north of Rio Janeiro. The chief places of export are Rio Janeiro, Bahia, and Pernambuco. It is brought to the United States in large bags or bales.[1]

In 1866 the cultivation of ipecac was introduced into India by King, but it was not until twenty years later (1886), when it was found

[1] UNOFFICIAL VARIETIES OF IPECAC.—From time to time there have been imported into Europe various drugs stated to be ipecac, but differing from the official drug. Of these the most important are White Ipecac; the Larger Striated Ipecac of Planchon (*J. P. C.*, Déc. 1872); and the Lesser Striated Ipecac of Planchon.

White Ipecac. Amylaceous Ipecac. Undulated Ipecac. Larger Undulated Ipecac. Ipecac of Carthagena.—The origin of this variety of ipecac was attributed by Martius to species of *Richardsonia* (*Richardia* of Linnæus), especially *R. scabra, R. braziliensis* of Gomez, and *R. emetica*, but an authentic specimen of the plant, received from Colombia, was found by Hanbury to resemble very closely the official ipecac plant, and H. Baillon has described the source of white ipecac as a new species of *Psychotria* or *Uragoga*, under the specific name of *granatensis*, syn. *Psychotria emetica*, Mutis (not Vell.); the plant is probably merely a variety of the official species. White ipecac occurs in fragments from 5 to 8 millimeters in diameter, cylindrical, marked with rings which are but little pronounced and often wanting. Its color is whitish gray, sometimes verging towards reddish or yellowish. When broken it shows a very thick, hard, horny bark, with a dry, whitish or grayish-brown or black, farinaceous surface, displaying in the full sunlight little shining points. It is chiefly distinguished from the official drug by its greater size, its gray external color, the feebleness of its undulation, and the comparative smallness of its woody centre. It is inodorous and insipid, and contains, according to Pelletier, a very large proportion of starch, with only 6 per cent. of impure emetine and 2 per cent. of fatty matter. Richard found three and one-half parts of emetine in the hundred: Palangié found 3 per cent., but in 1860 Lefort obtained from a specimen nearly as much emetine as occurs in the official roots. White ipecac evidently varies in its strength, and, as it sometimes is mixed with genuine roots, it would seem probable that it is the root of the official plant modified by climatic influence, or is composed of inferior roots obtained from very old specimens of the official plants. This probability is confirmed by the microscopic characters, the structure of the root being very closely similar to that of the official drug.

Larger Striated Ipecac (Planchon). *Violet Striated Ipecac. Ipecac of St. Martha. Ipecac of Carthagena. Striated Elastic Ipecac* (Attfield).—This variety of ipecac is generally acknowledged to be the product of *Psychotria emetica*, Mutis, not Vell., growing in the deep forests of Colombia. It is a small shrub, with a stem twelve or eighteen inches high, simple, erect, round, slightly pubescent, and furnished with opposite, oblong-lanceolate, pointed leaves, narrowed at their base into a short petiole, and accompanied with pointed stipules. The flowers are small, white, and supported in small clusters towards the end of an axillary peduncle. The drug occurs in rather long fragments, sometimes 9 or 10 centimeters (3 or 4 inches), with a thickness of from 5 to 9 millimeters (¼ to ⅜ of an inch). The pieces are for the most part almost straight, sometimes sinuous, more rarely tortuous. At distant intervals they are marked by contractions, or circular furrows. Their whole surface is largely striated longitudinally. To their upper part are often attached one or more remaining portions of the stem, distinguished from the root by their much smoother surface. Their color is a grayish brown, tending sometimes to reddish brown. Like other ipecacs, they have an outer cortical and a central ligneous portion. The former is soft, so that it may even be penetrated by the nail. It has a horny aspect, and a variable color, passing from whitish, by shades of rose, violaceous, and blackish violet. Its thickness is at least two-thirds of the root, and becomes still greater when this is immersed in water. The central part is yellowish white. The root has little odor, and a taste scarcely nauseous, sometimes flat, and often sweetish. As to the microscopic characters, the most striking are probably the total absence of the starch granules, and the relatively very small diameter of the vessels in the central part. Chemically this variety is characterized by the presence of a principle capable of reducing the cupro-potassic reagent. It is so abundant in the cortical part that a simple digestion in water gives a liquid with strong reducing powers, but without deviating action on polarized light. The larger striated ipecac comes from Colombia.

Lesser Striated Ipecac (Planchon). *Ipecac des Côtes d'Or* (Pelletier). *Black Ipecac. Black Striated Ipecac. Striated Brittle Ipecac* (Attfield). *False Ipecac* (Holmes).—It is not known from what plant this is obtained. It occurs in very short fragments, 2 or 3 centimeters at most long, and 2 or 3 millimeters in thickness; some nearly cylindrical, others narrowly fusiform; others again formed of roundish or pyriform segments, somewhat thicker than the preceding, placed end to end. The color is generally of a gray brown, darker than that of the other kind. The longitudinal striæ are fine, and regular on the transverse section. The cortical portion is as it were horny, and its consistence firmer than in the larger kind; the central part is yellowish, and under the microscope exhibits numerous pores. The ligneous centre is at once distinguished by the size of its vessels, which give it a porous appearance. The presence of the starch granules is another of the distinguishing characters of this variety. It contains a larger proportion of emetine than the preceding, yielding, according to the analysis of Pelletier, 9 per cent.

According to Martius, different species of *Ionidium* (*Viola*, Linn.) also produce what is called *white ipecac*. The roots of all the species of Ionidium possess emetic or purgative properties. The root of *I. Ipecacuanha* is described by Guibourt as being six or seven inches long, as thick as a quill, somewhat tortuous, and exhibiting at the point of flexion semicircular fissures, which give it some resemblance to the root of the Cephaëlis. It is often bifurcated at both extremities, and terminates at the top in a great number of small ligneous stalks. It is wrinkled longitudinally, and of a light yellowish-gray color. The bark is thin, and the interior ligneous portion very thick. The root has little taste or odor. According to Pelletier, 100 parts contain 5 of an emetic substance, 35 of gum, 1 of nitrogenous matter, and 37 of lignin. (*Histoire abrégée des Drogues simples*, i. 514.)

The root of a species of Ionidium growing in Quito has attracted some attention as a remedy in *elephantiasis*, under the South American name of *cuichunchulli*. The plant received from Bancroft the name of *I. Marcucci*; but Hooker found the specimen received from Bancroft to be the *I. parviflorum* of Ventenat. Lindley thinks a specimen he received under the same name from Quito to be the *I. microphyllum* of Humboldt. If useful in elephantiasis, it is so probably by its emeto-purgative action. (See *A. J. P.*, vii. 186.)

Under the name of *East Indian Ipecac* there has appeared in the London markets a root of a pale pinkish-brown color, tapering rapidly from the base to the apex, and having annulations much closer than in the true ipecac. It is especially distinguished from the latter root by being evidently monocotyledonous—that is, without the central woody column—the vascular bundles appearing under a pocket lens as a more or less irregular ring of brownish dots. R. A. Cripp obtained from it a minute quantity of an alkaloidal substance, certainly distinct from the alkaloids of ipecac (*P. J.*, lv.). Ranwez and Campion have also described a false ipecac derived from a monocotyledonous plant, *Cryptocoryne spiralis*. (*Ann. Pharm.*, i.)

that ipecac flourished in the Straits Settlements equally as well as in Brazil, that its cultivation became successful.

Properties.—Genuine ipecac is in pieces two or three lines thick, variously bent and contorted, simple or branched, consisting of an interior slender, light straw-colored, ligneous cord, with a thick, brittle, brownish, finely wrinkled, cortical covering, which presents on its surface a succession of circular, unequal, prominent rings or rugæ, separated by very narrow fissures, frequently extending nearly down to the central fibre. This appearance of the surface has given rise to the term *annelé,* or *annulated,* by which the true ipecac is designated by French pharmacists. The cortex is hard, horny, and semi-transparent, breaks with a resinous fracture, and easily separates from the tougher ligneous fibre, which possesses the medicinal virtues of the root in a much inferior degree. On microscopic examination the very thick bark is seen to be formed of uniform parenchymatous cells, without traces of the medullary rays, which are very distinct in the woody central cylinder. Attached to the root is frequently a smoother and more slender portion, which is the base of the stem, and should be separated before pulverization. Pereira has met, in the English market, with distinct bales composed of these fragments of stems, with occasionally portions of the root attached. Much stress has been laid upon the color of the external surface of the ipecac root, and diversity in this respect has even led to the formation of distinct varieties. Thus, the epidermis is sometimes deep brown or even blackish, sometimes reddish brown or reddish gray, and sometimes light gray or ash-colored; hence the varieties of ipecac root which were formerly recognized, the *brown, red* and *gray.* It is now known that the color of the root varies according to the circumstances of growth and soil, so that coloration as the basis of classification has been abandoned, and the ipecacs of commerce are divided according to their geographical sources, into the *Brazilian* or *Rio Ipecac,* the *Carthagena* or *Colombia Ipecac,* and the *Johore* or *Indian Ipecac;* of these, the two varieties which are recognized by the U. S. Pharmacopœia are described as follows: "*Rio Ipecac.*—In pieces of irregular length, rarely exceeding 25 Cm.; stem-portion 2 to 3 Mm. thick, light gray-brown, cylindrical and smoothish; root-portion usually red-brown, occasionally blackish-brown, rarely gray-brown, 3 to 6 Mm. thick, curved and sharply flexuous, nearly free from rootlets, occasionally branched, closely annulated with thickened, incomplete rings, and usually exhibiting transverse fissures, with vertical sides, through the bark; fracture short, the very thick, easily separable bark whitish, usually resinous, the thin, tough wood yellowish-white, without vessels; odor very slight, peculiar, the dust sternutatory; taste bitter and nauseous, somewhat acrid. *Carthagena Ipecac.*—Similar to Rio Ipecac, but about one-half thicker, dull gray externally, with thinner, merging annulæ, and the fractured surface of the bark gray." *U. S.*

Carthagena ipecac is usually to be distinguished from the Brazilian by its lighter color and the fact that many of its roots are scarcely at all annulated, and some are even smooth. On the other hand, in most specimens of Carthagena ipecac which we have examined, some of the roots could not be distinguished from those of the Brazilian variety. The cultivation of ipecac, which was introduced into India by the British Government, has especially succeeded in the neighborhood of Johore (Straits Settlement). On account of the great local demands in India, only a small amount of this ipecac comes into general commerce, and very little of it reaches the United States. *Johore* or *Indian ipecac* is especially characterized by the excellent appearance, regularity and large size of the roots, which are deeply annulated, somewhat light in color, and having to a marked degree the general physical and microscopical characteristics of the Brazilian root. According to Ransom, Paul and Cownley, and to Umney and Swinton, it is very rich in alkaloids, and, like the Brazilian root, has for its dominant alkaloid, emetine. (See *P. J.,* vol. 63, 69, 70.) Many years ago there was imported from Carácas into the United States a large gray ipecac with badly marked rings. This variety disappeared for a time, but is probably the *Colombian* or *Carthagena Ipecac* of modern commerce.

According to the researches of A. R. L. Dohme (*A. J. P.,* 1895), the stems adhering to the ipecac roots contain from fifteen to twenty per cent. less of the alkaloids than do the roots themselves. Moreover, it appears to be established that the portions of the stem distinct from the root contain much less of the alkaloids than does the base of the stem, so that the Pharmacopœia very properly directs that not more than 7 Cm. of the stems shall be allowed. The bark of ipecac root should make eighty per cent. of the whole. When the bark in either variety of ipecac is opaque, with a dull amylaceous aspect, the root is less active. As the woody part is nearly inert, and much more difficult of pulverization than the cortical, it often happens that, when the root is powdered, the portion last remaining in the mortar possesses scarcely any emetic power, and care should be taken to provide against any defect from this cause.[1] The German Pharmacopœia

[1] For elaborately illustrated articles upon the microscopy of ipecac and its adulterations, see Henry G. Greenish, *P. J.,* 1895, 685, and Albert Schneider, *Am. Drug.,* 1897. According to Greenish, the distinctive characteristics of the powder of either Brazilian or Carthagena ipecac are: (a) the form and size of the starch grains; (b) the absence of vessels, presence of perforated trachoides; (c) the acicular raphides; to these may be added (d) the emetine reaction with chlorine. The stem may in either case be distinguished from the root (in powder) by the presence (a) of sclerenchymatous cells; (b) of lignified cells of the pith; (c) of spiral vessels.

provides for the rejection of the last fourth of the powder. The color of the powder is a light grayish fawn.[1] Microscopically, ipecac root is composed of a suberous layer of thick-walled cells on the outside, next, of parenchymatous tissue, five or six strata of irregular four-sided cells, which from without inward at first increase and then diminish in size. Raphides are in small numbers, but all the cells are gorged with starch granules, which are mostly compound, being composed of from two to eight or even more grains, which are muller-shaped, with one or two flat surfaces. The hilum is usually distinct, with two or three radiating crevices, sometimes scarcely apparent. The individual starch granules are 1.5 micromillimeters or less in diameter, the compound granules range from 7 to 19 micromillimeters in their longest diameter. The existence of swollen granules indicates the use of artificial heat in drying the roots. The liber is composed of much smaller cells, is irregular in thickness, and is rather full of starch. The cambium layer is formed of three or four series of colorless cells. The wood has its medullary rays very slightly marked, and contains only a few vessels, which are situated near the centre of the root.

According to A. G. C. Patterson, neither by studying the yield of ash nor the microscopical characters of a powder, is it possible to determine whether it is derived from Brazilian or Colombian roots. Ipecac has little odor in the aggregate state, but when powdered has a peculiar nauseous odor, which in some persons excites violent sneezing, in others dyspnœa resembling an attack of asthma. The taste is bitter, acrid, and very nauseous. Water and alcohol extract its virtues, which are injured by decoction.

Ipecac depends for its medicinal properties upon the presence of the alkaloids *emetine* and *cephaëline;* there is also in it *ipecacuanhic acid,* discovered by Erwin Willigk, and shown by Reich (*A. Pharm.,* [2], 113, 208), to be a glucoside, having the formula $C_{14}H_{18}O_7$. (See *A. J. P.,* xxiii. 352.) Ipecac roots differ not only in the total percentage of alkaloidal contents but also in the proportion of the alkaloids, and the question whether Rio and Carthagena ipecac ought to be considered as interchangeable remedies has become one of importance. Paul and Cownley (*A. J. P.,* 1901), as the result of an exhaustive study, found that the two ipecacs do not differ materially in the total amount of alkaloid contained, but that whereas in the Brazilian root emetine is the dominant alkaloid, in the Colombian root cephaëline predominates, and that therefore the two roots cannot be considered as therapeutically identical. This work of Paul and Cownley has been confirmed by Carl Lowin (*A. J. P.,* 11), so that it would appear to be settled that in general terms Rio ipecac contains 1.5 per cent. of emetine and 0.5 of cephaëline; Carthagena contains 0.9 of emetine and 1.2 of cephaëline. The practical accuracy of these researches, however, has been challenged by the large dealers in the products of ipecac. In 1903, as the result of twenty assays of different lots of each drug, Caeser and Loretz of Halle report the results given in the following table.

	Total Alkaloids.	Emetine.	Cephaëline.	Ash.
Rio (Mato Grosso Root)	2.73	1.98	0.50	3.34
Rio (Bahia Root)	2.19	1.36	0.63	3.21
Indian from Johore	2.45	1.46	0.62	2.93
Carthagena	2.75	1.47	1.39	6.02

A. R. L. Dohme, of the firm of Sharp and Dohme of Baltimore, states that these analyses are in accord with their laboratory records, and the probabilities seem to be that neither of the varieties of ipecac root are consistent in the proportionate percentages of alkaloids, this proportion varying with the accidents of growth and surroundings of the individual plant.

Formerly Brazilian ipecac commanded in the American market a higher price than did the Carthagena variety. At this time, 1905, the Carthagena ipecac is from ten to fifteen cents a pound higher than the Brazilian, indicating that in some way it especially recommends itself to the manufacturing pharmacists. Paul and Cownley (*A. J. P.,* 1895, 256) give to the amorphous alkaloid the name *emetine,* and find it to have the formula $C_{15}H_{22}NO_2$ and the melting point 60° C. The crystalline alkaloid accompanying it in the Brazilian ipecac they call *cephaëline,* and give it the formula $C_{14}H_{20}NO_2$ and the melting point 102° C. According to this, emetine is *methyl-cephaëline.* The third alkaloid found by them, which in a later article (*A. J. P.,* 1901, pp. 87, 107) they name *psychotrine,* melts at 138° C., and apparently has a much higher molecular weight than emetine or cephaëline. This alkaloid and its salts are rapidly decomposed on exposure to light; in this respect differing from emetine and cephaëline, both of which are unaffected by light. It is a crystalline alkaloid which separates from ether in prisms of a lemon-yellow color.

Various processes have been published for the isolation of emetine, and these will be found in previous editions of this work (see U. S. D., 17th ed., 752), but according to the researches

The Carthagena ipecac can usually be distinguished by the great size of its starch grains, although there are some Carthagena roots that contain small granules of starch.

[1] Attempts have been made to adulterate powdered ipecac with the powder of almonds, but the fraud is readily detected by forming a paste with a little water and putting it into a hot place for half an hour, when, if the ipecac is pure, only its own odor will be perceived, but, if adulterated, a decided odor of almonds will be noticed. (*J. P. C.,* Juin, 1874, 479.)

above quoted, none yield pure emetine. The results of Paul and Cownley's researches (1899) are summarized below. W. G. Whiffen patented in Germany in 1898 a process for making emetine, basing it on the separation of emetine hydrobromide from extract of ipecac; cephaëline hydrobromide crystallizes with great difficulty, while emetine hydrobromide is easily crystallized and separated. (*C. D.*, 1898, 694.)

Emetine ($C_{15}H_{22}NO_2$), discovered by Pelletier in 1867, is an amorphous white powder; melting point 60° C. It forms crystalline salts with the halogens and nitric acid; dissolves readily in chloroform, ether, benzene, or alcohol, its alcoholic solution giving no coloration with ferric chloride. It is insoluble in solutions of caustic or carbonated alkalies, but easily dissolved in diluted acetic acid. Glacial acetic acid dissolves emetine without effecting substitution. From the acetic acid solution, potassium hydroxide precipitates a white, flocculent precipitate, insoluble in excess, but readily soluble in ether.

Emetine hydrobromide ($C_{15}H_{22}NO_2.HBr.2H_2O$), which is suggested as the most convenient salt of emetine for medicinal use, is permanent, occurring in white, silky needles, readily soluble in water, difficultly soluble in absolute alcohol or chloroform.

Cephaëline ($C_{14}H_{20}NO_2$) is crystalline, occurring in white, silky needles, becoming yellow on exposure to light; melting point, 96.9° C., when crystallized from ether, or 102° C., when the crystallization is effected by adding ammonia to a salt in the presence of ether. It dissolves easily in ether, benzene, chloroform, or alcohol. Ferric chloride added in small quantity to an alcoholic solution produces a dark reddish-brown coloration; this is believed to be due to the presence of phenol-hydroxyl. Cephaëline dissolves easily in solution of potassium hydroxide, and is not extracted by ether; it is easily soluble in acetic acid, and is reprecipitated by the cautious addition of potassium hydroxide as a white precipitate which is soluble in excess of the alkali. It is upon the peculiar behavior of cephaëline with caustic alkali and ether that the separation of cephaëline and emetine depends. Hesse assigns to emetine the formula $C_{30}H_{42}N_2O_4$, and to cephaëline $C_{28}H_{38}N_2O_4$.

Ipecacuanhic Acid.—According to the researches of Tokuye Kimura, ipecacuanhic acid occurs as a brown, hygroscopic, amorphous mass, freely soluble in warm water and alcohol but very slightly soluble in cold water or ether, insoluble in chloroform, having the formula $C_{17}H_{26}O_{10}$ or a multiple of the same. As a glucoside it is allied to the saponin acids but has no hæmolytic action and does not form soapy solutions. Its most characteristic reaction is that its solution strikes with ferric chloride a green alizarin tint, which, by the addition of ammonia or saturated baryta water, changes to violet or blackish, with the final separation of a blackish-brown precipitate. On the addition to the discolored solution of diluted hydrochloric acid the green color returns. According to the experiments of Kimura, ipecacuanhic acid is readily absorbed but is possessed of feeble physiological activity and is not germicidal, so that the value of ipecac in dysentery can scarcely depend upon its presence. (*A. I. P.*, 1903, 1.)

The U. S. Pharmacopœia (8th Rev.) introduced an assay process for determining the value of ipecac, this became necessary because of the variations in the quality of ipecac found in commerce and the difficulty of accurately judging of its quality by either macroscopical or microscopical characteristics.

Assay. U. S. (8th Rev.)—"Ipecac, in No. 80 powder, *fifteen grammes*, Ether, Chloroform, Ammonia Water, Distilled Water, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Hematoxylin T.S., *a sufficient quantity*. Introduce the Ipecac into an Erlenmeyer flask of 250 Cc. capacity, add 115 Cc. of ether and 35 Cc. of chloroform, shake the flask during five minutes, and then add 3 Cc. of ammonia water and again shake the flask at intervals during half an hour. Now add 10 Cc. of distilled water, shake the liquid until the powder collects in masses, and pour off 100 Cc. of the clear ethereal solution into a measuring cylinder. Transfer the latter to a separator, add 10 Cc. of normal sulphuric acid V.S. and 10 Cc. of distilled water. Shake the separator moderately during two minutes, and when the liquids have separated, draw off the lower acid solution into a second separator. Repeat the shaking out of the ether-solution with 3 Cc. of normal sulphuric acid V.S. and 5 Cc. of distilled water, drawing the acid solution into the second separator. Repeat the shaking out again, using 10 Cc. of distilled water, and add the aqueous solution to the second separator. Reject the ether in the first separator, introduce a small piece of red litmus paper into the second separator, add enough ammonia water to render the liquid alkaline, and 25 Cc. of ether, and then shake the separator vigorously during one minute; draw off the alkaline aqueous liquid into another separator, and transfer the ether-solution to a flask. Add 20 Cc. of ether to the alkaline liquid in the separator, shake it for one minute, and, having allowed the liquids to separate, draw off the alkaline liquid into the other separator, and transfer the ether-solution to the flask. Again shake out the alkaline liquid with 10 Cc. of ether, and, when the fluids have separated, reject the alkaline liquid and add the ether-solution to the liquid in the flask. Distil the ether from the flask with the aid of a water-bath, and dissolve the alkaloidal residue in 12 Cc. of tenth-normal sulphuric acid V.S., warming it gently on a water-bath if necessary. Then add five drops of hematoxylin T.S. and titrate with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-nor-

mal potassium hydroxide V.S. used, by 5, subtract the quotient from 12 (the 12 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.0238, and this product by 10, which will give the percentage of alkaloids in the Ipecac." *U. S.*

Flückiger (*Ph. Ztg.*, 1886, p. 30) gives a process for assaying ipecac, which consists in exhausting 10 to 15 grammes of the drug in very fine powder with boiling chloroform to which a drop of solution of ammonia has been added; the extraction is continued until the chloroform passing through shows no sign of alkaloid when treated with acidulated water. Upon distilling off the chloroform, the emetine is left in a very pure condition, and may be dried at 100° C. and weighed, or perhaps more conveniently titrated with Mayer's reagent. He found the average quantity of emetine in ipecac root not to exceed 1 per cent. (*P. J.*, 1886, 643.) H. W. Jones approves of this method, and modifies it by treating the residue from the chloroformic solution with water and diluted sulphuric acid, filtering, and recovering the alkaloid by means of chloroform and ammonia. (*P. J.*, 1886, p. 277.) For other methods see a paper by A. B. Lyons, *A. J. P.*, 1885, pp. 531, 542; also *Lyon's Assay of Drugs*, 1899, 181, 187.

Uses.—Ipecac is in large doses emetic, in smaller doses, diaphoretic and expectorant, and in still smaller, stimulant to the stomach, exciting appetite and facilitating digestion. In quantities not quite sufficient to cause vomiting, it produces nausea, and frequently acts on the bowels. As an emetic it is mild, but tolerably certain, and free from corrosive or narcotic properties, and especially fitted for use when no other effect than emptying the stomach is desired. It was employed as an emetic by the natives of Brazil when that country was first settled by the Portuguese, but, though described in the work of Pison, it was not known in Europe until 1672, and did not come into use until some years afterwards. John Helvetius, grandfather of the famous author of that name, having been associated with a merchant who had imported a large quantity of ipecac into Paris, employed it as a secret remedy, and with so much success in dysentery and other bowel affections that general attention was drawn to it, and the fortunate physician received from Louis XIV. a large sum of money and public honors on the condition that he should make it public. Ipecac appears to have a stimulant effect upon the general glandular structures in the digestive tract, which renders it of great value in *tropical dysenteries*. As a nauseating remedy it is used in *croup*, and as a diaphoretic combined with opium, in numerous diseases. (See *Pulvis Ipecacuanhæ et Opii.*) Its expectorant properties render it useful in the early stages of *acute bronchitis*. It has been given, also, with supposed advantage, in very minute doses, in *dyspepsia*, and in chronic disease of the gastro-intestinal mucous membrane, and as an anti-emetic. Ipecac is most conveniently administered, as an emetic, in the form of powder suspended in water, and if it fails to act in 15 to 20 minutes the dose should be repeated; this may be done several times with entire safety. Both cephaëline and emetine are powerful emetics, and in overdoses violent poisons. They have been found in the lower animals to be powerful depressants of the motor side of the spinal cord and to kill by a centric paralytic asphyxia. They are also depressant to the heart itself. On account of the violence of their action they are very rarely used in practical medicine. According to several writers the dose of impure emetine is about a grain (0.065 Gm.), of the pure not more than an eighth of a grain (0.008 Gm.), repeated at proper intervals until it causes vomiting. An ointment made with one part of powdered ipecac, one of olive oil, and two of lard, rubbed once or twice a day for a few minutes upon the skin, produces a copious and very permanent eruption, but is at present only very rarely employed as a counter-irritant.

Dose, emetic, twenty to thirty grains (1.3 to 2 Gm.); nauseating, two grains (0.13 Gm.); diaphoretic, one grain (0.065 Gm.); stomachic, one-fourth to one-half grain (0.016 to 0.032 Gm.).

Off. Prep.—Acetum Ipecacuanhæ, *Br.* (from liquid extract); Fluidextractum Ipecacuanhæ, *U. S.* (*Br.*); Pilula Ipecacuanhæ cum Scilla, *Br.;* Pilulæ Laxativæ Compositæ, *U. S.;* Pulvis Ipecacuanhæ et Opii, *U. S.* (*Br.*); Syrupus Ipecacuanhæ, *U. S.;* Tinctura Ipecacuanhæ et Opii, *U. S.* (from fluidextract); Trochiscus Ipecacuanhæ, *Br.;* Trochiscus Morphinæ et Ipecacuanhæ, *Br.;* Vinum Ipecacuanhæ, *U. S.* (from fluidextract), *Br.* (from liquid extract).

JALAPA. U. S., Br.

JALAP

(jạ-lā′pạ)

"The dried tuberous root of *Exogonium Purga* (Wenderoth) Bentham (Fam. *Convolvulaceæ*), yielding, when assayed by the process given below, not less than 8 percent. of total resin, but not more than 1.5 percent. of resin soluble in ether." *U. S.* "The dried tubercules of Ipomœa Purga, *Hayne.*" *Br.*

Radix Jalapæ, Radix Ipomœarum; Jalap Tubéreux ou officinal, *Fr. Cod.;* Tubera Jalapæ, *P. G.;* Jalape, Jalapenknollen, Jalapenwurzel, *G.;* Gialappa, Sclarappa, *It.;* Jalapa (Raiz de), *Sp.*

The precise botanical origin of jalap remained long unknown. It was at first ascribed by Linnæus to a Mirabilis, and afterwards to a new species of Convolvulus, to which he gave the name of *C. Jalapa*. The correctness of the latter reference was generally admitted, and, as the *Ipomœa macrorrhiza* of Michaux, growing in Florida and Georgia, was believed to be identical with the *C. Jalapa* of Linnæus, it was

thought that this valuable drug, which had been obtained exclusively from Mexico, might be collected within the limits of the United States; but the error of this opinion was soon demonstrated. John R. Coxe of Philadelphia, received living roots of jalap from Mexico in 1827, and succeeded in producing a perfect flowering plant, of which a description, by Nuttall, was published in the *Am. J. M. S.* for January, 1830. The same plant has since been cultivated in various parts of Europe,[1] and has been introduced into the Neilgherry Hills of India, where it grows vigorously. J. H. Balfour (*Curtis's Bot. Mag.*, Feb. 1847) maintains that the plant belongs to the genus Exogonium of Choisy, as defined in De Candolle's *Prodromus*, being distinguished from Ipomœa by its exserted stamens. Bentham and Hooker, however, do not acknowledge the validity of the various genera into which Ipomœa has been broken up by Choisy (*Genera Plantarum*, ii.). Engler and Prantl have restored the genus Exogonium [*E. Purga* (Wender.), Benth.] for the plant yielding the root called jalap.

Exogonium Purga, Balfour, *Curtis's Bot. Mag.*, 3d ser., vol. iii. tab. 4280; *B. & T.* 186. *Ipomœa Jalapa*, Nuttall; Carson, *Illust. of Med. Bot.*, ii. 13, pl. 61. *Ipomœa Purga*, Hayne, *Darstell. und Beschreib.*, etc., xii. 33 and 34; Lindley, *Flor. Med.*, 396.—The root of this plant is a roundish somewhat pear-shaped tuber, externally blackish, internally white, with long fibres proceeding from its lower part, as well as from the upper rootstalks. A tuber produced by Coxe was, in its third year, between two and three inches in diameter. The stem is round, smooth, much disposed to twist, and rises to a considerable height upon neighboring objects, about which it twines. The leaves are heart-shaped, entire, smooth, pointed, deeply sinuated at the base, prominently veined on their under surface, and supported upon long footstalks. The lower leaves are nearly hastate, or with diverging angular points. The flowers, which are large and of a lilac-purple color, stand upon peduncles about as long as the petioles. Each peduncle supports two or, more rarely, three flowers. The calyx is without bracts, five-leaved, obtuse, with two of the divisions external. The corolla is funnel-form. The stamens are five in number, with oblong, white, somewhat exserted anthers. The stigma is simple and capitate.

The jalap plant is a native of Mexico, where it is dug during the whole year, and usually dried over the hearths of the Indian huts. It derives its name from the city of Jalapa, in the state of Vera Cruz, in the neighborhood of which it grows, at the height of about 6000 feet above the ocean. The drug is brought from the port of Vera Cruz in bags containing usually between 100 and 200 pounds.[1] The jalap plant is now successfully cultivated in the government cinchona plantations in India. Analyses of the Indian tubers show that when grown on fresh soil they contain from 16 to 17 per cent. of resin, and that by manuring the percentage is notably increased, even to 22 per cent. For an account of the cultivation of jalap in Madras, see *Am. Drug.*, 1896, 127.

Properties.—The tuber comes either whole, or divided longitudinally into two parts, or in transverse circular slices. The entire tubers are irregularly roundish, or ovate and pointed, or pear-shaped, usually much smaller than the fist, and the larger ones marked with circular or vertical incisions, made to facilitate their drying. The root is preferred in this state, as it is less apt to be defective and is more easily distinguished from the adulterations than when sliced. A much larger proportion comes entire than formerly, indicating a greater scarcity of the older roots, which it is necessary to slice in order to dry them properly. The tuber is heavy, compact, hard, brittle, with a shining undulated fracture, not fibrous, but exhibiting irregular dark concentric lines, and, when examined under the microscope, numerous compound starch grains, clustered crystals of calcium oxalate, and cells containing resin (resinous points when viewed under a low magnifying power). Externally the tuber is brown and wrinkled, internally of a grayish color, diversified by concentric darker circles, in which the matter is denser and harder than in the intervening spaces. Jalap is always kept by pharmacists in the state of powder, which is of a yellowish-gray color, and when inhaled irritates the nostrils and throat, and provokes sneezing and coughing. The odor of the root, when cut or broken, is heavy, sweetish, and rather nauseous; the taste is sweetish, somewhat acrid, and disagreeable. Jalap is officially described as follows: "Napiform, pyriform or oblong, 3 to 8 Cm. long and 1 to 5 Cm. in diameter, the large roots often incised, more or less wrinkled, dark brown, with lighter colored spots, and short transverse ridges; hard, compact, internally dark brown, with numerous concentric circles composed of small resin cells; fracture resinous, lustrous, not fibrous; odor slight, but peculiar, smoky and sweetish; taste sweetish and acrid." *U. S.* It yields its active properties partly to water, partly to alcohol, and completely to diluted alcohol.

Buchner and Herberger supposed that they had discovered a basic substance, which they called *jalapin*. G. A. Kayser found that the resin of jalap previously discovered by Cadet de Gassicourt consists of two portions, one of which, amounting to seven parts out of ten, is hard and insoluble in ether, the other is soft and soluble in that menstruum. The hard resin

[1] The jalap grows freely in the south of England, but the season is too short for the production of seed by it, although the root has yielded 11.97 per cent. of resin. (*P. J.*, Feb. 1869.)

[1] The root of *I. pandurata* (L.), Meyer, *Man Root, Man of the Earth*, of this country, is sometimes met with in American commerce. C. Manz found a resin in it. (*A. J. P.*, 1881, 384.)

he named *rhodeoretin,* and found to be identical with the jalapin of Buehner and Herberger. By reaction with the alkalies it is converted into an acid, called *rhodeoretinic acid.* Rhodeoretin is slightly soluble in water, freely so in alcohol, and insoluble in ether, chloroform, or benzene, and the alcoholic solution is precipitated both by ether and water. It is dissolved by solutions of the alkalies, more quickly if heated, and is not precipitated by acids, having become soluble by conversion into the acid above referred to. It purges violently in the dose of three or four grains, and is supposed to be the active principle of jalap. Mayer confirmed and extended the observations of Kayser. He gave the name of *convolvulin* to Kayser's rhodeoretin, and stated its formula as $C_{31}H_{50}O_{16}$. This substance is colorless when pure, dissolving easily in ammonia water, and is not reprecipitated by acids, because of its conversion into *convolvulinic acid,* which is a

1. *Action of solvents.*

Solvent.	Jalapin.	Convolvulin.
Chloroform.	Readily soluble.	Slightly soluble.
Ether.	Very soluble.	Insoluble.
Petrol. naphtha.	Slightly soluble.	Insoluble.
Oil of turpentine.	Slightly soluble.	Insoluble.
Benzene.	Slightly soluble.	Insoluble.
Carbon disulph.	Easily soluble.	Insoluble.
Water.	Slightly soluble.	Slightly soluble.
Hydrochloric acid.	Slightly soluble.	Readily soluble.
Sulphuric acid.	Very soluble, with production of maroon color changing to black.	Readily soluble, with production of bright red coloration.
Potassium hydroxide.	Easily soluble.	Easily soluble, with production of odor of whisky when heated.
Ammonia water.	Readily soluble, more so than convolvulin.	Slightly soluble.

2. *Reactions with Oxidizing Agents on convolvulin and jalapin dissolved in concentrated sulphuric acid.*

Agent.	Jalapin.	Convolvulin.
Potassium dichromate.	Produces odor of rancid butter and reddish brown color.	Produces odor of rancid butter and olive-green color.
Potassium permanganate.	Same reactions.	Same reactions.
Potassium nitrate.	Same reactions, but not so strong.	Same reactions.
Potassium chlorate.	Same reactions, but not so strong.	Same reactions.
Manganese dioxide.	Same odor, and color dark green.	Same odor, and color rose-pink.

hydroxide of the glucoside convolvulin. This, on being treated with nitric acid, yields *sebacic acid.* Convolvulin possesses in a high degree the purgative properties of jalap. Mayer obtained from *Ipomœa orizabensis* a resin which he called *jalapin,* which was afterwards shown by Keller to be identical with the resin of scammony. Mayer's jalapin differs from convolvulin in being soluble in ether. The formula of jalapin, according to Samuelson, is $C_{34}H_{56}O_{16}$. Poleck (*A. J. P.,* 1892, p. 465) continued the investigation of the jalapin from *I. orizabensis,* and confirmed the identity of it with scammonin, giving it the formula $C_{34}H_{56}O_{16}$. He suggested that the name of jalapin, which is misleading, should be replaced by *orizabin.* A. Kromer (*Ph. Z. R.,* 1894, Nos. 1–7) also made a study of convolvulin. He finds it to be lævogyrate, and gives it the formula $C_{61}H_{108}O_{27}$, which was later changed (*Die Glykoside,* Van Rijn, 1900, p. 391), and is now given by Hoehnel as $C_{54}H_{96}O_{27}$, which is deduced from its analysis and decomposition products; alkalies decompose it into one molecule of volatile *methylethyl-acetic acid,* $C_5H_{10}O_2$, one molecule of *purginic acid,* $C_{25}H_{46}O_{12}$, and one molecule of *convolvulinic acid,* $C_{45}H_{80}O_{28}$. (See also *A. Pharm.* 1901, 373.) This latter is amorphous, yielding a white hygroscopic powder soluble in water and alcohol, insoluble in ether; strong sulphuric acid colors it red or brown-red; by the action of acids one molecule of convolvulinic acid yields five molecules of a glucose and one molecule of *convolvulinolic acid,* $C_{15}H_{30}O_3$, which is insoluble in water, melts at 51.5° C., is not colored by sulphuric acid, and is isomeric with jalapinolic acid and scammonolic acid, both of which melt at from 63° to 64° C. A. F. Stevenson (*N. R.,* 1879, 359) has studied the two resins found in jalap, and furnishes a tabular statement of the differences between the soft resin jalapin and the hard resin convolvulin, which is given in the following table. For the method of obtaining the resin of jalap pure, see *Resina Jalapæ.*

Jalap is apt to be attacked by worms, which, however, are said to devour the amylaceous or softer parts, and to leave the resin, so that the worm eaten drug is more powerfully purgative than that which is sound. Thus, out of 397 parts of the former, Henry obtained 72 parts of resin, while from an equal quantity of the latter he procured only 48 parts. Hence, worm eaten jalap should be employed for obtaining the resin, but should not be pulverized, as it would afford a powder of more than the proper strength. The drug is also liable to various adulterations, or fraudulent substitutions, which, however, can usually be detected without difficulty. Those which have attracted particular attention are mentioned in the note below.[1]

[1] *Tampico Jalap* (*Purga de Sierra Gorda,* Mexican.)—This drug closely resembles in appearance, odor, and taste the true jalap, but the tubers are somewhat smaller, more elongated and shrivelled. According to Ambrose Andouard, it is the *jalap digité majeur* of Guibourt. Through the efforts of Daniel Hanbury of London, aided by two Prussian officials in Mexico, Hugo Finck, vice-consul at Cordova, and

The percentage of resin is determined by the following assay process:

Assay. U. S. (8th Rev.)—"Jalap, in No. 60 powder, *ten grammes;* Ether, Alcohol, Chloroform, Distilled Water, each, *a sufficient quantity.* Insert a pledget of purified cotton in the neck of a funnel or small glass percolator, introduce the powdered Jalap and pour ether upon it,

E. Bonecke, consul-general at Mexico, the origin of the drug was traced to the state of Guanajuato, where it grows along the Sierra Gorda, near San Luis de la Paz. In this place it is purchased from the Indians, and conveyed by mules to Tampico, where it enters into commerce. Through the agency of the same gentlemen, Hanbury, after some failures, succeeded in obtaining a living tuber, from which he raised a flourishing plant that proved to be an undescribed species of the genus *Ipomœa,* differing from *I. Purga* by its bell-shaped corolla and pendulous flower-buds. To it Hanbury gave the name *I. simulans* (*A. J. P.,* July, 1870). H. Spirgatis of Königsberg, obtained a resin by preparing a tincture of the Tampico jalap, evaporating, washing, boiling the residue in water, redissolving in alcohol, and decolorizing by charcoal. He gave it the name of *tampicin.* Its physical properties are similar to those of the jalap resin. It is brittle, tasteless, inodorous, insoluble in water, soluble in ether and alcohol, and in solution has a feeble acid reaction. By strong alkalies it is changed into a soluble acid which Spirgatis calls *tampicic acid.* By the action of diluted sulphuric, nitric, or hydrochloric acid, it is converted, slowly if cold, but rapidly with heat, into a peculiar acid called *tampicolic,* with sugar. For the mode of preparing these acids, and their properties, the reader is referred to an article in *N. R.,* July, 1871, p. 50. The melting point of tampicin is 130° C.; its formula is $C_{36}H_{54}O_{14}$. The percentage of it yielded by the drug varies from a minimum of 10 per cent. (Hanbury) to a maximum of 15 per cent. (Umney). Andouard states that it is purgative.

According to Herlant, even in powder it is easy to detect the presence of the root of *Mirabilis Jalapa,* which is sometimes used as an adulterant to jalap, by the presence of acicular raphides (calcium oxalate). Tampico jalap can also be distinguished from the Vera Cruz variety by the microscope. In Tampico jalap the starch is arranged in little compact masses in the cell, while in Vera Cruz jalap the starch occurs in grains irregularly united, or isolated and much larger than those of the Tampico variety. The agglomerated masses of resin in the Tampico jalap are smaller than those in the Vera Cruz jalap.

Mechoacan.—Jalap is said to be sometimes adulterated with *bryonia root,* but no instance of the kind has come under our notice, and the two drugs are so widely different that the fraud should be instantly detected. (See *Bryonia.* PART II.) It is probable, however, that the adulteration which has been considered as bryonia root is the *mechoacan,* which in Europe is sometimes called American bryony and was formerly erroneously supposed to be derived from a species of Bryonia. Mechoacan is a product of Mexico, which was taken to Europe even before the introduction of jalap. The plant producing it has been conjectured to be *I. pandurata* (L.), Meyer, of Michaux, which is believed to grow in Mexico near Vera Cruz, as well as in our Southern States, and the root of which is said to weigh, when of full size, from fifty to sixty pounds, and, according to Baldwin, has little or no purgative power. But this origin is quite uncertain; Guibourt states that the mechoacan of Europe is the product of *Asclepias contrayerva.* (*J. P. C.,* iv., 1866.) Mechoacan is in circular slices, or fragments of various shapes, white and farinaceous within, and, as found in the European markets, generally destitute of bark, of which, however, portions of a yellowish color sometimes continue to adhere. The larger slices are sometimes marked with faint concentric striæ, and upon the exterior surface are brown spots and ligneous points, left by the radicles after removal. (Guibourt.) Though tasteless when first taken into the mouth, it becomes after a time slightly acrid. It is very feebly purgative. We have seen flat circular pieces of root, mixed with jalap, altogether answering this description, except that the cortical portion still remained, between which and the starchy parenchyma there was an evident line of division.

Orizaba Root. Male Jalap. Light, Woody, or *Fusiform Jalap. Jalap Stalks. Purgo Macho* (Mexican).—This is the product of a plant named by M. Ledanois *Convolvulus orizabensis,* now known as *I. orizabensis* (Pell.), Ledan., from the city of Orizaba, in the neighborhood of which it grows abundantly. A description of it was first published in this country by D. B. Smith, in a paper in *A. J. P.* (ii. 22). For an account of the plant the reader is referred to the same journal (x. 224). The recent root is large, spindle-shaped, sometimes twenty inches in length, branched at its lower extremity, yellow on its outer surface, and white and milky within. The drug, as described by Guibourt, is in circular pieces, two or three inches in diameter, or in longer and more slender sections. As we have seen it, the shape of the pieces is often such as to indicate that the root has been sliced transversely and each circular slice divided vertically into quarters. The horizontal cut surface is dark from exposure, unequal from the greater shrinking in desiccation of some parts than others, and presents the extremities of numerous fibres, which are often concentrically arranged, and run in the longitudinal direction of the root. Internally the color is grayish, and the texture, though much less compact than that of jalap, is sometimes almost ligneous. The taste is at first slight, but after a time becomes somewhat acrid and nauseous. It has cathartic properties similar to those of the true jalap, but feebler, requiring to be given in a dose of from thirty to sixty grains in order to operate effectively. (*J. P. C.,* xxiv. 166.) The resin of *C. orizabensis,* which has been unfortunately named *jalapin* by Mayer, is, according to that chemist, changed by boiling with baryta water into an acid called *jalapic acid,* and both jalapin and jalapic acid are glucosides, being resolved by boiling with dilute acid into glucose, and a peculiar substance which he designates as *jalapinol.* (See *J. P. C.,* 3e sér., xxix. 123.) It differs from jalap resin in consisting of only one principle, which is entirely soluble in ether. But both resins are distinguished from all others by being gradually dissolved in concentrated sulphuric acid, and deposited again after some hours in a soft state. (*Chem. Gaz.,* No. 53; from *Ann. Ch. Ph.*) Its formula is $C_{34}H_{56}O_{16}$. Samuelson (*In. Dis.,* Breslau, 1883), who has made a study of it, considers it to be the anhydride of the dibasic jalapic acid, $C_{34}H_{60}O_{18} - 2H_2O = C_{34}H_{56}O_{16}$. Potassium permanganate oxidizes jalapinol to jalapinolic acid, $C_{16}H_{30}O_3$. Hanbury and Flückiger obtained 11.8 per cent. of it from the root, and state that it is probably the jalapin of English pharmacy. It is considered by chemists identical with the resin of scammony, and is affirmed to have similar drastic properties. These results were confirmed by Poleck (*loc. cit.*) except that jalapinol could not be obtained.

Rose-scented Jalap. Overgrown Jalap.—A false jalap was some years since brought into market, imported from Mexico into New York in considerable quantities, and was offered for sale under the name of *overgrown jalap.* A specimen brought to Philadelphia and examined by a committee of the College of Pharmacy presented the following characters. It was in light, entire or vertically sliced tubers, of different forms and magnitudes, spindle-shaped, ovate and kidney-form, some as much as six inches long and three thick, others much smaller, externally somewhat wrinkled, with broad, flattish, light-brown ridges, and shallow darker furrows, internally grayish white, with distant darker concentric circles, sometimes uniformly amylaceous, of a dull rough fracture, a loose texture, a slight, peculiar, and sweetish odor, and a feeble jalap-like taste. The powder was of a light-gray color, and did not irritate the nostrils or throat during pulverization. The root differed from mechoacan by the absence of the marks of rootlets, and from male jalap by the want of a fibrous structure. It yielded by analysis, in 100 parts, 3 of a soft and 4 of a hard and brittle resin, 17 of gummy extract, 28 of starch and inulin, 10 of gum and albumen, 23.2 of lignin, and 14.8 of saccharine matter and salts of lime, including loss. In doses of from fifteen to twenty grains it produced no effect on the system. A similar root was described by Guibourt by the name of *rose-scented jalap.* It was taken to France from Mexico, mixed with genuine jalap. It proved as inefficacious as overgrown jalap as a purgative, and probably had the same origin. This spurious drug is probably the product of a Convolvulus or Ipomœa. (See *A. J. P,* xiv. 289.)

Two varieties of false jalap, imported into New York, are described by John H. Currie in the *N. Y. J. Pharm.* for Jan. 1852. The first corresponds with the root above described as that of *Convolvulus orizabensis,* or *male jalap,* both in appearance and in the character of its resinous ingredient. The second is a tuberous root, resembling, in shape, color, and size, the butternut, or fruit of *Juglans cinerea,* being

keeping the funnel or percolator well covered, until 50 Cc. of percolate have been obtained. Transfer the percolate to a tared beaker, evaporate the ether by means of a water-bath, and weigh the residue. The weight multiplied by ten will give the percentage of ether-soluble resin in the Jalap. Continue the percolation of the powder (which has been exhausted by the ether) with alcohol, until 100 Cc. of percolate have been obtained. Measure 20 Cc. of this percolate into a separator, add 20 Cc. of chloroform, mix the liquids and then add 20 Cc. of distilled water, and shake the separator thoroughly for one minute. When the liquids have completely separated, draw off the chloroform into a tared beaker, wash the separator with 5 Cc. of chloroform, and add the washings to the tared beaker. Evaporate the chloroform with the aid of a water-bath, and then dry the residue to a constant weight. This weight multiplied by fifty will give the percentage of resin insoluble in ether in the Jalap. Add to this the percentage of ether-soluble resin already determined, and the result will be the percentage of total resin contained in the Jalap." *U. S.*

The average percentage of resin in Jalap has of late years distinctly lessened; indeed this fact has received official recognition. The U. S. P. 1890 required 12 per cent., and the French Codex 1884, 16 to 18 per cent. Much of the commercial jalap is far below the lowered official standard, and this appears to be due, not, as believed by Flückiger, to the extraction of the resin from the roots in Mexico, but to the fact that the wild tubers are collected indiscriminately from November to March; the cultivators of India are very careless in their methods. The lowness of the U. S. P. standard (8 per cent.) is to be regretted, especially as the Br. Ph. requires 11 per cent., but it is probably necessary, practically, to meet the commercial conditions. The German Pharmacopœia of 1900, however, requires 9 per cent. (For various analyses of commercial Jalap see U. S. D., 18th ed., also *J. P.*, lxxii. p. 152.)

"Jalap, when assayed by the process described under 'Jalapæ Resina,' should yield not less than 9 nor more than 11 per cent. of resin having the properties of the official resin." *Br.* For Alcock's method of assay see *A. J. P.*, 1892, 533.[1]

Jalap should be rejected when it is light, of a whitish color internally, of a dull fracture, spongy, or friable. Powders of calomel and jalap, taken on long voyages to southern climates, are said, when brought back, to have become consolidated, and so far chemically altered as plainly to exhibit globules of mercury. This change is ascribed by Schacht and Wackenroder to a fungous growth. (*A. Pharm.*, xxxix. 239.) The best criterion of good quality in jalap is the proportion of its resinous constituent, and all specimens intended for use in the powdered form, or in any liquid preparation, should be rejected if they contain less than 8 per cent. of resin.

Uses.—Jalap is an active cathartic, operating briskly and sometimes painfully upon the bowels, and producing copious watery stools. The aqueous extract purges moderately, without much griping, and is said to increase the flow of urine. The portion not taken up by water gripes severely. The aqueous extract obtained from jalap, previously exhausted by rectified spirit, is said to have no cathartic effect, but to operate upon the kidneys. (Duncan.) The alcoholic extract, usually called resin of jalap, purges actively, and often produces severe griping. From these facts it would appear that the virtues of this cathartic do not depend exclusively upon any one principle. Experiments, however, by John C. Long of Philadelphia, seem to show that the gummy extract, which he took in the quantity of a drachm without any effect, is inert, while the soft resin, or that soluble in ether, which was thought to have but feeble power, if any, acted powerfully as a hydragogue cathartic in a dose of three grains. (*A. J. P.*, 1861, p. 489.) Jalap was introduced into Europe in the latter part of the sixteenth or the beginning of the seventeenth century, and at one time ranked among the purgative medicines most extensively employed. It is applicable to most cases in which an active cathartic is required, and from its hydragogue powers is especially adapted to the treatment of dropsy. It is generally given in connection with other medicines, which assist or qualify its operation. In dropsical complaints it is usually combined with potassium bitartrate. With calomel it forms a cathartic com-

black or nearly so externally, dull over most of the surface but glossy in spots, with deep longitudinal incisions, internally yellow or yellowish white, with a horny fracture, and upon the transversely cut surface marked with sparse dots, as if from delicate fibres. It contains no resin, and appears to be inert.

In the *J. P. C.* (Dec. 1863, p. 477, and March, 1864, p. 212) three other tubers are described by Guibourt which have been offered in the market for jalap,—one named *false jalap of New Orleans*, because imported into France from that city, the second *digitate jalap* (*jalap digité*), from the arrangement of its component tubers, and the third *radiated false jalap* (*faux-jalap rayonné*), from the stellate appearance of the cut surface. These jalaps do not closely resemble in physical properties the true root.

Another false jalap, some tubers of which were exhibited to Procter by Mexicans, who stated that they were produced on grounds in Mexico belonging to them, is described by him in *A. J. P.* (Sept. 1868, p. 389), to which the reader is referred for a particular account of it. Though differing in shape and interior structure from genuine jalap, they had precisely the odor of that product, and a similar wrinkled appearance and mottled brown color externally, and were probably derived from a plant either of the same genus as jalap or of one closely related to it.

[1] The question as to possible substitutes for the official species is also growing in importance. Flückiger pointed out that the seeds of the *Ipomœa hederacea* (*Kaladana seeds*) yield 8 per cent. of resin identical with that obtained from *Ipomœa Purga*, and the Additions to the British Pharmacopœia now recognize *Kaladana* and its resin. Shimoyama of Tokio, has shown that jalap resin can be obtained from the *Ipomœa triloba* (*Pharbitis triloba*) of Japan. M. K. Hyrano confirms this, and states that the seeds of the plant have long been used in Japan, under the name of "*kengashi*." (For details, and method of extracting the resin, see *P. J.*, Oct. 1888.)

pound which has long been highly popular, in the United States, in *bilious fever* and other complaints attended with *congestion of the liver* or portal circle. In overdoses it may produce dangerous hypercatharsis. It is said to purge when applied to a wound. Jalapin when taken internally is probably absorbed, but as yet its presence has never been detected in the urine, and it remains uncertain whether it is eliminated or destroyed. Müller (*In. Dis.*, Dorpat, 1885) found traces of it in the blood, and even in the heart, lungs, and spleen, of cats poisoned with it.

The *dose* of jalap, in powder, is from ten to twenty grains (0.65 to 1.3 Gm.); of the extract, from four to eight grains (0.26 to 0.5 Gm.); of the resin, from two to four grains (0.13 to 0.26 Gm.). The *dose* of calomel and jalap is five grains (0.32 Gm.) of each; of potassium bitartrate and jalap, two drachms (7.7 Gm.) of the former and from ten to fifteen grains (0.65 to 1.0 Gm.) of the latter.[1]

Off. Prep.—Extractum Jalapæ, *Br.;* Pulvis Jalapæ Compositus, *U. S., Br.;* Pulvis Scammonii Compositus, *Br.;* Resina Jalapæ, *U. S.* (*Br.*); Tinctura Jalapæ, *Br.*

KAOLINUM. U. S., Br.

KAOLIN

(kā-o-lī'nŭm)

"A native aluminum silicate, consisting chiefly of the pure silicate [$H_2Al_2Si_2O_8 + H_2O = 257.12$], powdered and freed from gritty particles by elutriation." *U. S.* "A native aluminium silicate, powdered, and freed from gritty particles by elutriation." *Br.*

Terra porcellanea; Porcelain Clay, Fuller's Earth, Bolus Alba; Terre à porcelaine, *Fr.;* Porcellanerde, Porcellanthon, *G.*

This substance was introduced into the U. S. P. (8th Rev.) for the purpose of forming the basis of the new official preparation *Cataplasma Kaolini* (see page 306).

Kaolin, $Al_2(SiO_3)_3 + Al_2O(OH)_4$, occurs in abundant deposits as a decomposition product of felspar; the latter is a double silicate of aluminum and alkali, and in its weathering, the alkali is gradually eliminated. A pure kaolin contains approximately 47 per cent. of silica, 40 per cent. of alumina, and 13 per cent. of water.

Pure kaolin is almost infusible, but the presence of impurities, notably undecomposed felspar, increases its fusibility greatly. On the other hand, fire clays which are infusible are kaolins containing a considerable amount of free silica.

Large deposits of kaolin have been recently opened in Florida. It is now used extensively for clarifying oils, such as lard and cotton seed oils and mineral lubricating oils. It is officially described as "a soft, white, or yellowish-white powder, or in lumps, having an earthy or clay-like taste, insoluble in water, and in cold dilute solutions of the acids and alkali hydroxides. When moistened with water, Kaolin assumes a darker color and develops a marked clay-like odor. If 1 Gm. of Kaolin be mixed with 10 Cc. of water and 5 Cc. of sulphuric acid in a porcelain dish, no effervescence should occur, and if the mixture be evaporated until the excess of water has been removed, and further heated until dense white fumes of sulphuric acid appear, then after cooling and adding 20 Cc. of water, boiling for a few minutes and filtering, there should remain on the filter a gray insoluble residue of *impure silica.* If to one-half of the filtrate ammonia water be added, a gelatinous precipitate of *aluminum hydroxide,* insoluble in excess, should be obtained. If to the remaining half of the filtrate, sodium hydroxide T.S. be added, it should yield a gelatinous precipitate which is almost or completely soluble in an excess of the reagent. If 2 Gm. of Kaolin be rubbed in a mortar with 10 Cc. of water, the mixture should not acquire more than a slight reddish tint on the addition of 0.5 Gm. of sodium salicylate (absence of more than traces of *iron*). If Kaolin be ignited at a red heat, it should leave not less than 85 per cent. of non-volatile residue." *U. S.* The British Pharmacopœia describes it as "a soft whitish powder insoluble in *water* or in diluted acids. The product of its fusion with alkalies, digested in *water,* and neutralized with *hydrochloric acid,* affords the reactions characteristic of aluminium, a gelatinous precipitate of silica being formed." *Br.*

Uses.—Kaolin is used as an absorbent powder when dusted upon the surface of the body in irritated conditions of the skin. *Cimolite* is a perfumed powder having similar physical properties to kaolin. Kaolin is not easily affected by most chemical reagents, and it forms a good diluent or excipient for silver nitrate, potassium permanganate, or other salts which are decomposed by organic substances.

Off. Prep.—Cataplasma Kaolini, *U. S.;* Pilula Phosphori, *Br.*

KINO. U. S., Br.

KINO

(kī'nō)

"The inspissated juice of *Pterocarpus Marsupium* Roxburgh (Fam. *Leguminosæ*)." *U. S.*

[1] The British Addendum recognizes the following preparation:—"*Tinctura Jalapæ Composita. Compound Tincture of Jalap.* Jalap, in No. 40 powder, 1 oz., 262 grains [Imperial] or 80 grammes; Scammony, in No. 40 powder, 175 grains [Imperial] or 20 grammes; Turpeth, in No. 40 powder, 88 grains [Imperial] or 10 grammes; Alcohol (60 per cent.) *a sufficient quantity.* Moisten the mixed powders with two fluid ounces [Imp. meas.] or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure one pint [Imp. meas.] or one thousand cubic centimetres.

Dose, ½ to 1 fluidrachm." *Br.*

"The juice obtained from incisions made in the trunk of Pterocarpus Marsupium, *Roxb.*, evaporated to dryness." *Br.*

Gummi (s. Resina) Kino; Indian Kino, Malabar Kino; Kino de l'Inde, *Fr. Cod.*; Kino, *G.*; Goma quino, *Sp.*

The term kino was originally applied to a vegetable extract or inspissated juice taken to London from the western coast of Africa, and introduced to the notice of the profession by Fothergill. Vegetable products obtained from various other parts of the world, resembling kino in appearance and properties, afterwards received the same name, and much confusion and uncertainty existed, and in some degree still exist, in relation to the botanical and commercial history of the drug. We shall first consider the general properties of medicines denominated kino, then the several varieties.

Properties.—Kino, as found in commerce, is usually in small, irregular, angular, shining fragments, seldom as large as a pea, of a dark reddish-brown or blackish color, very brittle, easily pulverizable, and affording a reddish powder, much lighter colored than the drug in its aggregate state. It is officially described as in "small, angular, dark red, shining pieces, brittle, in thin layers ruby-red and transparent; inodorous, very astringent, and sweetish, tingeing the saliva deep-red. Soluble in alcohol, nearly insoluble in ether, and slowly soluble in cold water." *U. S.* If in large masses, it may be reduced without difficulty into these minute fragments. It is without odor, and has a bitter, highly astringent taste, with a somewhat sweetish after-taste. It burns with little flame, and does not soften with heat. It imparts its virtues and a deep red color to water and alcohol, but is nearly insoluble in ether. Cold water forms with it a clear infusion. Boiling water dissolves it more largely, and the saturated decoction becomes turbid on cooling, and deposits a reddish sediment. The tincture is not disturbed by water. When long kept, it often gelatinizes, and loses its astringency. (See *Tinctura Kino.*) Kino undoubtedly consists chiefly of a modification of tannic acid or tannin, which has received the name of *kino-tannic acid,* with extractive, gum, and sometimes probably a little resin, but we need a careful analysis of the different well-ascertained varieties. The aqueous solution is precipitated by gelatin, the soluble salts of iron, silver, lead, and antimony, mercuric chloride, and sulphuric, nitric, and hydrochloric acids. The precipitate with iron is of an olive or greenish-black color. The alkalies favor the solubility of kino in water, but essentially change its nature and destroy its astringency. Both Pharmacopœias require that kino should be almost entirely soluble in *alcohol* (90 per cent.), but should yield little or nothing to *ether;* the Br. Ph. also demands that not less than 80 per cent. should be soluble in boiling *water.*

1. East India Kino. *Malabar Kino.*—This is the variety at present probably most used and most highly esteemed, and the only one recognized by the British and United States Pharmacopœias. Its origin was long unknown. It is now ascertained, through the researches of Pereira, Royle, Wight, and others, to be the product of *Pterocarpus Marsupium,* a lofty tree growing upon the mountains of the Malabar coast of Hindostan. Kino is the juice of the tree extracted through longitudinal incisions in the bark and afterwards dried in the sun. Upon drying it breaks into small fragments, and is put into wooden boxes for exportation. It is collected near Tellicherry, and exported from Bombay. It is sometimes imported into this country directly from the East Indies, but more commonly from London. From a communication in the *Journal of the Asiatic Society of Bengal,* by F. Mason, it appears that kino is also collected in the Tenasserim provinces, in Farther India, and has been exported from Maulmain to Europe. It is produced by a tree called *Pa-douck,* which was supposed to be a species of Pterocarpus, although its precise characters were not certainly known. (*A. J. P.,* xxi. 134.) Christison subsequently recognized, in a description of this tree furnished to him by Begbie of Maulmain, the precise characters of *Pterocarpus Marsupium,* so that this kino has the same origin as that from Malabar. *Pterocarpus indicus,* of the Mauritius Islands, where it is known as *sang dragon,* also yields a red kino to commerce.

Macaranga Kino is obtained from *Macaranga Roxburghii,* Wright, of the Deccan peninsula. It occurs in the form of odorless, tasteless tears or irregular masses. The tears have fibrous fractures and when immersed in water yield unravelling fibres giving the appearance of a sea anemone. According to Hooper this kino yields from 6 to 15 per cent. of a peculiar tannin and is closely allied to Butea kino, from which it is distinguished by fibrous tears and the fact that it contains so much gum which swells without dissolving in water. (*P. J.,* 66, 616.)

East India kino is in small, angular, glistening fragments, of a uniform consistence, appearing as if formed by the breaking down of larger masses. The larger fragments are opaque and nearly black, but minute splinters are sometimes translucent, and of a deep garnet redness when viewed by transmitted light. This variety of kino is very brittle, readily breaking between the fingers, and easily pulverized, affording a dark reddish powder, a portion of which, resulting from the mutual attrition of the fragments, is often found interspersed among them. When chewed, it softens in the mouth, adheres somewhat to the teeth, and tinges the saliva a blood-red color. In odor, taste, and chemical relations it corresponds with the account already given of kino in general. When kino is boiled in water, the decoction deposits, on cooling, a bright red substance, and a similar deposition takes place when a cold filtered aqueous solution is long exposed with a broad surface to the air. Ac-

cording to Hennig, kino consists of tannic acid with a trace of gallic acid, kinoic acid, pectin, ulmic acid, and inorganic salts, with excess of earthy bases. (See *A. J. P.*, xv. 544.) C. Etti obtained a new constituent, *kinoin*, by extracting kino with ether. He finally adopted the following method as more practicable. One part of gum kino is added to 2 parts of boiling diluted (1 to 5) hydrochloric acid. Kino-red immediately separates as a soft mass, becoming gradually solid on cooling, while the *kinoin*, mixed with a small quantity of kino-red, remains in solution. The solid residue is once more boiled with water, the liquids are united and shaken with ether. The ethereal solution, on evaporation, leaves a crystalline reddish residue, which is dissolved in hot water, on the cooling of which tolerably pure crystals of *kinoin* are obtained. By continued recrystallization they are obtained colorless. Their formula is $C_{14}H_{12}O_6$, and *kino-red* is the anhydride of this:

$$2C_{14}H_{12}O_6 - H_2O = C_{28}H_{22}O_{11}$$

This kino-red, heated to 160° to 170° C., parts with a molecule of water and yields a lower anhydride, $C_{28}H_{20}O_{10}$. Both anhydrides are precipitated by gelatin, but kinoin itself is not. When heated with hydrochloric acid to 120° to 130° C., kinoin yields methyl chloride, gallic acid, and catechol, and hence probably has the constitution of a *guaiacol* or *methyl-catechol gallate*. Kino contains about 1.5 per cent. of kinoin. (*Ber. d. Chem. Ges., N. R.*, Feb. 1879.) Kremel found Malabar kino, Butea gum, eucalyptus kino, and the kino from *Coccoloba uvifera* to be free from Etti's kinoin, but to contain a body acquiring, like kinoin, a red color with ferric chloride, which proved to be *pyrocatechuic acid;* this was present either alone or mixed with gallic acid. (*A. J. P.*, 1883, 267.) In an examination made by David Hooper of ten varieties of East Indian kino, the proportion of tannic acid was found, after thoroughly drying the kino, to vary from 80 to 97 per cent. of the whole mass. (*Agricultural Ledger of India*, No. 11, 1901.)

2. West India or Jamaica Kino.—This is believed to be the product of the *Coccoloba uvifera*, L., or *sea-side grape*, a tree twenty feet or more in height, bearing beautiful broad shining leaves, and large bunches of purple berries, to which it owes its vernacular name. It grows in the West Indies and neighboring parts of the continent. The kino is said to be obtained by evaporating a decoction of the wood and bark, which are very astringent. Many years since, a thick reddish-brown liquid was imimported into Philadelphia from the West Indies, which, when dried by exposure to the air in shallow vessels or by heat, afforded an extract having all the properties of kino, for which it was sold by the druggists. This has long been exhausted, but some years since, a considerable quantity of West India kino was brought into this market, which may still be found in small quantities in commerce. It was contained in large gourds, into which it was evidently poured while in a liquid or semi-liquid state, and then allowed to harden. When taken from the gourd it breaks into fragments of various sizes, upon an average about as large as a hazelnut, and having some tendency to the rectangular form. The consistence of these fragments is uniform, their surface smooth and shining, and their color a dark reddish brown approaching to black. They are, however, neither so glistening nor so black as the East India kino. In mass they are quite opaque, but in thin splinters are translucent and of a ruby redness. They are readily broken by the fingers into smaller fragments, are easily pulverized, and yield a dull-reddish powder, considerably lighter colored than that of the former variety. The West India kino is without odor, and has a very astringent, bitterish taste, with a scarcely observable sweetish after-taste. It adheres to the teeth when chewed, though rather less than the East India variety, and colors the saliva red. The solubility of Jamaica kino was very carefully examined by Robert Bridges, who found that cold water dissolved 89 per cent., and ordinary official alcohol 94 per cent. The portion dissolved by alcohol and not by water was probably of a resinous nature, as it appeared to be viscid, and very much impeded the filtration of the aqueous solution. Considering the nature of this substance, the form of kino in which it was found is probably, like that from the East Indies, an inspissated juice. Guibourt, who states that Jamaica kino is but slightly dissolved by cold water, must have operated on a different product.

3. South American Kino. *Caraccas Kino.* In 1839, an astringent extract was described which had recently been introduced into our market, derived from Caraccas, and known by that name to the druggists. Since that period it has come much more extensively into use. It is probably the same as that described by Guibourt, in the last edition of his *History of Drugs*, as the kino of *Colombia*. As imported, this variety of kino is in large masses, some weighing several pounds, covered with thin leaves, or exhibiting marks of leaves upon their unbroken surface, externally very dark, and internally of a deep reddish-brown or dark port-wine color. It is opaque in the mass, but translucent in thin splinters, very brittle, and of a fracture always shining, but in some masses wholly rough and irregular, in others rough only in the interior, while the outer portion, for an inch or two in depth, breaks with a rather smooth and uniform surface, like that of the West India kino. This outer portion is easily broken into fine angular fragments, while the interior crumbles quite irregularly. Some of the masses are very impure, containing pieces of bark, wood, leaves, etc.; others are more homogeneous, and almost free from impurities. The masses are broken up by means of a mill so as to resemble East India kino, from which, however, this variety differs in

being more irregular, less sharply angular, more powdery, and less black. On comparing the finer and more angular portions of the masses of this kino with the West India variety, Geo. B. Wood could discover no difference between the two kinds either in color, lustre, taste, or other sensible property. The colors of the powder were also identical. South American kino was found by Bridges to yield 93.5 per cent. to cold water, and 93 per cent. to alcohol; so that, while it has almost the same solubility as Jamaica kino in alcohol, it is somewhat more soluble in cold water. The aqueous solution in this case was not embarrassed by the adhesive matter which impeded the filtration in the former variety, and the want of a minute proportion of resinous matter in the South American kino is the only apparent difference between the two drugs. It is not improbable that they are derived from the same plant, and there is no difficulty in supposing that this may be the *Coccoloba uvifera,* as that tree grows as well upon the continent as in the islands.

4. African Kino.—The original kino employed by Fothergill was known to be the product of a tree growing in Senegal, and upon the banks of the Gambia, on the western coast of Africa, but the precise character of the tree was not ascertained until a specimen, sent home by Mungo Park during his last journey, enabled the English botanists to decide that it was the *Pterocarpus erinaceus* of Lamarck and Poiret.[1] The Edinburgh and Dublin Colleges accordingly referred kino in chief to this plant, but, in so doing, overlooked the fact that not one of the varieties now used is brought from Africa. The importation of African kino has long ceased.[2] In 1896, however, a consignment of African kino reached London. It was examined by E. M. Holmes, who stated that it was evidently yielded by *P. erinaceus.* (*C. D.,* 1896, 226.) It is said to be still used by the Portuguese of Angola, under the name of *Sangue de Drago.* As described by Fothergill, the African kino, for which he proposed the name of *gummi rubrum astringens Gambinense,* was in lumps of about the size of those of gum Senegal or dragon's blood, and so similar in appearance to the latter that a good judge might easily be deceived. These lumps were hard, brittle, opaque, and almost black, but minute fragments were reddish and transparent like garnet. The drug was inodorous, of a strongly astringent and sweetish taste, and soluble in water to the extent of about five or six parts out of seven, forming a deep red astringent infusion. There can be little doubt that this variety of kino is a concrete juice, which exudes either spontaneously or from wounds in the bark, and hardens in the air. (*Med. Obs. and Inq.,* i. 358.)

East African Kino.—This drug in external characteristics resembles Malabar kino, but its pieces are very sharply angular. It is the product of the *Pterocarpus Bussei,* Harms, and has been chemically examined by E. Schaer, who states that it contains neither *pyrocatechin* nor *kinoin,* but otherwise affords reactions similar to those of Malabar kino.

5. Australian Kino. *Botany Bay Kino. Red Gum.*—This kino was formerly supposed to be yielded by *Eucalyptus resinifera,* but is now known to be produced by a very large number of species. It is occasionally obtained in dry masses in the crevices in trees, sometimes by incisions into the bark, but more usually is simply scraped off the outside of the tree. It has been stated that five hundred pounds of the kino are sometimes yielded in a single year by one tree, but this seems to be a great exaggeration. Occasionally the juice reaches England unevaporated.[1] Australian kino usually occurs in dark, reddish-brown masses or grains, which when sufficiently thin may be translucent and garnet-like. It is very likely to contain much foreign matter, especially the scrapings from the bark. Coming from so many sources, it varies considerably in its physical characteristics and its relations to solvents. Although the Australian kino is produced by so many trees and is much used in Australia, it does not seem to be an important article of commerce. For further information concerning it the reader is referred to an elaborate paper on it by J. H. Maiden,

[1] A particular account of *Pterocarpus erinaceus* and its concrete juice, with a figure, by W. F. Daniell, is contained in the *P. J.* for August, 1854 (vol. xiv. p. 55).

[2] *Butea gum,* which has sometimes been mistaken for African kino, is the concrete juice of the *Butea frondosa,* Roxb., or *Dhak-tree* of Hindostan, and also to some extent of *B. superba.* The juice flows from natural fissures, and from wounds made in the bark of the tree, and quickly hardens. It is in small elongated tears, or irregular angular masses, less in size than a grain of barley, apparently black and opaque, but translucent and of a ruby-red color when examined in small fragments by transmitted light; in some specimens the tears are much paler than described, and of a very beautiful ruby tint. Many of the tears have small portions of bark adhering to them. They are very brittle, and readily pulverizable, yielding a reddish powder. They are very astringent to the taste, do not adhere to the teeth when chewed, and tinge the saliva red. The relations of this product to water, alcohol, and other chemical reagents are nearly the same as those of ordinary kino. When freed from impurities, consisting of from 15 to 25 per cent. of wood, bark, sand, etc., it contains, according to E. Solly, 73.26 per cent. of tannin, 5.05 of soluble extractive, and 21.67 of gum and other soluble substances. It is used in the arts in India, and might undoubtedly be employed as kino in medicine. It is, however, very seldom imported into England, and never, at present, into this country. Pereira found a quantity in an old drug store in London, and sent a portion to Guibourt, from which that writer drew up his description of African kino. It is possible that the kino which formerly reached us, full of small pieces of wood, bark, etc., may have been the *Butea gum.* For a description of the seeds of *B. frondosa* from which *Bengal Kino* is derived, see *Ph. Rev.,* 1896, 232.

[1] *Kino juice* has a fine deep red color, a slightly aromatic odor, and a decidedly astringent taste, and on evaporation yields a genuine kino in varying amount. It must not be confounded with the so-called *Liquid Kino,* or *apple tree juice,* which is obtained from incisions in the *Angophora intermedia* or *narrow-leaved apple tree* of Australia. This varies from the consistency and colorlessness of water to an orange brown or reddish-brown liquid as thick as molasses. It contains catechin and tannic acid, and is said to be especially employed for the purposes of tanning nets.

in *P. J.*, Oct. 1889;[1] also *A. J. P.*, 1897, 1. Eucalyptus kino contains catechin, pyrocatechin, and kinoin, and in some specimens a volatile oil, giving a slightly aromatic odor to the drug, which is especially developed by hydrochloric acid. (See also *Eucalypti Gummi.*) J. H. Maiden (*A. J. P.*, 1895, 575) states that Australian kino contains *eudesmin* and *aromadendrin.* The former of these when purified exists as a pure white mass with a lustre resembling spermaceti. It is soluble in hot water, but crystallizes out again on cooling. It is soluble in alcohol, ether, acetic ether, and chloroform, but not in benzene, petroleum spirit, or carbon disulphide. It is dissolved by sulphuric acid with a dark color changing to purple, by nitric acid with a beautiful yellow color. Its formula is given as $C_{26}H_{30}O_8$, and its melting point as 99° C. The second substance was also obtained crystallized from boiling water, and melted at 162° C. No analysis has been made of it.

6. Myristica Kino.—There has been produced in Southern India a kino consisting of smaller or larger angular pieces, of deep garnet color, in thin fragments, and having the general characteristics of Malabar kino; according to E. Schaer, it is a product of *Myristica malabarica*, of *M. fragrans*, and probably of other species of the genus. In all important respects these kinos are said to correspond with Malabar kino, but to be distinguishable by containing crystals of calcium tartrate. *Myristica Kino* is probably a distinctive product from the so-called *Syndai varnish*, a rich red fluid obtained from the *Myristica gibbosa*, Hook f., and employed in Assam as a varnish. It is highly astringent and after exposure becomes perfectly impervious, the changes being due to the presence of a ferment or enzyme. As has been shown by D. Hooper (*P. J.*, June 20, 1903), Syndai varnish, if kept in corked bottles, gelatinizes in a few weeks. Edmund White made an investigation into the cause of the gelatinization of tincture of kino (*P. J.*, May, 1903), from which it appeared that this phenomenon was due to the presence in the kino of an enzyme belonging to the oxydases, and this enzyme was subsequently isolated by David Hooper from the fresh juice of *Myristica gibbosa* (*Proc. A. Ph. A.*, 1903, 733) yielding an unofficial variety of kino. It is believed by White that this enzyme may be eliminated from the official as well as other kinos by a judicious method of collection, and considers it probable that the following one, adopted by J. G. F. Marshall and described in the *"Agricultural Ledger"* (1900, No. 11, 381), will accomplish this: "A longitudinal cut is made with an axe or knife, called *macha katti*, through the bark of the trees, down to the cambium, about 1½ ft. long, and side cuts are made to lead into this. A bamboo tube is then fixed at the bottom of the main incision in order to catch the juice. In the course of about twenty-four hours the flow of gum ceases and the bamboo is taken down. When several of these bamboo cups are nearly full they are taken to headquarters and emptied into a large cauldron and the juice boiled. During the boiling, the impurities, consisting of pieces of bark, wood and leaves, rise to the surface and are skimmed off. When sufficiently concentrated to the consistence of a thick extract it is exposed to the sun, in thin layers, in shallow vessels until it is dry enough to crumble to pieces. The kino is then weighed and packed away in wooden cases." (*P. J.*, 1903, 702.)

It is said that catechu, broken into small fragments, has sometimes been sold as kino. Fortunately, little injury can result from the substitution, as the medicinal virtues of the two substances are very nearly the same.

Uses.—Kino is powerfully astringent, and in this country is much used for the suppression of morbid discharges. In *diarrhœa*, not attended with febrile excitement or inflammation, it is often an excellent adjunct to opium and the absorbent medicines, and is a favorite addition to chalk mixture. It is also used in *chronic dysentery* when astringents are admissible; in *leucorrhœa* and *diabetes;* and in *passive hemorrhages*, particularly those from the uterus and the intestines. The infusion may be made by pouring eight fluidounces of boiling water on two drachms of the extract, and straining when cool. Aromatics may be added, if deemed advisable. The dose is a fluidounce (30 Cc.). The proportion of alcohol in the tincture renders it frequently an unsuitable preparation.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Pulvis Catechu Compositus, *Br.;* Pulvis Kino Compositus, *Br.;* Tinctura Kino, *U. S., Br.*

KRAMERIA. U. S. (Br.)

KRAMERIA [Rhatany]

(krą-mē'rĭ-ą)

"The dried root of *Krameria triandra* Ruiz and Pavon (Peruvian Krameria), *Krameria Ixina* Linné (Savanilla Krameria) or of *Krameria argentea* Martius (Para or Brazilian Krameria) (Fam. *Krameriaceæ*)." *U. S.* "The dried root of (1) Para Rhatany, a species of Krameria, attributed to Krameria argentea, *Mart.;* or of (2) Peruvian Rhatany, Krameria triandra, *Ruiz and Pavon.*" *Br.*

Krameriæ Radix, *Br.*, Rhatany Root; Radix Ratanhæ; Ratanhia, *Fr. Cod.;* Radix Ratanhiæ, *P. G.;* Ratanhiawurzel, *G.;* Ratania, *It.;* Ratania (Raiz de), *Sp.*

There is a difference of opinion among botanists concerning the family to which Krameria belongs. Chodat (*Arch. d. Sc. Phys. et Nat.*, t. xxiv., Nov. 1890) placed the genus in a dis-

[1] The descriptions given by authors of this kino vary, because the Australian kinos themselves vary so much. Gathered with different degrees of care, and from probably fifty species of trees, they, of course, must be of varying character.

tinct order by itself,—viz., the Krameriaceæ. Engler and Prantl consider its proper place to be among the Cæsalpinoideæ-Krameriеæ in the fam. Leguminosæ.

Krameria triandra, Ruiz and Pavon, *Flor. Peruv.* i. 61.—The rhatany plant is a shrub, having a long, much-branched, spreading root, of a blackish-red color; with a round, procumbent, very dark colored stem, divided into numerous branches, of which the younger are leafy and thickly covered with soft hairs, giving them a white, silky appearance. The leaves are few, sessile, oblong-ovate, pointed, entire, presenting on both surfaces the same silky whiteness with the young branches. The flowers are lake-colored, and stand singly on short peduncles at the axils of the upper leaves. The stamens are three. The nectary is of four leaflets, the two upper spatulate, the lower roundish and shorter. The fruit is globular, of the size of a pea, surrounded by stiff reddish-brown prickles, and having one or two seeds. It is a native of the Peruvian Andes, growing in dry argillaceous and sandy places. It flowers at all seasons, but is at the height of its bloom in October and November. The root is dug up after the rains, and, according to Tschudi, it is especially obtained in the southern provinces of Peru. Closely allied to it is *K. Ixina,* L., which is, however, distinguished by having four stamens, and occurs in Guiana and Northern Brazil. The name *rhatany* is said to express in the tongue of the Peruvian Indians the creeping character of the plant yielding the root.

Rhatany is received in pieces of various shapes and dimensions, some being simple, some more or less branched, the largest as much as an inch in thickness, derived from the main body of the root, the smallest not thicker than a small quill, consisting of the minute ramifications. The pieces are often nearly cylindrical, and as much as two or three feet in length. Sometimes many of the radicles are united in a common head, which is short, and from half an inch to two inches or more in diameter. The roots are composed of a dark, reddish-brown, slightly fibrous, easily separable bark, and a central woody portion, less colored, but still reddish or reddish yellow.

"*Peruvian Krameria.*—Root-branches several or many, usually attached to a short, hard, and woody tap-root, which is 1.5 to 4 Cm. thick, roughly fissured, and supporting a knotty, several- to many-headed crown; roots of variable length, rarely exceeding 50 Cm. and usually less than 1 Cm. thick, cylindrical, flexuous or wavy, very flexible; externally light red-brown, more or less marked with dark, scaly patches, especially upward, otherwise smoothish, devoid of transverse fissures; fracture tough and splintery, the pinkish-brown bark occupying less than one-third of the radius, the wood yellowish or pinkish-white, finely radiate; inodorous and of a very astringent taste.

Savanilla and Brazilian Kramerias.—Branches usually occurring detached from the tap-root and crown, less flexuous than those last described, externally of a purple-brown or chocolate brown, and with numerous transverse cracks or fissures; fracture less tough than that of Peruvian Krameria, the bark and wood both darker, the bark occupying two-fifths or more of the radius, the taste more astringent than that of Peruvian Krameria." *U. S.*[1]

The British Pharmacopœia now recognizes two varieties of rhatany, which it describes as follows. "1. Para Rhatany occurs in cylindrical pieces, and is characterized by its purplish-brown color and smooth thick bark, marked at intervals by deep transverse cracks, and adhering firmly to the wood, which is of a pale reddish-brown color. Fracture short. 2. Peruvian

[1] There are various rhatanies in European commerce. *Savanilla,* or *New Granada Rhatany,* is yielded by the *K. tomentosa,* St. Hil. (*K. Ixina,* var. β), growing in Colombia, British Guiana, and Northern Brazil. According to Flückiger and Hanbury, it is never so knotty and irregular as the true rhatany, and is well distinguished by its dull purplish-brown color, its thick, smooth bark (⅓ to ½ the diameter of the wood), marked with longitudinal furrows and here and there deep transverse cracks, and by the bark not easily splitting off. Its tannic acid is different from that of the Peruvian drug. If the powdered root be shaken with water and reduced iron, filtered, and the liquid diluted with distilled water, an intense violaceous color will be produced. *Peruvian Rhatany,* similarly treated, gives a dingy brown. Thin sections of true rhatany, moistened with a ferrous salt, become grayish; Savanilla rhatany, violet. *Para Rhatany* was described by Berg in 1865, and is believed to be the root of *K. argentea.* It is in long pieces (some 16 to 20 inches), from an eighth to three-quarters of an inch in thickness, of a dark-gray or brownish color, and, like the Savanilla, becoming bluish black when immersed in a solution of ferrous sulphate, owing to the presence of tannic acid in the bark. In this variety the root has a peculiar elasticity distinguishing it from the Peruvian and Savanilla varieties. Some of the pieces exhibit numerous corky warts. There are also microscopical characters which distinguish it. Two forms of rhatany which Cotton has described as *Black and Brown Antilles Rhatany,* because produced in these islands, though admitted also to be derived from different places on the neighboring continent, have been pronounced by Flückiger, after a careful examination, to be identical with the Para rhatany. (*P. J.,* July, 1870, p. 84.) According to the studies of R. G. Dunwoody, this rhatany contains the same active principles as the root of *K. triandra,* but in slightly less quantity. (*A. J. P.,* 1890.)

A rhatany appeared not long since in the London market from Guayaquil. It is described as a large woody root from one-half inch to two inches in diameter. The bark is of a reddish-brown color with blackish streaks, is thin in comparison to the medituillium, is of a fibrous texture, and is somewhat striated on the surface and dotted over with small warts. It has a very astringent taste, but no marked odor. E. M. Holmes thinks that it is not the product of the genus Krameria. According to the analysis of Passmore, *Guayaquil rhatany* contains a larger quantity of tannin than the Peruvian drug, but less than the Para or the Savanilla rhatany. (*P. J.,* xvi. 878.) A spurious rhatany of unknown botanical origin, has appeared in the English market coming from Peru. The root is tapering and varies from two to three and a half inches in length, and a quarter to five-eighths of an inch in diameter. The bark is reddish brown, rough, scaly, and longitudinally grooved. The root has a short fracture and a medituillium of about 24 wedge shaped bundles, is odorless and of an astringent taste. For detailed macro- and microscopical descriptions, see P. H. Marsden, *P. J.,* 1901, 618.

According to an analysis made in the University of Wisconsin, the *Krameria lanceolata,* Torrey, of North America yields 34.5 per cent. of extract and 17 per cent. of tannin, and is therefore richer than the official drug. When treated with iron it strikes a deep-purple color, and is thus easily distinguished from Para rhatany, which gives a dirty brown, and from Savanilla rhatany, which gives a violet color.

Rhatany is characterized by its dark reddish-brown color and its yellowish woody axis, from which the bark readily separates. The bark is thinner than that of Para Rhatany, bright reddish brown internally, and rough and scaly except in the smaller pieces. Fracture splintery." Rhatany is without odor, but has a bitter, very astringent, slightly sweetish taste, which is connected with its medicinal virtues, and is much stronger in the cortical than in the ligneous part. The smallest pieces are therefore preferable, as they contain the largest proportion of the bark. The powder is of a reddish color. The virtues of the root are extracted by water and alcohol, to which it imparts a deep reddish-brown color. From the researches of Vogel, Gmelin, Peschier, and Trommsdorff, it appears to contain tannic acid, lignin, and minute quantities of gum, starch, saccharine matter, and an acid which Peschier considered as peculiar and named *krameric acid.* The tannic acid is in three states: 1st, that of purity, in which it is without color; 2d, that of phlobaphene or anhydride, in which it has lost its astringency and been rendered insoluble by the action of the air; and, 3d, that of extractive, which is a soluble combination of tannin and its anhydride, and is the substance which imparts to the infusion and tincture their characteristic reddish-brown color. (Soubeiran, *J. P. C.*, xix. 596.) The tannic acid of rhatany (*krameria-tannic* or *ratanhia-tannic acid*) is separated by treating the ethereal extract of the bark with alcohol, and evaporating the alcoholic solution. It gives a dark-green precipitate with ferric chloride, a flesh-colored one with gelatin, and none with tartar emetic. (Gmelin.) The tannin of rhatany, in the presence of melted potassium hydroxide, is transformed into *protocatechuic acid* and *phloroglucin,* and with diluted acids gives glucose and a peculiar red coloring principle called *ratanhia red,* $C_{26}H_{22}O_{11}$. (*J. P. C.*, Janv. 1868, p. 73.) The proportion of red astringent matter obtained by Vogel was 40 per cent. The mineral acids and most of the metallic salts throw down precipitates with the infusion, decoction, and tincture of rhatany, and are incompatible in prescription.

In examining a specimen of extract of rhatany from America, Wittstein discovered an alkaloid, which he thought to be identical with tyrosine. A somewhat different result was obtained by Ruge, who, after an examination, showed that the new alkaloid is not identical with tyrosine, for it has the formula $C_{10}H_{13}NO_3$, while that of tyrosine is $C_9H_{11}NO_3$, but is rather homologous with it. Like tyrosine, it is an amido-acid, and forms salts equally with mineral acids and with strong bases. It was called *ratanhine* by Ruge. Gintl (*A. J. P.*, 1869, p. 300) obtained ratanhine from *resina d'angelim pedra,* a resin from Brazil. Krietmair has also obtained this principle from a sample of extract of rhatany. (See *A. J. P.*, 1875, p. 266.)

Cold water, by means of displacement or percolation, extracts all the astringency of rhatany, forming a clear deep-red infusion, which upon careful evaporation yields an almost perfectly soluble extract. The root yields its virtues also to boiling water by maceration, but the resulting infusion becomes turbid upon cooling, in consequence of the deposition of apotheme taken up by the water when heated. By boiling with water a still larger proportion of the apotheme is dissolved, and a considerable quantity of the pure tannin becomes insoluble in cold water, and medicinally inert, either by combining with the starch which is also dissolved, or by conversion into apotheme through the agency of the atmosphere. The decoction is, therefore, an ineligible preparation, and the extract resulting from its evaporation, though greater in weight than that from the cold infusion, contains much less soluble and active matter. Alcohol dissolves a larger proportion of the root than water, but this is owing to the solution of apotheme, and the alcoholic extract contains little if any more of the astringent principle than that prepared by cold water, while it is encumbered with much inert matter. (See *Extractum Krameriæ.*)

Uses.—Rhatany is generally tonic and powerfully astringent, and may be advantageously given in *chronic diarrhœa, passive hemorrhages,* especially *menorrhagia,* some forms of *leucorrhœa,* and in all those cases in which kino and catechu are beneficial. It has long been used in Peru as a remedy in bowel complaints, as a corroborant in cases of enfeebled stomach, and as a local application to spongy gums. Ruiz, one of the authors of the Peruvian Flora, first made it known in Europe. It was not until after the year 1816 that it began to come into general use. It has the advantage over the astringent extracts imported, that, being brought in the state of the root, it is free from adulteration, and may be prescribed with confidence. In the form of infusion, tincture, and extract, rhatany has been used locally in *fissure of the anus, prolapsus ani,* and *leucorrhœa.*

Dose, of the powder, twenty to thirty grains (1.3 to 2.0 Gm.); but the decoction (an ounce to the pint) is preferable, the dose being from one to two fluidounces (30 to 60 Cc.).

Off. Prep.—Extractum Krameriæ, *U. S., Br.;* Fluidextractum Krameriæ, *U. S.;* Infusum Krameriæ, *Br.;* Liquor Krameriæ Concentratus, *Br.;* Pulvis Catechu Compositus, *Br.;* Syrupus Krameriæ, *U. S.* (from fluidextract); Tinctura Krameriæ, *U. S., Br.;* Trochisci Krameriæ, *U. S.* (*Br.*) (from extract); Trochiscus Krameriæ et Cocainæ, *Br.* (from extract).

LACTUCARIUM. U. S.

LACTUCARIUM

(lăc-tū-cā′rĭ-ŭm)

"The concrete milk-juice of *Lactuca virosa* Linné (Fam. *Compositæ*)." *U. S.*

Lactucarium Anglicum, Lactucarium Germanicum; Strong-scented Lettuce, Green Endive; Lactucarium, *Fr. Cod.;* Giftlattichsaft, *G.;* Lactucario, *Sp.*

The plants of this genus yield when wounded a milky juice, to which, indeed, they owe their generic name. In some of them this juice possesses valuable narcotic properties. This is the case, among others, with *L. sativa, L. virosa,* and *L. altissima.* It was supposed that our native *L. canadensis,* L., or *wild lettuce,* might have similar virtues, and Bigelow was informed by physicians who had employed it that it acts as an anodyne, and promotes the secretion from the skin and kidneys. But, according to Aubergier, the milky juice of this plant is of a flat and sweetish taste without bitterness, contains much mannite, but no bitter principle, and is destitute of narcotic properties. (*Ann. Thér.,* 1843, p. 18.) The probability is that it is nearly or quite inert.[1] Therefore, though formerly holding a place in the U. S. Pharmacopœia, it has been discarded. In Europe *Lactuca Scariola,* L., is said to be substituted for the official plant.

Lactuca sativa, Willd., *Sp. Plant.* ii. 1523, *B. & T.* 161.—The garden lettuce is an annual plant. The stem, which rises above two feet, is erect, round, simple below, and branching in its upper part. The lower leaves are obovate, rounded at the end, and undulating; the upper are smaller, sessile, cordate, and toothed; both are shining, and of a yellowish-green color. The flowers are pale yellow, small, and disposed in an irregular terminal corymb. Before the flower-stem begins to shoot, the plant contains a bland pellucid juice, has little taste or odor, and is much used as a salad for the table, but during the period of inflorescence it abounds in a milky juice, which readily escapes from incisions in the stem, and has been found to possess decided medicinal as well as sensible properties. The juice is more abundant in the wild than in the cultivated plants. The original native country of the garden lettuce is unknown. The plant has been cultivated from time immemorial, and flourishes equally in hot and temperate latitudes. Some botanists suppose that *L. virosa* of the old continent is the parent of all the varieties of the cultivated plant.

Lactuca virosa, Willd., *Sp. Plant.* iii. 1526; Woodv., *Med. Bot.,* p. 75, t. 31; *B. & T.* 160. The *acrid* or *strong-scented lettuce* is biennial, with a stem from two to four feet high, erect, prickly near the base, above smooth and divided into branches. The lower leaves are large, oblong-ovate, undivided, toothed, commonly prickly on the under side of the midrib, sessile, and horizontal; the upper are smaller, clasping, and often lobed; the bracts are cordate and pointed. The flowers are numerous, of a sulphur-yellow color, and disposed in a panicle. The plant is a native of Europe.

L. virosa is lactescent, and has a strong disagreeable odor like that of opium, and a bitterish, acrid taste. It was admitted by the late Edinburgh and Dublin Pharmacopœias as one of the sources of lactucarium, which it is said to yield in greater quantity and of better quality than the garden lettuce. Schutz of Germany, obtained only 17 grains, on the average, from a single plant of the garden lettuce, while a plant of *L. virosa* yielded 56 grains.

Lactucarium is chiefly produced in Scotland, in Rhenish Prussia, and in France. According to Fairgrieve, in Scotland[1] the plant cultivated is *L. virosa,* var. *montana.* Late in July or early in August the collectors proceed over the field, cutting the head of each stalk and scraping the flow into their vessels. This is repeated several times daily until the plants are exhausted. (*P. J.,* iii. 972.) Aubergier is said to have been the only French producer. He cultivated the *L. altissima,* a gigantic Caucasian plant, which reaches the height of 9 feet. In collecting, transverse incisions were made daily, beginning at the top. In Germany the plan is the same as that practised in Scotland.[2]

Lactucarium,[3] as brought from England, is in small, irregular lumps, about the size of a pea or larger, of a reddish-brown color externally, and of a narcotic odor and bitter taste. As prepared near Edinburgh, it is commonly in roundish, compact, and rather hard masses, weighing several ounces. (Christison.) A variety known in our market as *German lactucarium* is in pieces about an inch and a half long by an inch in thickness, four-sided, with one side convex and the three others flat, or slightly concave from shrinking, as if quarter sections of a saucer-shaped cake which had been divided before it was quite dry. The color on the outer or convex surface is darkish brown, that of the cut surfaces light yellowish brown. From experiments by Parrish and Bakes, the German appears to be inferior to the English, as 44 per cent. of spirituous extract was obtained from the latter, and only 36 per cent. from the former, while the two extracts were about equal in their sensible properties. (*A. J. P.,* 1860, p. 226.) French lactucarium resembles the German, except in being in circular cakes about an inch and a half in diameter. The official description is as follows: "Usually in quarter sections of hemispherical masses, or in irregular, angular pieces;

[1] An investigation of our native *Lactuca canadensis* by Maisch has led to conclusions differing essentially from those of Aubergier. The milky juice collected by Maisch himself from plants in his neighborhood was converted quickly into a gelatinous mass, that shrunk much in drying, and, so far from a flat taste, had a persistent bitterness, and a heavy, nauseous, narcotic odor. Having prepared a syrup from this concrete juice, he gave it for trial to Da Costa and August Müller, who found it decidedly useful, and by the latter physician it was pronounced quite equal to the imported German lactucarium. (*A. J. P.,* 1869, p. 145.)

[1] For the mode of cultivating and preparing lactucarium in England, see a communication by Thos. Fairgrieve to *P. J.,* June, 1873, p. 972.

[2] For various plans which have been suggested for collecting the drug, see 14th ed. U. S. D.

[3] The *thridace* of François, at one time supposed to be identical with lactucarium, is in all probability nothing more than the inspissated expressed juice of lettuce, and, indeed, was directed as such in the French Codex of 1837, the leaves being rejected, and the stalks alone, near the flowering period, being subjected to pressure.

externally dull reddish-brown or grayish-brown; internally light brown or yellowish, the cut surface having a waxy lustre and somewhat porous; odor distinct, opium-like; taste strongly bitter. Lactucarium is partly soluble in alcohol and in ether. When triturated with water it yields a turbid mixture. When boiled with water it softens and yields a brownish-colored liquid which, after cooling, is not colored blue by iodine T.S." *U. S.* In color, taste, and odor, lactucarium bears considerable resemblance to opium, and has sometimes been called *lettuce opium.* It does not attract moisture from the air. It yields nearly half its weight to water, with which it forms a deep-brown infusion. It is partly soluble in ether and alcohol. From its resemblance in sensible properties and therapeutic effects to opium, it was conjectured to contain morphine, or some analogous principle, but this conjecture has not yet been verified. Buchner, Aubergier, and Walz claim severally to have discovered the active principle, which has been named *lactucin,* but the substances obtained by these different chemists are not exactly identical in properties, and the lactucin of Walz and Aubergier is considered by Lenoir as owing its bitterness to impurities, separated from which it is without taste and inert. For a full account of the earlier analyses of lactucarium, see 16th edition U. S. D. Ludwig found, in 100 parts, 48.63 of substances insoluble in water, and 51.37 of substances soluble in water. Of the insoluble matter 42.64 parts were of *lactucerin* or *lactucone,* in snow-white aggregated granules, dissolving in strong hot alcohol which deposits it on cooling, readily soluble in ether but insoluble in water, incapable of saponification by potassium hydroxide, and therefore not properly a fat, and in alcoholic solution faintly reddening litmus paper. On the other hand, Hesse states that lactucone is a mixture of esters, of which one, $C_{36}H_{58}O_2(C_2H_3O)_2$, is a diacetyl ester yielding, when saponified, *a-lactucerol,* $C_{36}H_{60}O_2$, and acetic acid, while the other is a mono-acetyl ester, $C_{36}H_{59}O_2(C_2H_3O)$. Of the 51.37 parts soluble in water, 6.98 were albumen, 1.75 lactucerin, held in solution by other substances, 27.68 bitter extract soluble in water and in alcohol, and 14.96 aqueous extract insoluble in alcohol of 0.830. The former of these extracts was found to contain a peculiar acid substance called *lactucic acid,* and the lactucin of Aubergier. *Lactucic acid* is of difficult crystallization, light yellow, strongly bitter, without sour taste, of an acid reaction, and readily soluble in alcohol and water. It has as much claim as any other discovered substance to be considered the active principle of lactucarium.

The assertion sometimes made that Lactuca virosa contains a mydriatic alkaloid has been disproved by J. C. Braithwaite and H. E. Stevenson, *P. J.,* 1903, 148. Farr and Wright (*P. J.,* 1904, p. 16) claim, however, to have definitely established the presence of a mydriatic alkaloid, giving alkaloidal reactions with Mayer's and Thresh's reagents, and producing a powerful mydriatic effect upon the eye. Besides the above ingredients, Ludwig found in lactucarium a substance resembling mannite, oxalic acid, another organic acid not well determined, a soft resin, potassium, magnesium, and ferric oxide. Distilled with diluted sulphuric acid, it gave an acid product smelling like lactucarium, which, saturated with calcium carbonate, and again distilled with potassium bisulphate, yielded an acid fluid having the odor of valerian. (*A. J. P.,* xx. 57.)

Kromayer (*Ann. Ch. Ph.,* 105, p. 3) found also *lactucopikrin,* $C_{44}H_{32}O_{21}$, a brown, amorphous, and very bitter substance of weak acid reaction. It is easily soluble in water and alcohol. Ludwig's lactucic acid Kromayer considers to be an oxidation product of lactucopikrin.

Hesse (*Handwörterbuch,* iv. p. 8) prepared *lactucerin,* and finds it to crystallize in white needles, fusing point 210° C., soluble in hot ligroin, chloroform, and benzene. On fusion with potassium hydroxide it yields acetic acid and *lactuceryl alcohol,* $C_{18}H_{30}O$, which forms white needles, fusing at 162° C., and is easily soluble in ether, chloroform, and hot alcohol. Hesse has since (*Ann. Ch. Ph.,* 234, p. 243) determined that lactucarium contains the acetates of *α-* and *β-lactucerol,* $C_{18}H_{30}O$. These compound ethers are saponified with alcoholic potash and water added, which precipitates *α-* and *β-*lactucerol. These are washed, dried in the air, and taken up with boiling alcohol. On cooling, *α-*lactucerol separates out first and can be purified by recrystallization, while the *β-*lactucerol is obtained from the mother liquor. The acetate of *α-*lactucerol fuses at 210° C., while that of *β-*lactucerol fuses at 230° C. For an examination of *Russian lactucarium,* by L. Schiperovitch, see *Ph. Z. R.* or *D. C.,* 1886.

Uses.—The ancients believed that lettuce had soporific properties, and many years ago J. R. Coxe of Philadelphia, first proposed the employment of the inspissated milky juice as a medicine. It was chiefly, however, through the recommendation by Duncan Sr., of Edinburgh, that the medicine came into use and was adopted as official in various pharmacopœias. It is claimed for it that it has, although in a very much inferior degree, the anodyne and calming properties of opium, without its disposition to derange the digestive organs. It has been employed in this country to some extent to allay *cough* and quiet *nervous irritation,* but we believe that the general experience is in accord with our own in finding it to be almost devoid of narcotic properties. We have never been able to obtain any good results from its use. Water distilled from lettuce (*eau de laitue*) is used in France as a mild sedative, in the quantity of from two to four ounces. The fresh leaves boiled in water are sometimes employed in the shape of cataplasm. It is said that in Egypt a mild oil is derived from the seeds, fit for culinary use.

Dose, ten to twenty grains (0.65 to 1.3 Gm.), but much larger quantities may be given without obvious effects.

Off. Prep.—Syrupus Lactucarii, *U. S.* (from tincture); Tinctura Lactucarii, *U. S.*

LAMELLÆ.

DISCS

(lą-mĕl'læ)

Gelatina Medicata in Lamellis; Medicated Gelatin Disks; Disques de Gélatine, *Fr.;* Gelatinlamellen, Gelatinplättchen, *G.*

Under this head are included in the British Pharmacopœia minute *gelatin discs* which contain traces of alkaloids, and which are designed to be inserted by oculists under the eyelid, in order to produce, through solution in the tears, such effects as they desire. A hot solution of gelatin containing the alkaloid in proper proportion is poured on a slightly greased glass or porcelain plate, cooled and dried, and then cut into discs, which, by previous calculation, will be found to contain the requisite quantity of medicament. A little glycerin is added to keep them from getting too hard and dry.

LAMELLÆ ATROPINÆ. Br.

DISCS OF ATROPINE

(lą-mĕl'læ ăt-rọ-pī'næ)

Disques d'Atropine, *Fr.;* Atropinplättchen, *G.*

"Discs of Gelatin, with some Glycerin, each weighing about 1-50 grain (1.3 milligrammes), and containing 1-5000 grain (0.013 milligramme) of Atropine Sulphate." *Br.*

LAMELLÆ COCAINÆ. Br.

DISCS OF COCAINE

(lą-mĕl'læ cō-cą-ī'næ)

Disques de Cocaine, *Fr.;* Cocainplättchen, *G.*

"Discs of Gelatin, with some Glycerin, each weighing about 1-30 grain (2.17 milligrammes), and containing 1-50 grain (1.3 milligrammes) of Cocaine Hydrochloride.

Each Disc is four times the strength of a Disc of Cocaine of the British Pharmacopœia of 1885." *Br.*

LAMELLÆ HOMATROPINÆ. Br.

DISCS OF HOMATROPINE

(lą-mĕl'læ hō-măt-rọ-pī'næ)

Disques d'Homatropine, *Fr.;* Homatropinplättchen, *G.*

"Discs of Gelatin, with some Glycerin, each weighing about 1-50 grain (1.3 milligrammes), and containing 1-100 grain (0.65 milligramme) of Homatropine Hydrobromide." *Br.*

Lucas (*C. D.,* 1899, 959) furnishes an improved formula for these discs; it is as follows: Gelatin, 30 gr.; Glycerin, 3 gr.; Distilled water, 150 gr.; Homatropine hydrobromide, 10 gr. Dissolve and pour on to a waxed plate, so as to produce a film exactly 4 inches square. When dry, but still supple, punch out discs 1-7 inch diameter.

The product is about 784 discs, the remainder of the film being wasted. Each disc will weigh rather less than 1-20 gr. No inconvenience has been found in using discs weighing 1-15 gr., as, owing to their extreme tenuity, they soften as soon as they are inserted beneath the eyelid.

LAMELLÆ PHYSOSTIGMINÆ. Br.

DISCS OF PHYSOSTIGMINE

(lą-mĕl'læ phȳ-sọ-stĭg-mī'næ)

Disques d'Ésérine, *Fr.;* Physostigminplättchen, *G.*

"Discs of Gelatin, with some Glycerin, each weighing about 1-50 grain (1.3 milligrammes), and containing 1-1000 grain (0.065 milligramme) of Physostigmine Sulphate." *Br.*

LAPPA. U. S.

LAPPA [Burdock Root]

(lăp'pa)

"The dried root of *Arctium Lappa* Linné, or of other species of *Arctium* (Fam. *Compositæ*), collected from plants of the first year's growth." *U. S.*

Radix Bardanæ, Bazzies, Beggars' Buttons, Cuckoo Button, Harebur; Bardane, *Fr. Cod.;* Glouteron, *Fr.;* Klettenwurzel, *G.;* Bardana, *It.*

The stem of the burdock is succulent, pubescent, branching, and three or four feet in height, bearing very large, cordate, denticulate leaves, which are green on their upper surface, whitish and downy on the under, and stand on long footstalks. The flowers are purple, with heads globose, and in terminal panicles. The involucre consists of imbricated scales, with hooked extremities, by which they adhere to cloth and the coats of animals. The achenes are oblong, somewhat compressed and three-angled, ribbed, truncate. Although a native of Europe, burdock is abundant in the United States, where it grows on the roadsides, among rubbish, and in cultivated grounds. There are three recognized species of Arctium in North America,—viz., *A. tomentosum* (Lam.), Schk. (Woolly or Cottony Burdock); *A. Lappa,* L. (Burdock, Clotbur or Great Bur); and *A. minus,* Schk. (Common Burdock).

The burdock has a simple, spindle-shaped root a foot or more in length, brown externally and white and spongy within, furnished with thread-like fibres, and having withered scales near the top. It is officially described as "nearly simple, fusiform, of variable length, 5 to 20 Mm. in diameter near the crown; frequently split or in broken pieces, externally grayish-brown, longitudinally wrinkled, the

crown somewhat annulate, sometimes surmounted by a woolly tuft of leaf remains; fracture somewhat horny; a dark cambium separating the thick brownish bark from the yellowish porous and radiate wood, centrally hollow or containing a white pith-like tissue; odor slight; taste mucilaginous, sweetish, and slightly bitter." *U. S.* For medicinal purposes the root should be gathered when about a year old.

Inulin has been found in it by Guibourt, and sugar by Fée, while F. E. Hendershott believes that it contains a glucoside, besides arabin and pectin and extractives. (*Proceedings of Mich. Pharm. Assoc.,* 1887.) Trimble also obtained from the root a bitter, crystalline glucoside. (*Ph. Era,* 1888, p. 133.) Thos. Donaldson (*A. J. P.,* 1890, p. 123) found 8.6 per cent. of yellow fixed oil and about 1 per cent. of white waxy matter. A small quantity of volatile oil (0.065 per cent.) has been found in burdock root according to *Haensel's Report,* Oct. 1902. The inulin usually exists in parenchymatous cells in a different state, but if sections of the green root be dehydrated by soaking in 95 per cent. alcohol, the inulin will be found in spheroidal form.

An interesting account of burdock and its use as an edible vegetable in Japan, by Inazo Nitobe, may be found in *A. J. P.,* 1897, 416.

Uses.—Burdock root is considered to be a diuretic and diaphoretic alterative, especially useful in the *gouty, scorbutic,* and *syphilitic* and *scrofulous diatheses;* also in various chronic skin diseases, especially in *psoriasis, prurigo,* and *acne.* (*M. S. Rep.,* 1868.) To prove effectual, its administration must be long continued. A pint may be given daily of the decoction, made by boiling two ounces of the root in three pints of water to two pints. The fluidextract and syrup have also been prepared. The fresh leaves have been employed both externally and internally in cutaneous eruptions and ulcerations. The fruit has been largely substituted for the root, especially in the form of the tincture of burdock fruit.

Dose, thirty to ninety grains (2 to 5.8 Gm.).

Off. Prep.—Fluidextractum Lappæ, *U. S.*

LAUROCERASI FOLIA. Br.

CHERRY-LAUREL LEAVES

(lâụ′rō-cĕr′ạ-sī fō′lī-ạ)

"The fresh leaves of Prunus Laurocerasus, *Linn.*" *Br.* (Fam. Rosaceæ.)

Cherry Bay; Laurier-cerise, *Fr. Cod.;* Kirschlorbeer, *G.;* Lauroceraso, *It.;* Laurel-cerezo (Hoja de), *Sp.*

Prunus Lauro-cerasus, Willd., *Sp. Plant.* ii. 898; *B. & T.* 98. *Cerasus Lauro-cerasus,* De Cand., *Prodrom.* ii. 540.—This is a small evergreen tree, rising 15 or 20 feet, with long spreading branches, which, as well as the trunk, are covered with a smooth, blackish bark. The leaves, standing alternately on short strong footstalks, are oval-oblong, from five to seven inches in length, acute, finely toothed, firm, coriaceous, smooth, beautifully green and shining, with oblique nerves, and yellowish glands at the base. The flowers are small, white, strongly odorous, and disposed in simple axillary racemes. The fruit is an oval drupe, very similar in shape and structure to a small black cherry. The cherry-laurel is a native of Asia Minor, but is cultivated in Europe, both for medicinal use and for the beauty of its shining evergreen foliage. Almost all parts of it have more or less of the odor of hydrocyanic acid.

In their recent and entire state cherry-laurel leaves have scarcely any odor; but, when bruised, they emit the characteristic odor of the plant in a high degree. Their taste is somewhat astringent and strongly bitter, with the flavor of the peach kernel. They are officially described as "thick, coriaceous, on short strong petioles, oblong, or somewhat obovate, from five to seven inches (twelve and a half to seventeen centimetres) in length, tapering towards each end, recurved at the apex, distantly but sharply serrate and slightly revolute at the margins, dark green, smooth, and shining above, much paler beneath, and with a prominent midrib, on either side of which, near the base, are one or two glandular depressions." *Br.* They yield a peculiar oil and hydrocyanic acid by distillation with water, which they strongly impregnate with their flavor. One pound, avoirdupois, of the fresh leaves yields 40.5 grains of the oil. (*Ph. Cb.,* 1855, 205.) The oil resembles that of bitter almonds, for which it is said to be sometimes sold in Europe, where it is employed to flavor liquors and various culinary preparations, but, as the glucoside of cherry-laurel leaves is decomposed more slowly than ordinary crystallized amygdalin, it is liable to hold hydrocyanic acid, and hence to be poisonous. The glucoside referred to has been termed *laurocerasin,* or "amorphous amygdalin." It is decomposed by emulsin into hydrogen cyanide, benzaldehyde, and sugar, but more slowly than ordinary amygdalin. Its optical activity also differs from that of ordinary amygdalin. (Jacobsen, *Die Glykoside,* 25.) That the oil exists already formed, to a certain extent, in the fresh leaves, is rendered probable by the fact, stated by Winckler, that they yield it in considerable quantity when distilled without water. (*J. P. C.,* xxv. 195.) The fresh leaves are used to flavor milk, cream, etc., and more safely than the oil, though they also are poisonous, when too largely employed.

Uses.—The leaves of the cherry-laurel possess properties similar to those of hydrocyanic acid, and the water distilled from them is much employed in various parts of Europe for the same purposes as that active medicine. But it deteriorates by age, and therefore, as kept by pharmacists, must be of variable strength. J. Bröker, a Dutch pharmacologist, has satisfied

himself, by numerous experiments, that the proportion of hydrocyanic acid in the leaves varies with the season, the age of the plant, the character of the soil and of the weather, and thinks that, in consequence of this variability, they are inferior for medicinal use to bitter almonds, which in this respect have a more uniform composition. He found the proportion of the acid in the leaves greatest in July, and least in February. (*B. F. M. R.*, Oct. 1868, p. 517.) It is not, therefore, to be regretted that the want of the plant in this country has prevented the general introduction of so variable a remedy as the distilled water. (See *Aqua Laurocerasi.*)

Off. Prep.—Aqua Laurocerasi, *Br.*

LEPTANDRA. U. S.

LEPTANDRA [Culver's Root]

(lĕp-tăn'drą)

"The dried rhizome and roots of *Veronica virginica* Linné (Fam. *Scrophulariaceæ*)." *U. S.*

Culver's Physic, Black Root; Racine de Leptandra, ou de Véronique de Virginie, *Fr.;* Leptandra-Wurzel, *G.*

Veronica virginica, Linn.; Gray, *Man. of Bot., etc.* p. 290. *Leptandra virginica,* Nuttall, *Genera of N. Am. Plants,* i. 7; Rafinesque, *Med. Flora,* vol. ii.— This plant, commonly called *Culver's root,* or *Culver's physic,* is an herbaceous perennial, with a simple, erect stem, three or four feet high, smooth or downy, furnished with leaves in whorls, and terminating in a long spike of white flowers. The leaves, of which there are from four to seven in each whorl, are lanceolate, pointed, and minutely serrate, and stand on short footstalks. A variety was seen by Pursh with purple flowers, which was described and figured as a distinct species by Rafinesque, under the name of *L. purpurea.* The plant flowers in July and August. It grows throughout the United States east of the Mississippi, affecting mountain meadows in the South and rich woods in the North, and is not unfrequently cultivated.

Properties.—The root consists of a rhizome or root-stalk several inches in length, sometimes branched, with numerous long slender radicles. As found in commerce, the rhizome is usually broken into pieces an inch or more long, from two to four lines in thickness, either beset with the rootlets or very rough from their remains when broken, hard and firm, and of difficult fracture, dark brown externally, light-colored and ligneous within. The rootlets are round, smooth, slender, generally broken, but, when not so, six inches or more in length, and almost black, being much darker than the caudex. The official description is as follows: "Rhizome of horizontal or oblique growth, somewhat bent and branched, from 4 to 15 Cm. long and 3 to 8 Mm. in diameter; externally gray-brown to blackish-brown, with cup-shaped scars on the upper side; annulate, the inferior and lateral surfaces with coarse roots and root-scars; fracture tough and woody, branches readily separable from the main rhizome; internally, bark dark brown, 0.3 to 1 Mm. thick, wood hard, yellowish, pith large, purplish-brown; roots slender, longitudinally wrinkled, fragile; odor slight; taste bitter, slightly acrid." *U. S.* The odor is feeble and not disagreeable, the taste bitterish, somewhat nauseous, and feebly acrid. Water and alcohol extract the virtues of the root. For a microscopical description of leptandra, by A. P. Breithaupt, see *A. J. P.,* 1897, 235. According to E. S. Wayne of Cincinnati, it contains volatile oil, extractive, tannin, gum, resin, and a peculiar crystalline principle, to which the virtues of the medicine may be ascribed. To this principle the name of *leptandrin* properly belongs. F. F. Mayer confirmed the presence of the crystalline principle, and proved it to be a glucoside. Wayne obtained it by treating an infusion of the root with lead subacetate, filtering, precipitating the excess of lead by sodium carbonate, filtering to separate the lead carbonate, passing the filtered liquid through animal charcoal which absorbed all the active matter, washing the charcoal with water until the washings began to be bitter, then treating it with boiling alcohol, and allowing the alcoholic solution to evaporate spontaneously. By dissolving the powder thus obtained in water, treating this with ether, and allowing the ether to evaporate, needle-shaped crystals were obtained, which had the bitter taste of the root. The resinous matter obtained by making a tincture of the root and precipitating this with water has been improperly called leptandrin, and considered the active principle. The pure resin is probably inert, and the preparation referred to owes what activity it may possess to some of the true leptandrin associated with it. Leptandrin is soluble in water, alcohol, and ether. It has not been isolated for use. (*Proc. A. Ph. A.*, 1856, p. 34.) Subsequently Wayne obtained from the root a saccharine principle having the properties of *mannite.* (*A. J. P.*, 1859, p. 557.) G. Steinmann (*A. J. P.*, 1887, p. 229) obtained pale lemon-yellow crystals of a peculiar agreeable odor and a very bitter taste. They were not precipitated from solution by Mayer's reagent or by tannin, and did not yield glucose on being boiled with diluted sulphuric acid.

Uses.—The recent root is said to act violently as a cathartic, and sometimes as an emetic. In the dried state it is much milder, but less certain. The practitioners calling themselves eclectics consider it an excellent cholagogue, and use both the impure resin, which they call leptandrin, and the root itself as a substitute for mercurials.[1] A. P. Dutcher of Cleveland,

[1] J. U. Lloyd communicated a process for resin of leptandra (or leptandrin) to the American Pharmaceutical Association in 1880. (See *A. J. P.*, 1880, 491.)

Ohio, has not found it to act decidedly on the liver, but believes that it has a special influence on the muciparous follicles of the intestines, and acts very advantageously in cases of *duodenal indigestion* and *chronic constipation.* (*M. S. Rep.,* March 28, 1868.) Rutherford, in his experiments upon dogs, found leptandrin to act rather feebly upon the liver.

Dose, fifteen to sixty grains (1 to 3.9 Gm.); of the impure resin, two to four grains (0.13 to 0.26 Gm.).

Off. Prep.—Extractum Leptandræ, *U. S.* (from fluidextract); Fluidextractum Leptandræ, *U. S.*

LIMONIS CORTEX. U. S., Br.

LEMON PEEL

(lĭ-mō'nĭs cŏr'tĕx)

"The recently separated outer rind of the ripe fruit of *Citrus Limonum* Risso (Fam. *Rutaceæ*)." *U. S.* "The fresh outer part of the pericarp of the fruit of Citrus medica, *Linn.,* var. β Limonum, *Hook. f.*" *Br.*

Limonis Pericarpium; Ecorce (Zeste) de Citron, de Limon, *Fr. Cod.;* Cortex Citri Fructus, *P. G.;* Citronenschale, Limonenschale, *G.;* Scorza di Limone, *It.*

Off. Prep.—Infusum Aurantii Compositum, *Br.;* Infusum Gentianæ Compositum, *Br.;* Syrupus Limonis, *Br.;* Tinctura Limonis Corticis, *U. S.* (*Br.*).

LIMONIS SUCCUS. U. S. (Br.)

LEMON JUICE

(lĭ-mō'nĭs sŭc'cŭs)

"The freshly expressed juice of the ripe fruit of *Citrus Limonum* Risso (Fam. *Rutaceæ*)." *U. S.* "The freshly expressed juice of the ripe fruit of Citrus medica, *Linn.,* var. β Limonum, *Hook. fil.*" *Br.*

Succus Limonis, *Br.,* Succus Citri; Lime Juice; Suc de Citron (de Limon), *Fr. Cod.;* Citronensaft, Limonensaft, *G.;* Succo di limone, *It.;* Zumo de limon, *Sp.*

For some general remarks on the genus CITRUS, see *Aurantii Cortex.*

Citrus medica, Willd., *Sp. Plant.* iii. 1426; Woodv., *Med. Bot.,* p. 582, t. 189.—This tree closely resembles *Citrus Aurantium,* before described. The leaves, however, are larger, slightly indented at the edges, and stand upon footstalks which are destitute of the winged appendages that characterize the other species. The flowers, moreover, have a purplish tinge on their outer surface, and the fruit is entirely different in appearance from the orange. There are several varieties of *Citrus medica,* which some botanists consider as distinct species, but which scarcely differ except in the character of their fruit. Those particularly deserving of notice are the citron, lemon, and lime. 1. In the *citron, C. medica* of Risso (*Bentley & Trimen,* p. 53), the fruit is very large, sometimes six inches in length, ovoidal, with a double rind, of which the outer layer is yellowish, thin, unequal, rugged, with innumerable vesicles filled with essential oil; the inner is white, very thick and spongy. It is divided in the interior into nine or ten cells, filled with oblong vesicles, which contain an acid juice precisely like that of the lemon, and used for the same purposes. The rind is applied to the preparation of conserves, to which it is adapted by its thickness. The fruit is called *cédrat* by the French. 2. The *lemon* (*C. medica,* var. *limon* of Linnæus, *Citrus Limonum* of Risso) (*Bentley & Trimen,* p. 54) is smaller than the preceding, with a smoother and thinner rind, a pointed nipple-shaped summit, and a very juicy, acid pulp. In other respects it closely resembles the citron, to which, however, it is usually preferred in consequence of the greater abundance of its juice. 3. The *lime* is still smaller than the lemon, with a smoother and thinner rind, oval, rounded at the extremities, of a pale-yellow or greenish-yellow color, and abounding in a very acid juice, which renders it highly useful for the purposes to which the lemon is applied. It is the product of the variety *C. acris* of Miller. According to E. M. Holmes the West India limes are much richer in acid than are those produced in the South of Europe; the juice of the spineless variety was found to contain 37.73 grains per ounce; the ordinary West India lime 36.15 grains per ounce; the Sicily lime 30.32 grains per ounce.[1]

The *Citrus medica,* like the orange-tree, is a native of Asia. It is now known to grow wild in Northern India, and was introduced into Europe from Persia or Media. It was first cultivated in Greece, afterwards in Italy, as early as the second century, and has now spread over the whole civilized world, being raised by artificial heat where the climate is too cold to admit of its exposure during winter to the open air.

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[1] *Lime juice as a beverage.*—We are indebted to Frank C. Simson of Halifax, for the following communication upon this subject. Lime juice is used very largely as an antiscorbutic. It is "the juice of *Citrus Limetta,* produced most largely in Jamaica and other West India Islands. It is obtained from both cultivated and wild trees, the former being superior in flavor while the latter contains a larger portion of citric acid. The tree resembles closely the Citrus Limonum and furnishes two crops annually which extend over a period of three months each.

"*Preparation.*—Properly picked limes are sliced and pressed between wooden rollers, care being taken that the pressure is not too great, in order to prevent the oil from being expressed with the juice; such portions of the oil as are expressed are collected in the pulp and set aside for future distillation. The juice at first is milky white, but after standing for some time separates from the pulp, part floating and the other part sinking; it then goes through the usual process of filtering through pulp or paper. The use of the juice as a beverage and febrifuge has increased many hundred fold in the last few years, and is now considered superior to any juice of the Citrus family. The juice should contain from 6½ to 9 per cent. citric acid. This varies as to the quality of the fruit and the district from which it is produced. Jamaica producing the best. The article is much sophisticated as found ordinarily in commerce, being often largely adulterated with tartaric acid, and even mineral acids are sometimes used."

We are supplied with lemons and limes chiefly from the West Indies, the Mediterranean and California. Though the former of these fruits only is directed by the United States Pharmacopœia, both kinds are employed indiscriminately for most medicinal purposes, and the lime affords a juice at least equal, in proportional quantity and acidity, to that obtained from the lemon.[1]

As lemons rapidly deteriorate on keeping, if exposed to the air, the suggestions of protecting them by dipping them in melted paraffin, or by using a varnish of shellac dissolved in alcohol, made by George Mee of London, are not without value. Mee found that lemons thus covered with varnish continued sound for a period of many months. (See *A. J. P.*, 1866, p. 474.)

Properties.—The exterior rind of the lemon has a fragrant odor, and a warm, aromatic bitter taste, somewhat similar to that of the orange, though less agreeable. It is usually found in narrow, thin bands, with very little of the spongy, white, inner layer adhering to it, and is officially described as follows: "Outer surface lemon-yellow, the tissue beneath containing numerous large oil reservoirs; odor highly fragrant; taste pungently aromatic." *U. S.* It contains a bitter principle, and yields, by expression or distillation, an essential oil, which is much used for its flavor. Both this and the rind itself are recognized in the Pharmacopœias. (See *Oleum Limonis.*) When the white, spongy portion of the rind is boiled in water, and the decoction evaporated, crystals are deposited of a substance called *hesperidin.* This is a glucoside, and has the formula $C_{22}H_{28}O_{12}$, and is decomposed by diluted acids into hesperetin, $C_{16}H_{14}O_6$, and glucose, $C_6H_{12}O_6$. It turns dingy black when gently warmed with alcoholic solution of ferric chloride. It is bitter, but as it is found most largely in the spongy and comparatively tasteless part of the rind, it may be doubted whether it is entitled to be considered as the active bitter principle. (See *A. J. P.*, xxvi. 553.) Lemon peel yields its virtues to water, wine, and alcohol. E. G. Clayton (*An.*, 19, 134) calls attention to the distinction between lemon peel and orange peel when moistened by strong hydrochloric acid. Orange peel under these circumstances changes in color from a yellow to a rich dark green color, while lemon peel retains its hue or assumes a dingy yellowish-brown tint. The juice is the part for which the fruit is most esteemed. It is sharply acid, with a peculiar grateful flavor, and consists chiefly of water, citric acid (about 10 per cent.), gum and sugar (from 3 to 4 per cent.), and inorganic salts (2.28 per cent.). It sometimes has in it a little volatile oil, derived by pressure from the rind. The U. S. P. gives the following standard tests: "A slightly turbid, yellowish liquid, having the odor of lemon; taste acid and often slightly bitter. Specific gravity: 1.030 to 1.040 at 25° C. (77° F.). It reddens blue litmus paper and should contain from 7 to 9 percent. of citric acid. If a few drops of barium chloride T.S. be added to filtered Lemon Juice, no turbidity or white precipitate should be produced (absence of *sulphuric acid* or *sulphates*). If an equal volume of sulphuric acid containing a few drops of alcohol be added to Lemon Juice, and the liquid heated, no odor of acetic ether should be developed (absence of *acetic acid*). Upon the addition of solution of potassium acetate (1 in 3) and alcohol in excess, no white crystalline precipitate should form after allowing the liquid to stand fifteen minutes (absence of *tartaric acid*). At least 10 Cc. of normal potassium hydroxide V.S. should be required to neutralize 10 Cc. of Lemon Juice, phenolphthalein T.S. being used as indicator." *U. S.* "A slightly turbid yellowish liquid, with a sharply acid taste. Specific gravity 1.030 to 1.040. One fluid ounce contains 30 to 40 grains (or 100 cubic centimetres contain 7 to 9 grammes) of citric acid. When Lemon Juice is evaporated to dryness, and the residue is incinerated, it should yield not more than 3 per cent. of ash. 110 minims (or 100 cubic centimetres) of Lemon Juice are neutralized by about 11½ grains (or 11.4 grammes) of Potassium Bicarbonate, by about 9½ grains (or 9.5 grammes) of Sodium Bicarbonate, and by about 16½ grains (or 16.5 grammes) of Sodium Carbonate." *Br.*

As lemons cannot always be obtained, the juice is often kept in a separate state, but, from its liability to spontaneous decomposition, it speedily becomes unfit for medicinal use, and, though various means have been resorted to for its preservation, it can never be made to retain for any length of time its original flavor unaltered. The best substitute for lemon juice is a solution of crystallized citric acid in water, in the proportion of about an ounce to the pint, with the addition of a little oil of lemon, but even this solution is nearly useless as an antiscorbutic. One of the most effectual methods of preserving the juice is to allow it to stand for a short time after expression, until a coagulable matter separates, then to filter, and introduce it into glass bottles, with a stratum of almond oil or other sweet oil upon its surface. It will keep still better if the bottles containing the filtered juice be suffered, before being closed, to stand for fifteen minutes in a vessel of boiling water. Another mode is to add one-tenth of alcohol and to filter. The juice may also be preserved by concentrating it either by evaporation with a gentle heat, or by exposure to a freezing temperature, which congeals the aqueous portion and leaves the juice much stronger than before. When used, it may be diluted to the former strength, but, though the acid properties are retained, the flavor of the juice is found to have been deteriorated. Lemon syrup is another form in which the juice is preserved.

[1] *Limeseed Oil.*—The seed of the lime contains 58 per cent. of fixed oil, which is said to equal in flavor the best olive oil. Its tendency to resist rancidity is reputed to be very great. (*B. C. D.*, 1894, 411.)

The British Pharm. (1885) gave the sp. gr. of lemon juice at from 1.035 to 1.045, and the quantity of citric acid in a fluidounce of it from 30 to 40 grains. W. W. Stoddart found, in lemons from six different sources, an average of 42.53 grains in an ounce of the juice, and a mean sp. gr. of 1.044. By other authorities the proportions are given very differently. Thus, Watts gives 20.5 grains to the ounce, or 4.7 per cent. of the juice. The fact is that the quantity of acid varies very greatly. Stoddart found it to diminish rapidly with the advance of summer, with little change in the sp. gr. (*P. J.*, Oct. 1868.) H. H. Robins, after examining large consignments of lemons, states that the average yield taken from a year's receipts was 35.23 grains in a fluidounce. (*C. D.*, 1896, 742.) A solution of tartaric acid in water, with the addition of a little sulphuric acid, and flavored with the oil of lemon, has been fraudulently substituted for lemon juice, particularly as an antiscorbutic on long voyages, for which purpose it is quite useless. An application of the test for tartaric and sulphuric acids will at once detect the fraud.

Uses.—The rind of the lemon is sometimes used to qualify the taste and increase the power of stomachic infusions and tinctures. The juice is refrigerant, and, properly diluted, forms a refreshing and agreeable beverage in *febrile* and *inflammatory affections*. It may be given with sweetened water in the shape of lemonade, or may be added to the mildly nutritive drinks, such as gum water, barley water, etc., usually administered in *fevers*. It is also much employed in the formation of those diaphoretic preparations known by the names of *neutral mixture* and *effervescing draught*. (See *Mistura Potassii Citratis*, 1880.) One of the most beneficial applications of lemon juice is to the prevention and cure of *scurvy*, for which it may be considered almost a specific. For this purpose, ships destined for long voyages should always be provided with a supply of the concentrated juice. In England every foreign-going ship is required by law to take such a supply of lemon juice that every seaman shall have a daily allowance of an ounce after having been ten days at sea. It has been employed with advantage in *acute rheumatism* in doses of from one to four fluidounces (30 to 120 Cc.) from four to six times a day. It has been used with benefit as a local application in *pruritus of the scrotum*, in *uterine hemorrhage* after delivery, in *sunburn*,[1] and as a gargle in *diphtheritic sore throat*.

Off. Prep.—Syrupus Limonis, *Br.*

LINIMENTA.

LINIMENTS

(lĭn-ĭ-mĕn'tă)

Embrocations; Liniments, Embrocations, *Fr.*; Linimenta, Linimente, Einreibungen, *G.*

[1] An excellent formula for this purpose is: glycerin and lemon juice, each, a fluidounce, bismuth subnitrate a drachm; apply freely to the affected parts.

These are preparations intended for external use, of such a consistence as to render them conveniently applicable to the skin by gentle friction with the hand. The preparations official in the U. S. P. 1880 belonging to this class which were omitted in the 1890 edition of the U. S. Pharmacopœia were the *Liniments of Cantharides* and *Subacetate of Lead*. The U. S. P. (8th Rev.) retained all of those official in the previous edition excepting the *Linimentum Sinapis Compositum*.

LINIMENTUM ACONITI. Br.

LINIMENT OF ACONITE

(lĭn-ĭ-mĕn'tŭm ăc-ŏ-nī'tī)

Liniment d'Aconit, *Fr.*; Akonitliniment, *G.*

"Aconite Root, in No. 40 powder, 20 *ounces* (Imperial) or 500 grammes; Camphor, 1 *ounce* (Imp.) or 25 grammes; Alcohol (90 per cent.), *a sufficient quantity*. Mix the powdered Aconite Root with *twenty fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; set aside in a closed vessel for three days, agitating occasionally; transfer to a percolator; when the liquid ceases to pass, continue the percolation with more of the Alcohol, allowing the liquid to drop into a receiver containing the Camphor, until *thirty fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the liniment are produced." *Br.*

The British preparation is simply a very strong tincture of aconite root and camphor; that of the U. S. P. 1870 [2] was almost equivalent to a fluidextract of aconite. Either may be applied alone by means of a camel's-hair pencil, or in connection with two parts or more of soap liniment or chloroform liniment, by rubbing it on the part affected. Experiments made by W. Donovan with a tincture prepared by macerating the fresh root, sliced, in rectified spirit for only twenty-four hours, proved that the preparation thus made, though acting in the same way, was much more powerful than the official (*Br.*). (*P. J.*, 2d ser., vi. 57.) The inference is that the fresh root should be used in preparing this liniment, and that a simple maceration is all that is required. There is a great waste both of aconite and of spirit in the process, as no provision is made, either by displacement with water or by expression, to separate from the mass in the percolator the strongly impregnated spirit retained in it. According to J. T. Porter, it requires twenty-eight parts, by measure, for every sixteen parts, by weight, of the dry root. On expressing the

[2] *Linimentum Aconiti*, U. S. 1870.—"Take of Aconite Root, in fine powder, *eight troyounces*; Glycerin *a fluidounce*; Alcohol *a sufficient quantity*. Moisten the powder with four fluidounces of Alcohol, and let it macerate for twenty-four hours; then pack it in a conical percolator, and gradually pour Alcohol upon it until two pints of tincture have been obtained. Distil off a pint and a half of alcohol, and evaporate the remainder until it measures seven fluidounces; to this add the Glycerin, and mix them thoroughly." *U. S.* 1870.

marc the loss of spirit was reduced to from 6 to 12 per cent. (*Ibid.*, xi. 66.) It is to be regretted that percolation to exhaustion and partial evaporation were not directed, as in the U. S. process for fluidextracts.

LINIMENTUM AMMONIÆ. U. S., Br.

AMMONIA LINIMENT [Volatile Liniment]

(lĭn-ĭ-mĕn'tŭm ąm-mō'nĭ-æ)

Liniment of Ammonia, Linimentum volatile, Linimentum ammoniacale; Liniment ammoniacal (volatil), *Fr. Cod.;* Savon ammoniacal, *Fr.;* Linimentum Ammoniatum, *P. G.;* Flüchtiges Liniment, Flüchtige Salbe, *G.;* Linimento ammoniacale, *It.;* Linimento amoniacal, *Sp.*

* "Ammonia Water, *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims]; Alcohol, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Cotton Seed Oil, *five hundred and seventy cubic centimeters* [or 19 fluidounces, 131 minims]; Oleic Acid, *thirty cubic centimeters* [or 1 fluidounce, 7 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them by agitation in a bottle, which should be well stoppered. This Liniment should be freshly prepared, when wanted." *U. S.* "Solution of Ammonia, 1 *fl. ounce* (Imperial measure) or 25 cubic centimetres; Almond Oil, 1 *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Olive Oil, 2 *fl. ounces* (Imp. meas.) or 50 cubic centimetres. Shake together." *Br.*

The process of the U. S. Pharmacopæia differs from that of the U. S. P. 1870 not only in the proportion of ammonia water, which has been slightly reduced, but in the substitution of cotton seed oil for olive oil. The addition of 5 per cent. of alcohol prevents immediate separation, renders the mixture more uniform, and aids materially in binding together the oily and aqueous constituents, while the oleic acid aids still more in this direction. A liniment is now furnished which is liquid at ordinary temperatures. The ammonia liniment of the U. S. P. 1870 was usually solid and unmanageable. While complete saponification is not a desideratum in this liniment, a better oil than cotton seed oil is pure lard oil, which will form a white, smooth mixture.

The U. S. and British Pharmacopœias agree at present very nearly in the strength of this liniment, the U. S. preparation being somewhat the stronger. In the process, the ammonia reacts with the oil to form a soap, which is partly dissolved, partly suspended in the water, producing a white, opaque emulsion. The liniment is an excellent rubefacient, frequently employed in *inflammatory affections of the throat*, in *catarrhal and other pectoral complaints of children*, and in *rheumatic pains*. It is applied by rubbing it, or placing a piece of flannel saturated with it, over the affected part. Should it occasion too much inflammation, it must be diluted with oil.

LINIMENTUM BELLADONNÆ. U. S., Br.

BELLADONNA LINIMENT

(lĭn-ĭ-mĕn'tŭm bĕl-lą-dŏn'næ)

Liniment of Belladonna; Liniment de Belladone, *Fr.;* Belladonnaliniment, *G.*

* "Camphor, *fifty grammes* [or 1 ounce av., 334 grains]; Fluidextract of Belladonna Root, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Camphor in about *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the Fluidextract, and then add enough of the latter to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Liquid Extract of Belladonna, 10 *fl. ounces* (Imperial measure) or 250 cubic centimetres; Camphor, 1 *ounce* (Imp.) or 25 grammes; Distilled Water, 2 *fl. ounces* (Imp. meas.) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity*. Dissolve the Camphor in *six fluid ounces* (Imp. meas.) or one hundred and fifty cubic centimetres of the Alcohol; add the Liquid Extract of Belladonna, the Distilled Water, and sufficient of the Alcohol to produce twenty *fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Liniment. Set aside for twenty-four hours; filter." *Br.* The process for this liniment in both Pharmacopœias has been improved by using an assayed fluidextract. It affords a valuable means of applying belladonna externally.

LINIMENTUM CALCIS. U. S., Br.

LIME LINIMENT [Carron Oil]

(lĭn-ĭ-mĕn'tŭm căl'cĭs)

Liniment of Lime; Liniment calcaire, *Fr. Cod.;* Savon calcaire, *Fr.;* Kalkliniment, *G.;* Linimento de calce, *It.;* Linimento Oleo-calcareo, *Sp.*

* "Lime Water, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Linseed Oil, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them by agitation." *U. S.* "Solution of Lime, 2 *fl. ounces* (Imperial measure) or 50 cubic centimetres; Olive Oil, 2 *fl. ounces* (Imp. meas.) or 50 cubic centimetres. Shake together." *Br.*

The lime forms a soap with the oil, of which there is a great excess, that separates upon standing. Olive oil, as directed by the British Pharmacopœia, is often substituted for that of flaxseed, which was originally used, but it possesses no other advantage than that of having a less unpleasant odor. The use of cotton seed oil in the U. S. P. 1880 did not meet the expectations of those who proposed it, and the U. S. P. 1890 reinstated linseed oil. This is a very useful application in recent *burns* and *scalds*, when smeared thickly upon lint or cotton

batting. It is sometimes called *Carron oil*, from having been much employed at the Carron iron works in Scotland.

LINIMENTUM CAMPHORÆ. U. S., Br.

CAMPHOR LINIMENT

(lĭn-ĭ-mĕn'tŭm căm'phọ-ræ)

Liniment of Camphor, Linimentum Camphoratum; Huile camphrée, *Fr. Cod.;* Liniment camphré, *Fr.;* Kampherliniment, Kampheröl, *G.*

* "Camphor, in coarse powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Cotton Seed Oil, *eight hundred grammes* [or 28 ounces av., 96 grains], to make *one thousand grammes* [or about two pints]. Introduce the Camphor and the Cotton Seed Oil into a suitable flask, and apply a gentle heat, by means of a water-bath, loosely stoppering the flask during the operation. Agitate the flask occasionally, until the Camphor is dissolved." *U. S.*

"Camphor, in flowers, 1 *ounce* (Imperial) or 20 grammes; Olive Oil, 4 *fl. ounces* (Imp. meas.) or 80 cubic centimetres. Dissolve the Camphor in the Olive Oil." *Br.*

S. D. Wetterstroem prefers cold solution to the official method, thus avoiding any loss of camphor. (*West. Drug.*, 1897, 68.) This liniment is employed as an anodyne embrocation in *sprains, bruises, rheumatic or gouty affections of the joints,* and other local pains. It is also supposed to have a discutient effect when rubbed upon glandular swellings. J. Weichselbaum has found camphor liniment to be a specific for the *itching* produced by cowhage. (*A. J. P.*, xlii. 519.) Camphor liniment should not be confounded with camphorated oil of the German Pharmacopœia which is much weaker (1 in 10). (See *Camphora*, page 274.) For methods of assaying camphor liniment see *C. D.*, 1900, 338; *P. J.*, 1898, 545; *P. J.*, 1902, 106; *Am. Drug.* 1905, 345.

Off. Prep.—Ceratum Camphoræ, *U. S.;* Linimentum Chloroformi, *Br.;* Linimentum Hydrargyri, *Br.;* Linimentum Terebinthinæ Aceticum, *Br.*

LINIMENTUM CAMPHORÆ AMMONIATUM. Br.

AMMONIATED LINIMENT OF CAMPHOR

(lĭn-ĭ-mĕn'tŭm căm'phọ-ræ ăm-mọ-nī'ą-tŭm)

Compound Liniment of Camphor, *Br.;* Liniment ammoniacal camphré, *Fr. Cod.;* Linimentum ammoniato-camphoratum, *P. G.;* Flüchtiges Kampherliniment, Ammoniak- und Kampher-Liniment, *G.;* Linimento ammoniacale canforato, *It.;* Linimento amoniacal alcanforado, *Sp.*

"Camphor, 2½ *ounces* (Imperial) or 50 grammes; Oil of Lavender, 1 *fl. drachm* (Imp. meas.) or 2.5 cubic centimetres; Strong Solution of Ammonia, 5 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Dissolve the Camphor and Oil of Lavender in *twelve fluid ounces* (Imp. meas.) or two hundred and forty cubic centimetres of the Alcohol; add the Strong Solution of Ammonia gradually, shaking them together until, after adding sufficient of the Alcohol to produce *twenty fluid ounces* (Imp. meas.) or four hundred cubic centimetres of the Liniment, a clear solution is formed." *Br.*

This is used as a rubefacient and at the same time anodyne embrocation in local pains, particularly of a rheumatic character.

LINIMENTUM CHLOROFORMI. U. S., Br.

CHLOROFORM LINIMENT

(lĭn-ĭ-mĕn'tŭm ċhlō-rọ-fôr'mī)

Liniment of Chloroform; Liniment au Chloroforme, *Fr. Cod.;* Chloroformliniment, *G.*

* "Chloroform, *three hundred cubic centimeters* [or 10 fluidounces, 69 minims]; Soap Liniment, *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them by agitation." *U. S.*

"Chloroform, 2 *fl. ounces* (Imperial measure) or 50 cubic centimetres; Liniment of Camphor, 2 *fl. ounces* (Imp. meas.) or 50 cubic centimetres. Mix." *Br.*

A very great improvement was made in this preparation by the Committee of Revision of 1880, in the substitution of soap liniment for the olive oil. This change had been proposed in a previous edition of the Dispensatory, and it was desirable on account of the greasy residue which was left on the skin by the old preparation. The British Pharmacopœia has retained the oily vehicle. This is an excellent local application in painful affections. As the chloroform rapidly evaporates, it is desirable, in order to obtain its full anodyne effect, to guard against this by using waxed paper, or some other impermeable covering.

LINIMENTUM CROTONIS. Br.

LINIMENT OF CROTON OIL

(lĭn-ĭ-mĕn'tŭm crọ-tō'nĭs)

Liniment crotoné, *Fr.;* Krotonölliniment, *G.*

"Croton Oil, 1 *fl. ounce* (Imperial measure) or 20 cubic centimetres; Oil of Cajuput, 3½ *fl. ounces* (Imp. meas.) or 70 cubic centimetres; Alcohol (90 per cent.), 3½ *fl. ounces* (Imp. meas.) or 70 cubic centimetres. Mix." *Br.*

This is a pustulating preparation, the irritant influence of which has been increased by the substitution of the oil of cajuput and the alcohol for the olive oil of the original formula. From ten to thirty minims (0.6 to 1.9 Cc.) or more may be rubbed upon a limited surface, and repeated twice a day or oftener until an eruption is produced.

LINIMENTUM HYDRARGYRI. Br.

LINIMENT OF MERCURY

(lĭn-ĭ-mĕn′tŭm hȳ-drär′gy-rī)

Linimentum Mercuriale; Liniment mercuriel, *Fr.;* Quecksilberliniment, *G.*

"Ointment of Mercury, 1 *ounce* (Imperial) or 30 grammes; Strong Solution of Ammonia, 160 minims (Imp. meas.) or 10 cubic centimetres; Liniment of Camphor, *a sufficient quantity.* Add the Strong Solution of Ammonia to sufficient of the Liniment of Camphor to produce *one fluid ounce and a half* (Imp. meas.) or forty-five cubic centimetres; triturate the Ointment of Mercury with sufficient of the Liniment of Camphor to produce *one fluid ounce and a half* (Imp. meas.) or forty-five cubic centimetres; mix the two liquids." *Br.*

This is a stimulating liniment, employed for the discussion of chronic *glandular enlargements, swellings of the joints,* and *venereal tumors,* and to promote the absorption of fluid. It is said to be more likely to salivate than is mercurial ointment. One fluidrachm (3.7 Cc.) may be rubbed upon the affected part night and morning. It should be thoroughly agitated before being applied.

LINIMENTUM OPII. Br.

LINIMENT OF OPIUM

(lĭn-ĭ-mĕn′tŭm ō′pī-ī)

Anodyne Liniment; Liniment opiacé, *Fr.;* Opiumliniment, *G.*

"Tincture of Opium, 2 *fl. ounces* (Imperial measure) or 50 cubic centimetres; Liniment of Soap, 2 *fl. ounces* (Imp. meas.) or 50 cubic centimetres. Mix; set aside for a few days; filter." *Br.*

This is commonly called *anodyne liniment,* and is employed as an anodyne and gently rubefacient embrocation in *sprains, bruises,* and *rheumatic* or *gouty pains.* We are informed that the preparation which has been commonly used under the name of *anodyne liniment* is that of the late London Pharmacopœia, as given in former editions of the U. S. Dispensatory, consisting of one part by measure of tincture of opium and three parts of soap liniment, and consequently having only half the opiate strength of the present British liniment.

LINIMENTUM POTASSII IODIDI CUM SAPONE. Br.

LINIMENT OF POTASSIUM IODIDE WITH SOAP

(lĭn-ĭ-mĕn′tŭm pǫ-tăs′sĭ-ī ī-ŏd′ĭ-dī cŭm są-pō′nē)

Liniment savonneux ioduré, *Fr.;* Jodkalium-Seifenliniment, *G.*

"Curd Soap, recently prepared and in shavings, 2 *ounces* (Imperial) or 40 grammes; Potassium Iodide, 1½ *ounces* (Imp.) or 30 grammes; Glycerin, 1 *fl. ounce* (Imp. meas.) or 20 cubic centimetres; Oil of Lemon, 1 *fl. drachm* (Imp. meas.) or 2.5 cubic centimetres; Distilled Water, 10 *fl. ounces* (Imp. meas.) or 200 cubic centimetres. Reduce the Curd Soap to fine shreds; mix it with the Distilled Water and Glycerin in a porcelain dish on a water-bath; when the Soap is dissolved, pour the liquid into a mortar in which the Potassium Iodide has previously been powdered; mix briskly by trituration; continue the trituration until the mixture is cold; set aside for an hour; then rub well the Oil of Lemon into the cream-like product." *Br.*

This preparation is apparently intended, by application to the surface, which may be attended with a gentle friction, to produce the absorption of the iodide, and thus to obtain its alterative and deobstruent effects through the circulation. The soap and glycerin act as demulcents, and thus obviate in some measure the local irritation of the salt.[1]

LINIMENTUM SAPONIS. U. S., Br.

SOAP LINIMENT

(lĭn-ĭ-mĕn′tŭm są-pō′nĭs)

Tinctura Saponis Camphorata, *U. S.* 1850; Spiritus Nervinus Camphoratus; Liquid Opodeldoc; Camphorated Tincture of Soap; Liniment savonneux camphré, *Fr.;* Linimentum saponato camphoratum, *P. G.;* Flüssiger Opodeldok, *G.;* Linimento di sapone con canfora, *It.*

* "Soap, dried and granulated, *sixty grammes* [or 2 ounces av., 51 grains]; Camphor, in small pieces, *forty-five grammes* [or 1 ounce av., 257 grains]; Oil of Rosemary, *ten cubic centimeters* [or 162 minims]; Alcohol, *seven hundred and twenty-five cubic centimeters* [or 24 fluidounces, 247 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Add the Soap to *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of boiling Water, heat the mixture on a water-bath until a clear gelatinous mass results. Mix this, while

[1] It seems to have been clearly established by the discussion carried on in *P. J.*, 2d ser., xi., that Castile soap, and even individual brands of soap, vary so much that it is impossible to get uniform results from the former official process, the preparation sometimes being beautifully transparent and jelly-like, at other times opaque and ointment-like. Various remedies were proposed, but finally N. Smith called attention to the fact that the formula adopted by the reviewers of the Pharmacopœia differs from the original one of Rumsey. This Smith states to be as follows: "Take of White Curd Soap (made from Russian tallow) two ounces; Potassium Iodide one ounce and a half; Glycerin one ounce; Distilled Water ten ounces; Essential Oil of Lemon one drachm. Reduce the Soap into fine shreds, and melt in a water-bath, with the whole of the Water and the Glycerin; when the Soap is perfectly dissolved, pour it into a No. 9 Wedgwood mortar in which the potassium iodide has been previously reduced to fine powder; mix briskly, and continue the trituration until the mortar has become cool and the liniment assumes the character of ice-cream. Set aside for an hour, after which gently rub in the Oil of Lemon." It will be noticed that Rumsey's process has been practically adopted by the present British Pharmacopœia.

yet warm, with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, and stir it until solution is effected. Dissolve the Camphor and Oil of Rosemary in *two hundred and twenty-five cubic centimeters* [or 7 fluidounces, 292 minims] of the Alcohol by agitation in a bottle; add this solution to the warm Soap mixture; mix thoroughly, and, if necessary, add enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Set it aside in a cool place for twenty-four hours, then filter." *U. S.*

"Soft Soap, 2 *ounces* (Imperial) or 40 grammes; Camphor, 1 *ounce* (Imp.) or 20 grammes; Oil of Rosemary, 3 *fl. drachms* (Imp. meas.) or 7.5 cubic centimetres; Alcohol (90 per cent.), 16 *fl. ounces* (Imp. meas.) or 320 cubic centimetres; Distilled Water, 4 *fl. ounces* (Imp. meas.) or 80 cubic centimetres. Dissolve the Soap in the Distilled Water; dissolve the Camphor and Oil of Rosemary in the Alcohol; mix the solutions; set aside for one week; filter." *Br.*

This process is intended to furnish a saturated solution of Castile soap. The recommendation in the 16th edition of this Dispensatory, that granulated soap be used in preference to soap in shavings in this liniment, was adopted by the U. S. Pharmacopœia Eighth Revision, for powdered soap does not vary greatly in the proportion of water left in it; the process is one recommended by Geo. W. Sloan of Indianapolis, and if all the details are carefully followed it is a great improvement over that of the U. S. Pharmacopœia 1880. The improvement was made in the last revision of the U. S. P. of making a gelatinous mass of the soap by adding it to sufficient boiling water and heating it until dissolved; the soft mass easily dissolves in the alcoholic solution of the oils. The British preparation is now made with soft (potash) soap; this method was recommended by J. T. Hornblower. (*C. D.*, 1894, 571.) The liniment is said to be made more quickly and precipitation is avoided. In 1859 Dean showed that sodium oleate is freely soluble in alcohol, while the palmitate is nearly insoluble, consequently the latter salt is left behind in the old British process. Although olive oil contains a large percentage of olein, yet it has been proposed to substitute almond oil,[1] for it is still richer. The economy of this is, however, very doubtful. Castor oil has also been suggested. (*A. J. P.*, xliv. 529.) G. W. Barckhausen states that the potassa soaps are perfectly soluble in alcohol, and suggests rape seed oil as a good base. (*A. J. P.*, 1873, p. 17.)

In former editions of the U. S. Pharmacopœia, this preparation, though commonly called *Soap Liniment*, received the name of *Tinctura Saponis Camphorata*, to distinguish it from a similar preparation called *opodeldoc*, which, having a soft semi-solid consistence, held the title *Linimentum Saponis Camphoratum*.[2]

Soap liniment is much used, as an anodyne and gently rubefacient embrocation, in *sprains*, *bruises*, and *rheumatic* or *gouty pains*.

Off. Prep.—Linimentum Chloroformi, *U. S.*; Linimentum Opii, *Br.*

LINIMENTUM SAPONIS MOLLIS. U. S.

LINIMENT OF SOFT SOAP [Tincture of Green Soap]

(lĭn-ĭ-mĕn'tŭm sa-pō'nīs mŏl'lĭs)

Tinctura Saponis Viridis, U. S. P. 1880; Spiritus Saponis Kalini Hebra; Teinture de Savon vert, *Fr.*; Hebra's Seifenspiritus, *G.*

"Soft Soap, *six hundred and fifty grammes* [or 22 ounces av., 406 grains]; Oil of Lavender Flowers, *twenty cubic centimeters* [or 325 minims]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Oil of Lavender Flowers with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol, dissolve in this the Soft Soap by stirring or agitation, and set the solution aside for twenty-four hours. Then filter it through paper, adding sufficient alcohol to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is the *tincture of green soap* of Hebra under a new name; it should never have been called Tinctura Saponis Viridis, as it belongs clearly in the class of liniments and is always used externally. C. E. Smith suggested the preparation of this liniment from the fixed oil directly, which has the advantage of convenience as well as of greater uniformity of strength.[3] If a green color is desirable in this

[1] A formula for making almond oil soap on the small scale may be found in *P. J.*, 2d ser., xi. 417.

[2] *Opodeldoc.*—"Take of Common Soap, sliced, *three ounces;* Camphor *an ounce;* Oil of Rosemary, Oil of Origanum, each, *a fluidrachm;* Alcohol *a pint.* Digest the Soap with the Alcohol, by means of a sand-bath, till dissolved; then add the Camphor and Oils, and, when they are dissolved, pour the liquid into broad-mouthed bottles. This liniment has, when cold, the consistence of a soft ointment." *U. S. P.* 1850.

This preparation differs from the official Linimentum Saponis chiefly in being prepared with common white soap, made with animal fat, instead of Castile soap, which is made of olive oil. The former is peculiarly adapted to the purposes of this formula, in consequence of assuming, when its alcoholic solution cools, the consistence characteristic of the liniment. It is customary after the solution of the soap has been effected to pour the liquid into small wide-mouthed glass bottles, containing about four fluidounces, in which it concretes into a soft, translucent, uniform, yellowish-white mass. This liniment melts with the heat of the body.

[3] *Liniment of Soft Soap.*—Dissolve 75 Gm. potassium hydroxide in 200 Cc. of water, put the solution in a bottle of about 1500 Cc. capacity, add 325 Gm. linseed oil and 300 Cc. alcohol, and shake the mixture briskly for some time, until there is no further separation of oil on standing. Let the solution stand in a moderately warm place for twenty-four (to forty-eight) hours, then dissolve in it 20 Cc. oil of lavender, add enough water to make the product measure 1000 Cc., mix and filter. The process is easily finished in ten days, the main precaution to be observed being that the potassium hydroxide be neither stronger nor weaker than 90 per cent., unless allowance be made for difference in strength. Refined cotton-seed oil or olive oil may be used instead

preparation, it may be obtained by using hemp seed oil or Malaga olive oil (see *Proc. A. Ph. A.*, 1903, 420).

LINIMENTUM SINAPIS. Br.

LINIMENT OF MUSTARD

(lĭn-ị-mĕn'tŭm sị-nā'pĭs)

Liniment Sinapisé composé, *Fr.;* Zusammengesetztes Senfliniment, Senfliniment, *G.*

"Volatile Oil of Mustard, 1½ *fl. drachms* (Imperial measure) or 2 cubic centimetres; Camphor, 120 grains (Imp.) or 3 grammes; Castor Oil, 5 *fl. drachms* (Imp. meas.) or 7 cubic centimetres; Alcohol (90 per cent.), 4 *fl. ounces* (Imp. meas.) or 43 cubic centimetres. Dissolve the Camphor in the Alcohol; add the Oil of Mustard and Castor Oil; mix." *Br.*

This preparation, which was dropped from the U. S. P. (8th Rev.), may be made by the U. S. P. 1890 process;[1] it affords a convenient method of applying the volatile oil of mustard, and may often be appropriately used as a substitute for sinapisms. The extract of mezereon is also a very energetic irritant. The castor oil seems to be added in order to increase somewhat the consistence of the liniment, and was probably chosen from among oleaginous substances in consequence of its solubility in alcohol. The effect is increased if the liniment be applied on flannel, and volatilization guarded against by covering it with oiled silk. For the circumstances calling for the use of this liniment, see *Sinapis.*

LINIMENTUM TEREBINTHINÆ. U. S., Br.

TURPENTINE LINIMENT

(lĭn-ị-mĕn'tŭm tĕr-ẹ-bĭn'thị-næ)

Linimentum Terebinthinatum; Liniment of Turpentine; Liniment térébenthiné, *Fr.;* Terpentinliniment, *G.*

* "Rosin Cerate, *six hundred and fifty grammes* [or 22 ounces av., 406 grains]; Oil of Turpentine, *three hundred and fifty grammes* [or 12 ounces av., 151 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Dissolve the Rosin Cerate, previously melted in a dish on a water-bath, in the Oil of Turpentine, and mix them thoroughly." *U. S.*

"Soft Soap, 1½ *ounces* (Imperial) or 37.5 grammes; Distilled Water, 5 *fl. ounces* (Imp. meas.) or 125 cubic centimetres or a sufficient quantity; Camphor, 1 *ounce* (Imp.) or 25 grammes; Oil of Turpentine, 13 *fl. ounces* (Imp. meas.) or 325 cubic centimetres. Mix the Soft Soap with *two fluid ounces* (Imp. meas.) or fifty cubic centimetres of the Distilled Water; dissolve the Camphor in the Oil of Turpentine; gradually add the latter solution to the former, triturating until the mixture becomes a thick creamy emulsion; lastly mix with sufficient Distilled Water to produce *one pint* (Imp. meas.) or five hundred cubic centimetres." *Br.*

The U. S. preparation is the liniment originally proposed by Kentish, and subsequently so highly lauded as a remedy in *burns* and *scalds.* It should be applied as soon after the occurrence of the accident as possible, and should be discontinued when the peculiar inflammation excited by the fire is removed. The best mode of application is to cover the burnt or scalded surface with pledgets of patent lint saturated with the liniment. It should not be allowed to come in contact with the sound parts. This liniment may also be successfully applied in other cases of cutaneous inflammation requiring stimulation, as in certain conditions of *erysipelas.* The present British preparation, so far as regards its rubefacient operation, may be looked upon as almost undiluted oil of turpentine, the soft soap having little other effect than to give consistence to the liniment, and the camphor acting as an anodyne, and both being too small in bulk to dilute the oil materially. It is a very ineligible and variable preparation.

LINIMENTUM TEREBINTHINÆ ACETICUM. Br.

LINIMENT OF TURPENTINE AND ACETIC ACID

(lĭn-ị-mĕn'tŭm tĕr-ẹ-bĭn'thị-næ ạ-cĕt'ị-cŭm)

Linimentum Album; Acetic Turpentine Liniment, Stokes' Liniment; Liniment térébenthiné acétique, *Fr.;* Terpentin- und Essig-liniment, *G.*

"Oil of Turpentine, 4 *fl. ounces* (Imperial measure) or 100 cubic centimetres; Glacial Acetic Acid, 1 *ounce* (Imp.) or 25 grammes; Liniment of Camphor, 4 *fl. ounces* (Imp. meas.) or 100 cubic centimetres. Mix." *Br.*

This is a powerful rubefacient liniment, combining the irritant properties of the oil of turpentine and acetic acid, though somewhat diluted by the camphor liniment.[1] Glacial acetic acid was substituted for acetic acid in the 1885

of linseed oil without changing the proportion of potassium hydroxide, but these oils usually produce a liniment of lighter color than would be obtained from linseed oil. (*A. J. P.*, 1896, 187.)

[1] *Linimentum Sinapis Compositum, Compound Liniment of Mustard.*—"Volatile Oil of Mustard, *thirty cubic centimeters* [or 1 fluidounce, 7 minims]; Fluid Extract of Mezereum, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Camphor, *sixty grammes* [or 2 ounces av., 51 grains]; Castor Oil, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 390 minims]. Dissolve the Camphor in *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, and add the Fluid Extract of Mezereum; then add the Oil of Mustard and the Castor Oil, and, finally, enough Alcohol to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 390 minims]. Mix thoroughly." *U. S.* 1890.

[1] *St. John Long's Liniment.*—Under this name a liniment is often used which is made as follows: "Take the yolk of one egg, 5 fluidrachms of Acetic Acid, 3 fluidounces of Oil of Turpentine, 2½ fluidounces of Rose Water, and ½ fluidrachm of Oil of Lemon. Make an emulsion."

revision in equivalent proportion; the change is an improvement pharmaceutically, as it now affords a clear solution.

LINUM. U. S., Br.

LINSEED FLAXSEED

(lī'nŭm)

"The ripe seed of *Linum usitatissimum* Linné (Fam. *Linaceæ*)." *U. S.* "The dried ripe seeds of Linum usitatissimum, *Linn.*" *Br.*

Lini Semina, *Br.* (1885); Semence de Lin, *Fr. Cod.*; Grains de Lin, *Fr.*; Semen Lini, *P. G.*; Leinsamen, Flachssamen, *G.*; Lino, Semi di Lino, *It.*; Lino (Semilla de), Linaza, *Sp.*

Off. Prep.—Linum Contusum, *Br.*

LINUM CONTUSUM. Br.

CRUSHED FLAXSEED

(lī'nŭm cŏn-tū'sŭm)

"Linseed reduced to a coarse powder." *Br.*

Linum usitatissimum, Willd., *Sp. Plant.* i. 1533; *B. & T.* 39.—Common flax is an annual plant, with an erect, slender, round stem, about two feet in height, branching at top, and, like all other parts of the plant, entirely smooth. The leaves are small, lanceolate, acute, entire, of a pale-green color, sessile, and scattered alternately over the stem and branches. The flowers are terminal, and of a delicate-blue color. The calyx is persistent, and composed of five ovate, sharp-pointed, three-nerved leaflets, which are membranous on their border. The petals are five, obovate, striated, minutely scalloped at their extremities, and spread into funnel-shaped blossoms. The filaments are also five, united at the base, and the germ, which is ovate, supports five slender styles, terminating in obtuse stigmas. The fruit is a globular capsule, about the size of a small pea, having the persistent calyx at the base, crowned with a sharp spine, and containing ten seeds in distinct cells. This highly valuable plant, now almost everywhere cultivated, is said by some to have been originally derived from Egypt, by others from the great elevated plain of Central Asia. It flowers in June and July, and ripens its seed in August.[1]

The seeds are oval, oblong, flattened on both sides, with acute edges, somewhat pointed at one end, one to two lines in length, smooth, glossy, brown externally, and yellowish white within, "ovate or oblong-lanceolate, flattened, 4 or 5 Mm. long, obliquely pointed at one end; externally chestnut-brown, very smooth and glossy, covered with a transparent, mucilaginous outer wall which swells in water; embryo whitish or greenish, with two large, plano-convex and oily cotyledons, embedded in a thin perisperm; odor slight; taste mucilaginous, oily." *U. S.* They are inodorous, and have an oily mucilaginous taste. Meyer found in them fixed oil, wax, resin, extractive, tannin, gum, nitrogenous mucilage, starch, albumen, gluten, and various salts. Meurein could find no starch, but detected phosphates, which had escaped the notice of Meyer. (*J. P. C.*, 3e sér., xx. 97.) Their investing coat abounds in a peculiar gummy matter or mucilage, which is readily imparted to hot water, forming a thick viscid fluid, that lets fall white flakes upon the addition of alcohol, and affords a copious dense precipitate with lead subacetate. The viscid mucilage of linseed cannot be filtered until it has been boiled. It contains in the dry state more than 10 per cent. of mineral substances; when freed from these and dried at 110° C., it corresponds, like althæa mucilage, to the formula $C_{12}H_{20}O_{10}$. The seeds by exhaustion with cold or warm water afford of it about 15 per cent. By boiling with nitric acid, it yields crystals of mucic acid; by diluted mineral acids, it is broken up into dextrogyrate gum, sugar, and cellulose. (Kirchner and Tollens, *Ann. Ch. Ph.*, 175, 215.)

Jorissen and Hairs (*Drogues Simples*, t. ii. 685) obtained from the young plant a glucoside, to which they gave the name of *linamarin*, which crystallizes in colorless needles, melting at 134° C., without odor, but possesses a fresh and bitter taste. It differs from amygdalin in not being decomposed by emulsin, but diluted acids decompose it into sugar, hydrocyanic acid, and a third product which is volatile and possesses certain of the characters of the acetones. No benzaldehyde is formed. Linseed contains about 4 per cent. of nitrogen, corresponding to about 25 per cent. of proteid substances. After expression of the oil these substances remain in the cake, so that the latter contains 5 per cent. of nitrogen and constitutes a very important article for feeding cattle and is termed *cake meal*. In the ripe state linseed is altogether destitute of starch, though this substance is found in the immature seed in the very cells which subsequently yield the mucilage. The mucilage may be considered, as in analogous cases, to be a product of the transformation of starch. (Flückiger, *Pharmacographia*, 2d ed., p. 99.) The interior of the seed, or nucleus, is rich in a peculiar oil, which is separated by expression, and extensively employed in the arts on account of its drying properties. (See *Oleum Lini.*)

The ground seeds are found in commerce under the name of *flaxseed meal*. This is of a

[1] The linseeds in commerce have been divided by E. M. Holmes into two groups. The first group, characterized by the seeds being of sufficient size for six or seven to weigh a grain, contains Bombay, Bold Calcutta, Sicilian, and Ionian seed; in the group of small seeds (10 to 12 to the grain) are English, Dutch, Russian, and ordinary Calcutta varieties. An important practical point noticed by Holmes is that many of these seeds are apparently purposely adulterated with weed seeds, which are nearly always smaller than the linseeds, and can therefore be separated by the sieve. When linseed meal is to be made for medicinal use, this separation should always be insisted upon, as many of the weed seeds are from Cruciferæ, and are irritating. For detailed information as to varieties of linseed, weed seeds, etc., the reader is referred to Holmes's paper. (*P. J.*, July, 1881; also *N. R.*, 1881.)

dark-gray color, highly oleaginous, and when mixed with hot water forms a soft adhesive mass, much employed for luting by practical chemists. "Ground Linseed (Linseed Meal or Flaxseed meal) should be recently prepared and free from unpleasant or rancid odor. It is a grayish-yellow powder containing brownish fragments, and when exhausted by carbon disulphide should yield not less than 30 per cent. of a fixed oil, all of which is saponifiable. If 0.1 Gm. of ground Linseed be mixed with 20 Cc. of water and the mixture heated to boiling, then cooled and diluted with cold water to 100 Cc., the addition of 0.5 Cc. of iodine T.S. should not produce more than a pale blue color (limit of *starch*)." *U. S.* The average composition of linseed oil cake is thus given by Schaedler (*Technologie der Fette und Oele*, 1883): moisture, 10.56 per cent.; oil, 9.83 per cent.; non-nitrogenous fibre, 44.61 per cent.; ash, 6.5 per cent.; proteid matter, 28.5 per cent. Much of the linseed meal of commerce is simply cake meal, which was, indeed, official in the former Br. Ph., but such meal is unfit for medicinal use, not only because it contains very little oil, but also because the oil which is in it has, through rupture of the cells and partial expression, been so exposed to the air as to become rancid. Linseed meal is sometimes adulterated with corn meal, or other meals containing starch, whose presence is at once revealed by the iodine test.[1] It is sometimes found in the market adulterated with petroleum or other mineral oil, doubtless made by powerfully pressing the pure linseed meal and substituting for the linseed oil the less expensive product, petroleum. (*A. J. P.*, 1902, 31.)

Uses.—Flaxseed is demulcent and emollient. The mucilage obtained by infusing the entire seeds in boiling water, in the proportion of half an ounce to the pint, is much and very advantageously employed in *catarrh, dysentery, nephritic* and *calculous complaints, strangury,* and other inflammatory affections of the mucous membrane of the lungs, intestines, and urinary passages. By decoction, water extracts a portion of the oleaginous matter, which renders the mucilage less fit for administration by the mouth, but superior as a laxative enema. The meal mixed with hot water forms an excellent emollient poultice.

[1] The value of a sample of crushed linseed can be absolutely determined only by analysis. It should contain from 25 to 35 per cent. of oil, not more than 8 or 8.5 per cent. of husk, and less than 8 per cent. of ash. The following *test* is said to be sufficient for practical purposes: "Put half an ounce of the meal into a glass vessel, pour six ounces of boiling water over it, stir well, and allow it to stand for twelve hours. If first-class, it should absorb all the water, and show a thin scum of white glutinous liquid on the top, which will adhere closely to a glass rod or a wooden pencil dipped into it. If the meal does not absorb nearly all the water, it is of inferior quality. The amount of inferiority must be judged by the amount of water not absorbed, and by the character of the fluid on the top of the solution. If it is thin and non-glutinous, the meal is of inferior quality."

LIQUOR ACIDI ARSENOSI. U. S. (Br.)

SOLUTION OF ARSENOUS ACID

(lĭ'quŏr ăç'ĭ-dī är-sẹ-nō'sī)

"An aqueous solution, which should contain Arsenous Acid corresponding in amount to 1 percent. of arsenic trioxide [$As_2O_3 = 196.44$]." *U. S.*

Liquor Arsenici Hydrochloricus, *Br.;* Liquor Arsenici Chloridi, *U. S. P.* 1870; Hydrochloric Solution of Arsenic, Soluté d'Acide Arsénieux, *Fr. Cod.;* Liqueur de Boudin, Liqueur arsénicale hydrochlorique, *Fr.;* Chlorarsenik-Lösung, *G.*

* "Arsenic Trioxide, *ten grammes* [or 154 grains]; Diluted Hydrochloric Acid, *fifty grammes* [or 1 ounce av., 334 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Diluted Hydrochloric Acid with *two hundred and fifty grammes* [or 8 ounces av., 358 grains] of Distilled Water, in a tared porcelain dish, add the Arsenic Trioxide, and boil the mixture until the Arsenic Trioxide is dissolved. Then add enough Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces., 120 grains]. Filter through paper." *U. S.*

"Arsenious Anhydride, in powder, 87½ *grains* (Imperial) or 10 grammes; Hydrochloric acid, 2 *fl. drachms* (Imp. meas.) or 12.5 cubic centimetres; Distilled Water, *a sufficient quantity.* Heat the Arsenious Anhydride and the Hydrochloric Acid with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of Distilled Water in a one-pint (or one-litre) flask until a clear solution is obtained; cool; add sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Solution." *Br.*

This solution is stronger than the Liquor Arsenici Chloridi of the U. S. P. 1870. It contains 4.5 grains of arsenous acid in a fluidounce; the U. S. P. 1870 preparation corresponded in strength with the old British solution (4 grains in a fluidounce). The increase in strength was made in order to make the relation one that would be easy to recollect, namely, 1 per cent. by weight, and the British Pharmacopœia has wisely followed the example, so that both preparations are practically identical. The name has also been changed, as the former title was a misnomer. The hydrochloric acid does not enter into combination with the arsenic trioxide; it merely aids in its solution. The British title is, in our opinion, to be preferred, because the U. S. name does not indicate the presence of the hydrochloric acid.

Properties.—The hydrochloric solution of arsenic trioxide was first recognized by the U. S. Pharmacopœia at the revision of 1870. According to the British Pharmacopœia, it is "a colorless liquid having an acid reaction. 25 cubic centimetres diluted with *water* should discharge the color of 50.8 to 50.9 cubic centimetres of the *volumetric solution of iodine,* the

presence of a slight excess of *sodium bicarbonate* being maintained throughout the operation." "110 minims contain 1 grain of Arsenious Anhydride; 100 cubic centimetres contain 1 gramme." *Br.* The following description and test is given in the U. S. P. (8th Rev.): "A clear, colorless liquid, odorless, having an acidulous taste and an acid reaction. If to 24.6 Gm. of Solution of Arsenous Acid about 2 Gm. of sodium bicarbonate and 100 Cc. of water be added, not less than 50 Cc. of tenth-normal iodine V.S. should be required to produce a permanent yellow tint (corresponding to 1 Gm. of arsenic trioxide in 100 Gm. of the Solution)." *U. S.*

Uses.—The medicinal properties of this solution are the same as those of Fowler's solution, with which it corresponds in strength, being nearly three times as strong as the former London solution of arsenic chloride.

Dose, from two to eight minims (0.12 to 0.5 Cc.).

LIQUOR ACIDI CHROMICI. Br.

SOLUTION OF CHROMIC ACID

(lĭ'quŏr ăç'ĭ-dī çhrō'mĭ-cī)

Soluté d'Acide Chromique, *Fr. Cod.;* Chromsaurelösung, *G.*

"An aqueous solution containing the equivalent of 25 per cent. of Chromic Anhydride, CrO_3; or 29.5 per cent. of chromic acid regarded as H_2CrO_4." *Br.*

"Chromic Anhydride, 1 *ounce* (Imperial) or 25 grammes; Distilled Water, 3 *fl. ounces* (Imp. meas.) or 75 cubic centimetres. Dissolve." *Br.*

This is officially described as "an orange-red, inodorous, caustic, strongly acid liquid. Specific gravity 1.185. It should respond to the tests described under 'Acidum Chromicum.'" *Br.* It is simply a definite solution of chromic acid, and will probably be found convenient as a caustic application. (See *Chromii Trioxidum,* p. 334.) It is not used internally.

LIQUOR AMMONII ACETATIS. U. S., Br.

SOLUTION OF AMMONIUM ACETATE

[Spirit of Mindererus]

(lĭ'quŏr ăm-mō'nī-ī ăç-ē-tā'tĭs)

"An aqueous solution which should contain not less than 7 percent. of Ammonium Acetate [$CH_3.COONH_4 = 76.51$], with small amounts of acetic and carbonic acids." *U. S.*

Spiritus Mindereri; Liquor Ammoniæ Acetatis; Acétate d'Ammoniaque liquide, *Fr. Cod.;* Esprit de Mindérérus, *Fr.;* Liquor Ammonii Acetici, *P. G.;* Ammoniumacetatlösung, Essigsaure Ammoniumlösung, *G.*

• "Ammonium Carbonate, *five grammes* [or 77 grains]; Diluted Acetic Acid, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Add the Ammonium Carbonate (which should be in translucent pieces, free from white, pulverulent bicarbonate) gradually to the cold Diluted Acetic Acid, and stir until it is dissolved. This preparation should be freshly made when wanted." *U. S.*

"Ammonium Carbonate, 1 *ounce* (Imperial) or 50 grammes; Acetic Acid, Distilled Water, of each *a sufficient quantity.* Dissolve the Ammonium Carbonate in ten times its weight of Distilled Water; neutralize with Acetic Acid; add sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Solution. A little of the Solution, heated in a test-tube to expel carbonic anhydride, should be neutral or only slightly acid to *test-papers.* Solution of Ammonium Acetate should be preserved in a green glass bottle." *Br.*

This preparation is an aqueous solution of ammonium acetate.[1] The U. S. process by which it is formed involves the decomposition of ammonium carbonate by diluted acetic acid. The formula of commercial ammonium carbonate is complex, but the reaction is expressed by the following equation:

$$CO(OH)ONH_4.CO(NH_2)ONH_4 + 3(C_2H_3O_2.H) = 3(C_2H_3O_2.NH_4) + H_2O + 2CO_2$$

Distilled vinegar was formerly used, but it has been abandoned for diluted acetic acid, which is much to be preferred, because, besides furnishing a solution of the acetate of uniform strength, a result which cannot be attained by the employment of distilled vinegar, it avoids the production of a brownish solution, which uniformly follows the use of the latter, especially when it has been condensed in a metallic worm. The quantity of ammonium carbonate necessary to saturate a given weight of the acid of average strength cannot be laid down with precision, on account of the variable quality of the salt. The preparation, when made with the diluted acetic acid of the U. S. Pharmacopœia, contains about 7 per cent. of ammonium acetate. It is more convenient to add the salt to the acid than to add the acid to the salt, as the point of saturation is thus more easily attained. In ascertaining this point by test paper, the alkaline reaction will begin, though a portion of free acetic acid may still remain, a little of it being insufficient to overcome the natural alkaline reaction of the salt. A complication is caused by the presence of free carbon dioxide, which may be expelled from the liquid towards the end of the saturation by warming it. Supposing it to be free from carbon dioxide, the best rule is to cease adding the ammonium carbonate upon the occurrence of the least sign of alkalinity.

The formula of the U. S. P. 1890 differed from that formerly official in dropping what has been called the "mixed solution process,"

[1] For method of making dry ammonium acetate, see *A. J. P.*, 1875, 25. See also *A. J. P.*, 1902, 13.

and the U. S. P. (8th Rev.) has retained the 1890 process without change. It is to be regretted that the old process of saturating the diluted acetic acid with the ammonium carbonate was not entirely abandoned in the last revision and the process of mixing the solutions alone directed. The separate solutions keep well, and the rapidity and ease with which this preparation can be made by the pharmacist, by simply mixing equal measures of the solutions, are advantages which at once recommend its exclusive use, while the physician is more likely to secure a fresh preparation, and one which usually retains a quantity of carbon dioxide to render the preparation grateful to the patient.

As some pharmacists will prefer to make solution of ammonium acetate in this way, the following process, based on that of the U. S. P. 1880, is offered. Ammonium Carbonate, *one hundred grammes* [or 3 ounces av., 230 grains]; Acetic Acid, *two hundred and seventy cubic centimeters* [or 9 fluidounces, 62 minims]; Distilled Water, *one thousand seven hundred and thirty cubic centimeters* [or 58 fluidounces, 240 minims]. Dissolve the Ammonium Carbonate in *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 60 minims] of Distilled Water, and filter the solution. To the Acetic Acid add *seven hundred and eighty cubic centimeters* [or 26 fluidounces, 180 minims] of Distilled Water. Keep the solutions in separate, well-stoppered bottles, and when solution of ammonium acetate is to be dispensed measure equal quantities of each solution and mix them.

The present British process does not differ essentially from ours; in the Br. Pharmacopœia of 1864 the strong solution of ammonia was used instead of the carbonate, and the ammonia combined directly with the acetic acid, without other reaction. There was an advantage in this process in the use of ammonia instead of its carbonate, as the difficulty of ascertaining the precise point of saturation arising from carbon dioxide was avoided, but in this solution, as in the neutral mixture, a great benefit remedially is gained by the presence of carbonic acid, which reconciles the stomach to the medicine, and sometimes even allays vomiting in febrile diseases. With this view of the subject it is better to use ammonium carbonate; the change has been made in the present Br. Pharmacopœia; but the advantages are practically lost because the solution is nearly always made in advance of actual use, and official solution of ammonium acetate is rarely sparkling, but as generally dispensed it has a flat, mawkish taste quite in contrast with that made by the "mixed solution process."

Properties.—Solution of ammonium acetate, when made of pure materials, is "a clear, colorless liquid, free from empyreuma, of a mildly saline, acidulous taste, and an acid reaction. It is wholly volatilized by heat. When Solution of Ammonium Acetate is heated with potassium hydroxide T.S., ammonia is evolved. If to 5 Cc. of the Solution 1 Cc. each of sulphuric acid and alcohol be added, and the mixture boiled, the odor of acetic ether will be developed." *U. S.* When it contains an excess of alkali, its taste is bitterish. It should be freshly prepared at short intervals, as its acid becomes decomposed and a portion of ammonium carbonate is generated. When pure it is not precipitated by barium chloride. Silver nitrate precipitates crystals of silver acetate, soluble in water, and especially in nitric acid. An insoluble precipitate with this test is silver chloride, and shows the presence of hydrochloric acid. Potassium hydroxide disengages ammonia; sulphuric acid, acetous vapors.

When evaporated to dryness, the residue is wholly dissipated by heat, with the odor of ammonia. It is incompatible with acids, the fixed alkalies and their carbonates, lime water, magnesia, magnesium sulphate, corrosive sublimate, the iron, copper, and zinc sulphates, and silver nitrate. When it contains free carbon dioxide it produces with lead acetate or subacetate a precipitate of lead carbonate, which, being mistaken for the sulphate, has led to the erroneous conclusion that sulphuric acid was present in the distilled vinegar, when this has been employed. *Ammonium acetate* is a salt of difficult crystallization, and very deliquescent. When perfect it probably has an alkaline reaction, like potassium and sodium acetates. It may be obtained by sublimation from a mixture of equal parts of dry potassium or calcium acetate and ammonium chloride, or, according to Berthelot, by dissolving glacial acetic acid in ammonia, keeping the retort cool, and adding enough water to prevent the crystallization of the salt during the neutralization; the solution is then evaporated in a current of dry, gaseous ammonia until the liquid solidifies on cooling. It is then introduced into a large dish, and this placed upon caustic lime, under a large bell glass, into which a considerable quantity of ammonia gas is injected. After a few days the crystalline mass is broken, and the dish replaced as before upon lime in an ammoniacal atmosphere, under the bell glass. When this operation has been repeated several times, a perfectly pure ammonium acetate is obtained, which crystallizes in large needles, like potassium nitrate, and resembles ammonium formate; it is extremely soluble in water, and does not possess an acid reaction. (*A. J. P.*, 1875, p. 25.) It is formed by the union of one molecule of acetic acid, $H.C_2H_3O_2$, with one group, NH_4, from $NH_4.OH$, the hydroxide, or $(NH_4)_2CO_3$, the carbonate. When evaporated to dryness, however, it readily yields an acid salt, $C_2H_3O_2.NH_4 + C_2H_3O_2.H$. The molecular weight of the normal salt is about 76.5.

Uses.—Solution of ammonium acetate is a feeble diaphoretic which was formerly much employed in febrile diseases.

Dose, from half a fluidounce to a fluidounce and a half (15 to 45 Cc.) every three or four hours, mixed with water and sweetened with sugar.

Off. Prep.—Liquor Ferri et Ammonii Acetatis, *U. S.*

LIQUOR AMMONII CITRATIS. Br.

SOLUTION OF AMMONIUM CITRATE

(lĭ'quŏr ăm-mō'nī-ī cĭ-trā'tĭs)

Citrate d'Ammoniaque liquide, *Fr.;* **Ammonium-citratlösung, Citronensaure Ammoniak-Flüssigkeit,** *G.*

"Ammonium Carbonate, 1¾ *ounces* (Imperial) or 87.5 grammes or a sufficient quantity; Citric Acid, 2½ *ounces* (Imp.) or 125 grammes; Distilled Water, *a sufficient quantity.* Dissolve the Citric Acid in five times its weight of Distilled Water; neutralize with Ammonium Carbonate; add sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Solution. A little of the Solution, heated in a test-tube to expel carbonic anhydride, should be neutral or only slightly acid to *test-papers.* Solution of Ammonium Citrate should be preserved in a green glass bottle." *Br.*

This solution may be used for the same purposes as Solution of Ammonium Acetate.

Dose, from two to six fluidrachms (7.5 to 22.5 Cc.).

LIQUOR ANTISEPTICUS. U. S.

ANTISEPTIC SOLUTION

(lĭ'quŏr ăn-tĭ-sĕp'tĭ-cŭs)

Liqueur Antiseptique, *Fr.;* **Antiseptische Lösung,** *G.*

• "Boric Acid, *twenty grammes* [or 309 grains]; Benzoic Acid, *one gramme* [or 15 grains]; Thymol, *one gramme* [or 15 grains]; Eucalyptol, *one-fourth cubic centimeter* [or 4 minims]; Oil of Peppermint, *one-half cubic centimeter* [or 8 minims]; Oil of Gaultheria, *one-fourth cubic centimeter* [or 4 minims]; Oil of Thyme, *one-tenth cubic centimeter* [or 1.5 minims]; Alcohol, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Purified Talc, *twenty grammes* [or 309 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Boric Acid in *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of Water, and the Benzoic Acid in *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of Alcohol, and pour the aqueous solution into the alcoholic solution. Then dissolve, in a mortar, the Thymol in the Eucalyptol and Oils of Peppermint, Gaultheria, and Thyme; thoroughly incorporate the Purified Talc, and add, with constant trituration, the solution first prepared. Allow the mixture to stand, with occasional agitation, during forty-eight hours, filter, add *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Alcohol to the clear filtrate, and a sufficient quantity of Water to make the finished product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This solution was introduced for the first time in the U. S. P. (8th Rev.) and is largely employed.

Uses.—This liquid is a feeble antiseptic solution of pleasant taste, especially adapted for use as a mouth wash; it is also used as an application to cuts and wounds to prevent festering and aid in healing them quickly.

LIQUOR ARSENI ET HYDRARGYRI IODIDI. U. S. (Br.)

SOLUTION OF ARSENOUS AND MERCURIC IODIDES. [Donovan's Solution]

(lĭ'quŏr ăr'sẹ-nī ĕt hy-drär'gy-rī ī-ŏd'ĭ-dī)

"An aqueous solution, which should contain not less than 1 percent. of Arsenous Iodide and 1 percent. of Mercuric Iodide." *U. S.*

Liquor Arsenii et Hydrargyri Iodidi, *Br.,* **Solution of Arsenious and Mercuric Iodides; Liquor Arsenici et Hydrargyri Iodidi,** *Br.* **1867,** *U. S.* **1870; Solution of Hydriodate of Arsenic and Mercury; Solutio Donovani; Soluté d'Iodo-arsénite de Mercure, Liqueur de Donovan,** *Fr.;* **Jodquecksilber Arsenik-lösung, Donovansche Tropfen,** *G.*

• "Arsenous Iodide, *ten grammes* [or 154 grains]; Red Mercuric Iodide, *ten grammes* [or 154 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Rub the Arsenous Iodide and Red Mercuric Iodide together in a mortar, add *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of Distilled Water, and continue the trituration until solution is effected. Filter the solution, and pass sufficient Distilled Water through the filter to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Mix thoroughly." *U. S.*[1]

"Arsenious Iodide, 87½ *grains* (Imperial) or 10 grammes; Mercuric Iodide, 87½ *grains* (Imp.) or 10 grammes; Distilled Water, *a sufficient quantity.* Triturate the Arsenious Iodide and Mercuric Iodide with *three* to *four fluid ounces* (Imp. meas.) or one hundred and

[1] *Clemens's Solution.—Arsenic bromide* was introduced as a remedy in diabetes by Clemens. It is best administered in the form of a solution, which has been prepared by R. F. Fairthorne according to the following formula: "77 grains of metallic arsenic in powder are added in small portions to 240 grains of bromine, the latter being placed in a long test-tube immersed in ice-water to control the otherwise violent reaction. One hundred grains of the tribromide obtained are dissolved in sufficient distilled water to make ten fluidounces. One minim will then contain one-forty-eighth of a grain." According to Clemens, the commencing dose of such a solution is one minim three times a day, increased gradually until the equivalent of one-fifth of a grain of the salt is daily exhibited. The clinical reports in regard to this remedy in *diabetes* seem to indicate that along with a restricted diet it is occasionally of distinct service, but in the majority of instances fails to accomplish good.

fifty to two hundred cubic centimetres of the Distilled Water until nearly all is dissolved; pass through a filter; wash the latter with sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Solution. A clear pale yellow liquid with a metallic taste. It affords the reactions characteristic of mercuric salts, arsenium, and iodides. 110 minims correspond to 1 grain of Arsenious Iodide, AsI_3, and to 1 grain of Mercuric Iodide, HgI_2; 100 cubic centimetres correspond to 1 gramme of each salt." *Br.*

This solution was introduced to the notice of the medical profession in 1839 by Donovan of Dublin, as a therapeutic agent combining the medicinal virtues of its three ingredients, and was adopted as an official preparation in the U. S. and Dublin Pharmacopœias of 1850. It was dropped from the British Pharmacopœia of 1867, but reintroduced in the 1885 revision, and fortunately made to correspond in strength with the U. S. preparation,—namely, 1 per cent. of each of the active ingredients. The formula of the U. S. Pharmacopœia is the simplified one of Procter, which consists essentially in dissolving equal weights of arsenic triiodide and mercuric iodide (red iodide) in a measured quantity of distilled water.

Properties.—"A clear, colorless or pale yellowish liquid, without odor, and having a disagreeable metallic taste." *U. S.* Sometimes, however, the color is orange-yellow, owing to the presence of free iodine. This may be recombined by rubbing the solution with a little metallic mercury, or arsenic in fine powder, and the proper hue be thus restored. The solution is incompatible with laudanum and the soluble salts of morphine. The British solution has the sp. gr. 1.016.

Uses.—This preparation has been found decidedly useful as an alterative in various diseases of the skin, such as the different forms of *psoriasis, impetigo, porrigo, lepra, pityriasis, lupus,* and *venereal eruptions,* both papular and scaly. In *chronic rheumatism* and in advanced specific diseases, especially "*night pains,*" it is often useful.

Dose, from one to five minims (0.06 to 0.3 Cc.), three times a day, given preferably in distilled water.

LIQUOR ATROPINÆ SULPHATIS. Br.

SOLUTION OF ATROPINE SULPHATE

(lĭ'quŏr ăt-rŏ-pī'næ sŭl-phā'tĭs)

Soluté de Sulfate d'Atropine, *Fr.;* Schwefelsaure Atropinlösung, *G.*

"Atropine Sulphate, 17½ *grains* (Imperial) or 1 gramme; Salicylic Acid, 2 *grains* (Imp.) or 0.12 gramme; Distilled Water, 4 *fl. ounces* (Imp. meas.) or 100 cubic centimetres or a sufficient quantity. Dissolve the Atropine Sulphate and Salicylic Acid in sufficient recently boiled and cooled Distilled Water to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the solution. 110 minims contain 1 grain of Atropine Sulphate; 100 cubic centimetres contain 1 gramme." *Br.*

This solution contains 1 per cent. of atropine sulphate. Camphor water was substituted for distilled water on account of its antiseptic properties at the 1885 revision. Salicylic acid and distilled water are now used (1898) with the same object in view.

Dose, one minim (0.06 Cc.).

LIQUOR BISMUTHI ET AMMONII CITRATIS. Br.

SOLUTION OF BISMUTH AND AMMONIUM CITRATE

(lĭ'quŏr bĭs-mū'thī ĕt ăm-mō'nī-ī cĭ-trā'tĭs)

Liquor Bismuthi; Solution of Bismuth, Liquid Bismuth; Soluté de Citrate de Bismuth ammoniacal, *Fr.;* Citronensaure Wismuth-Ammoniak-Lösung, Wismuth-Ammoniakcitratlösung, *G.*

"Bismuth Oxynitrate, 613 *grains* (Imperial) or 70 grammes; Potassium Citrate, 613 *grains* (Imp.) or 70 grammes; Potassium Carbonate, 175 *grains* (Imp.) or 20 grammes; Nitric Acid, 1 *fl. ounce* (Imp. meas.) or 50 cubic centimetres; Solution of Ammonia, Distilled Water, of each *a sufficient quantity.* Dissolve the Bismuth Oxynitrate in the Nitric Acid diluted with an equal volume of Distilled Water; add Distilled Water with constant stirring until the liquid is very faintly opalescent; add the Potassium Citrate and Carbonate dissolved in a little Distilled Water; heat the liquid to the boiling point; cool; separate the precipitate; wash it with Distilled Water until free from nitrates. Gradually add Solution of Ammonia to the moist precipitate until it is just dissolved; dilute with Distilled Water to *one pint* (Imp. meas.) or one thousand cubic centimetres; filter." *Br.*

The British Pharmacopœia (1898) adopted a new process for this preparation, which is a modification of Bartlett's process. (See below.) An acid solution of bismuth is treated with a solution of potassium citrate and potassium carbonate, the precipitate washed and dissolved in solution of ammonia, and then diluted with water in proper proportions. (See *Bismuthi et Ammonii Citras,* p. 238.) For suggested improvements in manipulating this process see a paper by Cowley and Catford in *P. J.,* 1899, 604; also *Y. B. P.,* 1899, 451.

Some years since, a secret preparation was made and sold by Schacht of Clifton, England, under the name of *Liquor Bismuthi.* Ch. R. C. Tichborne, having analyzed the liquid and found it to contain bismuth oxide, ammonia, and citric acid, announced the discovery at a meeting of the Pharmaceutical Society, when Schacht, being present, acknowledged the correctness of the analysis, stating, at the same time, that he had never made a secret of the composition of his solution to medical practitioners, and that a fluidrachm of his liquid contained one grain of the trioxide. (*P. J.,*

1864, p. 301.) A formula for the preparation was given by Tichborne, which, however, on repeated trial by N. Gray Bartlett of Chicago, proved to be impracticable. After numerous experiments, Bartlett succeeded in making a solution which had all the desired qualities. (See *A. J. P.*, Jan. 1865.) He first prepares a bismuth citrate by dissolving a troyounce of bismuth subcarbonate in 720 grains of nitric acid, diluting the solution after effervescence has ceased with a fluidounce and a half of distilled water gradually introduced, and then adding this solution, slowly and with constant stirring, to another solution made by dissolving 600 grains of potassium citrate in *two pints* of distilled water. By an interchange, potassium nitrate and bismuth citrate are formed, the latter of which, being insoluble, is precipitated, and is obtained by throwing the whole upon a filter, thoroughly washing the salt with distilled water, and then drying it on bibulous paper with a gentle heat. The next step is to prepare the bismuth and ammonium citrate. This is done by rubbing the bismuth citrate with sufficient distilled water to make a paste, and adding to this gradually, and with constant trituration, stronger ammonia water until the citrate is dissolved, care being taken to avoid an excess of ammonia. The solution is now filtered, and spread on glass to dry.

Various modifications of Bartlett's process have been suggested, though it may be doubted whether any one of them, on the whole, is preferable to the original. Besides the processes offered by T. P. Blunt and Tichborne, in England, A. E. Ebert and Markoe have each proposed a modification of Bartlett's process. (See *A. J. P.*, 1866, p. 1, and 1869, p. 151.) In Ebert's formula the solution of bismuth nitrate is decomposed by potassium hydroxide in the presence of citric acid, instead of the potassium citrate already formed; in Markoe's, crystallized sodium carbonate is substituted for the caustic alkali, to which various objections exist. After precipitating the solution of bismuth nitrate to which citric acid has been added, with sodium carbonate, washing the precipitate to get rid of the sodium nitrate, and dissolving the residue of the precipitate in ammonia water, Markoe completes the process by determining the proportion of bismuth trioxide contained in the solution, and then diluting the liquid so that each fluidrachm shall contain one grain of trioxide. For other methods of making this solution, see 17th ed. U. S. D., 794.

The British Pharmacopœia describes this preparation as "a colorless solution, with a slightly metallic taste. Specific gravity 1.070. Slightly alkaline to *test-paper;* is freely miscible with *water;* heated with alkalies evolves ammonia, and yields a white precipitate. Evaporated to dryness and the product ignited, a residue with a yellow edge results, which when suitably treated should not yield any reaction characteristic of silver, lead, copper, arsenium, iron, selenium, or tellurium. A mixture of 10 cubic centimetres of the Solution with 40 cubic centimetres of *water,* treated with *hydrogen sulphide* in excess, yields a black precipitate, which, when washed and dried, should weigh at least 0.55 gramme. 1 fluid drachm contains an amount of bismuth equivalent to about 3 grains, or 1 cubic centimetre the equivalent of 0.5 gramme, of Bismuth Oxide." *Br.*

Bismuth and ammonium citrate, obtained by Bartlett's process, is in fine, glossy, translucent, colorless scales, of a slightly acidulous, somewhat metallic, not disagreeable taste, very soluble in water, but not deliquescent, and of an acid reaction. (See page 238.) From an analysis by Bartlett, it appears to possess the formula $Bi,C_6H_5O_7.NH_3 + 3H_2O$. Rother, however (1876), considers that the formula should be written $C_6H_5O_7(NH_4)_3Bi(OH)_3$.

There is no occasion for a permanent solution of this salt, as it may at any time be dissolved when wanted for use. But, as it is in the liquid form that it has obtained its present reputation, we give a formula for a permanent solution prepared by Bartlett. Dissolve 260 grains of bismuth and ammonium citrate in fourteen fluidounces of distilled water, neutralize the solution with ammonia water, and add two fluidounces of alcohol. The solution of the salt without addition is liable to spontaneous decomposition, but, in the opinion of Bartlett, it is completely protected by the ammonia and alcohol, so that in this state it will keep indefinitely.

Uses.—This preparation is much more astringent than are the insoluble salts of bismuth, and is at the same time irritant, and not possessed of the peculiar medicinal properties which grow out of insolubility of the subnitrate or subcarbonate. It is, therefore, not a substitute for these, and is adapted to the treatment of *diarrhœas* of relaxation rather than of irritation.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR CALCIS. U. S., Br.

LIME WATER SOLUTION OF CALCIUM HYDROXIDE

(lĭ'quŏr căl'cĭs)

"A saturated aqueous solution, which should contain not less than 0.14 percent. of pure Calcium Hydroxide [$Ca(OH)_2 = 73.56$]. The percentage of Calcium Hydroxide varies with the temperature at which the saturated solution is prepared, being about 0.17 percent. at 15° C. (59° F.), the percentage diminishing as the temperature rises." *U. S.*

Aqua Calcariæ Ustæ, Calcaria Soluta, Aqua Calcis; Solution of Calcium Hydrate, Solution of Lime; Eau (Soluté) de Chaux, *Fr. Cod.;* Aqua Calcariæ, *P. G.;* Kalkwasser, *G.;* Acqua di calce, *It.;* Agua de cal, *Sp.*

* "Lime, *twelve grammes* [or 185 grains]; Distilled Water, *a sufficient quantity.* Slake

the Lime by the very gradual addition of *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Distilled Water, and agitate occasionally during half an hour. Allow the suspended particles to subside, decant the supernatant liquid and reject it. Then add to the residue *thirty-six hundred cubic centimeters* [or 121 fluidounces, 350 minims] of Distilled Water, agitate thoroughly, let the mixture stand for twenty-four hours, agitate again, then let the coarser particles of solid matter subside, and pour the liquid, holding the undissolved calcium hydroxide in suspension, into a glass-stoppered bottle. From time to time shake the bottle, so as to keep the solution saturated. Pour off the clear liquid when required for use." *U. S.*

"Calcium Hydroxide, 2 *ounces* (Imperial) or 50 grammes; Distilled Water, *a sufficient quantity.* Wash the Calcium Hydroxide with Distilled Water until free from chlorides; then shake it with *one gallon* (Imp. meas.) or four litres of Distilled Water in a stoppered green glass bottle for two or three minutes; set aside for twelve hours. The clear Solution may be drawn off with a siphon as it is required for use, and should then be transferred to a green glass bottle." *Br.*

A solution of calcium hydroxide, $Ca(OH)_2$, in water is the result of these processes. By the slaking of the lime it is reduced to powder, and rendered more easily diffusible through the water. According to both Pharmacopœias, the solution is to be kept in bottles with a portion of undissolved hydroxide, which causes it always to be saturated whatever may be the temperature and to whatever extent it may be exposed to the air. If care be taken to have a considerable quantity of the solution in the bottle, and to avoid unnecessary agitation, the upper portion will always remain sufficiently clear for use. The employment of distilled water as the solvent may seem a useless refinement, but in many places the common water is very impure. Water dissolves but a minute proportion of lime, and, contrary to the general law, less when hot than when cold. Hence the propriety of employing cold water in the process. According to Phillips, a pint of water (the wine pint of the U. S. P. 1870) at 212° F. dissolves 5.6 grains of lime, at 60° F. 9.7 grains. For Green's automatic device for dispensing lime water in excellent condition, see *Proc. A. Ph. A.*, 1893, 474; see also 1904, 66.

The practice of using the undissolved lime indefinitely by refilling the bottle with water, is reprehensible, as notwithstanding the excess, its tendency to become carbonated and insoluble is great, and lime water is often dispensed deficient in strength; it is much safer to use the lime but once or twice than to run the risk of dispensing a liquid of insufficient strength.

Properties.—Lime water is "a clear, colorless liquid without odor, and having an alkaline taste. It absorbs carbon dioxide from the air, a pellicle of calcium carbonate forming on the surface of the liquid. On being heated it becomes turbid, due to the separation of calcium hydroxide which redissolves when the liquid is cooled. It gives a strongly alkaline reaction with red litmus paper. The alkaline reaction of the Solution should entirely disappear, after it has been saturated with carbon dioxide, and subsequently boiled (absence of *alkalies* and their *carbonates*). In other respects it should conform to the reactions and tests for an aqueous solution of lime given under *Calx.* Fifty Cc. should require, for complete neutralization, not less than 19 Cc. of tenth-normal sulphuric acid V.S. (corresponding to about 0.14 percent. of calcium hydroxide), phenolphthalein T.S. being used as indicator." *U. S.* Exposed to the air it attracts carbon dioxide, and becomes covered with a pellicle of insoluble calcium carbonate, which, subsiding after a time, is replaced by another, and so on successively until the whole of the lime is exhausted. Hence the necessity of keeping lime water either in closely corked bottles which should be full, or, what is more convenient, in bottles with an excess of lime. "24 cubic centimetres should require for neutralization 10 cubic centimetres of the *decinormal volumetric solution of sulphuric acid.* It should yield no characteristic reaction with the tests for lead or for chlorides. 1 fluid ounce contains the equivalent of about ½ grain, or 1000 cubic centimetres rather more than 1 gramme, of Lime, CaO." *Br.*

Uses.—Lime water is antacid, tonic, and astringent, often very useful in *dyspepsia* with acidity of stomach, *diarrhœa* and *diabetes.* Mixed with from one to three measures of milk, which completely covers its offensive taste, it is one of the best remedies in our possession for *nausea* and *vomiting* dependent on irritability of stomach. In severe repeated vomiting with loss of digestive power a diet exclusively of lime water and milk (one to six) is often very effectual. Having been found to possess the property of dissolving false membrane, it has naturally been employed as a local remedy in *pseudo-membranous croup.* There are two methods of applying the remedy; one by directing lime water spray, produced by the atomizer, so that it shall be inhaled by the patient; the other by causing the patient to inhale freely the vapors arising from lime undergoing the process of slaking with water. When employed to allay *nausea,* it is usually given in the dose of a tablespoonful mixed with the same quantity of milk, and repeated at intervals of half an hour, an hour, or two hours. If too long continued it debilitates the stomach. The urine of persons who take large quantities of lime water is often alkaline, and sometimes distinctly ammoniacal. According to the researches of John J. Abel, this is due to the presence in the urine of calcium carbamate, which is prone to undergo ammoniacal disintegration.

Dose, one to four fluidounces (30 to 120 Cc.).

Off. Prep.—Linimentum Calcis, *U. S., Br.;* Lotio Hydrargyri Flava, *Br.;* Lotio Hydrargyri Nigra, *Br.;* Mucilago Acaciæ, *U. S.*

LIQUOR CALCIS CHLORINATÆ. Br.

SOLUTION OF CHLORINATED LIME

(lĭ'quŏr căl'cĭs ȼhlō-rĭ-nā'tæ)

Soluté d'Hypochlorite de Chaux, *Fr. Cod.;* Chlorure de Chaux liquide, *Fr.;* Chlorkalklösung, Chlorkalk-Flüssigkeit, *G.*

"Chlorinated Lime, 1 *pound* (Imperial) or 500 grammes; Distilled Water, 1 *gallon* (Imp. meas.) or 5 litres. Mix; transfer the mixture to a stoppered bottle; set aside for three hours, shaking occasionally; filter through calico. Preserve the filtrate in a stoppered bottle in a cool, dark place." *Br.*

For the properties and uses of this preparation, see *Calx Chlorinata.* The British Pharmacopœia gives the following test of its strength: "Specific gravity about 1.055. Each gramme mixed with 0.5 gramme of *potassium iodide* dissolved in *water,* when acidulated with 1 cubic centimetre of *hydrochloric acid,* gives a brownish-red solution which requires for the discharge of its color not less than 5.6 cubic centimetres of the *volumetric solution of sodium thiosulphate,* corresponding to 2 per cent. of available chlorine. The Solution should yield, when fresh, about 3 per cent. of available chlorine." *Br.* This determines its strength in chlorine, by ascertaining the quantity of iodine which the chlorine contained in it is capable of separating from potassium iodide. Notwithstanding, however, that a test of its character is thus given by the Pharmacopœia, its strength must vary according to the quality of the chlorinated lime employed. It is one of the best antidotes for hydrogen sulphide, ammonium sulphydrate, potassium sulphide, and hydrocyanic acid. For external application the solution may be diluted with twice its bulk of water, or may be used of the full strength in some cutaneous affections.

Dose, for internal use, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.).

LIQUOR CALUMBÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF CALUMBA

(lĭ'quŏr cą-lŭm'bæ cŏn-cĕn-trā'tŭs)

"Calumba Root, in No. 5 powder, 10 *ounces* (Imperial) or 500 grammes; Alcohol (90 per cent.), 4½ *fl. ounces* (Imp. meas.) or 225 cubic centimetres; Distilled Water, 20 *fl. ounces* (Imp. meas.) or 1000 cubic centimetres or a sufficient quantity. Macerate the Calumba for twenty-four hours with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of Distilled Water, press strongly; again macerate the residue for twenty-four hours with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of Distilled Water; press strongly. Mix the expressed liquids, and heat for five minutes at 180° F. (82.2° C.). When cold add the Alcohol; set aside; decant or filter, adding sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Concentrated Solution." *Br.*

This was a new preparation of the last British Pharmacopœia. It should, in our opinion, be named "*Infusum Calumbæ Concentratum,*" as it is nothing more than a concentrated infusion preserved with alcohol, and intended to be used by the pharmacist for the quick preparation of the infusion of calumba by dilution with water. It is ten times as strong as the ordinary infusion.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR CAOUTCHOUC. Br.

SOLUTION OF INDIA-RUBBER

(lĭ'quŏr caŏut'chŏuc)

"India-rubber, 1 *ounce* (Imperial) or 50 grammes; Benzol, 10 *fl. ounces* (Imp. meas.) or 500 cubic centimetres; Carbon Bisulphide, 10 *fl. ounces* (Imp. meas.) or 500 cubic centimetres. Cut the India-rubber into fine shreds, and place it in a well-stoppered bottle containing the previously mixed Benzol and Carbon Bisulphide. Set aside in a cool place, and agitate occasionally until solution is effected." *Br.*

This solution is an improvement on the solution of gutta-percha formerly official; it was introduced into the Br. Pharm. (1898) mainly for use in the preparation of mustard paper. It may be used like collodion as an external protective application.

Off. Prep.—Charta Sinapis, *Br.*

LIQUOR CHIRATÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF CHIRETTA

(lĭ'quŏr ȼhĭ-rā'tæ cŏn-cĕn-trā'tŭs)

"Chiretta, in No. 40 powder, 10 *ounces* (Imperial) or 500 grammes; Alcohol (20 per cent.), 25 *fl. ounces* (Imp. meas.) or 1250 cubic centimetres or a sufficient quantity. Moisten the Chiretta with *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of the Alcohol; pack in a closed percolator; set aside for three days; percolate with the remaining Alcohol, added in ten equal portions at intervals of twelve hours; continue percolation with more Alcohol until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This is a "concentrated" infusion of the Br. Ph. 1898, intended to be used by the pharmacist for making the ordinary infusion of chiretta by dilution with water. It is twenty times as strong as the infusion of chiretta, Br. Ph. 1885.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR CHLORI COMPOSITUS. U. S.

COMPOUND SOLUTION OF CHLORINE, CHLORINE WATER [To replace Aqua Chlori, Pharm. 1890]

(lĭ'quŏr ĉhlō'rī cŏm-pŏs'ĭ-tŭs)

"An aqueous solution, containing, when freshly prepared, about 0.4 percent. of Chlorine [Cl = 35.18], with some oxides of chlorine and potassium chloride." *U. S.* "Produced by saturating Distilled Water with chlorine. The chlorine may be obtained by the interaction of Hydrochloric Acid and Manganese Peroxide, and should be purified by passing through a small quantity of water contained in a wash-bottle." *Br. Appendix.*

Solution of Chlorine, *Br.;* Aqua Chlorini, U. S. P. 1870; Aqua Chlori, Chlorum Solutum, Aqua Oxymuriatica; Soluté de Chlore composé, Eau Chlorée, Chlore liquide, *Fr.;* Aqua Chlorata, *P. G.;* Zusammengesetzte Chlorlösung, Chlorwasser, *G.;* Acqua di cloro, *It.;* Agua de cloro, *Sp.*

* "Potassium Chlorate, granulated, *five grammes* [or 77 grains]; Hydrochloric Acid, *eighteen cubic centimeters* [or 292 minims]; Distilled Water, *a sufficient quantity,* to make about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Add the Hydrochloric Acid, diluted with *twenty cubic centimeters* [or 325 minims] of Distilled Water, to the Potassium Chlorate contained in a flask of the capacity of about *two thousand cubic centimeters* [or 67 fluidounces, 301 minims]. Insert in the flask a stopper perforated to admit a funnel of the capacity of about *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] containing about *ten grammes* [or 154 grains] of purified cotton well wetted with cold water; place the flask on a water-bath containing boiling water, for a period of from two to three minutes; when the flask is completely filled with a greenish-yellow gas, remove it from the bath and add cold Distilled Water through the cotton in the funnel, in two separate portions of *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] each. After the addition of each separate portion of cold Distilled Water, stopper the flask securely, invert, and thoroughly agitate the contents. This solution should be freshly made when wanted." *U. S.*

In the U. S. P. (8th Rev.) the old process for making chlorine water was dismissed and the present process introduced under the name of *Liquor Chlori Compositus.* This contains besides chlorine some chlorine dioxide and a little potassium chloride, and it has been classed with the "Liquors." The reaction is as follows:

$$2KClO_3 + 4HCl = 2KCl + 2H_2O + 2ClO_2 + Cl_2$$

The process of the U. S. P. 1890 is appended.[1] Compound solution of chlorine can be used when chlorine water is directed or prescribed in all cases, except in some delicate chemical tests; its advantages lie chiefly in the greater ease and simplicity of the process.

Properties.—Chlorine water of the U. S. P. 1890 was described as "a clear, greenish-yellow liquid, having the suffocating odor and disagreeable taste of Chlorine, and leaving no residue on evaporation. It instantly decolorizes dilute solution of litmus, indigo, and other vegetable coloring matters. When shaken with an excess of mercury until the odor of Chlorine has disappeared, the remaining liquid should be at most but faintly acid (limit of *hydrochloric acid*). On adding 17.7 Gm. of Chlorine Water

[1] *Aqua Chlori, Chlorine water,* U. S. 1890.—"Manganese Dioxide, *ten grammes* [or 154 grains]; Hydrochloric Acid, *thirty-five cubic centimeters* [or 1 fluidounce, 88 minims]; Water, *seventy-five cubic centimeters* [or 2½ fluidounces]; Distilled Water, *four hundred cubic centimeters* [or 13½ fluidounces]. Place the Dioxide in a flask connected by a suitable tube with a small wash-bottle containing *fifty cubic centimeters* [or 1½ fluidounces] of Water, and connect this with a bottle having a capacity of *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and containing *four hundred cubic centimeters* [or 13½ fluidounces] of Distilled Water which has previously been boiled and allowed to cool. Add to the Dioxide in the generating flask the Hydrochloric Acid, previously diluted with *twenty-five cubic centimeters* [or 1 fluidounce] of Water, and, by means of a sand-bath, apply a gentle heat. Conduct the generated Chlorine through the Water contained in the wash-bottle into the bottle containing the Distilled Water, which should be loosely stopped with cotton and kept, during the operation, at a temperature of about 10° C. (50° F.). When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating, until the Distilled Water is saturated. Finally, pour the Chlorine Water into small, dark amber-colored, glass-stoppered bottles, which should be completely filled therewith, and keep them in a dark and cool place. Chlorine Water, even when kept from light and air, is apt to deteriorate. When it is required of full strength, it should be freshly prepared." *U. S.* 1890.

The chlorine gas is extricated from the hydrochloric acid by the manganese dioxide, while the manganous chloride and water produced remain in the flask, and the chlorine is passed, through an intermediate vessel containing a little water for purifying it, into the bottle containing the distilled water, loosely stoppered, until the vacant part of the bottle is filled with it to the exclusion of the atmospheric air.

$$MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$$

The bottle, being then corked, is shaken so as to cause the absorption of the gas by the water. Of course the stopper must be from time to time loosened, in order to allow the entrance of air to supply the partial vacuum created by the absorption of the chlorine. The chlorine water is directed to be kept secluded from the light, because otherwise it would be converted into hydrochloric acid, through the union of the chlorine with the hydrogen of the water.

Deacon's process.—Henry Deacon has discovered that chlorine may be made by passing hydrochloric acid vapor and oxygen over copper sulphate at a temperature of from 400° to 700° F., the copper salt coming out unchanged. For details of this process the reader is referred to *Roscoe* and *Schorlemmer's Chemistry,* vol. i. p. 114.

to a solution of 1 Gm. of potassium iodide in 10 Cc. of water, the resulting deep-red liquid should require for complete decoloration not less than 20 Cc. of sodium hyposulphite decinormal volumetric solution (corresponding to at least 0.4 per cent. of Chlorine)." *U. S.* 1890. Like gaseous chlorine, it destroys vegetable colors. When cooled to about the freezing point, it forms deep yellow crystalline plates, consisting of chlorine hydrate. It is intended to contain at least twice its volume of the gas. According to Riegel and Walz, chlorine water containing two and a half volumes of the gas at 12.2° C. (54° F.) keeps best. The official test indicates the quantity of chlorine in the solution, by the amount of the hyposulphite required to decolorize an equivalent quantity of iodine, liberated from the potassium iodide. Chlorine water decomposes on keeping, and both Pharmacopœias direct that "it should be recently prepared." In view of the unstable properties of chlorine water, liquid chlorine in sealed glass tubes (each containing five grammes) can be procured in commerce, the contents of one tube being sufficient to prepare a litre of the water.

Chlorine is an elementary gaseous fluid of a greenish-yellow color and characteristic odor and taste. It is a supporter of combustion. Its specific gravity is 2.47, and its atomic weight 35.18. When the attempt is made to breathe it, even much diluted, it excites cough and a sense of suffocation, and causes a discharge from the mucous membrane of the nostrils and bronchial tubes. Breathed in considerable quantities, it produces spitting of blood, violent pains, and sometimes death.

Uses.—Chlorine water has been employed internally in *typhus, scarlatina, malignant sore throat,* and *diphtheria,* but has fallen into complete desuetude. Externally it is employed, duly diluted, as a gargle in *small-pox, scarlatina,* and putrid *sore throat,* as a wash for ill-conditioned *ulcers* and *cancerous sores,* and as a local bath in *diseases of the liver.* It has been used with advantage as an application to *buboes* and large *abscesses.* As it depends upon chlorine for its activity, its medicinal properties coincide with those of chlorinated lime and chlorinated soda, under which heads they are more particularly given. It should not be prescribed in mixtures, almost all organic substances causing a rapid disappearance of the chlorine. Even sugar has this action, and glycerin still more markedly.

Gaseous chlorine has been employed in *chronic bronchitis* and *pulmonary consumption,* exhibited by inhalation, in minute quantities, four or six times a day. It has been asserted that its first effect is to produce some dryness of the fauces, with increased expectoration for a time, followed ultimately by diminution of the sputa and by amendment. The liquid in the inhaler may be formed either of water containing from ten to thirty minims (0.6 to 1.8 Cc.) of chlorine water, or of chlorinated lime dissolved in forty parts of water, to which a drop or two of sulphuric acid must be added, each time the inhalation is practised. The inhaler should be placed in water heated to about 37.7° C. (100° F.).

Dose, of chlorine water, one to four fluidrachms (3.75 to 15 Cc.).

LIQUOR CRESOLIS COMPOSITUS. U. S.

COMPOUND SOLUTION OF CRESOL

(lĭ'quŏr crē-sō'lĭs cŏm-pŏs'ĭ-tŭs)

Soluté de Crésol composé, *Fr.;* Liquor Cresoli saponatus, *P. G.;* Kresolseifenlösung, *G.*

* "Cresol, *five hundred grammes* [or 17 ounces av., 279 grains]; Linseed Oil, *three hundred and fifty grammes* [or 12 ounces av., 151 grains]; Potassium Hydroxide, *eighty grammes* [or 2 ounces av., 360 grains]; Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Dissolve the Potassium Hydroxide in *fifty grammes* [or 1 ounce av., 334 grains] of Water in a tared dish, add the Linseed Oil, and mix thoroughly. Then add the Cresol and stir, until a clear solution is produced, and finally sufficient Water to make the finished product weigh *one thousand grammes* [or 35 ounces av., 120 grains]." *U. S.*

Compound Solution of Cresol was introduced into the U. S. P. (8th Rev.) to supply the demand for an antiseptic solution which mixes freely with water. With some samples of cresol there has been experienced some difficulty in securing immediately a clear solution, showing that combination has not been effected, but by allowing the mixture to stand, with occasional stirring, the solution will become clear. LaWall and Cook (*A. J. P.,* 1906, 169) suggest a modification of the manipulation which secures a clear solution immediately; it is as follows: "Heat the linseed oil (350 grammes) in a deep capacious vessel, on a water bath, to a temperature of about 70° C. Dissolve the potassium hydroxide (80 grammes) in 450 Cc. of water, warm the solution to about 70° C., add it to the linseed oil and mix thoroughly. Then incorporate 40 Cc. of alcohol and continue the heat without stirring until a small portion of the mixture is found to be soluble in boiling water without the separation of oily drops. The soap, thus prepared, is now dissolved in 500 grammes of cresol and a sufficient quantity of water added to make the solution weigh 1000 grammes."

Uses.—This solution is intended as a substitute for the many commercial preparations of cresol on the market. Although it forms a clear solution with distilled water, with tap water it becomes cloudy, owing to precipitation of lime soaps. This change, however, does not appear to interfere with its therapeutic properties. It is a powerful germicidal mixture, surpassing phenol as a destroyer of micro-organisms. It is also less caustic than

phenol, but the statement that it is much less poisonous has been shown to be untrue. It is especially useful for sterilizing instruments and the skin, its soapy nature making it peculiarly valuable for the latter purpose. It may be diluted with from 30 to 90 times its bulk of water (3 per cent. to 1 per cent. solution). It has been used to a small extent internally as an antiseptic in fermentative gastritis.

Dose, one to two minims (0.06 to 0.12 Cc.).

LIQUOR CUSPARIÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF CUSPARIA

(lĭ′quŏr cŭs-pā′rĭ-æ cŏn-cĕn-trā′tŭs)

"Cusparia Bark, in No. 40 powder, 10 *ounces* (Imperial) or 500 grammes; Alcohol (20 per cent.), 25 *fl. ounces* (Imp. meas.) or 1250 cubic centimetres or a sufficient quantity. Moisten the Cusparia with *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of the Alcohol; pack in a closed percolator; set aside for three days; percolate with the remaining Alcohol, added in ten equal portions at intervals of twelve hours; continue percolation with more Alcohol until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This is a concentrated infusion of the Br. Pharm. 1898, intended to be used by the pharmacist for making infusion of cusparia by dilution with water. It is ten times as strong as the infusion of cusparia (Br. Pharm. 1885).

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR EPISPASTICUS. Br.

BLISTERING LIQUID

(lĭ′quŏr ĕp-ĭ-spăs′tĭ-cŭs)

Linimentum Cantharidis; Liqueur Vésicant, Huile de Cantharides térébenthinée, *Fr.;* **Spanischfliegenliniment, Blasenziehende Flüssigkeit,** *G.*

"Cantharides, in No. 20 powder, 10 *ounces* (Imperial) or 500 grammes; Acetic Ether, *a sufficient quantity.* Mix the Cantharides with *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of Acetic Ether; pack in a percolator; at the expiration of twenty-four hours pour Acetic Ether over the contents of the percolator; allow the solution to pass slowly through until *one pint* (Imp. meas.) or one thousand cubic centimetres of the Liquid is obtained. This preparation is twice the strength of the Blistering Liquid of the British Pharmacopœia of 1885." *Br.* This liquid is used in making the British Blistering Collodion. (See p. 386.)[1] Greenish and Wilson propose that the official blistering liquid be prepared by the following formula: Cantharidin, 1 part; castor oil, 6 parts; rosin 3 parts; acetic ether, enough to make 300 fluid parts. The castor oil and rosin are added to replace the natural fat of the cantharides, and are necessary to aid the absorption of the cantharides by the skin. (*P. J.*, 1898, 259.)

Off. Prep.—Collodium Vesicans, *Br.*

LIQUOR ETHYL NITRITIS. Br.

SOLUTION OF ETHYL NITRITE

(lĭ′quŏr ē′thĭl nī-trī′tĭs)

"A mixture of ninety-five parts by volume of Absolute Alcohol with five parts by volume of Glycerin, containing when freshly made 3 per cent. by weight, and even when long kept not less than 2½ per cent. by weight of ethyl nitrite. The ethyl nitrite is obtained by the interaction of alcohol (90 per cent.), sodium nitrite, and diluted sulphuric acid, at a low temperature." *Br.*

Soluté de Nitrite d'Ethyle, *Fr.;* **Aethylnitritlösung,** *G.*

This was a new official preparation in the Br. Ph. 1898; it might be called improved spirit of nitrous ether; it is difficult to explain the reason for its introduction without the dismissal of spirit of nitrous ether; the strength is very slightly greater than that of the spirit, and a choice should be made between them. The addition of glycerin as a preservative, and the substitution of absolute alcohol for rectified spirit, are relied upon to make a permanent solution. This method was proposed by Dunstan and Dymond (*P. J.*, 1888, 861), who believe that ethyl nitrite is the *sole* valuable constituent in spirit of nitrous ether; glycerin prevents loss of the very volatile ethyl nitrite, while the absence of water is secured by the use of absolute alcohol, water in the alcohol being shown to be the principal cause of decomposition and loss of ethyl nitrite. Solution of ethyl nitrite was strongly recommended by Leech, and the advantage claimed for it is that it is free from aldehyde. The increased cost, due to the use of absolute alcohol, will be apt to prevent the extensive use of the Solution. It is described as "a limpid liquid, practically colorless, of characteristic apple-like odor and taste. It is highly inflammable. Specific gravity 0.823 to 0.826. When Solution of Ethyl Nitrite is poured on an acidulated strong solution of *ferrous sulphate* contained in a test-tube, a deep olive-brown coloration is produced at the surface of contact of the two

[1] Very nearly corresponding to this preparation is the *Linimentum Cantharidis,* or *Cantharides Liniment,* of the U. S. P. 1880. Made according to the formula, it is a very active counter-irritant, when too freely applied producing deep vesication. "Cantharides, in No. 60 powder, *fifteen parts* [or one ounce av.]; Oil of Turpentine, *a sufficient quantity,* to make *one hundred parts* [or half a pint]. Digest the Cantharides with *one hundred parts* [or half a pint] of Oil of Turpentine in a closed vessel, by means of a water-bath, for three hours; then strain and add enough Oil of Turpentine through the strainer to make the Liniment weigh *one hundred parts* [or measure half a pint]." *U. S.* 1880.

liquids, widening as the tube is gently shaken. The Solution should not effervesce when shaken carefully with *sodium bicarbonate* (absence of acid). 10 cubic centimetres, mixed with 5 cubic centimetres of the *volumetric solution of sodium hydroxide* and 5 cubic centimetres of *water,* should not assume a yellow color (absence of aldehyde). 1 volume, agitated briskly at intervals during five minutes in a brine-charged nitrometer with 1 volume of *solution of potassium iodide* and 1 volume of *diluted sulphuric acid,* should yield, at the ordinary temperature (60° F. or 15.5° C.) and pressure (30 inches or 760 millimetres of mercury), and when freshly prepared, at least 7.6 volumes of nitric oxide gas; and even after the Solution has been kept for some time, and the vessel containing it has occasionally been opened, it should possess at least five-sixths of the strength just indicated. Solution of Ethyl Nitrite should be stored in small bottles." *Br.* This preparation affords a means of giving ethyl nitrite internally.

Dose, from twenty to sixty minims (1.3 to 3.75 Cc.). (See *Spiritus Ætheris Nitrosi.*)

LIQUOR FERRI ACETATIS. Br.

SOLUTION OF FERRIC ACETATE

(lĭ'quŏr fĕr'rī ăç-ē-tā'tĭs)

Solution of Acetate of Iron; Solution of Peracetate of Iron; Liquor Ferri Acetici; Liqueur d'Acétate de Fer, Acétate Ferrique liquide, *Fr.;* Ferriacetatlösung, Essigsaure Eisen-Flüssigkeit, *G.*

"Solution of Ferric Sulphate, 2½ *fl. ounces* (Imperial measure) or 125 cubic centimetres; Solution of Ammonia, 4 *fl. ounces* (Imp. meas.) or 200 cubic centimetres or a sufficient quantity; Glacial Acetic Acid, liquefied, 1½ *fl. ounces* (Imp. meas.) or 75 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Solution of Ammonia with *one pint* (Imp. meas.) or one litre of Distilled Water; gradually add to this the solution of Ferric Sulphate diluted with *one pint* (Imp. meas.) or one litre of Distilled Water; stir well together, taking care that ammonia is, even finally, in slight excess, as indicated by the odor of the mixture; let the whole stand for two hours, stirring occasionally; transfer it to a calico filter; wash the precipitated ferric hydroxide with Distilled Water until free from sulphates; let it drain; squeeze it to remove superfluous moisture; dissolve it in the Glacial Acetic Acid; make the volume up to *one pint* (Imp. meas.) or one litre with Distilled Water; allow any insoluble matter to subside; pour off the clear Solution." *Br.* The U. S. P. (8th Rev.) very properly dismissed this solution as it is very rarely used in America and it is not a stable preparation of iron. The U. S. 1890 process is appended.[1]

[1] *Liquor Ferri Acetatis, Solution of Ferric Acetate.*—"An aqueous solution of Ferric Acetate [$Fe_2(C_2H_3O_2)_6 = 464.92$], containing about 31 per cent. of the anhydrous salt, and corresponding to about 7.5 per cent. of metallic iron." *U. S.* 1890.

The formula of this preparation is practically identical with that of the solution of iron acetate of the former German Pharmacopœia. The British process consists in first forming ferric hydroxide, by precipitating a solution of ferric sulphate with ammonia water, washing and draining the precipitate, and finally dissolving it in glacial acetic acid. The solution is readily effected in the cold, and no heat whatever should be used, to avoid decomposition. It is impossible to prevent change, however, by time, an insoluble precipitate invariably making its appearance. The former German Pharmacopœia directed diluted acetic acid, and its *Liquor Ferri Subacetici* was not so strong as the U. S. P. 1890 solution, having only the sp. gr. 1.087 to 1.091, corresponding to 5 per cent. of iron. The British preparation (sp. gr. 1.031) is still weaker. The strong solution of acetate of iron (Br. Ph. 1885) is no longer official. (See U. S. D., 17th ed., 798.)

Properties.—The solution of the U. S. P. 1890 was described as "a dark reddish-brown, clear liquid, of an acetous odor, a sweetish, acidulous, somewhat styptic taste, and a slightly acid reaction. Specific gravity, about 1.160 at 15° C. (59° F.). The diluted Solution yields a brownish-red precipitate with ammonia water, and a blue one with potassium ferrocyanide test-solution. When heated to boiling, the Solution yields a brownish-red precipitate, and when heated with sulphuric acid, it emits acetous vapors. If the iron be completely precipitated from a portion of the Solution by an excess of ammonia water, the filtrate should be colorless, and should not yield a white or dark-colored precipitate with hydrogen sulphide test-solution (absence of *zinc* or *copper*), nor should it leave a residue on evapo-

"Solution of Ferric Sulphate, *one thousand grammes* [or 35 ounces av., 120 grains]; Glacial Acetic Acid, *two hundred and sixty grammes* [or 9 ounces av., 75 grains]; Ammonia Water, *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims]; Water, Distilled Water, each, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Ammonia Water with *three thousand cubic centimeters* [or 101 fluidounces, 213 minims] of cold Water, and the solution of Ferric Sulphate with *ten thousand cubic centimeters* [or 338 fluidounces, 70 minims] of cold Water. Add the latter solution slowly to the diluted Ammonia Water, stirring constantly. Let the mixture stand until the precipitate has subsided as far as practicable, and then decant the supernatant liquid. Add to the precipitate *six thousand cubic centimeters* [or 202 fluidounces, 426 minims] of boiling Water, mix well, and again set the mixture aside, as before. Repeat the washing with successive portions of boiling Water, in the same manner, until the washings are no longer affected by sodium cobaltic nitrite test-solution (showing the removal of ammonia and its salts). Transfer the mixture to a wet muslin strainer, allow the precipitate to drain completely, and press it, folded in the strainer, until its weight is reduced to *seven hundred grammes* [or 24 ounces av., 303 grains] or less. Now add the precipitate gradually to the Glacial Acetic Acid contained in a tared jar provided with a glass stopper, stirring the mixture after each addition until each portion added is nearly dissolved before adding another portion. Finally, add enough Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains], mix thoroughly, allow it to become clear by subsidence, and decant the clear solution. Keep the product in well-stoppered bottles, in a cool place, protected from light." *U. S.* 1890.

ration and gentle ignition (absence of *salts of the fixed alkalies*). If to a small portion of the Solution, diluted with about 10 volumes of water, a few drops of freshly prepared potassium ferricyanide test-solution be added, a pure brown color should be produced, without a tinge of green or greenish-blue (absence of *ferrous salt*). If 1.12 (1.1176) Gm. of the Solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch test-solution, it should require about 15 Cc. of sodium hyposulphite decinormal volumetric solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 0.5 per cent. of metallic iron)." *U. S.* 1890. "A red liquid with a sour styptic taste and acetous odor, miscible with *water* and *alcohol* (90 per cent.) in all proportions. It affords the reactions characteristic of ferric salts and of acetates. It should not yield any characteristic reaction with the tests for lead, copper, arsenium, zinc, calcium, sodium, potassium, ammonium, nitrates, or ferrous salts, and only very slight reactions with the tests for sulphates. Specific gravity 1.031." *Br.*

Uses.—Ferric acetate is an excellent chalybeate; this solution is not so well adapted for internal administration as is the tincture of ferric acetate or the solution of iron and ammonium acetate. It was introduced into a former Pharmacopœia for the purpose of making the tincture, but it was rarely used; it may be serviceable when mixed with water, with the addition of an aromatic syrup.

Dose, from two to ten minims (0.12 to 0.6 Cc.).

LIQUOR FERRI CHLORIDI. U. S. (Br.)

SOLUTION OF FERRIC CHLORIDE

(lī'quọr fĕr'rī ȼhlō'rị-dī)

"An aqueous solution of Ferric Chloride, which should contain not less than 29 percent. of the anhydrous salt [$FeCl_3 = 161.04$], corresponding to 10 percent. of metallic iron." *U. S.* "110 minims contain 22½ grains of Iron; 100 cubic centimetres contain 22.5 grammes." *Br.*

Liquor Ferri Perchloridi Fortis, *Br.*, Liquor Ferri Muriatici Oxydati, Strong Solution of Ferric Chloride, Solution of Chloride of Iron; Chlorure Ferrique dissous, *Fr. Cod.*; Soluté de Perchlorure de Fer, Chlorure Ferrique liquide, *Fr.*; Liquor Ferri Sesquichlorati, *P. G.*; Flüssiges Eisenchlorid, Eisenchloridlösung, *G.*; Solucion de Cloruro Ferrico, *Sp.*

* "Iron, in the form of fine, bright wire, and cut into small pieces, *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]; Hydrochloric Acid, *six hundred and eighty grammes* [or 23 ounces av., 432 grains]; Nitric Acid, Distilled Water, each, *a sufficient quantity*, to make *one thousand grammes* [or 35 ounces av., 120 grains]. Introduce the Iron Wire into a flask having a capacity of about *two thousand cubic centimeters* [or 67 fluidounces, 301 minims], pour upon it a mixture of *four hundred and twenty grammes* [or 14 ounces av., 357 grains] of Hydrochloric Acid and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Distilled Water, and heat upon a water-bath for not less than one hour and fifteen minutes, or until effervescence ceases; then boil the liquid, filter it through paper, and, having rinsed the flask and Iron Wire with a little hot Distilled Water, pass the rinsings through the filter. To the filtered liquid add *two hundred and twenty grammes* [or 7 ounces av., 333 grains] of Hydrochloric Acid, add the mixture slowly and gradually, in a stream, to *sixty-five grammes* [or 2 ounces av., 128 grains] of Nitric Acid contained in a capacious porcelain vessel, and warm gently. After effervescence ceases, apply heat, by means of a sand-bath, stirring occasionally, until the liquid is free from Nitric Acid. If the solution has acquired a black color, continue the addition of Nitric Acid, drop by drop, until red fumes are no longer evolved and the solution assumes a clear reddish-brown color. Finally, add the remaining *forty grammes* [or 1 ounce av., 180 grains] of Hydrochloric Acid and enough Distilled Water to make the Solution weigh *one thousand grammes* [or 35 ounces av., 120 grains]." *U. S.*

"Iron, 4 *ounces* (Imperial) or 80 grammes; Hydrochloric Acid, 20½ *fl. ounces* (Imp. meas.) or 410 cubic centimetres; Nitric Acid, 1½ *fl. ounces* (Imp. meas.) or 30 cubic centimetres; Distilled Water, *a sufficient quantity*. Place the Iron in a flask; add a mixture of *twelve and a half fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of Hydrochloric Acid and *seven* [*fluid*] *ounces* (Imp. meas.) or one hundred and forty cubic centimetres of Distilled Water; expose to a moderate temperature until effervescence ceases; then boil; filter from undissolved Iron; rinse the flask and contents with a little Distilled Water; pour the rinsings over the filter; add to the filtrate *seven fluid ounces* (Imp. meas.) or one hundred and forty cubic centimetres of Hydrochloric Acid; mix; pour the solution in a slow continuous stream into the Nitric Acid, chemical action being promoted if necessary by the application of slight heat; evaporate the product until no more nitrous fumes escape and a precipitate begins to form; add *one fluid ounce* (Imp. meas.) or twenty cubic centimetres of Hydrochloric Acid, and sufficient Distilled Water to produce *seventeen and a half fluid ounces* (Imp. meas.) or three hundred and fifty cubic centimetres of the Solution." *Br.* (See *Liquor Ferri Perchloridi*, p. 716.) The strength of solution of ferric chloride U. S. P. (8th Rev.) was reduced from the former standard of 13 per cent. of iron

(U. S. P. 1890) to 10 per cent. of iron, which corresponds to the solution of the German Pharmacopœia; this strength is sufficient for all purposes, and is more convenient for calculations. The British preparation contains 15.84 per cent. of iron. By the reaction between the hydrochloric acid and the iron, ferrous chloride is produced, which by the subsequent agency of the hydrochloric and nitric acids is converted into ferric chloride, or, as it is denominated in the British Pharmacopœia, perchloride of iron, this being retained in solution by the water with the excess of acid. This preparation was included in the original British Pharmacopœia, but was not official with us until 1870. The original British formula (1864) was defective in several respects. For an account of these see the 13th edition of this book. The formula for the present British solution has been modelled after that of the U. S. Pharmacopœia.

When iron is treated with hydrochloric acid there is a copious evolution of hydrogen, and an emerald-green solution of ferrous chloride ($FeCl_2$) results. Green crystals having the composition $FeCl_2,4H_2O$ separate if the solution is permitted to rest. In the official process, water is added to the hydrochloric acid in order to retain the crystals in solution, and the mixture is heated while still in contact with the excess of iron, in order to hasten the complete conversion of all the hydrochloric acid into ferrous chloride. The action slackens very materially as the quantity of hydrochloric acid is gradually lessened in the mixture, but when it is brought, as officially directed, to the boiling point, a saturated solution is produced. After filtering from the excess of iron, half the original quantity of hydrochloric acid is added,—this for the purpose of supplying the amount which is requisite to form the solution of ferric chloride,—and the mixture is then gradually poured into nitric acid, which at once converts the solution of green ferrous chloride into the solution of red ferric chloride. Formerly the nitric acid was added to the solution; now the order is reversed, in accordance with the recommendation of C. L. Diehl, to prevent frothing. (See *A. J. P.*, 1867, p. 140.) The reaction between the acids and the solution may be thus expressed:

$$6FeCl_2 + 2HNO_3 + 6HCl =$$

Ferrous chloride. Nitric acid. Hydrochloric acid.

$$6FeCl_3 + N_2O_2 + 4H_2O$$

Ferric chloride. Nitrogen dioxide. Water.

If the solution should have a blackish color, and not a clear ruby-red, it is due to the presence of a nitro-compound composed of a portion of ferrous chloride and nitrogen dioxide, $FeCl_2 + N_2O_2$. As this compound is easily decomposed, all that is necessary is to heat the liquid and add a few drops of nitric acid, when the blackish color soon disappears, nitrogen dioxide is liberated, and a ruby-red solution remains. Any excess of nitric acid is to be evaporated off.[1] The final addition of hydrochloric acid is to compensate for any loss which may have been suffered by heating the solution, and to secure an excess of the acid in the finished preparation; otherwise a reddish-brown deposit of oxychloride would gradually form, and precipitation would result upon dilution with alcohol in making the official tincture.

The solution of ferric chloride, properly made, is "a reddish-brown liquid, having a faint odor of hydrochloric acid, an acid, strongly styptic taste, and an acid reaction. Specific gravity: about 1.282 at 25° C. (77° F.). The diluted Solution yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in nitric acid, with silver nitrate T.S. If the iron be completely precipitated from a portion of the Solution by an excess of ammonia water, the filtrate should be colorless, and should not yield a precipitate with hydrogen sulphide T.S. (absence of *zinc* or *copper*); nor should it leave a fixed residue on evaporation and gentle ignition (absence of *salts of the fixed alkalies*). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Solution (1 in 10), the crystal should not become colored brown, nor should a brownish-black color develop around it (absence of *nitric acid*). If to a diluted portion of the Solution (about 1 in 20) a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced, which should not at once turn green or greenish-blue (absence of *ferrous salts*). If to 3 drops of Solution of Ferric Chloride, 10 Cc. of tenth-normal sodium thiosulphate V.S. be added, and then slowly heated to boil-

[1] The use of chlorine instead of nitric acid for converting the ferrous chloride to the ferric condition is advocated by C. W. Weiss (*Ph. Ztg.; N. R.*, 1883, p. 247), and J. W. England has devised the following process, based upon such substitutions, which is alleged to furnish a purer product:

"Take of Iron, in the form of fine wire, and cut in small pieces, 15 parts (3¾ oz. av.); Hydrochloric Acid, 59 parts (14¾ oz. av.); Chlorine Gas, Distilled Water, each, a sufficient quantity to make 100 parts (25 oz. av.). Place the Iron Wire in a capacious flask, and pour upon it 54 parts (13½ oz. av.) of Hydrochloric Acid, previously diluted with 25 parts (6¼ oz. av., or 6 fluidounces) of Distilled Water. Heat the liquid slowly, until the reaction is ended, and effervescence ceases; then rapidly heat to the boiling point, filter through paper, and, having rinsed the flask and residue with a little boiling distilled water, pass the washings through the filter. To the filtrate add immediately 5 parts (1¼ oz. av.) of Hydrochloric Acid, followed by the addition of 20 parts (5 oz. av.) of boiling Distilled Water. Keep the liquid nearly boiling, and pass through it a stream of gaseous chlorine (generated in the usual way), agitating occasionally, until a small portion, tested with freshly-prepared potassium ferricyanide test-solution, gives no indication of the existence of a ferrous compound by producing a blue precipitate. Lastly, add, after any free chlorine present has been removed by heat, sufficient distilled water to make the whole product weigh 100 parts (25 oz. av.)." (*A. J. P.*, 1885, p. 113.) August Drescher (*D. C.*, 1887, p. 4) proposes the use of hydrogen dioxide (H_2O_2), now an article of commerce, as a substitute for either nitric acid or chlorine.

ing, no brownish-red precipitate of ferric hydroxide should separate (absence of *oxychloride*). If 10 Gm. of the Solution be diluted to measure 100 Cc., and 11.1 Cc. of this be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch T.S., it should require not less than 20 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue or greenish color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 0.5 percent. of metallic iron)." *U. S.* Water and alcohol unite with it in all proportions. The British preparation (*Liquor Ferri Perchloridi Fortis*) is stronger than the U. S. official, the sp. gr. of the former being 1.420 at 15.5° C. (60° F.), of the latter 1.282 at 25° C. (77° F.) it should be remembered, however, that there is in the British Pharmacopœia, another solution of ferric chloride which is weaker; it has the sp. gr. 1.110 and is termed *Liquor Ferri Perchloridi.* (See page 716.) "An orange-brown solution with a strong styptic taste, miscible with *water* and *alcohol* in all proportions. It affords the reactions characteristic of ferric salts and chlorides, and should not yield any characteristic reaction with the tests for lead, copper, arsenium, zinc, calcium, sodium, potassium, ammonium, nitrates, or ferrous salts. Specific gravity about 1.42. 5 cubic centimetres of it diluted with 80 cubic centimetres of *water* should give, upon the addition of an excess of *solution of ammonia,* a reddish-brown precipitate which when well washed and incinerated, weighs 1.6 grammes.[1] 110 minims contain 22½ grains of Iron; 100 cubic centimetres contain 22.5 grammes." *Br.*

From the experiments of Adrian it appears that sugar has the property when mixed in certain proportions with solution of ferric chloride of converting it partly into ferrous chloride. The alteration commences immediately on the addition of sugar, as shown by the deeper color of the liquid; after some hours potassium ferricyanide will indicate the presence of a ferrous salt, and after twenty-four hours the greater proportion of the ferric salt has undergone the change.[2] (*B. M. S. J.,* March, 1868.)

Uses.—This preparation was brought prominently into notice by Pravaz, a surgeon of Lyons, who found that a few drops of a strong solution, injected into a blood vessel, produced coagulation of all the blood in the vessel for the extent of an inch or more. Its use as a styptic was the natural result of this observation. In this capacity it has been used in the cure of *varices,* and has even been recommended as an injection in ordinary *aneurisms.* In arresting *hemorrhages* from cut surfaces or wounded vessels it has proved remarkably successful. It has also been found advantageous as an application to *nasal polypi, erectile tumors,* or *nævi materni* in infants, in *ulcers* about the nails, and in various cutaneous affections. (See *Ferric Chloride.*) Attempts have been made to cure *nævi materni* by the injection of the solution into the erectile tumor, but this proceeding is hazardous and has caused death. (*Ann. Thér.,* 1867, p. 117.) It has been used externally with asserted success in *varicose veins.* It may be used internally, properly diluted, for the general purposes of chalybeates, and especially as a substitute for the tincture of ferric chloride, when the alcohol of that preparation is objectionable. In *post-partum hemorrhage* it has been largely employed, a solution of it, varying in strength from a drachm to a half ounce to the pint, being thrown directly into the relaxed uterus. It is used in preparing tincture of ferric chloride.

Dose, one to five minims (0.06 to 0.3 Cc.).

Off. Prep.—Ferri Chloridum, *U. S.;* Liquor Ferri Perchloridi, *Br.;* Tinctura Ferri Chloridi, *U. S.* (*Br.*).

LIQUOR FERRI ET AMMONII ACETATIS. U. S.

SOLUTION OF IRON AND AMMONIUM ACETATE
[Basham's Mixture]

(lĭ′quŏr fĕr′rī ĕt ăm-mō′nĭ-ī ăç-ē-tā′tĭs)

Mistura Ferri et Ammonii Acetatis, U. S. P. 1880.

* "Tincture of Ferric Chloride, *forty cubic centimeters* [or 1 fluidounce, 169 minims];

[1] F. C. J. Bird calls attention to the fact that when the British Pharmacopœia process for preparing strong solution of ferric chloride is strictly adhered to the final product will contain a quantity of ferric chloride corresponding to 1.44 Gm. Fe_2O_3 per 5 Cc. instead of 1.6 Gm. required. The specific gravity (about 1.42) also does not conform to a solution yielding 1.60 Gm. ferric oxide per 5 Cc., such a solution having the sp. gr. 1.488 at 15.5° C. To obtain such a solution the formula must be modified on lines pointed out by the author. (*Y. B. P.,* 1899, 361-362.)

[2] The solution of ferric chloride, when kept, has a disposition to deposit the insoluble oxychloride of iron, and the resulting excess of hydrochloric acid is injuriously irritating. To obviate this disadvantage, Burin du Buisson recommends the following mode of preparation. "Saturate as quickly as possible pure and colorless hydrochloric acid with [gelatinous] hydrated ferric oxide; evaporate the solution to somewhat less than one-half over a gentle fire; and then continue the evaporation by means of the salt-bath, taking care to remove the aqueous vapors, which would cause the formation of hydrochloric acid, and a deposition of insoluble oxychloride. When the solution has attained the consistence of thick syrup (in which state it curdles on cooling, without, however, becoming a solid mass), cease evaporating, add an excess of the gelatinous hydrate diluted with a little water, agitate for a quarter of an hour, and afterwards allow the liquor to rest for several hours. Next add distilled water sufficient to bring the solution to the density of 30° Baumé, and allow it to stand for eight days in contact with an excess of the hydrate; after which filter, and again allow it to stand for two weeks." This strength of the solution is required for the cure of *varices.* For injection into *aneurismal tumors* it is sufficient to employ a solution of 20° or even 15°. These degrees of Baumé correspond to the following percentages, 30° to 29.70 per cent. of the dry salt, 20° to 17.05 per cent., and 15° to 12.10 per cent. (See *Ferri Chloridum.*)

Diluted Acetic Acid, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Solution of Ammonium Acetate, *five hundred cubic centimeters* [or 16 fluidounces, 435 minims]; Aromatic Elixir, *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims]; Glycerin, *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims]: Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. To the Solution of Ammonium Acetate (which should not be alkaline) add, successively, the Diluted Acetic Acid, the Tincture of Ferric Chloride, the Aromatic Elixir, and the Glycerin, and lastly, enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. This preparation should be freshly made when wanted." *U. S.*

The first name of this preparation has been changed to "Liquor" in accordance with the views expressed in the 16th edition of this work, as it belongs to the class of solutions, and is not a mixture in the modern acceptation of the term. The formula has been improved by the addition of glycerin, which enables the solution to remain undecomposed somewhat longer, and by the increase in strength; the amount of active ingredients in the U. S. P. (8th Rev.) being double that of the former Pharmacopœia. It should be borne in mind, however, that this was never intended to be a permanent solution, and in time precipitation and decomposition surely set in. Some pharmacists adopt the plan of keeping all the ingredients, except the tincture of ferric chloride and water, mixed together in advance, and when called upon to dispense the solution, to add the proper quantity of tincture and water; this saves time and enables them to dispense a clear solution. When freshly made, it is a transparent, bright red liquid. When cloudy, the absence of sufficient free acid is indicated. The iron is in the form of an acetate, while there is formed, as one of the products of decomposition, a small quantity of ammonium chloride, the larger proportion of ammonium acetate remaining undecomposed. Basham's mixture is actively chalybeate, and also astringent, and is very largely used in *chronic Bright's disease*.

Dose, from one-fourth to one-half fluidounce (7.5 to 15 Cc.).

LIQUOR FERRI PERCHLORIDI. Br.

SOLUTION OF PERCHLORIDE OF IRON

(lĭ'quŏr fĕr'rī pĕr-ȼhlō'rĭ-dī)

Solution of Ferric Chloride.

"Strong Solution of Ferric Chloride, 5 *fl. ounces* (Imperial measure) or 250 cubic centimetres; Distilled Water, *a sufficient quantity*. Mix the Strong Solution of Ferric Chloride with sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of this Solution of Ferric Chloride." *Br.* (See p. 714.)

This is one-fourth the strength of the *Liquor Ferri Perchloridi* of the Br. Pharmacopœia of 1864, which is the *Liquor Ferri Perchloridi Fortis* of the present edition. (See p. 713.) It is of the same ferruginous strength as the British Tincture of Ferric Chloride. The specific gravity of this solution is 1.110, and it may be substituted for the tincture of ferric chloride when alcohol is objectionable, as it has the same strength; it is very astringent, and is perhaps less active as a diuretic than the tincture.

Dose, from ten to thirty minims (0.6 to 1.8 Cc.) well diluted.

LIQUOR FERRI PERNITRATIS. Br.

SOLUTION OF FERRIC NITRATE

(lĭ'quŏr fĕr'rī pĕr-nī-trā'tĭs)

Solution of Pernitrate of Iron; Azotate (Pernitrate) de Fer liquide, *Fr.*; Eisennitratlösung, Ferrinitratlösung, Salpetersaure Eisenoxyd-Lösung, *G.*

"Iron, 1 *ounce* (Imperial) or 20 grammes; Nitric Acid, 4½ *fl. ounces* (Imp. meas.) or 90 cubic centimetres; Distilled Water, *a sufficient quantity*. Dilute the Nitric Acid with *sixteen [fluid] ounces* (Imp. meas.) or three hundred and twenty cubic centimetres of the Distilled Water; introduce the Iron; set aside until the metal is dissolved, taking care to moderate the action, should it become too violent, by the addition of a little more Distilled Water; filter the liquid; add enough Distilled Water to produce *thirty fluid ounces* (Imp. meas.) or six hundred cubic centimetres of the Solution." *Br.*

This solution was dropped by the U. S. P. (8th Rev.); the formula of the U. S. P. 1890 is appended.[1] Solution of ferric nitrate was made in the U. S. P. 1870 by first forming

[1] *Liquor Ferri Nitratis, Solution of Ferric Nitrate*, U. S. 1890.—"An aqueous solution of Ferric Nitrate [$Fe_2(NO_3)_6 = 483.1$], containing about 6.2 per cent. of the anhydrous salt, and corresponding to about 1.4 per cent. of metallic iron." *U. S.* 1890.

"Solution of Ferric Sulphate, *one hundred and eighty grammes* [or 6 ounces av., 153 grains]; Ammonia Water, *one hundred and sixty cubic centimeters* [or 5 fluidounces, 197 minims]; Nitric Acid, *seventy-one grammes* [or 2 ounces av., 220 grains]; Distilled Water, Water, each, *a sufficient quantity*, to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Ammonia Water with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of cold Water, and the Solution of Ferric Sulphate with *fifteen hundred cubic centimeters* [or 50 fluidounces, 345 minims] of cold Water. Add the latter solution slowly to the diluted Ammonia Water, with constant stirring. Let the mixture stand until the precipitate has subsided as far as practicable, and then decant the supernatant liquid. Add to the precipitate *one thousand cubic centimeters* [or 33 fluidounces, 390 minims] of cold Water, mix well, and again set the mixture aside, as before. Repeat the washings with successive portions of cold Water, in the same manner, until the washings produce but a slight cloudiness with barium chloride test-solution. Pour the washed ferric hydrate on a wet muslin strainer, and let it drain thoroughly. Then transfer it to a porcelain capsule, add the Nitric Acid, and stir with a glass rod, until a clear solution is obtained. Finally, add enough Distilled Water to make the finished product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Filter, if necessary." *U. S.* 1890.

ferrous nitrate by dissolving iron wire in diluted nitric acid, and then converting this into ferric nitrate by heating with an additional quantity of nitric acid; there was a slight excess of nitric acid left in the solution (about 1.4 per cent.). It was believed by the Committee of Revision of the U. S. P. 1890 that a solution of more definite composition would be made by adopting Louis Dohme's process. In this, ferric hydroxide is dissolved in nitric acid in such proportion that the solution of ferric nitrate shall contain 6.2 per cent. of the anhydrous salt when assayed by the official process, and about 1 per cent. of free nitric acid.[1]

Properties.—The U. S. (1890) solution was "a clear amber-colored or reddish liquid, odorless, having an acid, styptic taste, and an acid reaction. Specific gravity, about 1.050 at 15° C. (59° F.). The Solution gives a brownish-red precipitate with ammonia water, and a blue one with potassium ferrocyanide test-solution. If a clear crystal of ferrous sulphate be added to a cooled mixture of equal parts of the Solution and of concentrated sulphuric acid, the crystal will become brown and be surrounded by a brownish-black zone. If 1.12 (1.1176) Gm. of the Solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch test-solution, it should require about 2.8 Cc. of sodium hyposulphite decinormal volumetric solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 0.5 per cent. of metallic iron)." *U. S.* 1890.

It contains no ferrous nitrate, and does not give a blue precipitate with potassium ferricyanide. The British preparation is described as "a clear solution of a reddish-brown color, distinctly acid and astringent to the taste. It affords the reactions characteristic of ferric salts and of nitrates. It should not yield any characteristic reaction with the tests for lead, copper, arsenium, zinc, calcium, sodium, potassium, ammonium, chlorides, sulphates, or ferrous salts. Specific gravity 1.107. 5 cubic centimetres treated with an excess of *solution of ammonia* should give a precipitate which, when washed, dried, and incinerated, weighs 0.23 gramme. 110 minims contain 3½ grains of Iron; 100 cubic centimetres contain 3.3 grammes." *Br.* It is, therefore, about twice as strong as the U. S. Pharm. 1890 solution.

Ferric nitrate is somewhat deliquescent, very soluble in water, and sparingly soluble in nitric acid. It consists of the double atom of iron, Fe_2, which is hexatomic, combined with 6 groups, NO_3, and crystallizes either with 12 molecules of water in colorless cubes, or with 18 molecules of water in colorless monoclinic crystals, yielding, therefore, either $Fe_2(NO_3)_6 + 12H_2O$ or $Fe_2(NO_3)_6 + 18H_2O$.

Uses.—This astringent chalybeate was introduced to the notice of the profession by William Kerr, in 1832, and has been commended in *atonic chronic diarrhœa,* and even in *mucous diarrhœa* attended with pain, but without ulcerations of the intestines; in our experience it has seemed to be irritating, and has generally failed to accomplish good. It has also been used with alleged good effect in *menorrhagia,* and both internally and by injection in *leucorrhœa,* when occurring in pale, exsanguine, and feeble subjects; it should be sufficiently diluted to cause only a slight heat and smarting in the vagina.

Dose, according to Graves, is five or six minims (0.3 to 0.4 Cc.), gradually increased to fifteen minims (0.9 Cc.), sufficiently diluted, given in the course of the day. Garrod and Squire state the dose of the British preparation as from thirty minims to a fluidrachm (1.8 to 3.75 Cc.). Considering that a fluidrachm (3.75 Cc.) of the British solution contains 7.865 grains (0.49 Gm.) of the salt, this appears to us a very large dose.

LIQUOR FERRI SUBSULPHATIS. U. S.

SOLUTION OF FERRIC SUBSULPHATE [Solution of Basic Ferric Sulphate, Monsel's Solution]

(lĭ'quŏr fĕr'rī sŭb-sŭl-phā'tĭs)

"An aqueous solution of variable chemical composition, containing an amount of basic ferric sulphate corresponding to not less than 13.57 percent. of metallic iron." *U. S.*

Solution of Subsulphate of Iron; Solution of Persulphate of Iron; Liqueur hémostatique de Monsel, *Fr.;* Basisch-schwefelsaure Eisenoxydlösung, Monsel's Eisenlösung, Monselsche Eisenlösung, *G.*

* "Ferrous Sulphate, in clear crystals, *six hundred and seventy-five grammes* [or 23 ounces av., 284 grains]; Sulphuric Acid, *sixty-five grammes* [or 2 ounces av., 128 grains]; Nitric Acid, Distilled Water, each, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Add the Sulphuric Acid to *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Distilled Water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), then add *seventy grammes* [or 2 ounces av., 205 grains] of Nitric Acid, and mix well. Divide the Ferrous Sulphate, coarsely powdered, into four equal portions, and add these portions, one at a time, to the hot liquid, stirring after each addition until effervescence ceases. If, after the Ferrous Sulphate has been dissolved, the solution is of a black color, add Nitric Acid, a few drops at a time, with heating and stir-

[1] *Syrup of Ferrous Nitrate* may be prepared by Procter's formula. (See U. S. D., 16th ed., p. 903.)

ring, until it no longer causes red fumes to be evolved; then boil the Solution until it assumes a ruby-red color and is free from Nitric Acid. Lastly, add enough Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Filter if necessary. Keep it in well-stoppered bottles, in a moderately warm place (not under 22° C. or 71.6° F.), protected from light. This solution sometimes crystallizes, forming a semi-solid, whitish mass. When this occurs, the application of a gentle heat to the bottle will restore the liquid condition." *U. S.*

This process is essentially that of E. R. Squibb. The object is to obtain in solution *Monsel's Persulphate of Iron,* improperly so called, as it differs both in composition and in properties from the salt of iron properly named persulphate. The composition of the true persulphate is $Fe_2(SO_4)_3$, and it is a neutral salt, while Monsel's persulphate has the composition $5Fe_2(SO_4)_3.Fe_2(HO)_6$,[1] and is properly a subsalt, as it is very appropriately designated in the U. S. Pharmacopœia. With this preliminary explanation, the process will be easily understood.

In its preparation the ferrous sulphate is converted into ferric sulphate at the expense of the nitric acid; but the sulphuric acid, mixed with the nitric, is in quantity insufficient to form the normal salt. The sesquioxide is therefore but partially saturated, and a subsalt results, having the constitution above mentioned.[2]

Properties.—The solution of ferric subsulphate is "a dark reddish-brown liquid, odorless or nearly so, of an acid, strongly styptic taste, and an acid reaction. Specific gravity: about 1.548 at 25° C. (77° F.). Miscible with water and alcohol, in all proportions, without decomposition. The diluted Solution yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in hydrochloric acid, with barium chloride T.S. On slowly mixing 2 volumes of the Solution with 1 volume of concentrated sulphuric acid, in a beaker, a semi-solid white mass should separate on standing (difference from *tersulphate*). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Solution (about 1 in 10), the crystal should not become brown, nor should a brownish-black color develop around it (absence of *nitric acid*). If to a diluted portion of the Solution (1 in 20), a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced; it should not at once turn green or greenish-blue (absence of *ferrous salt*). If 10 Gm. of the Solution be diluted to measure 100 Cc., and 11.1 Cc. of this be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), with 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at the temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch T.S., it should require not less than 27.2 (27.15) Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue or greenish color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 0.5 percent. of metallic iron)." *U. S.* A little sulphuric acid decolorizes the liquid in a considerable degree, and an excess of the same acid converts it into a white, soft, pasty solid, resembling plaster of Paris which has begun to solidify after mixture with water. This test, according to Squibb, is quite characteristic. (*N. Y. Journ. Med.*, 1860, p. 173.)

By evaporation, upon a glass surface, with a moderate heat, the solution yields ferric subsulphate, or *Monsel's salt,* in the form of thin transparent scales, of a light reddish-brown color, deliquescent, and readily soluble in water. Attention was first called to the special styptic virtues of ferric sulphate by Monsel in 1852; but it was not until 1857 that he published the formula for the peculiar salt which now goes by his name, and the solution of which is the subject of the present article. (See *J. P. C.*, Sept. 1857; also *Ibid.*, Juillet, 1859.)

Uses.—In consequence of its deficiency of sulphuric acid, this salt is less irritant than the ferric sulphate, while it has at least equal, if not greater, astringency. It is very efficacious as a styptic, through its power of coagulating the blood. The solution may be applied by means of a small sponge or pencil of spun glass to the bleeding surface or vessel. In cases of *hæmoptysis,* a dilution of it (from five to ten minims to the fluidounce) has been used with advantage, by means of the atomizer. It is an excellent styptic in *hemorrhage* from the stomach and bowels.

Dose, from three to six minims (0.2 to 0.4 Cc.), properly diluted, and repeated as often as necessary.

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[1] Spencer U. Pickering believes that the true composition of basic ferric sulphate is represented by the formula $Fe_2(SO_4)_3,5Fe_2O_3.H_2O$. (See *J. Chem. S.*, xliii. 182.)

[2] J. Creuse offers the following formulas for the preparation of the solutions of *ferric sulphate* and *ferric subsulphate,* holding them to be superior to the official because they require no especial apparatus and generate no noxious vapors:

For the ferric sulphate, take of Ferrous Sulphate, in coarse powder, twelve troyounces; Sulphuric Acid two troyounces and sixty grains; Potassium Chlorate three hundred and forty-eight grains; Boiling Water twelve fluidounces. Dissolve the ferrous sulphate in the boiling water in a glass flask, or in any convenient bottle; add the sulphuric acid gradually, and, while the liquid is hot, add the potassium chlorate by small portions. When all is dissolved, filter, and complete twenty-four fluidounces. The following formula explains the reactions:

$$6FeSO_4 + 3H_2SO_4 + KClO_3 = 3Fe_2(SO_4)_3 + 3H_2O + KCl$$

For the subsulphate, take of the ingredients above enumerated, respectively, twelve troyounces, one troyounce and thirty grains, three hundred and forty grains, ten fluidounces; proceed as before; evaporate to twelve fluidounces, and filter. (*A. J. P.*, xliii. 169.) The solutions thus obtained contain some potassium chloride.

LIQUOR FERRI TERSULPHATIS. U. S. (Br.)

SOLUTION OF FERRIC SULPHATE

(lĭ'quŏr fĕr'rī tĕr-sŭl-phā'tĭs)

"An aqueous solution, which should contain about 36 percent. of normal Ferric Sulphate [$Fe_2(SO_2.O_2)_3 = 397.05$], corresponding to not less than 10 percent. of metallic iron." *U. S.*

Liquor Ferri Persulphatis, *Br.;* Solution of Normal Ferric Sulphate, Solution of Tersulphate of Iron; Solution of Persulphate of Iron; Persulfate de Fer liquide, *Fr.;* Ferrisulfatlösung, Schwefelsaure Eisenoxydlösung, Flüssiges Schwefelsaures Eisenoxyd, *G.*

* "Ferrous Sulphate, in clear crystals, *five hundred grammes* [or 17 ounces av., 279 grains]; Sulphuric Acid, *ninety-six grammes* [or 3 ounces av., 169 grains]; Nitric Acid, Distilled Water, each, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Add the Sulphuric Acid to about *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Distilled Water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), then add *fifty-six grammes* [or 1 ounce av., 427 grains] of Nitric Acid, and mix well. Divide the Ferrous Sulphate, coarsely powdered, into four equal portions, and add these portions, one at a time, to the hot liquid, stirring after each addition until effervescence ceases. When all of the Ferrous Sulphate is dissolved, if the solution has acquired a black color, add Nitric Acid, a few drops at a time, heating and stirring until it no longer causes red fumes to be evolved, and the Solution assumes a clear reddish-brown color; then boil the liquid until it is free from nitric acid. Lastly, add enough Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Filter, if necessary." *U. S.*

"Ferrous Sulphate, 8 *ounces* (Imperial) or 400 grammes; Sulphuric Acid, 6 *fl. drachms* (Imp. meas.) or 37.5 cubic centimetres; Nitric Acid, 6 *fl. drachms* (Imp. meas.) or 37.5 cubic centimetres; Distilled Water, *a sufficient quantity.* Add the Sulphuric Acid to *ten* [*fluid*] *ounces* (Imp. meas.) or five hundred cubic centimetres of the Distilled Water; dissolve the Ferrous Sulphate in the mixture with the aid of heat; mix the Nitric Acid with *two* [*fluid*] *ounces* (Imp. meas.) or one hundred cubic centimetres of the Distilled Water; add to this diluted acid, warmed, the solution of Ferrous Sulphate; concentrate by boiling, until, by the sudden disengagement of ruddy vapors, the liquid ceases to be black and acquires a red color. If any ferrous salt remain in the solution, add a few drops of Nitric Acid and boil again. When the solution is cold, make up the quantity to *eleven fluid ounces* (Imp. meas.) or five hundred and fifty cubic centimetres by the addition, if necessary, of Distilled Water." *Br.*

The strength of this solution has been increased in the U. S. Pharm. (8th Rev.). The U. S. P. (1890) required a strength equivalent to 8 per cent. of metallic iron, the present Pharmacopœia requires 10 per cent. The ferrous sulphate is directed to be in clear crystals, meaning by this "not effloresced," because when the crystals are coated with a whitish powder they have lost water of crystallization, and the proportion of iron present is variable. The nitric acid in the process gives up enough of its oxygen to convert it entirely into ferric sulphate, and the effervescence is owing to the escape of nitrogen dioxide; this becomes red nitrogen tetroxide by contact with the air. The conversion of the ferrous salt into ferric salt is incomplete until the effervescence ceases, and the color, from black, as it was at first, has become reddish brown. Indeed, in order to convert the whole into ferric sulphate it is necessary to continue the heat until nitrous odor ceases to be evolved, and thus the entire absence of nitric or nitrous acid from the solution is insured. But in consequence of the higher oxidation of the iron the sulphuric acid of the sulphate is insufficient to saturate it. Enough sulphuric acid, therefore, is added to meet this demand. The process is completed by adding enough water to make a definite weight. The U. S. and British formulas are the same in principle.

Properties.—The solution, prepared according to the U. S. formula, is "a dark reddish-brown liquid, almost odorless, having an acid, strongly styptic taste, and an acid reaction. Specific gravity: about 1.432 at 25° C. (77° F.). Miscible with water and alcohol, in all proportions, without decomposition. The diluted Solution yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in hydrochloric acid, with barium chloride T.S. On slowly mixing 2 volumes of the Solution with 1 volume of concentrated sulphuric acid, in a beaker, no solid white mass should separate on standing (difference from *subsulphate*). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Solution (about 1 in 10), the crystal should not become brown, nor should a brownish-black color develop around it (absence of *nitric acid*). If to a small portion of the Solution, diluted with about 10 volumes of water, a few drops of freshly prepared potassium ferricyanide T.S. be added, a pure brown color should be produced, without a tinge of green or greenish-blue (absence of *ferrous salt*). If 1.11 Gm. of the Solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch T.S.,

it should require not less than 20 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue or greenish color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. indicating 0.5 percent. of metallic iron)." *U. S.* The solution, diluted with water, gives a white precipitate with barium chloride, showing that it contains a sulphate. It keeps well, and we have seen a specimen made by the U. S. 1870 process, ten years old, which retained all its properties unchanged and had deposited nothing. It is described in the Br. Pharmacopœia as "a dense solution of a dark red color, inodorous and very astringent, miscible in all proportions with *alcohol* and *water*. It affords the reactions characteristic of ferric salts and of sulphates. It should yield no characteristic reaction with the tests for ferrous salts. Specific gravity 1.441. 5 cubic centimetres diluted with 80 cubic centimetres of *water* should give, upon the addition of an excess of *solution of ammonia*, a precipitate which, when well washed and incinerated, weighs 1.04 grammes." *Br.* Proctor found that a preparation containing 120 grains of sesquioxide to the fluidounce is apt to deposit the anhydrous sulphate on standing.

Uses.—This solution, though powerfully astringent, is too irritant for general use. The chief employment of it is in making other ferruginous preparations in which the ferric hydroxide is wanted, and it should always be kept on hand for the quick preparation of the antidote to arsenic.

Off. Prep.—Ferri et Ammonii Citras, *Br.;* Ferri et Quininæ Citras, *Br.;* Ferri Hydroxidum, *U. S.;* Ferri Hydroxidum cum Magnesii Oxido, *U. S.;* Ferrum Tartratum, *Br.;* Liquor Ferri Acetatis, *Br.*

LIQUOR FORMALDEHYDI. U. S.

SOLUTION OF FORMALDEHYDE

(lĭ′quŏr förm-ăl-dē-hȳ′dī)

"An aqueous solution, containing not less than 37 percent., by weight, of absolute Formaldehyde [H.COH = 29.79], an oxidation product of methyl alcohol. It should be kept in well-stoppered bottles, in a cool place, protected from light." *U. S.*

Formol, Formalin; Soluté d'Aldehyde Formique, *Fr.;* Formaldehydum solutum, *P. G.;* Formaldehydlösung, *G.;* Formol, *Sp.*

Preparation.—Formaldehyde was first prepared in 1868 by Hofmann by passing a mixture of air and methyl alcohol vapor over heated platinum, and it is still practically obtained only from the oxidation of methyl alcohol. This is accomplished in "formaldehyde lamps," or on a larger scale in forms of apparatus such as that described by G. L. Taylor (*A. J. P.*, 1898, 195) as follows: The methyl alcohol to be converted is contained in a circular steel tank, capable of resisting heavy pressure; in the bottom of this tank is placed a coil of copper pipe into which steam at a high temperature is admitted; by this means the alcohol in the tank is boiled, and the resulting vapor is confined until a pressure of 75 to 80 pounds is reached, when it is allowed to escape into an air-mixer. This mixer is so constructed that an exactly determined quantity of air can be intimately combined with the methyl alcohol vapors. From the mixer the combination of air and vapor passes with great force and velocity through a fine tube into the converter, which has been brought to a dull red heat. This converter consists of two concentric copper tubes, the space between which is filled with broken coke or other material of a similar nature. The inner tube is finely perforated with many small holes. The alcohol vapor is admitted into this inner tube, and, escaping through the perforations, is oxidized by coming in contact with the heated coke and the copper surface of the outer tube. The gases so produced pass into the condenser, which consists of a cylindrical tank—which may be of copper; it contains a copper pipe, through which circulates a refrigerating mixture capable of reducing the temperature in the tank to about 0° C., at which temperature formic aldehyde condenses into a clear mobile liquid, which boils at —21° C., and which polymerizes to paraformaldehyde at 20° C. After a certain process of purification, enough water is added to the formaldehyde so obtained to form a 40 per cent. solution; but this solution is not, strictly speaking, a solution of formaldehyde, as the pure formaldehyde polymerizes the moment the temperature rises above 20° and it is this property which renders the addition of water or alcohol necessary. Hence the aqueous solution of formaldehyde probably contains some paraformaldehyde. The commercial products are always aqueous solutions, the common strength being the 37 per cent. solution; a 50 per cent. solution is not permanent.

Properties.—Solution of formaldehyde or "Formaldehyde," as it is commonly called, is officially described as "a clear, colorless liquid, having a pungent odor and caustic taste; its vapor acts as an irritant upon the mucous membrane. Specific gravity: 1.075 to 1.078 at 25° C. (77° F.). Miscible in all proportions with water and alcohol. On standing, Solution of Formaldehyde sometimes loses its transparency, the cloudiness being due to the separation of paraformaldehyde. If Solution of Formaldehyde be evaporated over sulphuric acid, or in a vacuum, white, solid, paraformaldehyde is rapidly formed, which is insoluble in water, and which, when heated to about 100° C. (212° F.), sublimes, and between 153° and 172° C. (307.4° and 341.6° F.) melts, gaseous formaldehyde being evolved. Solution of Formaldehyde should be neutral, or only faintly acid, to litmus paper. If 5 Cc. of Solution of Formaldehyde be diluted with 25 Cc. of distilled water, and 3 Cc. of silver am-

monium nitrate T.S. be added, a gray precipitate of finely divided metallic silver, which often adheres in part to the sides of the test-tube as a metallic mirror, will be produced. If to 5 Cc. of sulphuric acid in which a little salicylic acid has been dissolved, 2 drops of Solution of Formaldehyde be added and the liquid very gently warmed, a permanent deep red color should immediately appear. If 20 Cc. of Solution of Formaldehyde be evaporated to dryness on a water-bath, a white amorphous mass should remain, which, upon ignition, should not leave a residue (absence of *fixed impurities*). If 20 Cc. of Solution of Formaldehyde, to which 2 drops of phenolphthalein T.S. have been added, be titrated with normal potassium hydroxide V.S., not more than 0.5 Cc. of the latter should be required for neutralization (absence of more than 0.1 percent. of *formic* and *other acids*). If 20 Cc. of Solution of Formaldehyde be diluted with 60 Cc. of distilled water, and the liquid divided into four approximately equal portions, no turbidity or precipitate should be produced on the addition, severally, of silver nitrate T.S. (absence of *chloride*), barium chloride T.S. (absence of *sulphate*), hydrogen sulphide T.S. or potassium ferrocyanide T.S. (absence of *iron, lead, copper,* etc.), ammonium oxalate T.S. (absence of *calcium*)." *U. S.*

Formaldehyde may be determined in aqueous solutions by treatment with excess of standard ammonia, which converts it into hexamethylenamine. The excess of ammonia may then be titrated with standard acid. The mixture of the formaldehyde solution and ammonia should stand for at least twelve hours. This method, however, has not been found in practice to be as accurate as the hydrogen dioxide method, which was therefore chosen by the Revision Committee as the basis of the official assay process. (See below.) Because of the use of formaldehyde as a preservative of milk and food products the detection of small amounts of it is a matter of great importance. Several of the tests proposed are primarily applicable to milk only, being based on reactions which take place in the presence of milk proteids, so that if these tests are to be applied in testing other liquids for the presence of formaldehyde, the material must be mixed with an equal quantity of milk which has been shown previously to be free from formaldehyde. The principal tests may be divided into two groups, those in which a colored zone is obtained at the junction of two liquids, one of which has been superimposed upon the other, and those in which a color reaction is obtained in the body of the liquid tested. The first group includes the resorcinol-sulphuric acid test, the phenol-sulphuric acid test, and the sulphuric acid test of Hehner (carried out in the presence of milk). The method of application of the two tests first mentioned is as follows: To 5 Cc. of the liquid to be tested, one or two drops of a one per cent. aqueous solution of phenol or resorcinol are added, and this liquid is then allowed to flow gently down the inside of the test tube containing 2 or 3 Cc. of the sulphuric acid so as to form a layer above the acid without mixing. In the presence of formaldehyde a rose-colored zone is produced in extreme dilution, or in more concentrated solutions an opaque pinkish zone above the rose-colored one. In the Hehner test, the liquid to be tested is mixed with an equal volume of formaldehyde-free milk, and this mixture is allowed to flow down the inside of the test tube upon 2 or 3 Cc. of commercial sulphuric acid containing a trace of ferric chloride. A violet zone is formed in the presence of formaldehyde. The general color tests constituting the second group of tests are the phenylhydrazine test with its modifications, the phloroglucinol test, the resorcinol-soda test, and the hydrochloric acid test. (A full discussion and comparison of these tests by C. H. LaWall will be found in *Am. Drug.,* 1905, vol. xlvii. p. 33.)

A. B. Lyons (*Proc. A. Ph. A.,* 1905, 326) proposes the use of *beef peptone* in place of milk (except when milk is under investigation) in Hehner's test (see above). He also suggests the use of morphine and sulphuric acid as a test for formaldehyde. (*Proc. A. Ph. A.,* 1905, 329.)

Assay. U. S. (8th Rev.).—"Transfer 3 Cc. of Solution of Formaldehyde to a well-stoppered Erlenmeyer flask, and weigh accurately. Add 50 Cc. of normal sodium hydroxide V.S., and follow this immediately, but slowly, through a small funnel, with 50 Cc. of solution of hydrogen dioxide, to which a drop of litmus T.S. has been added, and which has been neutralized with normal sodium hydroxide V.S. After the reaction has ceased and the foaming has subsided, rinse the funnel and sides of the vessel with distilled water, and, after allowing it to stand ten minutes, titrate back with normal sulphuric acid V.S., using litmus T.S. as indicator. Subtract the number of Cc. of normal sulphuric acid V.S. consumed, from 50 (the number of Cc. of normal sodium hydroxide V.S. employed), multiply the remainder by 2.979, and divide the product by the weight of the Solution taken; the quotient represents the percentage, by weight, of absolute Formaldehyde in the liquid." *U. S.*

Uses.—In accordance with the discovery by Trillat in 1888, formaldehyde is a powerful germicide, ranking considerably below corrosive sublimate but above phenol. Various organisms can resist the influence of a one per cent. solution for three-quarters of an hour. When diffused through the air it should always be associated with an abundance of moisture, and it acts especially well when there is also a high temperature. It has a very powerful action on various forms of organic matter; one part in four thousand completely decolorizes wine, precipitating extractive and coloring matters. It does not, however, act

destructively upon books, clothing, or ordinary fabrics. Upon the higher animals its action is comparatively feeble, excepting as a violent irritant, producing when inhaled, even in an extremely diluted form, severe bronchitis or even pneumonia, and when taken internally a severe or fatal gastritis. As a poison it is more dangerous taken by the mouth than when exhibited hypodermically. Although an active coagulant of albumin in very dilute form, it so acts on albumin as to prevent its coagulation by heat. Its absorption is possible and the fact that the urine of animals to which it has been given is incapable of decomposition indicates that it is eliminated unchanged or more probably as formic acid. In human poisoning the symptoms have been those of a violent gastritis, and nephritis with stupor and coma in severe cases. It is alleged (André, *A. J. P.*, 1900, 493) that ammonia or its acetates are antidotal to formaldehyde, forming hexamethylene tetramine.

Formaldehyde is never used in medicine except as a germicide, and as such is too irritant for use upon the body itself except under rare circumstances. When employed to disinfect such solid materials as may be soaked in it, the one per cent. solution should be used for 24 hours immersion. In disinfecting an apartment, windows, doors, chimneys, ventilators, and similar openings should be tightly closed, while the air should be made to contain at least one per cent. of formaldehyde gas, and at the end of twenty-four hours, when the apartment may be opened, should still be strongly impregnated. The gas may be obtained by the atomization of formalin or other solution of formaldehyde, but not by the simple evaporation of the solution, since the formaldehyde, upon the application of heat, becomes largely polymerized into a solid, *paraformaldehyde*, which gives off formaldehyde slowly and in small quantities. It is stated that the addition of glycerin to the solution of formaldehyde prevents the polymerization by heat of the formaldehyde, so that the so-called *glycoformalin* (formaldehyde thirty parts, water, sixty parts, glycerin ten parts) is preferable to the aqueous solution, although its use has the distinct disadvantage of leaving many articles in the room sticky from a coating of glycerin. The two per cent. solution of formaldehyde is very effective for the disinfecting of the hands of the surgeon, but has been found too irritating to be practical. A one to two per cent. solution is sometimes employed for the rendering of instruments aseptic, but its use is usually less convenient than that of a simple chamber in which by means of heated paraformaldehyde the instruments may be disinfected. It is stated that by the employment of this apparatus instruments contained in a chamber measuring one cubic foot may be absolutely disinfected in fifteen minutes by the evaporation of five grains of paraformaldehyde at a cost of one cent.

Formaldehyde is used for the preservation of human bodies; an injection of a one per cent. solution usually proves to be a sufficient quantity. The hardening of the tissues and the giving off of irritant vapors by the cadaver have however been found to be a great objection to its employment for purposes of this character.[1]

LIQUOR HYDRARGYRI NITRATIS. U. S. (Br.)

SOLUTION OF MERCURIC NITRATE

(lĭ'quŏr hȳ-drär'gy-rī nī-trā'tĭs)

"A liquid, which should contain about 60 percent. of Mercuric Nitrate [$Hg(NO_2.O)_2 = 321.64$], and about 11 percent. of free nitric acid." *U. S.*

Liquor Hydrargyri Nitratis Acidus, *Br.*; Acid Solution of Mercuric Nitrate; Solution of Nitrate of Mercury; Solution of Pernitrate of Mercury; Liquor Hydrargyri Nitrici Oxydati; Azotate Mercurique liquide, *Fr. Cod.*; Deutazotate (Pernitrate) de Mercure liquide, *Fr.*; Mercurnitratlösung, Quecksilberoxydnitratlösung, Flüssiges Salpetersaures Quecksilberoxyd, *G.*

* "Red Mercuric Oxide, *forty grammes* [or 1 ounce av., 180 grains]; Nitric Acid, *forty-five grammes* [or 1 ounce av., 257 grains]; Distilled Water, *fifteen grammes* [or 231 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Mix the Nitric Acid with the Distilled Water, and dissolve the Red Mercuric Oxide in the mixture. Keep the product in glass-stoppered bottles." *U. S.*

"Mercury, 4 *ounces* (Imperial) or 120 grammes; Nitric Acid, 5 *fl. ounces* (Imp. meas.) or 150 cubic centimetres; Distilled Water, 1½ *fl. ounces* (Imp. meas.) or 45 cubic centimetres. Mix the Nitric Acid with the Distilled Water in a flask; dissolve the Mercury in the mixture without the application of heat; then boil gently for fifteen minutes; cool, and preserve the Solution, which should weigh about three times the quantity of the Mercury employed, in a stoppered bottle not exposed to the light." *Br.*

In the British process, mercury is dissolved, with the assistance of heat, in an excess of nitric acid, and there is formed an acid mercuric nitrate, which is brought to a determinate bulk by evaporation. The proportion of nitric

[1] *Kaiserling's solution* and method of using are as follows: Formaldehyde (40 per cent.), 750 Cc.; distilled water, 1000 Cc.; potassium nitrate, 10 Gm.; potassium acetate, 30 Gm. The heart, kidneys, and brain are kept during a period of twenty-four hours in Kaiserling's fluid, though no harm is done if they remain from thirty-six to forty-eight hours. The specimen is then transferred to alcohol of 80 per cent., where it should remain for not longer than twelve hours. Subsequently it is to be put in alcohol of 95 per cent. for two hours, and finally preserved in a mixture of equal parts of water and glycerin, to which thirty parts of potassium acetate have been added.

acid is sufficient not only to form mercuric nitrate, but also to furnish a large excess of acid.

Properties.—Solution of mercuric nitrate is "a clear, nearly colorless, heavy liquid, having a faint odor of nitric acid, and a strongly acid reaction. Specific gravity: about 2.086 at 25° C. (77° F.). On evaporating a few drops of the Solution in a porcelain dish, a white residue is left, which, on being heated, becomes successively yellow, red, and brown, and is finally completely volatilized. On a bright surface of copper, the Solution deposits a coating of metallic mercury. The Solution, diluted with water, yields with potassium hydroxide T.S. a yellow precipitate; and with potassium iodide T.S. a bright red one, soluble in an excess of the reagent. A clear crystal of ferrous sulphate dropped into the Solution rapidly acquires a brown color, and becomes surrounded by a brownish-black zone. No precipitation or cloudiness should occur in the Solution on the addition of water, or of diluted hydrochloric acid (absence of *mercurous salt*)." *U. S.* "A colorless and strongly acid liquid, which affords the reactions characteristic of mercuric salts and nitrates. It should not yield any characteristic reaction with the tests for mercurous salts. Specific gravity about 2.0." *Br.*

In the U. S. P. 1880 the definition stated that this solution contained about 50 per cent. of mercuric nitrate; in the *A. J. P.*, 1886, p. 577, F. X. Moerk affirmed that it did not afford a 50 per cent. solution, but a stronger one,—*i.e.*, a 60 per cent. To make a 50 per cent. solution the following quantities should be used: Red Mercuric Oxide 33.32 parts; Nitric Acid 37.38 parts; Distilled Water sufficient to make 100 parts.

Mercuric nitrate, the salt present in this preparation, can be obtained in large crystals of the composition $Hg(NO_3)_2 + 4H_2O$, when its solution is allowed to evaporate slowly over sulphuric acid. The same salt, which is very deliquescent, is obtained as a crystalline magma by adding strong nitric acid to the concentrated solution.

Uses.—This preparation is much used as a caustic application to *cancers, lupus, ulcerations* of the *cervix, chancres,* etc. When a very free use is desired, it may be applied to the diseased surface by a camel's-hair brush, or preferably by a brush made of spun glass; usually, however, the application is made with a glass rod, or a match or similar fragment of wood. In *acne* and *boils,* a drop proportioned in size to the pustule applied to the apex is sometimes of service. The parts touched immediately become white, the surrounding parts inflame, and in a few days a yellow scab is formed, which gradually falls off. Sometimes the application produces salivation. When it is desirable to avoid this result, the cauterized part should be washed with water immediately after the application of the caustic. It is not used internally.

LIQUOR HYDRARGYRI PERCHLORIDI. Br.

SOLUTION OF MERCURIC CHLORIDE

(lī′quọr hȳ-drär′gy̱-rī për-ȩhlō′rị-dī)

Liquor Hydrargyri Bichloridi; Solution of Bichloride of Mercury; Solution of Corrosive Sublimate; Sublimatlösung, *G.*

"Mercuric Chloride, 10 *grains* (Imperial) or 1 gramme; Distilled Water, 1 *pint* (Imp. meas.) or 875 cubic centimetres. Dissolve. This Solution contains 1-16 grain of Mercuric Chloride in 1 fluid drachm, or 0.114 gramme in 100 cubic centimetres." *Br.*

This solution may be used as affording a convenient method of exhibiting corrosive sublimate. The ammonium chloride formerly used (Br. Ph. 1885) to aid in dissolving the mercuric chloride has been omitted in the process of the Br. Ph. 1898.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR IODI COMPOSITUS. U. S. (Br.)

COMPOUND SOLUTION OF IODINE [Lugol's Solution]

(lī′quọr ī-ō′dī cọm-pŏṣ′ị-tŭs)

"An aqueous solution, which should contain not less than 5 percent. of iodine and 10 percent. of potassium iodide." *U. S.*

Liquor Iodi Fortis, *Br.;* Strong Solution of Iodine; Liniment of Iodine, *Br.* 1885; Liquor Iodinii Compositus, *U. S.* 1870; Soluté ioduré de Lugol, *Fr.;* Lugolsche Jodlösung, *G.*

* "Iodine, *five grammes* [or 77 grains]; Potassium Iodide, *ten grammes* [or 154 grains]; Distilled Water, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Iodine and Potassium Iodide in a sufficient quantity of Distilled Water to make the product weigh *one hundred grammes* [or 3 ounces av., 231 grains]. Keep the Solution in glass-stoppered bottles." *U. S.*

"Iodine, 1¼ *ounces* (Imperial) or 50 grammes; Potassium Iodide, ¾ *ounce* (Imp.) or 30 grammes; Distilled Water, 1¼ *fl. ounces* (Imp. meas.) or 50 cubic centimetres; Alcohol (90 per cent.), 9 *fl. ounces* (Imp. meas.) or 360 cubic centimetres. Dissolve the Potassium Iodide and the Iodine in the Distilled Water in a bottle; add the Alcohol and shake." *Br.*

In this solution iodine is dissolved in water with the assistance of potassium iodide. Iodine dissolves sparingly in water, but freely in a solution of this salt. In using potassium iodide to render iodine more soluble in water, the iodide is generally taken in a quantity twice the weight of the iodine, and this is the proportion adopted in the U. S. formula. The preparation is a *concentrated* solution of iodine with potassium iodide, and is intended to

facilitate the administration of the combination in drops. The present formula does not differ in strength from that of 1880. The specific gravity of the U. S. compound solution of iodine is 1.124 at 15° C. In the Br. Pharmacopœia a solution is directed having much more iodine than the U. S. solution, and weaker in potassium iodide, the former having about fifty grains of iodine and thirty grains of potassium iodide in the fluidounce, while the latter has nearly twenty-six grains of iodine and fifty-two grains of potassium iodide in the fluidounce, the difference in the fluidounce of the two Pharmacopœias being too small to enter into the calculation. The British solution is made with alcohol, and closely resembles the *Liniment of Iodine* of the Br. Ph. 1885. "For complete decolorization 6.3 Gm. of the Solution should require not less than 24.75 Cc. of tenth-normal sodium thiosulphate V.S. (each Cc. of the tenth-normal sodium thiosulphate V.S. corresponding to 0.2 percent. of Iodine)." *U. S.* The medicinal properties of the solution depend mainly on the free iodine contained in it.

Dose, of the U. S. P. solution, five minims (0.3 Cc.), containing about a quarter of a grain of iodine, three times a day, given in at least four tablespoonfuls of water or of milk, so as to avoid irritation of the stomach. The British solution, although not intended for internal administration, might be given in doses of two minims (0.12 Cc.).

LIQUOR KRAMERIÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF KRAMERIA

(lĭ'quŏr krą-mē'rĭ-æ cŏn-cĕn-trā'tŭs)

"Krameria Root, in No. 40 powder, 10 *ounces* (Imperial) or 500 grammes; Alcohol (20 per cent.), 25 *fl. ounces* (Imp. meas.) or 1250 cubic centimetres or a sufficient quantity. Moisten the Krameria with *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of the Alcohol; pack in a closed percolator; set aside for three days; percolate with the remaining Alcohol, added in ten equal portions at intervals of twelve hours; continue percolation with more Alcohol until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This concentrated solution of the Br. Ph. 1898 is really a 50 per cent. fluidextract, or a half strength official fluidextract. It belongs to the class of "liquors" introduced for the purpose of diluting with water to make infusions. (See *Infusum Krameriæ,* p. 655.) F. C. J. Bird has shown that the keeping properties of this preparation, which under the official conditions are very unsatisfactory, can be improved by the addition of about 5 per cent. of alcohol, or, better still, by adding 10 per cent. of glycerin. A preparation containing one-tenth its volume of glycerin remained bright, without deposit, when slightly acidified with acetic acid and allowed to stand for a few days, or when kept under ordinary conditions for some months, and also remained clear, without formation of any precipitate, when exposed to a temperature of about 0° C. Under similar conditions the official preparation yielded copious precipitates, while that containing 5 per cent. more alcohol also became turbid and gave a deposit, though in a lesser degree. Moreover, the preparation containing glycerin was rendered less turbid than the others on dilution with water, while its taste was somewhat more agreeable and its astringency practically the same. (*Y. B. P.,* 1902, 461-465.) This preparation fully represents the crude drug, and may be used internally.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR MAGNESII CARBONATIS. Br.

SOLUTION OF MAGNESIUM CARBONATE
[Fluid Magnesia]

(lĭ'quŏr măg-nē'shĭ-ī cär-bŏ-nā'tĭs)

Eau magnésienne, Magnésie liquide, *Fr.;* Kohlensaure Magnesialösung, Magnesiawasser, *G.*

"Magnesium Sulphate, 2 *ounces* (Imperial) or 40 grammes; Sodium Carbonate, 2½ *ounces* (Imp.) or 50 grammes; Distilled Water, *a sufficient quantity.* Dissolve the two salts separately, each in *half a pint* (Imp. meas.) or two hundred cubic centimetres of the Distilled Water; heat the solution of Magnesium Sulphate to the boiling point; add to it the solution of Sodium Carbonate; boil them together until carbonic anhydride ceases to be evolved; collect the precipitated magnesium carbonate on a calico filter; wash it with Distilled Water until the filtrate is free from sulphate. Mix the washed precipitate with *a pint* (Imp. meas.) or four hundred cubic centimetres of Distilled Water; place the mixture in a suitable apparatus; force into it pure washed carbonic anhydride; let the mixture remain in contact with excess of carbonic anhydride, retained under a pressure of about three atmospheres, for twenty-four hours or longer; decant the Solution, into which again pass carbonic anhydride. Keep the Solution in bottles of convenient sizes, securely closed to prevent the escape of carbonic anhydride." *Br.*

The object of this process is to obtain a solution of magnesium carbonate by means of carbon dioxide, the carbonate being insoluble in pure water. The first step is to prepare a freshly precipitated hydrated magnesium carbonate, which is more readily dissolved than is a carbonate which has been kept for some time. As the magnesium carbonate of the Br. Pharmacopœia consists of three molecules of the neutral carbonate and one of magnesium hydroxide with four molecules of water, it follows that, in its preparation from the two

salts used in the process, a portion of carbon dioxide escapes, and the boiling is directed to be continued until the escape of the gas ceases, so that the normal composition may be insured, and a longer heat, which might affect the constitution of the carbonate so as to diminish its solubility, avoided. The precipitate is thoroughly washed, in order to remove every trace of sodium sulphate, which may be indicated by the non-action of the test of barium chloride. The next step is to dissolve the precipitated carbonate in water impregnated with carbon dioxide, and, as the solution even thus favored is slowly effected, the carbonate is directed to remain exposed to the action of carbon dioxide, under pressure, for twenty-four hours, and still the whole of the carbonate is not dissolved, and filtration is necessary. According to the Br. Pharm. the solution "effervesces slightly, or not at all, when the containing vessel is first opened. It should yield no characteristic reaction with the test for sulphates. 20 cubic centimetres evaporated to dryness afford a white residue of pure hydrous magnesium carbonate, which after being calcined weighs between 0.16 and 0.19 gramme. This residue is insoluble in *water*, and when dissolved in dilute acid responds to the tests for magnesium. This Solution contains nearly 10 grains of the official Magnesium Carbonate in 1 fluid ounce, or about 2 grammes in 100 cubic centimetres." *Br.* On exposure to the air, some of the carbon dioxide escapes, and a portion of the salt is deposited. Redwood proposes to remedy this by reducing the strength of the solution. (*P. J.*, 2d ser., xi. 397.) Indeed, it has been shown by C. Muncy that the preparation as it occurs in commerce is usually much below the standard strength.

This solution is but slightly effervescent, is clear, and should be free from bitterness. Nevertheless its taste is more disagreeable than is that of the undissolved carbonate, over which it has no advantage.

Dose, as an antacid laxative, from one to two fluidounces (30 to 60 Cc.).

LIQUOR MAGNESII CITRATIS. U. S.

SOLUTION OF MAGNESIUM CITRATE

(lĭ'quŏr măg-nē'shĭ-ī cĭ-trā'tĭs)

Liquor Magnesii Citrici; Solution of Citrate of Magnesium; Limonade purgative au Citrate de Magnésie, *Fr. Cod.;* Flüssige Citronensaure Magnesia, Magnesiumcitratlösung, Magnesiumlimonade, *G.;* Limonata magnesiaca, *It.;* Limonada purgante de citrato magnesico, *Sp.*

* "Magnesium Carbonate, *fifteen grammes* [or 231 grains]; Citric Acid, *thirty-three grammes* [or 1 ounce av., 72 grains]; Syrup of Citric Acid, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Potassium Bicarbonate, *two and one-half grammes* [or 39 grains]; Water, *a sufficient quantity.* Dissolve the Citric Acid in *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims] of Water, and, having added the Magnesium Carbonate, stir until it is dissolved. Filter the solution into a strong bottle of the capacity of about *three hundred and sixty cubic centimeters* [or 12 fluidounces, 83 minims], containing the Syrup of Citric Acid. Then add enough Water to nearly fill the bottle, drop in the Potassium Bicarbonate, and immediately stopper the bottle securely. Lastly, shake the mixture occasionally, until the Potassium Bicarbonate is dissolved. This solution should be freshly prepared when wanted." *U. S.*

This formula first appeared in the second edition of the U. S. Pharmacopœia of 1850. The original formula was soon found to have defects. Four-fifths of the carbonate was dissolved in the citric acid, and the solution filtered into a bottle containing the syrup of citric acid, and then the reserved fifth, mixed with water, was added to the acid citrate, and the bottle tightly corked. The addition of the reserved carbonate was intended to impregnate the preparation with carbon dioxide by its solution in the excess of citric acid. To effect the solution of this reserved carbonate required at least half an hour. But the chief objection to the formula as originally framed was that the magnesium citrate, when the solution was kept for some days, crystallized out in the form of a white granular precipitate, which rendered the solution unfit for medicinal use. This precipitate was found by Procter to be $Mg_3(C_6H_5O_7)_2 + 14H_2O$. This still occurs to some extent, although more slowly, and probably cannot be avoided except by a very great reduction in the amount of magnesia.[1] The U. S. P. (8th Rev.) process improved the formula by increasing the quantity of citric acid, using 33 Gm. instead of 30 Gm. formerly used. The use of potassium bicarbonate introduces potassium citrate, but in too small a proportion to be of any consequence. It is somewhat more convenient to use calcined magnesia in place of the carbonate, and in one of the best processes that we have seen the fifteen grammes of carbonate in the official formula are replaced by five grammes of Jenning's light calcined

[1] *Extemporaneous Liquor Magnesii Citratis.*—The following formula has been proposed by J. C. Wharton as a means of always giving a customer a fresh solution of the citrate, which is substantially the same as that of the U. S. Pharmacopœia. "Syrup No. 1. Take of simple Syrup two pints; Spirit of Lemon sixty-four minims; Potassium Bicarbonate six hundred and forty grains. Mix, and make solution, and keep ready for use. Syrup No. 2. Take of Calcined Magnesia eighty-eight grains; Citric Acid four hundred and eight grains: Distilled Water a sufficient quantity. Mix the Magnesia and Citric Acid in a mortar and add one and a half fluidounces of Water. Stir with a pestle, and break up the lumps of acid if there be any. After solution is effected, add sufficient Water to make up the amount of one bottle nearly full, when mixed with two fluidounces of Syrup No. 1. These two solutions are to be kept separately. When Solution of Magnesium Citrate is called for, pour into the bottle Syrup No. 1 first, without touching the mouth or sides of the bottle; then pour in along the sides of the bottle Syrup No. 2, so as to avoid as far as possible mixing them, cork and agitate." For Edel's process, see *Proc. A. Ph. A.*, 1894, 582; Widlum's process, *Proc. A. Ph. A.*, 1896, 428.

magnesia. We prefer a modification in the manipulation of the official process; if instead of the solution being filtered into the bottles containing the syrup it is filtered into a separate vessel, and then the proper quantity poured very carefully down the inside of the bottle, or with the aid of a funnel having only a lateral opening so that the liquid is delivered against the sides of the bottle, so as not to disturb the heavy layer of syrup, if then the crystals of bicarbonate be dropped in, very little loss of carbon dioxide will ensue if the bottle is at once securely stoppered. When the bottle is dispensed, a vigorous shake at once liberates the carbon dioxide, and the patient is sure to have a highly effervescent liquid. Special bottles for this solution can now be procured which have a "patent stopper" attached; they are very convenient. Solid magnesium citrate is best used in the form of the effervescent magnesium citrate of the U. S. P. 1890.[1]

Properties.—This official solution is founded on a preparation proposed by Roge Delabarre, and improved by Rabourdin of Paris, It is an aqueous solution of magnesium citrate, containing an excess of citric acid, impregnated with carbon dioxide and sweetened with syrup. When properly prepared, it is a clear liquid, having an agreeable taste like that of lemonade. Overlooking the excess of acid which it contains, the salt present is the tribasic citrate, in which the six atoms of hydrogen from two molecules of citric acid are replaced by three atoms of magnesium. Accordingly, it consists of two molecules of citric acid and three atoms of magnesium. It is advisable in preparing the solution to introduce the magnesia in small portions, for if too hastily added it is liable to cause the formation of the neutral citrate, which cannot afterwards be readily dissolved. (*A. J. P.*, 1867.) Dorvault makes a solid magnesium citrate which is perfectly and readily soluble, by melting on a sand bath 100 parts of crystallized citric acid in its water of crystallization, and thoroughly incorporating with it 29 parts of calcined magnesia. A pasty mixture is formed, which soon hardens, and may be pulverized for use. Magnesium citrate, thus prepared, is soluble in twice its weight of water. When in saturated solution it soon precipitates as a nearly insoluble hydroxide, but with eight or ten times its weight of water it forms a permanent solution. Simonin finds that an insoluble magnesium citrate may be restored to solubility in boiling water by being thoroughly rubbed up with water so as to form a paste. The necessary trituration will be abridged if a little citric acid be added. (*Ann. Thér.*, 1857.)[2]

[1] *Magnesii Citras Effervescens.* U. S. 1890. *Effervescent Magnesium Citrate.* Magnesii Citras Granulatus, *U. S.* 1880; Granulated Citrate of Magnesium. "Magnesium Carbonate, *ten grammes* [or 154 grains]; Citric Acid, *forty-six grammes* [or 1 ounce av., 272 grains]; Sodium Bicarbonate, *thirty-four grammes* [or 1 ounce av., 87 grains]; Sugar, in fine powder, *eight grammes* [or 123 grains]; Alcohol, Distilled Water, each, *a sufficient quantity.* Mix the Magnesium Carbonate intimately with *thirty grammes* [or 1 ounce av., 25 grains] of Citric Acid and *four cubic centimeters* [or 65 minims] of Distilled Water, so as to form a thick paste. Dry this at a temperature not exceeding 30° C. (86° F.), and reduce it to a fine powder. Then mix it intimately with the sugar, the Sodium Bicarbonate, and the remainder of the Citric Acid previously reduced to a very fine powder. Dampen the powder with a sufficient quantity of Alcohol, so as to form a mass, and rub it through a No. 6 tinned-iron sieve. Then dry it, and reduce it to a coarse, granular powder. Keep the product in well-closed vessels." *U. S.* 1890. This was an official salt, intended to furnish an agreeable, effervescent drink. It is very important to obey the direction to keep it in well-closed bottles, for if access of air be permitted the moisture would soon cause the acid to act upon the carbonates and liberate the carbon dioxide gas gradually, and thus destroy the effervescent character of the preparation, its principal recommendation. Large quantities of so-called effervescent magnesium citrate are sold in this country and in England which contain no magnesium citrate at all, being effervescent salts of sodium tartrate. W. L. Scoville analyzed three commercial specimens. (*Ph. Rec.*, 1892, 267.) One English brand contained anhydrous magnesium sulphate, Rochelle salt, sodium bicarbonate, tartaric acid, and sugar; another English salt contained magnesium sulphate, sodium sulphate, potassium carbonate, sodium bicarbonate, tartaric acid, and sugar; a Philadelphia preparation contained magnesium carbonate, citric and tartaric acids, sodium and potassium bicarbonates, and sugar. It is in the form of "a white, coarsely granular salt, without odor, and having a mildly acidulous, refreshing taste. Deliquescent on exposure to the air. Soluble, with copious effervescence, in 2 parts of water at 15° C. (59° F.), and very soluble in boiling water; almost insoluble in alcohol. The aqueous solution (1 in 20) has an acid reaction, and, after the addition of ammonium chloride test-solution and a slight excess of ammonia water, it yields, with sodium phosphate test-solution, a white, crystalline precipitate. If to another portion of the aqueous solution a little calcium chloride test-solution be added, and then a slight excess of ammonia water, the filtered liquid will deposit a white precipitate on boiling. A saturated aqueous solution of the salt, when mixed with potassium acetate test-solution and a small quantity of acetic acid, should not yield a white, crystalline precipitate (absence of *tartrate*)." *U. S.* 1890. The medicinal properties are those of its solution, except that, as it does not contain a large excess of acid, it is less pleasant to the palate, but may in some cases suit the stomach better. (See *Liquor Magnesii Citratis.*) It has also the advantages of portability. The dose is from one to three teaspoonfuls.

[2] *Solid Magnesium Citrate.*—This salt as heretofore prepared, though soluble at first, is apt to become more or less insoluble when kept, in consequence of molecular change. The following process, by de Letter, of Brussels, yields a salt which is said to retain its solubility indefinitely. "Take of Citric Acid 20 parts, and of Magnesium Carbonate 12 parts. Powder the acid finely, and mix it intimately with the carbonate, also in fine powder. Allow the mixture to stand, at the ordinary temperature, for four or five days, or until it ceases to manifest reaction, when a little is thrown into water. During this time the powder slowly swells up, and gradually assumes the appearance of a spongy mass. Dry this at 30° C. (86° F.), pulverize it, and keep the powder in closely-stoppered vials." According to de Letter, water, in a certain quantity, favors the formation of an insoluble hydroxide, and hence the success of his process, in which no other water is present than that which is solidified in the dry materials. (*A. J. P.*, 1863, p. 312.) Hager has been unable to prepare a soluble salt by the process of de Letter. He considers magnesium citrate as presenting itself in three forms: 1, *crystallizable*, soluble in from 80 to 90 parts of water, with the formula $Mg_3(C_6H_5O_7)_2 + 7H_2O$; 2, *amorphous*, soluble in 2 parts of water; and, 3, *metamorphous*, soluble in 8 or 10 parts of water, with a strong tendency to crystallize. It is the crystalline variety, presenting the form of microscopic needles, that occasions the difficulty, and its production should be avoided. Hager proceeds in the following manner. Rub 40 parts of citric acid and 25 of magnesium carbonate, both in powder, with sufficient alcohol of 0.833 to make a thick mixture, and, having allowed this to stand for several days, at a medium temperature, dry it at a heat of 45°

For other modifications, suggestions, etc., see Kondratowisch, *N. R.*, 1883, p. 246; Neynaber, *A. J. P.*, 1884, p. 472 (the proposed substitution of acetic acid by the latter is not desirable, because of the impossibility of avoiding an empyreumatic taste); also A. B. Stevens, *Proc. Mich. State Pharm. Assoc.*, 1885; and F. W. Sennewald, *Nat. Drug.*, 1887.

Magnesium metatartrate has been proposed, in the place of the citrate, by Léger, who, however, states that as a purgative it is more powerful than the citrate, resembling the sulphate. On account of its pleasant taste it might, perhaps, be substituted for Epsom salt. Léger prepares *metatartaric acid* in the following manner. Into a porcelain dish put a small amount of tartaric acid, and heat it, with occasional agitation, on a slow fire until it fuses; then add successively small portions of the acid, so as not to cool the mass, lest it solidify and burn. When the dish is two-thirds full, cease adding the acid, but continue the heat until the mass, at first puffed up and doughy, is completely melted into an amber-colored liquid. Withdraw it from the fire, and when sufficiently cooled form it into pebbles, which must be kept in closely-stoppered bottles on account of their being hygroscopic. This acid is very soluble in water, and in this state greedily attacks the magnesium carbonate, forming with it a salt which is permanent even when in solution. (*J. P. C.*, xix. 226.)

Uses.—This solution is a cooling cathartic, and operates mildly. It has come into extensive use in the United States, on account of the facility with which it may be taken and its acceptability to the stomach.

Dose, as a purge, the whole quantity directed in the formula, or twelve fluidounces (360 Cc.); as a laxative, half that quantity.

LIQUOR MORPHINÆ ACETATIS. Br.

SOLUTION OF MORPHINE ACETATE

(lĭ'quŏr mör-phĭ'næ ăç-ẹ-tā'tĭs)

Soluté d'Acétate de Morphine, *Fr.;* Essigsaure Morphinlösung, *G.*

"Morphine Acetate, 17½ *grains* (Imperial) or 1 gramme; Diluted Acetic Acid, 38 *minims* (Imp. meas.) or 2 cubic centimetres; Alcohol (90 per cent.), 1 *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Distilled Water, *a sufficient quantity*. Mix the Alcohol with an equal volume of Distilled Water, adding the Diluted Acetic Acid; dissolve the Morphine Acetate in the mixture; dilute with sufficient Distilled Water to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Solution of Morphine Acetate. 110 minims contain 1 grain of Morphine Acetate; 100 cubic centimetres contain 1 gramme." *Br.*

Morphine Acetate often contains a little uncombined morphine, in consequence of the escape of a portion of the acid during its evaporation, and especially when this is pushed to dryness. It is on this account apt to be unreliable. Hence the addition of the diluted acetic acid, which at the same time neutralizes the alkaloid in excess and enables the solution to be completely effected. The alcohol is added as a preservative. The present solution contains about 1 per cent. of morphine acetate.

Dose, from fifteen to thirty minims (0.9 to 1.8 Cc.), equivalent to from one-eighth to one-fourth of a grain of the morphine acetate, and to about as many drops of tincture of opium as minims of the solution.

LIQUOR MORPHINÆ HYDROCHLORIDI. Br.

SOLUTION OF MORPHINE HYDROCHLORIDE

(lĭ'quŏr mör-phĭ'næ hȳ-drọ-ȼhlō'rĭ-dī)

Solution of Hydrochlorate of Morphine, *Br.* 1885; Liquor Morphiæ Muriatis, *Dub.;* Solution of Muriate of Morphia; Soluté de Hydrochlorate de Morphine, *Fr.;* Salzsaure Morphinlösung, *G.*

"Morphine Hydrochloride, 17½ *grains* (Imperial) or 1 gramme; Diluted Hydrochloric Acid, 38 *minims* (Imp. meas.) or two cubic centimetres; Alcohol (90 per cent.), 1 *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Distilled Water, *a sufficient quantity*. Mix the Alcohol with an equal volume of Distilled Water, adding the Diluted Hydrochloric Acid; dissolve the Morphine Hydrochloride in the mixture; dilute with sufficient Distilled Water to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Solution of Morphine Hydrochloride. 110 minims contain 1 grain of Morphine Hydrochloride; 100 cubic centimetres contain 1 gramme." *Br.*

The use of the alcohol is to prevent spontaneous decomposition, that of the acid probably to assist in the solution of the salt. The solution contains about 1 per cent. of morphine hydrochloride.

Dose, from fifteen to thirty minims (0.9 to 1.8 Cc.).

LIQUOR MORPHINÆ TARTRATIS. Br.

SOLUTION OF MORPHINE TARTRATE

(lĭ'quŏr mör-phĭ'næ tăr-trā'tĭs)

Soluté de Tartrate de Morphine, *Fr.;* Weinsteinsaure Morphinlösung, *G.*

"Morphine Tartrate, 17½ *grains* (Imperial) or 1 gramme; Alcohol (90 per cent.), 1 *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Distilled Water, *a sufficient quantity*. Mix the Alcohol with an equal volume of Distilled Water; dis-

C. (113° F.). The product is the amorphous salt, soluble in 2.5 parts of water, in half an hour at 15.5° C. (60° F.), immediately at 30° C. (86° F.). Its solution, whether made with hot or cold water, retains its clearness after long standing. The salt is neutral; and contains about 13 mols. of water. To succeed certainly it is necessary that the magnesium carbonate be free from dust and impurities. (*A. J. P.*, 1864, p. 19.)

solve the Morphine Tartrate in the mixture; add sufficient Distilled Water to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Solution." *Br.*

This solution was introduced into the Br. Ph. 1898 because of the superior solubility and stability of the morphine tartrate, and its adaptability for hypodermic administration, alcohol being used to preserve the liquid. It is of the same strength as the other solutions of morphine, about 1 per cent. "110 minims contain 1 grain of Morphine Tartrate; 100 cubic centimetres contain 1 gramme." *Br.*

Dose, from fifteen to thirty minims (0.9 to 1.8 Cc.).[1]

LIQUOR PANCREATIS. Br.

PANCREATIC SOLUTION

(lĭ'quŏr păn-crē'ă-tĭs)

"A liquid preparation containing the digestive principles of the fresh pancreas of the pig. The preparation is most active when the animal from which it is obtained has been fed shortly before being killed. *Five ounces* (Imperial) or two hundred and fifty grammes of the pancreas, freed from fat and external membrane and finely divided by trituration with washed sand or powdered pumice stone, should be digested, in a closed vessel, in *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of Alcohol (20 per cent.) for seven days, and then filtered." *Br.*

Liquor Pancreaticus; Soluté de Pancréatine, *Fr.;* Pancreatinlösung, Pankreasessenz, *G.*

This official preparation of the Br. Ph. 1898 has been introduced to supply the demand for a liquid digestive solution made from the pancreas; it closely resembles the preparation recommended by Benger. (*Proc. Roy. Soc.,* xxxii. 145; see also *Pancreatinum.*) The test, modelled on the U. S. P. test for pancreatin, is as follows: "If 2 cubic centimetres of the Solution, together with 0.2 gramme of *sodium bicarbonate* and 20 cubic centimetres of *water,* be added to 80 cubic centimetres of milk, and the mixture be kept at a temperature of 113° F. (45° C.) for one hour, coagulation should no longer occur on the addition of *nitric acid.*" *Br.* The solution digests albuminoids, converts starch into sugar in an alkaline solution, albumin and fibrin into peptones, and peptonizes milk. As it acts normally in alkaline solutions, while the gastric juices are strongly acid, its practical value as an internal medicament is doubtful.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

[1] Various solutions of morphine sulphate have been in vogue, but have been abandoned by the Pharmacopœias on account of their tendency to undergo decomposition. The U. S. 1870 solution (*Liquor Morphiæ Sulphatis*) contained 1 grain of morphine sulphate to the fluidounce; the Br. 1885 solution 4.375 grains in the same quantity. *Magendie's solution of Morphine* was of the strength of 16 grains to the fluidounce.

LIQUOR PICIS CARBONIS. Br.

SOLUTION OF COAL TAR

(lĭ'quŏr pī'cĭs căr-bŏ'nĭs)

Soluté de Goudron de Houille, *Fr.;* Kohlentheerlösung, *G.*

"Prepared Coal Tar, 4 *ounces* (Imperial) or 200 grammes; Quillaia Bark, in No. 20 powder, 2 *ounces* (Imp.) or 100 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Moisten the powdered Quillaia Bark with *one fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Alcohol, and complete the percolation process with the remainder of the Alcohol as for Tinctures, *one pint* (Imp. meas.) or one thousand cubic centimetres being produced. To the resulting percolate add the Prepared Coal Tar, and digest the mixture at 120° F. (48.9° C.) for two days, occasionally stirring. Cool and decant, or filter." *Br.*

This solution of the Br. Ph. 1898 is practically identical with *Liquor Carbonis Detergens, Coal Tar Saponine,* and similar well known preparations which have been largely used by dermatologists. The process for solution of coal tar is modelled after that for *compound tincture of coal tar,* proposed by L. A. Duhring (*Am. J. M. S.*), who recommended digesting 1 part of coal tar with 6 parts of tincture of quillaja for eight days, and then filtering. It owes its virtues largely to phenol and other derivatives of coal tar. (See *Coal Tar,* PART II.)

Solution of coal tar is stimulating, and is prescribed, diluted with from ten to fifty parts of water, as a wash in *eczema, psoriasis, pruritis,* and other skin diseases.

LIQUOR PLUMBI SUBACETATIS. U. S. (Br.)

SOLUTION OF LEAD SUBACETATE
[Goulard's Extract]

(lĭ'quŏr plŭm'bī sŭb-ăç-ē-tā'tĭs)

"An aqueous liquid, which should contain in solution not less than 25 percent. of Lead Subacetate [approximately $Pb_2O(CH_3.COO)_2 = 543.74$]." *U. S.*

Liquor Plumbi Subacetatis Fortis, *Br.,* Strong Solution of Lead Subacetate; Acetum Plumbi, Acetum Saturni, Plumbum Hydrico-Aceticum Solutum; Acétate (sous-) de Plomb liquide, *Fr. Cod.;* Extrait de Goulard, Vinaigre de Plomb (de Saturne), *Fr.;* Liquor Plumbi Subacetici, *P. G.;* Bleiessig, *G.*

• "Lead Acetate, *one hundred and eighty grammes* [or 6 ounces av., 153 grains]; Lead Oxide, *one hundred and ten grammes* [or 3 ounces av., 385 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. To the finely powdered Lead Oxide contained in a porcelain dish, of about one liter [or 2 pints] capacity, add slowly and in portions, with constant stirring, the Lead Acetate which has

been previously dissolved in *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of boiling Distilled Water, and boil the liquid for half an hour, with occasional stirring. Finally, when cool, filter the Solution, and add sufficient Distilled Water, which has been previously boiled and cooled, to make the finished product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Keep the Solution in well-stoppered bottles." *U. S.*

"Lead Acetate, 5 *ounces* (Imperial) or 250 grammes; Lead Oxide, in powder, 3½ *ounces* (Imp.) or 175 grammes; Distilled Water, *a sufficient quantity.* Boil the Lead Acetate and the Lead Oxide in *one pint* (Imp. meas.) or one thousand cubic centimetres of Distilled Water for half an hour, constantly stirring, and maintaining the volume of the liquid by occasional additions of Distilled Water; filter; when the liquid is cold add sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Strong Solution." *Br.* The sp. gr. of the solution is 1.275.

The U. S. (8th Rev.) process does not differ essentially from that formerly official, the quantities of both lead ingredients were, however, slightly increased. Crystallized lead acetate consists of one atom of lead 205.35, two acetic acid groups 117.16, and three molecules of water 53.64 = 376.15. The formula is $Pb(C_2H_3O_2)_2 + 3H_2O$. Litharge, as usually found in commerce, is an impure lead oxide. When solution of lead acetate is boiled with lead oxide, a large quantity of the oxide is dissolved, and a lead subacetate is formed which remains in solution. The precise composition of the subacetate varies with the proportion of lead acetate and of litharge employed. Thus, starting with three molecules of normal acetate, $Pb_3(C_2H_3O_2)_6$, we may have $Pb_3O(C_2H_3O_2)_4$ and $Pb_3O_2(C_2H_3O_2)_2$ formed successively. The latter of these oxyacetates is known as Goulard's, and a mixture of the two constitutes the basis of the official solution. In executing the process, the litharge should be employed in very fine powder, and, according to Thénard, should be previously calcined in order to decompose the lead carbonate which it always contains in greater or less proportion, and which is not dissolved by the solution of the acetate. Nevning states that a solution of lead subacetate more permanent than the official one may be prepared by simply allowing litharge to remain for twenty-four hours in a solution of lead acetate, with occasional agitation. This preparation probably contains much less of the lead oxide than does the official solution. Courtonne recommends dissolving seventy-five parts by weight of crystallized lead acetate in one hundred and sixty-five parts of water, and adding eleven parts of ammonia water, sp. gr. 0.923. This quick method has the disadvantage of containing ammonium acetate in small quantity. (*Chem. Ztg.*, 1894.) For Haussmann's method by agitating the lead salts with hot water, see *A. J. P.*, 1897, 559; *A. J. P.*, 1896, 427; *M. R.*, 1896, 329; *Ph. Rev.*, 1896, 250.

Properties.—The solution of lead subacetate of the U. S. Pharmacopœia is "a clear, colorless liquid, odorless, having a sweetish, astringent taste, and an alkaline reaction. On exposure to the air it absorbs carbon dioxide, which causes the formation of a white precipitate. Specific gravity: about 1.235 at 25° C. (77° F.). When Solution of Lead Subacetate is added to a solution of acacia, it produces a dense, white precipitate (distinction from *normal lead acetate*). In other respects the Solution conforms to the reactions and tests for an aqueous solution of lead acetate given under *Plumbi Acetas.* If 10 Gm. of the Solution be diluted with distilled water, which has been previously boiled and cooled, to measure 100 Cc., and 13.6 (13.594) Cc. of this be added to 35 Cc. of tenth-normal oxalic acid V.S., contained in a graduated cylinder, and, after thoroughly shaking, the mixture be diluted with distilled water to measure 50 Cc., and again well shaken, then, after the precipitate has settled, 10 Cc. of the clear solution, after diluting with about 50 Cc. of water and adding 5 Cc. of sulphuric acid, should require not more than 2 Cc. of tenth-normal potassium permanganate V.S. to produce a permanent pink tint (each Cc. of tenth-normal oxalic acid V.S. required for the precipitation of the 13.6 Cc. of the diluted Solution, corresponding to 1 percent. of Lead Subacetate)." *U. S.* "A clear colorless liquid, with alkaline reaction and sweet astringent taste. It becomes turbid by exposure to the air. It forms with *mucilage of gum acacia* an opaque white jelly. It affords the reactions characteristic of lead and of acetates. Specific gravity 1.275. Each gramme should require for complete precipitation 17 cubic centimetres of the *decinormal volumetric solution of sulphuric acid.*" *Br.* When concentrated by evaporation, it deposits on cooling crystalline plates, which, according to Barker are flat, rhomboidal prisms, with dihedral summits.[1] It has an alkaline reaction, tingeing the syrup of violets green, and reddening turmeric paper. One of its most striking properties is the extreme facility with which it is decomposed. Carbon dioxide throws down a white precipitate of lead carbonate; and this happens by mere exposure to the air, or by mixture even with distilled water, if this has had an opportunity of absorbing carbon dioxide from the atmosphere. It affords precipitates also with the alkalies, alkaline earths, and their carbonates, with sulphuric

[1] *Crystallized Lead Subacetate.*—Jeannel prepares crystallized lead subacetate in accordance with the following formula. Triturate six parts of neutral lead acetate with two parts of pure litharge, and add one part of water. Heat in a porcelain dish, stirring with a glass rod, until fusion and finally ebullition occur. After two or three minutes of boiling, filter through paper in a funnel heated by a sand bath. Allow to cool and crystallize. (*J. P. C.*, 4e sér., xl. 54.)

and hydrochloric acids free or combined, with hydrogen sulphide and the sulphydrates, with the soluble iodides and chlorides, and, according to Thénard, with solutions of nearly all neutral salts. Solutions of gum, tannin, most vegetable coloring principles, and many animal substances, particularly albumin, produce with it precipitates consisting of the substance added and lead oxide. It should be kept in well-stoppered bottles. It is known to contain a salt of acetic acid by emitting an acetous odor when treated with sulphuric acid, and a salt of lead by yielding a white precipitate with an alkaline carbonate, a yellow one with potassium iodide, and a black one with hydrogen sulphide. It is distinguished from the solution of lead acetate by being precipitated by gum arabic. For a method (other than the official) of assaying this solution volumetrically, see *P. J.*, 1886, 656.

Uses.—This solution is astringent and sedative, but is employed only as an external application. It is highly useful in inflammation arising from *sprains, bruises, burns, blisters,* etc., to which it is applied by means of linen cloths, which should be removed as fast as they become dry. It always, however, requires to be diluted. From four fluidrachms to a fluidounce (15 to 30 Cc.), added to a pint (480 Cc.) of distilled water, forms a solution sufficiently strong in ordinary cases of external inflammation. When applied to the skin denuded of the cuticle, the solution should be still weaker, as constitutional effects might result from the absorption of the lead. Paralysis is said to have been produced by its local action; and poisoning by its injection for gonorrhœa has been reported. (*Dublin Journ. Med. Sci.*, 1874.) The solution has the common name of *Goulard's extract*, derived from a surgeon of Montpellier by whom it was introduced into general notice, though previously employed.

Off. Prep.—Ceratum Plumbi Subacetatis, *U. S.*; Liquor Plumbi Subacetatis Dilutus, *U. S.*, *Br.*

LIQUOR PLUMBI SUBACETATIS DILUTUS. U. S., Br.

DILUTED SOLUTION OF LEAD SUBACETATE
[Lead Water]

(lĭ'quŏr plŭm'bī sŭb-ăç-ẹ-tā'tĭs dī-lū'tŭs)

"An aqueous liquid, which should contain about 1 percent. of Lead Subacetate." *U. S.*

Aqua Saturnina; Goulard's Lotion, Goulard Water, *Br.*; Diluted Solution of Subacetate of Lead; Lotion a l'Acétate de Plomb, *Fr. Cod.*; Eau de Saturne, Eau de Goulard, Eau blanche, *Fr.*; Aqua Plumbi, *P. G.*; Bleiwasser, Kuhlwasser, *G.*

* "Solution of Lead Subacetate, *forty grammes* [or 1 ounce av., 180 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Solution of Lead Subacetate with enough Distilled Water, previously boiled and cooled, to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Keep the Solution in well-stoppered bottles." *U. S.*

"Strong Solution of Lead Subacetate, 2 *fl. drachms* (Imperial measure) or 5 cubic centimetres; Alcohol (90 per cent.), 2 *fl. drachms* (Imp. meas.) or 5 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Alcohol with *nineteen and a half fluid ounces* (Imp. meas.) or three hundred and ninety cubic centimetres of recently boiled and cooled Distilled Water; add the Strong Solution of Lead Subacetate and shake." *Br.*

In the U. S. D. comments on the U. S. process of 1850 it was stated that the strength of our official preparation, though double what it formerly was, might be still further increased with propriety. In the edition of the U. S. Pharmacopœia of 1870 the proportion was increased from two to three fluidrachms to the pint, and this proportion has been practically retained in the preparation now official. The direction to dilute the strong solution with distilled water *previously boiled and cooled* is an improvement, as even the small amount of carbon dioxide dissolved in distilled water usually made the lead water cloudy. Owing to the liability to serious results due to the frequent confounding of the name lime water and lead water, it is safer to dispense lead water in a slightly opalescent condition, while lime water should be perfectly transparent. The Br. preparation, though stronger than the old one of the London College, is still feeble. The minute proportion of alcohol in the British solution can have little effect. The preparation should be excluded from the air as much as possible.

LIQUOR POTASSII ARSENITIS. U. S. (Br.)

SOLUTION OF POTASSIUM ARSENITE
[Fowler's Solution]

(lĭ'quŏr pŏ-tăs'sī-ī är-sẹ-nī'tĭs)

"An aqueous solution, which should contain Potassium Arsenite corresponding in amount to 1 percent. of arsenic trioxide." *U. S.* "110 minims contain 1 grain of Arsenious Anhydride; 100 cubic centimetres contain 1 gramme." *Br.*

Liquor Arsenicalis, *Br.*; Arsenical Solution; Solutio Arsenicalis Fowleri, Kali Arsenicosum Solutum; Soluté d'Arsénite de Potasse, *Fr. Cod.*; Liqueur de Fowler, Liqueur arsénicale de Fowler, *Fr.*; Liquor Kalii arsenicosi, *P. G.*; Fowlersche Tropfen, Fowlersche Lösung, *G.*; Soluzione alcalina di arsenito de potassio, Liquore del Fowler, *It.*; Solucion de arsenito potasico, Licor arsenical de Fowler, *Sp.*

* "Arsenic Trioxide, in fine powder, *ten grammes* [or 154 grains]; Potassium Bicarbonate, *twenty grammes* [or 309 grains]; Compound Tincture of Lavender, *thirty grammes* [or 1 ounce av., 26 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Boil the Arsenic

Trioxide and Potassium Bicarbonate, in a tared dish, with *one hundred grammes* [or 3 ounces av., 231 grains] of Distilled Water, until solution has been effected. Then add enough Distilled Water to make the solution weigh *nine hundred and seventy grammes* [or 34 ounces av., 94 grains], and, lastly, add the Compound Tincture of Lavender. Filter through paper." *U. S.*

"Arsenious Anhydride, in powder, 87½ *grains* (Imperial) or 10 grammes; Potassium Carbonate, 87½ *grains* (Imp.) or 10 grammes; Compound Tincture of Lavender, 5 *fl. drachms* (Imp. meas.) or 31.25 cubic centimetres; Distilled Water, *a sufficient quantity*. Heat the Arsenious Anhydride and the Potassium Carbonate with *ten fl. ounces* (Imp. meas.) or five hundred cubic centimetres of Distilled Water in a one-pint (or one-litre) flask until a clear solution is obtained; cool; add the Compound Tincture of Lavender and sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Solution." *Br.* The sp. gr. of this solution is about 1.010.

This preparation originated with Fowler of Stafford, England, and was intended as a substitute for the celebrated remedy known under the name of "the *tasteless ague drop.*" The strength of the present official solution is somewhat greater than that of the Fowler's solution of U. S. P. 1870; it now contains potassium arsenite corresponding in amount to 1 per cent. of arsenic trioxide, and the British solution has been made to correspond with this. It is a potassium arsenite dissolved in water, and is formed by the combination of the arsenic trioxide with the potassium of the bicarbonate or carbonate, carbon dioxide being evolved. In the present U. S. process the bicarbonate has been preferred to the carbonate, and in order to expedite the process the quantity has been doubled. As the bicarbonate is decomposed to carbonate by boiling water, there is present in the finished solution some potassium carbonate. According to M. H. Buignet, ebullition disengages the carbon dioxide slowly, so that after four hours' boiling the solution still retains about one-sixth of this gas. (*J. P. C.*, 1856, p. 440.) The name by which the preparation is designated in the U. S. Pharmacopœia is the more correct. The contact of arsenic trioxide with potassium bicarbonate in the presence of a small quantity of boiling water gives rise to effervescence with decomposition of bicarbonate. It has, however, been denied that potassium carbonate is decomposed by arsenic trioxide, which is supposed to be merely held by it in solution, and, in this view of the nature of the preparation, the British name of Arsenical Solution would be appropriate. The compound spirit of lavender is added to give it taste and prevent its being mistaken for water. For Oldberg's process, see *Proc. A. Ph. A.*, 1893, 430; see also *A. J. P.*, 1895, 403.

In making this preparation care should be taken that the arsenic trioxide is pure. This object is best secured by using the form which comes in small pieces instead of the commercial powder, and powdering the lumps in a mortar. Calcium sulphate is a common impurity in the powdered oxide, and if present will remain undissolved, and cause the solution to be weaker than it should be. Another insoluble impurity in the powdered oxide is calcium arsenite, which is sometimes present to the amount of 25 per cent. (Buignet.) Hence, if the arsenic trioxide does not entirely dissolve the solution must be rejected.

Properties.—Solution of potassium arsenite is a transparent liquid, having slightly the color, taste, and odor of the compound tincture of lavender. It has an alkaline reaction. It is decomposed by the usual reagents for arsenic, by silver nitrate, the salts of copper, lime water, and hydrogen sulphide, and is incompatible with the infusions and decoctions of cinchona. Before hydrogen sulphide will act, the solution must be acidulated with some acid, as hydrochloric or acetic. "If 24.6 Gm. of Solution of Potassium Arsenite be diluted with water to 100 Cc., the mixture very slightly acidified with diluted hydrochloric acid, and then made alkaline with 2 Gm. of sodium bicarbonate, it should require not less than 50 Cc. of tenth-normal iodine V.S. to produce a permanent yellow tint (corresponding to 1 Gm. of arsenic trioxide in 100 Gm. of the solution)." *U. S.* "A reddish liquid, alkaline to *test-papers*, and having the odor of lavender. 25 cubic centimetres, neutralized with *hydrochloric acid*, and diluted with *water*, should discharge the color of 50.8 to 50.9 cubic centimetres of the *volumetric solution of iodine*, the presence of a slight excess of *sodium bicarbonate* being maintained throughout the operation. 110 minims contain 1 grain of Arsenious Anhydride; 100 cubic centimetres contain 1 gramme." *Br.* According to R. Fresenius, solutions of alkaline arsenites slowly absorb oxygen from the air, and are in part converted into arsenates. Hence the propriety of keeping this solution in small bottles well filled. Mohr states that the alkaline reaction of the official solution delays the change, and experience has confirmed this statement. The slight precipitate found in this solution after keeping proved to be silicic acid, caused by the action of the alkaline solution on the glass container.

Uses.—This solution has the general action of the arsenical preparations on the animal economy, already described under the head of *Arseni Trioxidum*. Its liquid form makes it convenient for exhibition and gradual increase, and it is the preparation generally resorted to when arsenic is given internally. It has been much employed in *intermittent fever*. In *chorea* it is almost a specific, and in *nervous diseases* of debility it is often very useful. In *malarial affections* and *chorea* it should be administered in ascending doses until the puffiness about the eyes or disturbance of the bowels betrays the arsenical impression. Fowler's solution is a

very valuable remedy in various *skin diseases*, and has the great advantage over the solid preparations that the dose may be readily increased from day to day. One hundred minims of the solution contain the equivalent of very nearly one grain of arsenic trioxide. For the peculiar effects upon the human organism, see *Arseni Trioxidum.*

Duflos's antidote to the poisonous effects of Fowler's solution, and of the salts of the acids of arsenic generally, is ferric acetate with excess of base, made by dissolving freshly precipitated ferric hydroxide in acetic acid to saturation, adding an equal quantity of the hydroxide to the solution, and diluting the whole with water to the consistence of cream. If the official solution of ferric acetate be used in an emergency, the free acid should first be neutralized with a little ammonia.

Dose, of potassium arsenite solution, three to five minims (0.2 to 0.3 Cc.).

LIQUOR POTASSII CITRATIS. U. S.

SOLUTION OF POTASSIUM CITRATE
[Neutral Mixture]

(lĭ'quŏr pŏ-tăs'sĭ-ī cĭ-trā'tĭs)

"An aqueous liquid, containing in solution not less than 8 percent. of anhydrous Potassium Citrate [$C_3H_4(OH)(COOK)_3 = 304.2$], with small amounts of citric and carbonic acids." *U. S.*

Mistura Potassii Citratis; Liquor Kalii Citrici; Citrate de Potasse liquide, *Fr.*; Flüssiges Citronensaures Kali, Kaliumcitratlösung, *G.*

* "Potassium Bicarbonate, *eight grammes* [or 123 grains]; Citric Acid, *six grammes* [or 92 grains]; Distilled Water, *a sufficient quantity*, to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Dissolve the Potassium Bicarbonate and the Citric Acid, each, in *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Distilled Water. Filter the solutions separately, and wash the filters with enough Distilled Water to obtain, in each case, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]. Finally, mix the two solutions, and, when effervescence has nearly ceased, transfer the liquid to a bottle. This preparation should be freshly made when wanted." *U. S.*

Solution of Potassium Citrate has been made identical with the mixture formerly official as *Mistura Potassii Citratis;* nevertheless, the mixture made with lemon juice will continue to be preferred by some practitioners; its formula is therefore retained here as a foot-note.[1] The *official solution* is stronger than the mixture, and is more definite in composition; lemon juice varies in strength, and consequently the amount of potassium citrate in the resulting mixture cannot be uniform. On the other hand, the mixture is much to be preferred on account of its more agreeable taste. An improvement has been made in the present official solution in directing the acid and the alkaline salt to be dissolved separately, and the direction to dispense the preparation in a fresh condition will undoubtedly lead to the keeping of the filtered solutions, by the pharmacist, in separate bottles, and mixing in equal measures or weights when prescribed. The solutions keep well for a considerable length of time, and the greater convenience and saving of time and labor, besides

[1] *Mistura Potassii Citratis*, U. S. 1880. *Mixture of Citrate of Potassium.* [*Neutral Mixture.*] *Mistura Neutralis; Potion gazeuse* (*effervescente*), Fr. "Fresh Lemon Juice, strained, *one hundred parts* [or four fluidounces]; Bicarbonate of Potassium, about *ten parts*, or, *a sufficient quantity*. Add the Bicarbonate of Potassium gradually to the Lemon Juice until it is neutralized. This preparation should be freshly made, when wanted for use."

In this preparation the potassium of the bicarbonate unites with the citric acid of the lemon juice and carbon dioxide is liberated. The result, therefore, is a solution of potassium citrate in water impregnated with carbon dioxide, with the flavor from the lemon juice. The solution has a greenish-yellow color, and it is not usually dispensed in a perfectly transparent condition, owing to the difficulty of filtering out the very fine albuminous precipitate found in lemon juice. About 48 grains of the crystals of the bicarbonate, 33 grains of the pure and perfectly dry carbonate, or 45 grains of the hydrated carbonate found in commerce, are sufficient to saturate a fluidounce of good lemon juice, but the strength of the juice is variable, and the carbonate is apt to absorb moisture from the air, so that precision as to quantities cannot be readily attained. Hence the propriety of the direction, in the process for the neutral mixture, to add the alkaline carbonate to saturation. The point of saturation may be determined by the cessation of effervescence, by the absence of either an acid or an alkaline taste, and still more accurately by litmus paper, which should not be rendered bright red by the solution, or blue if previously reddened by an acid. The inequality of strength in the lemon juice renders the neutral mixture prepared with it more or less uncertain, though, if the apothecary selects ripe and sound fruit, and expresses the juice himself, the preparation will be found to approach sufficiently near a uniform standard for all practical purposes. Nevertheless, if the physician wishes absolute precision, he may order the neutral mixture to be made with crystallized citric acid, as directed in *Liquor Potassii Citratis;* or he may pursue the following plan, suggested in former editions of this work. Dissolve two drachms of potassium bicarbonate in two fluidounces of water; saturate the solution with good fresh lemon juice and strain; and, lastly, add enough water to make the mixture measure six fluidounces. A fluidounce is the dose of this solution.

Effervescing Draught.—Under this name, potassium citrate is often prepared extemporaneously, and given in the state of effervescence. The most convenient mode of exhibition is to add to a fluidounce of a mixture consisting of equal parts of lemon juice and water, half a fluidounce of a solution containing fifteen grains of potassium carbonate, or twenty grains of the bicarbonate. Should effervescence not occur, as sometimes happens, when the carbonate is used, in consequence of the weakness of the lemon juice, more of the juice should be added; as, unless sufficient acid be present to neutralize the alkalinity, part of the carbonate will pass into the state of bicarbonate, and the gas be prevented from escaping. The fifteen grains of potassium carbonate above mentioned are scarcely sufficient to saturate the lemon juice, if of ordinary strength; but a little excess of the acid renders the preparation more agreeable to the taste. Some prefer the bicarbonate in the preparation of the effervescing draught, because it will always effervesce with lemon juice, no matter what may be the strength of the latter. But this is an objection. The carbonate serves, by the absence of effervescence, to indicate when the lemon juice is very weak in acid, and the defect may then be easily remedied by the addition of more juice. When the bicarbonate is used, if there should be a deficiency of acid, it is not discovered, and the patient takes a considerable portion of undecomposed bicarbonate, instead of the full quantity of citrate intended.

the satisfaction of dispensing an effervescing solution, will be strong inducements to adopt this course.

Properties.—The U. S. Pharmacopœia describes the solution as "a clear, colorless liquid, odorless, having a mildly saline taste, and a slightly acid reaction. It should conform to the reactions and tests for an aqueous solution of the salt given under *Potassii Citras*. If 10.14 Gm. of Solution of Potassium Citrate be evaporated to dryness and then thoroughly carbonized at a temperature not exceeding a low red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the filtrate should require, for complete neutralization, not less than 16 Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator (each Cc. of the half-normal sulphuric acid V.S. consumed representing 0.5 percent. of anhydrous Potassium Citrate)." *U. S.*

Uses.—The solution of potassium citrate has long been used under the name of *neutral mixture, saline mixture,* or *effervescing draught.* It formerly was much used as a refrigerant diaphoretic, in cases of *fever* with dry skin, but has been largely superseded by the more potent antipyretics. In some cases, however, it makes a useful vehicle for the administration of antipyrine and similar drugs. The *effervescing draught* is especially valuable in *malarial, remittent* and other *fevers,* when there is great irritability of the stomach. The whole of the effervescing draught made in accordance with the formula (page 732) may be taken at once, the dose being repeated in from one to three hours according to the symptoms.

Dose, of official solution, four fluidrachms (15 Cc.).

LIQUOR POTASSII HYDROXIDI.
U. S. (Br.)

SOLUTION OF POTASSIUM HYDROXIDE
[Liquor Potassæ, Pharm. 1890, Solution of Potassa]

(lĭ'quọr pọ-tăs'sĭ-ī hȳ-drŏx'ĭ-dī)

"An aqueous solution, containing about 5 percent. of Potassium Hydroxide [KOH = 55.74]." *U. S.* "An aqueous solution containing in 110 minims 6.2 grains, or in 1 fluid ounce 27 grains of potassium hydroxide, KOH." *Br.*

Liquor Potassæ, *Br.;* Kali Hydricum Solutum, Lixivium Causticum; Solution of Potash; Potasse caustique liquide, Lessive caustique, *Fr.;* Liquor Kali Caustici, *P. G.;* Aetzkalilauge, Kalilauge, *G.*

* "Potassium Hydroxide, *sixty grammes* [or 2 ounces av., 51 grains]; Distilled Water, *nine hundred and forty grammes* [or 33 ounces av., 69 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Dissolve the Potassium Hydroxide in the Distilled Water. The Potassium Hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (85 percent.). Potassium Hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5100 by the percentage of absolute Potassium Hydroxide contained therein. Solution of Potassium Hydroxide should be kept in bottles made of green glass, and provided with glass stoppers coated with paraffin or petrolatum." *U. S.*

In the U. S. P. (8th Rev.) the only process for making this solution is the simple one of dissolving potassium hydroxide in sufficient distilled water to make a 5 per cent. solution, the former process of decomposing potassium bicarbonate with lime and mixing with water having been dropped. As this is sometimes used it is appended.[1]

The British Pharmacopœia 1898 does not give a detailed process, merely specifying that one fluidounce shall contain twenty-seven grains of potassium hydroxide.

According to Wöhler, solution of pure potassium hydroxide for analytical purposes may be conveniently obtained by exposing for half an hour to a moderate red heat, in a copper crucible, one part of pure potassium nitrate, and two or three parts of copper cut into small pieces. The resulting mass, consisting of potassium hydroxide and black oxide of copper, is treated with water, and the solution poured into a narrow cylindrical vessel, where it is left until it gets perfectly clear by the deposition of the oxide of copper. It is then drawn off, and kept in well-stoppered bottles. (*Chem. Gaz.,* Nov. 15, 1853, p. 429.) Graf and Riegel assert that potassium hydroxide, thus obtained, contains potassium nitrate and nitrite, but A. Geuther found it perfectly pure, when the process was properly conducted. (*Chem. Gaz.,* June 1, 1856.) A pure hydroxide may also be obtained by the process of Mohr, which consists in precipitating solution of potassium sulphate with caustic baryta, obtained from the nitrate. Thus procured, the alkali is entirely free from chlorine, silica, and sulphuric acid. (*P. J.,* xvi. 310.)

[1] *Liquor Potassæ,* U. S. P. 1890.—An aqueous solution of Potassium Hydrate [KOH = 55.99] containing about 5 per cent. of the hydrate. "Potassium Bicarbonate, *eighty-five grammes* [or 3 ounces av.]; Lime, *forty grammes* [or 1 ounce av., 180 grains]; Distilled Water, *a sufficient quantity.* Dissolve the Potassium Bicarbonate in *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Distilled Water, heat the solution until effervescence ceases, and then increase the heat to the boiling point of the liquid. Slake the Lime with about *twenty cubic centimeters* [or 325 minims] of Distilled Water, then mix it well with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Distilled Water, pour the mixture into a tared flask, and, having heated it to boiling, gradually add to it the solution of Potassium Bicarbonate, and boil during ten minutes. Then add enough Distilled Water to the flask to make the contents weigh *one thousand grammes* [or 35 ounces av., 120 grains], and set the flask aside, well stoppered, until the contents are cold. Lastly, strain the liquid through linen, set it aside in a well-stoppered bottle until it has become clear by subsidence, and separate the clear solution by decantation, or by means of a siphon." *U. S.* 1890.

Properties.—Solution of potassium hydroxide is "a clear, colorless liquid, odorless, having a very acrid and caustic taste, and a strongly alkaline reaction. Specific gravity: about 1.046 at 25° C. (77° F.). It should conform to the reactions and tests for an aqueous solution of potassium hydroxide given under *Potassii Hydroxidum*. To neutralize 28 (27.87) Gm. of Solution of Potassium Hydroxide should require about 25 Cc. of normal sulphuric acid V.S., methyl-orange T.S. being used as indicator (each Cc. of normal sulphuric acid V.S. indicating 0.2 percent. of absolute Potassium Hydroxide)." *U. S.* "A colorless, odorless, and transparent liquid having a nauseous taste. It is strongly alkaline. It should not yield any characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, calcium, magnesium, sodium, or ammonium, and should be free from more than traces of carbonates, chlorides, or sulphates. Specific gravity 1.058. 9 cubic centimetres should require for neutralization 10 cubic centimetres of the *volumetric solution of sulphuric acid*, corresponding to 0.557 gramme of potassium hydroxide, KOH, or to 6.19 grammes in 100 cubic centimetres, or to 5.85 grammes in 100 grammes. Solution of Potash should be preserved in a green glass bottle furnished with an air-tight stopper." *Br.* It acts rapidly on animal and vegetable substances, and when rubbed between the fingers produces a soapy feeling, in consequence of a partial solution of the cuticle. It dissolves gum, resins, and extractive matter, and forms soap with oily and fatty bodies. Lead may be detected by a black precipitate produced by ammonium sulphydrate. When solution of potassium hydroxide is used as a test for diabetic urine, it should be free from lead, the presence of which renders the test ambiguous. With hydrochloric acid and platinic chloride it produces a yellow precipitate, showing that the alkali present is potassium hydroxide. It is incompatible with acids, acidulous salts, and all metallic and earthy salts held in solution by an acid; also with all ammoniacal salts, and with calomel and corrosive sublimate. The two official solutions of potassium hydroxide vary in strength, the U. S. solution having the sp. gr. 1.046 at 25° C. (77° F.) and the Br. 1.058. These solutions are very dilute, that of the U. S. Pharm., which is the weaker, containing only 5 per cent. of potassium hydroxide; the percentage of potassium hydroxide in the solution of the Br. Pharm. is 5.85. On account of its strong attraction for carbon dioxide, solution of potassium hydroxide should be carefully preserved from contact with the air.

Uses.—Solution of potassium hydroxide is antacid, diuretic, and antilithic, and was formerly much used, but, on account of its irritant properties, has been superseded by the carbonated alkalies.

Dose, ten to thirty minims (0.6 to 1.8 Cc.).

Off. Prep.—Fluidextractum Senegæ, *U. S.*

LIQUOR POTASSII PERMANGANATIS. Br.

SOLUTION OF POTASSIUM PERMANGANATE

(lĭ'quŏr pŏ-tăs'sĭ-ī pĕr-măn'gą-nā'tĭs)

Soluté de Permanganate de Potasse, *Fr.*; Kaliumpermanganatlösung, *G.*

"Potassium Permanganate, 87½ *grains* (Imperial) or 10 grammes; Distilled Water, *a sufficient quantity*. Dissolve the Potassium Permanganate in sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Solution. 110 minims contain 1 grain of potassium permanganate; 100 cubic centimetres contain 1 gramme." *Br.*

This is an unstable 1 per cent. solution of potassium permanganate which decomposes upon exposure and deposits manganese oxides.

Dose, of the British Pharmacopœia, from two to four fluidrachms (7.5 to 15 Cc.), equivalent to from 1.1 to 2.2 grains of the salt. Very few stomachs will bear more than one grain (0.065 Gm.) of the permanganate.

LIQUOR QUASSIÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF QUASSIA

(lĭ'quŏr quâs'sĭ-æ cŏn-cĕn-trā'tŭs)

"Quassia Wood, in No. 40 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (20 per cent.), 22 *fl. ounces* (Imp. meas.) or 1100 cubic centimetres or a sufficient quantity. Mix the Quassia with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol; pack in a closed percolator; set aside for three days; percolate with the remaining Alcohol, added in ten equal portions at intervals of twelve hours; continue percolation with more Alcohol until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This solution was introduced into the British Pharmacopœia 1898 mainly to facilitate the preparation of infusion of quassia by diluting the solution with water.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR RHEI CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF RHUBARB

(lĭ'quŏr rhē'ī cŏn-cĕn-trā'tŭs)

"Rhubarb Root, in No. 5 powder, 10 *ounces* (Imperial) or 500 grammes; Alcohol (20 per cent.), 25 *fl. ounces* (Imp. meas.) or 1250 cubic centimetres or a sufficient quantity. Moisten the Rhubarb with *five fl. ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of the Alcohol; pack in a closed percolator; set aside for three days; percolate with the remaining Alcohol, added in ten equal portions at in-

tervals of twelve hours; continue percolation with more Alcohol until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This solution has been introduced into the British Pharmacopœia to facilitate the preparation of the infusion of rhubarb. (See p. 656.) F. C. J. Bird finds that the concentrated solution of rhubarb when prepared by the method of the Brit. Pharm. cannot be considered quite satisfactory, for, on keeping, it almost invariably throws down a brownish-yellow deposit. Moreover, experimental data, which are given in the form of a table, show that only about 60 per cent. of the available extractive of the root is contained in the Br. Pharm. solution. The author finds the addition of glycerin most effective to prevent the formation of a precipitate, and recommends a modification of the official formula, according to which the first 17 fl. oz. of percolate are reserved, the subsequent 3 fl. oz. of percolate evaporated to a soft extract, which is dissolved in 3 fl. oz. of glycerin and added to the reserved portion so as to make 20 fl. oz. of finished product. A sample of liquor so prepared has remained quite free from deposit for several months. (*Y. B. P.*, 1903, 496.)

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR SARSÆ COMPOSITUS CONCENTRATUS. Br.

CONCENTRATED COMPOUND SOLUTION OF SARSAPARILLA

(lĭ'quŏr sär-sæ cŏm-pŏs'ĭ-tŭs cŏn-cĕn-trā'tŭs)

"Sarsaparilla, cut transversely and bruised, 20 *ounces* (Imperial) or 1000 grammes; Sassafras Root, in shavings, 2 *ounces* (Imp.) or 100 grammes; Guaiacum Wood, in shavings, 2 *ounces* (Imp.) or 100 grammes; Dried Liquorice Root, bruised, 2 *ounces* (Imp.) or 100 grammes; Mezereon Bark, cut small, 1 *ounce* (Imp.) or 50 grammes; Alcohol (90 per cent.), 4½ *fl. ounces* (Imp. meas.) or 225 cubic centimetres; Distilled Water, *a sufficient quantity.* Infuse the Sarsaparilla in three successive portions of *five pints* (Imp. meas.) or five litres of the Distilled Water, for one hour each, at 160° F. (71.1° C.). Boil the other solid ingredients with Distilled Water until exhausted. Rapidly concentrate the mixed infusion and decoction until, when cold, the liquid measures *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres; add the Alcohol; set aside for at least fourteen days; filter. The product should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This preparation was introduced into the British Pharmacopœia 1898 to provide a reasonably stable solution from which the decoction can be made by dilution.

Precipitation is apt to occur on standing. The precipitate is, however, inert and may be filtered out.

Dose, of the solution, from two to eight fluidrachms (7.5 to 30 Cc.).

LIQUOR SENEGÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF SENEGA

(lĭ'quŏr sĕn'ę-gæ cŏn-cĕn-trā'tŭs)

"Senega Root, in No. 20 powder, 10 *ounces* (Imperial) or 500 grammes; a mixture of two parts of Alcohol (20 per cent.) and one part of Alcohol (45 per cent.), 25 *fl. ounces* (Imp. meas.) or 1250 cubic centimetres or a sufficient quantity. Moisten the Senega with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the menstruum; pack in a closed percolator; set aside for three days; percolate with the remaining menstruum, added in ten equal portions at intervals of twelve hours; continue percolation with more menstruum until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This solution was introduced into the Br. Ph. 1898 for the purpose of providing a method of making the infusion by simple dilution.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR SENNÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF SENNA

(lĭ'quŏr sĕn'næ cŏn-cĕn-trā'tŭs)

"Senna, in No. 5 powder, 20 *ounces* (Imperial) or 1000 grammes; Tincture of Ginger, 2½ *fl. ounces* (Imp. meas.) or 125 cubic centimetres; Alcohol (90 per cent.), 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Distilled Water, *a sufficient quantity.* Divide the Senna into three equal portions; slightly moisten one portion with Distilled Water; pack in a percolator; set aside for twenty-four hours; pass Distilled Water through it until *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres are obtained. Slightly moisten the second portion of Senna with this liquid; pack in a percolator; set aside for twenty-four hours; percolate with the remainder of the liquid obtained from the first portion, and also with an additional *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres obtained by passing more Distilled Water through the first portion. Repeat the process with the third portion of the Senna, and continue successive percolation through the three portions, until a quantity of *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres has been collected from the third percolator. Heat the liquid to

180° F. (82.2° C.) for five minutes; cool; add the Alcohol and Tincture of Ginger, previously mixed; set aside for seven days; filter. The product should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This solution was introduced into the British Pharmacopœia mainly to provide a strong stable solution from which the infusion may be made by dilution. (See p. 657.) This preparation is an excellent laxative and purgative. According to F. C. J. Bird this is the most unsatisfactory of the Br. Pharm. liquors, on account of its unstable qualities and the deposition, with loss of extractive, when kept for any length of time. Another weak point is found in the process itself, which requires the maceration of the senna leaves with distilled water for a period requiring at least seventy-two hours, or probably much more, if the official directions are strictly followed. In consequence of this prolonged exposure, especially if such be during warm weather, the infusion is liable to decomposition, before it is finished. The process of extraction adopted for the senna is also less efficient than in the case of any of the other liquors, notwithstanding that the extraction is effected by repercolation, for the product, as shown experimentally, contains only from 55 to 56 per cent. of the available extractive of the leaves. With the view to remedying some of these defects, he suggested that chloroform water should be used instead of distilled water, the chloroform to be driven off by heating to 180° F., as is now directed; that the quantity of alcohol to be added be increased in the formula from 2 fl. oz. to 2¼ fl. oz., and that the filtered product, after standing seven days, be again heated to 180° F. in a closed vessel for half an hour or longer until the precipitate aggregates and the supernatant liquor becomes transparent; the product is brilliantly clear, and keeps for months without change. (*Y. B. P.*, 1903, 496.)

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

LIQUOR SERPENTARIÆ CONCENTRATUS. Br.

CONCENTRATED SOLUTION OF SERPENTARY

(lĭ′quŏr sĕr-pĕn-tā′rĭ-æ cŏn-cĕn-trā′tŭs)

"Serpentary Rhizome, in No. 40 powder, 10 *ounces* (Imperial) or 500 grammes; Alcohol (20 per cent.), 25 *fl. ounces* (Imp. meas.) or 1250 cubic centimetres or a sufficient quantity. Moisten the Serpentary with *five fluid ounces* (Imp. meas.) or two hundred and fifty cubic centimetres of the Alcohol; pack in a closed percolator; set aside for three days; percolate with the remaining Alcohol, added in ten equal portions at intervals of twelve hours; continue percolation with more Alcohol until the product measures *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This solution was introduced into the British Pharmacopœia mainly to facilitate the preparation of the infusion. (See p. 658.)

Dose, from one-half to two fluidrachms (1.8 to 7.5 Cc.).

LIQUOR SODÆ CHLORINATÆ. U. S., Br.

SOLUTION OF CHLORINATED SODA

[Liquor Sodæ Chloratæ, Pharm. 1890, Labarraque's Solution]

(lĭ′quŏr sō′dæ ȼhlō-rĭ-nā′tæ)

"An aqueous solution of several chlorine compounds of sodium, containing at least 2.4 percent., by weight, of available chlorine." *U. S.*

Liquor Natri Chlorati; Liquor Natri Hypochlorosi; Bleaching Solution; Chlorure de Soude liquide, *Fr. Cod.*; Liqueur de Labarraque, *Fr.*; Chlornatronlösung, Bleichflüssigkeit, *G.*; Solucion de hipoclorito sodico, Licor de Labarraque, *Sp.*

• "Monohydrated Sodium Carbonate, *sixty-five grammes* [or 2 ounces av., 128 grains]; Chlorinated Lime, *ninety grammes* [or 3 ounces av., 76 grains]; Water, *a sufficient quantity*, to make *one thousand grammes* [or 35 ounces av., 120 grains]. Triturate the Chlorinated Lime (which should contain not less than 30 percent. of available chlorine) with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, gradually added, until a uniform mixture results. Allow the heavier particles to subside, and transfer the thinner, supernatant portion to a filter. Then triturate the residue again with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, transfer the whole to the filter, and, when the liquid has drained off, wash the filter and contents with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water. Dissolve the Monohydrated Sodium Carbonate in *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of hot Water, and add this solution to the previously obtained filtrate contained in a suitable vessel. Stir or shake the mixture thoroughly, and, if it should become gelatinous, warm the vessel very gently, until the precipitate subsides. Then transfer the mixture to a new filter, and, when no more liquid drains from it, wash the filter and contents with enough Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Keep the Solution in well-stoppered bottles, protected from light, and in a cool place." *U. S.*

"Chlorinated Lime, 16 *ounces* (Imperial) or 400 grammes; Sodium Carbonate, 24 *ounces* (Imp.) or 600 grammes; Distilled Water, 1 *gallon* (Imp. meas.) or 4 litres. Dissolve the Sodium Carbonate in one-quarter of the Distilled Water; thoroughly triturate the Chlorinated Lime with the remainder of the Distilled Water; mix the two liquids; filter." *Br.* Sp. gr. 1.054 at 15.5° C. (60° F.).

This solution was first brought into notice as a disinfecting agent by Labarraque, an apothecary of Paris. It was afterwards found to possess valuable therapeutic properties. The U. S. process is practically that of Payen, adopted in the French Codex of 1837. It consists in decomposing a solution of monohydrated sodium carbonate by one of chlorinated lime. Calcium carbonate is precipitated and the chlorinated soda remains in solution. The proportion employed gives an excess of sodium carbonate, the presence of which renders the solution more permanent. Sodium bicarbonate has been recommended instead of sodium carbonate, on account of the state of crystalline powder in which the calcium carbonate is precipitated, rendering its separation from the supernatant solution very easy, while the precipitate produced by sodium carbonate is a kind of magma from which the liquor is not readily decanted. It is stated also that a little excess of the bicarbonate is useful in various ways. (*Ann. Thér.*, 1866, 107.)

Properties.—The U. S. solution is "a clear, pale greenish liquid, having a faint odor of chlorine, and a disagreeable, alkaline taste. Specific gravity: about 1.050 at 25° C. (77° F.). The Solution at first colors red litmus paper blue, and then bleaches it. The addition of hydrochloric acid to the Solution causes an evolution of chlorine and carbon dioxide. If 7 Gm. of the Solution be mixed with 50 Cc. of water, and 2 Gm. of potassium iodide and 10 Cc. of hydrochloric acid be added, not less than 48 Cc. of tenth-normal sodium thiosulphate V.S. should be required to discharge the final yellow color of the liquid (each Cc. of the tenth-normal sodium thiosulphate V.S. corresponding to 0.05 percent. of available chlorine)." *U. S.* "A colorless alkaline liquid, with astringent taste and faint odor of chlorine. It decolorizes *solution of indigo sulphate.* It is decomposed by *hydrochloric acid,* evolving chlorine. It should yield not more than the slightest reaction with the tests for calcium or for carbonates. Specific gravity 1.054. If 3.5 grammes be added to a solution of 1 gramme of *potassium iodide* in 100 cubic centimetres of *water* acidulated with 3 cubic centimetres of *hydrochloric acid,* a brownish-red color should be produced, for the discharge of which at least 25 cubic centimetres of the *volumetric solution of sodium thiosulphate* should be required, corresponding to about 2½ per cent. of available chlorine." *Br.* This test, like that of our own Pharmacopæia, is intended to determine the chlorine strength of the solution. The hydrochloric acid liberates the chlorine, which then liberates from the potassium iodide an equivalent quantity of iodine, by which the solution is rendered brown, and, the iodine being converted into hydriodic acid by the sodium thiosulphate, the solution again becomes colorless. The quantity of the solution of the latter salt required to bleach the liquid measures the amount of iodine, and this, that of the chlorine which has separated it. The color of turmeric is first rendered brown, and afterwards destroyed. When carefully evaporated, a mass of damp crystals is obtained, which, when redissolved in water, possesses the properties of the original liquid. Solution of chlorinated soda, when exposed to the air, absorbs carbon dioxide and slowly evolves chlorine which acts as a disinfectant.

Nature and Composition.—In their chemical nature these solutions are identical. Assuming the chlorinated lime to be essentially calcium hypochlorite with calcium chloride (see page 268), the solutions, after decantation from the precipitated calcium carbonate, will contain *sodium hypochlorite* with *sodium chloride:*

$$Ca(OCl)_2 + CaCl_2 + 2Na_2CO_3 = 2CaCO_3 + 2NaOCl + 2NaCl$$

Besides these there will be present more or less *sodium carbonate,* according as there happens to be in the chlorinated lime less or more chlorine to decompose it. In all cases, however, there will be an excess of sodium carbonate, as the best chlorinated lime does not contain sufficient chlorine to effect its entire decomposition, in the proportion in which it is taken in the formula.

Uses.—Solution of chlorinated soda possesses the medicinal properties of chlorinated lime, *i.e.,* dependent on its available chlorine. Formerly it was used internally in various conditions of *adynamia* and *zymosis;* it is, however, at present rarely so given. As a local remedy it is very actively stimulant and antiseptic, and has been used to a considerable extent not only in the treatment of external *infected wounds* or *ulcers* but also in infected conditions of the vagina, uterus, bladder, mouth, fauces, and other cavities which can be reached from the outside. Usually in these cases it should be diluted with from 15 to 30 parts of water, and when it is employed in indefinite quantity, as in washing out the bladder by means of the double canula, half an ounce is sufficient in one and a half pints of water. When used by means of lint or in other ways for the treatment of skin eruptions, the dilution should contain from 10 to 30 per cent.

Dose, ten to twenty minims (0.6 to 1.3 Cc.).

LIQUOR SODII ARSENATIS. U. S., Br.

SOLUTION OF SODIUM ARSENATE

(lĭ'quŏr sō'dĭ-ī är-sĕ-nā'tĭs)

"An aqueous solution, which should contain Sodium Arsenate corresponding in amount to not less than 1 percent. of Exsiccated Sodium Arsenate." *U. S.* "110 minims contain 1.77 grains of crystallized sodium arsenate, ($Na_2HAsO_4,7H_2O$,) or the equivalent of one grain of the anhydrous salt. 100 cubic centimetres contain 1.77 grammes of the crystallized salt, equivalent to 1 gramme of the anhydrous salt." *Br.*

Liquor Sodii Arseniatis, *Br.* 1885; Solution of Arseniate of Sodium; Soluté d'Arseniate de Soude, *Fr.;* Arsensaure Natronlösung, *G.*

* "Exsiccated Sodium Arsenate, *one gramme* [or 15.4 grains]; Distilled Water, *a sufficient quantity*, to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Exsiccated Sodium Arsenate in a sufficient quantity of Distilled Water to make the product weigh *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

"Sodium Arsenate, recently rendered anhydrous, 17½ *grains* (Imperial) or 1 gramme; Distilled Water, *a sufficient quantity*. Dissolve the anhydrous Sodium Arsenate in sufficient Distilled Water to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Solution of Sodium Arsenate." *Br.*

This is simply an official form for the administration of sodium arsenate. (See *Sodii Arsenas* and *Sodii Arsenas Exsiccatus*.) "The Solution should conform to the reactions and tests for an aqueous solution of the salt given under *Sodii Arsenas Exsiccatus*." *U. S.* The present official solution is somewhat stronger than that of the U. S. P. 1870. It now contains 1 per cent. of exsiccated sodium arsenate, where formerly there was present but 0.87 per cent., and the British solution has been made to correspond in strength. The salt is directed to be dried, in order that the solution may be of a uniform strength, as, from the mode in which the sodium arsenate is ordered to be prepared, it is scarcely possible that it should always contain precisely the same quantity of water of crystallization. It is important in drying it to limit the heat to 302° F., lest a portion of the arsenic should be volatilized.

Dose, from three to five minims (0.2 to 0.3 Cc.), to be cautiously increased, if necessary.

LIQUOR SODII ETHYLATIS. Br.

SOLUTION OF SODIUM ETHYLATE

(lĭ'quŏr sō'dĭ-ī ĕth-y-lā'tĭs)

Solution of Sodium Alcoholate; Soluté d'ethylate de soude, *Fr.*; Natriumethylatlösung, Natriumalkoholatlösung, *G.*

"Sodium, clean and bright, 22 *grains* (Imperial) or 1 gramme; Absolute Alcohol, 1 *fl. ounce* (Imp. meas.) or 20 cubic centimetres. Cautiously dissolve the Sodium in the Absolute Alcohol contained in a flask, the latter being kept cool by a stream of cold water." *Br.*

This preparation was introduced into the British Pharmacopœia in 1885. It is described as "a colorless liquid of syrupy consistence, becoming brown by keeping. Specific gravity 0.867. When slightly heated it boils and gives off alcoholic vapors, leaving a white residue which, on being strongly heated, becomes charred. If the white residue be mixed with *water* and heated, it yields ethylic alcohol, and the solution, on evaporation, leaves a white residue consisting almost wholly of caustic soda. This solution should be recently prepared. It contains 18 per cent. of the solid substance, C_2H_5ONa." *Br.* It may be made more conveniently by dissolving twenty grains of sodium ethylate in eighty grains of absolute alcohol. It is used solely as a caustic, and is said to produce very little pain. No water should be allowed to come in contact with it.

LIQUOR SODII HYDROXIDI. U. S.

SOLUTION OF SODIUM HYDROXIDE

[Liquor Sodæ, Pharm. 1890, Solution of Soda]

(lĭ'quŏr sō'dĭ-ī hȳ-drŏx'ĭ-dī)

"An aqueous solution, containing about 5 percent. of Sodium Hydroxide [NaOH = 39.76.]." *U. S.*

Solution of Caustic Soda; Natrium Hydricum Solutum; Soude caustique liquide, *Fr. Cod.*; Lessive des Savonniers, *Fr.*; Liquor Natri Caustici, *P. G.*; Aetznatronlauge, Natronlauge, *G.*; Solucion de sosa caustica, *Sp.*

* "Sodium Hydroxide, *fifty-six grammes* [or 1 ounce av., 427 grains]; Distilled Water, *nine hundred and forty-four grammes* [or 33 ounces av., 130 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Dissolve the Sodium Hydroxide in the Distilled Water. The Sodium Hydroxide used in this process should be of the full strength and quality directed by the Pharmacopœia (90 percent.). Sodium Hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken; the proper amount for the above formula being ascertained by dividing 5040 by the percentage of absolute Sodium Hydroxide contained therein. Solution of Sodium Hydroxide should be kept in bottles made of green glass, and provided with glass stoppers coated with paraffin or petrolatum." *U. S.*

The process for Solution of Soda U. S. P. 1890 is appended.[1]

Solution of sodium hydroxide is prepared in the same way as solution of potassium hydroxide. In the U. S. P. (8th Rev.) the process is that of simple solution of sodium hydroxide in water; in the U. S. P. 1890 process by a double decomposition between sodium

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[1] *Liquor Sodæ*, U. S. 1890. *Solution of Sodium Hydrate.*—"An aqueous solution of Sodium Hydrate [NaOH = 39.96], containing about 5 per cent. of the hydrate." *U. S.*

"Sodium Carbonate, *one hundred and seventy grammes* [or 6 ounces av., 153 grains]; Lime, *fifty grammes* [or 1 ounce av., 334 grains]; Distilled Water, *a sufficient quantity*. Dissolve the Sodium Carbonate in *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of boiling Distilled Water. Slake the Lime with about *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of Distilled Water, then mix it well with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Distilled Water, pour the mixture into a tared flask, and, having heated it to boiling, gradually add to it the solution of Sodium Carbonate, and boil during ten minutes. Then add enough Distilled Water to the flask to make the contents weigh *one thousand grammes* [or 35 ounces av., 120 grains], and set the flask aside, well stoppered, until the contents are cold. Lastly, strain the liquid through linen, set it aside in a well-stoppered bottle until it has become clear by subsidence, and separate the clear solution by decantation, or by means of a siphon." *U. S.* 1890.

carbonate and calcium hydroxide, there are formed sodium hydroxide in solution, and calcium carbonate which precipitates:

$$Na_2CO_3 + Ca(OH)_2 = 2NaOH + CaCO_3$$

In this process an excess of lime is used, which is necessary to insure a full decomposition of the carbonate.

Properties.—Solution of sodium hydroxide, sometimes called solution of caustic soda, is "a clear, colorless liquid, odorless, having a very acrid and caustic taste, and a strongly alkaline reaction. Specific gravity: about 1.056 at 25° C. (77° F.). It should conform to the reactions and tests for an aqueous solution of sodium hydroxide given under *Sodii Hydroxidum.* To neutralize 20 (19.9) Gm. of Solution of Sodium Hydroxide there should be required about 25 Cc. of normal sulphuric acid V.S., methyl-orange T.S. being used as indicator (each Cc. of normal sulphuric acid V.S. indicating 0.2 percent. of absolute Sodium Hydroxide)." *U. S.* Its properties and tests are the same as those of solution of potassium hydroxide, with the exception that no precipitate is produced by platinic chloride or tartaric acid. The alkali dissolved must be viewed as sodium hydroxide (Na.OH), of which two molecules are formed by the union of the oxide with water, according to the reaction:

$$Na_2O + H_2O = 2Na.OH$$

Dose, ten to thirty minims (0.6 to 1.8 Cc.).

Off. Prep.—Fluidextractum Taraxaci, *U. S.;* Oleum Terebinthinæ Rectificatum, *U. S.*

LIQUOR SODII PHOSPHATIS COMPOSITUS. U. S.

COMPOUND SOLUTION OF SODIUM PHOSPHATE

(lī′quọr sō′dĭ-ī phŏs-phā′tĭs cŏm-pŏṣ′ị-tŭs)

Soluté de Phosphate de Soude composé, *Fr.;* Zusammengesetzte Natriumphosphatlösung, *G.*

* "Sodium Phosphate, uneffloresced crystals, *one thousand grammes* [or 35 ounces av., 120 grains]; Sodium Nitrate, *forty grammes* [or 1 ounce av., 180 grains]; Citric Acid, *one hundred and thirty grammes* [or 4 ounces av., 256 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Sodium Phosphate and Sodium Nitrate, in a mortar, with the Citric Acid, until completely liquefied, then add sufficient Distilled Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Filter the liquid. Keep the Solution in well-stoppered bottles in a moderately warm place." *U. S.*

Compound Solution of Sodium Phosphate is official for the first time in the U. S. P. (8th Rev.). Its introduction grew out of the necessity for a permanent solution of sodium phosphate, for this salt is slow in dissolving and valuable time is often wasted at the prescription desk on this account. The additions of sodium nitrate and citric acid are for the purpose of the prevention of crystallization during cold weather. The solution contains 1 Gm. of sodium phosphate in 1 Cc. of solution or about 57 grains in a fluidrachm.

Properties.—"If to 1 Cc. of the Solution, diluted with an equal volume of water, a slight excess of ammonia water, followed by 1 Cc. of magnesia mixture T.S., be added, a white crystalline precipitate will be obtained. If 1 Cc. of the Solution, diluted with 5 Cc. of water, be mixed with an equal volume of sulphuric acid, and to the cooled mixture a crystal of ferrous sulphate be added, a dark brown zone will appear around the crystal. If 5 Cc. of the Solution be neutralized with ammonia water, an excess of calcium chloride T.S. added, and the mixture filtered, the filtrate, upon boiling, should deposit a white precipitate." *U. S.*

Uses.—See *Sodii Phosphas.*

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

LIQUOR STRYCHNINÆ HYDROCHLORIDI. Br.

SOLUTION OF STRYCHNINE HYDROCHLORIDE

[Solution of Hydrochlorate of Strychnine, Brit. Pharm. 1885.]

(lī′quọr strȳ̆ch-nī′næ hȳ-drọ-ch̨lō′rị-dī)

Liquor Strychniæ; Soluté de Chlorhydrate de Strychnine, *Fr.;* Salzsaure Strychninlösung, *G.*

"Strychnine Hydrochloride, 17½ *grains* (Imperial) or 1 gramme; Alcohol (90 per cent.), 1 *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Distilled Water, *a sufficient quantity.* Dissolve the Strychnine Hydrochloride in the Alcohol mixed with sufficient Distilled Water to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Solution of Strychnine Hydrochloride. 110 minims contain 1 grain of Strychnine Hydrochloride; 100 cubic centimetres contain 1 gramme." *Br.*

This is the solution of hydrochloride of strychnine of the British Pharmacopœia which was formerly official as *Liquor Strychniæ;* the name has been made definite, and the strength slightly increased, so as to make it conform with the other active solutions; it contains about 1 per cent. of strychnine. The spirit is added for its preservation. A change was made in the last revision of the Br. Pharm. 1898 whereby strychnine hydrochloride is dissolved directly in water containing a little alcohol. This is said to prevent the tendency of the solution to crystallize in cold weather, a fault of the Br. Ph. 1885 process.

Dose, from five to ten minims (0.3 to 0.6 Cc.), equal respectively to about the twenty-fourth and the twelfth of a grain (0.0025 to 0.005 Gm.) of the alkaloid.

LIQUOR THYROIDEI. Br.

THYROID SOLUTION

(lĭ'quŏr thȳ-röĭ'dē-ī)

"A liquid prepared from the fresh and healthy thyroid gland of the sheep." *Br.*

Thyroid Essence, Thyroid Extract; Schilddrüsenessenz, Schilddrüsenextrakt, *G.*

"Remove the external fat and connective tissue from thyroid glands taken from sheep immediately after killing; cut the glands across, and reject any that contain cysts, are hypertrophied, or are otherwise abnormal. Count the healthy glands that remain; slice them and bruise them thoroughly in a mortar; for each entire gland (consisting of two lobes) add *thirty-four minims* or two cubic centimetres of Glycerin, and *thirty-four minims* or two cubic centimetres of a 0.5 per cent. solution of Phenol in Distilled Water; transfer the mixture, well stirred, to a flask, and close the neck with a plug of Cotton Wool; allow it to stand for twenty-four hours; then strain through linen, with strong pressure; add to the strained liquid sufficient of the 0.5 per cent. solution of Phenol to make *one hundred minims* or six cubic centimetres of the Solution for each gland used." *Br.*

This solution, introduced into the British Pharmacopœia 1898, is intended to represent the activity of the thyroid gland. It is described as a "pinkish turbid liquid, entirely free from any odor of putrescence. It must be freshly prepared, and kept in well-stoppered, sterilized bottles. 100 *minims* or 6 cubic centimetres represent one entire thyroid gland." *Br.*

For its medicinal properties, see *Thyroideum Siccum.*

Dose, five to fifteen minims (0.3 to 0.9 Cc.).

LIQUOR ZINCI CHLORIDI. U. S., Br.

SOLUTION OF ZINC CHLORIDE

(lĭ'quŏr zĭn'cī ȼhlō'rĭ-dī)

"An aqueous solution, containing about 50 percent., by weight, of Zinc Chloride [$ZnCl_2$ = 135.26]." *U. S.*

Chlorure de Zinc liquide, Soluté de Burnett, *Fr.;* Flüssiges Chlorzink, Chlorzinklösung, *G.*

* "Zinc, granulated, *two hundred and forty grammes* [or 8 ounces av., 204 grains]; Hydrochloric Acid, *eight hundred and forty grammes* [or 29 ounces av., 276 grains]; Nitric Acid, *twelve grammes* [or 185 grains]; Precipitated Zinc Carbonate, *twelve grammes* [or 185 grains]; Distilled Water, *a sufficient quantity,* to make about *one thousand grammes* [or 35 ounces av., 120 grains]. To the Zinc, contained in a glass or porcelain vessel, add *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of Distilled Water; then gradually add the Hydrochloric Acid, and digest until reaction ceases and the Acid is saturated. Pour off the solution, add the Nitric Acid, and heat the solution at a temperature not exceeding 115° C. (239° F.), until a portion, if removed and cooled, solidifies. Allow it to cool, and dissolve the solidified mass in a sufficient quantity of Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]. Then add the Precipitated Zinc Carbonate, agitate the mixture occasionally during twenty-four hours, and set it aside until it has become clear by subsidence. Finally, separate the clear Solution by decantation, or by means of a siphon." *U. S.*

"Granulated Zinc, 1 *pound* (Imperial) or 400 grammes; Hydrochloric Acid, 44 *fl. ounces* (Imp. meas.) or 1100 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Hydrochloric Acid with *one pint* (Imp. meas) or 500 cubic centimetres of Distilled Water in a porcelain dish; add the Zinc; apply gentle heat until gas is no longer evolved; boil for half an hour, supplying the water lost by evaporation; allow the product to cool. Test a few drops of the resulting liquid for iron and lead.

If either be present, filter the remainder of the product into a bottle, and add *solution of chlorine* by degrees, with frequent agitation, until the liquid acquires a permanent odor of chlorine; add Zinc Carbonate in small quantities at a time, with renewed agitation, until a brown sediment appears and the whole of the iron or lead is thus precipitated; filter the liquid into a basin, and evaporate to the bulk of *two pints* (Imp. meas.) or one thousand cubic centimetres. If no iron or lead be present, filter the cooled product and evaporate it to *two pints* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The zinc chloride is made in the usual way, by dissolving zinc in hydrochloric acid. The nitric acid in the U. S. process is added in order that any iron present shall be converted into ferric chloride, from which it is afterwards precipitated by the zinc carbonate. In the older processes the former object was accomplished by the use of solution of chlorinated lime, the latter by chalk. This is a decided improvement, as the use of the chalk as a precipitant introduced into the preparation some calcium chloride, while the zinc carbonate adds only a little zinc chloride in solution. Hydrogen dioxide has been used instead of nitric acid as an oxidizing agent by Besthorn and others. The preparation is completed by bringing it to a certain weight by the addition of distilled water, and by filtration to separate the precipitated iron and any excess of the carbonate. On account of the difficulty of freeing zinc from iron contamination, Francis Hemm proposes the simpler process of making this solution from iron-free zinc oxide; he dissolves 300 Gm. of such zinc oxide in 840 Gm. of hydrochloric acid in a porcelain dish, with the aid of heat, cools, filters, and evaporates the filtrate to 1000 Gm. (*Am. Drug.,* 1900, 199.)

Properties.—As procured by the U. S. P. process, solution of zinc chloride is "a clear, colorless liquid, odorless, having a very astringent, metallic taste, and an acid reaction. Specific gravity: about 1.548 at 25° C. (77° F.). It should conform to the reactions and tests for an aqueous solution of the salt given under *Zinci Chloridum*." *U. S.* "A colorless liquid of astringent and sweetish taste. Specific gravity 1.530. It should respond to the tests for zinc and for chlorides. It should not yield any characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium, magnesium, or sulphates." *Br.* The British solution contains about 175 grains of zinc in the Imperial fluidounce. The U. S. P. solution does not differ much, containing about 170 grains to the fluidounce (wine measure).

Uses.—This solution is equivalent to Burnett's disinfecting fluid noticed below. It is a powerful disinfectant, and, when applied, duly diluted with water, to cancerous and other offensive *ulcers*, destroys their fetor so long as the dressings are kept moist with it. The solution is recommended by Gaudriot in *gonorrhœa* in both sexes, as having remarkable remedial powers. For men he uses an injection, composed of from twenty-four to thirty-six drops in four fluidounces of water. A small quantity only is injected about an inch up the urethra, two or three times a day. For women he employs a vaginal suppository, formed of five drops of the solution, half a grain of morphine sulphate, and three drachms of a paste consisting of a drachm and a half of starch, a drachm of mucilage of tragacanth, and half a drachm of sugar. The suppository is introduced every day, or every second day.

Burnett's disinfecting fluid, like the official solution, is an aqueous solution of zinc chloride. It contains 200 grains of zinc in each Imperial fluidounce, and has the sp. gr. 2. It is, therefore, considerably stronger than the Dublin solution. It is so called after Sir William Burnett, who introduced it into use, in 1840, as a powerful deodorizing and disinfecting agent in neutralizing noxious effluvia and in arresting animal and vegetable decomposition. Diluted with water it forms Sir William's patent preservative against the dry-rot. The concurrent testimony of a number of observers shows that it acts as an excellent disinfectant for ships, hospitals, dissecting rooms, water closets, privies, etc. Injected into the blood vessels, it preserves bodies for dissection, without impairing their texture, and is said not to injure the knives employed, but the accuracy of the latter statement is doubtful. The advantage is claimed for it that, while it destroys putrid odors, it has no odor of its own. For preserving anatomical subjects, one part of the disinfecting fluid to eighteen of water will form a solution of the proper strength. For disinfecting operations on a large scale, a pint may be mixed with four gallons of water. Solution of zinc chloride is not used internally.

LIQUORES.

SOLUTIONS

(lĭ-quō'rēs)

Solutés, *Fr.;* Liquores, *P. G.;* Lösungen, *G.;* Soluzione, *It.;* Solucion, *Sp.*

The U. S. Pharmacopœia includes in this class of preparations all *aqueous* solutions without sugar in which the substance acted on is wholly soluble in water, excluding those in which the dissolved matter is gaseous or very volatile, as in the Aquæ, or Waters.

Although several changes were made in the strength of preparations of this class in the U. S. Pharmacopœia of 1880 for the sake of round numbers and to adjust the relative quantity of solid to the solvent, so as to avoid fractions in the percentages, yet it was a question then whether these were advantages sufficient to overbalance the disadvantage of changing the doses of important preparations. Since the important change was made, which makes the powerful solutions contain one per cent. of active ingredient, it would certainly be a serious mistake to alter this proportion in the future. The standard of 1 per cent. for arsenical solutions was adopted by the Conférence Internationale pour l'Unification de la Formule des Médicaments Héroïques in 1902 and will undoubtedly be accepted by all the Pharmacopœias.

In the British Pharmacopœia it has been deemed expedient, in almost all instances in which the substance to be dissolved is an isolated solid body, to make the solutions of uniform strength, without regard to the physiological powers of the medicine, or its ordinary dose. There is a convenience in this plan to the prescriber, in relation to all medicines which habitually present themselves to his mind in the solid state, but to alter the strength of a solution which has been long known, and the dose of which is familiar, in order to make it conform with others, is to run the risk of frequent serious errors for the sake of an idea. The Br. Pharm. 1898 introduced under this head ten concentrated infusions, with the object of affording an easy method of making, through dilution, ordinary infusions. The titles (see *Liquor Calumbæ Concentratus*) are very inappropriate.

LITHII BENZOAS. U. S.

LITHIUM BENZOATE

(lĭth'ĭ-ī bĕn'zo-ăs)

$LiC_7H_5O_2 = 127.11$

"It should contain not less than 98.5 per cent. of pure Lithium Benzoate [$C_6H_5.COOLi$], and should be kept in well-stoppered bottles." *U. S.*

Lithium Benzoicum; Benzoate de Lithine, *Fr. Cod.;* Benzoësaures Lithium, Lithiumbenzoat, *G.;* Benzoato lítico, *Sp.*

This salt of lithium is made by decomposing lithium carbonate with benzoic acid. E. B. Shuttleworth (*A. J. P.*, 1875) deviates from the usual method of first making a hot solution of benzoic acid and then adding carbonate until effervescence ceases, by reversing the order. One ounce (av.) of lithium carbonate is put into a dish with nine fluidounces of water, the mixture is heated, and three and a quarter ounces (av.) of benzoic acid in small portions added, until the carbonate is all decomposed and effervescence ceases; the solution is filtered and evaporated to dryness, or crystallized if desired. The yield is three and a half ounces. The advantage of this process is a saving in time and labor in evaporating:

$$Li_2CO_3 + 2HC_7H_5O_2 = 2LiC_7H_5O_2 + H_2O + CO_2$$

No process is given in the Pharmacopœia.

Properties.—It is officially described as a "light, white powder, or small, shining, crystalline scales; odorless, or of faint benzoin-like odor, and of a cooling, sweetish taste; permanent in the air. Soluble in 3 parts of water, and in 13 parts of alcohol, at 25° C. (77° F.); in 2.5 parts of boiling water, and in 10 parts of boiling alcohol. Its solubility in water is increased by the presence of sodium benzoate, but lessened when alcohol is in the solvent. When heated, the salt fuses; at a higher temperature it chars, emits inflammable vapors having a benzoin-like odor, and finally leaves a residue of lithium carbonate mixed with carbon. This residue imparts a crimson color to a non-luminous flame, and its aqueous solution has an alkaline reaction upon litmus paper. The aqueous solution (1 in 20) of Lithium Benzoate has an alkaline reaction upon litmus, but is neutral to phenolphthalein T.S. The addition of a few drops of ferric chloride T.S. to the above solution will produce a voluminous flesh-colored precipitate of ferric benzoate. If an excess of hydrochloric acid be added to a concentrated aqueous solution of 0.6 Gm. of Lithium Benzoate, a white precipitate of benzoic acid will be formed, which, after collecting upon a filter and thoroughly washing and drying, should respond to the tests of purity given under *Acidum Benzoicum*. If the filtrate and washings from this precipitate be evaporated almost to dryness on a water-bath, in a flat-bottomed flask of 50 Cc. capacity, and 10 Cc. of amyl alcohol (boiling point 132° C.) be added, and the mixture cautiously heated until the lower aqueous layer has evaporated, then, after the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.004 Gm. (limit of *other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution. If 1 Gm. of the salt be dissolved in 20 Cc. of water, and the benzoic acid precipitated by the addition of a sufficient quantity of hydrochloric acid, the filtrate should respond to the following tests of purity: The addition of ammonia water until the solution has an alkaline reaction should produce neither turbidity nor precipitation, either before or after boiling (absence of *iron, aluminum,* etc.). Another portion of this solution should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 0.5 Gm. of Lithium Benzoate be thoroughly mixed with about 1 Gm. of powdered anhydrous ammonium sulphate and cautiously ignited in a porcelain crucible, until of constant weight, the residue should weigh not less than 0.210 Gm., nor more than 0.216 Gm." *U. S.* Curtman stated that much of the lithium benzoate in the market contains not only sodium benzoate, but also hippurate, derived from urine-benzoic acid. This renders it much more soluble in water than the pure salt, and also more soluble in alcohol. The precipitated benzoic acid should melt at 121.4° C.; hippuric acid, if pure, melts at 187.5° C. Hence a high melting point for the separated benzoic acid points to this source of contamination.

Uses.—Lithium benzoate has been highly recommended as a remedy against *gout* (*Ed. M. J.*, Jan. 1875), and has been used to some extent.

Dose, from fifteen to thirty grains (1 to 2 Gm.).

LITHII BROMIDUM. U. S.

LITHIUM BROMIDE

(lĭth'ĭ-ĭ brō'mĭ-dŭm)

$LiBr = 86.34$

"It should contain when well dried not less than 97 percent. of pure Lithium Bromide, and should be kept in well-stoppered bottles." *U. S.*

Lithium Bromatum; Bromure de Lithium, *Fr. Cod.*; Bromlithium, Lithiumbromid, *G.*

This salt was made official in the U. S. P. 1880. Yvon prepares lithium bromide by mixing 37 parts of lithium carbonate, 200 parts of distilled water, and 80 parts of bromine, and passing a current of hydrogen sulphide through the mixture until the color of bromine has disappeared. A slight heat is then applied, to drive off excess of hydrogen sulphide and to agglutinate the sulphur. After filtration the liquor is concentrated and finally crystallized by desiccating it under a bell glass, over sulphuric acid. It may also be obtained by double decomposition. Lithium sulphate is first formed by treating 37 parts of lithium carbonate with 49 parts of monohydrated sulphuric acid diluted with its own volume of water. Then 119 parts of potassium bromide are dissolved in the smallest possible quantity of water. When the two solutions are mixed, an abundant precipitate of potassium sulphate is produced on the addition of a little alcohol. The whole is evaporated to dryness, the operation finished on a water bath, and the residue is treated with alcohol, which removes only lithium bromide

and deposits it again on evaporation. The bromide may then be crystallized from water or kept in solution of known strength.[1] (*P. J.*, Sept. 18, 1876.) No process is given in the Pharmacopœia.

Properties.—It is officially described as "a white, granular salt, odorless, and having a sharp, slightly bitter taste; very deliquescent. Soluble in 0.6 part of water at 25° C. (77° F.), and in 0.3 part of boiling water; very soluble in alcohol; also soluble in ether. At a low red heat the salt fuses, and at a higher heat it is slowly volatilized. It imparts a crimson color to a non-luminous flame. Silver nitrate T.S. produces a yellowish-white precipitate insoluble in nitric acid, and in a moderate excess of ammonia water. The aqueous solution is slightly alkaline to litmus paper. If there be added to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform, followed by chlorine water added cautiously, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of *iodine*). If 0.5 Cc. of sodium cobaltic nitrite T.S. be added to 5 Cc. of an aqueous solution of the salt (1 in 20), no precipitate or turbidity should occur within 10 minutes (limit of *potassium*). If to 0.4 Gm. of Lithium Bromide contained in a flat-bottomed flask of 50 Cc. capacity, an excess of hydrochloric acid be added, and the mixture evaporated almost to dryness on a water-bath, and if 10 Cc. of amyl alcohol (boiling point 132° C.) be added and the mixture cautiously heated until the lower aqueous layer has evaporated, then, upon the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.007 Gm. (limit of *other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution. The addition of a slight excess of ammonia water to the aqueous solution of the salt (1 in 20), which has been acidulated with hydrochloric acid, should produce neither turbidity nor precipitation, either before or after boiling (absence of *iron, aluminum*, etc.). An aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of dry Lithium Bromide be dissolved in sufficient distilled water to measure 100 Cc., then 20 Cc. of this solution, to which 2 drops of potassium chromate T.S. are added, should require not less than 22.5 Cc., nor more than 23.9 Cc., of tenth-normal silver nitrate V.S. to produce a permanent red color." *U. S.*

Uses.—Lithium bromide was first brought into notice as a remedy by S. Weir Mitchell, who asserts that its action differs from that of the other bromides only in being more hypnotic. Although careful physiological studies of it are wanting, there is little reason for believing that it differs essentially from other bromides in its influence upon the human organism. It should be administered in dilute aqueous solution. Each drachm of it contains fifty-five grains of bromine, and it therefore exceeds potassium bromide in bromine strength.

Dose, fifteen to thirty grains (1 to 2 Gm.).

LITHII CARBONAS. U. S., Br.

LITHIUM CARBONATE

(lĭth'ĭ-ī cär'bo-năs)

$Li_2CO_3 = 73.51$

"It should contain not less than 98.5 percent. of pure Lithium Carbonate [$CO.(OLi)_2$], and should be kept in well-stoppered bottles." *U. S.* "Lithium Carbonate, Li_2CO_3, is obtained from native silicates of lithium." *Br.*

Carbonas Lithicus: Carbonate of Lithia; Carbonate de Lithine, *Fr. Cod.*; Carbonate lithique, *Fr.*; Lithium Carbonicum, *P. G.*; Lithiumcarbonat, Kohlensaures Lithium, *G.*; Carbonato di litio, *It.*; Carbonato de litina o litico, *Sp.*

The alkali *lithia*, so far as has yet been ascertained, is rare in nature, for, though extensively diffused, it exists in very small proportion, except in a few scarce minerals. It was discovered by Arfvedson in 1817, in certain minerals from the iron mines of Utö, as *petalite, triphane*, and a variety of *tourmaline*. (Berzelius.) It has since been found in other minerals, as *lepidolite, spodumene, amblygonite*, etc., and in numerous mineral waters, as those of Carlsbad, Pyrmont, Kissingen, Kreuznach, Aix-la-Chapelle, Vichy, etc., in Europe, and the Gettysburg spring in the United States, in which it exists generally as a carbonate or a bicarbonate. By spectrum analysis it has been detected in the waters of the Atlantic and of the Thames, in the ashes of plants grown on a granite soil, and even in milk and human blood. In the mother waters of tartaric acid, in the factories, it has been found in a proportion to justify extraction. It was at one time largely obtained from a *phosphatic triphyline* found in Bavaria, in which it existed as a phosphate, but this source is said to have been exhausted. It is estimated that there are about 55,000 pounds of lithium salts used in the United States each year, of which about one-tenth is imported. The quantity of lithium minerals produced in the United States (California and South Dakota) in 1903 amounted to 1,155 tons, valued at the place of production at $23,425. There are several methods of extracting lithia from the minerals containing it,

[1] *Lithium Iodide* (LiI = 132.8) may be prepared by taking of iodine 127 parts, iron, in filings, 35 parts, lithium carbonate 38 parts, distilled water 300 parts. Prepare a solution of ferrous iodide, using the whole of the distilled water, filter, add the lithium carbonate to the still warm liquid, and heat gently to promote complete decomposition. The liquid must be slightly alkaline. Filter, wash the precipitated ferrous carbonate, add the washings to the filtrate, evaporate the latter, pour it out to cool and harden, and immediately transfer it into well-dried, glass-stoppered vials. It forms a white salt very soluble in water and alcohol. One gramme of it is entirely precipitated by 1.27 Gm. of silver nitrate. (*N. R.*, July, 1877.)

an account of which may be seen in *Roscoe and Schorlemmer,* vol. ii., Part I, page 158. They contain the alkali in various proportions, from 4.5 per cent. in lepidolite to 11 per cent. in amblygonite. Lithium carbonate is prepared from lepidolite in the following manner. 10 parts of finely powdered lepidolite, 10 parts of barium carbonate, 5 parts of barium sulphate, and 3 parts of potassium sulphate are fused at a very high temperature in a wind furnace. The heavy barium silicate and sulphate sink to the bottom, and a layer of potassium and lithium sulphates is found at the top of the fused mass. These can be extracted by simple lixiviation, and then the carbonate prepared by double decomposition with ammonium carbonate.

Lithia, Li_2O, is the oxide of the metal lithium, and ranks in chemical properties with the fixed alkalies. In the form of hydroxide, LiOH, it is white and translucent; does not deliquesce in the air, but absorbs carbon dioxide, and becomes opaque; is fusible below ignition, but not volatilizable at a white heat; is soluble in water, but less so than potassium or sodium hydroxides; is sparingly soluble in alcohol, and in solution has an acrid alkaline taste, caustic properties, and a strong alkaline reaction. The salts of lithium are generally freely soluble, with the exception of the neutral carbonate and phosphate, the latter of which is nearly insoluble. *Lithium,* which was first obtained by Bunsen and Matthiessen, in 1855, is silver-white, brilliant, softer than lead, ductile, capable of welding, and the lightest known solid. Its sp. gr. is 0.594, melting point 180° C. (356° F.), atomic weight 6.98, and symbol Li. For a method of making lithium for scientific demonstration on the small scale by electrolysis see *Ph. Rev.,* 1899, 264.

Lithium carbonate may be prepared directly from one of the lithia minerals, in the manner already described, or from lithium sulphate or chloride in concentrated solution by adding ammonium carbonate. The precipitated salt should be washed with alcohol and dried.

Properties.—It is "a light, white powder, odorless, and having an alkaline taste; permanent in the air. Soluble in 75 parts of water at 25° C. (77° F.), also in 140 parts of boiling water;[1] much more soluble in water saturated with carbon dioxide; insoluble in alcohol; soluble in diluted acids with active effervescence. At a low red heat the salt fuses; at a higher temperature it loses some of its carbon dioxide, and is partially converted into lithium oxide. Its solution in hydrochlorie acid imparts a crimson color to a non-luminous flame. The aqueous solution has an alkaline reaction upon litmus paper. If 1 Gm. of Lithium Carbonate be dissolved in 40 Cc. of diluted acetic acid, no insoluble residue should remain. If 1 part of Lithium Carbonate be mixed with 20 parts of water, and hydrochloric acid be added, drop by drop, with agitation until solution takes place, the resulting solution should, after boiling and cooling, respond to the following tests when applied to separate portions: The addition of ammonia water until the solution has an alkaline reaction, should produce neither turbidity nor precipitation, either before or after boiling (absence of *iron, aluminum,* etc.). Another portion of this solution should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 0.2 Gm. of Lithium Carbonate contained in a flat-bottomed flask of 50 Cc. capacity a slight excess of hydrochloric acid be added, and the mixture evaporated almost to dryness on a water-bath, and if 10 Cc. of amyl alcohol (boiling point 132° C.) be added and the mixture cautiously heated, until the lower aqueous layer has evaporated, then, upon the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.003 Gm. (limit of *other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution. If 0.5 Gm. of Lithium Carbonate be dissolved in 20 Cc. of normal sulphuric acid V.S., the resulting solution should require not more than 6.6 Cc. of normal potassium hydroxide V.S. for complete neutralization, methyl-orange T.S. being used as indicator." *U. S.* "In white powder or in minute crystalline grains, soluble in about 70 parts of cold *water,* insoluble in *alcohol* (90 per cent.). Its aqueous solution turns *red litmus paper* blue. It is dissolved with effervescence by *hydrochloric acid;* the solution evaporated to dryness leaves a residue, which communicates a crimson color to flame. This residue redissolved in water yields a precipitate with *solution of sodium phosphate.* 1 gramme of the salt neutralized with *sulphuric acid* and afterwards heated to redness leaves 1.479 grammes of dry lithium sulphate, corresponding to 98.5 per cent. of the pure carbonate. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, zinc, magnesium, sodium, potassium, ammonium, or chlorides, and only the slightest reactions with the tests for calcium and for sulphates." *Br.* Its aqueous solution has an alkaline reaction.[2]

Uses.—Lithium carbonate has the ordinary remedial properties of the alkaline carbonates, over which, however, it possesses advantages, under certain circumstances, which render it a

[1] F. A. Flückiger states that lithium carbonate is less soluble in warm water than in cold water. He recommends as a test of purity that it should require for solution 70 parts or a little more of water at 15° C., and states further that its solution saturated at 90° C. has the sp. gr. 1.009 at 15° C.; this latter solution contains 1 part of the salt in 111.3 parts of water. (*A. Pharm.,* 1887, p. 509.)

[2] *Effervescing Lithium Carbonate.*—Take of Citric Acid 40 parts, Sodium Bicarbonate 50 parts, and Lithium Carbonate 10 parts. Powder and mix well, then introduce into a wide flat-bottomed dish, and heat to about 100° C. (212° F.), stirring constantly until the powder becomes granular. Separate the granules of uniform size by means of appropriate sieves, and preserve them in well-stoppered bottles. (See *Lithii Citras Effervescens.*)

valuable addition to the materia medica. In the year 1843, Alexander Ure of London, called attention to the extraordinary solvent power of a solution of lithia for uric acid, with which, unlike the other alkalies, it forms a very soluble salt, and suggested its injection into the bladder, for the solution or disintegration of *uric acid calculi*. In 1857, Garrod of London, gave it internally in cases of *gout* and *gouty diathesis* in reference to the same property, as well as in consideration of its low combining number and consequent extraordinary neutralizing power. From these properties, it is admirably adapted to cases in which it is desirable to eliminate uric acid from the system, and especially to cases of gout, in which there is a strong indication to prevent the formation of insoluble salts of uric acid, and their deposition in the bladder, kidneys, or joints, and to favor the solution of such salts when already formed, as in the chalky deposits in the joints and ligamentous tissues of gouty patients, consisting chiefly of sodium urate. Garrod has, moreover, found lithium carbonate, in dilute solution, not only to exceed the other alkalies in rendering the urine neutral or alkaline, but also to act powerfully as a diuretic, probably more so than the corresponding salts of potassium and sodium. (*M. T. G.*, March, 1864, 303.)

Dose, five to fifteen grains (0.32 to 1.0 Gm.).

LITHII CITRAS. U. S., Br.

LITHIUM CITRATE

(lĭth'ĭ-ī cī'trās)

$Li_3C_6H_5O_7 + 4H_2O = 280.08$

"It should, when carefully dried, contain not less than 98.5 percent. of pure Lithium Citrate [$C_3H_4(OH)(COOLi)_3$], and should be kept in well-stoppered bottles." *U. S.* "Lithium Citrate, $C_3H_4.OH.(COOLi)_3,4H_2O$, is prepared by saturating citric acid with lithium carbonate." *Br.*

Lithiæ Citras, Lithium Citricum: Citrate of Lithium, Citrate of Lithia: Citrate de Lithine, *Fr. Cod.*; Citronensaures Lithium, Lithiumcitrat, *G.*

To saturate the 50 grains of lithium carbonate directed by the British Pharm. (1885) 90.54 grains of the crystallized acid will be required, so that there is a slight deficiency on the part of the acid, whereas it should be in slight excess, and, according to Squire, 100 grains of the acid should be used instead of 90 grains. (See also *P. J.*, Sept. 11, 1875.) This proportion was employed in the U. S. Pharmacopœia process of 1870. See foot-note.[1]

[1] "Take of Carbonate of Lithium *one hundred grains*; Citric Acid, in crystals, *two hundred grains*; Distilled Water *two fluidounces*. Dissolve the Citric Acid in the water gently heated, and to the solution gradually add the Carbonate of Lithium until perfectly dissolved, heating the solution so long as effervescence is produced. Evaporate, by means of a steam- or sand-bath, to a viscid consistence, dry the residue in an oven, at a temperature of about 240°, then rapidly pulverize it, and preserve the powder in a well-stoppered bottle." *U. S.* 1870.

C. Umney (*P. J.*, Sept. 11, 1875) advocates the use of the crystallized salt in place of that made by either of the former official processes. He obtained it by setting aside a solution of the sp. gr. 1.230, when a salt crystallized out having the formula $Li_3C_6H_5O_7.4H_2O$; it is described as definite and reliable as found in commerce, and "not deliquescent." (See also *P. J.*, 1883, p. 783.)

Properties.—Lithium citrate is in the form of "a white powder, or colorless crystals, odorless, and having a cooling, faintly alkaline taste; deliquescent on exposure to moist air. Soluble in about 2 parts of water at 25° C. (77° F.), and in 1.5 parts of boiling water; almost insoluble in alcohol or ether. At a red heat the salt chars, emits inflammable vapors having a pungent odor, and finally leaves a black residue of lithium carbonate mixed with carbon. It imparts a crimson color to a nonluminous flame. The aqueous solution is neutral to litmus paper, and should not redden phenolphthalein T.S. If an aqueous solution of Lithium Citrate (1 in 20) be boiled with an equal volume of calcium chloride T.S., a white precipitate will form. If the residue obtained by igniting 0.2 Gm. of the salt at a red heat be treated with a slight excess of diluted hydrochloric acid, and the filtrate and washings evaporated almost to dryness on a water-bath, in a flat-bottomed flask of 50 Cc. capacity, and if 10 Cc. of amyl alcohol (boiling point 132° C.) be added, and the mixture cautiously heated until the lower aqueous layer has evaporated, then, upon the addition of 3 drops of hydrochloric acid and boiling for three minutes, the resulting insoluble residue should weigh not more than 0.002 Gm. (limit of *other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution. The solution of the salt (1 in 20) acidulated with hydrochloric acid should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 0.5 Gm. of anhydrous Lithium Citrate be cautiously ignited in a porcelain crucible, and if, after cooling, the residue be moistened with a few drops each of nitric and sulphuric acids and again cautiously ignited, repeating the operation until the residue becomes white and of constant weight, then the residue of lithium sulphate should weigh not less than 0.387 Gm., nor more than 0.394 Gm. The residue of lithium sulphate resulting from the above ignition, after being dissolved in 10 Cc. of boiling water and acidified with hydrochloric acid, should, upon the addition of ammonia water until the solution has an alkaline reaction, not become turbid or form a precipitate, either before or after boiling (absence of *iron, aluminum*, etc.)." *U. S.* "2 grammes of the salt dried at 212° F. (100° C.) should lose about 0.38 gramme; at 240° F. (115.5° C.) an additional 0.13 gramme; and, when burned at a low red heat with a free access of air, should leave 0.77 gramme of white residue, correspond-

ing to 98.5 per cent. of the pure citrate. It should be free from the impurities mentioned under 'Lithii Carbonas.'" *Br.* That the salt is a citrate will be shown by its solution becoming turbid when boiled with lime water, but clear again on cooling.

Uses.—These are essentially the same as those of the carbonate, as the citric acid is burnt up in the system and a lithium carbonate formed, which is finally eliminated by the kidneys. While thus acting like the carbonate, it has the advantage over that salt of having a less disagreeable taste and of being less disposed to irritate the stomach,—the same advantages that, in many instances, potassium citrate has over the carbonate of that alkali.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Lithii Citras Effervescens, *U. S.*, *Br.*

LITHII CITRAS EFFERVESCENS. U. S., Br.

EFFERVESCENT LITHIUM CITRATE

(lĭth'ĭ-ī cī'trās ĕf-fẹr-vĕs'cẹns)

Limonade sèche au Citrate de Lithine, *Fr.*; Brause-lithiumcitrat, *G.*

"Lithium Citrate, *fifty grammes* [or 1 ounce av., 334 grains]; Sodium Bicarbonate, dried and powdered, *five hundred and seventy grammes* [or 20 ounces av., 46 grains]; Tartaric Acid, dried and powdered, *three hundred grammes* [or 10 ounces av., 255 grains]; Citric Acid, uneffloresced crystals, *one hundred and ninety-five grammes* [or 6 ounces av., 384 grains], to make about *one thousand grammes* [or 35 ounces, 120 grains]. Powder the Citric Acid and mix it intimately with the Lithium Citrate and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated between 93° and 104° C. (199.4° and 219.2° F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles." *U. S.*

"Sodium Bicarbonate, in powder, 58 *ounces* (Imperial) or 580 grammes; Tartaric Acid, in powder, 31 *ounces* (Imp.) or 310 grammes; Citric Acid, in powder, 21 *ounces* (Imp.) or 210 grammes; Lithium Citrate, 5 *ounces* (Imp.) or 50 grammes. Mix the Lithium Citrate with the Citric Acid, then add the Tartaric Acid, and, lastly, the Sodium Bicarbonate, triturating thoroughly. Place the whole in a dish or pan of suitable form heated to between 200° and 220° F. (93.3° and 104.4° C.). When the mixture, by the aid of careful manipulation, has assumed a granular character, separate it, by means of suitable sieves, into granules of uniform and convenient size. Dry the granules at a temperature not exceeding 130° F. (54.4° C.). The product should weigh about 100 *ounces* (Imp.) or 1000 grammes." *Br.*

This process was improved in the U. S. P. (8th Rev.) by omitting the sugar (which tends to darken the product), and by making a granular salt; the U. S. P. 1890 product was in the form of a dry powder.

Uses.—This effervescent salt forms an agreeable method of administering lithia; its medicinal properties are those of lithium citrate.

Dose, two drachms (7.7 Gm.), given in solution.

LITHII SALICYLAS. U. S.

LITHIUM SALICYLATE

(lĭth'ĭ-ī săl-ĭ-cȳ'lās)

$LiC_7H_5O_3 = 142.99$

"It should contain not less than 98.5 percent. of pure Lithium Salicylate [$C_6H_4(OH)COOLi$], and should be kept in well-stoppered bottles." *U. S.*

Salicylate de Lithine, *Fr. Cod.*; Lithium salicylicum, *P. G.*; Lithiumsalicylat, *G.*; Salicilato de litina, *Sp.*

No process is given in the Pharmacopœia for this official salt. It may be prepared by adding to a mixture of eleven parts of salicylic acid and three parts of lithium carbonate twenty-five parts of water, and heating until effervescence ceases, filtering and evaporating. It may be obtained in crystals but is usually seen in the form of a granular powder.

Properties.—It is officially described as "a white or grayish-white powder, odorless, and having a sweetish taste; deliquescent in a moist atmosphere. Very soluble in water and in alcohol. When heated, the salt is decomposed, emitting the odor of phenol, and finally leaving a residue of lithium carbonate and carbon. It imparts a crimson color to a non-luminous flame. The aqueous solution slightly reddens blue litmus paper. The aqueous solution should be colorless (absence of *iron* and *organic coloring matters*), and should not effervesce upon the addition of diluted acids (absence of *carbonate*). If copper sulphate T.S. be added to an aqueous solution of the salt (1 in 20), the mixture should have a bright green color. If a few drops of ferric chloride T.S. be added to an excess of a concentrated aqueous solution of Lithium Salicylate (1 in 4), a deep red color will be produced, which, after the liquid is largely diluted and mixed with more ferric chloride T.S., will change to a deep bluish-violet tint. Upon adding to 0.5 Gm. of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and cautiously, drop by drop, about 1 Cc. of methyl alcohol, then, on heating the mixture to boiling, the odor of oil of gaultheria will be evolved. If an excess of hydrochloric acid be added to a concentrated aqueous solution of 0.7 Gm. of Lithium Salicylate, a voluminous precipitate of salicylic acid will be formed, which, after

collecting upon a filter and thoroughly washing and drying, should conform to the reactions and tests given under *Acidum Salicylicum*. If the filtrate and washings from this precipitate be evaporated almost to dryness on a water-bath, in a flat-bottomed flask of 50 Cc. capacity, and 10 Cc. of amyl alcohol (boiling point 132° C.) added, and if, after cautiously heating until the lower aqueous layer has evaporated, 3 drops of hydrochloric acid be added and the solution boiled for three minutes, the resulting insoluble residue should weigh not more than 0.005 Gm. (limit of *other alkalies*). The removal of the water from the amyl alcohol mixture is facilitated by passing a current of air through the hot solution. If 1 Gm. of the salt be dissolved in 20 Cc. of water, and the salicylic acid precipitated by the addition of a sufficient quantity of hydrochloric acid, the filtrate should respond to the following tests of purity: The addition of ammonia water until the solution has an alkaline reaction should produce neither turbidity nor precipitation, either before or after boiling (absence of *iron, aluminum,* etc.). Another portion of this solution should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 0.5 Gm. of dry Lithium Salicylate be thoroughly mixed with about 1 Gm. of powdered anhydrous ammonium sulphate, and cautiously ignited in a porcelain crucible until of constant weight, the residue should weigh not less than 0.188 Gm., nor more than 0.192 Gm." *U. S.*

Uses.—This salt has been introduced into the U. S. Pharmacopœia as a remedy in *gout* and *rheumatism,* uniting the virtues of salicylic acid and of lithium. It will probably be found efficient, and has the great advantage over salicylic acid of being freely soluble in water and much less irritant to the stomach. One drachm contains the equivalent of about 57 grains of salicylic acid and 3 grains of lithium.

Dose, twenty to forty grains (1.3 to 2.6 Gm.).

LOBELIA. U. S., Br.

LOBELIA

(lo-bē′lĭ-a)

"The dried leaves and tops of *Lobelia inflata* Linné (Fam. *Campanulaceæ*), collected after a portion of the capsules have become inflated." *U. S.* "The dried flowering herb of Lobelia inflata, *Linn.*" *Br.*

Indian or Wild Tobacco, Asthma-weed, Puke-weed, Bladder Pod, Eyebright; Lobélie enflée, *Fr. Cod.;* Herba Lobeliæ, *P. G.;* Lobelienkraut, *G.;* Lobelia, *It.*

Lobelia inflata, L., *Sp. Pl.* (1753) 931; Willd., *Sp. Plant.* i. 946; Bigelow, *Am. Med. Bot.,* i. 177; Barton, *Med. Bot.* i. 181; Carson, *Illust. of Med. Bot.,* i. 60, pl. 51; *B. & T.* 162.—This species of Lobelia, often called *Indian tobacco,* is an annual or biennial indigenous plant, usually a foot or more in height, with a fibrous root, and a solitary, erect, angular, very hairy stem, much branched about midway, but rising considerably above the summits of the highest branches. The leaves are scattered, or alternate, petiolate, the upper sessile, ovate, or oblong, about two inches (5 Cm.) long, irregularly toothed, pubescent, pale green. The flowers are numerous, small, disposed in leafy terminal racemes, and upon short axillary footstalks. The calyx is five-toothed and much inflated in fruit. The corolla, which is of a delicate blue, has a labiate border, with the upper lip divided into two, the lower into three segments. The united anthers are curved, and enclose the stigma. The fruit is an oval, striated, inflated capsule, crowned with the persistent calyx, and containing, in two cells, numerous very small, oblong, reticulated brown seeds.[1] The transverse section of the stem exhibits laticiferous vessels in the bast.

Lobelia inflata[2] is a very common weed, growing on the roadsides and in neglected fields throughout the Eastern United States and Canada. Its flowers begin to appear towards the end of July, and continue to expand in succession until the occurrence of frost. All parts of it are medicinal, but, according to Eberle, the root and inflated capsules are most powerful. The plant should be collected in August or September, when the capsules are numerous, and should be carefully dried. It may be kept whole or in powder. As found in commerce, it is often in oblong compressed cakes, prepared by the Shakers or the herb dealers.

Dried lobelia has a slightly irritating odor, and when chewed, though at first without much taste, soon produces a burning acrid impression upon the posterior parts of the tongue and palate, very closely resembling that occasioned by tobacco, and attended in like manner with a flow of saliva and a nauseating effect. "Leaves alternate, the lower short-petioled, the upper sessile, ovate or oblong, 4 to 9 Cm. long; irregularly serrate-denticulate, the divisions with a yellowish-brown, gland-like apex; pale green, pubescent; stems coarsely angled, often purplish, hairy, terminating in long racemes of small short-pedicelled flowers having an adherent 5-toothed calyx and a small tubular corolla, cleft to the base on the upper side, the one-sided limb 5-lobed, and pale blue in the fresh

[1] In case of poisoning by lobelia, the seeds may be recognized by the following microscopic characters. (Fred. Curtis, *Lond. Med. Gaz.,* July, 1851.) They are almond-shaped, about 1-30th of an inch long by 1-75th broad, puce-colored, regularly marked with longitudinal ridges and furrows, and cross ridges generally at right angles with the former, so that the surface presents the appearance of basket work. No other seeds could be mistaken for them, except those of *Lobelia cardinalis,* which, however, are larger, coarser, of a lighter color, and with the superficial rectangular checkering less distinct.

[2] Two other North American species of lobelia have been used in medicine, but appear to be of very little value,—*L. cardinalis,* or cardinal flower, as an anthelmintic; *L. syphilitica,* as an antisyphilitic. (See W. P. C. Barton's *Medical Botany.*) V. Rosen has found in the *L. nicotianæfolia,* which grows in the mountain ranges of Ceylon and the Madras Peninsula, two alkaloids,—one liquid and identical with lobeline, the other a crystalline solid. He believes, as the result of some physiological experiments, that the plant has the same properties as those of *L. inflata.* (*P. J.,* 1886, p. 838.)

state, the five stamens united; capsule inflated, 2-celled, containing numerous minute brownish, ellipsoidal, coarsely reticulate seeds; odor slight, irritating; taste strongly acrid." *U. S.* The powder is greenish. The plant yields its virtues readily to water and alcohol. Water distilled from it has its odor without its acrimony. Procter found the plant to contain an odorous volatile principle, probably volatile oil; a peculiar alkaline principle, named lobeline; a peculiar acid, first noticed as distinct by Pereira, called *lobelic acid;* besides gum, resin, chlorophyll, fixed oil, lignin, salts of lime and potassium with ferric oxide. The seeds contain at least twice as much of lobeline, in proportion, as the whole plant, which yielded only one part in five hundred. They contain also 30 per cent. of a nearly colorless fixed oil having the drying property in an extraordinary degree. *Lobeline* was obtained by Procter by the following process. The seeds were treated with alcohol acidulated with acetic acid, until deprived of acrimony, and the tincture was evaporated; the resulting extract was triturated with magnesia and water, and, after repeated agitation for several hours, the liquor, holding lobeline in solution, was filtered; this was then shaken repeatedly with ether until no longer acrid, and the ethereal solution, having been decanted, was allowed to evaporate spontaneously. The residue, which was reddish brown and of the consistence of honey, was deprived of coloring matter by dissolving it in water, adding a slight excess of sulphuric acid, boiling with animal charcoal, saturating with magnesia, filtering, agitating with ether until this fluid had deprived the water of acrimony, and finally decanting and allowing the ether to evaporate. Thus obtained, *lobeline* is a yellowish liquid, lighter than water, of a somewhat aromatic odor, and a very persistent, acrid taste. It is soluble in water, but much more copiously in alcohol and ether, and the latter fluid readily removes it from its aqueous solution. It has an alkaline reaction, and forms soluble and crystallizable salts with sulphuric, nitric, and hydrochloric acids, and a very soluble but not crystallizable salt with acetic acid. It forms an insoluble compound with tannic acid, which instantly precipitates it from its solution. By a boiling heat it is entirely decomposed, losing all its acrimony, but when combined with acids it may be subjected to ebullition with water without change. (*A. J. P.*, ix. 105, xiii. 1; see also a paper by W. D. Richardson, Jr., *A. J. P.*, 1872, p. 293.)[1] Paschkis and Smita (*M. Chem.*, xi. p. 131) obtained the alkaloid as a viscous oil with an odor resembling at once that of honey and that of tobacco. Siebert has also obtained both from the herb and seeds of lobelia a pale-yellow alkaline syrup, the crystallized hydrochloride and chloroplatinate of which indicated the formula $C_{15}H_{23}NO_2$ for the free alkaloid. Enders has also isolated the acrid substance of the drug, and gives to it the name *lobelacrin*. It is obtained in warty tufts of a brown color, soluble in ether and chloroform, but only slightly in water. It is decomposed by boiling with diluted acids or alkalies into sugar and lobelic acid. Lewis (*P. J.* [3], 10, p. 56) considers lobelacrin as only a mixture of lobeline lobelate with free lobelic acid. (*Pharmacographia*, 2d ed., 400.) Lloyd considers the lobelacrin of Enders to be a mixture of inflatin, resin, lobeline, and the fixed oil which lobelia seed contains in the proportion of about 30 per cent. S. Colhoun of Philadelphia, was the first to announce the existence of a peculiar principle in lobelia, capable of forming salts with the acids, but he did not obtain it in an isolated state. An important inference from the effects of heat upon lobeline is that, in preparing lobelia for use, the plant should never be heated in connection with a salifiable base. J. U. Lloyd isolated from lobelia a crystalline substance, melting at 225° C., which had been observed previously by Procter. Lloyd named it *inflatin;* it is colorless, tasteless, and odorless, insoluble in water or glycerin, soluble in carbon disulphide, benzene, chloroform, ether, and least soluble in alcohol. It is a neutral principle, and appears to have no therapeutic value. (*Ph. Rund.*, 1887, 32.)

Uses.—Lobelia is said to have been used as a medicine by the aborigines of America, but was first brought into general professional notice by Cutler of Massachusetts. The leaves or capsules, chewed for a short time, occasion giddiness, headache, general tremors, and ultimately nausea and vomiting. When swallowed in the full dose, the medicine produces speedy and severe vomiting, attended with continued and distressing nausea, copious sweating, and great general relaxation. When toxic doses are taken, these symptoms are very severe, and have added to them burning pain in the fauces or œsophagus, progressive failure of voluntary motion, rapid, feeble pulse, fall of temperature, and finally collapse with stupor or coma; in some cases convulsions precede death. Death has often resulted from its empirical use. Its poisonous effects are most likely to occur when, as sometimes happens, it is not rejected by vomiting. The experiments of I. Ott upon the lower animals show that the poison causes paralysis of the motor nerve trunks, of the peripheral vagi, and probably also of the vasomotor centres. Death seems to occur from failure of respiration, due, in part at least, to the condition of the motor nerves.

As an emetic, lobelia should never be used; at present it is rarely employed at all except in *spasmodic asthma*, the paroxysms of which it often greatly mitigates, and sometimes wholly relieves, even when not given in doses large enough to produce vomiting. It has been used also in *catarrh, croup, pertussis,* and other

[1] William Bastick of London, published (*P. J.*, Dec. 1850) an article on lobeline, apparently in entire ignorance of the previous work of Procter. His process does not differ essentially from that above given. In one magnesia is used to decompose the native salt of lobeline, in the other lime, the caustic alkalies not being applicable to the purpose, as they decompose this alkaloid with great facility.

laryngeal and *pectoral affections,* but is chiefly valuable where there is *bronchial spasm;* it must always be employed with caution. The tincture affords the most eligible mode of administration; in asthmatic cases it may be given in doses of fifteen minims (0.9 Cc.) every hour until an effect is produced. The fluidextract and the tincture are official. The process for the vinegar, which was dropped by the U. S. Pharmacopœia of 1890, will be found in the foot-note.[1] Nunes (*T. G.,* 1889) asserts that he has used lobeline in a number of cases of *asthma* with most excellent results in doses of from three-fourths of a grain to six grains a day; but it can scarcely be doubted that he had a very impure alkaloid, and that such doses of a pure sample would be highly dangerous.

Dose, antispasmodic, five grains (0.32 Gm.).

Off. Prep.—Fluidextractum Lobeliæ, *U. S.;* Tinctura Lobeliæ, *U. S.;* Tinctura Lobeliæ Ætherea, *Br.*

LOTIO HYDRARGYRI FLAVA. Br.

YELLOW MERCURIAL LOTION

(lō′tī-ō hȳ-drär′gy-rī flā′vạ)

Aqua Phagedænica Flava; Lotio Flava, Yellow Wash, Yellow Lotion; Eau phagédénique, *Fr. Cod.;* Eau divine de Fernel, Phagédénique, *Fr.;* Phagedänisches Wasser, Altschadenwasser, *G.*

"Mercuric Chloride, 20 *grains* (Imperial) or 0.46 gramme; Solution of Lime, 10 *fl. ounces* (Imp. meas.) or 100 cubic centimetres. Mix." *Br.* This lotion is about 11 per cent. stronger than that official in the Br. Ph. 1885.

LOTIO HYDRARGYRI NIGRA. Br.

BLACK MERCURIAL LOTION

(lō′tī-ō hȳ-drär′gy-rī nī′grạ)

Aqua Phagedænica Nigra; Lotio Nigra, Aqua Nigra, Aqua Mercurialis Nigra; Black Wash, Black Lotion; Eau Phagédénique noire, *Fr.;* Schwarzes Wasser, *G.*

"Mercurous Chloride, 30 *grains* (Imperial) or 0.685 gramme; Glycerin, ½ *fl. ounce* (Imp. meas.) or 5 cubic centimetres; Mucilage of Tragacanth, 1¼ *fl. ounces* (Imp. meas.) or 12.5 cubic centimetres; Solution of Lime, *a sufficient quantity.* Triturate the Mercurous Chloride with the Glycerin and Mucilage of Tragacanth; transfer to a bottle; add *two fluid ounces* (Imp. meas.) or 20 cubic centimetres of the Solution of Lime; shake well; add sufficient Solution of Lime to produce *ten fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Lotion." *Br.* The addition of glycerin and mucilage of tragacanth improves this lotion by aiding in the suspension of the insoluble powder.

[1] *Acetum Lobeliæ,* U. S. 1880. *Vinegar of Lobelia.* (*Vinaigre de Lobélie enflée,* Fr.; *Lobelienessig,* G.) "Lobelia, in No. 30 powder, *ten parts* [or one and three-fourths ounces av.]; Diluted Acetic Acid, *a sufficient quantity,* to make *one hundred parts* [or one pint]. Moisten the powder with *five parts* [or one fluidounce] of Diluted Acetic Acid, pack it firmly in a conical glass percolator, and gradually pour Diluted Acetic Acid upon it until *one hundred parts* [or one pint] of filtered liquid are obtained." *U. S.* Vinegar of Lobelia may also be prepared by macerating the powder in one pint of Diluted Acetic Acid for seven days, expressing the liquid, and filtering through paper. This is an active preparation of lobelia. Dose, as an expectorant for an adult, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.). In the paroxysm of spasmodic *asthma* one fluidrachm (3.75 Cc.) may be given every two or three hours until relief is obtained.

LOTIONES.

LOTIONS

(lō-tī-ō′nēṣ)

Washes; Lotions, *Fr.;* Waschungen, *G.*

This class has been introduced into the British Pharmacopœia in order to give official recognition to two preparations, the *black wash* or *lotio nigra,* and the *yellow wash,* or *lotio flava,* which have long been in use, and which will be found above, and treated of under Calomel and Corrosive Sublimate at pages 622 and 617 of this work.

LUPULINUM. U. S., Br.

LUPULIN

(lū-pū-lī′nŭm)

"The glandular trichomes separated from the fruit of *Humulus Lupulus* Linné (Fam. *Moraceæ*)." *U. S.* "Glands obtained from the strobiles of Humulus Lupulus, *Linn.* It should contain not more than 40 per cent. of matter insoluble in *ether,* and yields not more than 12 per cent. of ash when incinerated." *Br.*

Lupulina, *Pharm.* 1870; Lupulinic Glands; Lupulin, *Fr. Cod.;* Lupulite, *Fr.;* Glandulæ Lupuli, Hopfenmehl, Lupulin, *G.;* Luppolino, *It.;* Lupulino, *Sp.*

Lupulin is officially described as "a granular powder, bright brownish-yellow becoming yellowish-brown, and resinous; its component trichomes somewhat globular or ellipsoidal, 0.1 to 0.3 Mm. in diameter, multicellular; having the characteristic odor and taste of hops. Not less than 60 percent. of Lupulin is soluble in ether, and when incinerated, it should yield not more than 10 percent. of ash." *U. S.* (See *Humulus,* p. 615.)[1]

Dose, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Fluidextractum Lupulini, *U. S.;* Oleoresina Lupulini, *U. S.*

[1] J. S. Ward found, as the result of an examination, four samples of lupulin, which fairly represent the commercial article, to yield 54.24, 41.49, 40.04, and 39.41 per cent. of extractive, soluble in ether, and to yield 27.01, 29.10, 30.86, and 31.42 per cent. of ash. The samples were all gritty. (*P. J.,* 1886, 656.)

LYCOPODIUM. U. S.

LYCOPODIUM

(lȳ-cọ-pō′dĭ-ŭm)

"The spores of *Lycopodium clavatum* Linné or of other species of *Lycopodium* (Fam. *Lycopodiaceæ*)." *U. S.*

Semen Lycopodii, Pulvis Lycopodii, Sulphur Vegetabile; Vegetable Sulphur; Lycopode, *Fr. Cod.*; Soufre végétal, *Fr.*; Lycopodium, *P. G.*; Bärlappsamen, Streupulver, Hexenmehl, Blitzpulver, *G.*; Licopodio, *It., Sp.*

Lycopodium clavatum, Linn., *Sp. Plant.* (1753) 1101; *B. & T.* 299.—This plant, commonly called *club moss*, has a trailing, branching stem, several feet long, and thickly beset with linear-lanceolate, flat, ribless, smooth, partly serrate leaves with a capillary point, curved upward, and of a deep green color. The fructification is in terminal spikes, single or in pairs, with crowded ovate, entire, pointed scales, bearing in the axil a transversely oval sporange which splits nearly to the base and contains the narrow reticulate spores. The plant is a native of Europe, Asia, and America.

The spores are collected in Switzerland and Germany. Lycopodium is "a fine, pale yellowish, very mobile powder, nearly inodorous and tasteless, floating upon water and not wetted by it, but sinking on being boiled with it, and burning with a quick flash when thrown into a flame. Spores tetrahedral with one convex side, the surface being delicately reticulated, from 0.025 to 0.040 Mm. in diameter. The microscope should show no pollen or starch grains or particles of sand. The ash remaining upon ignition should not exceed 5 percent." *U. S.* Bucholz in 1807 pointed out the existence of a fixed oil. Flückiger, however, by thoroughly comminuting the spores of lycopodium with sand, obtained 47 per cent. of a bland oil of bright yellow color and sp. gr. 0.925, which does not congeal even at —15° C. (5° F.). A. Barkowski obtained from the spores of Lycopodium clavatum 48.5 per cent. of a neutral non-drying oil, very similar to almond oil. This oil contains 2 per cent. of a fatty acid called *lycopodic acid* ($C_{18}H_{36}O_4$), 80 per cent. of oleic acid, a minute quantity of a vegetable cholesterin similar to that obtained by Hesse from Calabar beans, 8.2 per cent. of glycerin and 3 per cent. of arachidic, palmitic and stearic acids. The lycopodic acid crystallizes in silky needles, it is doubly refracting like quartz, and appears to be isomeric with dioxystearic acid. (*D. C.*, 1891, 155.) Stenhouse found volatile bases to be present in very small amount. The ash amounts to 4 per cent. It contains alumina and 1 per cent. of phosphoric acid, and is not alkaline. (*Pharmacographia*, 2d ed., 732.) Lycopodium is often adulterated with the pollen of the pines and firs, and sometimes with talc and starch. In Nashville, Tenn., a specimen came into the possession of Benj. Lillard which was found to contain one-half of its bulk of dextrin. (*Ch. Ph.*, Sept. 1873.) Folleto recommends two reactions to detect pollen: one by adding to a syrupy solution of zinc chloride, potassium iodide and iodine to saturation; the pollen is colored yellow by this reagent, lycopodium is not colored; the other reagent is methyl-green, which colors pollen green, but does not color lycopodium. (*Ph. Centralh.*, 1896, 527.)

Uses.—Lycopodium is used as an absorbent application to *excoriated surfaces*, especially those which occur in the folds of the skin in infants. In pharmacy it answers the purpose of facilitating the rolling of the pilular mass, and of preventing the adhesion of the pills when formed. The moss itself has been esteemed diuretic and antispasmodic; its decoction has been employed in *rheumatism, diseases of the lungs and kidneys*, and in the removal of *plica Polonica*, but it has fallen into complete desuetude.

MAGNESII CARBONAS. U. S. (Br.)

MAGNESIUM CARBONATE

(măg-nē′sĭ-ī cär′bọ-năs)

Approximately $(MgCO_3)_4 \cdot Mg(OH)_2 + 5H_2O = 482.26$

"Magnesium Carbonate [$(CO.O_2Mg)_4.Mg(OH)_2 + 5H_2O$] should yield, upon ignition, not less than 40 percent. of residue, of which not less than 96 percent. should consist of pure magnesium oxide." *U. S.*

Magnesii Carbonas Levis, Light Magnesium Carbonate, *Br.*; **Magnesii Carbonas Ponderosus**, Heavy Magnesium Carbonate, *Br.*; Magnesia Hydrico-carbonica, Carbonas Magnesicus, Magnesia Alba, Magnesiæ Carbonas, Carbonate of Magnesia; Carbonate de Magnésie officinal, *Fr. Cod.*; Magnésie blanche, *Fr.*; Magnesium carbonicum, *P. G.*; Magnesiumcarbonat, Kohlensaure Magnesia, Weisse Magnesia, *G.*; Idrocarbonato di magnesio, Carbonato di Magnesia, *It.*; Carbonato Magnesico, Magnesia blanca, *Sp.*

In the U. S. P. (8th Rev.) magnesium carbonate is official under one name "Magnesii Carbonas;" this corresponds nearly with "Magnesii Carbonas Levis" of the British Pharmacopœia.

Magnesium Carbonate sometimes occurs as a native mineral known as *magnesite*, the best deposits of which are those of the Grecian Archipelago, though a common variety is found in Chester Co., Pa. That which is sold in commerce is prepared on a large scale by the manufacturer. In the British Pharmacopœia directions are given for preparing it in two forms: that of *Magnesii Carbonas Levis*, or Light Magnesium Carbonate; and that of *Magnesii Carbonas Ponderosus*, or Heavy Magnesium Carbonate. The following are the directions:

1. Magnesii Carbonas Levis. *Light Magnesium Carbonate*, Br.—"This preparation, $3(MgCO_3),Mg(HO)_2,4H_2O$, may be obtained by the following process. Magnesium Sulphate, 10 *ounces* (Imperial) or 125 grammes;

Sodium Carbonate, 12 *ounces* (Imp.) or 150 grammes; Distilled Water, *a sufficient quantity*. Dissolve the Magnesium Sulphate and the Sodium Carbonate each in *half a gallon* (Imp. meas.) or one litre of cold Distilled Water; mix the two solutions; boil the mixture for fifteen minutes; transfer the precipitate to a calico filter; pour upon it boiling Distilled Water until the washings are free from sulphates; dry at a temperature not exceeding 212° F. (100° C.)." *Br.* The resulting carbonate is characterized in the British Pharmacopœia as "a very light powder, which, when examined under the microscope, is found to consist of amorphous particles with numerous slender prisms intermixed. The other characters and tests are the same as those of Heavy Magnesium Carbonate." *Br.*

2. Magnesii Carbonas Ponderosus. *Heavy Magnesium Carbonate.* Br.—"This preparation, $3(MgCO_3),Mg(HO)_2,4H_2O$, may be obtained by the following process. Magnesium Sulphate, 10 *ounces* (Imperial) or 125 grammes; Sodium Carbonate, 12 *ounces* (Imp.) or 150 grammes; Distilled Water, boiling, *a sufficient quantity*. Dissolve the Magnesium Sulphate and the Sodium Carbonate each in a *pint* (Imp. meas.) or two hundred and fifty cubic centimetres of the Distilled Water; mix the solutions, and evaporate to dryness; digest the residue for half an hour with *two pints* (Imp. meas.) or five hundred cubic centimetres of the Distilled Water, and having collected the insoluble matter on a calico filter, wash it repeatedly with the Distilled Water until the washings are free from sulphates; dry the product at a temperature not exceeding 212° F. (100° C.)." *Br.*

This is essentially the old process of the Dublin College, and yields a product which is characterized in the British Pharmacopœia as "A white granular powder, which dissolves readily, with effervescence, in the diluted mineral acids, the solutions affording the reactions characteristic of magnesium. 5 grammes calcined at a red heat should be reduced to 2.1 grammes. It should yield no characteristic reaction with the tests for iron, aluminium, or calcium, and only the slightest reactions with the tests for chlorides or sulphates." *Br.*

Potassium carbonate is less desirable than sodium carbonate for the preparation of magnesium carbonate. It is difficult to separate the last portions of potassium sulphate from the precipitate, and potassium carbonate usually contains silica, which is thrown down with the magnesia. The consequence is that, when prepared with that salt, magnesium carbonate is liable to be gritty to the touch and to have a saline taste. The following method is said to be pursued by some of the best manufacturers. To a saturated solution of 100 parts of magnesium sulphate, a solution of 125 parts of crystallized sodium carbonate is gradually added, the solutions being constantly stirred. The mixture is heated to ebullition, to complete the precipitation of the magnesia, which is then washed with tepid and finally with cold water, until the washings no longer give a precipitate with barium salts. When sufficiently washed, the carbonate is allowed to drain for one or two days on large linen filters, and is then placed in wooden moulds with a porous bottom of brick or gypsum, and subjected to pressure in order to give it a square and compact form. According to Otto and Gabler, very pure magnesium carbonate is made at Nauheim, Germany. Pattinson's process is used. It depends upon the fact that, on treating calcined dolomite, in the presence of water, with carbon dioxide under pressure, the magnesia dissolves as bicarbonate before any of the accompanying lime enters in solution. The calcined and finely powdered mineral is introduced, together with water, into a cylinder with a horizontal axis, and, while it is being kept in constant motion by a stirring apparatus, carbon dioxide, under a pressure of five to six atmospheres, is forced into it. The resulting solution of magnesium bicarbonate, which is perfectly free from lime, if the process has been properly managed, is then transferred to a vertical cylinder, where it is heated with steam, whereby magnesium carbonate is separated, which is collected, formed into prismatic pieces, and dried. The carbon dioxide required issues from the earth immediately outside of the factory, and the dolomite is furnished by the quarries of May and Urban, near Dietz and Steelen on the Lahn. (*A. Pharm.*, Aug. 1880; *N. R.*, Sept. 1881.) J. G. Ferrier criticized the processes for making the carbonates by the British Pharmacopœia; he stated that there was a conspicuous want of uniformity in the results obtained. (*P. J.*, 1904, 586.)

The density of magnesium carbonate is said to depend upon the strength of the solutions from which it is first precipitated, and its fineness and softness to the touch, upon the use of sodium carbonate in its preparation. Much of the magnesium carbonate formerly used in this country was imported from England and Ireland, but that now consumed in the United States is chiefly a home product. The Keasbey & Mattison Company, who are the largest manufacturers of carbonate at the present time, use the process of decomposing calcined dolomite by forcing carbon dioxide into its aqueous mixture, and heating this to precipitate the carbonate. When made from bittern, magnesium carbonate is contaminated with calcium carbonate, salts of lime being contained in sea water, and when it is prepared from magnesite, or from magnesian schist, iron is almost always present. The only way in which these impurities can be avoided is to prepare pure magnesium sulphate by repeated crystallization, and to use a pure sodium carbonate. It is also necessary that the water with which the precipitate is washed should be free from earthy salts, which would be decomposed and contaminate the magnesia. Kippenberger pre-

pares crystallized magnesium carbonate by shaking *freshly* precipitated magnesium carbonate with a solution of potassium bicarbonate at the ordinary temperature; much of the magnesium carbonate dissolves and crystallizes out of the filtered solution upon standing for a day. Sodium bicarbonate may be used instead of the potassium salt, but the crystals are smaller. (*Zeit. Anorg. Chem.*, 1894, 177.)

Properties.—Magnesium carbonate is inodorous, nearly insipid, perfectly white, smooth to the touch, and nearly insoluble in water, requiring 2493 parts of cold and 9000 parts of hot water for solution. It is decomposed by strong heat, by all the acids, by potassium, sodium, calcium, barium and strontium hydroxides, and by acidulous and metallic salts. It is officially described as in "light, white, friable masses, or a bulky, white powder, without odor, and having a slightly earthy taste; permanent in the air. Practically insoluble in water, to which, however, it imparts a slightly alkaline reaction; insoluble in alcohol, but soluble in dilute acids with effervescence. When strongly heated, the salt loses water and carbon dioxide, and is converted into magnesium oxide. A filtered solution of the salt in diluted sulphuric acid, when mixed with ammonium chloride T.S. and an excess of ammonia water, yields with sodium phosphate T.S., a white crystalline precipitate." *U. S.* Pereira states that the *light carbonate*, when examined with the microscope, is seen to consist of an amorphous powder, more or less intermingled with slender prismatic crystals, which appear as if they were eroded or efflorescent; the *heavy carbonate* consists of granules of various sizes, without any traces of the prismatic crystals observed in the former variety.

A solution in carbonic acid water, prepared by passing carbon dioxide into a reservoir containing magnesium carbonate suspended in water, has been introduced into use as a cathartic and antacid. *Dinneford's Magnesia* is a solution of this nature. According to Christison, it contains only nine grains of carbonate in the fluidounce, though alleged to contain twice that quantity. Its taste is more disagreeable than that of the undissolved carbonate. A formula for this preparation has been introduced into the British Pharmacopœia, with the name of *Liquor Magnesiæ Carbonatis* (see page 724).

Adulterations and Tests.—The following are the official tests: "If a mixture of 1 Gm. of Magnesium Carbonate with 50 Cc. of water be heated to boiling, and, after cooling, filtered, the filtrate, if evaporated to dryness upon a water-bath, should leave not more than 0.001 Gm. of residue (limit of *foreign soluble salts*). Ten Cc. of a solution of the salt (1 in 50), prepared by the addition of sufficient acetic acid for solution, should not be rendered more than slightly opalescent within five minutes by ammonium oxalate T.S. (limit of *calcium*). If 1 Gm. of Magnesium Carbonate be ignited in a porcelain crucible, the residue should weigh not less than 0.40 Gm. If 1 Gm. of Magnesium Carbonate be dissolved in 20 Cc. of diluted hydrochloric acid, the solution should be colorless and not give an immediate blue coloration upon the addition of potassium ferrocyanide T.S. (limit of *iron*), nor should another solution of the same strength respond to the Time-Limit Test for other *heavy metals* (see PART III, Test No. 121). If 0.400 Gm. of recently ignited and cooled Magnesium Carbonate be dissolved in 25 Cc. of normal sulphuric acid V.S., not more than 5.8 Cc. of normal potassium hydroxide V.S. should be required for neutralization, methyl-orange T.S. being used as indicator (each Cc. of normal sulphuric acid V.S. consumed, being equivalent to 5 percent. of pure magnesium oxide)." *U. S.* Magnesium carbonate may contain an alkaline carbonate or sulphate, or both, from insufficient washing; also sodium chloride, alumina, and calcium carbonate. If water boiled on it changes turmeric, an alkaline carbonate is indicated. If barium chloride produces a precipitate in the water, the presence of a sulphate or carbonate is shown, and if silver nitrate produces precipitation, a chloride is indicated. When dissolved in an excess of hydrochloric acid, an excess of ammonia will throw down alumina, which is almost always present in minute quantity, and ammonium oxalate, afterwards added to the filtered chloride solution, will throw down calcium oxalate if lime be present. When the same solution, nearly neutralized, is rendered blue by potassium ferrocyanide, iron is indicated.

Composition.—According to Berzelius, magnesium carbonate of commerce (*magnesia alba*) is a combination of three molecules of magnesium carbonate with one of magnesium hydroxide. According to Phillips, whose analysis agrees with a subsequent one by Fownes, four molecules of the carbonate are combined with one of the hydroxide and four of water. (*P. J.*, iii. 480.) The formula given by the British Pharmacopœia is $3MgCO_3 + Mg(OH)_2 + 4H_2O$; in other words, a combination of three molecules of magnesium carbonate, one of magnesium hydroxide, and four of water, while the U. S. Pharmacopœia of 1890 made it $4MgCO_3 + Mg(OH)_2 + 5H_2O$, which is retained in the U. S. P. (8th Rev.). The composition of this salt varies with the mode of preparation.

Uses.—Magnesium carbonate is antacid, and, by combining with acid in the stomach, becomes generally cathartic. When it undergoes no change in the alimentary canal it produces no purgative effect. Under these circumstances it may usually be made to operate by following it with draughts of lemonade. It is useful in all cases which require a laxative antacid, and, though prone to produce flatulence in consequence of the liberation of its carbon dioxide in the stomach and bowels, and therefore in

ordinary cases inferior to calcined magnesia, it sometimes operates favorably, in consequence of this very property, in *sick stomach* attended with acidity. Magnesium carbonate is also an excellent antilithic when uric acid is present in excess. It is best administered in water or milk. In order that it may be uniformly diffused through water, it should be previously rubbed down with syrup or ginger syrup. Magnesium carbonate is a useful agent for diffusing camphor and the volatile oils through water, in preparing unofficial medicated waters, and is also used with a similar purpose as a diffusing agent in preparing syrups or elixirs.

Dose, thirty to one hundred and twenty grains (2 to 7.7 Gm.).

Off. Prep.—Liquor Magnesii Citratis, *U. S.;* Trochiscus Bismuthi Compositus, *Br.* It is used also in several official syrups.

MAGNESII OXIDUM. U. S. (Br.)

MAGNESIUM OXIDE, MAGNESIA [Magnesia, Pharm. 1890, Calcined Magnesia]

(măg-nē'şĭ-ī ŏx'ĭ-dŭm)

$MgO = 40.06$

"It should contain, after ignition, not less than 96 percent. of pure Magnesium Oxide. It should be kept in well-closed vessels." *U. S.* "Light Magnesium Oxide, MgO, is prepared by exposing Light Magnesium Carbonate to a dull red heat." *Br.*

Magnesia Levis, *Br.,* Light Magnesia; Magnesia Calcinata; Magnésie calcinée, *Fr. Cod.;* Magnésie, *Fr.;* Magnesia Usta, *P. G.;* Gebrannte Magnesia, *G.;* Ossido di magnesio, *It.;* Oxido magnesico, *Sp.*

In the British Pharmacopœia 1885 directions were given for preparing two forms of magnesia, one called *Magnesia Levis,*[1] or *Light Magnesia,* from the *Light Carbonate,* and the other *Magnesia Ponderosa,* from the *Heavy Carbonate.* It is the former which corresponds with our ordinary magnesia. Neither Pharmacopœia gives a detailed process.

By exposure to a red heat, the water and carbon dioxide of the magnesium carbonate are expelled, and the earth is obtained pure. According to Black, the carbonate loses seven-twelfths of its weight by calcination. Brande says that the loss varies from 50 to 60 per cent., of which from 15 to 20 per cent. is water:

$$(MgCO_3)_4 + Mg(OH)_2 + 5H_2O = 5MgO + 6H_2O + 4CO_2$$

About the close of the process the earth exhibits a luminous or phosphorescent appearance, which is said to be a good criterion of its freedom from carbon dioxide. (Duncan.) A more certain indication, however, is the absence of effervescence when hydrochloric acid is added to a little of the magnesia, previously mixed with water. It is an error to suppose that a very intense heat is requisite in the calcination. The temperature of ignition is sufficient for the expulsion of the water and carbon dioxide, and any increase serves only to render the magnesia harder, denser, less readily soluble in acids, and consequently less useful as a medicine. In order to insure a pure product, care should be taken that the carbonate employed be free from lime. It should be rubbed to powder before being introduced into the pot or crucible, and, as in consequence of its lightness it occupies a very large space, the plan has been proposed of moistening and compressing it in order to reduce its bulk; but the French pharmaceutical writers direct that the vessels employed should be sufficiently large to contain a considerable quantity of the carbonate, without the necessity of resorting to compression.[1] The official direction, to keep the magnesia, after it has been prepared, in well closed vessels, is founded on the fact that it absorbs carbon dioxide and water from the air, but, as the absorption of the gas goes on very slowly, and that of water does not injure the preparation, the caution is often neglected. (See *P. J.,* 1898, 389.) The great bulk of the oxide renders its introduction into small bottles inconvenient. A four ounce bottle holds only about an ounce of the purest and finest magnesia. But its specific gravity is greatly increased by trituration, and four times the quantity may be thus pressed into the same space. The density of *Henry's Magnesia,* which is at least four times that of the oxide prepared in the ordinary way, has been ascribed to this cause. It has also been attributed to the influence of intense heat employed in the calcination. The conjecture has even been advanced, that this magnesia, which has enjoyed so great a popularity in England and this country, is prepared by precipitating a solution of magnesium sulphate by potassium hydroxide, as the product afforded by this plan is comparatively dense. It is asserted that the magnesia prepared from the carbonate procured by precipitating magnesium sulphate with potassium carbonate is softer to the touch and bears a closer resemblance to Henry's than that prepared from the ordinary carbonate. The fact is explained by the presence in such magnesia

[1] "Take of Light Carbonate of Magnesium *four ounces.* Put it into a Cornish or Hessian crucible closed loosely by a lid, and expose it to a low red heat until a small quantity, taken from the centre of the crucible, cooled, moistened with water, and dropped into warm diluted sulphuric acid, causes no effervescence." *Br.* 1885.

[1] In a paper by A. Vée (*J. P. C.,* Avril, 1860, p. 84) it is stated that the magnesia of commerce, in consequence of imperfect preparation, is often found dense, granular, harsh, and of difficult solubility in the acids. To remedy this inconvenience the only method heretofore known was to prepare it in small quantities, and to stir the magnesia during calcination with an iron spoon. The difficulty in preparing it properly on the large scale depends upon the unequal action of the heat on large masses, so that the outer part becomes heated in excess before the inner is sufficiently so. To remedy this inconvenience, Vée uses a furnace and crucible of a peculiar shape, so arranged that the magnesia may not be in layers thicker than seven centimeters (2.7 inches), may be exposed equably to heat, and not longer exposed than may be necessary for its decomposition. For an account of the apparatus, and of the proper method of management, see *A. J. P.,* 1862, p. 522.

of a little potassium sulphate, from which it is difficult entirely to free it in consequence of the sparing solubility of this salt, and of a portion of silica, which originally existed in the potassium carbonate employed to decompose the magnesium sulphate, and of which sodium carbonate is destitute. According to Richard Phillips, Jr., if equivalent quantities of crystallized magnesium sulphate and crystallized sodium carbonate be boiled together in water, the mixture evaporated to dryness, the residual salts calcined, and the sodium sulphate dissolved out by water, the magnesia obtained will be dense. (See *A. J. P.,* xvi. 118.) By packing the carbonate closely in the crucible, or by moistening and then compressing it strongly in a cloth, before calcination, a heavy magnesia is obtained. The advantages of Henry's magnesia, independently of the convenience of its less bulk, are its greater softness and more ready miscibility with water. A preparation similar to Henry's is made by T. J. Husband of Philadelphia. In reference to the preparation of heavy magnesia, T. H. Barr, after trying various methods, obtained the best results either by precipitating a hot concentrated solution of magnesium sulphate with a like solution of sodium carbonate, or by decomposing magnesium chloride by heat. (*A. J. P.,* xxvi. 193.) P. E. Alessandri proposes the following method, which is both simple and rapid, for preparing "heavy" calcined magnesia. Take ordinary calcined magnesia, free from carbonate, moisten it, in a mortar, with pure absolute alcohol, and triturate it, at first gently, afterwards with some force, but not rapidly. During the agitation, the magnesia is to be moistened three or four times with fresh portions of the alcohol, and the operation is suspended when the bulk of the magnesia appears to remain stationary. Then remove the mass, dry it, rub it to powder, and pass it through a sieve. The product occupies only about one-fifteenth of the original bulk; but it is too expensive for practical uses. (*N. R.,* March, 1882.)

Magnesia is now manufactured extensively in the United States, the domestic product having almost entirely supplanted that which was formerly imported from Great Britain. The Keasbey & Mattison Company have erected extensive works at Ambler, Pa., although the greater part of their output is magnesium carbonate, which is used in the arts mainly as a non-conductor of heat. This company also makes light and heavy calcined magnesia for medicinal purposes, and dolomite is now exclusively used as the source of the magnesium compounds. (See *Magnesii Carbonas* for further information.)

Pereira found *light magnesia,* under the microscope, to exhibit the same forms observed in the light carbonate, namely, one portion was amorphous and of a flocculent or granular consistence, and another was composed of fragments of prismatic crystals, while the *heavy magnesia* was homogeneous, exhibiting no traces of crystals, and consisting of minute granules more or less cohering into small soft balls or masses. (*P. J.,* viii. 235.)

Properties.—Magnesium oxide or magnesia is a very light, white, inodorous powder, of a feeble alkaline taste. Its sp. gr. is commonly stated at 2.3. It was deemed infusible until melted by means of the oxyhydrogen blowpipe of Hare. When sufficiently heated, it conducts electricity and shines with an intense light, which fact is utilized in the Nernst lamp. Water sprinkled upon it is absorbed to the extent of about 18 per cent., but with scarcely any increase of temperature. It is almost insoluble, requiring, according to Fyfe, 5142 parts of water at 60° F., and 36,000 parts of boiling water, for solution. Water thus impregnated has no effect on vegetable colors, but magnesia itself produces a brown stain by contact with moistened turmeric paper. Magnesia is a metallic oxide, consisting of one atom of magnesium and one of oxygen. It is officially described as "a white, very bulky, and very fine powder, without odor, and having an earthy, but not a saline, taste. On exposure to the air, it slowly absorbs moisture and carbon dioxide. Almost insoluble in water, and insoluble in alcohol, but soluble in dilute acids. When moistened with water, it has a faintly alkaline reaction upon red litmus paper. On stirring 1 part of Magnesium Oxide with 15 parts of water, in a beaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient consistence to prevent it from dropping out when the beaker is inverted. A solution of Magnesium Oxide in diluted sulphuric acid, mixed with ammonium chloride T.S. and an excess of ammonia water, yields, with sodium phosphate T.S., a white, crystalline precipitate. If a mixture of 1 Gm. of Magnesium Oxide with 50 Cc. of water be heated to boiling, and, after cooling, filtered, the filtrate should not show more than a faintly alkaline reaction with red litmus paper, and when evaporated to dryness should not leave more than 0.005 Gm. of residue (limit of *foreign soluble salts*). If a mixture of 0.1 Gm. of Magnesium Oxide with 5 Cc. of water be heated to boiling, and, after cooling, be poured into 5 Cc. of acetic acid, solution should take place without the evolution of more than a few isolated gas bubbles (limit of *carbonate*). Ten Cc. of a solution of Magnesium Oxide (1 in 50), prepared by the addition of sufficient acetic acid for solution, should not be rendered more than slightly opalescent within five minutes by ammonium oxalate T.S. (limit of *calcium*). If 1 Gm. of Magnesium Oxide be dissolved in 50 Cc. of diluted hydrochloric acid, the solution should be colorless and not give an immediate blue coloration upon the addition of potassium ferrocyanide T.S. (limit of *iron*), and a solution of Magnesium Oxide (1 in 20) in diluted hydrochloric acid should not respond to the Time-Limit Test for other *heavy metals* (see PART III, Test No. 121). If Mag-

nesium Oxide be exposed to a low red heat in a porcelain crucible, it should not lose more than 15 percent. of its weight (limit of *water of hydration*). If 0.400 Gm. of recently ignited and cooled Magnesium Oxide be dissolved in 25 Cc. of normal sulphuric acid V.S., not more than 5.8 Cc. of normal potassium hydroxide V.S. should be required for neutralization, methyl-orange T.S. being used as indicator (each Cc. of the normal sulphuric acid V.S. consumed being equivalent to 5 percent. of pure Magnesium Oxide)." *U. S.* "A bulky white powder differing from Heavy Magnesia only in its greater lightness, the volumes corresponding to the same weight being to each other in the ratio of three and a half to one." *Br.*

Magnesium is a white, very brilliant metal, of sp. gr. 1.75, resembling silver, malleable, fusible at a low temperature, and convertible into magnesia by the combined action of air and moisture. It burns with great facility, and yields by its combustion a light which is intensely white and very rich in actinic or chemically active rays, so that it finds wide application in signal lights and for photography. Many of the so-called "flash powders" contain metallic magnesium in a finely divided state as their basis. There is a magnesium hydroxide, possessing the formula $Mg(OH)_2$. With nitric and hydrochloric acids magnesia forms salts which are soluble in alcohol and very deliquescent. It is precipitated from its saline solutions by the pure alkalies in the state of a hydroxide, and by potassium and sodium carbonates as a carbonate, but it is not precipitated by the alkaline bicarbonates, nor by common ammonium carbonate.

Magnesia is liable to contain, as impurities, magnesium carbonate, lime, alumina, silica, and small quantities of the soluble salts employed or produced in the preparation of the carbonate from which it is procured. Lime, which is a very frequent impurity, and imparts to the magnesia a more strongly alkaline and more disagreeable taste, is detected by ammonium oxalate or potassium bicarbonate. Neither of these salts disturbs a neutral solution of pure magnesia in a diluted acid, but if lime is present, both produce a precipitate, the former of calcium oxalate, the latter of calcium carbonate. According to Wittstein, calcium oxalate is soluble in the neutral salts of magnesia, requiring 50 parts of magnesium chloride, and 90 of magnesium sulphate, and consequently there might be no precipitate, or one redissolved by the liquid, should the proportion of lime be very small. (*J. P. C.*, 4e sér., iii. 216.) As magnesia is completely dissolved by hydrochloric acid, silica and other impurities insoluble in that acid would be left behind. Alumina is indicated by the production of a precipitate when ammonia is added in excess to a solution of fifty grains of magnesia in a fluidounce of hydrochloric acid. If the magnesia contain a soluble sulphate or carbonate, barium chloride will reveal it by producing a precipitate with water digested on the magnesia. Rochelle salt occurs as an impurity in magnesia, probably as the result of accident. (*A. J. P.*, Jan. 1873.)

Uses.—Magnesium oxide is antacid and laxative, and is much used, under the name of *calcined magnesia*, in *dyspepsia, sick headache,* gout, and other complaints attended with sour stomach and constipation. It is also a favorite remedy in the complaints of children, in which acidity of the primæ viæ is often a prominent symptom. Its antacid properties render it useful in *gravel* attended with an excessive production of uric acid. Its advantages over magnesium carbonate are that it may be given in a smaller dose and does not occasion flatulence.[1] The dose as a laxative is from thirty grains to a drachm (2.0 to 3.9 Gm.); as an antacid merely, or an antilithic, from ten to thirty grains (0.65 to 2.0 Gm.) twice a day. When it meets with no acid, it is apt to linger in the stomach or bowels, and may in that case be followed by lemonade. It should be administered in water or milk, and thoroughly triturated so as to render the mixture uniform. If mixed with less than 14 or 15 times its weight of water, and allowed to stand for a day or two, magnesia is apt to form a more or less concrete mass, owing to the production of a hydroxide. This change does not take place, or at least takes place much less readily, when magnesia already saturated with moisture is employed instead of that freshly calcined. In this connection Duncan recommends boiling the magnesia for a few moments with half the quantity of water prescribed to prevent subsequent caking. It has been conjectured that anhydrous magnesia might prove injurious to the stomach by solidifying its liquid contents, and the oxide which has become saturated with moisture by exposure to a damp air is preferably recommended. Freshly precipitated magnesium hydroxide will serve as an antidote to arsenic trioxide, though less efficient than ferric hydroxide. The experiments of Carles have shown that the soluble *magnesium saccharate* is not superior as an antidote for arsenic to simple magnesia. Ohleyer (*L. L.*, July, 1873) employs magnesia as a dressing in *ulcers* and *abrasions,* while Vergely recommends for *burns* calcined magnesia triturated with milk so as to form a paste, which should be applied thickly several times a day.

Dose, thirty to sixty grains (2.0 to 3.9 Gm.).

Off. Prep.—Ferri Hydroxidum cum Magnesii Oxido, *U. S.;* Fluidextractum Rhamni Purshianæ Aromaticum, *U. S.;* Pulvis Rhei Compositus, *U. S., Br.*

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[1] *Trochisci Magnesiæ.* U. S. 1880. *Troches of Magnesia.*—"Magnesia, three hundred grains (19.50 Gm.); Nutmeg, in fine powder, *fifteen grains* (1.00 Gm.); Sugar, in fine powder, *nine hundred grains* (58.50 Gm.); Mucilage of Tragacanth, *a sufficient quantity,* to make *one hundred troches.* Rub the Magnesia and powder together until they are thoroughly mixed; then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches.*" *U. S.* These each contain three grains (0.20 Gm.) of Magnesia, and are useful in *acidity of the stomach,* especially when attended with constipation.

MAGNESII OXIDUM PONDEROSUM. U. S. (Br.)

HEAVY MAGNESIUM OXIDE, HEAVY MAGNESIA
[Magnesia Ponderosa, Pharm. 1890]

(măg-nē'şī-ī ŏx'ĭ-dŭm pŏn'dẹ-rō'sŭm)

$MgO = 40.06$

"A white, dense, and very fine powder, which should conform to the reactions and tests given under *Magnesii Oxidum*. It differs, however, from the latter in not readily uniting with water to form a gelatinous hydroxide." *U. S.* "Heavy Magnesium Oxide, MgO, is prepared by exposing Heavy Magnesium Carbonate to a dull red heat." *Br.*

Magnesia Ponderosa, *Br.*, Heavy Calcined Magnesia; Oxide of Magnesium; Magnésie Calcinée pesante, *Fr.*; Schwere gebrannte Magnesia, *G.*

This was directed, in the British Pharmacopœia 1885, to be prepared precisely in the same manner as light magnesia, using, however, the heavy carbonate (Heavy Magnesium Carbonate, *Br.*). It is described by the Br. Ph. 1898 as "a white powder, insoluble in *water*, but readily dissolved by acids, the solutions affording the reactions characteristic of magnesium. It should yield no characteristic reaction with the tests for iron, aluminium, calcium, or carbonates, and only the slightest reactions with the tests for chlorides or sulphates. When heated to dull redness it should lose little or no weight." *Br.* The two varieties of light and heavy magnesia differ only in their weight in the same bulk, the volumes corresponding to the same weight being to each other in the ratio of three and one-half to one. (See *Magnesii Oxidum*, page 753.)

Dose, thirty to sixty grains (2 to 3.9 Gm.).

MAGNESII SULPHAS. U. S., Br.

MAGNESIUM SULPHATE [Epsom Salt]

(măg-nē'şī-ī sŭl'phăs)

$MgSO_4 + 7H_2O = 244.69$

"It should contain not less than 99.7 percent. of pure Magnesium Sulphate [$SO_2.O_2Mg + 7H_2O$], and should be kept in well-closed vessels." *U. S.* "Magnesium Sulphate, $MgSO_4$, $7H_2O$, may be prepared by the interaction of the native magnesium carbonates and diluted sulphuric acid; or by purifying the native sulphate." *Br.*

Sal Amarum, Sal Epsomense, Sal Anglicum, Sal Sedlicense, Sulfas Magnesicus; Sulphate of Magnesia; Sulfate de Magnésie, *Fr. Cod.*; Sel d'Epsom, Sel de Sedlitz, Sel amer, *Fr.*; Magnesium sulfuricum, *P. G.*; Magnesiumsulfat, Schwefelsaures Magnesia, Bittersalz, *G.*; Solfato di magnesio, Sulfato magnesico, *Sp.*

Magnesium Sulphate is a constituent of sea water, and of some saline springs. It also occurs native, either crystallized in slender, prismatic, adhering crystals, or as an efflorescence on certain rocks and soils which contain magnesia and a sulphate or sulphide. In the United States it is found in the great caves so numerous to the west of the Alleghany Mountains. In one of these caves, near Corydon in Indiana, it formed a stratum on the bottom several inches deep, or appeared in masses sometimes weighing ten pounds, or disseminated in the earth of the cavern, one bushel of which yielded from four to twenty-five pounds of the sulphate. It also appeared on the walls of the cavern, and, if it was removed, acicular crystals again appeared in a few weeks. (Cleveland.)

Under the name of *kieserite*, a mineral is obtained from the saline deposits at Stassfurt, in Germany, which consists chiefly of impure magnesium sulphate. The production of kieserite for the year 1901 was 27,088 tons, and for 1902, 27,576 tons. It is used as a source for preparing magnesium sulphate, and is exported from Germany; for a historical paper on Epsom salt by M. I. Wilbert see *Proc. A. Ph. A.*, 1904, 351.

Magnesium sulphate was originally procured by evaporating the waters of saline springs at Epsom, in England. Grew prepared it in this manner in 1675. It was afterwards discovered that the brine remaining after the crystallization of common salt from sea water furnished by careful evaporation precisely the same salt, and, as this was a much cheaper product, it superseded the former. The residual brine, or bittern, consists of magnesium sulphate and magnesium and calcium chlorides. As the magnesium sulphate crystallizes first, it may with proper care be obtained nearly pure, although most frequently the salt prepared in this way is deliquescent from the presence of magnesium chloride. It may be freed from this impurity by washing the crystals with their own saturated solution. It was from this source that the greater part of the Epsom salt of commerce was long obtained in Europe. The salt works of New England supplied our own market with an impure and deliquescent sulphate. With the improvements of chemistry, other and better processes have been adopted. In the neighborhood of Genoa and Nice, magnesium sulphate is prepared in large quantities from a schistose rock containing magnesia and iron sulphide. The mineral is roasted, and exposed in heaps for some months to the action of air and water. It is then lixiviated, the ferrous sulphate decomposed by lime water, and the salt obtained pure by repeated solution and crystallization.

William Henry of Manchester, whose calcined magnesia became famous throughout the world, took out a patent for a mode of preparing magnesia and its salts from the double magnesium and calcium carbonate,—the *dolomite* of mineralogists. His process was to drive off the carbon dioxide by heat, and to convert the remaining earth into hydroxides. He treated these with a sufficient quantity of hydrochloric

acid to dissolve out the lime, and then converted the magnesia into a sulphate either by sulphuric acid or by ferrous sulphate.

The salt is extensively manufactured in Baltimore and Philadelphia from a silicious magnesium hydroxide. This mineral occurs in veins in the serpentine and other magnesian rocks which abound in the neighborhood of Baltimore and in the southern counties of Pennsylvania. The advantage which it possesses over the dolomite, in the preparation of this salt, is the almost entire absence of lime, owing to which there is little or no waste of acid, and the operation is much simplified. The mineral is reduced to a fine powder and saturated with sulphuric acid. The mass is then dried and calcined at a red heat, in order to convert any ferrous sulphate which may be present into ferric oxide. It is then dissolved in water, and calcium sulphide added to separate any remaining portion of iron. The salt is crystallized and dissolved a third time, in order to purify it. The sulphate prepared by this process is generally very pure and clean, although it sometimes contains a trace of ferrous sulphate. A very pure magnesium sulphate free from chloride is obtained as a side product in the manufacture of carbon dioxide from magnesite when sulphuric acid is used to decompose the carbonate. This industry has assumed large proportions because of the demand for liquified carbon dioxide in the manufacture of aerated and effervescing mineral waters.

Properties.—Magnesium sulphate is in "small, colorless, prismatic needles or rhombic prisms, without odor, and having a cooling, saline, and bitter taste; slowly efflorescent in the air. Soluble in 0.85 part of water at 25° C. (77° F.), and in 0.13 part of boiling water; insoluble in alcohol. When heated to 52° C. (125.6° F.), or exposed to warm air, the salt loses one molecule of water, and is converted into a white powder. At about 130° C. (266° F.) it still retains 1 molecule of water, and at a temperature between 200° and 238° C. (392° and 460.4° F.) it is rendered anhydrous. An aqueous solution of Magnesium Sulphate is neutral to litmus paper. When mixed with ammonium chloride T.S. and ammonia water, the aqueous solution of the salt yields with sodium phosphate T.S., a white crystalline precipitate. With barium chloride T.S. it yields a white precipitate insoluble in hydrochloric acid. Ten Cc. of the aqueous solution of the salt (1 in 20) should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "Soluble in 1 part of cold *water*, and possessing a bitter taste. It affords the reactions characteristic of magnesium and of sulphates. 0.5 gramme dissolved in 250 cubic centimetres of *water*, when set aside for twelve hours with a mixture of *solution of ammonia, solution of ammonium chloride,* and *solution of sodium phosphate,* yields a precipitate which, when thoroughly washed, dried, and heated to redness, weighs 0.22 gramme. Magnesium Sulphate should yield no characteristic reaction with the tests for iron, aluminium, zinc, calcium, sodium, potassium, ammonium, or nitrates, and only the slightest reactions with the tests for chlorides." *Br.* It usually occurs in small acicular crystals, which are produced by agitating the solution while crystallizing. It slowly effloresces in the air.

Magnesium sulphate is completely decomposed by potassium and sodium hydroxides and their carbonates, by lime, barium and strontium oxides, and their soluble salts. Ammonia partially decomposes it, and forms with the remainder a double sulphate. Potassium and sodium bicarbonates do not decompose it, except by the aid of heat. An economic use which has been recommended of magnesium sulphate is the addition of a strong solution to ordinary white-wash, whereby a beautiful whiteness may be given to walls and ceilings. A little of it, moreover, added to starch considerably increases its stiffening properties, and at the same time in some degree resists the action of fire. (*Chem. News,* April, 1867.)

Uses.—Magnesium sulphate is an active but safe cathartic, operating with little pain or nausea, and producing watery stools. It is more acceptable to the stomach than most medicines of its class, and will often be retained when others are rejected. Like many of the other neutral salts, it is refrigerant, and may be made to act as a diuretic by keeping the skin cool and walking about after it has been taken. It is well adapted to the treatment of *fevers* and *inflammatory affections.* It is also useful in *colic* and *obstinate constipation,* and may be employed in most cases which require the use of a cathartic without being attended with debility or relaxation of the stomach and bowels. The medium dose is an ounce (31 Gm.), but advantage often results from its administration in divided doses frequently repeated. It is often given in combination with other medicines, especially with senna, the griping effect of which it tends to obviate. The most agreeable form for administering the salt, and that in which it usually agrees best with the stomach, is a solution in carbonic acid water with lemon syrup. By Henry of Dublin, it is highly recommended in connection with diluted sulphuric acid. To seven ounces of a saturated aqueous solution of the salt he adds an ounce of the diluted sulphuric acid, and gives a tablespoonful of the mixture for a dose, in a wineglassful of water.

The experiments of Recke, Hay, and Henry Curci show that when injected into the veins magnesium sulphate acts as a violent poison, producing at first increase of the blood pressure with slowing of the pulse, and finally lowering of the blood pressure, quickening of the pulse, and death, sometimes by failure of

respiration, at other times by cardiac arrest. As Christison reported the case of a boy ten years old who was said to have been killed by two ounces of the salt without the induction of purgation, it is possible that under some circumstances very large amounts of magnesium sulphate given by the mouth may be sufficiently absorbed to produce poisonous effects.

Many years ago the hypodermic use of magnesium sulphate as a purgative was reported upon favorably by clinicians, but certainly this use of the remedy failed to become at all general. The method has been recommended by Fincke, Rohé, Wade, James Wood, and by MacCallum, who assert that the hypodermic injection of from one and a half to four and a half grains of the magnesium sulphate will produce watery stools in the majority of cases, but no purgation follows in from twenty to forty per cent. of the cases. The effects of the injection of large doses into the lower animals must cause some hesitation in the use of large amounts of the magnesium sulphate hyopdermically. Rectal injections of from one to three ounces of the saturated solution of the magnesium sulphate often act very favorably, but are somewhat uncertain.

Dose, one to eight drachms (3.9 to 31 Gm.).

Off. Prep.—Infusum Sennæ Compositum, *U. S.;* Liquor Magnesii Carbonatis, *Br.;* Magnesii Carbonas Levis, *Br.;* Magnesii Carbonas Ponderosus, *Br.;* Magnesii Sulphas Effervescens, *U. S., Br.;* Mistura Sennæ Composita, *Br.*

MAGNESII SULPHAS EFFERVESCENS. U. S., Br.

EFFERVESCENT MAGNESIUM SULPHATE

(măg-nē'şĭ-ī sŭl'phăs ĕf-fẹr-vĕs'cẹnş)

Magnesium Sulphuricum Effervescens; Magnesiæ Sulphas Effervescens; Effervescent Sulphate of Magnesia; Effervescent Epsom Salt; Brausendes Magnesiumsulfat, *G.;* Sulfato magnesico effervescente, *Sp.*

* "Magnesium Sulphate, unefflorescd crystals, *five hundred grammes* [or 17 ounces av., 279 grains]; Sodium Bicarbonate, dried and powdered, *four hundred and three grammes* [or 14 ounces av., 94 grains]; Tartaric Acid, dried and powdered, *two hundred and eleven grammes* [or 7 ounces av., 193 grains]; Citric Acid, unefflorescd crystals, *one hundred and thirty-six grammes* [or 4 ounces av., 349 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Dry the Magnesium Sulphate on a water-bath, until it ceases to lose weight, then, after powdering the dry salt, mix it intimately with the Citric Acid, which has previously been powdered, and the Tartaric Acid, and thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.). When the mixture has acquired a moist consistence by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles." *U. S.*

"Magnesium Sulphate, in crystals, 50 *ounces* (Imperial) or 500 grammes; Sodium Bicarbonate, in powder, 36 *ounces* (Imp.) or 360 grammes; Tartaric Acid, in powder, 19 *ounces* (Imp.) or 190 grammes; Citric Acid, in powder, 12½ *ounces* (Imp.) or 125 grammes; Refined Sugar, in powder, 10½ *ounces* (Imp.) or 105 grammes. Dry the Magnesium Sulphate at about 130° F. (54.4° C.) until it has lost twenty-three per cent. of its weight; powder the product; mix it with the Refined Sugar and then with the other ingredients. Place the mixture in a dish or pan of suitable form heated to between 200° and 220° F. (93.3° and 104.4° C.). When the mixture, by the aid of careful manipulation, has assumed a granular character, separate it into granules of uniform and convenient size by means of suitable sieves. Dry the granules at a temperature not exceeding 130° F. (54.4° C.). The product should weigh about 100 *ounces* (Imp.) or 1000 grammes." *Br.*

This effervescent salt is intended to furnish a less disagreeable form of administering Epsom salt.

Dose, from two drachms to one ounce (7.7 to 31 Gm.).

MALTUM. U. S.

MALT

(măl'tŭm)

"The grain of barley, *Hordeum distichon* Linné (Fam. *Gramineæ*), partially germinated artificially, and then dried." *U. S.*

Maltum Hordei; Barley Malt; Malt d'Orge, *Fr.;* Gerstenmalz, Malz, *G.*

Preparation.—Malt is prepared on an enormous scale for brewing purposes in all parts of the world where the climate is suited to the growth of barley. The object of the process for making malt, commonly known as malting, is to allow germination of grain to go just far enough to develop the maximum amount of *diastase*, the ferment by which the starch is converted into sugar, which may afterwards undergo the alcoholic fermentation during the process of brewing. In order to achieve this, the barley is first *steeped,—i.e.,* allowed to remain one or two days in cold water, of which it absorbs from 10 to 50 per cent.; second, *couched,—i.e.,* thrown into heaps upon a floor and allowed to develop heat and germinate; third, when the *acrospire* or shoot is one-third the length of the grain, the latter is *floored,—i. e.,* spread upon wide floors to dry; fourth, *kiln-dried,—i.e.,* exposed to such a temperature as thoroughly to dry it and kill the young plant. If the temperature be raised high enough to scorch the grain, it becomes *Amber Malt,* or *Black Malt,* according to the extent of the cara-

melizing. Besides the diastase, a second soluble ferment is formed during the malting process, the so-called *peptase,* which in the after-mash process changes the proteids of the malt into peptones and parapeptones which give nutritive value to the beer.

Properties.—It is composed of germinated grains with the radicles and acrospires adhering, and is officially described as follows: "Yellowish or amber-colored grains, shading to brown; crisp when fractured, the interior surface whitish, or tinged with brown if the grains have been heated sufficiently to cause caramelization. It should have an agreeable, characteristic odor, and a sweet taste due to the conversion of the starch in the seed into maltose, through the action of diastase. Malt should float on cold water. The solid soluble constituents of Malt, obtained by evaporating an aqueous infusion to dryness, should weigh not less than 70 percent. of the dried Malt from which they are derived. The acidity of Malt (calculated as lactic acid), should not exceed 0.3 percent." *U. S.*

Uses.—Malt is not itself used directly in medicine, but is official as the basis of Malt Extract. From it are also prepared the so-called *Malt Liquors* by making an infusion (*wort*) of the bruised malt, adding hops and various other substances, and fermenting. *Ale, brown stout,* and *porter* are made by rapid fermentation at a comparatively high temperature (75° F.), while *lager beer* is prepared by a very slow, prolonged fermentation at a low temperature.

Off. Prep.—Extractum Malti, *U. S.*

MANGANI DIOXIDUM PRÆCIPITATUM. U. S. (Br.)

PRECIPITATED MANGANESE DIOXIDE

[To replace Mangani Dioxidum, Pharm. 1890]

(măn'gą-nī dī-ŏx'ĭ-dŭm præ-cĭp-ĭ-tā'tŭm)

"Chiefly Manganese Dioxide [MnO_2 = 86.36] with small amounts of other oxides of manganese, corresponding to not less than 80 percent. of Manganese Dioxide." *U. S.* "The powdered native peroxide, MnO_2, pyrolusite." *Br. Appendix.*

Manganese Peroxide, *Br.* 1898, *Appendix;* Manganum Hyperoxydatum; Oxydum Manganicum; Peroxide of Manganese; Deutoxide of Manganese, Black Oxide of Manganese, Pyrolusite; Oxyde (Bi-) de Manganèse, *Fr. Cod.;* Oxyde noir de Manganèse, *Fr.;* Braunstein, *G.;* Biossido di manganese, *It.;* Manganesa, Pyrolusita, *Sp.*

* "Manganese Sulphate, *fifty grammes* [or 1 ounce av., 334 grains]; Ammonia Water, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Solution of Hydrogen Dioxide, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Distilled Water, *a sufficient quantity.* Dissolve the Manganese Sulphate in *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Distilled Water. Dilute the Ammonia Water with an equal volume of Distilled Water, and mix it with the Solution of Hydrogen Dioxide, which has also been diluted with an equal volume of Distilled Water. Pour the mixed solutions, slowly, with constant stirring, into the solution of Manganese Sulphate. Allow the mixture to stand for one hour, stirring frequently. Then decant the supernatant clear liquid from the precipitate, and wash the latter repeatedly by affusion and decantation with hot Distilled Water, using *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] each time. Collect the precipitate on a plain filter, and continue the washing with hot Distilled Water until the washings no longer have an alkaline reaction upon red litmus paper, and produce no turbidity when mixed with barium chloride test solution. Allow the precipitate to drain, then dry it at 150° C. (302° F.)." *U. S.* The official precipitated manganese dioxide of the U. S. P. (8th Rev.) is prepared from manganous sulphate by the simultaneous action of ammonium hydroxide (which precipitates manganese hydroxide), and of hydrogen dioxide, which oxidizes this at once into the hydrated manganese dioxide. This precipitate, after thorough washing, is dried at 150° C., so that there remains MnO_2 as the final product.

A change was made in the U. S. P. (8th Rev.) and a process for preparing manganese dioxide was introduced; this was due to the fact that it has become very difficult to obtain native manganese dioxide of good quality; the official precipitated manganese dioxide is of course more expensive than the native oxide, but much to be preferred in making pharmaceutical preparations. *Metallic manganese* was discovered by Scheele and Gahn in 1774, and is obtained from the native black oxide by intense ignition with charcoal. As obtained by C. Brunner, manganese is brittle, grayish white, and very hard, being capable of cutting glass and scratching the best tempered steel. It is susceptible of the most perfect polish, and decomposes water at a boiling temperature. Its sp. gr. is about 7.2.

Deville obtained the metal by heating the black oxide with charcoal in excess in a lime crucible. The metal thus obtained is more refractory than iron, while that procured by Brunner fused at the same heat as white cast iron. Greene and Wahl have lately succeeded in getting the metal in large masses by the reduction of the ores with the aid of silicon, which they add in the form of an iron silicide. The atomic weight of manganese is 54.6. With oxygen it forms five and possibly seven compounds: MnO, Mn_2O_3, Mn_3O_4, MnO_2, and Mn_2O_7. The *monoxide* is of a light green color, and is the oxide present in or corresponding to manganous salts. The *sesquioxide* is black or dark brown, when in the hydrated state; the magnetic oxide, Mn_3O_4, is red; the dioxide is black; and the permanganic oxide, Mn_2O_7, is, when in the free state, a very unstable dark reddish-brown liquid. The monoxide is

a stable base, the sesquioxide is feebly basic, and the dioxide when acted upon by acids yields manganous salts, while oxygen is evolved. The highest oxide is acid-forming, yielding permanganic acid, $HMnO_4$, the salts of which are known as permanganates. (See *Potassii Permanganas.*) There exists also an acid, H_2MnO_4 (manganic), of which the salts formed are called manganates. The oxide corresponding is not known, however. Metallic manganese is an occasional constituent of organic matter. It has been detected in minute quantity in bone, hair, brain, epidermis, gastric juice, bile, urine, and pus, and has been found by Millon and others in the blood. Glénard of Lyons, denies that it is a normal constituent of the blood, although sometimes present, but the evidence of numerous experimenters shows that it generally exists in that fluid, and when not detected it may be because the quantity present is too minute to be easily discovered.[1] According to E. Davy, potassium hydroxide, dissolved in an equal weight of water, forms a delicate test for manganese, not obscured by the presence of other metals. The smallest portion of matter suspected to contain the metal, being finely pulverized or in solution, is placed upon a slip of silver foil, and a drop of the test added. Upon evaporation to dryness with a spirit lamp, and raising the heat, the characteristic green potassium manganate will appear on the foil. (*Chem. Gaz.*, March 15, 1854.) Manganese is a constituent of all arable land, and is found in the ashes of most of the vegetables which form the food of man and the inferior animals. In the mineral kingdom it occurs sometimes as silicate (*rhodonite*) or carbonate (*diallogite*), and very abundantly as the black oxide, or dioxide, called *pyrolusite*. It is the latter mineral which constitutes the British official oxide.

But few mines of manganese dioxide exist, though the metal itself is very generally diffused throughout the mineral kingdom. It occurs most abundantly in the Russian Caucasus, which furnishes nearly half of the annual production of the world, in Chili, Cuba, Great Britain, Turkey, and Australia. In the United States it occurs in largest amount at Crimora, Va., Cartersville, Ga., and Batesville, Ark.; other isolated localities exist in California, Utah, Alabama, and Tennessee. The amount of manganese ore mined in the United States is at present very small, being only 3,146 tons in 1904, although large quantities of manganiferous iron ores, manganiferous silver ores and manganiferous zinc residues are obtained, which go into the manufacture of spiegeleisen and ferro-manganese. On the other hand, very pure manganese ore is imported chiefly from the Caucasus, the amount in 1905 having been 257,033 tons. It comes packed in casks or barrels, generally in lumps and coarse powder, just as it is dug out of mines, though occasionally it is received from England in a pulverized condition. It is a good rule to buy it unpowdered, as its quality can be better judged in that state. A dark shining crystalline appearance is an indication of good quality, although an assay will alone determine its quality with certainty.

Properties.—Manganese dioxide, as it occurs in nature, is very diversified in its appearance. Its sp. gr. varies from 4.7 to 4.9. It is found sometimes in brilliant needle-shaped crystals, often in compact masses having the metallic lustre, but far more frequently in the form of a dull earthy-looking substance of a black or brown color. It is purest when crystallized. As it occurs in commerce, it is usually in the form of a black powder, insoluble in water, and containing more or less oxidized iron, calcium carbonate, barium sulphate, and earthy matter. Iron, which is rarely absent, is detected by the production of a greenish or blue tint on the addition of potassium ferrocyanide to its hydrochloric solution. When exposed to a red heat it yields a portion of its oxygen, and is reduced to manganoso-manganic oxide. Hence its use in obtaining that gas. Good samples, after being dried, lose, when heated to whiteness, 12 per cent. of oxygen. It is distinguished from antimony sulphide by its infusibility, and by causing the evolution of chlorine on being heated with hydrochloric acid. When of a brown color, it is not of good quality.

The U. S. Pharmacopœia describes the precipitated manganese dioxide as "a heavy, very fine, black powder, without odor or taste; permanent in the air. Insoluble in water or alcohol. It is not affected by concentrated sulphuric acid, but when heated with this acid it is converted into manganous sulphate, with the evolution of oxygen. When heated with hydrochloric acid, it is converted into manganous chloride, with the evolution of chlorine. At a red heat Precipitated Manganese Dioxide gives off oxygen, and is converted into reddish-brown manganoso-manganic oxide (Mn_3O_4). On intimately mixing 1 part of the Dioxide with 1 part of potassium hydroxide and 1 part of potassium chlorate, introducing the mass into a crucible, moistening with water, drying and igniting, a dark fused mass is obtained which yields, with water, a green solution, changing to purplish-red on being boiled, or on the addition of diluted sulphuric acid. If to 1 Gm. of the Dioxide and 2 Gm. of oxalic acid, 20 Cc. of water be added, followed by 3 Cc. of sulphuric acid, and the mixture digested for several hours on a water-bath, complete solution should be effected (absence of *antimony sulphide* and *insoluble substances*). If 0.2 Gm. of Precipitated Manganese Dioxide be dissolved in a mixture of 50 Cc. of tenth-normal oxalic acid V.S. and 3 Cc. of sulphuric acid contained in a flask and heated on a water-bath, the resulting solution, after dilution with 100 Cc. of warm water, should

[1] For an elaborate article on the absorption of manganese, see *A. E. P. P.*, xviii. p. 129.

require the addition of not more than 13 (12.95) Cc. of tenth-normal potassium permanganate V.S. to produce a slight pink tint (corresponding to not less than 80 percent. of pure Manganese Dioxide)." *U. S.*

Uses.—Manganese dioxide is deemed tonic and alterative. When slowly introduced into the system, as happens to those engaged in grinding the mineral, it acts, according to Coupar of Glasgow, as a cumulative poison, inducing a disease which begins with a staggering gait and ends in paraplegia. It has been used in *amenorrhœa, syphilis, chlorosis, scurvy,* and various *skin diseases,* especially *itch* and *porrigo.* It has been employed, in a purified state, with alleged great advantage by Arthur Leared, in *stomachic pains* of a purely nervous character, such as are apt to come on after eating. He has also found it useful in *pyrosis,* and in other irritable states of the stomach which are purely functional. It has the advantage over the preparations of bismuth, in these cases, that it does not constipate. (*Glasgow Med. Journ.*, Jan. 1865, p. 79.) For external use, an ointment may be made of one or two drachms of the oxide to an ounce of lard. The hypophosphite and the sulphate are official. For other compounds of manganese, see PART II.

The native oxide is used in the arts for obtaining chlorine in the manufacture of bleaching powder, for giving a black glazing to pottery, and for freeing glass from the color which it derives from iron. In the laboratory it is employed to obtain oxygen and chlorine, and to form the salts of manganese. It is also used for liberating chlorine from hydrochloric acid and from sodium chloride, and iodine from sodium iodide contained in kelp.

Dose, three to twenty grains (0.2 to 1.3 Gm.).

MANGANI HYPOPHOSPHIS. U. S.

MANGANESE HYPOPHOSPHITE

(măn'gą-nī hȳ-pǫ-phŏs'phĭs)

$Mn(PH_2O_2)_2 + H_2O = 201.54$

"It should contain not less than 97 percent. of pure Manganese Hypophosphite [$(PH_2O.O)_2Mn + H_2O$], and be kept in well-stoppered vials." *U. S.*

Manganum Hypophosphorosum; Manganous Hypophosphite; Hypophosphite de Manganèse, Hypophosphite manganeux, *Fr.;* Unterphosphorigsaures Manganoxydul, *G.*

Preparation.—Manganese hypophosphite may be prepared by the interaction of manganese sulphate and calcium hypophosphite by mixing a solution containing 1.31 parts of the former with a solution containing 1 part of the latter, filtering out the precipitated calcium sulphate, evaporating and crystallizing. This salt was introduced into the U. S. P. (8th Rev.) solely for its use in making the Compound Syrup of Hypophosphites.

Properties.—Manganese hypophosphite is officially described as follows: "A pink crystalline powder, odorless, and nearly tasteless; permanent in the air. Soluble in 6.6 parts of water at 25° C. (77° F.), and in 6 parts of boiling water; almost insoluble in alcohol. The aqueous solution of the salt (1 in 20) is neutral to litmus paper, and yields, with ammonium sulphide T.S., a salmon-colored precipitate of manganese sulphide, soluble in acetic acid. When strongly heated in a dry test-tube, the salt evolves spontaneously inflammable hydrogen phosphide gas, and on complete ignition leaves a residue of manganous pyrophosphate. Manganese Hypophosphite is readily oxidized by nitric acid and other oxidizing agents. If a small quantity of an aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid, and mercuric chloride T.S. added in excess, a white precipitate of mercurous chloride will be produced, which, upon further addition of the acidulated solution, is reduced to metallic mercury. If to 0.5 Gm. of the salt 5 Cc. of acetic acid be added, no effervescence should occur (absence of *carbonate*). If 0.25 Gm. of the salt be boiled with 10 Cc. of potassium hydroxide T.S., a light salmon-colored precipitate will be produced which gradually acquires a brown color on exposure to the air, and if the filtered liquid, after being slightly acidulated with hydrochloric acid and then rendered alkaline with ammonia water, be divided into two portions, one should yield no precipitate upon the addition of magnesia mixture T.S. (absence of *phosphate*), while the remaining portion should not be affected by ammonium oxalate T.S. (absence of *calcium*). If 5 Cc. of the aqueous solution of the salt (1 in 10) be poured into an evaporating dish containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water and evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.*

Uses.—See *Calcii Hypophosphis.*

Dose, three to five grains (0.2 to 0.32 Gm.).

Off. Prep.—Syrupus Hypophosphitum Compositus, *U. S.*

MANGANI SULPHAS. U. S.

MANGANESE SULPHATE [Manganous Sulphate]

(măn'gą-nī sŭl'phăs)

$MnSO_4 + 4H_2O = 221.47$

"It should contain not less than 99.5 percent. of pure Manganese Sulphate [$SO_2.O_2Mn + 4H_2O$], and should be kept in well-stoppered bottles." *U. S.*

Manganesii Sulphas, *U. S.* 1870; Manganum Sulphuricum, Sulfas Manganosus; Sulfate de Manganèse, *Fr. Cod.;* Sulfate manganeux, *Fr.;* Schwefelsaures Manganoxydul, Manganosulfat, *G.;* Sulfato manganoso, *Sp.*

This salt may be prepared by heating the native black oxide with concentrated sulphuric acid. Oxygen is thereby evolved, and the sulphate is formed. The product, when exhausted by water, furnishes a solution of the salt which must be heated nearly to the boiling point, and treated with manganese carbonate, added in small portions at a time, which will precipitate any iron present, and change the color of the liquid from a dark red to a pale rose tint. The liquid is then filtered, evaporated to the consistence of a thin syrup, and set aside to crystallize. C. Lewis Diehl has obtained by means of the following process an abundant product of the pure salt. A mixture of 5 parts of black manganese oxide and 0.75 part of coarsely powdered charcoal is exposed to a red heat, in a covered crucible, until all the charcoal is consumed. The contents of the crucible, after cooling, are put into a porcelain dish, and treated with 6.5 parts of sulphuric acid. The whole is then evaporated to dryness, and the residue, being returned to the crucible, is again heated to redness. When cool, the mass is rubbed to powder if necessary, and treated twice with eight parts of boiling water, and the liquors, having been mixed, are filtered, evaporated until a pellicle appears, and set aside to crystallize. It is important that the liquid should be removed from the sand bath as soon as the pellicle begins to form, as, if the heat be continued longer, an insoluble sulphate will be deposited. If the black manganese oxide employed be of good quality, a pure sulphate will be obtained, any salt of iron or copper present being rendered insoluble by the heat. (*A. J. P.*, 1867.) Laster's process is as follows:

"Take of Black Oxide of Manganese 40 parts, Commercial Hydrochloric Acid 200 parts. Dissolve the black oxide in the acid beneath a chimney-flue, and, when solution is complete, and chlorine no longer evolved, mix very gradually 53 parts of sulphuric acid with the reddish liquid; continue the evaporation beneath the flue until acid vapor is no longer driven off, and the mass becomes dry. Dissolve this mass in 350 parts of water heated to the boiling point. Treat the solution with manganese carbonate until it becomes rose-red, filter or decant, evaporate and crystallize." (*A. J. P.*, 1868.) F. Mahla of Chicago, proposes to utilize chlorine residues. He takes the liquid remaining in the retort after the preparation of chlorine, adds to it sodium carbonate sufficient to precipitate all the metallic oxides, or at least to cause a slight alkalinity, collects the precipitate thus produced on a muslin filter, and washes it with pure water, until the filtrate no longer produces an obvious reaction with silver nitrate. Three-fourths of the moist mass are removed from the filter to an evaporating dish, and sufficient diluted sulphuric acid is added to dissolve it completely. The solution is heated nearly to the boiling point, and the remaining fourth of the mass from the filter is gradually added to it, until the liquid, after being filtered, is no longer blackened by tannic acid. The whole solution is then filtered, and the filtrate, with the waters, after washing, is evaporated to crystallization. The first crop of crystals is sometimes contaminated with calcium sulphate, from the calcium carbonate in the commercial black oxide employed in the process. To separate this impurity, evaporate to dryness, redissolve the residue in a little water, which leaves the calcium sulphate undissolved, and the pure solution of manganese sulphate is obtained by filtration. (*A. J. P.*, 1869.) Edo Claassen adds alcohol to the concentrated solution to promote crystallization. (*Ph. Rund.*, 1887.)

Properties.—Manganese sulphate has the formula $MnSO_4$, in which the dyad metal manganese replaces the H_2 of H_2SO_4. From its aqueous solution it crystallizes in rhombic prisms, which contain variable proportions of water of crystallization according to the temperature of the solution and other circumstances. Obtained by evaporation at a gentle heat, they contain four molecules of water; between 45° and 68°, five molecules; under 42°, seven molecules; and a concentrated solution, mixed with sulphuric acid, and evaporated, yields granular crystals with one molecule. Heated to 240°, these crystals lose three molecules of water, and at a red heat become anhydrous. (Brande and Taylor.) The crystals usually have a pale-rose or pink color. The salt has an astringent and bitterish taste. It is very soluble in water, but its solubility varies with its water of crystallization. When anhydrous, it is dissolved by two parts of water at 15.5° C. (60° F.), and in its own weight at 100° C. (212° F.). If carelessly prepared, it is likely to contain copper and arsenic, as well as iron. As it is the source of nearly all the preparations of manganese, it is of importance that it should be pure; hence the sulphate, as first obtained, should be calcined at a low red heat at least twice, to render the contaminating metals insoluble, and then tested in solution, to be sure of its purity. According to A. Görgeu, copper and iron, as well as nickle and cobalt, are completely precipitated by manganese sulphide. In applying this reagent, the impure solution is shaken for about a quarter of an hour with the sulphide, and then boiled for a few minutes. The description of it in the U. S. Pharmacopœia is as follows:

"Colorless, or pale rose-colored, translucent, tetragonal prisms (crystallized at a temperature between 20° and 30° C. (68° and 86° F.), and containing 4 molecules, or 32.29 percent. of water of crystallization); odorless, and having a slightly bitter and astringent taste. Slightly efflorescent in the air. Soluble in about 0.7 part of water at 25° C. (77° F.), and in 0.53 part of boiling water; insoluble in alcohol. The aqueous solution (1 in 20) is neutral or very slightly acid to litmus paper, and yields, with ammonium sulphide T.S., a

salmon-colored precipitate soluble in dilute acids; with potassium ferrocyanide T.S., a reddish-white precipitate; and with potassium ferricyanide T.S., a brown precipitate. With barium chloride T.S., it yields a white precipitate insoluble in hydrochloric acid. If a fragment of Manganese Sulphate be mixed with a little sodium hydroxide and the mixture fused, it will yield a dark green mass, dissolving in water with a green color. The aqueous solution of the salt (1 in 20), to which a few drops of hydrochloric acid and a few drops of chlorine water have been added, should, after having been boiled, not be colored red by potassium sulphocyanate T.S. (absence of *iron*). Another portion of the solution should not respond to the Time-Limit Test for *heavy metals,* omitting the addition of ammonia water (see PART III, Test No. 121). If the manganese be completely precipitated from an aqueous solution of 3 Gm. of the salt by the addition of ammonium carbonate T.S., the filtrate, on evaporation and gentle ignition, should leave no weighable residue (absence of *salts of the alkalies,* and of *magnesium*). A solution of 1 Gm., each, of the salt, and of sodium acetate, in 10 Cc. of water, to which a few drops of acetic acid have been added, should not be affected by hydrogen sulphide T.S. (absence of *zinc*). If 1 Gm. of the salt be gently ignited, in a porcelain crucible, it should lose not more than 0.323 Gm. of its weight (distinction from *Manganese Sulphate containing a larger amount of water of crystallization*)." *U. S.*

Uses.—At one time manganese sulphate was said to be an active cholagogue and purgative, but it has failed to come into use as such. According to Thomas Thomson of Glasgow, it resembles sodium sulphate both in taste and in effect, operating as a purgative in the dose of from one to two drachms (3.9 to 7.5 Gm.). From the circumstance that manganese had been found in small proportion in the blood, it was conjectured that this metal, like iron, might play an important part in the human economy, and trial was made of it in *anæmia,* as an adjuvant of the chalybeates, but the results have not been satisfactory and it is at present rarely given.

Dose, as a tonic, from five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Mangani Dioxidum Præcipitatum, *U. S.*

MANNA. U. S.

MANNA

(măn'nạ)

"The concrete saccharine exudation of *Fraxinus Ornus* Linné (Fam. *Oleaceæ*)." *U. S.*

Manne, *Fr. Cod.;* Manna, *P. G., It.;* Mana, *Sp.*

Manna is said to be obtained from several other trees besides *Fraxinus Ornus,* among which *F. rotundifolia, F. excelsior,* and *F. parviflora* have been particularly designated. Many saccharine substances, generally exudations from plants, have, from their resemblance to this substance, obtained the name of manna, and attracted more or less attention from writers. They are described in a note.[1]

[1] *False Mannas.*—An efflorescence of mannite is said to occur upon certain sea weeds upon exposure to the air. (*J. P. C.,* Avril, 1859.) The term "manna" has been applied to certain substances which have no relation to true manna, notably to the lichen *Lecanora esculenta,* which at times has suddenly fallen like rain over immense tracts of country, from Persia to the African Sahara. It occurs in the form of small roundish lumps, from the size of a pin's head to that of a pea, yellowish or grayish externally and whitish within, hard, inodorous, and insipid. It has been affirmed that this lichen does not contain starch, but it is really used as an article of food, and good bread is said to have been made out of it. (*Nature,* Jan. 1891.) It is probable that it is the manna of Scripture. A false manna produced in quantities on the old olive trees round about Mansourah is said to contain 52 per cent. of true mannite with 7.3 per cent. of reducing sugar. (*J. P.,* lxvi. 289.)

The proper false mannas, exudations from various trees, are best considered under the headings of the countries which yield them:

European False Manna, or *Briançon Manna,* an exudation from the common European larch (*Larix europœa,* or *Pinus Larix*), differs chemically from ordinary manna in containing no mannite. Berthelot found in it a peculiar sugar, which he named *melezitose.* (See *A. J. P.,* 1859, p. 61.) To this the formula $C_{18}H_{32}O_{16} + 2H_2O$ is given showing that it belongs to the class of the saccharides.

American False Manna.—A substance resembling manna, of a sweet, slightly bitter and terebinthinate taste, and actively purgative, exudes from incisions in *Pinus lambertiana,* of Oregon, and is used by the natives. (*Nar. of U. S. Expl. Exped.,* v. 232.) Berthelot has extracted from this product a peculiar saccharine principle, which he calls *pinite.* It is very sweet, but does not undergo the vinous fermentation. (See *A. J. P.,* xxviii. 157.) Pinite was for a long time classed among the sugars, but the latest researches seem to show that it is a hexahydric phenol derived from hexahydrobenzene. The formula is $C_7H_{14}O_6$, and it is a methyl derivative of inosite.

California Manna, or *Father Picolo's Manna.* Proust (*Ann. d. Chim.,* 1806, 145) alludes to a manna mentioned by Father Picolo as being deposited on a species of grass in California. J. U. Lloyd (*A. J. P.,* 1897, 337) believes Picolo's manna to be a saccharine deposit, caused by aphides on *Phragmites communis.* It is apparently still collected by the Indians.

African False Mannas.—*Turkish Manna* is a sweet product obtained from *Echinops persica,* Fisch., and is obtained by treating the cocoons of a coleopterous insect (*Larinus maculatus*) with hot water, filtering and crystallizing the sugar. From it Berthelot obtained a new variety of sugar, *trehalose,* $C_{12}H_{22}O_{11} + 2H_2O$. (*Gaz. Méd. de Paris,* 1857.) *Pinus Cedrus,* of Mount Lebanon, yields a similar product, which has some repute in Syria as a remedy in phthisis. (*P. J.,* xiii. 411.) In the neighborhood of Diarbekir, in Asiatic Turkey, a saccharine substance, known as *Diarbekir manna,* is found on the leaves of dwarf oaks, from which it appears to be exuded. (*Ibid.,* Nov. 1862, p. 546.) The manna of the oak of Kurdistan, spoken of by Flückiger, is probably the same as that of Diarbekir, which may be its entrepôt. According to Flückiger, this consists chiefly (90 per cent.) of a crystallizable sugar. It deviates to the right the plane of polarized light, and reduces in the cold the solution of copper oxide in soda and glycerin. This manna contains a mucilage, but no cane sugar or dextrin. (*J. P. C.,* Avril, 1873, p. 335.) *Quercus Vallonea,* Kotschy, and *Q. persica,* Jaub. et Spach, yield "oak manna," through insect agency, while certain species of *Echinops* (probably *E. persica,* Fisch.) yield the singular manna-like substance that is known as *Trehala* in Syria and as *Shukkar Tigal* in India. *Pyrus glabra* yields a manna which is collected by the people of Luristan, in Persia. It has long been known that *Salix fragilis* and probably other species of willow yield to the Persians a manna-like exudation. According to Raby (*L'Union Pharm.,* Mai, 1889), there are two varieties, *chirkhest* and *bidenguébin,* which con-

Fraxinus Ornus, L., *Sp. Pl.* (1753) 1057; Willd., *Sp. Plant.* iv. 1104; *B. & T.* 170. *Ornus europæa*, Persoon, *Synops.* i. 9; Lindley, *Flor. Med.* 547; Carson, *Illust. of Med. Bot.*, ii. 8, pl. 61.—The *flowering ash*[1] is a tree of moderate height, usually from twenty to twenty-five feet, very branching, with opposite, petiolate, pinnate leaves, composed of three or four pairs of leaflets, and an odd one at the end. The leaflets are oval, acuminate, obtusely serrate, about an inch and a half in length, smooth, of a bright green color, and supported on short footstalks. The flowers are white, and usually expand with the leaves. They grow in close panicles at the extremities of the young branches, and have a very short calyx with four teeth, and four linear-lanceolate petals.

Both *Fraxinus Ornus* and *Fraxinus rotundifolia* are natives of Sicily, Calabria, and Apulia, and both contribute to supply the manna of commerce. The former is cultivated in Sicily, yields manna after the eighth year, and continues to yield it for ten or twelve years, when it is usually cut down and young sprouts are allowed to grow up from the root. (Stettner, *A. Pharm.*, liii. 194.) During the hot months the juice exudes spontaneously from the bark, and concretes upon its surface, but, as the exudation is slow, it is customary to facilitate the process by making deep longitudinal incisions on one side of the trunk. In the following season these are repeated on the other side, and thus alternately for the whole period during which the tree yields manna, extending sometimes, it is said, to thirty or even forty years. Straw or chips are frequently placed so as to receive the juice, which concretes upon them. The manna varies in its character according to the mode of collection, the nature of the season, and the period of the year at which the exudation takes place. That procured in Sicily is said to be the best. Daniel Hanbury travelled through the old manna region, and satisfied himself that the collection of manna for commercial purposes is confined almost exclusively to Sicily. (*P. J.*, Nov. 1872, 421.) But a more recent writer (*Ibid.*, Nov. 1879) asserts that the manna trees are still cultivated in Calabria. For still later information on manna collection in Sicily, see notes by J. S. Ward. (*Ibid.*, 1893, 381.) For an interesting description of California mannas by J. U. Lloyd, particularly *Picolo's manna*, see *A. J. P.*, 1897, 329.

In commerce three varieties are distinguishable:

I. Flake Manna, or *manna canulata*, is the purest variety. It exudes spontaneously, or from incisions, during the hottest and dryest weather in July and August. According to Stettner, it is furnished by the upper incisions upon the trunk, while the lower incisions yield the inferior varieties. It is in irregular, unequal pieces, often several inches long, resembling stalactites, rough, light, porous, brittle, whitish or yellowish-white, and frequently concave on the surface by which they were attached to the trunk, and which is often soiled by impurities, sometimes by adherent fragments of the bark. When broken, these pieces exhibit a crystalline or granular structure. This variety is sometimes in small fragments, generally less than an inch in length.

2. Common Manna—the *manne en sorte* of French pharmacy—is next in quality, and is collected in September and the beginning of October, when the heat of the weather has begun to moderate. The juice does not now concrete so readily, and a portion, falling on the ground at the root of the tree, becomes more

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tain respectively, according to the analysis of Ludwig, *chirkhestite* ($C_6H_{14}O_6$), allied to sorbite, and *bidenguebinose* ($C_{12}H_{22}O_{11}$), allied to melezitose. Whether these mannas are really distinct from those sold in the Indian bazaars as coming from Afghanistan and Persia seems uncertain. Of these bazaar mannas the most important is the *Shirkoit* or *Oriental* manna. By Haussknecht it is referred to *Atraphaxis spinosa*; but J. E. T. Aitchison states that it is yielded by the *Cotoneaster nummularia*, Fisch. et Mey., a tall, stout shrub, whose smaller branches in July become covered with an exudation, which is eaten as a sweetmeat, and exported in quantity to Russia and India. The second variety, *Taranjabin*, is yielded by the camel-thorn, *Alhagi Camelorum*, Fisch., in Persia and Afghanistan, and probably by *Alhagi Maurorum* of De Candolle, a leguminous thorny shrub abundant in India,—if indeed the two species be distinct. According to A. Villiers, it is nearly pure melezitose. (*P. J.*, 3d ser., vii. 917.) A third kind of manna is *Gazangabin*, or *Gazanjabin*, yielded by *Tamarix gallica*, Linn., var. *mannifera*; a fourth kind is obtained from the *Salsola fœtida*, DC. (*P. J.*, Dec. 11, 1886, 467.) The *tamarisk* of Northern Africa (*Tamarix gallica*, Ehr.), which produces the small *tamarisk galls* of Mogador, containing 40 per cent. of tannic acid (*A. J. P.*, 1878, p. 27; also *N. R.*, 1877, p. 41), according to Burckhardt also gives origin to a species of manna that is used by the Bedouin Arabs near Mount Sinai with their food. This substance, however, according to Mitscherlich, contains no mannite, but consists wholly of mucilaginous sugar. Berthelot found a manna from Sinai to consist of 55 per cent. of cane sugar, 25 of levulose and glucose, and 20 of dextrin and analogous substances. (*Ann. Ch. Phys.*, lxvii.)

Persian Manna, or *Gez*, has been identified (*C. D.*, 1894, 790) as being derived from *Astragalus anisacanthus*, and is found in the districts of Khonsar, Feridan and Chahar Mahal, and Ispahan. In the form of sweetmeat, having the appearance of flour, it is sent all over Persia and much esteemed.

Australian Mannas.—A manna-like exudation on the *Eucalyptus viminalis*, Labill., growing in New South Wales, contains a saccharine matter called *melitose*, different in properties from mannite and from all the varieties of sugar, though isomeric with glucose. It is susceptible of the vinous fermentation. (See *A. J. P.*, xxviii. 157.) *Lerp* is produced upon the leaves of *Eucalyptus dumosa*, when very small, and sometimes appears spread over large extents of country like a kind of snow. The natives use it for food. It is a complex body, containing an unfermentable sugar, *eucalin*, gum, starch, inulin, and lignin. (*J. P. C.*, xvi. 240.) It is said to be a secretion from an insect, formed into minute cells, each of which is the abode of one of the insects. (See *A. J. P.*, 1862, p. 547.) *Myoporum platycarpum*, R. Br., the *sandalwood-* or *dogwood-tree* of Australia, exudes an exceedingly sweet and pleasant manna, which is much used as an article of food. F. W. Passmore obtained from *Eucalyptus Gunnii*, Hook., a sugar termed *melitriose*. (*P. J.*, 1891, 718.)

New South Wales Manna.—According to R. T. Baker (*Journ. and Proc. Roy. Soc. New South Wales*, xxx., 1897), this manna is produced in the form of nodules at the nodes of the stems of the blue grass *Andropogon annulatus*. It contains numerous crystals of mannite, amounting, according to the analysis of H. G. Smith, to 50 per cent.

[1] A syrup prepared from the inner bark of this tree has been employed in Europe by Devergie, with supposed advantage, in chronic *eczema* and *impetigo*. The bark contains much tannin, and a mucilaginous principle which renders diluted alcohol a better menstruum than boiling water. (*J. P. C.*, 3e sér., ix. 347.)

or less mixed with impurities, and forms imperfectly solid masses, which require to be further dried in the sun. Common manna consists of whitish or yellowish fragments, similar to the pieces of flake manna, but much smaller, mixed with a soft, viscid, uncrystallized brownish matter, identical with fat manna.

3. Fat Manna is collected in the latter part of October and November, when the weather is cooler and rains are more common. The juice is now still less disposed to concrete, and flowing down the trunk is received in a small excavation at its base. As found in commerce, it is in the form of a soft, viscous mass, containing few crystalline fragments, of a brown or yellowish-brown color, and full of impurities. The U. S. Pharmacopœia directs that such manna should be rejected.[1]

Properties.—Manna is officially described as "in irregular, more or less elongated, flattish, 3-sided pieces; externally yellowish-white; friable, somewhat waxy; internally whitish, porous and crystalline; odor suggestive of maple sugar; taste sweet, slightly bitter and faintly acrid. On heating 5 parts of Manna with 100 parts of alcohol to boiling, and filtering, the filtrate should rapidly deposit crystals of mannite." *U. S.* Manna has a slight, peculiar odor, and a sweet taste, which in the impure kinds is also very nauseous, but in the finest flake manna scarcely so much so as to be disagreeable. Its sp. gr. is 0.834. It melts with heat, and takes fire, burning with a blue flame. When pure it is soluble in three parts of cold and in its own weight of boiling water. From a boiling saturated aqueous solution it separates in partially crystalline masses on cooling. Alcohol also dissolves it. Boiling alcohol will dissolve 15 parts of manna, and upon cooling deposit beautiful crystals of mannite.

Fourcroy and Vauquelin found manna to consist of—1, a peculiar sweet principle, *mannite*, which constitutes 75 per cent.; 2, a variety of sugar; 3, a yellow nauseous matter, upon which the purgative property is thought chiefly to depend; and, 4, a little mucilage. Leuchtweiss obtained from 105 parts of manna 11.6 of water, 0.4 of insoluble matter, 9.1 of sugar, 42.6 of mannite, 40.0 of a mixture of mucilaginous matter containing mannite, resin, organic acid, and a nitrogenous substance, and 1.3 of ashes. In *manna canellata in fragmentis* he found 37.6 per cent. of mannite, and in *manna Calabrina* 32 per cent. (*Pflanzenstoffe*, 2d ed., p. 180.) Buignet discovered in manna a considerable proportion of dextrin. He appears to have been led to this discovery by observing a very energetic dextrogyrate power in flake manna, which could not be owing to the saccharine matter it contained, because the same power continued after all the sugar had been destroyed by fermentation. Dextrin forms about one-fifth part of flake manna, and a much larger part of the inferior kinds. It may be readily obtained separate by triturating 200 parts of flake manna with 400 of alcohol at 70° F. in successive portions, filtering the resulting mixture, by which the mannite is left behind, and then separating the sugar and dextrin contained in the clear liquor. This is done by concentrating the liquor to a syrupy consistence, and adding about 10 parts of alcohol at 90° F. The mixture separates into two layers, the upper consisting of a strong alcoholic solution of sugar, the lower of a saturated solution of dextrin in weak alcohol. The latter is separated, washed repeatedly with alcohol at 90° F., and then, after dilution with water, decolorization, and filtration, is evaporated gently by a water bath until it ceases to lose weight. The substance remaining is dextrin. The saccharine matter of manna is a mixture of cane sugar and levulose, which are in such proportion as almost to neutralize their reciprocal optic properties. All the forms of commercial manna contain both sugar and dextrin, and, though the quantity of the two jointly varies considerably, yet their relative proportion is invariable, being 2 molecules of dextrin and 1 molecule of sugar. This is the same result that is reached in the saccharification of starch, and the inference is fair that the dextrin and sugar in manna are the result of a transformation of starch in the plant. (*J. P. C.*, Juillet, 1868.) It is owing to the presence of glucose and dextrin that manna is capable of fermenting. Flückiger found in all samples of mannite examined a small amount of a dextrogyrate mucilage, which is precipitated by neutral lead acetate, and yields mucic acid when boiled with strong nitric acid. The greenish color of certain pieces of manna is produced by *fraxin*, $C_{16}H_{18}O_{10}$, a glucoside closely resembling *æsculin*. Fraxin crystallizes in colorless prisms, easily soluble in hot water and in alcohol, and has a faintly astringent and bitter taste. By diluted acids it is

[1] *Fictitious Manna.*—Attempts have been made to counterfeit manna, but the facility of detection renders such frauds unprofitable, and they are not often practised. R. P. Thomas described (*A. J. P.*, xxiv.) a sophisticated manna which differed from the genuine drug both in sensible and in chemical properties, not even containing mannite. Baumé describes a method in which common manna is purified so as to resemble flake manna. It consists in dissolving common manna in a little water, allowing the liquid to settle, decanting it in order to separate the impurities, then inspissating it so that it will congeal on cooling, and immersing threads in the inspissated liquid, several times successively, in the manner practised by candle makers. It may be still further purified by the use of animal charcoal. Thus prepared, it contains less mannite than flake manna, and less of the nauseous principle, but is said not to operate less effectively as a laxative. A fictitious manna is described by Edmond Histed (*P. J.*, April, 1870) as having been taken from Paris to London, which bears a close resemblance to flake manna, for which it might be mistaken upon a hasty notice. The resemblance is, moreover, increased by the fact that it contains mannite, of which Histed obtained 40 per cent., while fine natural flake manna yielded him 70 per cent. Closely examined, it is found to differ essentially from genuine flake manna, showing no crystals of mannite when broken, not having the taste and smell characteristic of good manna, and, besides, being cleaner, lighter-colored, more solid, and making a clearer solution in water. (See *A. J. P.*, 1870.) May not this have been a specimen of artificial flake manna, prepared from the inferior or common manna?

resolved into *fraxetin*, $C_{10}H_8O_5$, and *glucose*, $C_6H_{12}O_6$. Even its diluted solutions are fluorescent. (*Pharmacographia*, 2d ed.)

Mannite (*mannitol*) is white, inodorous, crystallizable in semi-transparent needles, of a sweetish taste, soluble in five parts of cold water, scarcely soluble in cold alcohol, but readily dissolved by that liquid when hot, and deposited when it cools. Its composition is $C_6H_{14}O_6$, and it is considered as belonging to the class of *hexatomic alcohols*. If mixed with chalk and cream-cheese and kept for some weeks at the temperature of 40° C. (104° F.), it yields alcohol largely, with the disengagement of carbonic acid and hydrogen and the production of lactic acid. No fungus is produced, as in the ordinary fermentation of sugar. (Berthelot, *J. P. C.*, xxx.) With lime, barium and strontium oxides, it forms definite compounds, soluble in water, and precipitable from their aqueous solutions by alcohol. (*Ibid.*, Jan. 1860.) It does not reduce an alkaline solution of copper oxide; and a test of its purity is thus presented. (*A. J. P.*, Jan. 1861, p. 26.) Its optical activity can be observed only after the addition of borax. It is then found to be dextro-rotatory. Emil Fischer has shown that there are three mannites obtainable; the ordinary mannite is the dextro-rotatory variety, and is always obtained in the reduction of *a*-mannose with sodium amalgam; a lævo-rotatory variety is obtained by the reduction of *l*-mannose; and an inactive mannite is obtained from the inactive mannose. These three physical isomers differ slightly in their fusing points and crystalline form. The native variety may be obtained by boiling manna in alcohol, allowing the solution to cool, and redissolving the crystalline precipitate; pure mannite is now deposited. Another method is to dissolve flake manna in water, precipitate by solution of lead subacetate, filter, throw down the excess of lead by sulphuric acid, evaporate the solution, and mix with alcohol. On cooling, the mannite is deposited. (Bonsall, *A. Pharm.*, cxxxiv. 70.) This principle has been found in numerous vegetables. It is said to be gently laxative in the dose of from one to two ounces (31 to 62 Gm.).

Manna, when long kept, acquires a deeper color, softens, and ultimately deliquesces into a liquid, which on the addition of yeast, undergoes the vinous fermentation. This is probably owing to its conversion into sugar by the absorption of enough oxygen to cause it to pass over into some variety of glucose or fermentable sugar. That which is driest resists this change the longest. It is said that manna recently gathered is less purgative than it afterwards becomes.

Uses.—Manna is a gentle laxative, usually operating mildly, but in some cases producing flatulence and pain. It is usually prescribed with other purgatives, particularly senna, rhubarb, magnesia, and the neutral salts, the taste of which it conceals, while it adds to the purgative effect. The *dose*, for children, is from one to four drachms (3.9 to 15.5 Gm.). It is usually given dissolved in water or some aromatic infusion; but the best flake manna may be administered in substance. Manna forms a combination with iron, which it preserves against oxidation. (See *P. J.*, March, 1873.)

Dose, half to one ounce (15.5 to 31 Gm.).

Off. Prep.—Infusum Sennæ Compositum, *U. S.*

MARRUBIUM. U. S.

MARRUBIUM [Hoarhound, Horehound]

(mar-rū'bĭ-ŭm)

"The dried leaves and flowering tops of *Marrubium vulgare* Linné (Fam. *Labiatæ*)." *U. S.*

Herba Marrubii; Marrube blanc, *Fr. Cod.*; Andornkraut, Weisser Andorn, *G.*; Marrubio, *It., Sp.*

Marrubium vulgare, L., *Sp. Pl.* (1753) 583; Willd., *Sp. Plant.* iii. 111; *B. & T.* 210.—*White Hoarhound* has a perennial fibrous root, and numerous annual stems, which are quadrangular, erect, very downy, and from twelve to eighteen inches high. The leaves are about an inch long, roundish-ovate, dentate or deeply serrate, obtuse, wrinkled, veined, downy above, hoary on the under surface, and supported in pairs on strong footstalks. The flowers are white, and in crowded axillary woolly whorls. The calyx is tubular, and divided at the margin into ten narrow segments, which are hooked at the end. The corolla is also tubular, whitish, with a labiate margin, of which the upper lid is bifid, the under reflected and three-cleft, with the middle segment broad and slightly scalloped; stamens four, included. The seeds are four, in the bottom of the calyx. The plant is a native of Europe, but has been naturalized in this country, where it grows on the roadsides, and flowers in July and August. The herb has a strong, rather agreeable odor, which is diminished by drying and lost by keeping. It is officially described as having "branches quadrangular, grayish-green, densely white-hairy; leaves opposite, petiolate, roundish-ovate, 1.5 to 5 Cm. long, obtuse, coarsely crenate, strongly rugose-veined, more or less white-hairy, especially underneath; flowers in dense axillary whorls, with a 10-toothed calyx, the divisions of which are slightly unequal, erect-spreading and pungent; corolla small, whitish, bilabiate; stamens four, included; fruit of four ovoid, obtuse, nearly smooth nutlets, about 1.5 Mm. long; odor distinct, rather agreeable; taste somewhat aromatic and bitter." *U. S.* The bitterness is extracted by water and alcohol. It contains a volatile oil, resin, tannin, lignin, and a bitter principle called *marrubiin* by Mein. This marrubiin is slightly soluble in cold water, crystallizes from alcohol in prismatic and from ether in tabular crystals, is not precipitated by tannin, and has a very bitter and somewhat acrid taste. The fusing point of the crystals

is 160° C., according to Kromayer. Marrubiin was afterwards obtained by Harms (*A. Pharm.*, 116, 141), by Hertel (*A. J. P.*, June, 1890), and by Morrison (*Ibid.*, July, 1890). A more recent study was by Matusow (*Ibid.*, 1897, 201). He gives to it the formula $C_{30}H_{48}O_6$, and states the melting point of the purified substance to be from 154° to 155° C. According to him, it is not a glucoside.

Uses.—Hoarhound is tonic, in large doses laxative, and may be so given as to increase the secretion from the skin, and occasionally from the kidneys. It was formerly considered a valuable deobstruent, and was recommended in *chronic hepatitis, jaundice, amenorrhœa, phthisis,* and various *cachetic affections.* By its gently tonic powers it may have proved advantageous in some of these complaints, but it exerts no specific influence over any of them, and has passed mainly from the hands of physicians into domestic use. It is employed chiefly in *catarrh,* and in other *chronic affections of the lungs,* attended with cough and copious expectoration. The infusion, made in the proportion of an ounce of the herb to a pint of boiling water, may be given in wineglassful doses.

Dose, thirty grains to a drachm (2.0 to 3.9 Gm.).

MASSA FERRI CARBONATIS. U. S.

MASS OF FERROUS CARBONATE [Vallet's Mass]

(măs'sạ fĕr'rī cär-bọ-nā'tĭs)

Pilula Ferri Carbonatis, *Br.* 1885, also *U. S.* 1870; Pilulæ Ferri Carbonici, Pilulæ Ferratæ Valleti; Pill of Carbonate of Iron, Vallet's Ferruginous Pills, Vallet's Pill Mass; Pilules de Carbonate ferreux, *Fr. Cod.;* Pilules ferrugineuses, Masse Pilulaire de Vallet, *Fr.;* Valletsche Pillen, *G.;* Pillole di Vallet, *It.*

* "Ferrous Sulphate, in clear crystals, *one hundred grammes* [or 3 ounces av., 231 grains]; Monohydrated Sodium Carbonate, *forty-six grammes* [or 1 ounce av., 272 grains]; Clarified Honey, *thirty-eight grammes* [or 1 ounce av., 150 grains]; Sugar, in coarse powder, *twenty-five grammes* [or 386 grains]; Syrup, Distilled Water, each, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Ferrous Sulphate and the Monohydrated Sodium Carbonate, each separately, in *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of boiling Distilled Water, and, having added *twenty cubic centimeters* [or 325 minims] of Syrup to the solution of the Iron salt, filter both solutions, and allow them to become cold. Introduce the solution of Monohydrated Sodium Carbonate into a bottle having a capacity of about *five hundred cubic centimeters* [or 16 fluidounces, 435 minims], and gradually add the solution of the Iron salt, rotating the bottle constantly or frequently, until carbonic acid gas no longer escapes. Add a sufficient quantity of Distilled Water to fill the bottle; then cork it and set it aside, so that the Ferrous Carbonate may subside. Pour off the supernatant liquid, and, having mixed Syrup and Distilled Water in the proportion of *one volume* of Syrup to *nineteen volumes* of Distilled Water, wash the precipitate with the mixture by decantation until the washings no longer have a saline taste. Drain the precipitate on a muslin strainer, and express as much of the Water as possible. Lastly, mix the precipitate at once with the Honey and Sugar, and, by means of a water-bath, evaporate the mixture in a tared dish, with constant stirring, until it is reduced to *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*[1]

The effect of saccharine matter in protecting iron from oxidation has been explained under the heads of *Ferri Carbonas Saccharatus* and *Syrupus Ferri Iodidi.* The U. S. mass of ferrous carbonate is another example of a ferruginous preparation in which the iron is protected from further oxidation by the same means. The process of the U. S. P. (8th Rev.) is nearly the same as that of the U. S. P. 1890, excepting that the monohydrated sodium carbonate has replaced the crystallized variety, and the quantity of the alkaline salt has been somewhat increased. The salts employed are the same as those used for obtaining the formerly official ferric subcarbonate, but in forming that preparation the carbonate which is at first precipitated absorbs oxygen, and loses nearly all its carbon dioxide in the processes of washing and drying. When, however, as in the U. S. formula above given, the reacting salts are dissolved in weak syrup instead of water, and the washing is performed with weak syrup also, the absorption of oxygen and loss of carbon dioxide during the separation of the precipitate are almost completely prevented. It only remains, therefore, to preserve it unaltered, and to bring it to the pilular consistence, and this is effected by admixture with honey and sugar, and evaporation by means of a water bath. It is essential to the success of this process that the ferrous sulphate should be pure, otherwise some ferric oxide will be present in the product. The process is that of Vallet of Paris, after whom the preparation is popularly called. The present U. S. process differs from that of 1870 in omitting to direct

[1] Wm. Silver Thompson states that the mass is more stable when made by the following formula than when prepared in the official manner. Take of Ferrous Sulphate eight ounces; Sodium Bicarbonate six ounces; Sugar, in fine powder, four and a half ounces; Clarified Honey half an ounce; Syrup, Water, each, a sufficient quantity. Dissolve each salt separately in water, add the sodium solution to the iron solution gradually, constantly stirring until the effervescence ceases, then add about a fluidounce of syrup, and again stir. After the carbonate has subsided, draw off the supernatant liquid, and repeat the washing with cold water slightly sweetened with syrup, until the washings are free from a saline taste; when, having again drawn off the supernatant liquid, transfer the precipitate to a muslin cloth, and express as much of the water as possible. To the precipitate, in a porcelain dish placed over a water bath, add the honey and sugar, and with frequent stirring evaporate to the pilular consistence. (*A. J. P.*, 1870, p. 30.)

boiled water for washing the precipitated ferrous carbonate. This is an important omission, because there is likely to be some oxidation of the salt, due to the air in the water. The British Pharmacopœia 1898 omitted Vallet's mass. (See *Ferri Carbonas Saccharatus.*) Gonnermann prepares *powdered Vallet's mass* by mixing intimately ten parts of milk sugar and five parts of powdered licorice root with sufficient freshly precipitated ferrous carbonate to make, when dried, thirty-five parts, and adding enough powdered licorice root to make the whole weigh forty parts. (*Ph. Post,* 1893, 238.)

Properties.—The U. S. preparation is in the form of a soft pilular mass, of a dark greenish-gray color, becoming black on exposure, and with a strong ferruginous taste. When carefully prepared, it is wholly and readily soluble in acids. It contains nearly half its weight of ferrous carbonate. The corresponding pill, obtained from the saccharine carbonate, may be supposed to contain one-third of ferruginous matter.

Uses.—The U. S. mass of ferrous carbonate, or Vallet's ferruginous mass, is an excellent preparation for use in simple *anæmia* and *chlorosis.* Its chief merits are its unchangeableness, its freedom from astringency, and its ready solubility in acids.

Dose, in pills, from three to five grains (0.20 to 0.32 Gm.), after meals.

MASSA HYDRARGYRI. U. S. (Br.)

MASS OF MERCURY [Blue Mass]

(măs'sạ hȳ-drär'gy̆-rī)

Pilula Hydrargyri, *Br.,* Mercury Pill; Pilulæ Hydrargyri, *U. S.* 1870; Pilulæ Cœruleæ, Massa Cœrulea; Blue Pills, Pills of Mercury; Mercurial Pill; Pilules mercurielles simples, *Fr. Cod.;* Pilule de Mercure, Pilules bleues, *Fr.;* Mercurialpillenmasse, *G.*

* "Mercury, *thirty-three grammes* [or 1 ounce av., 72 grains]; Glycyrrhiza, in No. 60 powder, *ten grammes* [or 154 grains]; Althæa, in No. 60 powder, *fifteen grammes* [or 231 grains]; Glycerin, *nine grammes* [or 139 grains]; Honey of Rose, *thirty-three grammes* [or 1 ounce av., 72 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Mercury with the Honey of Rose until it is extinguished and globules of Mercury are no longer visible under a lens magnifying at least ten diameters. Add the Glycerin, then the Glycyrrhiza and Althæa gradually, and continue the trituration until the mass is homogeneous. Keep the product in well closed containers." *U. S.*

"Mercury, 2 *ounces* (Imperial) or 40 grammes; Confection of Roses, 3 *ounces* (Imp.) or 60 grammes; Liquorice Root, in fine powder, 1 *ounce* (Imp.) or 20 grammes. Rub the Mercury with the Confection of Roses until metallic globules are no longer visible; add the Liquorice Root; beat together until thoroughly mixed." *Br.*

The mercury constitutes one-third of the mass. The ingredients for this mass do not differ essentially from those of the U. S. 1880 formula. The U. S. process is well suited for the needs of the pharmacist, as the mass can be made with ordinary apparatus extemporaneously.

The proportion of glycerin, in the formula of the U. S. (8th Rev.), has been slightly increased, and this modification overcomes the tendency to harden slowly and become unfitted for use which was characteristic of the U. S. 1890 preparation.

The precise condition of the mercury in this preparation is somewhat uncertain. By far the greater proportion is in a state of minute mechanical division, and not chemically altered. Some maintain that the whole of the metal is in this state, others, that a small portion is converted during the trituration into mercurous oxide, and that this is the ingredient upon which the activity of the pill depends. The supposed oxidation is attributed partly to the influence of the air upon the surface of the metal, greatly extended by the separation of its particles, partly to the action of the substance used in the trituration. If the mercury is not oxidized during the trituration, there can be little doubt that it becomes so, to a slight extent, by subsequent exposure. The obvious changes which the mass undergoes by time can be explained in no other way, and mercurous oxide is asserted to have been actually extracted from old mercurial pill. Harold Senier analyzed a number of samples of blue mass, with the view of determining the amount of metallic mercury and of mercurous and mercuric oxides. The results showed that the latter gradually increased in quantity with the age of the blue mass, which, 18 hours after preparation, contained but a trace of mercurous oxide; after three months, 0.24 per cent. of mercuric and 0.62 per cent. of mercurous oxides were obtained, and in another sample, 0.44 and 1.60 per cent. respectively. After two years, 1.80 per cent. of mercuric and 4.22 per cent. of mercurous oxides were present. (*P. J.,* 1876.) Nevertheless, it scarcely admits of dispute that the metal, independently of oxidation out of the body, is capable of producing the peculiar mercurial effects when introduced into the stomach, probably undergoing chemical changes there. The U. S. P. provides a test which limits the quantity of mercurous oxide and proves the absence of mercuric oxide; it will be difficult for the ordinary "blue mass" of commerce to withstand these requirements: "If a portion of the Mass be triturated in a mortar, with warm acetic acid, the filtrate should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of *mercurous oxide*). If another portion of the Mass be digested with warm, diluted hydrochloric acid and a little purified animal charcoal, the filtrate should not be affected by hy-

drogen sulphide T.S., or by stannous chloride T.S. (absence of *mercuric oxide*)." *U. S.* According to Mialhe, mercury is slowly converted into corrosive sublimate in the stomach, under the combined agency of air and sodium chloride. All agree that the efficacy of the preparation is proportionate to the extinction of the mercury; in other words, to the degree in which the metallic globules disappear. This extinction may be effected by trituration with various substances, and manna, syrup, honey, licorice, mucilage, soap, guaiac, and extract of taraxacum have been recommended, among others, for this purpose; but the confection or honey of rose has been adopted by the Pharmacopœias, as less open to objection than any others. The mercury is known to be completely extinguished when, upon rubbing a portion of the mass with the end of the finger upon a piece of paper, no globules appear, or the extinguishment may be more accurately judged by the official microscopic test. Powdered licorice root and powdered marshmallow root are added in order to give due consistence to the mass. The process now official was proposed by C. Lewis Diehl, and since the increase in the quantity of glycerin is very satisfactory. It is possible for the apothecary to make moderate quantities extemporaneously with no other appliances than the mortar and pestle. As the trituration requires to be long continued, which renders the process very laborious when conducted on the large scale, it is customary to prepare the mass by machinery. At Apothecaries' Hall, in London, the trituration is effected by the agency of steam. The machine there employed consists of "a circular iron trough for the reception of the materials, in which revolve four wooden cylinders, having also a motion on their axes." A machine for preparing blue mass, capable of being worked by hand or steam power, was invented by J. W. W. Gordon of Baltimore, and, having been found to answer well, was at one time in extensive use. (*A. J. P.*, xxi. 6.) We have referred, under *Hydrargyrum cum Creta* (page 638), to another ingenious apparatus, invented by Squibb, by which the extinguishment of mercury is very satisfactorily effected. Formerly much of the blue mass used in this country was imported, but at present the market is chiefly supplied by our own manufacturers. The preparation slowly changes color upon being kept, assuming an olive and sometimes even a reddish tint, in consequence, probably, of the further oxidation of the mercury.[1]

In consideration of the incomplete extinguishment of the mercury in many specimens of the blue pill, arising from the tedious process employed, F. B. Benger proposes to obtain the metal in a state of minute division. For this purpose he adds to a solution of an ounce of stannous chloride, in a mixture of two drachms of hydrochloric acid and two ounces of cold water, a boiling hot solution of 136 grains of corrosive sublimate in four ounces of distilled water, and stirs the mixture for a few seconds. The mercury of the corrosive chloride is thrown down in the form of a black powder, to which, after the liquid has been drawn off by means of a pipette, 30 grains of sugar, 100 grains of powdered licorice, and about a drachm of glycerin are added. The mass, being transferred to a porcelain slab, is allowed to become sufficiently dry, and then mixed with enough glycerin and licorice to make it weigh 300 grains. (*P. J.*, ii. 165.) Theoretically, this appears to be a good process, but only a long experience of its practical advantages would justify its substitution for a plan which has been followed for so many years with results, upon the whole, so satisfactory. An obvious objection to the process is the possibility, with carelessness of manipulation, of having in the preparation a minute proportion of corrosive sublimate or stannous chloride.

The blue pill is sometimes wanted in the state of powder, but, from its peculiar constitution, it is not eligible for reduction to this form, as the mercury is disposed to aggregate during pulverization, and, from the honey it contains, it is likely, when pulverized, to attract moisture from the air. Chas. Bullock recommended the following method of preparing a powder which, as nearly as possible, represents the blue pill, in reference to its therapeutic effects:

Powdered Blue Mass.—Take of finely powdered Elm bark, finely powdered Sugar, and Mercury, equal parts, and of Alcohol a sufficiency. Rub the mercury with the powdered bark, adding from time to time enough alcohol to maintain a pasty consistence, until the mercury is completely extinguished; then spread the mass on paper to dry. When dry, powder it, add the sugar, and rub the mixture thoroughly until the powder will pass through a sieve of fine bolting cloth. (*A. J. P.*, 1859, p. 271.)

Uses.—This mass is among the mildest of the mercurials, being less liable than most others to act upon the bowels, and exercising the peculiar influence of the remedy upon the

[1] Blue mass frequently contains less than the due proportion of mercury. The fraud may be detected by the following plan, suggested by Reid of New York, and modified by a committee of the Philadelphia College of Pharmacy.

A certain weight of the mercurial mass, say fifteen grains, is mixed with about one-fourth of its weight of iron filings, and introduced into a small green glass bulb, at the end of a somewhat curved tube, the open extremity of which is inserted, through a cork, into alcohol, contained in a broad-mouthed glass vial; another tube, open at both ends, passing through the cork, in order to permit the escape of uncondensed gases. Heat is then applied to the bulb by means of a spirit lamp, is gradually increased until the glass becomes red hot, and continued for an hour. The alcohol in the vial dissolves the empyreumatic products, and, by being allowed to rise in the tube, and then expelled, serves to wash out any mercury that may be condensed upon its sides. The alcohol is poured off from the condensed mercury, which is then washed with fresh alcohol, dried, and weighed. (See *A. J. P.*, xvii.)

system with less irritation. It is much employed for producing the sialagogue and alterative action of mercury, in doses of one to three grains (0.065 to 0.20 Gm.), guarded with opium if it disturbs the bowels. With a view to the alterative effect upon the digestive organs, three grains (0.20 Gm.) may be given every night, or every other night, for a time, and followed in the morning, if the bowels should not be opened, by a small dose of laxative medicine.

Dose, as a laxative, from five to fifteen grains (0.32 to 1.0 Gm.). It may also be used as a cholagogue cathartic combined with or speedily followed by a more certain purgative.

MASTICHE. U. S.

MASTIC

(măs'tĭ-ṣhē)

"A concrete resinous exudation from *Pistacia Lentiscus* Linné (Fam. *Anacardiaceæ*)." *U. S.*

Mastich; Mastix; Mastic, *Fr. Cod.;* Resina Mastiche, *G.;* Almaciga, Mastic, *Sp.;* Sakes, *Turk.;* Arah, *Arab.*

Pistacia Lentiscus, L., *Sp. Pl.* (1753) 1026; Willd., *Sp. Plant.* iv. 753; *B. & T.* 68.—The *lentisk* is a shrub or small tree, seldom more than twelve feet in height, much branched towards the top, and furnished with petiolate, abruptly pinnate leaves. The leaflets are from eight to twelve, and usually alternate, with the exception of the two upper, which are opposite. They are ovate-lanceolate, entire, obtuse, often mucronate, and sessile upon the common footstalk, which has a narrow foliaceous expansion on each side. The flowers are diœcious, and very small. The male are in an axillary ament; the female are arranged alternately upon a common peduncle, which is also axillary. The tree is a native of the countries bordering upon the Mediterranean. The fruit yields by expression a fixed oil, of a deep green color, and liquid at about 90° F., which the Arabs of North Africa use both as an article of diet and for light. A resinous exudation from the stem and branches is the official part, but it does not appear to be collected in all places where the tree flourishes. Under the name of *Bombay mastic* there occur in India masses of oleoresin said to be derived from the *Pistacia Terebinthus,* having the general appearance of true mastic with a deeper color, but lacking fragrance, and dissolving in hot alcohol. For an account of the collection of mastic from *P. Terebinthus* growing in the island of Cyprus, see *C. D.,* 1897, 273.

Mastic is obtained chiefly from the island of Scio, or Chios, in the Grecian Archipelago, where the tree is cultivated for this product. Incisions[1] are made in the trunk and principal branches, from which the juice slowly exudes, and either hardens in tears upon the bark, or drops on the ground, where it is received upon cloths or the bare earth, and concretes in irregular masses. The tears are most esteemed, and are the only form recognized by the U. S. P. They are of various sizes, oval or roundish, often compressed, smooth, semi-transparent, of a pale-yellow color, of a shining fracture, friable, and usually covered with a whitish powder, occasioned by their friction against each other. They are brittle, but become plastic when chewed. The masses consist of yellowish agglutinated tears, with others of a darker color and less translucent, and often fragments of wood, bark, or earthy matter intermingled.

It is officially described as "in subglobular, lenticular, elongated or pear-shaped tears, about 3 Mm. in diameter, pale yellow or greenish-yellow, transparent, having a glass-like lustre, the surface sometimes very slightly dusty; brittle, becoming plastic when chewed; odor slight, balsamic; taste mild, terebinthinate. Mastic is completely soluble in ether and almost completely soluble in alcohol. The acid number should not be less than 65 (see PART III, Test No. 98)." *U. S.*

Mastic is nearly inodorous, unless rubbed or heated, when it becomes fragrant. Its taste is weak, but agreeably terebinthinate, and, after long chewing, very slightly acrid. It is at first friable under the teeth, but soon becomes soft and ductile, and acquires a white opaque appearance. Its sp. gr. is 1.074. It is fusible and inflammable by heat. Alcohol dissolves about 90 per cent. of it, leaving a viscid substance which becomes brittle when dried, and for which the name of *masticin* or *beta-resin of mastiche* has been proposed. This substance, though not dissolved by alcohol, softens and swells up in it, as gluten does in water. Hlasiwetz gives $C_{20}H_{31}O$ as the formula of the resin. The portion dissolved by the alcohol is called by Johnston *alpha resin of mastiche* or *mastichic acid* because of its acid properties, and has the formula $C_{20}H_{32}O_2$. (*Handwörterbuch der Chemie,* iv. p. 280.) Mastic is wholly soluble in ether, chloroform, and oil of turpentine, scarcely soluble in the fixed oils, and insoluble in water. It consists chiefly of resin, with *masticin,* and a volatile oil, which can scarcely be said to have been obtained in a separate state, though it imparts flavor to alcohol and water distilled from the mastic, especially when this has been previously triturated with an equal weight of potassium carbonate. Flückiger, through Schimmel & Co., of Leipsic, ascertained that this volatile oil is present in mastic to the extent of 2 per cent.

[1] According to J. Léon Soubeiran the valuable tears are produced by spontaneous exudation from the branches. But the greater part of the resin comes from longitudinal incisions in the stem, made with a knife, close together, and extending from the root to the branches. In fifteen or twenty days the resin has concreted, and is collected in little panniers of white paper or cotton cloth. (*J. P. C.,* Nov., Déc., 1870, 359. See also *C. D.,* 1897, 273; also *Proc. A. Ph. A.,* 1897, 563.)

He found it to be a terpene of the composition $C_{10}H_{16}$. Schimmel & Co. (*Schim. Rep.*, April, 1897) state that mastic resin yields from 0.9 to 2.5 per cent. of a powerful balsamic essential oil of the same odor as the raw material, a sp. gr. of from 0.855 to 0.87 at 15° C., and an optical rotation (100-Mm. tube) of from +22° to +27°. Henry C. C. Maisch proposed a method of testing mastic (*A. J. P.*, 1901, 171) and Tschirch and Reutter (*A. Pharm.*, 1904, 104) examined mastic carefully; they found approximately 42 per cent. of free resin acids, of which 4 per cent. are soluble in 1 per cent. ammonium carbonate solution and 38 per cent. in 1 per cent. soda solution. The former are the isomeric *α*- and *β*-masticinic acids, $C_{23}H_{36}O_4$, the latter masticolic acid, $C_{23}H_{36}O_4$ (slight amount), amorphous *α*-masticonic acid, $C_{32}H_{48}O_4$ (20 per cent.), and *β*-masticonic acid, $C_{32}H_{48}O_4$ (18 per cent.). Besides this, mastic contains 30 per cent. *α*-masticoresen, $C_{35}H_{36}O_4$, soluble in alcohol; 20 per cent. of *β*-masticoresen (masticin), insoluble in alcohol, and 2 per cent. of an ethereal oil, possessing a pale yellow color and a somewhat camphoraceous odor. Finally, there is also a bitter principle, which could not be isolated in pure form. Mastic is occasionally adulterated with olibanum, sandarach, and other resinous bodies, and, in seasons of scarcity, with sea salt.

Uses.—Mastic was formerly thought to possess properties analogous to those of the turpentines, and was used in *debility of the stomach, hæmoptysis* from ulcerations, *leucorrhœa, chronic diarrhœa,* etc.; but its virtues were overrated, and it is at present scarcely ever given internally. In the East, however, an aqueous infusion is said to be still used in infantile *cholera,* and the Greeks employ cataplasms made by mixing it with bread and red wine, which they apply to the lower abdomen. (Landerer.) It is sometimes employed to fill the cavities of carious teeth, for which purpose it is well fitted by its softness. Great quantities of it are consumed in Turkey, where it is habitually chewed by the women, under the impression that it sweetens the breath and preserves the gums and teeth. The alcoholic solution has been employed as a styptic in *bleeding from the nose, leech bites,* etc., being applied by means of a camel's-hair pencil directly to the bleeding vessel. Dissolved in alcohol or oil of turpentine, it forms a brilliant varnish. A solution made by macerating half an ounce of mastic and fifteen grains of caoutchouc in two fluidounces of chloroform, and filtering in close vessels, forms a valuable *microscopic varnish.* The following mode of applying it to carious teeth has been recommended. Dissolve four parts of mastic in one of ether, in a bottle well stoppered. With the solution thus formed, which is yellow and of an oily consistence, saturate a small piece of cotton of the size of the carious cavity, and, having well cleansed and dried the cavity, introduce the cotton, without painful pressure, so as to fill it exactly. The resin attaches itself to the diseased surface of the tooth, which it protects from the air, and from the food taken into the mouth.

Dose, thirty grains (2 Gm.).

Off. Prep.—Pilulæ Aloes et Mastiches, *U. S.*

MATICO. U. S.

MATICO

(măt'ĭ-cō)

"The leaves of *Piper angustifolium* Ruiz and Pavon (Fam. *Piperaceæ*)." *U. S.*

Matico leaves; Feuilles de Matico, *Fr. Cod.;* Maticoblätter, *G.*

The genus Piper, according to Engler and Prantl, includes nearly six hundred species, which are distributed throughout the tropics of the Old and New World, being particularly numerous in tropical America and of relatively less number in Africa.

Piper angustifolium, Ruiz and Pavon, *Flor. Peruv.—Piper elongatum,* Vahl.—*Artanthe elongata,* Miquel.—This is a shrub with a jointed stem about twelve feet in height. In a dried specimen received from Ruschenberger, of the U. S. Navy, the leaves were sessile or very shortly petiolate, oval-lanceolate, acuminate, from two to six inches long by about an inch in breadth, bright green on the upper surface, paler and downy beneath, finely crenate, tessellated above, reticulate beneath, the meshes small, and the veins densely brownish hairy; of an agreeable aromatic odor and a strong spicy taste. The spikes are solitary, opposite the leaves, and cylindrical. The bracts are peltate or cucullate; the flowers hermaphrodite. The plant is a native of Peru, where the fruit, under the name of *thoho-thoho,* is employed in the same manner as cubeb. This species is also found in other parts of South America. The commercial drug matico is furnished, according to G. Dethan and R. Bertault (*J. P. C.*, 1897, 537), by two varieties of *Piper angustifolium,*—viz., *α-cordulatum* (*Artanthe elongata,* Miq.), and *β-ossanum,* which differ somewhat in the shape of the leaves. The former has the leaves larger, shorter, and broader, with an oblique cordate base. The midrib of *α-cordulatum* is much less convex below than in the other variety. In 1864 Bentley (*P. J.*, Jan. 1864) described a *false matico* from Central America believed to be yielded by the *Piper aduncum,* L. It is distinguished by the want of the reticulations on the upper and the down on the under surface which characterize true matico.

Properties.—The leaves, spikes, and stalks are mixed together, and more or less compressed, in the packages of the imported drug, and are all possessed of activity, though the leaves only are recognized by the Pharmacopœias. They are officially described as "from 10 to 15 Cm. long, short-petiolate, oblong-lanceolate; apex pointed, base unequally heart-shaped, margin very finely crenulate; tessellated above,

reticulate beneath, the meshes small, and the veins densely brownish-hairy; aromatic, spicy, bitterish, and astringent." *U. S.* Matico leaves are readily pulverized, forming a light-greenish, absorbent powder. The *maticin* of Hodges (*Philos. Mag.*, Sept. 1844) was found by Wiegand to be a salt of potassium. John J. Stell, who examined the drug in the expectation of discovering a principle analogous to cubebin or piperin, failed in the attempt. Flückiger found it to contain 2.7 per cent. of the volatile oil, which was slightly dextrogyrate and boiling in large part at 180° to 200° C. (356° to 392° F.). In the wintertime it deposited large crystals of a camphor fusing at 103° C. (217.4° F.), and having the odor and taste of the oil. The crystals have the formula $C_{12}H_{20}O$ according to Schimmel & Co. (*Schim. Rep.*, Oct. 1898, p. 37.) Kugler (*A. J. P.*, 1884, 477) and Thoms (*A. J. P.*, 1904, p. 584) state that the newer matico oils do not contain this camphor but contain *asarol* (propenyl-trimethyltrioxybenzene), $C_{12}H_{16}O_3$. Matico also affords, according to Marcotte, a crystallizable acid named *artanthic acid*, with some tannin. (*Pharmacographia*, 2d ed., p. 590.)

Uses.—Matico, on account of the presence in it of tannic acid, is feebly astringent and stimulant, acting much like cubeb upon the urinary passages. It is said to be employed in Peru in arresting *hemorrhages* and as a local application to *ulcers*, and has been used in European practice in the treatment of diseases of the genito-urinary organs such as those for which cubeb is commonly prescribed. It has also been praised as a remedy in *dysentery* and *diarrhœa* and especially as a local hæmostatic, in which it probably acts in part mechanically in the same manner as does agaric. The powder is sometimes used, but the fluidextract is preferable for internal administration.

Dose, forty-five to seventy-five grains (3 to 5 Gm.).

Off. Prep.—Fluidextractum Matico, *U. S.*

MATRICARIA. U. S.

MATRICARIA [German Chamomile]

(măt-rĭ-cā'rĭ-ą)

"The dried flower-heads of *Matricaria Chamomilla* Linné (Fam. *Compositæ*)." *U. S.*

Flores Chamomillæ Vulgaris; Wild Chamomile, Horse Gowan, Dog's Camovyne; Camomille commune (d'Allemagne), *Fr. Cod.*; Flores Chamomillæ, *P. G.*; Kamillen, Kamillenblumen, *G.*; Camomilla comune, *It.*; Manzanilla (Flor de), *Sp.*

Matricaria Chamomilla, Linn., *Sp. Plant.* (1753) 91.—This is an annual plant, with a branching stem a foot or two in height, bearing alternate leaves about two inches long, the lower ones tripinnate, the upper bipinnate or simply pinnate, and all of them very green, and nearly or quite smooth. The leaflets are linear and very small. The flower-heads appear singly at the ends of the stem and branches. They are about three-quarters of an inch in diameter, with the rays spreading. The bracts of the involucre are obtuse, green in the middle, and whitish, membranous, and translucent at the margin. The ray-florets are white, at first spreading, and ultimately reflected. The disk is of a deep yellow color, at first flat, but in the end convex, and in some cases somewhat conical.

The plant is a native of Europe, and is occasionally cultivated in our gardens. All parts of it are active, but the flowers only are official. These shrink in drying, so that they are scarcely half as large as in their recent state. Those found in commerce are imported from Germany. They are officially described as "about 6 or 8 Mm. broad, exclusive of the rays; with a flattish imbricated involucre, a conical, hollow, and naked receptacle, 10 to 20 white ligulate and reflexed pistillate ray-florets which are about 8 Mm. long, and numerous yellow, tubular, perfect disk-florets without pappus; odor somewhat disagreeably aromatic; taste strongly aromatic and bitter. The similar flower-heads of *Anthemis arvensis* Linné, and *Maruta Cotula* De Candolle (Fam. *Compositæ*), have conical, solid, and chaffy receptacles." *U. S.*

The dried flowers of matricaria are considerably smaller than those of common chamomile, and exhibit a larger proportion of the disk-florets compared with those of the ray. They have a strong, peculiar, rather unpleasant odor, and a disagreeable, bitter taste. Their active constituents are volatile oil and bitter extractive, which are readily taken up by water and alcohol. The oil, which is obtained by distillation with water, is thick, somewhat tenacious, of a fine deep blue color becoming green and brown by age, and almost opaque in mass. Though supposed by Gerhardt to be identical with the oil of chamomile (*Anthemis nobilis*), it has been shown to be distinct. (*P. J.*, Feb. 1862, p. 429.) It congeals at —4° F., has the sp. gr. 0.93, and contains a terpene, $C_{10}H_{16}$, and a colorless oil, $C_{10}H_{16}O$. *Schimmel & Co.'s Report* for April, 1897, states that the German chamomile oil contains a paraffin hydrocarbon, which was obtained as a snowy white solid melting at 53° to 54° C. The blue color is due to a volatile principle called *azulene* by Piesse, and *cærulein* by Gladstone and others. This, when distilled with potassium, yields a terpene, $(C_{10}H_{16})_3$, and with phosphoric oxide a hydrocarbon, $C_{10}H_{14}$. (Kachler, *Ber. d. Chem. Ges.*, iv. 36.)

Uses.—Matricaria is a mild tonic, very similar to chamomile in medicinal properties, and, like it, in very large doses an emetic. It is considered also in Europe to be antispasmodic and anthelmintic. It is much employed in Germany, but in this country scarcely at all, unless by German practitioners. It may be given for the same purposes and in the same manner as chamomile.

Dose, half an ounce (15.5 Gm.).

MEL. U. S.

HONEY

(mĕl)

"A saccharine secretion deposited in the honey-comb by the bee, *Apis mellifera* Linné." *U. S.*

Miel, *Fr. Cod.*; Mel, *P. G.*; Honig, *G.*; Miele, *It.*; Miel, *Sp.*

From the nectaries of various flowers the bee extracts a thin, aqueous fluid, nearly without flavor and insipidly sweet, sometimes known as *nectar*. As honey is made out of this substance it is very much affected by the character of the nectar, so that the nature of the plants which predominate in the vicinity of the hive is a matter of great importance to the bee culturist, not only in regard to the flavor of the honey which is yielded, but even to its freedom from poisonous qualities, cases having been reported from time to time of poisoning produced by the eating of honey which had not been tampered with after extraction from the hive. See *N. J. M. R.*, 1852, 46; "*Poisonous Honey*," by L. F. Kebler, *Proc. A. Ph. A.*, 1896, 167; H. Bley, *Ph. Ztg.*, Nov. 1885. The latter states that *Datura Stramonium* and *Gelsemium* are for honey making especially dangerous plants. The nectar when taken in by the bee is chemically changed by secretions from glands in the head and thorax, levulose, dextrose, and rarely sucrose being formed. The finest honey is that which is allowed to drain from the comb. If obtained from hives that have never swarmed, it is called *virgin honey*. An inferior kind is procured by submitting the comb to pressure, and if heat be employed previous to expression, the product is still more impure.

In the recent state honey is fluid,[1] but on being kept it is apt to form a crystalline deposit, and to be ultimately converted into a soft granular mass. In commerce it is found of every consistence, from that of a viscid liquid like thin syrup or oil, to that of lard or soft suet. Its color is sometimes white, but usually yellowish, and occasionally of a brownish or reddish tinge. It has a peculiar agreeable odor, varying somewhat with the flowers from which it was collected, and a very sweet, feebly aromatic taste, which is followed by a slight prickling or sense of acrimony in the fauces. Cold water dissolves it readily, alcohol with less facility. "A syrupy liquid of a light yellowish to yellowish-brown color, translucent when fresh, but gradually becoming opaque and crystalline, having a characteristic, aromatic odor, and a sweet, faintly acrid taste. When recent Honey is diluted with twice its weight of water, the resulting liquid should be almost clear, not stringy, and should have a specific gravity not lower than 1.099 (corresponding to a specific gravity of 1.370 for the original Honey). When Honey is incinerated in small portions at a time in a platinum crucible, it should not leave more than 0.3 percent. of ash. Honey has a faintly acid reaction upon litmus paper, and is lævogyrate. If 5 Gm. of Honey be dissolved in 20 Gm. of water, a clear or nearly clear solution will result, which should not be rendered more than faintly opalescent by a few drops of silver nitrate T.S. (limit of *chlorides*), or of barium chloride T.S. (limit of *sulphates*). If 2 Cc. of a filtered solution of the Honey (1 in 4) be placed in a test-tube 1 Cm. in diameter, and 1 Cc. of absolute alcohol be allowed to flow down the walls of the tube held in an inclined position, so as to form an overlying layer, this should remain clear, and the line of contact should not show more than barely noticeable opalescence, which soon disappears; a permanent milky zone should not be produced (absence of *starch sugar*). If 2 Cc. of pure concentrated sulphuric acid be placed in a test-tube of 1 Cm. diameter, and 0.5 Cc. of a solution of Honey (1 in 4) be allowed to flow upon it so as to form a distinct upper layer, no colored line of contact should show at once, and at the end of one hour the zone of contact should be at most yellowish or clear brown; a brownish color becoming nearly black at the end of half an hour should not develop (absence of *cane sugar*). On boiling 1 part of Honey with 5 parts of water, the resulting solution, when cold, should not be rendered blue or green on the addition of iodine T.S. (absence of *starch*)." *U. S.* It is essentially a strong aqueous solution of mixed dextrose and levulose, the mixture being improperly known

[1] *Propolis.*—This is a resinous substance, deposited by bees at the base of the hive, and in other parts which require protection from the outer air, of a nature entirely different from that of wax or honey, and supposed to be intended for the protection of the comb from injurious agencies. H. O. Hitchcock (*Chicago Med. Journ.*, 1867) considers it one of the best remedies in simple mucous *diarrhœa*, even when severe and attended with pain and vomiting. In many cases only a single dose is required. It appears to possess anodyne and soporific properties. He has found it also efficacious in *dysentery* in the early stages, but it has proved useless in the disease when fully established. In *chronic diarrhœa*, even of the kind contracted in camp and remarkable for its obstinacy, it has seemed to act like a charm. It is of a dark reddish or yellowish-brown color, of a shining fracture, an aromatic taste and odor, quite insoluble in water, nearly so in ether, but readily dissolved by alcohol and solution of potassium hydroxide. Hitchcock has used both a tincture and an alkaline solution: the former (two drachms of propolis and four fluidounces of alcohol) in doses of from thirty minims to a fluidrachm (1.8 to 3.75 Cc.); the latter (two drachms of the resin to a fluidrachm of solution of potassium hydroxide and four fluidounces of a menstruum consisting of equal parts of water and simple syrup) in the dose of half a fluidrachm (1.8 Cc.) after each stool.

Bee bread is the name given to a material found in some of the cells of the comb, consisting mainly of the pollen of plants. (*Chicago Med. Examiner*, Sept. 1865.) Jas. S. Whitmire found that in the dose of a drachm (3.9 Gm.) three times a day it caused great increase of the urinary secretion. No disagreeable effects followed its use, except a slight flatulency and looseness of the bowels. It is entirely palatable and inoffensive to the stomach. (*A. J. P.*, 1866.)

Eucalyptus Honey, or Black Honey.—This honey, a detailed description of which may be found in U. S. D., 16th ed., appears to have been not a natural but a sophisticated article.

as "glucose," and amounting generally to from 70 to 80 per cent. According to Wm. A. Selser, who separated wax from honey on a large scale, the proportion of wax in the honey comb averages 1 per cent.; from 1500 pounds he obtained 14¼ pounds of wax by actual experiment. (*A. J. P.*, 1904, 267.)

The analyses of pure, unadulterated honey, given in the following table, show the variations in its composition. They were made by J. Campbell Brown (*Analyst*, iii. 269).

Locality.	Levulose.	Dextrose.	Sucrose.	Wax, Pollen, and Insoluble Matter.	Ash.	Water expelled at 100° C.	Water expelled above 100° C. and Loss.
English	37.04	36.11	None.	Good trace.	.15	19.10	7.60
Welsh	37.66	39.24	None.	Trace.	.14	16.40	6.56
Normandy	37.36	42.02	None.	Slight trace.	.17	15.50	4.95
German	33.56	36.16	None.	Trace.	.17	19.11	11.00
Greek	40.43	31.77	None.	.05	.15	19.80	7.80
Lisbon	37.69	34.51	None.	Nearly 1.0	.14	18.80	6.86
Jamaica	33.60	34.80	2.2 (?)	2.1	.25	19.46	7.58
California	38.29	35.57	None.	Good trace.	.11	17.90	8.13
Mexican	36.39	35.04	None.	Trace.	.97	18.47	10.03

The *honey sugar* may be obtained by treating granular honey with a small quantity of alcohol, which, when expressed, takes along with it the other ingredients, leaving the crystals nearly untouched. The same object may be attained by melting the honey, saturating its acid with calcium carbonate, filtering the liquid, then setting it aside to crystallize, and washing the crystals with alcohol. Inferior honey usually contains a large proportion of uncrystallizable sugar and vegetable acid. Diluted with water, honey undergoes the vinous fermentation. In warm weather, honey itself, if not very pure, sometimes ferments, acquiring a pungent taste and deeper color.[1] The presence of dextrin in pure honey seems to be established. G. L. Spencer (*A. J. P.*, 1895, 27) has found as much as 4 per cent. of dextrin, and Haenle (*Zeit. An. Chem.*, 94, 99) has found that honey from Coniferæ always contains dextrin. Künnmann and Hilger (*A. J. P.*, 1896, 570) state that dextrin is present in all honey, whether dextrorotatory or lævo-rotatory, and claim to have identified it as achroo-dextrin. Starch is said to be occasionally added to the inferior kinds to give them a white appearance. The adulteration may be detected by adding water, which dissolves the honey and leaves the starch at the bottom of the vessel. Dilution with water may be suspected from the greater thinness of the honey and its want of disposition to crystallize.

Honey is largely adulterated with artificial glucose. This may be detected by the official tests, but the safest method is to determine the sugar by the use of Fehling's solution. The grape sugar may be determined directly in a weighed quantity of honey. An equal weight of the same honey is boiled with 2 per cent. sulphuric acid, and the sugar may be determined after inversion; finally the dextrin may be determined in a third portion by precipitation with alcohol. In pure honey the reduction after inversion with acid is not materially increased; in starch sugar (artificial glucose) it is increased. (Allen.) According to Oscar Haenle, glucose can also be detected by first dialyzing thoroughly and then polarizing, under which circumstance, if glucose be present, rotation to the right occurs; if the honey be pure the light is not affected. Undialyzed honey ordinarily polarizes to the left, but unadulterated conifer honeys are dextrogyrate. (*P. J.*, xxi.)

Uses.—Honey possesses the same medicinal properties as sugar, but is more disposed to affect the bowels. Though largely consumed as an article of food, it is seldom employed medicinally, except as a vehicle. Its taste and demulcent qualities render it a useful addition to gargles, and it is sometimes employed as an application to *foul ulcers*.

Off. Prep.—Mel Depuratum, *U. S.*, *Br.*

[1] Müllenhoff believes that the honey is preserved in the sealed cells of the comb by the secretion with it of a minute quantity of formic acid, and has found by experiment that the addition of one part of 25 per cent. formic acid is sufficient to keep permanently 250 parts of honey, but in this connection it should be remembered that the absence of contact with the air would account for the preservation of honey in the comb.

MEL BORACIS. Br.

BORAX HONEY

(mĕl bo-rā'cĭs)

Mel Sodii Boratis, *U. S.* 1870; Honey of Borax, Honey of Borate of Sodium; Miel boraté, Mellite de Borax, *Fr.*; Boraxhonig, *G.*

"Borax, in fine powder, 1 *ounce* (Imperial) or 50 grammes; Glycerin, ½ *ounce* (Imp.) or 25 grammes; Clarified Honey, 8 *ounces* (Imp.) or 400 grammes. Mix." *Br.*

This preparation was very properly dropped from the U. S. Pharmacopœia at the 1880 revision, as it may well be left to extemporaneous prescription. The U. S. formula of 1870 was practically identical with the British process given above. Borax honey is used in the thrush of infants and in aphthous ulcerations of the mouth.

MEL DEPURATUM. U. S., Br.

CLARIFIED HONEY [Mel Despumatum, Pharm. 1890]

(měl dĕp-ū-rā'tŭm)

"Honey of commerce, melted in a water-bath, and strained, while hot, through flannel previously moistened with warm water." *Br.*

Mellite simple, *Fr. Cod.;* Miel déspumé, *Fr.;* Mel depuratum, *P. G.;* Gereinigter Honig, *G.;* Miele depurato, *It.;* Miel depurada, *Sp.*

"Honey, *a convenient quantity,* Distilled Water, Glycerin, each, *a sufficient quantity.* Mix the Honey intimately with *two percent.* of its weight of paper-pulp, which has been previously reduced to shreds, thoroughly washed and soaked in water and then strongly expressed and again shredded. Then apply the heat of a water-bath, and, as long as any scum rises to the surface, carefully remove this. Finally, add enough Distilled Water to make up the loss incurred by evaporation, strain, and mix the strained liquid with *five percent.* of its weight of glycerin." *U. S.*

The U. S. method of clarifying honey was new as far as the Pharmacopœia was concerned in 1890. Paper-pulp is very effective as a clarifying agent, and the glycerin offers some protection to the honey against change. Honey may be made brilliant by hot filtration through paper. (See Remington's *Practice of Pharmacy,* "Hot Filtration," Fourth Edition, p. 214.)

Honey, by the heat of the water bath, becomes so fluid that the wax and other lighter impurities which it contains rise to the surface and may be skimmed off, while the heavier substances which may have been accidentally or fraudulently added, such as sand or other earth, sink to the bottom. It is officially required that "Clarified Honey should conform to the tests of purity given under *Mel.*" *U. S.* A neat method of separating is described in *N. R.,* Feb. 1880. It is as follows: "Pour the honey into a perfectly clean cylindrical vessel, with straight sides, rather narrow, and having a small lip at the open margin, and heat the vessel on a water-bath. When the water is hot, pour enough honey into the vessel to fill it to within about 1 inch of the edge, and allow it to remain at rest in the water-bath, at a moderate heat, for about one hour. During this time, most of the impurities will rise to the top, while some others may sink to the bottom. Now remove the vessel very carefully from the water-bath, and pour on top of the hot honey, very gently, a sufficient amount of cold water to fill the vessel completely. This will cause all the impurities floating on the honey to rise at once to the top of the cold water, where they will often solidify to a tough skin or cake, which may be taken off without difficulty. Then pour off the water through the lip, remove the last remnants, if necessary, by means of blotting paper, and filter the honey through a piece of well-washed, wetted, and dense white flannel. The resulting product—if the honey be pure—will be very brilliant." The French Codex simply directs four pounds of white honey to be heated with one pound of water, evaporated, skimmed, clarified by paper pulp, and then strained through flannel. Sp. gr. 1.27. The British Pharmacopœia describes it as "a viscid translucent liquid of a light-yellowish or brownish-yellow color, gradually becoming partially crystalline and opaque. It has a characteristic odor and very sweet taste. Incinerated it should not yield more than 0.25 per cent. of ash, the solution of which in *water* acidulated with *nitric acid* should not afford more than a slight turbidity with *solution of barium chloride* (absence of more than traces of sulphates). It should yield no characteristic reaction with the iodine test for starch." *Br.*

The following method of clarifying honey is recommended by André von Hirschberg. Boil 25 pounds of honey, to which half the quantity of water has been added, with a pulp obtained by stirring three sheets of white blotting paper with water, over a slow fire, till the paper is reduced to minute fibres. When the mixture cools, put it into a woollen filtering bag, previously moistened, and allow the honey to pass. It comes away quite clear. The pulp may then be washed, and the dark liquid evaporated by a water bath to the proper consistence. (*P. J.,* ix.) Another process, recommended by A. Hofmann, is to dissolve 28 pounds of honey in twice its weight of water, heat the solution to the boiling point, and then add a solution of three drachms of gelatin in three times its weight of water, and afterwards an aqueous solution of one drachm of tannin, or an infusion of two drachms of galls. The mixture is to be well stirred, and kept hot for an hour. Lastly, seven-eighths of the honey may be drawn off clear, the remainder filtered through flannel, and the whole evaporated. (*Ibid.,* xv. 121.) The use of tannin is objectionable, however, on account of its solubility in honey, and the danger of honey so purified reacting when brought in contact with ferric salts. (For other processes of purifying honey, see 14th edition of this work, p. 1321, and *A. J. P.,* 1877, p. 19; also 1879, pp. 193, 598; and 1880, p. 132.) Heugel's method is to mix two pounds each of honey and water with a half-ounce of magnesium carbonate, frequently agitate for two or three hours, filter through doubled white filtering paper, boil slowly, remove the scum carefully, and evaporate upon a steam bath to a syrupy consistence. Dieterich recommends the following process: Mix the honey with sufficient water (the amount depending on the consistence), heat for about seven hours on a water bath, and clarify it with 5 per cent. of its weight of powdered talc, neutralize, if necessary, with magnesium carbonate; allow to deposit, filter, add a few drops of acetic acid, and evaporate to the proper specific gravity. (*Ph. Ztg.,* 93, 712.)

Honey clarified with calcium carbonate and animal charcoal, or as in the first process described, is as clear and colorless as syrup made with sugar, but still retains a peculiar flavor. It is less disposed to ferment than crude honey, and is said not to be so liable to produce griping pain when swallowed.

Dose, one to four fluidrachms (3.75 to 15 Cc.).

Off. Prep.—Confectio Piperis, *Br.;* Confectio Rosæ, *U. S.;* Hydrargyrum cum Creta, *U. S.;* Massa Ferri Carbonatis, *U. S.;* Mel Boracis, *Br.;* Mel Rosæ, *U. S.;* Oxymel, *Br.;* Oxymel Scillæ, *Br.*

MEL ROSÆ. U. S.

HONEY OF ROSE

(mĕl rō′ṣæ)

Mellitum Rosatum; Mellite de Rose rouge, *Fr. Cod.;* Miel Rosat, *Fr.;* Mel Rosatum, *P. G.;* Rosenhonig, *G.;* Miele rosato, *It.;* Miel de rosas, *Sp.*

* "Fluidextract of Rose, *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims]; Clarified Honey, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Into a tared vessel introduce the Fluidextract of Rose, then add enough Clarified Honey to make the contents weigh *one thousand grammes* [or 35 ounces av., 120 grains], and mix thoroughly." *U. S.*

Though one of the official preparations in the London and Edinburgh Pharmacopœias, the Honey of Rose has been dropped in the British. The U. S. formula is based on that of Grahame. (See *A. J. P.,* 1859, p. 443.) As is well known, honey of rose deposits honey sugar upon standing even but a short time. Touflet (*Ph. Centralh.,* xxxvi. 307) obviates this precipitation in the following manner: Take of Powdered Rose Leaves, 25 parts; Alcohol, sp. gr. 0.875, 75 parts; Honey, 80 parts; Sugar, 34 parts. Percolate the rose leaves with the alcohol, filter and distil off the filtrate to 40 parts. To this add the honey and sugar, and bring to the boiling point. Honey of rose forms a pleasant addition to the gargles employed in *inflammation* and *ulceration* of the *mouth* and *throat.*

Dose, one fluidrachm (3.75 Cc.).

Off. Prep.—Massa Hydrargyri, *U. S.*

MENTHA PIPERITA. U. S.

PEPPERMINT

(mĕn′thą pĭp-ę-rī′tą)

"The dried leaves and flowering tops of *Mentha piperita* Linné (Fam. *Labiatæ*)." *U. S.*

Brandy Mint, Lamb Mint: Menthe poivrée, *Fr. Cod.;* Folia Menthæ Piperitæ, *P. G.;* Pfefferminzblätter, Pfeffermünze, *G.;* Menta piperita, *It., Sp.*

The genus Mentha comprises at least fifteen species, of which there are also a great many varieties. *M. piperita,* L. (1753), also Smith (1800),—the most important member of this genus, was long ago cultivated by the Egyptians, and is now grown in considerable amounts in Europe, North America, and Eastern Asia. It is also found growing wild in other parts of the world, as South America and Australia. The oldest existing peppermint district is in the neighborhood of Mitcham (Surrey), England. In some parts of the United States, especially in Michigan, the western part of New York, Ohio and Indiana, it is largely cultivated.[1] On the continent of Europe other species of Mentha (particularly *M. arvensis*) grow with *M. piperita,* deteriorating the product. In America other plants (as *Erigeron canadensis* and *Erechthites hieracifolia*) cause the same trouble. Besides *M. piperita* other species are cultivated, as some Asiatic varieties of *M. arvensis, M. spicata, M. longifolia* (var. *undulata*), *M. gentilis, M. dalmatica,* and *M. Pulegium.* For an account of the cultivation of peppermint in Russia see *Proc. A. Ph. A.,* 1902, 831.

Mentha piperita, L., *Sp. Pl.* (1753) 576; Willd., *Sp. Plant.* iii. 79; *B. & T.* 203; Carson, *Illust. of Med. Bot.,* ii. 16, pl. 63.—Peppermint is a perennial herbaceous plant, with a creeping root, and quadrangular, channelled, purplish, somewhat hairy stems, branched towards the top, and about two feet in height. The leaves are about two inches long, opposite, petiolate, ovate, serrate, pointed, smoother on the upper than on the under surface, and of a dark green color, which is paler beneath. The flowers are small, purple, and in terminal obtuse spikes, interrupted below, and cymosely arranged. Late in the season, the growth of the lateral lower branches often gives to the inflorescence the appearance of a corymb. The calyx is tubular, furrowed, and five-toothed, often purplish; the corolla is purplish, tubular, with its border divided into four segments, of which the uppermost is broadest, and notched at its apex. The four short stamens are concealed within the tube of the corolla; the style projects beyond it, and terminates in a bifid stigma. The plant should be cut for medicinal use in dry weather, in August, about the period of the expansion of the flowers. John C. Umney points out differences between white and black peppermint in *P. J.,* 1896, 123. For a paper on the histology of powdered peppermint by Smith Ely Jelliffe see *D. C.,* 1899, 252.

Properties.—It is officially described as follows: "Branches quadrangular, with scattered, deflexed hairs; leaves petiolate, ovate-lanceolate, 3 to 8 Cm. long, acute, sharply serrate, light or dark green; flower-whorls in oblong or oval spikes which are usually compact, or somewhat interrupted at the base, 1 to 1.5 Cm. broad, rounded at the summit, when in fruit becoming 3 to 7 Cm. long; calyx tubular, 5-toothed and often purplish; corolla small, purplish, and 4-lobed; stamens four, short and

[1] For an interesting account of the distribution of the peppermint culture in the United States and the amount of oil produced in 1897, see *Schimmel & Co.'s Report* for October, 1897, 40.

equal; odor strong and characteristic; taste pungent and cooling." *U. S.* The herb, both in the recent and in the dried state, has a peculiar, penetrating, grateful odor. There is sometimes difficulty in distinguishing between the leaves of *M. piperita* and those of *M. spicata.* According to Joseph Schrenk, crystals can always be found in the glandular hairs of the peppermint, but are absent in those of the spearmint. The crystals are doubly refractive, and so transparent that sometimes a polariscope is necessary for their easy detection. These crystals have been thought to be menthol, but they seem not to dissolve in alcohol, and their nature remains doubtful. The taste of the herb is aromatic, warm, pungent, camphorous, bitterish, and attended with a sensation of coolness when air is admitted into the mouth. These properties depend on a volatile oil, of which from 1 to 1.25 per cent. can be obtained from the herb. The leaves are said to contain a little tannic acid. The virtues of the herb are imparted to water, and more readily to alcohol.

Uses.—Peppermint is an aromatic stimulant, much used to allay *nausea,* relieve *spasmodic pains of the stomach and bowels,* expel *flatus,* or cover the taste or qualify the nauseating or griping effects of other medicines. The medicine is rarely used in infusion. (See *Oleum Menthæ Piperitæ.*)

Dose, one drachm (3.9 Gm.).

Off. Prep.—Spiritus Menthæ Piperitæ, *U. S.*

MENTHA VIRIDIS. U. S.

SPEARMINT

(mĕn'thą vĭr'ĭ-dĭs)

"The dried leaves and flowering tops of *Mentha spicata* Linné (*Mentha viridis* Linné) (Fam. *Labiatæ*)." *U. S.*

Herba Menthæ Acutæ (vel Romanæ); Brown, Lamb, Garden, or Mackerel Mint; Menthe verte, *Fr. Cod.;* Menthe romaine, Baume vert, Menthe à épi, *Fr.;* Grüne Münze, Römische Minze, *G.*

Mentha spicata, L., *Sp. Pl.* (1753) 576.—*Mentha viridis,* L., *Sp. Pl.* (1763) 804; Willd., *Sp. Plant.* iii. 76; *B. & T.* 302. *M. spicata,* var. *viridis,* L. (1753).

Spearmint, sometimes called simply *mint,* differs from *M. piperita* chiefly in having sessile or nearly sessile, lanceolate, naked leaves; elongated, interrupted, panicled spikes; setaceous bracts; and stamens longer than the tube of the corolla. It is a native of Europe and Asia, and naturalized in waste places from Nova Scotia and Ontario to Minnesota and Kansas in the West and Florida in the South United States. It is also cultivated for domestic use and for the sake of its oil. Its flowering season is August. The dried herb is officially described as "closely resembling Peppermint (see *Mentha Piperita*), but the leaves usually sessile and lanceolate, the flower-spikes usually slender, interrupted, cylindrical, or crowded, conical at the apex, 5 to 8 Mm. thick, becoming when in fruit 5 to 10 Cm. long; the stamens rather long; odor and taste resembling, but distinguishable from those of Peppermint." *U. S.* The taste and odor are retained for some time by the dried plant. They depend on a volatile oil. (See *Oleum Menthæ Viridis.*) Medicinally this oil acts like the oil of peppermint.

Dose, one drachm (3.9 Gm.).

Off. Prep.—Spiritus Menthæ Viridis, *U. S.*

MENTHOL. U. S., Br.

MENTHOL

(mĕn'thōl)

$C_{10}H_{19}OH = 154.98$

"A secondary alcohol [$C_6H_9(CH_3)(OH)(C_3H_7)1:3:4$], obtained from the oil from *Mentha piperita* Linné, or other peppermint oils. Menthol should be kept in well-stoppered bottles, in a cool place." *U. S.* "A crystalline substance, $C_6H_9.OH.CH_3.C_3H_7$, obtained by cooling the oil distilled from the fresh herb of Mentha arvensis, *DC., vars.* piperascens et glabrata, *Holmes;* and of Mentha piperita, *Sm.*" *Br.*

Pipmenthol, Peppermint Camphor; Menthol, *Fr. Cod.;* Camphre de Menthe, Mentholum, *Fr.;* Mentholum, *P. G.;* Menthol, Pfefferminzkampher, Mentha-Kampher, Pip-menthol, *G.;* Mentolo, *It.;* Mentol, *Sp.*

Menthol was admitted to the Br. Pharmacopœia of 1885, and was one of the new official substances of the U. S. Pharmacopœia 1890. Menthol, or *peppermint camphor,* may be obtained from either American or Japanese oil of peppermint by cooling the oil to a very low temperature, when the menthol crystallizes out, often in a dense mass; the adhering oil may be separated by expression. Menthol may also be obtained by fractional distillation, and there is reason to believe that the oil of peppermint of commerce is often contaminated with the dementholized oil. A larger yield of menthol is obtained from Japanese or Chinese oils, and for this reason Japanese menthol is largely found in commerce. It is practically identical with American menthol, differing, however, in the character of its crystals, which occur in small prisms instead of in long needles.

Properties.—The U. S. P. describes it as in "colorless, acicular or prismatic crystals having a strong and pure odor of peppermint, and a warm, aromatic taste, followed by a sensation of cold when air is drawn into the mouth. Menthol is only slightly soluble in water, but imparts to the latter its odor and taste. It is freely soluble in alcohol, ether, and chloroform. It melts at 43° C. (109.4° F.) to a colorless liquid, boils at 212° C. (413.6° F.), and volatilizes slowly at the ordinary temperature. When it is triturated with about an equal weight of camphor, thymol, or hydrated chloral, the mixture becomes liquid. Its alcoholic solution is neutral to litmus paper, and is lævogyrate. If a little Menthol be

heated in an open dish, on a water-bath, it should gradually volatilize without leaving any residue (absence of *wax, paraffin,* or *inorganic substances*). If a few crystals of Menthol be dissolved in 1 Cc. of glacial acetic acid, and then 3 drops of sulphuric acid and 1 drop of nitric acid added, no green color should be produced (absence of *thymol*)." *U. S.* "Melting point 107.6° F. (42° C.); it should not exceed 109.4° F. (43° C.). It has the odor and flavor of peppermint, producing a sensation of warmth on the tongue, and, if air is inhaled, a sensation of coolness. It is very slightly soluble in *water,* but readily soluble in *alcohol* (90 per cent.), the solutions having a neutral reaction. Boiled with *sulphuric acid* diluted with half its volume of *water,* Menthol acquires an indigo-blue or ultramarine color, the acid becoming brown. It should be entirely volatilized by the heat of a water-bath." *Br.*

Menthol belongs to the class of camphors. Its formula may be written $C_{10}H_{19}OH$, as it is recognized as being a saturated secondary alcohol. Chromium trioxide oxidizes menthol to *dextro-* and *lævo-menthone,* $C_{10}H_{18}O$, which is the ketone corresponding. The *menthones* are liquids, with an odor resembling that of peppermint. They boil at 207° C. Distillation with zinc chloride or phosphoric anhydride changes menthol into liquid *menthene,* $C_{10}H_{18}$, boiling at 167° C. (See papers by Kremers, Urban, and Richtmann on the menthol group, *Proc. A. Ph. A.,* 1893, 185; also 1896, 200.) Menthol has been grossly adulterated with spermaceti, paraffin, etc., and, after being compressed into pencils or cones, sold as a local panacea for headache and neuralgia.

Uses.—According to Pellacani, menthol is a spinal and motor nerve trunk paralyzant destroying both motility and sensibility. It also acts upon the sensory nerves. It is germicidal and resembles phenol in its general medicinal action. It is sometimes administered as an intestinal antiseptic but is chiefly used externally, especially as a local anæsthetic application for the relief of *neuralgic pains, toothache, sciatica,* etc. When it is applied in solid form to the skin it produces a burning pain, associated with a sensation of cold and some benumbing of the skin, and it is chiefly used in the shape of cones without dilution. In this way it has had a very wide popularity in the treatment of *headache, neuralgia,* and *superficial pains* of various character, but is at present not so much used as formerly. According to S. A. Russel, an ethereal solution of the strength of from 10 to 50 per cent. applied two or three times a day has a remarkable power of controlling superficial inflammations, such as *boils, carbuncles,* etc. Its solution (from two to ten grains in a fluidounce of water) is said to be effective in *pruritus ani, chronic painful eczemas, urticaria,* etc. It is also largely used as a local remedy in the treatment of inflammations about the mouth, such as *stomatitis, angina, tonsillitis,* etc., dissolved in liquid petrolatum, two grains to the fluidounce, or in troches.

Dose, one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Emplastrum Menthol, *Br.*

METHYLIS SALICYLAS. U. S.

METHYL SALICYLATE

[Methyl Salicylas, Pharm. 1890, Synthetic Oil of Gaultheria, Synthetic Oil of Wintergreen]

(mĕth′ȳl-īs săl-ĭ-cȳ′lăs)

$CH_3C_7H_5O_3 = 150.92$

"An ester [$C_6H_4(OH)COOCH_3$ 1 : 2], produced synthetically; it is the principal constituent of Oil of Gaultheria and Oil of Betula. For flavoring purposes, Oil of Gaultheria, Oil of Betula, and Methyl Salicylate may be regarded as identical products. It should be kept in well-stoppered bottles, protected from light." *U. S.*

Salicylate de Méthyle, *Fr.;* Methylsalicylat, Künstliches Wintergrünöl, *G.*

Methyl salicylate, or *artificial oil of wintergreen,* was introduced into the U. S. P. 1890 largely because of its extensive use and on account of its being a valuable synthetic; it is asserted that it can be produced of more uniform quality and is more definite and certain in its action than either the oil from gaultheria or the oil from birch, which are natural oils. (See *A. J. P.,* 1889, p. 398; *Ph. Rund.,* 1889, 283; see also 1892, p. 7, 9.) Methyl salicylate may be made by distilling salicylic acid, or a salicylate, with methyl alcohol and strong sulphuric acid. The following process was devised by G. M. Beringer (*A. J. P.,* 1887, p. 8). Dissolve half an ounce of salicylic acid in two fluidounces of absolute methyl alcohol, then gradually add one fluidounce of sulphuric acid; warm gently for twenty-four hours, then distil from a retort into which a current of steam is introduced. The distillate is to be well washed, and separated by decantation. The odor improves with age. Methyl salicylate has been found in a great number of plants. (See *A. J. P.,* 1898, 412; *Ph. Rev.,* 1898, 130; *Schim. Rep.,* 1898, 45; 1899, 46.)

Properties.—Methyl salicylate is officially described as "a colorless liquid, having a characteristic, strongly aromatic, wintergreen odor, and a sweetish, warm, and aromatic taste. Specific gravity: 1.180 to 1.185 at 25° C. (77° F.), according to the amount of moisture present. Boiling point: 219° to 221° C. (426.2° to 429.8° F.). It is optically inactive. Sparingly soluble in water; soluble, in all proportions, in alcohol, glacial acetic acid, and carbon disulphide. The alcoholic solution is neutral or slightly acid to litmus paper. If a drop of Methyl Salicylate be shaken with a little water, and a drop of ferric chloride

T.S. subsequently added, a deep violet color will be produced. When heated on a water-bath, in a flask provided with a suitable condenser, it should yield no distillate having the characteristics of *alcohol* or *chloroform.* If to 1 Cc. of Methyl Salicylate, contained in a capacious test-tube, 10 Cc. of sodium hydroxide T.S. be added, and the mixture agitated, a bulky, white, crystalline precipitate will be produced; then, if the test-tube, loosely corked, be allowed to stand in boiling water for about five minutes, with occasional agitation, the precipitate should dissolve, and form a clear, colorless or faintly yellowish solution, without the separation of any oily drops, either on the surface or at the bottom of the liquid (absence of *volatile oils,* or of *petroleum*). If the alkaline liquid thus obtained be subsequently diluted with about three times its volume of water, and a slight excess of hydrochloric acid added, a white, crystalline precipitate will be produced which, when collected on a filter, washed with a little water, and recrystallized from hot water, should respond to the tests of identity and purity given under *Acidum Salicylicum* (absence of *methyl benzoate,* etc.)." *U. S.*

Uses.—So far as is known, the physiological and remedial properties of the artificial oil of gaultheria do not differ from those of the natural product. (See *Oleum Gaultheriæ.*)

Dose, fifteen to thirty minims (0.9 to 1.8 Cc.).

Off. Prep.—Cataplasma Kaolini, *U. S.*

METHYLTHIONINÆ HYDROCHLORIDUM. U. S.

METHYLTHIONINE HYDROCHLORIDE METHYLENE BLUE

(mĕth-ȳl-thī-ọ-nī′næ hȳ-drọ-ȼhlō′rị-dŭm)

$C_{16}H_{18}N_3SCl = 317.36$

"Tetramethylthionine Hydrochloride, obtained by the action of hydrogen sulphide upon an oxidation product of para-amido-dimethylaniline." *U. S.*

Chlorhydrate de Tetraméthylthionine, *Fr.;* Tetramethylthioninchlorid, Methylen Blau, *G.*

This synthetic dye color belongs to the class of *thiazines* or dyestuffs in which two benzene nuclei are united by a nitrogen atom and a sulphur atom. Methylene blue was discovered by Caro in 1876, and was made by the oxidation of *p*-amido-dimethyl aniline in the presence of hydrogen sulphide. Both the hydrochloride of the base and the zinc chloride double salt of the same are known by the name of methylene blue. It is only the former that is used in medicine and constitutes the official salt. Methylene Blue must not be confounded with *methyl blue,* a dark blue powder which is used as an antiseptic; the latter is sodium triphenyl-pararosaniline-sulphonate.

Properties.—Methylene blue is officially described as "a dark green, crystalline powder, or in the form of prismatic crystals having a bronze-like lustre. It is readily soluble in water and somewhat less readily in alcohol, the solutions having a deep blue color. The addition of hydrochloric acid to its aqueous solution changes the color to a lighter shade of blue. The addition of sodium hydroxide T.S. to the aqueous solution changes the color to a purplish shade, and if added in excess, produces a precipitate having a dull violet color. The dry powder dissolved in sulphuric acid containing powdered zinc produces a solution which, upon standing, is gradually decolorized. Two Gm. of Methylthionine Hydrochloride, when ignited, should leave not more than 0.008 Gm. of residue, which should be free from zinc oxide (absence of *commercial dye,* and *other mineral impurities*). Two Gm. of Methylthionine Hydrochloride ignited with dry sodium carbonate and potassium nitrate should leave a residue which should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.*

Uses.—When taken internally methylene blue is absorbed and eliminated chiefly from the kidneys, coloring the urine blue. In therapeutic doses it produces no symptoms, and we know of no recorded cases of poisoning with the pure article. It is a feeble antiseptic and has been used to a considerable extent in *gonorrhœa, cystitis* and *pyelitis,* but its value is certainly not great. As an analgesic, it has been employed to a considerable extent in *neuralgia, locomotor ataxia,* etc., but is inferior to other aniline derivatives. In 1891, Ehrlich and Guttmann (*B. K. W.,* xxviii), led by its power as a staining agent over the malariæ plasmodium, suggested its practical use as an antiperiodic, and its value as such is well established. In 425 cases collected by H. C. Wood, Jr., there were 85 per cent. of recoveries. It does not produce disturbances of the special senses or of the gastro-intestinal tract, and therefore may be preferable to quinine in aural or gastro-intestinal affections. Further, on account of its lack of action upon the kidney, it is especially valuable in those forms of *malaria* accompanied with *hematuria,* the so-called "*black water fever.*" If the statement of Iwanoff, that it especially acts upon the adult forms of plasmodium be correct, it should be especially valuable in *chronic malaria,* and experience may prove that the best treatment of this condition is the administration of full doses of quinine at intervals of seven days, with the continuous use of the methylene blue.

Methylene blue is preferably administered in capsule. In malaria from ten to twenty grains (0.65 to 1.3 Gm.) may be given in the course of a day for ten days, and after this six to ten grains (0.4 to 0.65 Gm.) a day for two weeks. In obstinate cases a full dose of quinine may be exhibited every seventh day, the methylene

blue being omitted. The staining action of methylene blue upon any portion of the body or clothing with which it may come in contact, and its color effect upon the urine, should always be explained to the patient.

Dose, two to five grains (0.13 to 0.32 Gm.).

MEZEREUM. U. S. (Br.)

MEZEREUM

(mẹ-zē′rẹ-ŭm)

"The dried bark of *Daphne Mezereum* Linné, and of other European species of *Daphne* (Fam. *Thymeleaceæ*)." *U. S.* "The dried bark of Daphne Mezereum, *Linn.*, or of Daphne Laureola, *Linn.*, or of Daphne Gnidium, *Linn.*" *Br.*

Mezerei Cortex, *Br.*, Mezereon Bark; Cortex Mezerei, Cortex Thymeleæ (vel Coccognidii); Dwarf Bay, Wild Pepper, Spurge-flax, Spurge-olive, Magell; Mézéréon ou Bois gentil, *Fr. Cod.*; Lauréole, Thymelée, *Fr.*; Kellerhals, Seidelbastrinde, Kellerhalsrinde, *G.*; Mezereo, *It.*; Mecereon, *Sp.*

All the species of Daphne are possessed of active properties, but three only are official,—*D. Mezereum, D. Laureola,* and *D. Gnidium,* all of which are recognized in the British Pharm., and only the last in the French Codex.

1. *Daphne Mezereum,* L., *Sp. Pl.* (1753) 356; Willd., *Sp. Plant.* ii. 415; *B. & T.* 225; Carson, *Illust. of Med. Bot.,* ii. 26, pl. 72.—This is a very hardy shrub, three or four feet high, with a branching stem, and a smooth, dark gray bark, very easily separable from the wood. The leaves spring from the ends of the branches, are deciduous, sessile, obovate-lanceolate, entire, smooth, of a pale green color, somewhat glaucous beneath, and about two inches long. They are preceded by the flowers, which appear very early in spring, and sometimes bloom even amidst the snow. These are of a pale rose color, highly fragrant, and disposed in clusters, each consisting of two or three flowers, forming together a kind of spike at the upper part of the stem and branches. At the base of each cluster are deciduous floral leaves. The fruit is oval, shining, fleshy, of a bright red color, and contains a single round seed. Another variety produces white flowers and yellow fruit. This species of Daphne occurs throughout the forests of Europe, and extends in Western Asia from the Caucasus to the Altai. It is cultivated in Europe, and is occasionally found in our own gardens.

2. *Daphne Gnidium,* Willd., *Sp. Plant.* ii. 420; *B. & T.* 227.—In this species, called *garou* or *sain-bois* by the French, the leaves are linear-lanceolate, acute, entire, smooth, and irregularly but closely set upon the branches. The flowers are white, downy, odoriferous, and disposed in terminal panicled racemes. The fruit is globular, dry, at first green, but ultimately black. *D. Gnidium* grows in dry uncultivated places in the south of Europe, and flowers in June. Its bark, which in France is used indiscriminately with that of the former species, is of a deep purplish-brown color, and hairy in the younger portions. It appears to be equally as active, medicinally, as the other official species.

Besides the species above described, *Daphne Laureola,* or *spurge laurel,* is said to furnish a portion of mezereum of commerce, and is recognized by the British Pharmacopœia, but its product is inferior in acrimony, and consequently in medicinal activity.

Properties.—Mezereum, as it comes to us, chiefly from Germany, is in strips from two to four feet long and an inch or less in breadth, sometimes flat, sometimes partially rolled, and always folded in bundles or wrapped in the shape of balls. It is covered externally with a grayish or olive-, purplish-, or reddish-brown wrinkled epidermis, with transverse scars and minute black dots, very thin, and easily separable from the bark. Beneath the epidermis is a soft, greenish tissue. The inner bark is tough, pliable, fibrous, striated, and of a whitish color, with a silky surface. Its transverse section exhibits numerous groups of bast fibres in the secondary bast. When fresh it has a nauseous odor, but in the dry state is nearly inodorous. Its taste is first sweetish, but afterwards acrid and even corrosive. It yields its virtues to water by decoction.

The bark of the root was formerly directed, but the mezereum with which our markets are supplied is evidently the bark of the stem, and the Pharmacopœias at present very properly direct the bark, without designating the part from which it must be taken. The official description is as follows: "In long, thin, flexible, tough bands, the edges fringed with partly detached bast fibres; outer surface yellowish- or reddish-brown, obliquely striate or wrinkled, with numerous lenticels and occasional brownish-black fruit-heads of a lichen; inner surface yellowish-green or whitish, satiny-lustrous, finely striate; fracture tough, fibrous, the periderm readily separable from the yellowish-green cortex, inner bark lamellated; odor slight; taste very acrid." *U. S.* British writers state that the bark of the root is the most active. The berries and leaves of the plant are also active, and the former have sometimes proved fatal to children who have eaten them. Pallas states that they are used as a purgative by the Russian peasants, and that thirty berries are required to act. French authors observe that fifteen are sufficient to kill. A tincture of them is used in Germany as a local application in *neuralgia.*

Vauquelin discovered a peculiar principle in the bark of *Daphne alpina.* This has subsequently been found in other species, and has received the name of *daphnin.* Gmelin and Bär found it in the bark of *D. Mezereum,* associated with wax, an acrid resin, a yellow coloring matter, a reddish-brown extractive, and uncrystallizable and fermentable sugar, a gummy matter containing nitrogen, ligneous fibre, malic acid, and several malates. By J.

B. Eng it has been discovered, together with a volatile oil, in the flowers of *D. Mezereum.* (*Wittstein's Viertelj.*, viii. 23.) *Daphnin* is in prismatic crystals, grouped together, colorless, transparent, brilliant, slightly soluble in cold water, very soluble in boiling water and alcohol, without odor, and of a bitter, somewhat austere taste. By Zwenger it is said to be insoluble in ether. The same chemist states that it has an acid reaction, and acts like the glucosides, being resolvable by sulphuric or hydrochloric acid into sugar, and a peculiar crystallizable principle called *daphnetin*, $C_9H_6O_4 + H_2O$. He gives for daphnin the formula $C_{15}H_{16}O_9 + 2H_2O$, the same as that of *æsculin*, of which it is, therefore, an isomer. (*Ann. Ch. Ph.*, cxv. 1.)

The glucoside daphnin may be obtained by treating the alcoholic extract of the bark with water, decanting the solution, precipitating with lead subacetate, filtering, decomposing the excess of the subacetate by hydrogen sulphide, again filtering, evaporating to dryness, submitting the residue to the action of anhydrous alcohol, and evaporating the alcoholic solution to the point of crystallization. Though daphnin is probably not inert, it is not the principle upon which the virtues of mezereum chiefly depend. Vauquelin thinks that in the recent plant they reside in an essential oil, which by time and exposure is changed into a resin, without losing its activity. The acrid resin observed by Gmelin and Bär is probably the characteristic principle to which the bark owes its vesicating properties. It is obtained separate by boiling mezereum in alcohol, allowing the liquor to cool in order that it may deposit some wax which it has taken up, then distilling off the alcohol, and treating the residue with water, which leaves the resin. This is of a dark green, almost black color, hard and brittle, and of an exceedingly acrid and permanent taste. In the isolated state it is slightly soluble in water, and it is much more so when combined with the other principles of the bark. It appears, however, not to be a pure proximate principle, but rather a resinoid combination of an acrid fixed oil with another substance. The acrid principle of mezereum is partially given off by decoction with water, as proved by the irritating character of the vapor; but none of it appears to escape when the bark is boiled with alcohol. (Squire, *P. J.*, i.) W. Will and O. Jung have investigated daphnetin, which was shown in 1879 by Stünkel to be *dioxycoumarin*, $C_6H_2(OH)_2 < \begin{matrix} O & -CO \\ CH & = CH \end{matrix}$; they obtained but about one ounce of daphnetin from fifty pounds of extract of mezereum, and they proved that it has the same relation to pyrogallic acid that coumarin has to phenol, or umbelliferone to resorcinol. (*A. J. P.*, 1885.) *Coccognin*, isolated in 1870 by Casselmann from the fruits of *D. Mezereum*, appears to be closely allied to, if not identical with, daphnin. By the dry distillation of an alcoholic extract of mezereum bark, Zwenger obtained *umbelliferone*, $C_9H_6O_3$.

Uses.—The recent bark applied to the skin produces inflammation followed by vesication, and has been popularly used as an epispastic, from time immemorial, in some of the southern countries of Europe. The dried bark, though less active, is possessed of a similar property, and is occasionally employed in France by regular practitioners for the purpose of forming issues. A small square piece, moistened with vinegar, is applied to the skin, and renewed twice a day until a blister is formed, and occasionally afterwards to keep up the discharge. It is slow in its operation, generally requiring from twenty-four to forty-eight hours to vesicate. An irritant ointment[1] is prepared from mezereum, which is used for maintaining the discharge from blistered surfaces, and may be applied advantageously to obstinate, ill-conditioned, indolent *ulcers*. An alcoholic extract has also been employed to communicate irritant properties to issue-peas. Internally administered, mezereum is a stimulant capable of being directed to the skin or kidneys, and in large doses likely to excite purging, nausea, and vomiting. In overdoses it produces the fatal effects of the acrid poisons, and a case of apparently severe narcotic effects has been recorded. (*Am. J. M. S.*, xxi.) It had at one time much reputation as a remedy in the *secondary stages of syphilis*, and still enters as an ingredient into the compound decoction of sarsaparilla. It has also been thought to act favorably as an alterative in *scrofulous affections, chronic rheumatism*, and *obstinate diseases of the skin*. For this purpose it is usually given in decoction, never in substance.

Dose, ten grains (0.65 Gm.).

Off. Prep.—Fluidextractum Mezerei, *U. S.*; Fluidextractum Sarsaparillæ Compositum, *U. S.*; Liquor Sarsæ Compositus Concentratus, *Br.*

MISTURA AMMONIACI. Br.

AMMONIACUM MIXTURE

(mĭs-tū'rą ăm-mō-nī'ą-cī)

Emulsum Ammoniaci, U. S. 1890, Emulsion of Ammoniac; Ammoniac Mixture; Emulsio Ammoniaci, Lac Ammoniaci; Milk of Ammoniac; Mixture de Gomme ammoniaque, Lait d'ammoniaque, *Fr.*; Ammoniak-Emulsion, *G.*

[1] *Unguentum Mezerei*, U. S. 1880, *Mezereum Ointment; Pommade épispastique au Garou, Pommade de Mézéréon*, Fr.; *Seidelbastsalbe*, *G.*—"Fluid Extract of Mezereum, *twenty-five parts* [or two fluidrachms]; Lard, *eighty parts* [or three hundred and sixty grains]; Yellow Wax, *twelve parts* [or fifty-four grains] [to make about one ounce av.]. Melt together the Lard and Wax with a moderate heat, add the Fluid Extract, and stir the mixture constantly until the alcohol has evaporated; then continue to stir until cool." *U. S.* 1880.

This ointment is equivalent to the *Pommade épispastique au Garou* of the French Codex, which is prepared from the bark of *Daphne Gnidium*. It may also be made, as proposed by Guibourt, by mixing two drachms of the alcoholic extract of mezereum with nine ounces of lard and one ounce of wax. It is used as a stimulating application to *blistered surfaces* and to obstinate, ill-conditioned, and indolent *ulcers*.

"Ammoniacum, in coarse powder, ¼ *ounce* (Imperial) or 5 grammes; Syrup of Tolu, 4 *fl. drachms* (Imp. meas.) or 10 cubic centimetres; Distilled Water, 7½ *fl. ounces* (Imp. meas.) or 150 cubic centimetres. Triturate the Ammoniacum thoroughly with a little of the Distilled Water so as to form a thin paste; gradually add the remainder of the Distilled Water and the Syrup of Tolu, triturating until the mixture assumes a uniform milky appearance; strain through muslin." *Br.*

In this emulsion the resinous and oily constituents are suspended by means of the gum of the ammoniac, imparting a milky appearance to the preparation, which from this circumstance was formerly called *lac ammoniaci*, or *milk of ammoniac*. The greater portion of the resin subsides upon standing. This emulsion is no longer official in the U. S. P. (8th Rev.), the process of the U. S. P. 1890 is appended.[1] The British Pharmacopœia (1898) process directs the addition of a small quantity of syrup of Tolu, doubtless as a flavoring agent. The mixture is slightly curdled by acids.

Dose, one-half to a fluidounce (15 to 30 Cc.).

MISTURA CREOSOTI. Br.

CREOSOTE MIXTURE

(mĭs-tū'rą crē-ǫ-sō'tī)

Mixture de Créosote, *Fr.;* Kreosotmixtur, *G.*

"Creosote, 16 *minims* (Imperial measure) or 1 cubic centimetre; Spirit of Juniper, 16 *minims* (Imp. meas.) or 1 cubic centimetre; Syrup, 1 *fl. ounce* (Imp. meas.) or 30 cubic centimetres; Distilled Water, *a sufficient quantity*. Shake the Creosote with fourteen *fluid ounces* (Imp. meas.) or four hundred and twenty cubic centimetres of the Distilled Water; add the Syrup and the Spirit of Juniper, and sufficient Distilled Water to produce *sixteen fluid ounces* (Imp. meas.) or four hundred and eighty cubic centimetres of the Mixture." *Br.* The glacial acetic acid has been omitted from creosote mixture by the Br. Ph. 1898.

Dose, of this mixture, which is too weak for practical use, a fluidounce (30 Cc.), containing a minim (0.06 Cc.) of creosote.

MISTURA CRETÆ. U. S., Br.

CHALK MIXTURE

(mĭs-tū'rą crē'tæ)

Mixture avec la Craie, *Fr.;* Kreidemixtur, *G.*

* "Compound Chalk Powder, *twenty grammes* [or 309 grains]; Cinnamon Water, *forty cubic centimeters* [or 1 fluidounce, 169 minims]; Water, *a sufficient quantity*, to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Rub the Compound Chalk Powder in a mortar, with the Cinnamon Water and about *twenty cubic centimeters* [or 325 minims] of Water gradually added, to a uniform mixture; transfer this to a graduated vessel, and rinse the mortar with enough Water to make the product measure *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Mix the whole thoroughly. This preparation should be freshly made when wanted." *U. S.*

"Prepared Chalk, ¼ *ounce* (Imperial) or 5 grammes; Tragacanth, in powder, 15 *grains* (Imp.) or 0.7 gramme; Refined Sugar, ½ *ounce* (Imp.) or 10 grammes; Cinnamon Water, *a sufficient quantity*. Triturate the Prepared Chalk with the Tragacanth and Refined Sugar, and gradually add sufficient Cinnamon Water to produce *eight fluid ounces* (Imp. meas.) or one hundred and sixty cubic centimetres of the Mixture." *Br.*

The direction that this mixture be prepared extemporaneously is a decided improvement. Unsuccessful attempts have been repeatedly made to devise a formula which would yield a permanent product, and much injury has been done through the dispensing of chalk mixture in an incipient fermentative condition. The trifling amount of glycerin present in the chalk mixture official in 1870 was totally inadequate to preserve it during the warm summer months, when it is in greatest vogue. Compound Chalk Powder is now official (see *Pulvis Cretæ Compositus*); it will keep indefinitely, and, besides being itself a valuable addition to the materia medica, is quickly made into chalk mixture by rubbing it with the water and cinnamon water, so that there can be no excuse for not dispensing a fresh mixture. This mixture is a convenient form for administering chalk, and is much employed in *looseness of the bowels* accompanied with acidity. Laudanum and kino or catechu are very often added to increase its astringency.

Dose, four fluidrachms (15 Cc.), frequently repeated.

MISTURA FERRI COMPOSITA. U. S., Br.

COMPOUND IRON MIXTURE [Griffith's Mixture]

(mĭs-tū'rą fĕr'rī cǫm-pŏs'ĭ-tą)

Mixture ferrugineuse de Griffith, *Fr.;* Griffithsche Eisenmixtur, *G.*

* "Ferrous Sulphate, in clear crystals, *six grammes* [or 93 grains]; Myrrh, in small pieces, *eighteen grammes* [or 278 grains]; Sugar, *eighteen grammes* [or 278 grains]; Potassium Carbonate, *eight grammes* [or 123 grains]; Spirit of Lavender, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Rose Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms].

[1] *Emulsum Ammoniaci.* U. S. 1890. *Emulsion of Ammoniac* [*Mistura Ammoniaci*, Pharm. 1880.]. "Ammoniac, *forty grammes* [or 1 ounce av., 180 grains]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Ammoniac, in a warmed mortar, with *nine hundred cubic centimeters* [or 30 fluidounces] of Water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and wash the mortar and strainer with enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

Rub the Myrrh, Sugar, and Potassium Carbonate, in a mortar, with *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of Rose Water, at first very gradually added, so that a uniform mixture may result. Transfer this to a graduated vessel, add the Spirit of Lavender, then the Ferrous Sulphate, previously dissolved in about *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of Rose Water, and, lastly, enough Rose Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the whole thoroughly. This preparation should be freshly made when wanted." *U. S.*

"Ferrous Sulphate, 25 *grains* (Imperial) or 2.5 grammes; Potassium Carbonate, 30 *grains* (Imp.) or 3 grammes; Myrrh, 60 *grains* (Imp.) or 6 grammes; Refined Sugar, 60 *grains* (Imp.) or 6 grammes; Spirit of Nutmeg, 50 *minims* (Imp. meas.) or 4.5 cubic centimetres; Rose Water, 10 *fl. ounces* (Imp. meas.) or 437.5 cubic centimetres or a sufficient quantity. Reduce the Myrrh to powder; add the Potassium Carbonate and Refined Sugar; triturate the mixture with a small quantity of the Rose Water so as to form a thin paste; gradually add more Rose Water and the Spirit of Nutmeg; continue the trituration and further addition of Rose Water until *seven fluid ounces* (Imp. meas.) or three hundred and six and a quarter cubic centimetres of liquid result; dissolve the Ferrous Sulphate in *three fluid ounces* (Imp. meas.) or one hundred and thirty-one and a quarter cubic centimetres of the Rose Water; mix the liquids." *Br.*

This is very nearly the same as the celebrated tonic or anti-hectic myrrh mixture of Griffith. The ferrous sulphate is decomposed by the potassium carbonate, with the production of potassium sulphate and ferrous carbonate, while the excess of the alkaline carbonate forms a saponaceous compound with the myrrh. The mixture is at first of a greenish color, which it loses upon exposure to the air, in consequence of the conversion of the ferrous carbonate into the ferric compound. C. A. Staples remedies this tendency by making a concentrated myrrh emulsion of such strength that one fluidrachm of it contains the amount of myrrh and potassium carbonate found in a fluidounce of the official mixture, and also a concentrated syrup of ferrous sulphate, fifteen minims of which equal one fluidounce of compound iron mixture. When the latter is called for, the emulsion, properly diluted, is put in a bottle and the requisite quantity of the iron syrup added. (*A. J. P.*, Nov. 1871.) The official solution may, however, be kept for some time without change, if the vessel in which it is contained be well closed, but the best plan is to prepare it extemporaneously. The sugar contained in it helps somewhat to retard the further oxidation of the ferrous salt, and if considerably increased in amount would act still more efficiently. The finest pieces of myrrh in lump should be selected, and rubbed down with a little of the rose water, as the powdered myrrh of commerce is often impure, and otherwise does not make a good mixture, owing mainly to its loss of volatile oil.

This mixture is a good tonic in *debility of the digestive organs*, especially when attended with derangement of the menstrual function. Hence it is used with advantage in *chlorosis* and *hysterical affections*. It has been also much employed in the hectic fever of *phthisis* and *chronic catarrh*. It is contra-indicated by the existence of inflammation of the gastric mucous membrane.

Dose, from one-half to two fluidounces (15 to 60 Cc.) two or three times a day.

MISTURA GLYCYRRHIZÆ COMPOSITA. U. S.

COMPOUND MIXTURE OF GLYCYRRHIZA
[Brown Mixture]

(mịs-tū′rạ glȳç-ỵr-rhī′zæ cọm-pŏṣ′ị-tạ)

Mistura Fusca; Mixture de Réglisse, *Fr.*; Zusammengesetzte Lakritzenmixtur, *G.*

* "Pure Extract of Glycyrrhiza, *thirty grammes* [or 1 ounce av., 25 grains]; Syrup, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Acacia, granulated, *thirty grammes* [or 1 ounce av., 25 grains]; Camphorated Tincture of Opium, *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims]; Wine of Antimony, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Spirit of Nitrous Ether, *thirty cubic centimeters* [or 1 fluidounce, 7 minims]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Pure Extract of Glycyrrhiza and Acacia, in a mortar, with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water, until they are dissolved. Transfer the solution to a graduated vessel containing the other ingredients, and rinse the mortar with enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the whole thoroughly." *U. S.*

This is an exceedingly popular cough mixture, which was made official in the U. S. Pharmacopœia of 1850. The Sugar in the U. S. 1880 formula was replaced by Syrup in the U. S. P. 1890 and the mixture made sweeter, and the Acacia was replaced by Mucilage of Acacia. The latter change was of doubtful utility; indeed, the stability of the mixture would be improved if acacia were left out entirely; the "body" which seems to be needed could be much better supplied by the use of glycerin; in the U. S. P. (8th Rev.) acacia is used. The substitution in the official process of 1880 of pure Extract of Licorice for the former impure powdered extract was undoubtedly an improvement, although by the change the mixture has lost somewhat its original appearance, and a large proportion of the precipitate which gave it a distinctive character.

The spirit of nitrous ether is probably useful by somewhat retarding decomposition. W. L. Stephen (*A. J. P.*, 1892, 563) prefers a mixture without sediment, which he makes by rubbing into a paste half an ounce each of acacia, powdered extract of glycyrrhiza, and sugar with six fluidounces of water, heating until fluid, then adding half a fluidounce of spirit of nitrous ether, one fluidounce of wine of antimony, two fluidounces of camphorated tincture of opium, and sufficient water to make a pint. If pure extract of glycyrrhiza is used as directed by the official process the mixture is but slightly cloudy; there are no advantages in making a *mixture* transparent.

Dose, from one-half to one fluidounce (15 to 30 Cc.) for an adult; one fluidrachm (3.75 Cc.) for a child two years old. It should be well shaken when administered.

MISTURA GUAIACI. Br.

GUAIACUM MIXTURE

(mĭs-tū′rą guā′ĭą-cī)

Emulsio Resinæ Guaiaci; Mixture de Résine de Gayac, Lait de Gayac, *Fr.;* Guajak-Emulsion, Guajakharzmixtur, *G.*

"Guaiacum Resin, ½ *ounce* (Imperial) or 10 grammes; Refined Sugar, ½ *ounce* (Imp.) or 10 grammes; Tragacanth, in powder, 35 *grains* (Imp.) or 1.6 grammes; Cinnamon Water, 1 *pint* (Imp. meas.) or 400 cubic centimetres. Triturate the Guaiacum Resin with the Refined Sugar and the Tragacanth; add gradually the Cinnamon Water." *Br.*

For the changes of color which the Guaiac in this mixture undergoes, and which it produces in other substances, see *Guaiaci Resina,* p. 603. Tragacanth was substituted for acacia in the Br. Ph. 1898 process.

Dose, one-half to two fluidounces (15 to 60 Cc.), repeated two or three times a day, or more frequently.

MISTURA OLEI RICINI. Br.

CASTOR OIL MIXTURE

(mĭs-tū′rą ō′lę-ī rīç′ĭ-nī)

Emulsion of Castor Oil; Emulsion d'Huile de Ricin, *Fr.;* Ricinusoelmixtur, *G.*

"Castor Oil, 3 *fl. ounces* (Imperial measure) or 75 cubic centimetres; Mucilage of Gum Acacia, 1½ *fl. ounces* (Imp. meas.) or 37.5 cubic centimetres; Orange-flower Water of commerce, undiluted, 1 *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Cinnamon Water, 2½ *fl. ounces* (Imp. meas.) or 62.5 cubic centimetres. Mix the undiluted Orange-flower Water and the Cinnamon Water; place the mucilage of Gum Acacia in a mortar and to it add, alternately, in portions, the Castor Oil and the mixed Waters, with constant trituration." *Br.*

This emulsion of the British Pharmacopœia might be termed a "perfumed dose of castor oil." W. A. Gregson commented on the inconvenience of the requirement to use mucilage of acacia for preparing this mixture, and he uses the continental method as follows: Operating on one-fourth the B. P. quantity, 75 grains of powdered acacia are introduced in a dry mortar; and 6 fluidrachms of castor oil are added (all at once), then 3 fluidrachms of water, and the whole mixed intimately; having made them perfectly homogeneous, the aqueous fluids are added in quantities of one fluidrachm or more at a time, care being taken to maintain uniformity. (*P. J.*, 1899, 50.)

Dose, from one-half to two fluidounces (15 to 60 Cc.).

MISTURA RHEI ET SODÆ. U. S.

MIXTURE OF RHUBARB AND SODA

(mĭs-tū′rą rhē′ī ĕt sō′dæ)

Potion à la Rhubarbe alcaline, *Fr.;* Alkalische Rhabarbermixtur, *G.*

* "Sodium Bicarbonate, *thirty-five grammes* [or 1 ounce av., 103 grains]; Fluidextract of Rhubarb, *fifteen cubic centimeters* [or 243 minims]; Fluidextract of Ipecac, *three cubic centimeters* [or 49 minims]; Glycerin, *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims]; Spirit of Peppermint, *thirty-five cubic centimeters* [or 1 fluidounce, 88 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Sodium Bicarbonate in about *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Then add the Fluidextracts, the Glycerin, and the Spirit of Peppermint, and, lastly, enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This is a preparation closely resembling one which has been used in Brooklyn, N. Y., according to the formula published by E. R. Squibb. The ingredients in the original preparation were fluidextract of ipecac 51 minims, fluidextract of rhubarb 256 minims, sodium bicarbonate 512 grains, glycerin 12 fluidounces, peppermint water 2 pints. The formula in the U. S. P. 1880 did not contain fluidextract of ipecac. The official mixture may be given to children as a stomachic and carminative.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.), two to three times a day.

MISTURA SENNÆ COMPOSITA. Br.

COMPOUND MIXTURE OF SENNA

(mĭs-tū′rą sĕn′næ cŏm-pŏs′ĭ-tą)

Black Draught; Mixture de Séné composée, *Fr.;* Zusammengesetzte Senna-Aufguss, Zusammengesetzte Sennamixtur, *G.*

"Magnesium Sulphate, 5 *ounces* (Imperial) or 250 grammes; Liquid Extract of Liquorice, 1 *fl. ounce* (Imp. meas.) or 50 cubic centi-

metres; Compound Tincture of Cardamoms, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Aromatic Spirit of Ammonia, 1 *fl. ounce* (Imp. meas.) or 50 cubic centimetres; Infusion of Senna, *a sufficient quantity.* Dissolve the Magnesium Sulphate in *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Infusion of Senna; add the mixed Liquid Extract of Liquorice, Compound Tincture of Cardamoms, and Aromatic Spirit of Ammonia; and enough Infusion of Senna to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Compound Mixture." *Br.*

This is a new form of Compound Infusion of Senna, called commonly *black draught.* We prefer the form given under *Infusum Sennæ Compositum,* as being more easily prepared and quite as efficient.

Dose (Br. Pharm.), from one to two fluidounces (30 to 60 Cc.).

MISTURA SPIRITUS VINI GALLICI. Br.

MIXTURE OF BRANDY

(mĭs-tū'rą spīr'ĭ-tŭs vī'nī găl'lĭ-cī)

Brandy Mixture; Mixture de Cognac, *Fr.;* Branntweinmixtur, *G.*

"Brandy, 4 *fl. ounces* (Imperial measure) or 113 cubic centimetres; Cinnamon Water, 4 *fl. ounces* (Imp. meas.) or 113 cubic centimetres; Refined Sugar, ½ *ounce* (Imp.) or 14 grammes; Two yolks of eggs. Rub the yolks of eggs and Refined Sugar together; add the Cinnamon Water and Brandy; mix." *Br.*

This nutritious and stimulant draught is scarcely entitled to a place in the Pharmacopœia. It serves the purpose, however, of enabling the practitioner to prescribe the stimulant under an official designation.

Dose, from one to two fluidounces (30 to 60 Cc.).

MISTURÆ.

MIXTURES

(mĭs-tū'ræ)

Mixtures, *Fr.;* Mixturen, *G.;* Mixtura, *Sp.*

This term should be restricted, in the language of pharmacy, to those preparations in which insoluble substances, whether solid or liquid, are suspended in aqueous fluids, by the intervention of gum arabic, sugar, yolk of egg, or other viscid matter. When the suspended substance is of an oleaginous nature, the mixture is properly called an *emulsion,* and the U. S. Pharmacopœia has recognized them by creating a special class for these. (See *Emulsa,* p. 444.) The object of these preparations is usually to facilitate the administration, to conceal the taste, or to obviate the nauseating effects of unpleasant medicines, and their perfection depends upon the intimacy with which the ingredients are blended. Some skill and care are requisite for the production of uniform and perfect mixtures. As a rule, the body to be suspended should be thoroughly mixed by trituration with the substance intended to act as the inter-medium, before the aqueous vehicle is added. In Great Britain, and to some extent in this country, the term mixture is used indiscriminately for aqueous medicinal liquids having more than one ingredient, and for aqueous liquids which cannot be easily classified. Many of such liquids are perfectly transparent and should be in the class of Solutions.

MORPHINA. U. S.

MORPHINE

(mör-phī'ną)

$C_{17}H_{19}NO_3 + H_2O = 300.92$

"An alkaloid obtained from Opium." *U. S.*

Morphia, *U. S.* 1870; Morphinum, Morphium; Morphine, *Fr. Cod.;* Morphin, *G.;* Morfina, *It., Sp.*

The U. S. Pharmacopœia no longer contains a process for the extraction of morphine; that of 1870, which has been known as Staples's process, is given in the foot-note.[1]

Various processes for preparing morphine have been employed. In most of them the morphine is extracted from opium by maceration with water (either pure or acidulated), then precipitated by ammonia, and the crystals afterwards purified by the agency of alcohol, or by repeated solution in a diluted acid and precipitation. Sertürner, the discoverer of morphine, made an infusion of opium in distilled water, precipitated the morphine by ammonia in excess, dissolved the precipitate in diluted sulphuric acid, precipitated anew by ammonia, and purified by solution in boiling alcohol, and crystallization. In evaporating aqueous solutions containing morphine a temperature of 40° C. (104° F.) should not be exceeded.

Properties.—Morphine crystallizes from alcohol in the form of small, colorless, shining crystals. It is officially described as follows:

[1] "Take of Opium, sliced, *twelve troyounces;* Water of Ammonia, *six fluidounces;* Animal Charcoal, in fine powder, Alcohol, Distilled Water, each, *a sufficient quantity.* Macerate the Opium with four pints of Distilled Water for twenty-four hours, and, having worked it with the hand, again macerate for twenty-four hours, and strain. In like manner, macerate the residue twice successively with the same quantity of Distilled Water, and strain. Mix the infusions, evaporate to six pints, and filter; then add five pints of Alcohol, and afterwards three fluidounces of the Water of Ammonia, previously mixed with half a pint of Alcohol. After twenty-four hours, pour in the remainder of the Water of Ammonia, mixed, as before, with half a pint of Alcohol; and set the liquid aside for twenty-four hours that crystals may form. To purify these, boil them with two pints of Alcohol until they are dissolved, filter the solution, while hot, through Animal Charcoal, and set it aside to crystallize." *U. S.* 1870. For other processes, see U. S. D., 17th ed., 876.

"Colorless, or white, shining, rhombic prisms, or fine needles, or a crystalline powder, odorless, and having a bitter taste; permanent in the air. It loses all of its water of crystallization at 100° C. (212° F.). Soluble in 3330 parts of water, 100 parts of lime water, 168 parts of alcohol, 4464 parts of ether, 1800 parts of chloroform, 113.5 parts of amyl alcohol, and in 525 parts of acetic ether at 25° C. (77° F.); soluble in 1040 parts of water at 80° C. (176° F.), and in 76 parts of alcohol at 60° C. (140° F.); insoluble in benzene. When heated to about 200° C. (392° F.) it assumes a brown color, and then melts at 254° C. (489.2° F.). Upon ignition, it is slowly consumed without leaving a residue. Its aqueous solution shows an alkaline reaction to red litmus paper. Sulphuric acid (free from nitrous compounds) added to Morphine produces no color or only a slight yellowish tint, but on heating, a brown color is developed. Sulphuric acid containing a crystal of potassium iodate gives with Morphine a dark brown color. (*Codeine* yields a moss-green color, changing to brown, and *narcotine* a cherry-red color.) Sulphuric acid containing a trace of selenous acid gives with Morphine a blue color, changing to green and then to brown. (*Codeine* yields a green color, changing to blue, and afterwards to grass-green; *narcotine* gives a green color, changing to brown, and then to cherry-red.) Nitric acid produces with Morphine an orange-red color fading to yellow (difference from *quinine*). Sulphuric acid containing a trace of molybdic acid gives a purple color, changing to blue. Sulphuric acid containing in each Cc. one drop of solution of formaldehyde yields an intense purple color. Mercuric potassium iodide T.S. produces in a solution of Morphine a white gelatinous precipitate. A solution of sodium phosphomolybdate (1 in 20) produces in solutions of Morphine a yellow precipitate soluble in ammonia water. Sulphuric acid containing a crystal of potassium dichromate gives no color at first, but after a time a green color (absence of *strychnine*, which yields a purple color, or of *acetanilide*, which gives a crimson color, changing to green). Morphine solutions, when heated with an aqueous solution of potassium ferricyanide containing a drop of neutral ferric chloride solution, give a deep blue solution, from which, after standing, a blue precipitate separates (difference from *codeine*). If 0.1 Gm. of Morphine be dissolved in 10 Cc. of diluted hydrochloric acid, no red coloration should be produced by the addition of a few drops of ferric chloride T.S. (absence of *meconic acid* or *meconates*). If to a neutral solution of Morphine (1 in 100), made by the careful addition of diluted sulphuric acid, a few drops of ferric chloride T.S. be added, a blue color will be produced, which is destroyed by acids, alcohol, or by heating. On adding 4 Cc. of potassium hydroxide T.S. to 0.2 Gm. of Morphine, a clear, colorless solution, free from any undissolved residue, should result (absence of, and difference from, various *other alkaloids*), and no odor of ammonia should be noticeable (absence of *ammonium salts*)." *U. S.*

Von Gerichten and Schrötter (*Ber. d. Chem. Ges.*, 1882, pp. 1484 and 2179) showed that morphine and codeine were derivatives of phenanthrene, as when distilled with zinc dust they yielded phenanthrene, pyridine, and quinoline. Knorr (*Ber. d. Chem. Ges.*, 22, p. 2081) has shown that it is probable that morphine contains, combined with the phenanthrene nucleus, the *morpholine* group. Morpholine (tetra-hydro-oxazine), $NH<\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}>O$, is formed when dioxyethylamine is heated to 160° C. with hydrochloric acid, or is boiled with alkali. As seen from the formula, it bears a structural relation to both pyrrol and pyridine. For later views on the structure of the morphine molecule by Knorr and Vis, see *Proc. A. Ph. A.*, 1894, 1122. For a chemical bibliography of morphine, by H. E. Brown, see *Ph. Rev.*, 1897, and *Ph. Archiv.*, 1898.

Heated in the open air, morphine burns with a bright flame, and at a red heat is wholly dissipated. In the products resulting from the combustion of opium or morphine this alkaloid may be detected, proving that it is partly volatilized when burned. (Descharmes, *A. G. N.*, Fév. 1855, 240.) Morphine in solution is to a considerable extent absorbed by animal charcoal, which, though it will part with most of the alkaloid to alcohol, cannot be wholly deprived of it by repeated washings with that liquid, either cold or hot. (Lefort, *J. P. C.*, Août, 1861, 98.) Its solution restores the blue color of litmus paper reddened by acids, and turns the yellow of turmeric to brown. Hager (*Ph. Ztg.*, 93, 250, also *Proc. A. Ph. A.*, 1893, 680) states that on heating solutions containing morphine, oxygen is absorbed gradually and oxymorphine is formed; at a boiling temperature this change proceeds rapidly. The oxymorphine is much less active as a narcotic than is morphine. This absorption of oxygen takes place most rapidly in alkaline solutions and is also affected by the aid of potassium permanganate, potassium ferricyanide, and ammoniacal copper solution. The reaction is:

$$2C_{17}H_{19}NO_3 + O = (C_{17}H_{18}NO_3)_2O + H_2O$$

This product is known as *oxydimorphine* (or *pseudomorphine*). Morphine is, therefore, a powerful reducing agent, acting upon silver nitrate and gold chloride even in cold solutions. With the acids morphine forms salts, which are generally soluble, and are decomposed by the alkalies. It is dissolved also by the fixed and volatile oils. The solutions of potassium and sodium hydroxides also dissolve morphine, which is precipitated slowly from them on exposure to the air, in consequence of the absorption of carbon dioxide. Solution of ammonia has to a certain extent the same solvent power, and hence the necessity, in precipitating morphine by this alkali, not to employ it in great

excess. Solution of iodine with potassium iodide precipitates the salts of morphine in aqueous solution. With chlorine water morphine and its salts assume an orange color, and the same effect is produced on them by solution of chlorinated soda. (Fairthorne, *A. J. P.*, xxviii. 9.) By the contact of nitric acid they assume a blood red color, which ultimately changes to yellow, and this is one of the tests of morphine; but, as the same change of color is produced with brucine and impure strychnine, it cannot be relied on in the absence of other evidence. Nitric acid also produces a red color with oil of cloves, but in this case the red does not change to yellow. When added to a solution of iodic acid, or an acidulous iodate, morphine and its salts redden the liquid and set iodine free. (Sérullas.) This is a very delicate test, but is not conclusive, as various other organic substances act in a similar manner. J. Lefort, however, has found that the color produced by these substances is removed by ammonia, while the redness produced with morphine is greatly intensified by addition of that alkali. This test, thus modified by the addition of ammonia, is so delicate that, according to Lefort, it will detect one part of morphine in 10,000 parts of a liquid holding it in solution. (*J. P. C.*, Août, 1861, 113.)[1] Husemann's test consists in leaving morphine or its salt in contact with concentrated sulphuric acid for 12 or 15 hours, or in heating for half an hour with the acid to 100° C. (212° F.), and then adding either a little nitric acid, a nitrate or chlorate or chlorine water, or chlorinated soda, when a beautiful bluish or reddish-violet color, passing into deep blood-red and gradually paling, is developed. The presence of small quantities of coloring matter does not prevent this reaction, if chlorinated reagents are selected. A. Husemann asserts that this test will recognize the hundredth part of a milligramme of the alkaloid. (*A. J. P.*, xlvii. 210.) According to R. Schneider, a very delicate test is afforded by putting a drop of the suspected liquid on a plate, saturating with sugar, and putting alongside of it a drop of sulphuric acid; if morphine be present, a very intense purple will be developed at the point of contact, passing after half an hour into violet, then bluish green, and finally dirty yellow. (*J. P. C.*, 4e sér., xviii. 221.) According to H. Weppen, the delicacy of this test is much increased by the addition of a minute quantity of bromine water to the solution. Codeine and aconitine are stated, however, to give the same reaction. (*Ibid.*, 4e sér., xix. 246.)

Fröhde's reagent (a fresh solution of .005 Gm. sodium molybdate in 1 Cc. of pure concentrated sulphuric acid) strikes with morphine and its salts a beautiful blue-violet color, passing into blue, then green, finally back to bluish violet. This reaction is stated to be delicate but not characteristic. A. B. Prescott gave a thorough résumé of the views of investigators on this test in *A. J. P.*, 1876, 59. Bruylants combines Froehde's test with that of Husemann. A trace of Froehde's reagent added to a solution of morphine in sulphuric acid produces the well-known lilac tint; if the sulphuric acid solution be warmed and treated in the same way, a green tint will be noted. On dropping a particle of potassium nitrate into this green liquid, the color changes to red and finally yellowish. The other opium alkaloids give different tints. (*Proc. A. Ph. A.*, 1895, 1016.) In the presence of sulphuric acid morphine exhibits surprising powers as a reducing agent. Among the most notable instances of deoxidation may be mentioned those of silver oxide, hydrated bismuth oxide, the acids of tin, tungsten, vanadium, titanium, and molybdenum. A solution of titanic acid in concentrated sulphuric acid is one of the most delicate reagents for morphine. An intense brown-red to violet color is produced if titanic acid is added to concentrated sulphuric acid containing a trace of morphine in solution. (Flückiger, *N. R.*, Feb. 1880. See, also, *N. R.*, 1881, p. 237.) M. H. Kahlbrunner states that the most sensitive test is made with a solution (No. 1) of crystallized ferric chloride (thirty grains to four fluidrachms of distilled water) and a fresh solution (No. 2) of potassium ferricyanide (two grains in four drachms). To the suspected liquor five or six drops of No. 1 are added, and afterwards three or four drops of No. 2. If morphine be present, a color varying from deep blue to pale blue and bluish green, according to the proportion of the alkaloid, is developed. Neither gum, sugar, alcohol, glycerin, atropine, quinine, nor strychnine interferes with this test. An excess of alkali does so by decomposing the ferric chloride. This test depends upon the fact that the potassium ferricyanide solution is reduced by morphine to the ferrocyanide. It is affirmed that even 1-60,000th of one per cent. of morphine can be detected. (*Ibid.*; see also *Proc. A. Ph. A.*, 1897, 701.) G. Vulpius (*A. Pharm.*, 1887, 25) states that if about 0.00025 Gm. of a morphine salt be dissolved in a porcelain dish in about six drops of concentrated sulphuric acid, a few centigrammes of sodium phosphate added, and the mixture carefully heated, white fumes will be evolved and a violet color appear. On adding water drop by drop, a brilliant red appears, which, on further addition, changes to a dirty green. If the solution be then

[1] *Stas's Method of Extracting the Alkaloids from Mixtures.*—To separate the alkaloid from foreign matters, the mixture is treated alternately with water and alcohol in different degrees of concentration; the liquors thus obtained are filtered; tartaric or oxalic acid, but preferably the former, is added in excess; the mixture is heated to 71.1° or 76.6° C. (160° or 170° F.); the whole is placed upon a filter; the deposited matter is washed with concentrated alcohol; the alcoholic solution is evaporated at a temperature not exceeding 35° C. (95° F.); the residue is introduced into a small bottle; a solution of potassium or sodium hydroxide is added, little by little, and afterwards four or five times the measure of ether; the mixture is shaken and then allowed to stand; and, finally, the ether is decanted, and yields the alkaloid by spontaneous evaporation.

shaken with the same volume of chloroform, the latter will be colored blue. Isobutylic alcohol has been used by Nagelvoort for the detection of morphine and codeine. (See *Proc. A. Ph. A.*, 1894, 273.)

Siebold heats gently the suspected substance with some drops of concentrated sulphuric acid and a small quantity of chemically pure potassium perchlorate; a deep brown color will be produced if morphine is present. (*P. J.*, Oct., 1873.) According to H. S. Wellcome, one part of morphine in ten thousand parts of water can be recognized by chlorine water, if care be exercised not to decolorize by an excess of the reagent; the color varies from light orange-red to deep red according to the proportion of morphine present. Brucine is the only other alkaloid giving the same reaction, but, while the color produced by morphine is discharged by excess of chlorine, that caused by brucine is not affected. (*A. J. P.*, 1874, p. 305.) To discover morphine in the presence of quinine, see *Ibid.*, p. 361. Morphine and its salts assume a fine blue color with ferric chloride; at least this is true of the alkaloid, its sulphate, acetate, and oxalate, and the same effect will be produced by the other salts, if previously decomposed by an alkali, but that this test should be satisfactory it is necessary to operate on morphine either in powder or in concentrated solution. (Lefort.) A solution of morphine acetate or sulphate containing only one part of the salt in 100 precipitates silver from a solution of the nitrate of that metal. (Horsley.) Morphine is precipitated from its solutions by potassium or sodium hydroxide, and redissolved by an excess of the alkali. Infusion of galls and other vegetable substances containing tannic acid precipitate morphine in the state of a tannate, which is soluble in acetic acid, but according to Dublanc, the alkaloid is not precipitated by pure gallic acid. If ammonia be added to a mixture of the solutions of chlorine and morphine, there will be produced a dark brown color, which will be destroyed by a further addition of chlorine. For methods of separating narcotine, see U. S. D., 17th ed., 879.

The proportion of pure morphine which Turkey opium is capable of affording varies from 9 per cent., or less, to 20 per cent., according to the quality of the drug; but much less than the least quantity mentioned is often obtained, in consequence of the incomplete exhaustion of the opium, the loss in the process for preparing it, the destructive action of heat, or inferiority in the quality of the drug. (See *Opium.*) Formaldehyde reacts with both morphine and codeine to form medicinally active condensation products by the union of two molecules of the base with one molecule of the formaldehyde, with elimination of water; a methylene group CH_2 uniting with two alkaloidal residues each of which loses an H atom. That formed from morphine is an amorphous base, difficultly soluble in water but easily soluble in alkaline solution and in alcohol. It melts at 270° C., and forms a hydrochloride soluble in water. (*Proc. A. Ph. A.*, 1897, 702.)

Uses.—There can be no doubt that morphine is the chief narcotic principle of opium, from which, however, it differs somewhat in its mode of action. In consequence of its insolubility in water, morphine in its pure state is less convenient than its salts, which are therefore always preferred. The acetate, sulphate, and hydrochloride, which have been employed, act precisely alike therapeutically, and differ from opium chiefly in being less disposed to constipate the bowels. They are also somewhat less likely to cause disagreeable after-effects than is opium, but the deodorized tincture is certainly preferable to them for many purposes. They are further adapted for hypodermic use.[1] Oleic acid has also been proposed as a vehicle for morphine externally used, as it dissolves both the alkaloid and its salts perfectly in considerable proportion. A liniment of oleate of morphine has been proposed, consisting of 300 parts of oleic acid and 1 part of morphine, scented with a little oil of bergamot. (*Ibid.*, xxvi. 302.)

The toxicology of morphine is identical with that of opium.

As the proportion of acid necessary to neutralize morphine is very small, the dose of the alkaloid is practically the same as that of its salts.

Dose, one-fifth of a grain (0.012 Gm.), equivalent to a grain of powdered opium.

MORPHINÆ ACETAS. U. S., Br.

MORPHINE ACETATE

(mör-phī'næ ą-cē'tăs)

$C_{17}H_{19}NO_3.C_2H_4O_2 + 3H_2O = 396.26$

"The acetate [$CH_3COOH.C_{17}H_{19}NO_3 + 3H_2O$] of the alkaloid morphine should be kept in well-stoppered, dark amber-colored vials; a minute quantity of free acetic acid should be present to prevent decomposition." *U. S.*

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[1] *Morphine Lactate* ($C_{17}H_{19}NO_3,C_3H_6O_3$).—This salt crystallizes in four-sided prisms, one part being soluble in eight parts of water and ninety-three parts of alcohol. (*P. J.*, 1886, 958.)

Morphine Hydrocyanide.—J. M. Maisch noticed that when a soluble salt of morphine is added to a solution of soluble cyanide, crystals of morphine hydrocyanide form. This salt, although sparingly soluble in water, is freely dissolved by that liquid when acidulated. It is evident that potassium cyanide and morphine should not be prescribed together in solution, except in connection with free acid.

Morphine Hydrobromide, or *Morphine Bromide* ($C_{17}H_{19}NO_3HBr + 2H_2O$), is made by double decomposition between morphine sulphate and barium bromide. (*A. J. P.*, xliv. 447.)

Morphine Phthalate is made by adding pure morphine to a hot solution of *absolutely pure* phthalic acid as long as it is dissolved, filtering, and evaporating. One part of the salt is soluble in five parts of water. The solutions are perfectly neutral, and have been especially recommended by E. Bombelon for hypodermic use. (See article in *Ph. Ztg.*, 1887, 488.)

"The carefully dried salt, $C_{17}C_{19}NO_3,C_2H_4O_2$, $3H_2O$, obtained by neutralizing morphine with acetic acid." *Br.*

Morphiæ Acetas, *Br.* 1867, *U. S.* 1870; Acetate of Morphia; Morphinum Aceticum; Acetas Morphicus; Acétate de Morphine, *Fr.;* Essigsaures Morphium, Morphinacetat, *G.*

A process for this salt is no longer official; that of the U. S. P. 1870 is appended.[1]

In the U. S. process of 1870, morphine is saturated with acetic acid. A small excess of acid is attended with no inconvenience, as it is subsequently driven off by the heat. Care is required not to employ too much heat in the evaporation, as the acetate is easily decomposed, a portion of the acetic acid escaping, and leaving an equivalent portion of uncombined morphine. With attention to arrest the evaporation at a certain point, the acetate may be obtained in the state of crystals, but the crystallization is attended with some difficulty, and evaporation to dryness is almost universally preferred. Some recommend to dissolve the morphine in boiling alcohol, instead of suspending it in water, previously to the addition of the acetic acid. Less heat is thus required in the evaporation, and impurities in the morphine may often be detected, as they are likely to be insoluble in alcohol. To ascertain, in this case, whether the morphine is saturated, it is necessary to employ litmus paper, the blue color of which should not be restored if previously reddened by an acid. If the morphine used in preparing the acetate contain narcotine, it will be best to employ diluted acetic acid as the solvent, and to favor its solvent power by heat. Under these circumstances it dissolves only the morphine, leaving the narcotine nearly or quite untouched. (Hodgson, *A. J. P.,* v.) The British process (1885) differs from that of the U. S. Pharmacopœia of 1870 only in obtaining uncombined morphine, as the first step, by precipitating it from a solution of the hydrochloride, morphine itself not being official.

Properties.—It is officially described as "a white, or yellowish-white, crystalline or amorphous powder, having a faintly acetous odor, and a bitter taste. It gradually loses acetic acid when exposed to air, and becomes less soluble in water. Soluble in 2.25 parts of water, 21.6 parts of alcohol, 480 parts of chloroform, and in 5.2 parts of glycerin at 25° C. (77° F.); soluble in 2 parts of water at 80° C. (176° F.), and in 2.5 parts of alcohol at 60° C. (140° F.); insoluble in ether. When heated, the salt loses water and acetic acid, and melts at about 200° C. (392° F.). When ignited, it is consumed completely, leaving no residue. The addition of diluted ammonia water in slight excess to an aqueous solution of Morphine Acetate causes a white precipitate, which, when collected and washed, should conform to the reactions and tests given under *Morphina.* On adding sulphuric acid to the salt, vapors of acetic acid are evolved. Ferric chloride T.S. produces, in neutral aqueous solutions of the salt, a blue color, destroyed by acids, alcohol, or by heating. The color tests for the identification of Morphine Acetate and those showing the absence of impurities are identical with those described under *Morphina." U. S.* "A white crystalline or amorphous powder, almost entirely soluble in 2½ parts of *water* and in about 100 parts of *alcohol* (90 per cent.). It loses acetic acid when exposed to the air. It affords the reactions for morphine mentioned under 'Morphinæ Hydrochloridum,' and the reactions characteristic of acetates. 2 grammes of the salt form with 6 cubic centimetres of warm *morphinated water* a slightly turbid solution, which is rendered clear by the addition of 0.1 cubic centimetre of *acetic acid;* and this solution, when mixed with *solution of ammonia* in slight excess, yields a precipitate which, after washing and drying as described under 'Morphinæ Hydrochloridum,' weighs 1.42 grammes. If the salt yield a larger proportion of morphine than this, it should be recrystallized from hot water acidulated with *acetic acid.* Heated to redness with free access of air, it leaves no residue (absence of mineral impurities)." *Br.* Morphine acetate crystallizes in slender needles united in fasciculi. As ordinarily obtained by evaporation to dryness, it is not entirely soluble in water, a portion of it being uncombined morphine. To render it soluble, all that is necessary is to add a little acetic acid.

Uses.—This and the other official salts of morphine are of identical medicinal value. They are almost invariably preferred to the alkaloid itself, and are given by the mouth, in pill or solution, in doses of from one-eighth to one-half grain (0.008 to 0.032 Gm.). They are employed externally, sprinkled on blistered surfaces, and are very frequently exhibited by subcutaneous injection, but great caution must be observed that they are not thrown into a vein. We have seen one-sixth of a grain, thus given, produce almost instantaneous insensibility, with dropping of jaw, and other evidence of immediate death, from which the patient was saved with difficulty. When given hypodermically fifteen minutes before the anæsthetic, the morphine salt was found by Claude Bernard to prolong and intensify the anæsthesia in animals, and many surgeons have employed it in man in this way, with satisfactory results. The solutions for hypodermic use should be freshly prepared, as morphine salts, especially the acetate, are very prone to undergo decomposition, through the growth of a fungus.

[1] *Morphiæ Acetas,* U. S. 1870.—"Take of Morphia, in fine powder, *a troyounce;* Distilled Water *half a pint;* Acetic Acid *a sufficient quantity.* Mix the Morphia with the Distilled Water; then carefully drop Acetic Acid into the mixture, stirring it constantly until the Morphia is neutralized and dissolved. Evaporate the solution, by means of a water-bath, to the consistence of syrup, and set aside until it concretes. Lastly, dry the salt with a gentle heat, and rub it into powder."

Dose, one-eighth to one-half grain (0.008 to 0.032 Gm.).

Off. Prep.—Liquor Morphinæ Acetatis, *Br.*

MORPHINÆ HYDROCHLORIDUM. U. S., Br.

MORPHINE HYDROCHLORIDE
[Morphinæ Hydrochloras, Pharm. 1890, Morphine Hydrochlorate]

(mör-phī'næ hȳ-drọ-ȼhlō'rī'dŭm)

$C_{17}H_{19}NO_3.HCl + 3H_2O = 372.86$

"The hydrochloride [$HCl.C_{17}H_{19}NO_3 + 3H_2O$] of the alkaloid morphine should be kept in well-stoppered, amber-colored vials." *U. S.*
"The hydrochloride, $C_{17}H_{19}NO_3,HCl,3H_2O$, of an alkaloid obtained from opium." *Br.*

Morphiæ Murias, *Br.* 1867, *U. S.* 1870; Murias (Hydrochloras) Morphicus; Morphiæ Hydrochloras; Muriate of Morphia; Chlorhydrate de Morphine, *Fr. Cod.;* Morphinum Hydrochloricum, *P. G.;* Morphinhydrochlorid, Salzsaures Morphin, *G.*

A process for this salt is no longer official; that of the U. S. P. 1870 is appended.[1] The British process (1885) will be found in U. S. D., 17th ed., 882.

Properties.—This salt crystallizes in "white, silky, glistening needles or microcrystalline cubes, or a white, crystalline powder, odorless, and having a bitter taste; permanent in the air. It loses its water of crystallization at 100° C. (212° F.). Soluble in 17.2 parts of water, and in 42 parts of alcohol at 25° C. (77° F.); soluble in 0.5 part of water at 80° C. (176° F.), and in 35.5 parts of alcohol at 60° C. (140° F.); insoluble in ether and in chloroform. When heated to 250° C. (482° F.), it assumes a brown color, and on higher heating, chars without melting. On ignition, it is slowly consumed, leaving no residue. Its aqueous solution is neutral to litmus paper. On shaking an aqueous solution of the salt with diluted ammonia water in slight excess, a crystalline precipitate is formed, which, when collected and washed, should respond to all tests and reactions given under *Morphina.* Silver nitrate T.S. produces a white precipitate, insoluble in nitric acid. Ferric chloride T.S. produces, in neutral aqueous solutions of the salt, a blue color, which is destroyed by acids, alcohol, or by heating. On adding potassium carbonate T.S. to a solution of the salt (1 in 30), a white precipitate should be formed, which should dissolve in chloroform without color (absence of *apomorphine*). The color tests for the identification of Morphine Hydrochloride and those showing the absence of impurities are identical with those described under *Morphina.*" *U. S.* "Acicular prisms of a silky lustre, or a white powder consisting of minute cubical crystals, unchanged by exposure to the air. Soluble in 24 parts of cold *water,* 1 part of boiling *water,* and in 50 parts of *alcohol.* It should be without action on *litmus. Solution of ammonia* causes a white precipitate in the aqueous solution, with difficulty soluble in excess; *solution of potassium hydroxide* a similar precipitate readily soluble in excess. This precipitate yields mere traces to *benzol* (absence of other alkaloids). Moistened with *nitric acid* the salt yields an orange-red coloration; with *test-solution of ferric chloride* a dull greenish-blue coloration. Heated on a water-bath for ten or fifteen minutes with a few drops of *sulphuric acid,* cooled, and treated with a few drops of *diluted nitric acid,* it gives a violet color rapidly passing to blood-red. It dissolves without coloration in strong *sulphuric acid;* the addition of a small quantity of *sodium arsenate* to a portion of this solution causes a bluish-green coloration, and a small quantity of *bismuth oxynitrate* added to another portion gives a purplish-brown coloration. It affords the reactions characteristic of hydrochlorides. 2 grammes of Morphine Hydrochloride dissolved in 250 cubic centimetres of warm *morphinated water,* with *solution of ammonia* added in the slightest possible excess, will give on cooling a crystalline precipitate which, when washed with a little cold *morphinated water* and dried, should weigh 1.51 grammes. The drying should be accomplished, first by pressing the precipitate between sheets of bibulous paper, then by exposing it to a temperature between 131° and 140° F. (55° and 60° C.), and finally to a temperature of 230° F. (110° C.) for twenty minutes. Heated to redness with free access of air, it burns, leaving no residue (absence of mineral impurities)." *Br.* A saturated solution in boiling water forms a solid crystalline mass on cooling. The solution of morphine hydrochloride, when kept several months, has been known to produce vomiting, through the formation of traces of apomorphine. (*Ph. Centralh.,* 1885, 93.) The salt may be known to be a hydrochloride by responding to the official test with silver nitrate. Potassium hydroxide throws down from its solution a precipitate which is redissolved by an excess of the alkali. The salt is affected by heat, nitric acid, iodic acid, ferric chloride, and chlorine followed by ammonia, in the same manner as morphine. Sugar is said to have been used largely in the adulteration of this salt. It may be detected most readily by the deep red color produced when the adulterated salt is dissolved in strong sulphuric acid. (See *Saccharum.*)

This preparation of morphine is much used in Great Britain, but in this country less than either the sulphate or the acetate. For medicinal properties, see *Morphina.*

Dose, one-eighth to one-half grain (0.008 to 0.032 Gm.).

[1] "Take of Morphia, in fine powder, a *troyounce;* Distilled Water *four fluidounces;* Muriatic Acid *a sufficient quantity.* Mix the Morphia with the Distilled Water; then carefully drop in Muriatic Acid, constantly stirring, until the Morphia is neutralized and dissolved. Evaporate the solution, by means of a water-bath, so that on cooling it may crystallize. Lastly, drain the crystals, and dry them on bibulous paper." *U. S.* 1870.

Off. Prep.—Liquor Morphinæ Hydrochloridi, *Br.;* Suppositoria Morphinæ, *Br.;* Tinctura Chloroformi et Morphinæ Composita, *Br.;* Trochiscus Morphinæ, *Br.;* Trochiscus Morphinæ et Ipecacuanhæ, *Br.*

MORPHINÆ SULPHAS. U. S.

MORPHINE SULPHATE

(mör-phī'næ sŭl'phăs)

$(C_{17}H_{19}NO_3)_2.H_2SO_4 + 5H_2O = 752.83$

"The sulphate $[SO_2(OH)_2.(C_{17}H_{19}NO_3)_2 + 5H_2O]$ of the alkaloid morphine should be kept in well-stoppered, amber-colored vials." *U. S.*

Morphiæ Sulphas, *Br.* 1867, *U. S.* 1870; Morphinum Sulphuricum, Sulphas Morphicus; Sulphate of Morphia; Sulfate de Morphine neutre, *Fr. Cod.;* Schwefelsaures Morphium, Morphinsulfat, *G.;* Sulfato morfico, *Sp.*

No process is given in the present U. S. P.; that of the U. S. P. 1870 is appended.[1] Morphine sulphate is no longer official in the British Pharmacopœia 1898, the hydrochloride being used in Great Britain as in Germany almost exclusively.

In the process of 1870 the morphine is known to be saturated when it is wholly dissolved by the water. To ascertain whether the acid is added in excess, litmus paper may be resorted to. If the morphine employed contain narcotine, this will remain in the mother liquor, and will not contaminate the product. The mother liquor remaining after the first crystallization may be evaporated so as to afford a fresh supply of the sulphate, but, if the morphine was not originally quite pure, the second product will contain the impurities, and should not be used till it has undergone further purification. When impure morphine is employed, the mother liquor should be mixed with alcohol, or boiled with purified animal charcoal and filtered, and then decomposed by ammonia, which will precipitate the morphine; or the mother liquor may be mixed with a little milk of lime, filtered, and precipitated with solution of ammonium chloride, when the morphine will be nearly pure. This may be converted into the sulphate in the manner directed by the Pharmacopœia.

Another mode of obtaining morphine sulphate is to dissolve the alkaloid in boiling alcohol of 36° Baumé (sp. gr. 0.8428), saturate it while hot with sulphuric acid, add purified animal charcoal, boil for a few minutes, and filter the solution at the boiling temperature. Upon cooling, it deposits most of the sulphate, and the remainder may be obtained by evaporating the mother liquor. According to J. Calvert (*Pac. Drug.*, June, 1893) morphine sulphate is made as follows: Opium in any quantity is exhausted with water; the resulting liquid is precipitated with an alkaline base and crude morphine is the result. The crude morphine is dissolved in diluted sulphuric acid, the solution filtered through animal charcoal and evaporated to a density of 4½° to 5° B. The crystallizing apparatus is a leaden tank, about six inches in depth, of any size to correspond with the amount of morphine sulphate. It is hinged on a frame and has an outlet, with a plug or faucet at the lower end for drainage. The solution being ready and the apparatus adjusted, the hot solution is run into the crystallizer; the solution is stirred gently every few minutes until crystals commence to form on the surface, and then, by carefully stirring, when the solution has come to the right temperature, the morphine sulphate crystallizes suddenly into a solid mass. The mass of crystals is allowed to repose for 48 hours, the plug at the lower end of the tank is removed and the mother liquor is allowed to run off, at first slowly, and afterwards by elevating the tank the last of the liquor is removed; the drainage requires several days. The crystals in the apparatus are then cut up into pieces of the shape of bricks (commencing at the upper end), which are placed on an absorbent, and removed to a drying-room. In ordinary crystallization a certain part of the coloring matter is retained in the crystals. In this case, when the morphine is crystallized as described, and dried in bricks, nearly all the retained coloring matter comes to the surface, so that when the bricks come out of the drying-room the surfaces are brown, and in some cases almost black, showing that the coloring matter is eliminated. The next part of the process is to remove the colored part. This is effected by slicing off the dark portions, leaving the morphine sulphate perfectly white. The masses of crystals of morphine sulphate (which have been heretofore described as bricks) are in a condition to be made into a merchantable article. A very sharp knife and delicate handling is used. The bricks are placed on a table and cut into slices each measuring about ¼ inch. These slices are very gently crumbled in the hands or they are preferably cut into cubes or small pieces to distinguish them from other white crystals of a less poisonous nature.

In the evaporation of the solution of this salt, care should be taken not to carry the heat too far, for, when pushed to incipient decomposition with an excess of acid, a new substance is formed containing no morphine. This salt is sometimes adulterated. D. B. Dott met with a sample in the English market which contained 34.63 per cent. of anhydrous sodium sulphate. (*P. J.*, August 4, 1877.)

Properties.—It is officially described as in "white, feathery, acicular, silky crystals, or in

[1] "Take of Morphia, in fine powder, *a troyounce;* Distilled Water *half a pint;* Diluted Sulphuric Acid *a sufficient quantity.* Mix the Morphia with the Distilled Water, then carefully drop in Diluted Sulphuric Acid, constantly stirring until the Morphia is neutralized and dissolved. Evaporate by means of a water-bath, so that on cooling it may crystallize. Lastly, drain the crystals, and dry them on bibulous paper." *U. S.* 1870.

cubical masses, odorless, permanent in the air, and having a bitter taste. It loses three molecules of water of crystallization at 100° C. (212° F.), and the remaining two at 130° C. (266° F.). Soluble in 15.3 parts of water, and in 465 parts of alcohol at 25° C. (77° F.); soluble in 0.6 part of water at 80° C. (176° F.), and in 187 parts of alcohol at 60° C. (140° F.); insoluble in ether and chloroform. When heated to about 250° C. (482° F.), the salt assumes a brown color, and then chars without melting. When ignited, it is very slowly consumed, leaving no residue. Its aqueous solution is neutral to litmus paper. On adding a dilute solution of ammonia water in slight excess to its aqueous solution, and vigorously shaking the liquid, a precipitate is formed, which when collected and washed, should respond to all the tests and reactions given under *Morphina*. Barium chloride T.S. produces a white precipitate, insoluble in hydrochloric acid. Ferric chloride T.S., when added to neutral aqueous solutions of the salt, produces a blue color, which is destroyed by acids, alcohol, or by heating. The color tests for the identification of Morphine Sulphate, and those showing the absence of impurities, are identical with those described under *Morphina." U. S.* By exposure to a heat of 120° C. (248° F.) it loses 9.66 parts of the water, but cannot be deprived of the remainder without decomposition. (Liebig.) The official tests for it are those for sulphuric acid and for morphine. Considerable discussion has taken place in the pharmaceutical journals about the solubility in water of morphine sulphate. Owing to the ease with which the salt parts with its water of crystallization, even at ordinary temperatures, it is not difficult to account for some of the discrepancies that exist in the text-books on this subject. Yet there can be no doubt that the heretofore commonly quoted solubility, "twice its weight of cold water," is an oft-repeated error. J. U. Lloyd (*N. R.*, May, 1882) found it soluble in 21.60 parts of cold water. F. B. Power, after a determination by precipitation with barium chloride, found a commercial specimen of undoubted purity to require very nearly 24 parts of cold water, and the U. S. P. 1880 adopted his results. (*A. J. P.*, 1882, p. 97.) Virgil Coblentz subsequently examined five commercial samples, and practically confirmed Power's results, finding the specimens soluble respectively in 21.38, 23.90, 23.18, 17.69, and 18.97 parts of water. D. B. Dott criticises the methods employed by J. U. Lloyd, and to some extent those of Power, but fails to establish a very different result. (*P. J.*, 1882, p. 252.) The temperature used in obtaining these figures was 15.6° C. The solubility according to the U. S. P. (8th Rev.) is 15.3 parts of water at 25° C. (77° F.).

The *solution of morphine sulphate* formerly official was made by dissolving 1 grain of morphine sulphate in 1 fluidounce of distilled water, and, although the solution is more stable than that of any other of the morphine salts in common use, it will in time become weakened through the presence of microscopic plants belonging to the Confervoideæ, and hence it is not desirable to keep it on hand. According to Hamberg of Stockholm, the sulphate should be dissolved in boiling distilled water which is free from ammonia, phosphoric, nitric, and nitrous acids; the solution should be filtered through paper not previously moistened, and is best preserved in small well-filled vials closed with a glass stopper. (*Ph. Ztg.*, No. 49; *A. J. P.*, 1881.) For medicinal properties, see *Morphina* and *Morphinæ Acetas*, pp. 785, 788.

Dose, from one-eighth to one-half grain (0.008 to 0.032 Gm.), which may be given in pill or in solution.

Off. Prep.—Pulvis Morphinæ Compositus, *U. S.*

MORPHINÆ TARTRAS. Br.

MORPHINE TARTRATE

(mör-phī'næ tăr'trăs)

$(C_{17}H_{19}NO_3)_2C_4H_6O_6 + 3H_2O = 768.64$

Morphinum Tartaricum; Tartrate de Morphine, *Fr.*; Morphintartrat, Weinsaures Morphium, *G.*

"Morphine Tartrate, $(C_{17}H_{19}NO_3)_2C_4H_6O_6$, $3H_2O$, may be prepared by the combination of morphine and tartaric acid in molecular proportions." *Br.*

This salt of morphine has been introduced into the British Pharmacopœia 1898; it was brought into notice by Erskine Stuart (1880), and recommended for hypodermic injection because of its greater solubility in water over the other salts of morphine. (See *Injectio Morphinæ Hypodermica*, p. 658, and *Liquor Morphinæ Tartratis*, p. 727.) It is officially described as "a white powder consisting of fine nodular tufts of minute acicular crystals. Efflorescent at 68° F. (20° C.). Soluble in 11 parts of cold *water*, almost insoluble in *alcohol* (90 per cent.). It affords the reactions characteristic of morphine and of tartrates. 2 grammes dissolved in 20 cubic centimetres of warm *morphinated water*, with *solution of ammonia* added in the slightest possible excess, will give, on cooling, a crystalline precipitate which, after washing and drying as described under 'Morphinæ Hydrochloridum,' should weigh 1.47 grammes. Heated to redness with free access of air, it burns without leaving any residue (absence of mineral impurities)." *Br.* A. E. Tanner (*P. J.*, 1903, 134) found morphine tartrate in the English market of slow solubility; he investigated the subject and stated that an acid tartrate of morphine was sparingly soluble, that this was found in commerce and that it required 100 parts of cold water for its solution.

Uses.—Morphine tartrate is used for making hypodermic injections. See *Morphina*.

Dose, one-eighth to one-half grain (0.008 to 0.032 Gm.).

Off. Prep.—Injectio Morphinæ Hypodermica, *Br.;* Liquor Morphinæ Tartratis, *Br.*

MOSCHUS. U. S., Br.

MUSK

(mŏs′ḉhŭs)

"The dried secretion from the preputial follicles of *Moschus moschiferus* Linné." *U. S.* "The dried secretion from the preputial follicles of Moschus moschiferus, *Linn.*" *Br.*

Moschus Orientalis, M. Chinensis, M. Tibetanus; Chinese, Thibet or Tonquin Musk; Musc, *Fr. Cod.;* Bisam, Moschus, *G.;* Muschio, *It.;* Almizcle, *Sp.*

Moschus moschiferus, Gmelin, *Syst. Nat.* i. 172; *Rees's Cyclopædia.*—This animal bears a close resemblance to the deer in shape and size. It is usually about three feet in length and two feet high, with haunches considerably more elevated than the shoulders. From its upper jaw two tusks project downward out of the mouth, each about two inches long, curved backward, and serving to extract the roots which are used as food by the animal. The ears are long and narrow, and the tail very short. The fleece, consisting of strong, elastic, undulated hairs, varies in color with the season, the age of the animal, and perhaps the place which it inhabits. The general color is a deep iron-gray. The individual hairs are whitish near the root, and fawn-colored or blackish towards the tip. The musk is contained in an oval, hairy, projecting sac, found only in the male, situated between the umbilicus and the prepuce, from two or three inches long, and from one to two broad, opening by a small hairy orifice at its anterior part, and marked posteriorly by a groove or furrow which corresponds with the opening of the prepuce. It is lined internally by a smooth membrane, thrown into a number of irregular folds, forming incomplete partitions. In the vigorous adult animal, the sac sometimes contains six drachms of musk; but in the old, seldom more than two drachms, and none in the young.[1] The musk is secreted by the lining membrane, and in the living animal forms a consistent mass, which on the outside is compact, and marked with the folds of the membrane, but is less firm towards the centre, where there is sometimes a vacant space. As first secreted it is probably liquid, and a portion is occasionally forced out by the animal, to which it communicates its odor. The musk-deer inhabits the vast mountainous regions of Central Asia, extending from India to Siberia, and from the country of the Turcomans to China. It is an active and timid animal, springing from rock to rock with surprising agility, and frequenting the snowy recesses and most inaccessible crags of the mountains. Concealing itself during the day, it chooses the night for roaming in search of food, and, though said to be abundant in its native regions, is taken with difficulty. It is hunted for its hide, as well as for the musk. The natives often take it by snaring. As soon as the animal is killed, the sac is cut off, dried, and sent into the market.[2] It has been calculated that about twenty thousand deer, male and female, are annually killed.

Musk varies in quality with the country inhabited by the animal. That procured from the mountains on the southern borders of Siberia, and brought into the market through Russia, is comparatively feeble. Chinese musk has been said to come from Tonquin, but appears really to be chiefly obtained in Yun-Nan, a province in the extreme south of China, whence it is sent 1400 miles to Shanghai, the export centre. A variety intermediate between these is procured in the Himalaya Mountains and Thibet and sent to Calcutta. This is sometimes enclosed in the membranous lining of the sac, without the hairy envelope, and in this condition is said to be quite equal if not superior to that surrounded by the skin, as in the former condition it dries readily in the sun, while in the latter the aid of artificial heat is deemed necessary, by which the musk may sometimes be injured. (F. Peake, *P. J.,* Feb. 1861.) A musk which is also said to pass from Thibet into China is *Cabardine* musk. (See *C. D.,* 1890.)

Two varieties are known in commerce, the *Chinese, Thibet* or *Tonquin* musk, and *Russian* or *Siberian* musk.[3] Both come in sacs, convex and hairy on one side, flat and destitute of hair on the other. The hairs are brownish-yellow, grayish, or whitish, stiff and short, and arranged concentrically around the orifice of the sac. The Chinese, which is the more highly valued, is in bags of a rounder shape, covered with brownish-yellow or reddish-brown hairs, and containing at most a drachm and a half of large grained, dark, strong scented musk, of an ammoniacal odor. The Russian is in longer and larger bags, small-grained, of a light yellowish-brown color, and of a weaker and more fetid odor, with less odor of ammonia.

[1] According to Frederick Markham, as much as two ounces are sometimes obtained, and the average for a full-grown animal is an ounce; but, as many of the deer are killed young, the pods in the market do not contain more than half an ounce upon an average. He states that the musk of the younger animals is not so strong as that of the old, but is much pleasanter. (*P. J.,* xv. 472.)

[2] Attention has been drawn by E. Bertherand to the excrement of the *Algerian gazelle, Antilope dorcus,* L., which possesses a powerful musk-like odor. It is said to contain about 7 per cent. of an acid resin having a musky odor. (*Proc. A. Ph. A.,* xxvi. 332.)

[3] *American Musk.*—Owing to the costliness of true musk, the sacs derived from *Fiber zibethicus,* the common musk-rat, have been used as a substitute. This product possesses many of the properties of musk, and, although the odor is not identical, it can often replace it in perfumery if used judiciously. If the fatty matter present has become rancid, it should be washed out by agitating the bruised sacs with a little ether and pouring off the ethereal solution, then allowing the musk to become dry by exposure to the air, and carefully preserving the product in sealed packages.

Properties.—Musk is in grains or lumps concreted together, soft and unctuous to the touch, and of a reddish-brown or ferruginous color resembling that of dried blood. Some hairs of the pod are generally mixed with it. It is officially described as "usually in irregular, crumbly, somewhat unctuous grains, dark reddish-brown, having a peculiar, penetrating, and persistent odor and a bitterish taste. About 10 to 12 percent. of Musk is soluble in alcohol, the solution being light brownish-yellow, and on the addition of water becoming slightly turbid; from 50 to 75 percent. is soluble in water, the solution being deep brown, faintly acid, and strongly odorous; moisture not more than 15 percent., and ash not more than 8 percent." *U. S.* The odor is strong, penetrating and so diffusive that one part of musk communicates its odor to more than 3000 parts of inodorous powder. (Fée.) In some delicate individuals it produces headache and other disagreeable symptoms, and it has even caused convulsions. The taste is bitter, disagreeable, and somewhat acrid. The color of the powder is reddish-brown. Musk is inflammable, burning with a white flame, and leaving a light spongy charcoal. Reduced to ashes, it leaves about 5 per cent. of residue, containing potassium, calcium, magnesia, iron, carbonic, phosphoric, and sulphuric acids, chlorine, and traces of potassium ferrocyanide and ammonium sulphide. (W. Bernatzik.) It yields, upon analysis, a great number of proximate principles. Guibourt and Blondeau obtained water, ammonia, stearin, olein, cholesterin, an oily acid combined with ammonia, volatile oil, ammonium chloride, potassium and calcium chlorides, an unidentified acid combined with ammonia, potassium, and calcium, gelatin, albumin, fibrin, a highly carbonaceous matter soluble in water, a soluble calcareous salt and a combustible acid, calcium carbonate, and phosphate, with hair and sand. (*Ann. Ch. Phys.*, ix. 327.) Besides these constituents, Geiger and Reinman found a peculiar bitter resin, a peculiar substance in part combined with ammonia, and lactic acid both free and in combination. According to Guibourt and Blondeau, it contains 47 per cent. of volatile matter, thought by some to be chiefly ammonia, by others to be a compound of ammonia and volatile oil. Theimann obtained only from 10 to 15 per cent. But the quantity of volatile as well as of soluble matter varies exceedingly in different specimens. Thus, Theimann found from 80 to 90 per cent. of matter soluble in water, Buchner only 54.5 per cent., and other chemists intermediate proportions. The proportion soluble in alcohol, as ascertained by different experimenters, varies from 25 to 62 per cent. Ether is a good solvent. The aqueous infusion has a yellowish-brown color, a bitterish taste, a strong odor, and an acid reaction. The alcoholic tincture is transparent, and of a reddish-brown color, with the peculiar odor of musk. The action of potassium hydroxide upon musk is accompanied with the extrication of ammonia and an increase of its peculiar odor. By the influence of heat and moisture long continued, ammonia is developed, which acts upon the fatty matter, producing a substance resembling adipocere, but, according to Guibourt, without diminishing the medicinal activity. The correctness of this opinion, however, is perhaps questionable, and it is advisable to preserve the musk as much as possible unaltered. When kept in glass bottles, in a situation neither moist nor very dry, it remains for a great length of time without material change. The odor of musk is very much diminished by mixing it with emulsion or syrup of bitter almond, or with cherry-laurel water. From the experiments of Wimmer, it appears that musk loses its odor when rubbed with golden sulphide of antimony, and reacquires it on the addition of a little solution of ammonia. (*Ph. Cb.*, 1843, 406.) Camphor rubbed up with musk is also said to destroy its odor. (See *Artificial Musk*, PART II.)

Adulterations.—The price of this medicine is so high, and its sources are so limited, as to offer strong temptations to adulteration, and little genuine unmixed musk is to be found in the market. The sophistication commences in China, and is completed in Europe and this country. A common practice in the East is to open the sac and to supply the place of the musk with an adulterated mixture. Sometimes the scrotum of the animal is filled with this mixture, and not infrequently the sacs are made out of the skin. Dried blood, from its resemblance to musk, is one of the most common adulterations; but, besides this, sand, lead, iron filings, hair, animal membrane, tobacco, the dung of birds, wax, benzoin, storax, asphaltum, artificial musk, and other substances are introduced. These are mixed with a portion of musk, the powerful odor of which is diffused through the mass and renders the discovery of the fraud sometimes difficult. It is said that the Chinese sometimes mix the musk of Tonquin with that of Siberia. The bags containing the drug should have the characters before described as belonging to the natural sac, and should present no evidence of having been opened. The slit is sometimes carefully sewed up, sometimes glued together. The former condition may be discovered by close inspection, the latter by immersion in hot water. When the bag is made from any other portion of the skin, the difference may be detected, according to Neligan, by a microscope which magnifies 300 diameters. The genuine hairs exhibit innumerable cells, which are wanting in the spurious. (*Chem. Gaz.*, Feb. 1846, p. 79.) Musk which burns with difficulty, has a feeble odor and a color either pale or entirely black, feels gritty to the finger, is very moist so as to lose much weight in drying, or contains obvious impurities, should be rejected. Russian musk is said never to be adulterated before leaving Russia.[1] "Musk

[1] For an account of the effects of numerous reagents on musk, and other modes of identification,

should be free from earthy impurities, and should on incineration yield not more than 8 per cent. of ash." *Br.*

Uses.—Musk is stimulant and antispasmodic, in some way stimulating very decidedly the nervous centres when exhausted, without producing either in health or in disease very pronounced symptoms. It is a very valuable remedy in the treatment of nervous exhaustion coming on at or about the crisis of acute disease. When, in low cases of *typhus affections, subsultus tendinum, tremors, singultus,* and similar symptoms indicate the failure of nerve-power, its exhibition is often of great advantage. We have seen it apparently save life in the acme of *typhoid fever,* when the vital powers seemed to have almost succumbed, and when violent alterations of temperature or symptoms resembling those of coma vigil had manifested themselves. It was many years ago especially commended by Trousseau in the treatment of *adynamic pneumonia* of drunkards with severe cerebral symptoms. Under these circumstances it certainly appears to do great good. In very obstinate *hiccough* it is one of the most efficient of all of our remedies, and, according to G. B. Wood, it is very effective in those alarming *convulsions of infants* originating in spasm of the intestines. In the *laryngismus stridulus* or crowing disease of infants, Bouchut relied mainly on musk, having found it more efficacious than any of the narcotics. (*N. Y. M. J.,* Sept. 1868, p. 545.) According to our experience, musk rapidly loses its power of influencing the nerve centres, and for this reason, and on account of its costliness, its employment should always be delayed until severe nervous exhaustion becomes alarming. It may be given in pill, but is commonly given in emulsion or administered as an enema.

Dose, from five to fifteen grains (0.32 to 1.0 Gm.).

Off. Prep.—Tinctura Moschi, *U. S.*

MUCILAGINES.

MUCILAGES

(mū-cĭ-lăg′ĭ-nēs)

Mucilages, *Fr.;* Schleime, *G.;* Mucilagines, *It.*

Mucilage, in the ordinary acceptation of the term, and in the sense in which it is employed in the U. S. Pharmacopœia, is an aqueous solution of gum, or of substances closely allied to it. In the British Pharmacopœia the term is applied also to the semi-liquid, jelly-like substance resulting from the cooling of a hot solution of starch.

MUCILAGO ACACIÆ. U. S., Br.

MUCILAGE OF ACACIA

(mū-cĭ-lā′gō ą-cā′cĭ-æ)

Mucilage of Gum Arabic; Mucilage de Gomme, *Fr. Cod.;* Mucilage arabique, *Fr.;* Mucilago Gummi Arabici, *P. G.;* Gummischleim, *G.;* Mucilagine di gomma arabica, *It.;* Mucilago de goma arabica, *Sp.*

* "Acacia, in small fragments, *three hundred and forty grammes* [or 11 ounces av., 435 grains]; Lime Water, *three hundred and thirty grammes* [or 11 ounces av., 280 grains]; Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Wash the Acacia with cold Water, and allow it to drain. Add the Lime Water to it, and enough Water to make the mixture weigh *one thousand grammes* [or 35 ounces av., 120 grains], agitate or stir it occasionally until the Acacia is dissolved, and strain. Keep the product in well-stoppered, completely filled bottles, in a cool place." *U. S.*

"Gum Acacia, in small pieces, 4 *ounces* (Imperial) or 100 grammes; Distilled Water, *a sufficient quantity.* Rapidly rinse the Gum Acacia with a little Distilled Water; then dissolve it in *six fluid ounces* (Imp. meas.) or one hundred and fifty cubic centimetres of Distilled Water in a closed vessel and strain." *Br.*

The gum used for this purpose should be in small fragments or coarse powder, as it is more readily dissolved in this state than when finely pulverized. Straining is necessary to separate the foreign substances which are often mixed with gum arabic. This mucilage is semi-transparent, almost colorless if prepared from good gum, viscid, tenacious, of a feeble peculiar odor, and nearly tasteless. By straining a solution of gum through a layer of freshly precipitated alumina it can be almost entirely decolorized, particularly if the operation be repeated several times. By keeping, the mucilage becomes sour, in consequence of the spontaneous generation of acetic acid, and this happens even though it be enclosed in well-stoppered bottles; but, according to Guérin the solution of pure gum undergoes no change *in vacuo.* Heat in its preparation is said to favor the production of acid, and hence cold has been substituted for boiling water in the present formulas. The U. S. P. (8th Rev.) directs the addition of lime water in making this mucilage; this addition has proved advantageous by neutralizing the acidity generally found in acacia and it promotes stability. According to R. Rother (*A. J. P.,* xliv. 113), if glycerin be employed in the proportion of one to eight of the mass, and the mixture of water and glycerin be added to the gum in a bottle and solution secured by agitation at intervals over several hours, the resulting mucilage does not spoil; the presence of glycerin is objectionable, however, for many of the uses of mucilage of acacia. E. D. Oesch (*West. Drug.,* 1892, 38) adds about 6 per cent. of alcohol as a preservative. Keller preserves the mucilage by the addition of acetanilide (two

as well as of detecting adulterations, see a paper by W. Bernatzik, in *A. J. P.,* 1861, p. 427. There is a discrepancy between Bernatzik's statement of the solubilities of musk and that quoted in the text above. According to the latter, ether is a good solvent; according to the former, ether and chloroform possess scarcely any solvent power. Solubility, however, cannot be relied upon as a test.

grains in the fluidounce). (*C. D.*, 1896, 378.) Archer & Co. have found (*A. J. P.*, xlvi. 469) that if "Tolu water" be substituted for water the mucilage will keep for months. The Tolu water is made by rubbing two drachms of the tincture with magnesium carbonate and two pints of water, and filtering. Mucilage is employed chiefly in the making of pills, and in suspending insoluble substances in water. In prescribing it for mixtures, it should be recollected that it is a solution of definite strength, containing, according to the U. S. formula, half an ounce of the gum to each fluidounce of mucilage. The British mucilage is a little stronger. The adhesiveness of the mucilage is stated to be very much increased by the addition of one part of aluminum sulphate to one hundred and twenty-five parts of the mucilage.

Off. Prep.—Mistura Olei Ricini, *Br.;* Trochiscus Sulphuris, *Br.*

MUCILAGO SASSAFRAS MEDULLÆ. U. S.

MUCILAGE OF SASSAFRAS PITH

(mū-cį-lā'gō săs'są-frăs mę-dŭl'læ)

Mucilage de Moëlle de Sassafras, *Fr.;* Sassafrasmarkschleim, *G.*

℞ "Sassafras Pith, *two grammes* [or 31 grains]; Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Macerate the Sassafras Pith in the Water during three hours, and strain without expression. This preparation should be freshly made when wanted." *U. S.*

This mucilage may be prepared in a much shorter time, if the pith be broken into small fragments and the mixture often agitated. When a thicker mucilage is desired, J. W. England recommends beating the pith with sterilized water in a mortar until pasty, expressing through coarse muslin, returning the residue, and continuing the process until a thick mucilage is obtained. (*A. J. P.*, 1894, 350.) This will produce a cloudy mucilage, however, which is inferior to the preparation made without agitation. The use of sterilized water while not objectionable seems unnecessary unless the pith itself be sterilized. The mucilage is much used as an application to the eye in *conjunctivitis*. It may be taken as a drink *ad libitum* in *inflammations of the mucous passages*.

MUCILAGO TRAGACANTHÆ. U. S., Br.

MUCILAGE OF TRAGACANTH

(mū-cį-lā'gō trăg-ą-căn'thæ)

Mucilage de Gomme Adragante, *Fr. Cod.;* Mucilage adragant, *Fr.;* Traganthschleim, *G.;* Mucilagine di gomma adragante, *It.*

℞ "Tragacanth, *six grammes* [or 93 grains]; Glycerin, *eighteen grammes* [or 278 grains]; Water, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Mix the Glycerin with *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims] of Water in a tared vessel, heat the mixture to boiling, add the Tragacanth, and macerate during twenty-four hours, stirring occasionally. Then add enough Water to make the mixture weigh *one hundred grammes* [or 3 ounces av., 231 grains], beat it until it has a uniform consistence, and strain it forcibly through muslin." *U. S.*

"Tragacanth, in powder, 60 *grains* (Imperial) or 5.5 grammes; Alcohol (90 per cent.), 2 *fl. drachms* (Imp. meas.) or 10 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Tragacanth with the Alcohol in a bottle; add a sufficient quantity of Distilled Water to form *ten fluid ounces* (Imp. meas.) or four hundred cubic centimetres, and shake immediately." *Br.*

A part only of tragacanth is soluble in water. The remainder swells up and forms a soft tenacious mass, which may be mechanically mixed with water, but does not form a proper solution. Hence trituration is necessary to complete the incorporation of the ingredients. This mucilage is thick and very viscid, but not permanent, as the water separates from the insoluble portion of the tragacanth on standing. It is chiefly used in making pills and troches. The addition of glycerin renders it more serviceable as an excipient. From its great tenacity, it may be advantageously employed for the suspension of heavy insoluble substances, such as the metallic oxides, in water. When kept long, it is apt to undergo decomposition, and to become offensive, but it will keep well if enough phenol be added to impart its characteristic odor faintly. (*A. J. P.*, 1864.) Lyon (*P. J.*, 1901, 600) recommends the use of chloroform water as a preservative in making this mucilage; this is preferred in all cases if the mucilage is not to be used internally. The alcohol in the British process facilitates the quick production of the mucilage, and in addition acts as a preservative.

Off. Prep.—Lotio Hydrargyri Nigra, *Br.;* Trochisci Sodii Bicarbonatis, *U. S.*

MUCILAGO ULMI. U. S.

MUCILAGE OF ELM

(mū-cį-lā'gō ŭl'mī)

Mucilage of Slippery Elm Bark; Mucilage d'Ecorce d'Orme fauve, *Fr.;* Ulmenrindenschleim, *G.*

℞ "Elm, bruised, *six grammes* [or 93 grains]; Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Digest the Elm with the Water, on a water-bath, in a covered vessel, during one hour, then strain. This preparation should be freshly made when wanted." *U. S.*

This may be used *ad libitum* as a demulcent and nutritious drink in *catarrhal* and *nephritic*

diseases, and in *inflammatory intestinal affections.* It is much employed locally as a soothing application to *boils* and *carbuncles,* and as a demulcent in *dermatitis, erysipelas,* etc.

MYRISTICA. U. S., Br.

MYRISTICA [Nutmeg]

(mȳ-rĭs'tĭ-cą)

"The kernel of the ripe seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*)." *U. S.* "The dried seed of Myristica fragrans, *Houtt.,* divested of its testa." *Br.*

Muscade, *Fr. Cod.;* Nux Moschata, Noix muscade, *Fr.;* Semen Myristicæ, *P. G.;* Muskatnuss, *G.;* Noce moscata, *It.;* Nuez moscada, *Sp.*

Myristica fragrans, Houttuyn, *Nat. Hist.* vol. ii., part iii., 333; *B. & T.* 218.[1] *M. moschata,* Thunberg; Willd., *Sp. Plant.* iv. 869. *M. officinalis,* Linn., *Suppl.* 265; Lindley, *Flor. Med.* 21.—The nutmeg tree is about thirty feet high, with numerous branches, and an aspect somewhat resembling that of the orange tree. The leaves stand alternately on short footstalks, are oblong-oval, pointed, entire, undulated, obliquely nerved, bright green and somewhat glossy on their upper surface, whitish beneath, and of an aromatic taste. The flowers are male and female upon different trees. The former are disposed in axillary, peduncled, solitary clusters; the latter are single, solitary, and axillary; both are minute and of a pale yellowish color. The fruit, which appears on the tree mingled with the flowers, is round or oval, of the size of a small peach, smooth, at first pale green, but yellow when ripe, and marked with a longitudinal furrow. The external covering, which is at first thick and fleshy and abounds in an austere, astringent juice, afterwards becomes dry and coriaceous, and, separating into two valves from the apex, discloses a scarlet reticulated membrane or arillus, commonly called *mace,* closely investing a thin, brown, shining shell, which contains the kernel or *nutmeg.* The nutmeg tree is a native of the Moluccas and other neighboring islands, and abounds especially in that small cluster distinguished by the name of Banda, whence the chief supplies of nutmegs were long derived. But numerous varieties of the plant are now cultivated in Sumatra, Java, Singapore, Penang, Ceylon, and other parts of the East Indies, and have been introduced into the Isles of France and Bourbon, Cayenne, and several of the West India islands. The larger part of the nutmegs of commerce is, however, said still to come from the Dutch Banda Islands. The Penang nutmegs are distinguished by not being limed. The tree is produced from the seed. It does not flower until the eighth or ninth year, after which it bears flowers and fruit together, without intermission, and is said to continue bearing for seventy or eighty years. Little trouble is requisite in its cultivation. A branch of the female tree is grafted into all the young plants when about two years old, so as to insure their early fruitfulness. In the Moluccas the tree yields three crops annually. The fruit is gathered by hand, and the outside covering rejected. The arillode, mace of commerce,[2] is then carefully separated, so as to break it as little as possible, is flattened, dried in the sun, and afterwards sprinkled with salt water, with the view of contributing to its preservation. The nuts are dried in the sun or by ovens, and exposed to smoke until the kernel rattles in the shell. They are then broken open, and the kernels, having been removed and steeped for a short time in a mixture of lime and water, in order to preserve them from the attacks of worms, are next cleaned, and packed in

[1] Various species of the genus Myristica, other than those spoken of in the text, yield commercial seeds or products:

Ucuhula nut is a round or oval seed of *Myristica surinamensis.* It is one-half to two-thirds of an inch in diameter, light brown, but usually covered by a blackish, thin, friable testa. Internally it resembles the nutmeg, but is distinguished by the presence of extraordinarily large and handsome albuminous crystalloids. These seeds are said to contain over 70 per cent. of a solid yellow fat, melting at 36° C. (See *A. J. P.,* 1886; also *A. Pharm.,* July, 1888.) The kernel of the fruit of the Brazilian *Myristica officinalis,* Mart. (*M. Bicuhyba,* Schott), resembles the nutmeg in form and structure, but is covered with a black shell marked with broad furrows. It contains crystals like those above spoken of, but less splendid and regular, and apt to be in three forms. It yields a fat (*bicuhyba fat,* or *bicuhyba balsam*) very much like that of the ordinary nutmeg, but having a rather sour, sharp taste, melting at 47° C. It contains a peculiar fatty acid, *bicuhibastearic* acid. The *otoba fat* is the product of the fruit of *Myristica Otoba.* It is almost colorless, when fresh has a nutmeg-like odor, melts at 38° C., and contains *myristin, olein,* and *otobite.* The latter principle crystallizes in shiny, colorless crystals, melting at 133° C. The fruit of *Virola sebifera,* Aubl. (*s. Myristica sebifera,* Lam.), also yields a fatty substance which is known as *ocuba wax.* The so-called *California nutmeg* is not a nutmeg at all, but the seed of a coniferous tree, *Torreya californica.* It is oblong, with a smooth, brownish, thin testa, and affords a marbled cross-section. Its odor and taste are terebinthinate. Neither are the *Jamaica* or *calabash nutmeg,* from *Monodora Myristica,* the *New Holland* or *plume nutmeg,* from *Atherosperma moschata,* and the *clove nutmeg,* from *Agathophyllum aromaticum,* true nutmegs.

[2] Macis, U. S. 1890, *Mace,* occurs in narrow bands, 25 Mm. or more long, somewhat branched and lobed above, united into broader bands below; brownish-orange; fatty when scratched or pressed; odor fragrant, taste warm and aromatic." *U. S.* 1890. The structure of mace is largely made up of uniform, small, angular, parenchymatous cells, interspersed with numerous brown oil-cells of larger size. The inner part of the tissue contains also thin brown vascular bundles. The cells of the epidermis on either side are colorless, thick-walled, longitudinally extended, and covered with a peculiar cuticle of broad, flat, ribbon-like cells, which cannot, however, be removed as a continuous film. The parenchymatous cells are loaded with small albuminous granules, but do not contain starch. Mace is inferior when it is brittle, less than usually divided, whitish or pale yellow, or with little taste and odor. The presence of starch granules or other microscopic particles different from those spoken of in powdered mace is proof of adulteration. Mace contains from 7 to 9 per cent. of a volatile oil, the greater portion of which consists of *pinene,* along with which is some *myristicin,* $C_{12}H_{14}O_3$. Wallach separated two odorous fixed oils; one yellow, soluble in ether, insoluble in boiling alcohol; the other red, soluble in alcohol and ether in every proportion. Flückiger finds that, instead of the fats just described, there is about 25 per cent. of resin. (*Pharmacographia,* 509.)

casks or chests for exportation. Lumsdaine has found them to keep better if rubbed over with dry lime than when prepared in the moist way. (See *Am. J. Sci.*, Nov. 1851.) Tschirch confirms the value of liming as a preservative against the attacks of insects. (*Ph. Rev.*, 1898, 196.) Nutmegs are brought to this country either directly from the East Indies or indirectly through England and Holland. They are also occasionally imported in small quantities from the West Indies.

The amount of unground nutmegs imported into the United States for the year ending June 30, 1903, was 2,365,624 lbs., valued at $444,643, and for 1904, 1,498,600 lbs., valued at $288,388.

Properties.—The nutmeg (*nux moschata*) is of a roundish or oval shape, obtuse at the extremities, marked with vermicular furrows, of a grayish color, hard, smooth to the touch, yielding readily to the knife or the grater, but not very pulverulent. When cut or broken it presents a yellowish surface, varied with reddish-brown, branching, irregular veins, which give to it a marbled appearance. These dark veins abound in oily matter, upon which the medicinal properties depend. The odor of nutmeg is delightfully fragrant, the taste warm, aromatic, and grateful. Its virtues are extracted by alcohol and ether. Myristica is officially described as "ovoid or ellipsoidal, about 25 Mm. long; externally light brown, reticulately furrowed, with a circular scar at the broad end; internally more or less mottled from the infolding of the light brown perisperm and tegumen with the yellowish-brown endosperm; easily cut, the cut surface having a waxy lustre; odor strongly aromatic; taste agreeably aromatic, warm, and slightly bitter." *U. S.* Clifford Richardson (*Bulletin U. S. Dep. Agriculture*, No. 13, 1887) gives as the average of three analyses of imported nutmegs: water, 5.56 per cent.; ash, 2.88; volatile oil, 3.23; fixed oil or fat, 34.22; starch, etc., 39.62; crude fibre, 9.21; albuminoids, 5.28: total 100.00. The *volatile oil* is obtained by distillation with water. (See *Oleum Myristicæ.*)

Under the names of *long, female,* or *wild nutmeg, Macassar nutmeg, Papua nutmeg, New Guinea nutmeg, horse nutmeg,* certain seeds have long been known in European commerce; they have finally become an important article of trade, nearly 77,000 kilos of them having been sold in Holland in the year 1894. These seeds have been variously ascribed to *M. fatua,* Houtt. (*M. tomentosa,* Thunb., *M. macrophylla,* Roxb.) and other species of the genus Myristica,[1] but by Bassermann and Warburg have in all their varieties been traced to the *M. argentea,* Warburg, of New Guinea, from which country they are often taken to Macassar to finally enter commerce as Macassar nutmegs. (*P. J.*, 1898, 97.) The numerous varieties of these false nutmegs are readily reducible to two, which differ chiefly in size, the larger being commonly known as the Papua nuts, the smaller as the Macassar nuts. They are distinguished from the nutmeg by their greater length, their elliptical shape, their comparatively feeble odor and disagreeable taste, and by the absence of the dark brown veins.

Nutmegs have been punctured and boiled in order to extract their essential oil, and the orifice afterwards closed so carefully as not to be discoverable unless by breaking the kernel. The fraud may be detected by their lightness. They are also apt to be injured by worms, which, however, attack preferably the parts least impregnated with the volatile oil. The Dutch were formerly said to heat them in a stove in order to deprive them of the power of germinating and thus prevent the propagation of the tree. The largest nutmegs now command the highest prices. They should be rejected when very light in weight, with a feeble taste and odor, worm eaten, musty, or marked with black veins.

The *concrete* or *expressed oil of nutmeg* (*Oleum Myristicæ Expressum,* Br. 1885), often called *oil of mace,* or *nutmeg butter,* is obtained by bruising nutmegs, exposing them in a bag to steam, and then compressing them strongly between heated plates. A liquid oil flows out, which becomes solid when it cools. Nutmegs are said to yield from 10 to 12 per cent. of this oil, but Flückiger and Hanbury obtained as much as 28 per cent.[1] (See analyses of Richardson, quoted previously.) The best is imported from the East Indies in stone jars, or in rectangular blocks 10 inches long by 2½ inches wide, wrapped in palm leaves. It is solid, soft, unctuous to the touch, of a yellowish or orange-yellow color more or less mottled, with the odor and taste of nutmeg. It is composed, according to Schrader, of 52.09 per cent. of a soft oily substance, yellowish or brownish, soluble in cold alcohol and ether; 43.75 of a white, pulverulent, inodorous substance, insoluble in these liquids; and 4.16 of volatile oil. The pulverulent constituent, which received from Playfair the name of *myristin,* has a silky lustre, melts at 31° C. (88° F.), and yields on saponification glycerin and *myristic acid,* $C_{14}H_{28}O_2$. Myristin, $C_3H_5(OC_{14}H_{27}O)_3$, is a true fat, or *glyceryl myristate.* It is also found in spermaceti, in cocoanuts, and in the fixed oil of linseed and poppy oil. It may be obtained directly from nutmeg by

[1] The fresh juice of the *Myristica gibbosa* and *M. Kingii* are said to yield a kino-like extract containing over 30 per cent. of tannin. (*P. J.*, 65, 261.)

[1] A process for obtaining it by means of carbon disulphide has been proposed by Lepage of Gisors, in France, and has received the sanction of the Society of Pharmacy of Paris. It consists in treating the nutmeg, thoroughly comminuted, with three times its weight of the well-rectified liquid referred to, agitating the mixture frequently for 24 hours, expressing, repeating the process with two parts only of the menstruum, mixing the products of the two macerations, filtering in a covered vessel, and then distilling off the disulphide until the residue is entirely deprived of the solvent. (*J. P. C.*, 3e sér., xxxi. 28.) It would seem almost impossible to prevent the retention of a little of the solvent.

exhausting it by means of benzene, filtering the liquid, and allowing it to crystallize by spontaneous evaporation. To purify the product, it may be dissolved in a mixture of two parts of absolute alcohol and three of benzene with the aid of heat, then filtering the liquid while hot, and setting it aside. On cooling, it deposits the pure myristin in crystals. (*J. P. C.,* Juin, 1859, p. 471.) Analyzed by Koller, the expressed oil was found to contain, in 100 parts, 6 of a volatile oil analogous to the oil of mace, 70 of myristin, 20 of olein, 3 of resin, and 1 of salts, etc. (*A. Pharm.,* clxxiii. 280.) Wallach found in the volatile oil *pinene* and *dipentene* of the class of terpenes, and Semmler found *myristicol,* $C_{10}H_{18}O$, which is liquid, and *myristicin,* a solid ester of the composition $C_{12}H_{14}O_3$. An inferior kind of the oil is prepared in Holland, and sometimes found in commerce. It is in hard, shining, square cakes, lighter-colored than that from the East Indies, and with less odor and taste. It is supposed to be derived from nutmegs previously deprived of most of their volatile oil by distillation. An artificial preparation is sometimes sold for the genuine oil. It is made by mixing various fatty matters, such as suet, palm oil, spermaceti, wax, etc., adding some coloring substance, and giving flavor to the mixture by the volatile oil.

Uses.—Nutmeg unites to the medicinal properties of the ordinary aromatics considerable narcotic power. In the quantity of two or three drachms (7.7 or 11.6 Gm.), it has been known to produce stupor and delirium, and dangerous if not fatal consequences are said to have followed its free use in India. For cases, see *A. J. P.,* 1855; *B. M. J.,* Dec., 1889; also *L. L.,* Jan. 19, 1895. H. C. Wood found in experiments upon the lower animals that the oil of nutmeg is a powerful narcotic, with very much less sedative influence upon the heart than is possessed by most volatile oils. Injected into the circulation of the dog, it caused profound sleep, with slowing of the respiration, and, if the dose had been large enough, loss of reflex activity. Nutmeg is usually employed to cover the taste or correct the operation of other medicines, but more frequently as an agreeable addition to farinaceous articles of diet, and to various kinds of drink in cases of languid appetite and delicate stomach. It is usually given in substance, and is brought by grating to the state of a powder. *Mace* possesses properties essentially the same as those of nutmeg, and has caused alarming sensorial disturbances. (G. C. Watson, *Prov. M. S. J.,* Jan. 26, 1848.) It is, however, less used as a medicine. The dose of either is from five to twenty grains (0.32 to 1.3 Gm.). The volatile oil may be substituted, in the dose of from two to five minims (0.12 to 0.3 Cc.). The expressed oil is occasionally used as a gentle external stimulant, and is an ingredient in the *Emplastrum Picis* of the British Pharm. 1885.

Dose, five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Acetum Opii, *U. S.;* Pulvis Aromaticus, *U. S.;* Pulvis Catechu Compositus, *Br.;* Pulvis Cretæ Aromaticus, *Br.;* Spiritus Armoraciæ Compositus, *Br.;* Tinctura Lavandulæ Composita, *U. S., Br.;* Tinctura Rhei Aromatica, *U. S.;* Trochisci Sodii Bicarbonatis, *U. S.*

MYRRHA. U. S., Br.

MYRRH

(mȳr'rhą)

"A gum-resin obtained from *Commiphora Myrrha* (Nees) Engler (Fam. *Burseraceæ*)." *U. S.* "A gum-resin obtained from the stem of Balsamodendron Myrrha, *Nees,* and probably other species." *Br.*

Somali Myrrh, Herabol Myrrh; Gummi Resina Myrrha; Myrrhe, *Fr. Cod.;* Myrrha, *P. G.;* Myrrhe, *G.;* Mirra, *It., Sp.;* Murr, *Ar.;* Bowl, *Hindost.*

Though myrrh has been employed from the earliest times, it is still uncertain by what plant it is yielded. The *Amyris Kataf* of Forskhal, seen by that traveller in Arabia, was supposed by him to be the myrrh tree, but without sufficient proof. Afterwards Ehrenberg met on the frontiers of Arabia Felix with a plant from the bark of which he collected a gum-resin precisely similar to the myrrh of commerce. From the specimens of the plant taken by Ehrenberg to Germany, Nees von Esenbeck referred it to the genus Balsamodendron of Kunth, and named it *Balsamodendron Myrrha.* This genus was formed by Kunth from *Amyris,* and includes the *Amyris Kataf* of Forskhal, which may possibly also produce a variety of myrrh. The new genus differs from *Amyris* chiefly in having the stamens beneath instead of upon the ovary. It was not thought by De Candolle sufficiently distinct, but is now generally recognized under the name of *Commiphora,* first given it by Jacquin in 1797, and therefore preceding the name of Kunth by some 27 years. Berg found another species in Ehrenberg's collection, to which was attached a label by the discoverer, stating that he had collected myrrh from it, and proposed to call it *Balsamodendron ehrenbergianum.* (*A. J. P.,* 1873, 314.) Both Oliver and Trimen agree that this plant is not specifically distinct from *B. Opobalsamum.* The belief that myrrh is the product of *C. Myrrha* has been confirmed by the German traveller Hildebrand, who collected the plant in 1873, in the Adel Mountains, on the north Somali coast (*P. J.,* 3d ser., ix. 893). Deflers and Schweinfurth (*Ber. d. Pharm. Ges. zu Berlin,* 1893) are probably correct in believing that genuine myrrh is yielded by *Commiphora abyssinica* (Berg.), Engl., which is found in Southern Arabia, Erithrea, and Northern Abyssinia. *C. Schimperi* (Berg.), Engl., occurring in the Yemen, Abyssinia, and from Kern to Tigré, is likely also to yield some of the com-

mercial Arabian myrrh. *C. Myrrha* (Nees), Engl., does not apparently produce any myrrh, although Hildebrand states that a plant of the Somali region resembling *C. Myrrha*—but probably a distinct species, *C. Playfairii* (Hook. f.), Engl.,—yields naturally myrrh. On the other hand, the director of the Kew Gardens believes that myrrh is yielded by *C. Myrrha* and *C. simplicifolia,* while E. M. Holmes is of the opinion that Arabian myrrh is the product of *C. Myrrha.* It appears to be established that *C. Myrrha* produces *myrrh,* but it is probable that it is also yielded by other trees belonging to the genus *Commiphora,* which genus includes more than 60 species, natives of Arabia and Africa.

Commiphora Myrrha, Nees, Engler.—*Balsamodendron Myrrha,* Feé, *Cours d'Hist. Nat. Pharm.,* i. 641; Carson, *Illust. of Med. Bot.,* i. 28, pl. 20; *B. & T.* 60.—This is a small tree, with a stunted trunk, covered with a whitish-gray bark, and furnished with rough abortive branches terminating in spines. The leaves are ternate, consisting of obovate, blunt, smooth, obtusely denticulate leaflets, of which the two latter are much smaller than the one at the end. The fruit is oval-lanceolate, pointed, longitudinally furrowed, of a brown color, and surrounded at its base by the persistent calyx. The tree grows in Arabia Felix, in the neighborhood of Gison, in dwarfish thickets, interspersed among the Acaciæ and Euphorbiæ. The juice concretes spontaneously upon the bark.

Formerly the best myrrh was brought from the shores of the Red Sea by way of Egypt and the Levant, and hence received the name of *Turkey myrrh,* while the inferior qualities were imported from the East Indies, and commonly called *India myrrh.* These titles have ceased to be applicable, as myrrh of all qualities is now brought from the East Indies, whither it is carried from Arabia and the northeastern coast of Africa. Aden in the former region, and Berbera in the latter, would appear, from the statements of James Vaughan, to be the chief entrepôts of the trade. (*P. J.,* xii. 226.) Great quantities are collected on the African coast, near the mouth of the Red Sea, whence it is taken to Aden. (*Ibid.,* Oct. 1859, p. 217.) It is usually imported in chests containing between one and two hundred-weight. Sometimes the different qualities are brought separate, but oftener more or less mingled. Only the best kind should be selected for medicinal use.[1]

Properties.—Myrrh is in small irregular fragments or tears, or in larger masses, composed apparently of agglutinated portions differing somewhat in their shade of color. The pieces are exceedingly irregular in shape and size, being sometimes not larger than a pea, and sometimes, though rarely, almost as large as the fist. They are often powdery upon the surface. When of good quality, myrrh is reddish yellow or reddish brown and translucent, of a strong, peculiar, somewhat fragrant odor, and a bitter, aromatic taste. It is brittle and pulverizable, presenting when broken a shining surface, which in the larger masses is very irregular, and sometimes exhibits opaque whitish or yellowish veins. In powder it is of a light-yellowish color. Under the teeth it is at first friable, but soon softens and becomes adhesive. It is inflammable, but does not burn vigorously, and is not fusible by heat. Its sp. gr. is stated as 1.36. The inferior kind, commonly called *India myrrh,* is in pieces much darker than those described, more opaque, less odorous, and often abounding with impurities. We have seen pieces of India myrrh enclosing large crystals of sodium chloride, as if the juice had fallen from the tree and concreted upon the ground where this mineral abounds. Pieces of *bdellium,* and other gummy or resinous substances of unknown origin, are often mixed with it. Among these is a product which may be called *false myrrh.* It is in irregular pieces, of a dirty reddish-brown color, a vitreous brownish-yellow fracture, semi-transparent, of a faint odor of myrrh, and a bitter balsamic taste. Myrrh is best purchased in mass, as in powder it is liable to adulterations not easily detected. "In roundish or irregular tears or masses, dusty, brownish-yellow or reddish-brown; fracture waxy, somewhat splintery,

[1] According to G. Schweinfurth, *Mecca Balsam* is yielded by *Commiphora Opobalsamum,* from which it is collected in the valleys near Mecca. It is said to be the myrrh of the Bible, the error of translation having been made on account of the similarity of the old Hebrew word "mar" with the modern Arabic word "morr," the name of the true myrrh. Four varieties of myrrh are recognized by writers on Materia Medica. They are: First. *Somali Myrrh,* which is described in the *Pharmacographia* as follows: "Myrrh consists of irregular roundish masses, varying in size from small grains up to pieces as large as a hen's egg, and occasionally much larger. They are of an opaque reddish-brown color, with a dull, dusty surface. When broken they exhibit a rough or waxy fracture, having a moist and unctuous appearance, especially when pressed, and a rich brown hue. The fractured translucent surface often displays characteristic whitish marks, which the ancients compared to the semicircular mark at the base of the finger-nails. It has a peculiar fragrance and an aromatic, very bitter, and somewhat acrid taste." Second. *Arabian Myrrh* or *Fahdli,* described in the *Pharmacographia* as "occurring in irregular masses, seldom exceeding 1½ inches long, and having a somewhat gummy-looking exterior. The larger lumps seem formed by the cohesion of small, rounded, translucent, externally shining drops or tears. The fracture is like that of common myrrh, but less unctuous, and has not the whitish markings. The odor and taste are those of the ordinary drug." This myrrh is said to be collected on the hills about Shugraeea and Sureeae, east of Aden. Third. "*Meetiya,*" or *Arabian Myrrh of Dymock,* who states that it is sold in India as true myrrh. This myrrh has a dull surface, a dark reddish-brown color, a more unctuous and waxy fracture, and has white marks like Somali myrrh, which it resembles in taste, but its odor is rather less fragrant. Fourth. *Yemen Myrrh,* which is said by Hanbury to contain a resin which differs from that of Somali myrrh and the Arabian myrrh or Fahdli in that its solution in petroleum spirit does not give a violet color on the addition of bromine. This myrrh is said to enter commerce chiefly from Makulla via Aden and Bombay. It occurs in large pieces 1 to 3 inches long, irregularly rounded and characterized by a dark reddish brown color with a similarly colored fracture free from white streaks. Odor and taste similar to Somali myrrh, but stronger and more rank.

translucent on the edges, sometimes marked with whitish veins; odor balsamic; taste aromatic, bitter and acrid. When triturated with water, Myrrh yields a brownish-yellow emulsion; with alcohol it yields a brownish-yellow tincture which acquires a purplish-red tint on the addition of nitric acid. It does not swell or dissolve in water." *U. S.* Geo. F. Merson (*P. J.*, Jan. 1900, 42) proposes as a test of the quality of myrrh that it should yield not more than 5 per cent. of ash, which should be almost entirely soluble in diluted hydrochloric acid, and that when exhausted with 90 per cent. alcohol and dried at 100° C. one gramme should not afford more than 0.6 Gm. of residue.

Myrrh is partially soluble in water, alcohol, and ether. Triturated with water it forms an opaque yellowish or whitish emulsion, which deposits the larger portion upon standing. Its alcoholic tincture is rendered opaque by the addition of water, but throws down no precipitate. According to Neumann, alcohol and water severally extract the whole of its odor and taste. By distillation a volatile oil rises, having the peculiar flavor of myrrh, and leaving the residue in the retort simply bitter. The gum-resin is soluble in solutions of the alkalies, and, when triturated with them in a crystalline state, forms a tenacious liquid. Hence potassium carbonate may be used to facilitate its suspension in water. Hirschsohn recommends as a reagent for myrrh, *trichloracetal-chloroform,* which is obtained by conducting chlorine into seventy-five per cent. alcohol until turbidity ensues and two layers are formed; the lower of these is shaken with an equal volume of water and then with calcined magnesia and filtered. In one part by weight of the trichloracetal thus obtained, four parts by weight of hydrated chloral are dissolved by heating. The syrupy reagent thus made, which fumes slightly in the air, gives a violet color with the smallest quantity of pure Herabol myrrh. Hirschsohn failed to get a similar reaction with any other resin, not even with Bisabol myrrh. (*Ph. Centralh.*, 1903, 809.) An analysis by Ruickoldt gave 2.183 per cent. of volatile oil, 44.760 of resin, 40.818 of gum or arabin, 1.475 of water, and 3.650 of calcium and magnesium carbonate, with some gypsum and ferric oxide. The volatile oil has been called *myrrhol* or *myrrhenol,* and, according to Ruickoldt, has the formula $C_{10}H_{14}O$. Koehler (*A. J. P.*, 1890, p. 346) confirms this formula, and states that this body, while isomeric with thymol and carvol, is distinct from them. He found 7 or 8 per cent. of essential oil, instead of 2.18 as previously given. Gladstone (*J. Chem. S.* [2], 2, 1) found that the oil had a sp. gr. of 1.0189 at 7.5° C., a boiling point of 266° C., and was lævo-rotatory. The resin, which he calls *myrrhin,* $C_{28}H_{32}O_{10}$, is neutral, but becomes acid when kept for a short time in fusion. In the latter state Ruickoldt proposes to call it *myrrhic acid.* (*A. Pharm.*, lxi. 1.) Koehler (*Schim. Rep.*) finds in the portion soluble in alcohol an indifferent soft resin, to which he gave the formula $C_{26}H_{34}O_5$, containing three replaceable OH groups, and two dibasic resin acids, of the formulas $C_{26}H_{32}O_{16}$ and $C_{26}H_{32}O_9$. An investigation of the essential oil of *Bisabol* myrrh from the interior of the Somali country was made by W. Tucholka. (*Schim. Rep.*, Oct. 1897, 36.) He obtained by distillation 7.8 per cent. of an oil of 0.8836 sp. gr., boiling at from 220° to 270° C. From this was separated, by means of the crystalline hydrochloride, a terpene boiling at from 259° to 260.2° C., which the author calls *bisabolene,* and an oxygenated portion to which he gives the rather strange formula $C_{56}H_{96}O$. According to Bley and Diesel, myrrh containing little volatile oil always has an acid reaction, which they ascribe to the oxidation of the oil. They also found *formic acid* in the specimen examined by them. The same investigators propose as a test of myrrh the production of a transparent dirty-yellow liquid with nitric acid, while false myrrh affords a bright-yellow solution in the same fluid, and bdellium is not dissolved, but becomes whitish and opaque. (*A. J. P.*, xviii. 228.) According to Righini, if powdered myrrh, rubbed for fifteen minutes with an equal weight of ammonium chloride, and fifteen times its weight of water gradually added, dissolves quickly and entirely, it may be considered pure. Chas. E. Escott (*A. J. P.*, 1887) extracted a sample of myrrh with petroleum benzin, and on spontaneous evaporation of the solvent obtained 18.75 per cent. of oily residue. The gum left after treatment with alcohol had a barely perceptible odor of myrrh and a slightly mucilaginous taste, was neutral to test paper, and, though of a pale color, gave with water a dark-brown solution. The insoluble portion amounted to 15 per cent., or 8.4 per cent. of the weight of the myrrh. The diluted solution acquired a purple color by ferric chloride, changed to reddish yellow by ammonia. Stronger solutions were precipitated by alcohol, not gelatinized by borax, and the precipitate with lead subacetate was not redissolved. The gum makes a good mucilage, and, when making tincture of myrrh, the residue insoluble in the alcoholic menstruum should be saved for that purpose.

Uses.—Myrrh is a stimulant tonic, with some tendency to the lungs, and perhaps to the uterus. It is also employed as a tonic in *dyspepsia,* and as an expectorant and emmenagogue in *debilitated states* of the system, in the absence of febrile excitement or acute inflammation. The diseases in which it is usually administered are *chronic catarrh, phthisis pulmonalis,* other *pectoral affections* in which the secretion of mucus is abundant but not easily expectorated, *chlorosis, amenorrhœa,* and the various affections connected with this state of the uterine function. It is generally given combined with chalybeates or

other tonics, and in *amenorrhœa* very frequently with aloes. It is used also as an application to *spongy gums*, the *aphthous sore mouth* of children, and various kinds of *unhealthy ulcers*.

A *plaster of myrrh* is made by rubbing together powdered myrrh, camphor, and balsam of Peru, of each an ounce and a half, then adding the mixture to 32 ounces of lead plaster previously melted, and stirring well until the plaster thickens on cooling. It is then to be formed into rolls. This plaster may be employed in all cases where a gentle and long-continued rubefacient effect is desired.

Myrrh may be given in the form of powder or pill, or suspended in water, as in the famous antihectic mixture of Griffith, which is official under the name of *Mistura Ferri Composita*. The infusion is also sometimes given, and an aqueous extract has been recommended as milder than myrrh in substance. The tincture is used chiefly as a local application.

Dose, ten to thirty grains (0.65 to 2 Gm.).

Off. Prep.—Decoctum Aloes Compositum, *Br.;* Mistura Ferri Composita, *U. S., Br.;* Pilulæ Aloes et Myrrhæ, *U. S.* (*Br.*); Pilula Galbani Composita, *Br.;* Pilulæ Rhei Compositæ, *U. S.* (*Br.*); Tinctura Aloes et Myrrhæ, *U. S.;* Tinctura Myrrhæ, *U. S., Br.*

NAPHTHALENUM. U. S.

NAPHTHALENE [Naphtalinum, Pharm. 1890, Naphtalin, Naphthalin]

(năph-thă-lē'nŭm)

$C_{10}H_8 = 127.10$

"A hydrocarbon obtained from coal-tar, and purified by crystallization. It should be kept in well-stoppered, amber-colored bottles." *U. S.*

Naphthaline; Naphtaline, Naphtaléne, *Fr.;* Naphthalinum, *P. G.;* Naphthalin, *G.;* Naftalina, *It.*

This may be obtained by subjecting coal tar to distillation, when it passes over in the middle oil and heavy oil; in the fractions of the latter it often constitutes the main constituent, causing it to become almost solid on cooling. It is frequently produced during the dry distillation of organic bodies. For a method of preparing it on a large scale for commercial purposes, see a paper by Vohl, in the *J. P. C.*, 1868, 399; from *Polytech. Journ.;* see also Lunge's *Coal-tar and Ammonia*, London, 1887. It is made very extensively and cheaply at present, the sublimed commercial product being nearly pure. It is a white, shining, crystalline substance, fusible at 80° C. (176° F.), and boiling at 218° C. (424.4° F.), but volatilizing with vapor of water. According to Kopp, its sp. gr. in the liquid state is 0.9774; according to Alluard, at 98.8° C. (210° F.), 0.9628.

Properties.—It is officially described as in "colorless, shining, transparent laminæ, having a strong, characteristic odor resembling that of coal-tar, and a burning, aromatic taste; slowly volatilized on exposure to air; by exposure to light acquiring a brownish color. Insoluble in water, but when boiled with it, the water acquires a faint odor and taste; soluble in 13 parts of alcohol at 25° C. (77° F.), and very soluble in boiling alcohol; also very soluble in ether, chloroform, carbon disulphide, and fixed or volatile oils. Naphthalene volatilizes slowly at ordinary temperatures, but rapidly when heated. It also volatilizes with the vapors of water or alcohol. At 80° C. (176° F.) it melts, and at 218° C (424.4° F.) it boils. Its vapor is inflammable, burning with a luminous but smoky flame. When ignited, it is consumed, leaving no residue. Naphthalene is neutral to litmus paper moistened with alcohol. On shaking a small portion of Naphthalene with concentrated sulphuric acid, the acid should remain colorless, and should not acquire more than a pale reddish tint if the mixture be heated for five minutes on a water-bath (absence of *impurities derived from coal-tar*)." *U. S.*

Uses.—Naphthalene has acquired in recent years a new industrial utilization, in that it is the starting point in the manufacture of artificial indigo, which has already become an extensive industry. (See *Indigo*, PART II.) Naphthalene is possessed of antiseptic properties, and is poisonous to most fungi and probably to most insects. Under the name of "*tar camphor*," it has largely supplanted true camphor as a means of preventing the deposition by moths of eggs in woolen clothing, and of preventing the destruction by insects in natural history museums. In internal medicine it was some years ago brought forward by Dupasquier as an expectorant especially valuable in *chronic bronchitis* accompanied with a large amount of secretion. It has also been used with asserted excellent results as a tænicide, and as a vermifuge in cases of *seat worms*, when it should be given by injection, from fifteen grains to half a drachm in two to three ounces of olive oil. First employed by Rossbach of Jena, in *intestinal catarrh*, it has been largely used in all forms of *intestinal inflammation* and in *typhoid fever*. There seems to be no doubt that in some cases it acts very happily, but the reports concerning it vary, and the remedy is probably inferior to naphthol. Eighty grains are said to have been given in a day without deleterious effects, but J. A. Otte (*Chinese Med. Missionary Journ.*, xi. 1897) violently poisoned himself by eight grains of naphthalene. The symptoms were excessive vomiting and purging and great abdominal pain, followed by nephritis. Moreover, employees in gutta-percha works, where it is largely used, are said to be occasionally thrown into a peculiar condition of delirious intoxication. 77 grains caused in a man a cataract requiring extraction of the lens (*S. J.*, 1902.) Naphthalene has been used externally as an antiseptic dressing, and also in the treatment of various skin diseases. When given

internally, it should always be in the form of powder, and is best administered in capsules.

Dose, one to three grains (0.065 to 0.2 Gm.).

NUX VOMICA. U. S., Br.

NUX VOMICA

(nŭx vŏm'ĭ-cą)

"The dried, ripe seed of *Strychnos Nux-vomica* Linné (Fam. *Loganiaceæ*), yielding, when assayed by the process given below, not less than 1.25 percent. of strychnine." *U. S.* "The dried ripe seeds of Strychnos Nux-vomica, *Linn.*" *Br.*

Semen Nucis Vomicæ; Poison Nut, Quaker Buttons, Dog Buttons; Noix vomique, *Fr. Cod.;* Semen Strychni, *P. G.;* Krähenaugen, Brechnuss, *G.;* Noce vomica, *It.;* Nuez vomica, *Sp.*

Strychnos Nux-vomica, L., *Sp. Pl.* (1753) 189; Willd., *Sp. Plant.* i. 1052; *B. & T.* 178. This tree is of a moderate size, with numerous strong branches, covered with a smooth, dark gray bark. The young branches are long, flexuous, smooth, and dark green, with opposite, roundish-oval, entire, smooth and shining leaves, having three or five ribs, and short footstalks. The flowers are small, white, funnel-shaped, and in terminal corymbs. The fruit is a round berry, about as large as an orange, with a smooth, yellow or orange-colored, hard, fragile rind, and many seeds in a juicy pulp. It has frequently been asserted that the pulp is innocuous, but Flückiger and Hanbury, and also Dunstan and Short (*P. J.,* xv. 1), have demonstrated that it contains strychnine. Dunstan and Short have also proved that of the commercial varieties of nux vomica in percentage of contained strychnine Bombay seed stands first, then Cochin, and lastly Madras. (*P. J.,* 1883, 1053.)

The tree is a native of the East Indies, growing in Bengal, Malabar, on the Coromandel Coast, in Ceylon, in many islands of the Indian Archipelago, in Cochin-China, and in other neighboring countries. The wood and root are very bitter, and are employed in the East Indies for the cure of intermittents. The *radices colubrinæ* and *lignum colubrinum* of the older writers, long known in Europe as narcotic poisons, have been ascribed to this species of Strychnos, under the impression that they were identical with *Strychnos colubrina,* to which Linnæus refers them. They were ascertained by Pelletier and Caventou's researches to contain a large quantity of strychnine. The bark is said by O'Shaughnessy to answer exactly to the description given by authors of the *false Angustura,* and, like that, to contain a large quantity of brucine. The identity of the two barks was confirmed by Pereira by a comparison of specimens. (See *Cusparіæ Cortex.*)

Properties.—The seeds are about three-quarters of an inch in diameter, and two lines in thickness, flat or slightly convex on one side, and concave on the other, with a slight ridge extending from the centre of one side to the edge. They are thickly covered with fine, silky, shining, ash-colored or yellowish-gray hairs, springing from, and indeed composed of, elongated cells of a thin fragile coating or testa, which closely invests the interior nucleus or kernel. This is very hard, horny, usually whitish and semi-transparent, sometimes dark-colored and opaque, and very difficult of pulverization. It is composed chiefly of a hard, horny albumen, which on section is seen to be formed of numerous small parenchymatous cells. In a fissure in the centre lies the embryo. It is about a third of an inch long, with a club-shaped radicle and two cordate, five- to seven-nerved cotyledons. Nux vomica is officially described as "orbicular, nearly flat, sometimes irregularly bent, 15 to 30 Mm. in diameter, 3 to 5 Mm. thick; externally grayish or greenish-gray, the surface covered with short, closely appressed, satiny hairs; rounded or somewhat acute at the margin, with a slight ridge extending from the centre of one side to the edge; internally whitish-gray, horny, very tough, the endosperm in two more or less regular concavo-convex halves, between which, at one end, lie the heart-shaped, palmately nerved cotyledons; inodorous; taste intensely and persistently bitter. Powder light gray, the epidermal cells modified to strongly lignified hairs; endosperm cells thick-walled, containing a fixed oil and aleurone grains, and giving a blue or violet color with potassium dichromate and sulphuric acid; in the tissues of adhering fruit pulp occur a few small, nearly spherical starch grains." *U. S.* The powder is yellowish gray, and has a faint sweetish odor. The seeds are destitute of odor, but have an acrid, very bitter taste, which is much stronger in the kernel than in the investing membrane. They impart their virtues to water, but more readily to diluted alcohol. For a method of distinguishing powdered nux vomica from powdered ignatia and other powders, see *Proc. A. Ph. A.,* 1897, 503.

The chemists Pelletier and Caventou discovered in nux vomica two alkaline principles, *strychnine* and *brucine,* united with a peculiar acid which they named *igasuric.* Its other constituents are a yellow coloring matter, a concrete oil, gum, starch, a small quantity of wax, and several earthy phosphates. Charles Bullock, in preparing the alcoholic extract of nux vomica with a moderate continuous heat, so as to dry it sufficiently to be pulverized, separated from 150 pounds of the seeds 5 pints of a liquid oil. (*A. J. P.,* 1874, 405.)[1] Shenstone (*J. Chem. S.,* xxxix. 453) has shown that the *igasurine* of Desnoix is a mixture of strychnine and brucine. A glucoside, *loganin,*

[1] F. Meyer (*In. Dis.,* St. Petersburg, 1875) investigated the fatty oil from nux vomica, and found it to consist of the glycerides of capric, caprylic, caproic, butyric, and palmitic acids.

has also been found in the nux vomica seeds, but it exists more largely in the surrounding pulp. Dunstan and Short, its discoverers (*P. J.* [3], xiv. 1025), gave to it the formula $C_{25}H_{34}O_{14}$.[1] Boorsma stated that he had discovered a new alkaloid in the leaves of *S. Nux vomica* (*Bull. de l' Inst. Bot. de Buitenzorg*) and he named it *strychnicine;* it is only slightly poisonous. (See also *P. J.*, 1902, 65.)

Strychnine ($C_{21}H_{22}N_2O_2$) was discovered by Pelletier and Caventou in 1818, in both the nux vomica and the bean of St. Ignatius, and received its name from the generic title of the plants (*Strychnos*) to which these two products belong. According to these chemists, it exists much more abundantly in the bean of St. Ignatius than in the nux vomica, the former yielding 1.2 per cent., the latter only 0.4 per cent., of strychnine, but Dragendorff obtained from nux vomica from 1.9 to 2.1 per cent. of mixed alkaloids, about half of which was strychnine. (*Jahresbericht,* 1874, 103.)[2] For valuable practical information about the yield of the alkaloids, extracts, etc., by E. L. Patch, see *Proc. A. Ph. A.*, 1891, 91; also *P. J.*, 1889, 341; *Proc. Michigan Pharm. Assoc.*, 1889; *Proc. Ohio Pharm. Assoc.*, 1889; *P. J.*, 1890, 493.

Brucine ($C_{23}H_{26}N_2O_4$) was discovered by Pelletier and Caventou, first in the bark called *false Angustura,* in combination with gallic acid, and subsequently, associated with strychnine in the form of igasurates, in the nux vomica and the bean of St. Ignatius. It is crystallizable from alcohol, the crystals then containing $4H_2O$. It is without odor, but of a permanent, harsh, very bitter taste; is soluble in 850 parts of cold and in 500 of boiling water; very soluble in alcohol, whether hot or cold; it dissolves in 4 parts of chloroform, 440 parts of ether, 60 parts of benzene, and 120 parts of petroleum benzin. It is permanent in the air, but melts at a temperature a little above that of boiling water, and on cooling congeals into a mass resembling wax. The hydrated crystals melt at 115° C. (239° F.), and sublime at 204° C. (399.2° F.), while the anhydrous base melts at 178° C. (352.4° F.), changing color, and depositing carbon. (*P. J.*, 1868, 375.) It forms crystallizable salts with acids. Concentrated nitric acid produces with brucine or its salts an intense crimson color, which changes to yellow by heat, and upon the addition of stannous chloride becomes violet. A test for brucine, given by Stanislas Cotton, consists in adding to a warm solution of brucine (from 40° to 50° C.) in nitric acid, a concentrated solution of sodium thiosulphate (hyposulphite). The mixture first becomes violet, and then passes to green when the alkaline salt is in excess. (*J. P. C.*, Juillet, 1869, 18.) These effects serve to distinguish brucine from strychnine, and, if produced with the latter alkaloid, evince the presence of the former. According to Larocque and Thibierge, auric chloride produces, with solutions of the salts of brucine, precipitates at first milky, then coffee-colored, and finally chocolate-brown. (*Journ. de Chim. Méd.*, Oct. 1842.) Chlorine water produces with solution of brucine a rose color, due to the formation of *dichlor-brucine.* This is a reddish-brown, hygroscopic powder. (*A. Pharm.*, 1886, 934.) A *dinitro-brucine,* $C_{23}H_{24}(NO_2)_2N_2O_4$, has also been obtained by the action of nitrogen trioxide upon the brucine in alcoholic solution. Brucine appears to bear a definite relation to strychnine in chemical constitution, being a *dimethoxy-strychnine.* According to the analyses of Shenstone and Dragendorff, the bark of the nux vomica contains brucine, with a trace of strychnine, while in the leaves Hooper found only brucine. (*P. J.*, xxi.)

This alkaloid has been detected in the body three months after death, being present in all the solids and fluids, but especially in the liver and kidneys. (*B. M. S. J.*, July 10, 1873, p. 36.) Brucine may be procured from false Angustura bark, in a manner essentially the same as that in which strychnine is procured from nux vomica, with this difference, that the alcoholic extract obtained from the precipitate produced by lime or magnesia should be treated with oxalic acid, and subsequently with a mixture of rectified alcohol and ether, which takes up the coloring matter, leaving brucine oxalate. This is decomposed by magnesia, and the brucine is separated by alcohol, which by spontaneous evaporation yields it in the state of crystals. Prescott (*Organic Analysis,* 1887, p. 458) gives two methods for the separation of strychnine from brucine; first, by the use of

[1] *Loganin* is present in the pulp to the amount of 4 or 5 per cent., and is contained in small quantity also in the seeds. It was obtained by exhausting the pulp with a mixture of chloroform and alcohol (100 : 25). The exhaustion was effected in an apparatus for hot repercolation. The percolate, on cooling, deposited crystals, which when recrystallized a number of times from alcohol, and finally from absolute alcohol, were obtained pure. Loganin is easily soluble in water and alcohol, less soluble in ether, chloroform, and benzene. Its aqueous solution is not precipitated by any of the alkaloidal reagents. Its most characteristic reaction is found in its behavior with concentrated sulphuric acid. A very small quantity of loganin, when gently warmed with a few drops of concentrated sulphuric acid, yields a fine red color, which, on standing, develops into a deep purple. By boiling with dilute sulphuric acid, loganin is resolved into glucose (reducing Fehling's solution), and a body for which the name *loganetin* is proposed. This substance, like loganin, gives the characteristic reaction with sulphuric acid, but the purple color does not develop so rapidly. Loganetin is soluble in water and alcohol, less soluble in ether, carbon disulphide and chloroform. (*P. J.*, 1884, p. 1025.)

[2] Other species of Strychnos contain the poisonous alkaloids, and may some time become a commercial source of them. *Bidara laut* of the Indian bazaars, believed to be obtained from *S. ligustrina*, has been analyzed by Russow, who found the wood to contain 2.26 per cent. and the bark 7.38 per cent. of brucine without strychnine. Henry G. Greenish found in the wood and bark respectively of *S. colubrina* 0.96 per cent. and 5.54 per cent. of mixed alkaloids; the same analyst obtained from false Angustura bark (*S. Nux vomica*), young bark 3.10 per cent., old bark 1.68. (*P. J.*, 3d ser., ix. 1014.) According to Bernelot-Moens, the dry seeds of the *S. tieute* contain 1.469 per cent. of strychnine, with a trace of brucine. (*A. J. P.*, 1866, p. 506.) From the seeds of *Strychnos Rheedii*, W. R. Dunstan obtained a yield of 0.06 per cent. of brucine and no strychnine. (*Imp. Inst. Rep.*, 1901-2.)

alcohol of 0.97 sp. gr., which easily dissolves brucine, but has very slight solvent power upon strychnine; second, by Dunstan and Short's method with potassium ferrocyanide. This method has been reported upon by Holst and Beckurts (*Ph. Centralh.*, N. F., 1887, p. 119), who find that if the hydrochloric acid solution containing mixed alkaloids is not too dilute, on the addition of potassium ferrocyanide the whole of the strychnine will be precipitated as ferrocyanide, while the brucine salt will remain in solution.

The separation of brucine from strychnine is most conveniently effected by exposing the mixed alkaloids to the action of diluted nitric acid, which destroys brucine very rapidly while having no appreciable action on strychnine; this method is used in the official assay process (see below).

Igasurine was said to be found in the mother waters from which strychnine and brucine have been precipitated by lime. Jörgensen believed that it was identical with brucine (see *A. J. P.*, June, 1872, p. 257), and W. A. Shenstone confirmed this view. (*A. J. P.*, Dec. 1881.) Recent investigations show, however, that its existence is very doubtful.

Igasuric acid has been regarded as erroneously named, and investigators have stated that it was malic acid and tannic acid, while G. Sander (*A. Pharm.*, 1897, 133) believes that the acid found in nux vomica, heretofore known as igasuric acid, is *caffeo-tannic acid.*

The official process for determining the amount of strychnine present in nux vomica is as follows:

Assay. U. S. (8th Rev.)—"Nux Vomica, in No. 60 powder, *twenty grammes;* Ammonia Water, Ether, Chloroform, Alcohol, Normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Nitric Acid (sp. gr. 1.40), Sodium Hydroxide Solution (1 in 10), Tenth-normal Sulphuric Acid V.S., Sulphuric Acid Solution (3 percent. H_2SO_4), Iodeosin T.S., each, *a sufficient quantity.* Introduce the Nux Vomica into a 250 Cc. Erlenmeyer flask and add to it 200 Cc. of a mixture of 137.5 Cc. of ether, 44 Cc. of chloroform, 13.5 Cc. of alcohol and 5 Cc. of ammonia water; insert the stopper securely and macerate with frequent shaking during one hour and allow it to stand in a cool place for twelve hours. Decant into a measuring cylinder 100 Cc. of the liquid (representing 10 Gm. of Nux Vomica), and pour this into a separator, preferably of a globular shape. Rinse the cylinder with a little chloroform, add this to the separator, and then add 15 Cc. of normal sulphuric acid V.S.; shake the mixture moderately during one minute, being careful to avoid emulsification; when the liquids have separated completely, draw off the acid liquid into a beaker. Repeat the shaking out with successive portions of 5 and 3 Cc. of normal sulphuric acid V.S.; collect the acid solutions and pour them into a separator. If a drop of the last acid solution yields a precipitate with mercuric potassium iodide T.S., repeat the shaking out of the ether solution with 5 Cc. of normal sulphuric acid V.S. To the combined acid solutions in the separator, add a small piece of red litmus paper, 25 Cc. of chloroform and then sufficient ammonia water to render the liquid alkaline, and shake the separator thoroughly. When the liquids have separated draw off the chloroform into a flask of 100 Cc. capacity, and repeat the shaking out of the alkaline liquid with two successive portions of 15 Cc. each of chloroform, adding the latter to that already in the flask. Evaporate the combined chloroformic solutions in the flask until the alkaloidal residue is dry, then dissolve it in 15 Cc. of sulphuric acid (3 percent.) warming it on a water-bath. When the solution has cooled, add 3 Cc. of a cooled mixture of equal volumes of nitric acid (specific gravity 1.40) and distilled water, and after rotating the liquid a few times, set it aside for exactly ten minutes, shaking it gently three times during this interval. Transfer the resulting red liquid to a separator containing 25 Cc. of an aqueous solution of sodium hydroxide (1 in 10) and wash the flask three times with very small amounts of distilled water, and add the washings to the separator. If the liquid is not turbid add 2 Cc. more of the solution of sodium hydroxide. Now add 20 Cc. of chloroform to the separator, and shake it well by a rotating motion for a few minutes, allow the liquids to separate, and draw off the chloroform through a small filter wetted with chloroform, into a flask. Repeat this twice, using 10 Cc. of chloroform each time, and draw off both portions into the flask, using the same filter. Finally, wash the filter and funnel with 5 Cc. of chloroform, and then evaporate all the chloroform by means of a water-bath very carefully, to avoid decrepitation. To the alkaloidal residue add 6 Cc. of tenth-normal sulphuric acid V.S., 5 drops of iodeosin T.S., about 80 Cc. of distilled water, and 20 Cc. of ether. When all the alkaloid is dissolved, titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. until the aqueous liquid just turns pink. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract this number from 6 (the 6 Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.0332, and this product by 10, which will give the percentage of strychnine in the Nux Vomica." *U. S.*

As a test for nux vomica, Vielgruth proposes to treat a few grains of the suspected powder with proof spirit, evaporate the tincture to dryness at a heat not exceeding 96° F., then add a drop or two of diluted sulphuric acid, and again raise to the heat mentioned. If nux vomica be present, a beautiful carmine-red color will be produced, which will disappear in ten or fifteen minutes after cooling, and reappear, but less brightly, on the reapplication

of the heat. Schweissinger recommended the direct determination of the alkaloids in nux vomica by titration with hydrochloric acid as the best way of ascertaining the strength of pharmaceutical preparations. (*A. Pharm.*, 1885, 579.) Keller's method of estimating the alkaloids in nux vomica (see *Proc. A. Ph. A.*, 1895, 1024) is commended by Sander. (*A. Pharm.*, 1897, 133; see also *A. J. P.*, 1896, 189.)

Brucine.—On account of the difficulty of separating strychnine from brucine, it has been found by physiologists difficult to determine the exact action upon the human organism of the pure alkaloid. It would seem, however, from the studies of Reichert, made upon carefully tested brucine, that its physiological action is similar to that of strychnine, except that it is much less rapidly absorbed than is strychnine, is from forty to fifty times less powerful as a convulsant, is more poisonous to the sensory nerves, and is more uncertain in its effects upon bodily temperature. When brucine is brought in contact with the nerves of the frog it produces a rapid paralysis of the sensory fibres. Mays found that a five or ten per cent. solution of chemically pure brucine applied to the mouth of man causes rapid loss of sensibility, and asserts that a twenty per cent. solution is capable of exerting a decided local anæsthetic influence when placed upon the skin. He has found it very advantageous for the relief of the itching of *chronic pruritus*. Zeiss and Burnett find that a five per cent. solution gives a great relief as a local application in inflammations about the external ear, Burnett affirming that his results have been far more satisfactory than those which he has obtained with cocaine.

Uses.—The medicinal and toxic properties of nux vomica are those of its alkaloid. (See *Strychnina.*) The belief held by some physicians that it acts more favorably as a bitter upon the stomach has only this much of justification,—namely, that it is more slowly absorbed, and therefore acts locally somewhat more persistently.

Dose, one to four grains (0.065 to 0.26 Gm.).

Off. Prep.—Extractum Nucis Vomicæ, *U. S.*, *Br.* (from liquid extract); Fluidextractum Nucis Vomicæ, *U. S.* (*Br.*); Tinctura Nucis Vomicæ, *U. S.* (from extract), *Br.* (from liquid extract).

OLEA

OILS

(ō'lę-ą)

These are liquid or solid substances, unctuous to the touch and characterized by inflammability and the property of leaving a greasy stain upon paper. They are divided into two classes, the *fixed* and the *volatile*, because distinguished, as their names imply, most readily by their different behavior on the application of heat.

OLEA FIXA. *Fixed Oils.*

Fats, Fatty Oils; Huiles Graisses, Huiles fixés, *Fr.*; Fette, Fette Oele, *G.*; Olios, *It.*; Aceites, *Sp.*

These are sometimes termed *fatty oils*, because they constitute in part the vegetable and animal fats. The distinction between liquid and solid fats is for the most part a physical one only, as they contain the same chemical compounds, although in relatively different proportions. The fatty oils, though existing in greater or less proportion in various parts of plants, are furnished for use exclusively by the fruit, and, as a rule, are most abundant in the dicotyledonous seeds. They are obtained either by submitting the bruised seeds to pressure in hempen bags, or by boiling them in water, and skimming off the oil as it rises to the surface. When pressure is employed, it is customary to prepare the seeds for the press by exposing them to a moderate heat, so as to render the oil more liquid and thus enable it to flow out more readily. Another mode of extracting certain oils is by means of liquids having the power of dissolving them, and this method is now largely used in practice, carbon disulphide, carbon tetrachloride, and petroleum benzin being used. For the details of the process, see *A. J. P.*, Nov. 1868, 549. Fixed oils may be clarified by subsidence, filtration through animal charcoal or porous solids, precipitation with tannin, lead acetate, plaster of Paris, albumin, gelatin, or other agents; cellulose and asbestos filters are often used, and on the large scale, for separating mechanical impurities, centrifugal machines like those employed for milk. Fixed oils containing stearin or palmitin are likely to deposit these fats in cold weather, leaving the olein in a liquid condition. The olein may be separated by filtration in the cold.

Classification.

The following scheme of classification of the fixed oils, both liquid and solid (Allen, *Com. Org. Anal.*, 3d ed., vol. ii. part 1. pp. 88 to 102), gives a general view of their essential characters, points of difference, etc.

I. Olive Oil Group. *Vegetable Non-drying Oils.*—The oils of this group solidify on treatment with nitrous acid or mercuric nitrate, but do not lose their power of producing a greasy stain on paper, however long they may be exposed to the air. Their density varies from 0.914 to about 0.920, and hence is less than that of Groups III, IV, and V. Their fluidity is notably less than that of the drying oils.

This group includes almond oil (from *Amygdalus communis*), peach oil (from kernels of *Prunus Persica*), apricot oil (from kernels of *Prunus armeniaca*), oil of ben (from *Moringa oleifera*), earth nut oil (from *Arachis hypogæa*), and olive oil (from *Olea europæa*).

II. Rape Oil Group.—The oils of this group are all derived from the *Cruciferæ*. They

are non-drying but less distinctly so than the oils of Group I. They show higher saponification values, higher iodine absorption and less solid elaidins than Group I.

This group includes Colza oil and rape seed oil (from *Brassica campestris, B. napus* and other species); oil of black mustard (from seeds of *Brassica nigra*); oil of white mustard (from seeds of *Sinapis alba*).

III. Cotton Seed Oil Group.—The oils of this group occupy a position intermediate between the vegetable non-drying and the true drying oils (Groups I and IV). In density they somewhat exceed the oils of Group I, but are lighter than those of Groups IV and V. They form more or less elaidin on treatment with nitrous acid or mercuric nitrate, but do not become wholly solidified. On the other hand, they undergo more or less drying on exposure to the air, but not so markedly as the oils of Group IV.

This group includes beech nut oil (from *Fagus sylvatica*), cotton seed oil (from *Gossypium barbadense* and other species), hazel nut oil (from *Corylus avellana*, see *Proc. A. Ph. A.*, 1893), sesame or teel oil (from *Sesamum orientale*), and sunflower oil (from *Helianthus annuus; H. perennis*), camelina oil (from *Myagrum sativum*), and cress seed oil (from *Lepidium sativum*).

IV. Linseed Oil Group. *Vegetable Drying Oils.*—These oils are not solidified by treatment with nitrous acid or mercuric nitrate, but become gradually converted into solid masses or varnishes, by exposure to the air. In density the oils of this group vary from about 0.923 to 0.937, and hence are distinctly heavier than the non-drying oils and than most of the oils of Group III. On the other hand, they are lighter than the oils of Group V. The fluidity of the drying oils is also much higher than that of the non-drying oils.

This group includes niger seed oil (from *Guizotia oleifera*), hemp seed oil (from *Cannabis sativa*), linseed oil (from *Linum usitatissimum; L. perenne*), poppy seed oil (from *Papaver somniferum*), Scotch fir seed oil (from *Pinus sylvestris*), tobacco seed oil (from *Nicotiana Tabacum*), walnut oil (from *Juglans regia*), and weld seed oil (from *Reseda Luteola*).

V. Castor Oil Group.—The oils of this group are distinguished from those of Groups I, II, III, and IV, by their very high density and viscosity (*i.e.*, deficient fluidity). They are also remarkable for their ready solubility in alcohol, and their marked purgative properties. In their drying characters and behavior with the elaidin test they resemble the oils of the cotton seed oil group. Both castor and croton oil are miscible in all proportions with glacial acetic acid.

This group includes castor oil (from *Ricinus communis*), croton oil (from *Croton Tiglium*), Japanese or Chinese wood oil (from seeds of *Aleurites cordata* or *Elæococca vernicia*), boiled linseed oil, blown oils (made by oxidation of rape seed, cotton seed, linseed, lard, and other oils).

VI. Palm Oil Group. *Solid Vegetable Fats.* This group includes solid fats not containing notable quantities of glycerides of lower fatty acids. The densities for the melted fats at 98° and 99° C. are compared with the density of water at 15.5° C., taken as 1.000, and vary from 0.920 to 0.995.

This group includes palm oil (from fruit of *Elæis guineensis*), cacao butter (from nuts of *Theobroma Cacao*), nutmeg butter (from nuts of *Myristica fragrans*), and shea butter (from seeds of *Bassia Parkii*).

VII. Cocoanut Oil Group. *Solid Vegetable Fats.*—This group includes solid fats containing notable quantities of glycerides of lower fatty acids,—that is, of acids distilling with more or less facility in a current of steam at 100° C. The group includes cocoanut oil (from the nuts of *Cocos nucifera*), palm nut oil (from the kernels of the nuts from *Elæis guineensis*), laurel oil (from fruit of *Laurus nobilis*), Japan wax (berries of *Rhus succedanea*), myrtle wax (berries of *Myrica cerifera*). For a description with constants of some of the rarer fixed oils belonging to the vegetable group see papers by J. A. Wijs, *Ph. Zeit.*, 1903, 563; by Pancoast and Graham, *A. J. P.*, 1904, 70; and by Lewkowitsch, *P. J.*, 1904, 492.

VIII. Lard Oil Group. *Animal Oleins.*—This group includes those oils fluid at ordinary temperatures which are obtained from terrestrial animals. They resemble the whale or fish oils in their reaction with chlorine, but are not turned red or brown by boiling with caustic soda. On exposure to air and on treatment with nitrous acid or mercuric nitrate, they behave like the non-drying vegetable oils (Group I).

This group includes bone oil, lard oil, tallow oil, and neat's-foot oil. For a paper by P. L. Simmonds on various animal oils see *Bull. Pharm.*, 1893, 297, 344.

IX. Tallow Oil Group. *Solid Animal Fats.* This group comprises oils that are solid or semi-solid at ordinary temperatures. Their melting points vary somewhat, and are capable of permanent alteration. The group includes bone fat, butter fat, butterine and oleomargarine, hog's lard, horse fat, beef tallow and mutton tallow, and wool-fat (suint).

X. Whale Oil Group. *Marine Animal Oils.*—This group comprises the various fluid oils obtained from fish and cetaceous mammals. They are distinguished as a class by their offensive fishy odor, by the brown color they assume when subjected to the action of chlorine, and by the reddish color which is produced on boiling them with a solution of caustic alkali. With sulphuric acid they give colorations varying from light red to purple or brown. The fish oils do not dry up on exposure to air, and mostly yield but little elaidin on treatment with nitrous acid. The term *"train oil"* includes whale, seal, shark, cod,

and all similar oils. Cod oil (from *Gadus morrhua* and allied species), cod liver oil (from the same), menhaden oil (from *Alosa menhaden*), porpoise oil (from *Delphinus phocæna* and allied species), seal oil (from *Phoca* of various species), shark oil (from *Squalus maximus* and allied species), and whale oil (from *Balaena mistecetus* and allied species), are all members of this group.

XI. Sperm Oil Group. *Liquid Waxes.*—The members of this group differ from all the fatty oils of previous classes in not being glycerides, consisting essentially of esters of monatomic alcohols of the ethylic series, in which respect they resemble the true waxes, but are fluid at ordinary temperatures. They are less dense than glycerides, they do not dry or thicken notably on exposure to air, but they yield solid elaidins on treatment with nitrous acid. The group includes sperm oil (from cranial cavities of *Physeter macrocephalus*), doegling or bottle-nose oil, and dolphin oil.

XII. Spermaceti Group. *Waxes proper.* Spermaceti and the various waxes differ from the true fixed oils and fats in not forming glycerin when saponified, yielding instead certain of the higher monatomic alcohols, the identity of which varies with the nature of the wax. These alcohols are insoluble in water, and dissolve to but a limited extent in alcohol, but they are soluble in ether, chloroform, carbon disulphide, benzene, and petroleum benzin, and are apt to be mistaken for added paraffin wax when the substance is saponified and the soap extracted with a solvent.

This group includes beeswax (from honeycomb of various species of bees), Carnauba or Brazil wax (from the leaf-coverings of *Copernicus cerifera*), Chinese wax or Pela wax (produced by a species of *Coccus* which punctures the branches of certain trees), myrtle wax (from berries of *Myrica cerifera*), Ocuba wax (from *Myrica Ocuba*), palm wax (from bark of *Ceroxylon andicola*, of the Cordilleras), and spermaceti (deposit from the oil found in the cranial cavities of the sperm whale, *Physeter macrocephalus*).

When oils are decomposed by heat they emit vapors of *acrolein*, a highly volatile liquid resulting from the decomposition of glycerin, upon which the fumes of oils mainly depend for their irritating effects on the eyes and nostrils. Exposed to a red heat, in closed vessels, they yield, among other products of the destructive distillation, a large quantity of combustible and illuminating gases, among which ethylene and acetylene are readily recognized. Heated in the open air, they take fire, burning with a bright flame, and producing water and carbon dioxide. When kept in air tight vessels, they remain unchanged for a great length of time, but exposed to the atmosphere they attract oxygen and undergo change.[1] Some, in drying, lose their unctuous character, and are converted into a transparent, yellowish, flexible solid. These are called *drying oils*. Others, especially such as contain mucilaginous impurities, become rancid, acquiring a sharp taste and an unpleasant odor. This change is owing to the formation of an acid, from which the oil may be freed by boiling it for a short time with magnesium hydroxide and water.[2] The fixed oils are insoluble in water, but are miscible with that fluid by means of mucilage, forming mixtures which are called emulsions. They are in general very sparingly soluble in alcohol, but readily dissolved by ether, which serves to separate them from other vegetable proximate principles. By the aid of heat they can dissolve sulphur and phosphorus. The stronger acids decompose them, giving rise, among other products, to oleic, palmitic, and stearic acids. Boiled with diluted nitric acid, some of them give rise to malic and oxalic acids, besides other substances usually resulting from the action of this acid upon vegetable matter. Several acids are dissolved by them without producing any sensible change. They are decomposed by salifiable bases, which set free glycerin and oleic, stearic, or other fatty acids, which acids unite with the base employed. The compounds which these acids form with potassium and sodium hydroxide are called soaps. (See *Sapo* and *Emplastrum Plumbi.*) By the addition of one part of potassium or sodium carbonate, 160 parts of oil may be brought with distilled water into the form of an emulsion. The potassium and sodium soaps and the alkaline sulphides have a similar effect, but not

[1] *Effervescent Oils.*—K. Dieterich recommends oils and fats which have been super-saturated with carbon dioxide and introduced by him under the name of "effervescent oils" (see *Proc. A. Ph. A.*, 1900, 494). Under the influence of carbon dioxide, compounds which are easily split with the fatty acids are produced, which, particularly in the case of cod liver oil, permit the more complete absorption of the oil than is the case with oil not treated with carbon dioxide. The latter, moreover, acts as a preservative of the oils and renders them more palatable, destroying the unpleasant taste of cod-liver oil, and to a certain extent also that of added medicaments very materially. The absorbability of carbon dioxide is, however, not the same in all oils. Cod liver oil is capable of absorbing the largest quantity, castor oil the smallest, while olive oil stands intermediate. (*Ph. Centralh.*, 1901, 485.)

[2] Cloes has made investigations in relation to the influence of light in promoting oxidation, and obtained some curious results. The general influence of light is very great, as oils undergo comparatively little change in the dark for a long time; though in relation to some of them the change is at length as great as under the light. Thus, while the oil of poppies had in 30 days increased about 5 per cent. in weight under colorless light, and had gained only a 5000th in the dark, yet at the end of 150 days the weight in the former condition was rather lessened than augmented, and in the latter, or in the dark, had increased 6.4 per cent. The effect of the different colored rays is also very different. The change is at first most rapid under the white light, less so under the blue, and much less under the red, yellow, and green, being least of all with the green; but with the advance of time the blue overtakes and even passes the white and at the end of three or four months all are about equal in effect. Heat also accelerates the concretion of the oils, by favoring their oxidation; and the same effect is produced by introducing into the unchanged oil a little which has already been altered by exposure to the air. The oxidation of an oil may be very greatly hastened in this way without the aid of heat. (*J. P. C.*, 4e sér., ii. 345, 1865.)

the bicarbonates. The fixed oils also serve as good vehicles for various metallic bases and subsalts, which form soaps to a certain extent soluble in the oil, and thus become less irritant to the tissues. Oils thus impregnated may, like the pure oils, be brought to the state of emulsion with water, for convenient administration, by the addition of a small proportion of potassium carbonate. The fixed oils dissolve many of the alkaloids, the volatile oils, resin, and other proximate principles of plants. The alkaloids are more readily dissolved in them by being first combined with oleic acid, the oleates being more soluble than the alkaloids themselves. (Attfield, *P. J.*, March, 1863, p. 308.) According to Buignet, they are, with very few exceptions, indifferent to polarized light; of all those used in medicine, the only exceptions being the liver oils of the ray and dog fish, which have a very feeble lævo-rotatory power, and castor oil, which is decidedly dextrogyrate. (*J. P. C.*, Oct. 1861, p. 264.)

It is very likely that, with the exception of castor oil, whose rotatory power is due to the asymmetric carbon atom of the ricinoleic acid, the rotatory power is not due to the glycerides themselves but to small proportions of optically active substances such as cholesterol. (Lewkowitsch, *Chem. Analysis of Oils, Fats and Waxes,* p. 121.)

The fixed oils, whether animal or vegetable, in their natural state consist in most cases of at least two or three distinct oleaginous ingredients, one liquid at ordinary temperatures, and the other two concrete. The liquid is a distinct proximate principle, called *olein;* the concrete principles consist of *stearin* and *palmitin,* the former being found most largely in animal and the latter in vegetable oils or fats, and the two in most cases existing together in the same oil. As the most frequent of these proximate constituents of the fixed oils, and existing in many different oleaginous substances, olein, palmitin, and stearin merit a special notice. Preliminarily to their individual consideration, it will be proper to refer to their nature and composition generally.

These three substances, *olein, palmitin,* and *stearin,* together with *butyrin, caprin,* and other minor fat principles, are *glycerides;* that is, esters or salts of the triatomic alcohol glycerol, $C_3H_5(OH)_3$, and of the several fatty acids, oleic, palmitic, stearic, etc., all of which are monobasic acids. The three mentioned glycerides have the following composition:

$$\text{Olein, } C_3H_5\begin{cases}OC_{18}H_{33}O\\OC_{18}H_{33}O\\OC_{18}H_{33}O\end{cases}$$

$$\text{Palmitin, } C_3H_5\begin{cases}OC_{16}H_{31}O\\OC_{16}H_{31}O\\OC_{16}H_{31}O\end{cases}$$

$$\text{Stearin, } C_3H_5\begin{cases}OC_{18}H_{35}O\\OC_{18}H_{35}O\\OC_{18}H_{35}O\end{cases}$$

When these substances, or oils composed principally of them, are treated with alkali with the aid of heat, the following decomposition takes place:

$$C_3H_5\begin{cases}OC_{18}H_{33}O\\OC_{18}H_{33}O\\OC_{18}H_{33}O\end{cases} + 3NaOH =$$

$$C_3H_5\begin{cases}OH\\OH\\OH\end{cases} + 3Na.OC_{18}H_{33}O$$

that is, olein is decomposed by sodium hydroxide into *glyceryl hydroxide,* or *glycerol,* and *sodium oleate,* or a sodium soap.

The waxes differ from the fats proper in being esters of the higher monatomic alcohols, like *cetyl alcohol,* $C_{16}C_{33}.OH$, and *myricyl alcohol,* $C_{30}H_{61}.OH$, instead of being glycerides. The fatty acids present are partly palmitic and stearic, but more largely still higher ones, like *cerotic acid,* $C_{27}H_{54}O_2$.

Olein. Elain. Liquid Principle of Oils.—It is extremely difficult to obtain olein pure. Being in most oils associated with the solids stearin and palmitin, it must be separated by pressure and other mechanical means, which separation is not always perfectly effected. As ordinarily procured, therefore, olein contains more or less of palmitin or stearin, or both. In this somewhat impure state it is obtained either by the agency of alcohol or by expression. When one of the oils, olive oil, for example, is dissolved in boiling alcohol, the solution, on cooling, deposits the concrete principles, still retaining the olein, which it yields upon evaporation. The other method consists in compressing one of the solid fats, or one of the liquid oils rendered concrete by cold, between folds of bibulous paper, which absorb the olein, and give it up afterwards by compression under water. Olein is a liquid of oily consistence, congealing at —6° C. (21.2° F.), colorless when pure, with little odor and a sweetish taste, insoluble in water, soluble in boiling alcohol and ether. Its formula, as already stated, is $C_3H_5(OC_{18}H_{33}O)_3$, being an oleate of the triad radical *glyceryl,* C_3H_5. By reaction with nitric acid, or, more exactly stated, under the influence of nitrous acid fumes, olein is converted into a deep yellow, butyraceous mass. If this be treated with hot alcohol, a deep orange-red oil is dissolved, and a peculiar fatty matter remains, called *elaidin.* This is white, crystalline, fusible at 34° C. (93.2° F.), insoluble in water, readily soluble in ether, and appears to be isomeric with olein. It is resolved by saponification with the alkalies into *elaidic acid* and glycerin.

Palmitin.—Palmitic acid occurs in the more liquid fats, such as palm oil and cocoa-nut oil, as well as in butter and human fat, as glyceride, while in spermaceti and some forms of wax it is combined with monatomic alcohol radicals. Palmitin is the *palmitic acid glyceride,* or *glyceryl tripalmitate.* It is best obtained from palm oil.

Stearin.—This exists abundantly in tallow and other animal fats. It may be obtained by treating the concrete matter of lard, free from olein, by cold ether so long as anything is dissolved. The palmitin is thus taken up, and stearin remains. A better method is to dissolve suet in heated oil of turpentine, allow the solution to cool, submit the solid matter to expression in unsized paper, repeat the treatment several times, and finally dissolve in hot ether, which deposits the stearin on cooling. This is concrete, white, opaque in mass, but of a pearly appearance as crystallized from ether, pulverizable, fusible at 66.5° C. (152° F.), soluble in boiling alcohol and ether, but nearly insoluble in those liquids cold, and quite insoluble in water. It consists of glyceryl and stearic acid in combination as a glyceride, $C_3H_5(OC_{18}H_{35}O)_3$, and has been formed synthetically by heating a mixture of these two materials to 280° to 300° C.

Margarin.—What was long known under this name was stated by Heintz in 1852 (*J. Pr. Chem.*, 56, p. 1) to be a mixture of stearin and palmitin, and this view is now universally accepted by all authorities.

The fixed oils are liable to certain spontaneous changes, which have been investigated by Pelouze and Boudet. It appears from their researches that the oils are accompanied, in the seeds which contain them, with principles which act as a ferment and cause the oils to resolve themselves spontaneously into the several fatty acids which they afford on saponification, and into glycerin. This change takes place in the seeds as soon as the cells containing the oils are broken, so as to permit the contact of the fermenting principle existing in the grain. The decomposition of fats by the action of enzymes has been made a working method capable of technical application, by Connstein, Hoyer and Wartenburg. The enzyme contained in the castor oil bean has been found best adapted for this. An emulsion of fats, water, 10 per cent. of ground castor oil beans and a small amount of free acid are used, when the decomposition proceeds rapidly. As rancidity in fats renders them altogether useless in pharmacy, and as it is not always readily discoverable by the senses in its earlier stages, it becomes desirable to possess a test by which it may be detected. Such a test is to be found, according to Thos. B. Groves, in potassium iodide, which is rapidly decomposed by the new principles developed, and the orange-brown discoloration produced by the liberation of the iodine indicates the existence of rancidity, and the degree of that discoloration, approximately, the extent of the change. The alteration of color is said by Groves to be plainly perceptible when only one-twentieth of rancid fat is present. The presence of water in a fatty oil favors the production of rancidity.

It is also extremely important to be able to protect fats against this change. The complete exclusion of air, light, and moisture—and, when in relation to air this may not be entirely practicable, the destruction by heat of the ferment-germs contained in the air, by which the decomposition is often originated—will go far to effect this object; but it would often be very inconvenient, if not impossible, to carry these measures into complete effect, and hence the discovery of substances which may have the effect of retarding, if not wholly preventing, these fermenting processes, whether by the destruction of the ferment-germs or otherwise, is extremely desirable; this preservative effect has been known and practically used many years, and since the principle upon which they are supposed to act has been discovered the number has been extended. Thus, benzoin rubbed up with fats is well known to preserve them long against rancidity, and *benzoinated lard,* made by mixing ten per cent. of benzoin with melted lard, is one of the official preparations, and the buds of the poplar (*Populus nigra*) are perhaps still more effectual, as, according to Deschamps, lard impregnated with their virtues will keep good indefinitely. In the French Codex the poplar buds are employed in the *Pommade de Bourgeon de Peuplier,* in which 8 parts of the dried buds are used to 40 parts of the ointment, consisting of lard impregnated with the virtues of several narcotic substances, the fresh narcotic plants being boiled with lard until all their water is evaporated, and the buds afterwards digested in the strained liquid for 24 hours. Groves made experiments with many volatile oils and other analogous substances to test their preservative power, and, while many of them were found to have considerable effect, as cloves, Peruvian balsam, sassafras, guaiacum, and creosote, yet the one which appeared to act most efficiently was the *oil of pimenta,* and he proposes to add to the official *prepared lard* of the British Pharmacopœia either oil of pimenta or balsam of Peru, in the proportion of two drops to the ounce, in order to contribute to its preservation. (See *A. J. P.,* 1865, 54, 61.)

Animal fats are especially liable to become rancid when kept, and it is very desirable to obviate this effect, for, instead of having the mild demulcent properties which constitute their chief value, they become irritant, and unfit as vehicles for other substances to be applied to the skin. Hirzel says that animal fats may be kept in a good condition for a year by the following plan. Mix 14 pounds of the recently melted fat with 5 drachms of common salt and 15 grains of alum, in fine powder, heat till a scum is formed on the surface, separate the scum, and, when the clear liquid has cooled, wash it many times with water with malaxation, so as to remove all the salt, then evaporate the water at a heat insufficient to injure the fat. (*A. J. P.,* 1868, 334.)

The adulteration of the fixed oils may be effected in two ways,—by admixture with the

fatty oil of substances distinctly foreign to the fats, and by adding a cheaper or inferior oil to one of greater value. In the former case we may have the addition of paraffin wax, ceresine, mineral oils, neutral tar oils, resin oils, resin, and waxes. Of these, the first three are entirely unsaponifiable, resin oils contain but small quantities of saponifiable substances, waxes are partly saponifiable, and resin almost completely saponifiable. The determination of unsaponifiable matter is therefore of great importance. The common method for this is to saponify the suspected sample with alcoholic potassium hydroxide and then to shake out the unsaponifiable matter with ether or petroleum ether. From this solution, on evaporation, will be obtained the mineral, resin, or tar oils that may have been present. For these there are appropriate tests elsewhere noted. In case a cheaper oil or fat has been added for the purpose of adulterating a more valuable one, we must be guided by the determination of certain constants, such as those mentioned below by Cowley, or by the indication of certain qualitative color tests. The constants referred to are much more to be depended upon in such a case.

R. C. Cowley (*P. J.*, 1897, 331) regards the following as the most important determinations in examining fats and fixed oils. 1. Specific gravity. 2. Melting and solidifying points. 3. Melting and solidifying points of fatty acids. 4. Behavior with solvents. 5. The Hehner value. 6. The Reichert-Meissl value. 7. The saponification value. 8. The iodine value.

It is sometimes desirable to deprive the fixed oils of color. The following process for this purpose is recommended by Brunner. The oil is first brought to the state of emulsion by strongly agitating it with water rendered mucilaginous by gum or starch; the emulsion is treated for each part of oil with two parts of wood charcoal, previously well heated and coarsely powdered, the finer particles being sifted out; the pasty mass is then completely dried at a heat not exceeding 212° F., and exhausted by cold ether in a percolator; finally, the ethereal solution, having been allowed to stand, in order that any charcoal present in it may subside, is submitted to distillation, so as to separate the ether, and the oil remains colorless in the retort. (*J. P. C.*, Sept. 1858.) Berlandt recommends the following method. Shake strongly for some minutes 900 parts of the fixed oil with 120 parts of water holding in solution 3 parts of potassium permanganate, allow the mixture to stand for some hours in a warm place, and then filter. The oil becomes colorless. (*J. P. C.*, Oct. 1867.)

OLEA VOLATILIA. [*Olea Destillata.*]

Volatile Oils.

Olea Ætherea, Ætherolea; Ethereal Oils, Essential Oils, Distilled Oils; Huiles Volatiles, Huiles Essentielles, Huiles Distillées, Essences, *Fr.*; Flüchtige Oele, Aetherische Oele, *G.*; Essenze, *It.*; Esencias, *Sp.*

These are sometimes called *distilled oils*, from the mode in which they are usually procured; sometimes *essential oils*, from the circumstance that they possess, in a concentrated state, the properties of the plants from which they are derived. They exist in all odoriferous vegetables, sometimes pervading the plant, sometimes confined to a single part; in some instances contained in distinct cellules, and preserved after desiccation, in others formed upon the surface, as in many flowers, and exhaled as soon as formed. Occasionally two or more are found in different parts of the same plant. Thus, the orange tree produces one oil in its leaves, another in its flowers, and a third in the rind of its fruit. In a few instances, when existing in distinct cellules, they may be obtained by pressure, as from the rind of the lemon and orange; but they are generally procured by distillation with water. (See page 819.) Some volatile oils, as those of bitter almond and mustard, are formed, during the process of distillation, out of substances of a different nature pre-existing in the plant.

The volatile oils are usually yellowish, but often brown, red, green, or blue, and occasionally colorless. There is reason, however, to believe that in all instances the color depends on foreign matter dissolved in the oils. Septimus Piesse succeeded, by the fractional distillation of certain volatile oils, in separating a blue liquid, which, by repeated rectification, he has obtained quite pure. In this state it has the sp. gr. 0.910, and a fixed boiling point of 302.3° C. (572° F.), and yields a dense blue vapor having peculiar optical properties. He named this principle *azulene*, and believed that upon it depends the blueness of volatile oils wherever existing. The yellowness of the oils he ascribed to the resin resulting from their oxidation, the green and brown colors to a mixture of azulene and resin in various proportions. The formula of azulene he gave as $C_{16}H_{26}O$. (*Chem. News*, Nov. 21, 1863, p. 245.) Gladstone named this blue coloring constituent *cæruleïn*, and stated that it contains nitrogen and is colored green by acids and alkalies. The volatile oils differ from the fixed oils in not yielding glycerol when treated with alkalies.

The volatile oils have a strong odor, resembling that of the plants from which they were procured, though generally less agreeable. Their taste is hot and pungent, and, when they are diluted, is often gratefully aromatic. The greater number are lighter than water; some are heavier, and their sp. gr. varies from 0.847 to 1.17. They partially rise in vapor at ordinary temperatures, diffusing their peculiar odor, and are completely volatilized by heat. When distilled alone, they nearly always undergo partial decomposition. Heated in the open air, they take fire and burn with a bright flame attended with much smoke. Almost all those hitherto examined have the property of very decidedly deviating the plane of polarization of light, some in one direction, and some

in the other, and advantage may sometimes be taken of this property to detect adulterations of one of these oils with another. Exposed at ordinary temperatures, they absorb oxygen, assume a deeper color, become thicker and less odorous, and are ultimately converted into resin. This change takes place most rapidly under the influence of light. Before the alteration is complete, the remaining portion of oil may be recovered by distillation.[1]

The volatile oils are largely hydrocarbons, although with these are alcohol- or ketone-like bodies called *camphors,* and products of oxidation known under the general name of resins, and undoubtedly formed from the hydrocarbons. These hydrocarbons are generally known as *terpenes,* from oil of turpentine, which is taken as a type. *Olea ætherea sine terpeno* is the name proposed by Schweissinger for concentrated volatile oils made so by the removal of the non-fragrant hydrocarbon, and representing from two to thirty volumes of the ordinary essential oils. Thus, one volume of the concentrated oil represents two volumes of the oils of anise, cassia, fennel, gingergrass, mentha crispa, mentha piperita, cloves, sassafras, and star anise; two and one-half volumes of the oils of bergamot, caraway, and lavender; four volumes of cumin and rosemary; five volumes of thyme; six volumes of coriander; eight volumes of calamus; ten volumes of absinthe; twenty volumes of juniper; thirty volumes of angelica, lemon, and orange. It is asserted that these concentrated oils are more permanent, more soluble in alcohol and in water, have a finer odor, and are of constant composition, thus enabling the specific gravity and boiling point to be used as tests of purity. They should be kept in the dark. (*Ph. Centralh.,* 1888, No. 25.) Under the name of "*terpeneless volatile oils,*" similar products can now be found in the market; they are undoubtedly superior to the ordinary volatile oils both in odor and strength.

Wallach, to whom much of our knowledge on volatile oils is due, divides the hydrocarbons into classes, as follows:

1.—*True terpenes,* of the formula $C_{10}H_{16}$, of which there are two main groups: *a,* the *terpane* group, uniting with two molecules of haloid acid or four atoms of bromine; this group includes limonene, dipentene, sylvestrene, terpinolene, terpinene, and phellandrene, and its members boil between 175° and 185° C.; *b,* the *camphane* group, uniting with one molecule of haloid acid or two atoms of bromine; this group includes pinene, camphene, and fenchene, and its members boil between 151° and 161° C.

2.—*Hemiterpenes,* of the formula C_5H_8, such as isoprene.

3.—*Polyterpenes,* such as cedrene, cubebene, etc., of the formula $C_{15}H_{24}$ (sesquiterpenes); colophene, of the formula $C_{20}H_{32}$; and caoutchouc, of the formula $(C_{10}H_{16})_x$.

Hydrocarbons other than those of the terpene class or derivable from them, occur very sparingly in the natural oils. Thus there is of the paraffin series of saturated hydrocarbons, *heptane,* C_7H_{16}, occurring in the oil from the *Pinus sabiniana,* or California *digger pine,* and solid hydrocarbons of the same series in oil of rose, and probably in oils of wintergreen and sweet birch. Of the benzene series there is a single representative in *cymene,* $C_{10}H_{14}$, found in the oils of the Thymus and Monarda species.

In addition to these naturally occurring hydrocarbons, there is a class of artificially prepared hydrocarbons known as *hydroterpenes,* such as dihydrodipentene from dipentene, menthene and carvomenthene from menthol and carvone.

The terpenes in general are practically insoluble in water, but soluble in alcohol, ether, chloroform, benzene, petroleum benzin, and the fixed and volatile oils. (Allen, *Com. Org. Anal.,* 2d ed., vol. ii. p. 418.)

Many of the essential oils, however, contain, or may even owe their essential character and their value to other constituents than hydrocarbons. We shall briefly notice the most important of these, either describing them or referring to other places in the text where they are already described, and shall then give a classification of the commonly known essential oils based upon the character of the most important compounds present in them.

I. Alcohols and Their Esters.

Geraniol
Linalool
Citronellol
Terpineol
Menthol
Borneol.

II. Aldehydes.

Citral
Citronellal
Salicyl Aldehyde
Cumic Aldehyde
Benzaldehyde
Cinnamic Aldehyde.

III. Ketones.

Methyl-nonyl-ketone
Methyl-heptenone
Carvone
Pulegone
Menthone
Camphor
Fenchone
Thujone
Irone.

IV. Acids and Their Esters.

Methyl Salicylate
Methyl Anthranilate.

V. Phenols and Phenol Ethers.

Chavicol
Methyl-chavicol
Anethol
Thymol
Carvacrol
Eugenol
Methyl-eugenol
Iso-eugenol
Chavibetol
Safrol
Iso-safrol
Thymohydroquinone dimethyl ether
Asarol
Apiol.

[1] *Recovery of volatile oils from their resinified condition.*—A process for this purpose, employed by Curieux, is to treat the old resinified oil with a solution of borax and animal charcoal, these being first mixed to form a magma, the oil then added, and the mixture shaken for fifteen minutes. The borax unites with the resinous matter, and the magma, adhering to the sides of the vessel, leaves the oil clear and possessed of its original properties. (*A. J. P.,* Sept. 1858, p. 398.)

VI. Neutral Bodies, Oxides, etc.

Cineol (Eucalyptol).

VII. Sulphides and Sulphur Compounds.

Diallyl disulphide Allyl thiocyanate.

I. Alcohols and Their Esters.—This is an interesting group of open chain, unsaturated alcohols, which, with their esters and aldehydes, play a very important part in the composition of many essential oils. It is the geraniol, linalool and citronellol group.

1.—*Geraniol,* $C_{10}H_{18}O$, is a colorless liquid of a pleasant rose geranium odor, boiling at 229° to 230° C., under ordinary pressure, and at 120° C. under a pressure of 16 Mm. Its specific gravity is about 0.881 and its refractive index 1.4776. It is optically inactive. By careful oxidation with chromic trioxide it yields its aldehyde, citral, and by heating it in an autoclave with water to 200° C., it is partly converted into its isomer, linalool. Of the esters of geraniol the most important is the *geranyl acetate.* This is a fragrant oil of specific gravity 0.917, boiling at from 128° to 129° C., under a pressure of 16 Mm. It occurs naturally in several essential oils, and can be made artificially by the action of acetic anhydride upon geraniol.

2.—*Linalool,* $C_{10}H_{18}O$, is known in both of the optically active forms as well as in the inactive. It is a liquid having a pleasant odor, and boils under normal pressure at about 198° C., and at from 86° to 87° C. at 14 Mm. pressure. Its specific gravity ranges from 0.872 to 0.876, and its refractive index is 1.461. The most important of its esters is *linalyl acetate,* which occurs in many essential oils, as in oil of bergamot. It is an odoriferous liquid of the specific gravity 0.912, and boiling at from 105° to 108° C. at 11 Mm. pressure. It has also been prepared artificially.

3.—*Citronellol,* $C_{10}H_{20}O$, is found in oil of rose and in Spanish geranium oil. It is an odoriferous oil, boiling at from 117° to 118° C., under a pressure of 17 Mm.; specific gravity, 0.8565 at 17.5° C.; refractive index, 1.4566. When obtained from oil of rose it is lævogyrate, while when obtained by reducing the aldehyde it is dextrogyrate; in most geranium oils both varieties exist.

A second group comprises the mono-cyclic alcohols, terpineol, which is unsaturated, and menthol, a saturated compound.

4.—*Terpineol,* $C_{10}H_{17}OH$, occurs in liquid and solid modifications, inactive, as well as in the two optically active, varieties. Besides occurring naturally it is made artificially by the dehydration of terpin hydrate, and is largely used in the perfume industry because of its lilac odor. Its most important ester is the acetate, which occurs in cajuput and cardamom oils.

5.—*Menthol,* $C_{10}H_{19}OH$, is now official, and will be found described on page 777. Two of its esters are recognized as occurring with it in peppermint oil, menthyl acetate and menthyl iso-valerate. Of these the former is the more important. It is an oil having a penetrating odor, boiling at 224° C.

To a third group of compounds known as dicyclic, belongs:

6. *Borneol,* $C_{10}H_{18}O$.—This compound occurs naturally in both optically active modifications. It also occurs optically inactive. It forms crystalline masses, which, when quite pure, melt at 203° C. Borneol can be prepared artificially by reducing its ketone (camphor) with metallic sodium. In this case, however, there results a mixture of borneol and iso-borneol. Borneol forms a number of esters, of which *bornyl acetate* is the most important. This compound melts at 29° C., and has a specific gravity of 0.991 at 15° C. It is the characteristic constituent of the pine needle oils.

II. Aldehydes.—Of the alcohols just enumerated, only the first group are primary alcohols and will yield aldehydes. Thus, from geraniol, there is obtained by oxidation, citral the corresponding aldehyde, and from its isomer, linalool, the same.

1. *Citral,* $C_{10}H_{16}O$.—Although at one time called geranial, this compound is now universally known as citral, which indicates its importance in the oils of the *citrus* family. It is obtained most abundantly from lemon grass oil by the aid of the bisulphite process. It is an oily liquid, boiling at from 228° to 230° C., under ordinary pressure, and at 110° C., under 12 Mm. Its specific gravity is 0.8972 and its refractive index 1.493. It is optically inactive. Under the influence of alkalies, citral condenses with acetone with the elimination of water to form pseudo-ionone, $C_{13}H_{20}O$, which is converted into its isomer ionone by means of acids. Reduction with sodium produces the alcohol geraniol.

2.—*Citronellal,* $C_{10}H_{18}O$, the aldehyde of citronellol, occurs in several essential oils, as in citronella oil. It is an oily liquid of characteristic odor; specific gravity 0.8768, refractive index 1.4481. It is dextrogyrate.

Of the class of aromatic aldehydes, there are found in essential oils, salicyl aldehyde, cumic aldehyde, benzaldehyde, and cinnamic aldehyde.

3. *Salicyl Aldehyde,* $C_6H_4(OH)CHO$.—This body is an oily liquid of aromatic odor, boiling at 196° C., and having a specific gravity of 1.172. It occurs in the oils of the several varieties of *Spiræa.* It can also be formed by the oxidation of its alcohol saligenin, or by the action of chloroform and potassium hydroxide on phenol.

4. *Cumic Aldehyde,* $C_6H_4(C_3H_7)CHO$.—This is p-isopropyl-benzaldehyde, and is found in several essential oils, as in cumin oil. It is an aromatic oil, having a specific gravity of 0.973, and boiling at 235° C.

5. *Benzaldehyde,* $C_6H_5.CHO$.—This is now official (see page 229).

6. *Cinnamic Aldehyde,* $C_6H_5.CH:CH.CHO$. This is now official (see page 363).

III. Ketones.—This class of chemical compounds is largely represented in essential oils. Of aliphatic saturated ketones there is only one fairly important representative.

1.—*Methyl-nonyl-ketone,* $CH_3.CO.C_9H_{19}$, which is found in oil of rue, is a liquid of strong odor, boiling at 225° C. It solidifies when cooled, and melts at 13° C.

Of aliphatic unsaturated ketones there is also one occurring naturally.

2.—*Methyl-heptenone,* $CH_3.CO.C_6H_{11}$, is found in lemon grass oil and other oils, and results from the oxidation of citral or the distillation of cineolic anhydride.

The most commonly occurring ketones, however, belong to the cyclic compounds:

3. *Carvone,* $C_{10}H_{14}O$.—This compound, found in oils of caraway and dill, is a colorless oil boiling at 225° C. It is optically active, occurring in both forms. Its most interesting addition compound is that with hydrogen sulphide; this is obtained in crystals, decomposing with alcoholic potassium hydroxide and liberating pure carvone. When heated with glacial phosphoric acid, it is changed into the isomeric carvacrol, a phenol compound.

4. *Pulegone,* $C_{10}H_{16}O$.—This characteristic ketone of pennyroyal oil is a liquid boiling at 221° C., and having a specific gravity of 0.936. An isomeric body, iso-pulegone, has been obtained artificially.

5. *Menthone,* $C_{10}H_{18}O$.—This occurs along with the corresponding secondary alcohol menthol, in oil of peppermint. It is an oily liquid boiling at 208° C., with a specific gravity of 0.894. By the action of oxidizing agents it can be converted into thymol, $C_{10}H_{14}O$.

To the class of dicyclic ketones belong the following isomeric bodies:

6. *Camphor,* $C_{10}H_{16}O$.—This most important compound of the ketone class is official, and is described on page 274.

7. *Fenchone,* $C_{10}H_{16}O$.—This ketone occurs as dextro-fenchone in oil of fennel, and as lævo-fenchone in oil of thuja. When purified, it forms an oil of camphoraceous odor, boiling at 193° C., and having a specific gravity of 0.946.

8. *Thujone,* $C_{10}H_{16}O$.—This ketone is found in oils of thuja, tansy, wormwood and sage, and is identical with the bodies formerly known as *tanacetone* and *salvone.* It is an optically active liquid, boiling at from 200° to 203° C. and having a specific gravity of 0.917.

A more complex ketone yet to be noted is:—

9. *Irone,* $C_{13}H_{20}O$.—The characteristic constituent of orris oil, to which also the violet odor is due, is irone. It is an oil almost insoluble in water, but readily soluble in alcohol, boiling at 144° C. at 16 Mm., and having a specific gravity of 0.939 at 20° C. In the attempt to effect the synthesis of irone, Tiemann and Krüger obtained an isomeric body *ionone,* which is now used as the artificial violet odor.

IV. Acids and Their Esters.—While esters of several of the fatty acids, both saturated and unsaturated, are found in the essential oils, the compounds are not so distinctive or characteristic, that they require mention here. Of aromatic acids and their esters there are several of importance, however, comprising the most valuable constituents of the oil in which they occur.

1.—*Methyl Salicylate* is the chief constituent of the oils of wintergreen and sweet birch. As it is now official as a pure compound, it is described on page 778.

2. *Methyl Anthranilate* (*o-amidobenzoate*), $C_6H_4(NH_2)COOCH_3$.—This is the odoriferous constituent of neroli oil. It is an oil solidifying at low temperatures in crystals melting at 24.5° C., and boiling at 127° C. at 11 Mm. Its specific gravity is 1.163 at 26° C. It is strongly fluorescent and has a powerful neroli odor.

V. Phenols and Phenol Ethers.—This is an important class, largely represented in the volatile oils. Of monatomic phenols there are:

1. *Chavicol* (para allyl-phenol), $C_6H_4(OH)C_3H_5$.—This occurs in the *oil of Chavica Betle,* and is a colorless liquid having a strong odor and a specific gravity of 1.035 at 20° C., boiling at 237° C. Still more abundantly formed in nature is its methyl ether, which is:

2. *Methyl-chavicol,* $C_6H_4(OCH_3)C_3H_5$.—This occurs in the oils of anise, star anise, sweet-basil, bay, etc. It is a colorless liquid of an anise-like odor, boiling at from 215° to 216° C., and having a specific gravity of 0.946.

3.—*Anethol,* $C_6H_4(OCH_3)C_3H_5$, is the methyl ether of p-propenyl-phenol, and is therefore isomeric with methyl-chavicol. It can be formed from the latter by heating it with alcoholic potassium hydroxide. It is the most abundant constituent of the oils of anise, star anise and fennel. It forms white scales melting at 21° C., and boiling at 232° C.

4. *Thymol* (methyl-propyl-phenol), $C_6H_3.CH_3.(OH)C_3H_7$ 1 : 3 : 4.—This is one of the best known of the phenols occurring in volatile oils. As it is official its description will be found under *Thymol.*

5. *Carvacrol* (methyl-propyl-phenol), $C_6H_3.CH_3(OH)C_3H_7$ 1 : 2 : 4.—This important phenol, occurring in oils of marjoram and savory, is isomeric with thymol. It is a thick oil, solidifying at 0° C. and boiling at 236° C. It can be prepared artificially by heating carvone, an isomeric ketone, with phosphoric acid or by heating camphor with iodine.

Of diatomic phenols and their ethers, there are the following:

6.—*Eugenol,* $C_6H_3.OH.OCH_3.C_3H_5$ 4 : 3 : 1, is the methyl ether of allyl-dioxybenzene. It occurs in the oils of cloves, allspice, bay, Ceylon cinnamon and cinnamon leaves. As it is now official, its description will be found on page 456.

7.—*Methyl-eugenol,* $C_6H_3.(OCH_3)_2.C_3H_5$, is found together with eugenol in oil of bay.

8.—*Iso-eugenol* is the methyl ether of propenyl-dioxybenzene, and is produced from eu-

genol when the latter is heated with alcoholic potassium hydroxide. It is used in the manufacture of artificial vanillin.

9.—*Chavibetol* is another isomer of eugenol, and occurs with chavicol in oil of betel leaves.

10.—*Safrol,* $C_6H_3\begin{matrix}O\\O\end{matrix}>CH_2.C_3H_5$, is the methylene ether of allyl-dioxybenzene. It is found quite largely in the oils of sassafras, camphor, etc. As it is now official its description will be found under *Safrolum.*

11.—*Iso-safrol* is the methylene ether of propenyl-dioxybenzene, and is produced from safrol by heating the latter with alcoholic potassium hydroxide. It is used in the manufacture of *piperonal* (artificial heliotropin).

12.—*Thymohydroquinone dimethyl-ether,* $C_6H_2.(OCH_3)_2.CH_3.C_3H_7$, constitutes the bulk of the oil of *arnica root.* It is a liquid distilling at from 248° to 250° C.

Of triatomic phenols and their ethers, the representative is:

13. *Asarol,* $C_6H_2(C_3H_5)(OCH_3)_3$.—This is the trimethyl ether of propenyl-trioxybenzene. It forms the solid constituent of the oil of *Asarum europæum,* and occurs in prisms melting at 61° C., and boiling at from 295° to 296° C. It has also been made synthetically.

Of tetratomic phenols and their ethers, there is also a representative, as follows:

14.—*Apiol,* $C_{12}H_{14}O_4$, is the dimethyl-methylene ether of allyl-tetroxybenzene. It occurs in two isomers—the apiol from oil of parsley and dill apiol from some varieties of oil of dill. Of these, the former is a crystalline solid melting at 30° C. and boiling at 294° C., and the latter is an oily liquid boiling at 288° C.

VI. Neutral Bodies, Oxides, etc.—One important compound of frequent occurrence in volatile oils has not been classified under any of the preceding groups, for the reason that it is relatively inert in a chemical way and is considered as an oxide of neither distinct acid or basic character.

1. *Cineol* (*Eucalyptol*), $C_{10}H_{18}O$.—This is found in nature in large amounts in eucalyptus oil (hence the name "eucalyptol" sometimes given to it), in cajuput oil (hence the name of "cajuputol"), in lavender, wormseed, and other oils. As it is now official under the name of *eucalyptol,* its description will be found on page 453.

VII. Sulphides and Sulphur Compounds.

1.—*Di-allyl disulphide,* $C_6H_{10}S_2$, is a constituent of oil of garlic and occurs in many oils belonging to the *Cruciferæ.* It is a liquid of very unpleasant odor, boiling at 140° C.

2.—*Allyl Thiocyanate,* $C_3H_5.NSC$, is the principal constituent of the volatile oil of mustard. It is, however, a decomposition product of the glucoside potassium myronate, which breaks up under the influence of the ferment myrosin. The allyl thiocyanate can also be obtained artificially by distilling allyl iodide or bromide with alcoholic potassium thiocyanate. This artificial product is largely sold in place of the natural oil. It is a liquid having a very unpleasant odor, boiling at 151° C., and having a specific gravity of 1.017 at 10° C.

Classification.

Classification of the more commonly occurring volatile oils.—In considering the question of classifying the volatile oils, two methods of arrangement naturally suggest themselves, viz. a classification according to the botanical natural orders to which they belong, and a chemical classification based on the most important chemical constituents of the oils themselves. While the first of these is the more readily made, it suffers from the disadvantage of being cumbrous and less readily understood except by the botanist. On the other hand, the second plan shows at a glance the sources of the valuable odoriferous and medicinally and technically important constituents for which the volatile oils are largely used. That it has not been generally adopted is no doubt due to the fact that many of the oils contain several different constituents of value, and it is therefore difficult to make an assignment of some of them to individual chemical groups. Nevertheless, it is believed that the chemical classification adopted here will be found to have practical value for reference.

Group I.—*Oils containing mainly Terpenes and Sesquiterpenes.*

Oil of Cedarwood; cedrene and cedrol.
Copaiba Balsam; caryophyllene.
Cubeb; cadinene and cubeb camphor.
Dog Fennel; phellandrene.
Fleabane; d-limonene.
Galbanum; pinene and cadinene.
Ginger; sesquiterpene and phellandrene.
Hemp; cannibene and other terpenes.
Hops; humulene and tetrahydrocymene.
Myristica; terpenes and myristicol.
Orange; limonene with small amount of citral and citronellal.
Turpentine; pinene and sylvestrene.

Group II.—*Oils containing mainly Alcohols and their esters.*

a. Aliphatic saturated alcohols:

Oil of Heracleum; octyl alcohol and octyl ester.

b. Aliphatic unsaturated alcohols:

Oil of Bergamot; linalool and linalyl acetate.
Coriander; linalool and d-pinene.
Geranium; geraniol and geranyl esters.
Lavender; linalyl acetate and geraniol.
Lime; linalyl acetate and limonene.

Group II.—(*Continued.*)
Linaloes; linalool and geraniol.
Petit Grain; linalool and linalyl acetate.
Rose; geraniol and citronellol with esters.
c. Monocyclic and dicyclic alcohols.
Oil of Angostura; galipol, galipene, and cadinene.
Fir Cones; bornyl acetate and terpenes.
Golden Rod; borneol and bornyl esters.
Juniper Berries; juniper camphor and cadinene.
Ledum; ledum camphor.
Lovage; terpineol.
Mace; myristicol.
Patchouli; patchouli camphor and cadinene.
Peppermint; menthol and menthone.
Pine Needles; bornyl acetate and terpenes.
Rosemary; borneol and bornyl acetate.
Sandalwood; santalol and esters.
Savin; sabinol and sabinyl acetate.
Valerian; borneol and bornyl esters.
d. Aromatic Alcohols and Esters:
Oil of Jasmine; benzyl acetate and benzyl alcohol.

Group III.—*Oils containing Aldehydes as characteristic constituents.*
a. Aliphatic unsaturated aldehydes:
Oil of Citron peel; citral and limonene.
Citronella; citronellal and geraniol.
Lemon; Citral and citronellal.
Lemon grass; citral, citronellal, and methyl-heptenone.
Verbena; citral.
b. Aromatic aldehydes:
Oil of Bitter Almond; benzaldehyde.
Cassia; cinnamic aldehyde.
Cinnamon; cinnamic aldehyde and eugenol.
Cumin; cumic aldehyde.
Meadow Sweet; salicyl aldehyde.

Group IV.—*Oils containing Ketones as characteristic constituents.*
a. Aliphatic saturated aldehydes:
Oil of Rue; methyl-nonyl-ketone.
b. Aliphatic unsaturated aldehydes:
Oil of Lemon grass; methyl-heptenone.
c. Monocyclic and dicyclic ketones:
Oil of Artemisia; thujone.
Camphor; camphor.
Caraway; carvone and limonene.
Dill; carvone and limonene.
Orris; irone.
Pennyroyal; pulegone.

Group IV.—(*Continued.*)
Peppermint; menthone and menthol.
Sage; thujone with borneol and cineol.
Spearmint; carvone.
Tansy; thujone with borneol.
Thuja; thujone and fenchone.
Wormwood; thujone and thujyl alcohol.

Group V.—*Oils containing Acids and Esters.*
a. Aliphatic Acids:
Oil of Angelica; methyl-ethyl-acetic esters.
Calamus; heptylic and palmitic acid and esters.
Cardamom; acetic esters and cineol.
German Chamomile; caproic acid esters.
Roman Chamomile; butyric, angelic and tiglic esters.
b. Aromatic acids and esters:
Oil of Neroli; o-amido-benzoic-methyl ester.
Sweet Birch; methyl salicylate.
Gaultheria; methyl salicylate.
c. Undetermined acids:
Oil of Celery; sedanolide and lactone.
Elecampane; alantic acid and lactone.

Group VI.—*Oils containing Phenols and Phenol Ethers.*
a. Monatomic phenols and their ethers:
Oil of Ajowan; thymol and cymene.
Anise; anethol and methyl-chavicol.
Betel; chavicol and methoxy-chavicol.
Fennel; anethol and fenchone.
Marjoram; carvacrol and linalool.
Savory; carvacrol, pinene, and cymene.
Star Anise; anethol, methyl-chavicol and safrol.
Sweet Basil; Methyl-chavicol and d-linalool.
b. Diatomic phenols and their ethers:
Oil of Arnica Root; thymohydroquinone dimethyl-ether.
Bay; eugenol, methyl-eugenol and methyl-chavicol.
Camphor; safrol, eugenol and camphor.
Cascarilla Bark; eugenol and terpenes.
Cinnamon Leaf; eugenol and cinnamic aldehyde.
Cloves; eugenol and sesquiterpene.
Pimenta; eugenol and sesquiterpene.
Sassafras; safrol and camphor.

Group VI.—(*Continued.*)

c. Triatomic phenols and their ethers:

Oil of Asarum; asarol and methyl-eugenol.

Matico; asarol.

d. Tetratomic phenols and their ethers:

Oil of Parsley; apiol.

Group VII.—*Oils containing Neutral Bodies.*

Oil of Cajuput; cineol, terpineol and terpenyl acetate.

Eucalyptus; cineol, pinene, and aldehydes.

Laurel Leaves; cineol and pinene.

Myrtle; cineol, d-pinene and dipentene.

Wormseed; cineol and dipentene.

Group VIII.—*Oils containing Sulphur.*

Oil of Asafœtida; sulphides and pinene.

Garlic; diallyl-disulphide and allyl-propyl sulphide.

Mustard; allyl-thiocyanate, allyl-cyanide and carbon disulphide.

Onion; allyl-propyl sulphide.

Properties.—Volatile oils are slightly soluble in water. Agitated with this fluid they render it milky, but separate upon standing, leaving the water impregnated with their odor and taste. This impregnation is more complete when water is distilled with the oils, or from the plants containing them. Trituration with magnesia or its carbonate renders them much more soluble, probably in consequence of their minute division. The intervention of sugar also greatly increases their solubility, and affords a convenient method of preparing them for internal use. The oils which contain no oxygen are scarcely soluble in diluted alcohol, and, according to De Saussure, their solubility generally in this liquid is proportionate to the oxygen which they contain. The volatile oils dissolve sulphur and phosphorus with the aid of heat, and deposit them on cooling. By long boiling with sulphur they form brown, unctuous, fetid substances, formerly called *balsams of sulphur.* They absorb chlorine, which converts them into resin and then combines with the resin. Iodine produces a similar effect. They are decomposed by the strong mineral acids, and unite with several of the acids from the vegetable kingdom. When treated with a caustic alkali, some of them are converted into resin, which unites with the alkali to form a kind of soap. Several of the metallic oxides, and various salts which easily part with oxygen, convert them into resin. The volatile oils dissolve many of the proximate principles of plants and animals, such as the fixed oils and fats, resins, camphor, and several of the alkaloids. Exposed to air and light, they acquire a decolorizing property, analogous to that of chlorine, which is ascribed by Faraday to their combination with the ozonized oxygen of the atmosphere.

Adulterations.—The volatile oils are often sophisticated. Among the grosser adulterations are fixed oils, resinous substances, and alcohol, but the most dangerous are those made by mixing the pure oil with the cheaper volatile oils and terpenes and fractions from other oils like limonene. The presence of the fixed oils may be known by the permanent greasy stain which they leave on paper, while that occasioned by a pure volatile oil disappears entirely when exposed to heat. They may also in general be detected by their comparative insolubility in alcohol. Both the fixed oils and resins are left behind when the adulterated oil is distilled with water. If alcohol be present, the oil will become milky when agitated with water in a graduated tube, and after the separation of the liquids the water will occupy more space and the oil less than before. The following method of detecting alcohol was proposed by Beral. Put twelve drops of the suspected oil in a perfectly dry watch-glass, and add a piece of potassium about as large as the head of a pin. If the potassium remains for twelve or fifteen minutes in the midst of the liquid, there is either no alcohol present, or less than 4 per cent. If it disappears in five minutes, the oil contains more than 4 per cent. of alcohol; if in less than a minute, 25 per cent. or more. Borsarelli employs calcium chloride for the same purpose. This he introduces in small pieces, well dried and perfectly free from powder, into a small cylindrical tube, closed at one end, and about two-thirds filled with the oil to be examined, and heats the tube to 212° F., occasionally shaking it. If there is considerable proportion of alcohol, the chloride will be entirely dissolved, forming a solution which sinks to the bottom of the tube; if only a very small quantity, the pieces will lose their form, and collect at the bottom in a white adhering mass; if none at all, they will remain unchanged. (*J. P. C.,* xxvi. 429.) J. J. Bernoulli proposes as a test dry potassium acetate, which remains unaffected in a pure oil, but will be dissolved if alcohol be present, and form a distinct liquid. (See *A. J. P.,* xxv. 82.) Distillation, catching the first portion, and testing for alcohol by the iodoform reaction, will detect very small additions of alcohol. The most dangerous adulterant of volatile oils is a liquid sold under some "fancy name," found in the markets of London and other large cities, and recommended for "reducing" essential oils; one specimen examined by John Barclay (*P. J.,* 1896, 463) had a delicate odor, and could be mixed with oils of lemon and bergamot without being detected by odor or taste. It was believed to be a *lævo-pinene.* There are good reasons for believing that similar liquids are used to an enormous extent.

Sometimes volatile oils of little value are mixed with the more costly. The taste and odor afford in this case the best means of detecting the fraud. The specific gravity of the oils may also serve as a test of purity. When two oils, of which one is lighter and the other

heavier than water, are mixed, they may be separated by long agitation with this fluid, and will take a place corresponding to their respective specific gravities, but it sometimes happens that an unadulterated oil may thus be separated into two portions. The difference of apparent effect produced by iodine with the several oils has been proposed as a test, and bromine was employed for the same purpose by John M. Maisch, who used both these tests preferably in the state of ethereal solution, which, as it is liable to spontaneous change by keeping, should be prepared when wanted for use. According to Liebig, when iodine is made to act on a volatile oil, a portion of it combines with the hydrogen of the oil, forming hydriodic acid, while another portion takes the place of the lost hydrogen. Oil of turpentine may be detected by remaining in part undissolved when the suspected oil is treated with three or four times its volume of alcohol of the sp. gr. 0.84; or, according to Mero, by causing the suspected oil, when agitated with an equal measure of poppy oil, to remain transparent, instead of becoming milky, as it would do if pure. The latter test will not apply to the oil of rosemary. (*J. P. C.*, 3e ser., vii. 303.) G. S. Heppe suggests a very delicate test of oil of turpentine and most other non-oxygenated oils, when used to adulterate one of the oils containing oxygen. A piece of copper nitroprusside, of the size of a pin's head, is put into a little of the suspected oil in a test-tube, and heated until the liquid begins to boil. The boiling must be continued only a few seconds. If the oil be pure and oxygenated, the copper nitroprusside will become black, brown, or gray; if oil of turpentine or other non-oxygenated oil be present, the deposit will be green or bluish green, and the supernatant liquid colorless or yellowish. (*Chem. Gaz.*, April 15, 1857, p. 155; *Proc. A. Ph. A.*, 1858, p. 344.)

The different relations of the volatile oils to polarized light may, to a certain extent, be made available for the detection of adulterations, especially where the action of the adulterating oil is in an opposite direction to that of the oil adulterated. Thus, the oils of juniper, lavender, and rosemary, rotate the plane of polarization to the left, while American oil of turpentine rotates it to the right; and if this should be added to one of the other oils it might in some degree neutralize their action, and thus offer one means for its detection. Unfortunately, the French oil of turpentine, from the juice of the *Pinus maritima*, acts strongly in the opposite direction. But the very strength of its left-rotatory power might lead to its detection by the abnormal increase of this power which it would impart to the oils in question. Synthetic or artificial volatile oils are now largely manufactured. They vary greatly at times in their resemblance to the natural products. They will be considered under their respective titles elsewhere, a number having received official recognition.

Volatile oils may be preserved without change in small, well-stoppered amber-colored bottles, entirely filled with the oil, and secluded from the light.

Manufacture.—Most of the volatile oils may be prepared by the general formula of the U. S. P. 1870: "Put the substance from which the Oil is to be extracted into a retort or other vessel suited for distillation, and add enough water to cover it; then distil by a regulated heat into a large refrigeratory. Separate the Distilled Oil from the water which comes over with it." [1] *U. S.* 1870.

Under the general observations on the *Aquæ*, or *Waters*, will be found remarks upon the use of steam in preparing the Distilled Waters, which are to a considerable extent applicable also to the volatile oils.

The substances from which the volatile oils are extracted may be employed in either the recent or the dried state. Certain flowers, however, such as orange flowers and roses, must be used fresh, or preserved with salt or by means of glycerin, as they afford little or no oil after desiccation. Most of the aromatic herbs, also, as peppermint, spearmint, pennyroyal, and marjoram, are usually distilled while fresh, although it is thought by some that when moderately dried they yield a larger and more grateful product. Dried substances, before being submitted to distillation, require to be macerated in water until they are thoroughly penetrated by this fluid, and to facilitate the action of the water it is necessary that, when of a hard or tough consistence, they should be properly comminuted by slicing, shaving, rasping, bruising or other similar mechanical operation.

The water which is introduced into the still with the substance answers the double purpose of preventing the decomposition of the vegetable matter by regulating the temperature, and of facilitating the volatilization of the oil, which, though in most instances readily rising with the vapor of boiling water, requires, when distilled alone, a considerably higher temperature, and is at the same time liable to be partially decomposed. Some oils, however, will not ascend readily with steam at 100° C. (212° F.), and in the distillation of these it is customary to use water saturated with common salt, which does not boil under 110° C. (230° F.). Recourse may also be had to a bath of strong solution of calcium chloride, or to an oil bath. Other oils, again, may be volatilized with water at a temperature below the boiling point, and, as heat exercises an injurious influence over the oils, it is desirable that the distillation should be effected at as low a temperature as possible. To prevent injury from heat, it has been

[1] A large proportion of the volatile oils of European commerce is produced in Grasse, a town of France, twenty-five miles west of Nice. For an elaborate article on this industry and methods of preparation, see *A. Pharm.*, xxii. 473, abstracted in the *P. J.*, vol. xv. 468.

recommended to suspend the substance containing the oil in a wire basket, or to place it upon a perforated shelf, in the upper part of the still, so that it may be penetrated by the steam, without being in direct contact with the water. Another mode of effecting the same object is to distil it *in vacuo*. Duncan stated that the most elegant volatile oils he had even seen were prepared in this manner by Barry, the inventor of the process. The employment of steam heat also prevents injury, and the best volatile oils are now prepared by manufacturers in this way. Steam can be very conveniently applied to this purpose by causing it to pass through a coil of tube, of an inch or three-quarters of an inch bore, placed in the bottom of a common still. The end at which the steam is admitted enters the still at the upper part, and the other end, at which the steam and condensed water escape, passes out laterally below, being furnished with a stopcock, by which the pressure of the steam may be regulated and the water drawn off when necessary. In some instances it is desirable to conduct the steam immediately into the still near the bottom, by which the contents are kept in a state of brisk ebullition. This method is used in the preparation of the oil of bitter almond. The same method is applicable to the preparation of distilled waters.

The quantity of water added is not a matter of indifference. An excess above what is necessary acts injuriously by holding the oil in solution when the mixed vapors are condensed, and if the proportion be very large, it is possible that no oil whatever may be obtained separate. On the contrary, if the quantity be too small, the whole of the oil will not be distilled, and there will be danger of the substance in the still adhering to the sides of the vessel and thus become burnt. (See page 185.) Enough water should always be added to cover the solid material and prevent the latter accident. Dried plants require more water than the fresh and succulent. The whole amount of material in the still should not exceed three-fourths of its capacity, as otherwise there would be danger of the liquid boiling over. The form of the still has an influence over the quantity of water distilled, which depends more upon the extent of surface than upon the amount of liquid submitted to evaporation. By employing a high and rather narrow vessel we may obviate the disadvantage of an excess of water. (See p. 522.) Sometimes the proportion of oil in the substance employed is so small that it is wholly dissolved in the water distilled, even though the proportion of the liquid in the still is not greater than is absolutely essential. In this case it is necessary to redistil the same water several times from fresh portions of the plant, until the quantity of oil exceeds the solvent power of the water. This process is called *cohobation*.

The more volatile of the oils pass with facility along with the steam into the neck of the common still, but some which are less volatile are apt to condense in the head and thus return into the still. For the distillation of the latter, a copper still should be employed having a very low head. (See page 532.) As, after the distillation of any one oil, it is necessary that the apparatus should be thoroughly cleansed before being used for the preparation of another, it is better that the condensing tubes should be straight, rather than spiral as in the ordinary still. It should be recollected, moreover, that certain oils, such as those of anise and fennel, are rendered solid by a comparatively slight reduction of temperature, and that in the distillation of these the water employed for refrigeration should not be below 5.5° C. (42° F.).

The mixed vapors are condensed into a milky liquid, which is collected in a receiver, and, after standing for some time, separates into the oil and a clear solution of it, the former floating on the surface, or sinking to the bottom, according as it is lighter or heavier than water. The distillation should be continued so long as the liquid coming over has a milky appearance.

The last step in the process is to separate the oil from the water. For this purpose the *Florentine receiver*[1] may be used. This is a conical glass vessel, broad at the bottom and narrow towards the top, and very near its base furnished with a tubulure or opening, to which is adapted, by means of a pierced cork, a bent tube so shaped as to rise perpendicularly to seven-eighths of the height of the receiver, then to pass off from it at right angles, and near the end to bend downward. The condensed liquid being admitted through the opening at the top of the receiver, the oil separates, and, rising to the top, occupies the upper narrow part of the vessel, while the water remains at the bottom, and enters the tube affixed to the receiver. When the surface of the liquid attains in the receiver a higher level than the top of the tube, the water will necessarily begin to flow out through the latter, and may be received in bottles. The oil thus accumulates as long as the process continues, but it is evident that the plan is applicable only to the oils lighter than water. For the heavier oils, cylindrical vessels may be employed, to be renewed as fast as they are filled; but, as all the water cannot be removed by these plans, it is necessary to resort to some other method of effecting a complete separation. An instrument called a *separator* is usually employed for this purpose. It consists of a glass funnel, or a globular vessel, furnished with a stopper, and prolonged at the bottom into a very narrow tube. The lower opening being closed, the mixed liquids are introduced and allowed to stand until they

[1] For illustrations of this, and other forms of receivers, for collecting and separating immiscible liquids, see Remington's *Practice of Pharmacy*, 4th edition, p. 224.

separate. The orifice at the bottom is then opened, and, the stopper at the top being a little loosened, so as to admit the air, the heavier liquid slowly flows out, and may be separated to the last drop from the lighter, which floats above it. If the oil is heavier than the water, it passes out of the separator; if lighter, it remains within. According to George Leuchs, all oils obtained by distillation with water, even when perfectly clear, contain some water. (*A. J. P.*, 1873, p. 110.)

The water saturated with oil should be preserved for use in future distillations, as it can dissolve no more of the oil. One or more volatile acids are frequently found in the distilled water, as acetic, butyric, or valerianic, and Wunder has detected all three of these acids in the water distilled from chamomile flowers. (*J. Pr. Chem.*, lxiv. 499.) For an illustration of a cheap apparatus for distilling volatile oils by steam under slight pressure, see *Proc. A. Ph. A.*, 1894, 680.

According to Overbeck, all the volatile oils may be decolorized by distilling them from an equal weight of poppy seed oil and a saturated solution of common salt. (*A. Pharm.*, lxxxiv. 149.)

When first procured, the oils have a disagreeable empyreumatic odor, from which they may be freed by allowing them to stand for some days in vessels loosely covered with paper. They should then be filtered and introduced into small opaque bottles, which should be well stoppered so as to exclude the air. When altered by exposure to air, they may sometimes be restored to their original appearance and quality by agitation with a little recently heated animal charcoal, and the same method may be employed for freeing them from adhering water.

The volatile oils have the medicinal properties of the plants from which they are derived, and, as their remedial application has been mentioned under the heads of these plants respectively, it is unnecessary to treat of it in this place. They may be administered upon a lump of sugar; or triturated with at least ten times their weight of sugar, forming *oleosaccharates*, which are then dissolved in water; or made into emulsions with water, sugar, and gum arabic. In making emulsions with volatile oils, it has been recommended first to dissolve them in one of the fixed oils, the oil of almond for example, and then to emulsionize the oleaginous solution with syrup and gum arabic. For 100 parts of water, 15 of the almond oil in which the volatile oil is to be dissolved, 10 of powdered gum arabic, and 25 of syrup may be taken. (*J. P. C.*, Juin, 1864, p. 461.) The volatile oils are often kept dissolved in alcohol under the name of *essences*.[1] The following suggestions on preparing emulsions of the volatile oils may be useful. Oil of turpentine and other volatile oils, to be emulsionized in quantity, are most successfully treated by rubbing them with the powdered gum, and, when intimately mixed, adding at once, with rapid trituration, one and a half times the weight of the gum used, of water. By this treatment the volatile oil is thoroughly divided before contact with water, and, if the quantity of water indicated be added at once, the emulsion will have the right preliminary consistence, and unite with and emulsionize the volatile oils. If, however, but a little water be added, this will seize on the gum, forming a pilular mass, and throwing the volatile oil out of union. Such an emulsion is more permanent when a little fixed oil is used.

OLEATA

OLEATES

(ō-lę-ā′tą)

Oléates, *Fr.*; Oleate, *G.*

The oleates are a class of preparations which were introduced to the medical profession by John Marshall, F.R.S., in 1872. They are usually solutions of certain bases in oleic acid, and are made by triturating the solid substance with the oleic acid until it is dissolved. Whenever it is possible, the application of heat should be avoided, and it has been observed that the freshly precipitated oxides of the metals dissolve more readily than those which are old. The title *oleate* is probably the best that could be devised, although it must be understood that, as found in the Pharmacopœias, they are not pure chemical compounds, but merely compounds of the oxides or the alkaloids, as the case may be, with oleic acid dissolved in a great excess of the latter.[2]

[1] *Enfleurage.*—This term is applied by the French to the impregnation of fixed oils and fatty matters with the odors of certain sweet scented plants, such as jasmine, tuberose, and mignonette, the oils of which are so delicate and fugitive that they cannot well be separated by distillation. The process consists in exposing the fatty matter, placed in layers, in suitable frames, to the exhalations from the flowers, which are absorbed, and give their characteristic odor to the fat. Another plan is to expose alternate layers of the flowers, and of cotton impregnated with bland fixed oil, to the sun, and afterwards to express the oil from the cotton. (*A. J. P.*, xxix. 551.) The French sometimes give to the spirituous solutions made by extracting the odors from fats and oils with alcohol the name of *Essences*.

[2] L. Wolff published a process for obtaining the oleates, as follows: One part of Castile soap (sodium oleopalmitate) is dissolved in eight parts of water, the solution so obtained is allowed to cool and stand for 24 hours, when there will be a considerable deposit of sodium palmitate, while the supernatant liquor, containing mostly sodium oleate, is drawn off and then decomposed with a concentrated solution of a metallic salt which, if obtainable, should contain no free acid to prevent the formation of free oleo-palmitic acid. The heavy deposit of oleo-palmitate so derived is drained off, pressed out in the strainer, and the adherent water evaporated in a water bath; after this it is dissolved in about six to eight times its quantity of petroleum benzin, and the insoluble palmitate is left to subside, while the solution of oleate decanted therefrom is filtered off. The benzin evaporated will yield an oleate that is entitled to that name, as it is a chemical combination and will remain stable and efficacious. The oleates, so prepared, present an amorphous appearance, while the palmitates are of a crystalline character. (*A. J. P.*, 1881, p. 545.)

Oleates may be made either by direct combination of the ingredients or by double decomposition. When made by the latter method, a good quality of oleic acid should be treated with the proper quantity of solution of sodium hydroxide, to saponify it, any excess of the alkali being neutralized with a little tartaric acid. This soap solution is preferably used diluted.[1]

J. M. Good, in making the oleates of the alkaloids, proposes the use of sufficient oleic acid to dissolve the alkaloid and then diluting the solution with a bland fixed oil, such as almond oil. (*Proc. Missouri Pharm. Association,* 1891, p. 65.)[2]

The *medicinal properties* of the oleates are, of course, dependent upon the base, so that these preparations may be considered the equivalents of the corresponding ointments, over which, however, they have certain advantages. They are much cleaner and more elegant in appearance. They seem to be more irritating than the ointments, and, unless diluted with an equal bulk of cotton seed, olive, or other bland oil, are, when applied with friction, likely to provoke a cutaneous eruption or even pustulation. Marshall recommends that they be applied with a brush, or gently spread over the part with one finger.

OLEATUM ATROPINÆ. U. S.

OLEATE OF ATROPINE

(ōl-ē-ā'tŭm ăt-rō-pī'næ)

Atropinum Oleicum; Oléate d'Atropine, *Fr.;* Atropinoleat, *G.*

* "Atropine, *two grammes* [or 31 grains]; Alcohol, *two cubic centimeters* [or 32 minims]; Oleic Acid, *fifty grammes* [or 1 ounce av., 334 grains]; Olive Oil, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Atropine in a tared mortar with the Alcohol, then add about an equal volume of the Oleic Acid, and, after warming the mortar, stir until the Alcohol has evaporated, add the remainder of the Oleic Acid, and continue stirring until the Atropine is dissolved; then add sufficient Olive Oil to make the product weigh *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

Oleate of atropine was introduced into the U. S. P. (8th Rev.) for the first time; alcohol

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[1] *Sulpholeic Acid and Sulpholeates.*—Sulpholeates, or salts produced by the combination of alkalies with sulpholeic acid, have come into use on account of their ability to dissolve many substances or hold them in suspension as emulsifying agents. Sulpholeic acid is prepared as follows. Castor, almond, or other fixed oil is gradually mixed with 30 or 40 parts of concentrated sulphuric acid, the mixture being cooled, if necessary, with ice, to prevent a rise of temperature above 50° C. (122° F.). The reaction, which at first is quite violent, is allowed to go on for from six to twelve hours, after which the mixture of acid and glycerin is decanted, the residue mixed with 100 parts of water, and this, after stirring, is also decanted. The resulting sulpholeic acid is converted into *alkaline sulpholeate* by the addition of a hydroxide or carbonate of the required alkali. From this combination pure sulpholeic acid is obtained by careful decomposition with sulphuric acid, and agitation with purified benzin or ether, which leaves the acid on evaporation pure and anhydrous. (*Ph. Rund.,* 1885, p. 154.) According to A. Mueller Jacobs, when concentrated and in as pure a state as possible, the sulpholeates, as well as the free sulpho-acids themselves, mix readily and completely with a great variety of organic compounds, for instance with liquid hydrocarbons, particularly those of low boiling point, with chlorine, iodine, and bromine derivatives of the same, with ethers and alcohols, with organic sulphur compounds, such as carbon disulphide, oil of mustard, mercaptan, etc., and with all essential oils. They also dissolve varying quantities of sulphur, iodoform, solid hydrocarbons, such as naphthalene, naphthol, anthracene, and paraffin, the terpenes and camphenes. These liquid mixtures of sulpholeates and other bodies have the property of forming emulsions or even clear solutions with water. The limit of miscibility (in form of emulsion) or solubility varies considerably, and depends both on the degree of concentration of the sulpholeate serving as a menstruum, and on certain little understood properties of the substances mixed with it.

This peculiar behavior of the sulpholeates, and particularly of the sulpho-ricinoleate of alkalies, towards many otherwise insoluble or difficultly soluble substances, as well as their pronounced saponaceous character and the great readiness with which they take up and combine with liquids, is said to render them eminently suitable for various technical and medicinal uses.

The liquid alkaline salt which forms the solvent is termed *polysolve* by A. Mueller Jacobs, who believes that the sulpholeate mixtures will be found excellent solvents for substances the employment of which in a concentrated condition is accompanied by certain untoward effects, or may serve as vehicles in place of vaseline, oils, glycerin, etc., in perfumery, soap making or pharmacy. (*Am. Drug.,* 1884, p. 22.)

[2] *Cupri Oleas.*—Oleate of Copper is made by adding sodium oleate to a saturated solution of copper sulphate, then washing the precipitate. It is a handsome dark green, waxy solid, and is used chiefly in the treatment of ringworm.

W. A. H. Naylor communicates the following working formulas for unofficial oleates which he has found in practice to yield satisfactory products. The soap used is a genuine olive oil soap of high quality, and contains 15 per cent. of water.

Aluminum Oleate.—Dissolve 1 oz. av. pure potassium alum in 6 fl. oz. of boiling water and pour the solution, while stirring, into a solution of 2 oz. av. of soap in 10 fl. oz. of boiling water. The clotty precipitate is washed with boiling water by decantation, until free from sulphate, and dried over a water bath. The oleate is adhesive, of a yellowish-grey color, opaque, and weighs about 2¼ oz. av. On ignition it yields 6 per cent. of aluminum oxide (= 3.2 per cent. Al). This oleate is used in treating various skin diseases.

Bismuth Oleate.—Instead of crystallizing bismuth nitrate, as suggested by L. Wolff (see p. 820), the subnitrate may advantageously be used as follows: Dissolve 1 oz. av. of bismuth subnitrate, by the aid of heat, in 5½ fl. drachms of nitric acid, diluted with its own volume of distilled water; then dilute the solution with three times its volume of distilled water, and pour it, hot and while stirring, into a hot solution of 3 oz. av. of soap and 24 fl. oz. of water. The precipitate is washed with hot water by decantation, and dried over a water bath. The yield of dry oleate is about 3 oz. av. It has a light citron color and yields on ignition 22 per cent. of bismuth oxide (= 20 per cent. Bi).

Ferrous Oleate.—In spite of all precautions this oleate undergoes considerable oxidation during the process of its preparation, which must therefore be as expeditious as possible. Dissolve 1 oz. av. of pure ferrous sulphate in 5 fl. oz. of distilled water and pour the solution while stirring into a solution of 2 oz. av. of soap in 16 fl. oz. of water. When the precipitate produced has been sufficiently washed it should be at once strongly expressed and dried (in the unbroken state of press-cake), at a temperature not exceeding 50° C. (122° F.).

Ferric Oleate, on the other hand, is easily and quickly made, by pouring 4 fluid oz. of solution of iron acetate, B. P., 1898, into a solution of 2½ oz. av. of soap in 16 fl. oz. of boiling water. The washed precipitate, dried on the water bath, is of a deep red color, weighs a little over 2 oz. av., and yields 8 per cent. Fe_2O_3 (= 5.6 per cent. Fe) on ignition. It is readily soluble in fixed oils.

is used to facilitate the solution of the alkaloid, and olive oil is added to obviate the likelihood of producing a cutaneous eruption when the oleate is applied to the skin by friction; undiluted oleic acid is often irritating. It is used to obtain the local effects of atropine by inunction.

OLEATUM COCAINÆ. U. S.

OLEATE OF COCAINE

(ō-lē-ā'tŭm cō-cą-ī'næ)

Cocainum Oleicum; Oléate de Cocaine, *Fr.;* Cocainoleat, *G.*

* "Cocaine, *five grammes* [or 77 grains]; Alcohol, *five cubic centimeters* [or 81 minims]; Oleic Acid, *fifty grammes* [or 1 ounce av., 334 grains]; Olive Oil, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Cocaine in a tared mortar with the Alcohol, then add about an equal volume of the Oleic Acid, and, after warming the mortar, stir until the Alcohol has evaporated, add the remainder of the Oleic Acid, and continue stirring until the Cocaine is dissolved; then add sufficient Olive Oil to make the product weigh *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

Oleate of cocaine was introduced into the U. S. P. (8th Rev.) to provide a preparation which could be applied locally. The alcohol and olive oil are used for the same reasons that they were added to oleic acid and atropine in the oleate of atropine. (See *Oleatum Atropinæ.*)

OLEATUM HYDRARGYRI. U. S. (Br.)

OLEATE OF MERCURY

(ō-lē-ā'tŭm hȳ-drär'gy-rī)

"Precipitated Mercuric Oleate, formed by the interaction of mercuric chloride and sodium oleate." *Br.*

Hydrargyri Oleas, *Br.;* Mercuric Oleate; Hydrargyrum Oleicum; Oléate de Mercure. *Fr.;* Oelsaures Quecksilber, Quecksilberoleat, Mercurioleat, *G.*

* "Yellow Mercuric Oxide, in very fine powder, *twenty-five grammes* [or 386 grains]; Distilled Water, *twenty-five cubic centimeters* [or 406 minims]; Oleic Acid, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Yellow Mercuric Oxide with the Distilled Water in a tared mortar; add *seventy grammes* [or 2 ounces av., 205 grains] of Oleic Acid, and mix thoroughly; warm the mortar to a temperature not exceeding 50° C. (122° F.), stir occasionally until the water has evaporated, then add, if necessary, Oleic Acid to make *one hundred grammes* [or 3 ounces av., 231 grains], and mix thoroughly. Avoid contact with metallic utensils; preserve the Oleate in tightly stoppered bottles." *U. S.*

"Mercuric Chloride, 1 *ounce* (Imperial) or 32 grammes; Hard Soap, powdered, 2 *ounces* (Imp.) or 64 grammes; Oleic Acid, 1 *fl. drachm* (Imp. meas.) or 4 cubic centimetres; Distilled Water, boiling, *a sufficient quantity.* Dissolve the Mercuric Chloride in *ten fluid ounces* (Imp. meas.) or three hundred and twenty cubic centimetres of the Distilled Water. Triturate the Oleic Acid with the Hard Soap, and dissolve the product in *eleven fluid ounces* (Imp. meas.) or three hundred and fifty-two cubic centimetres of the Distilled Water. Mix the solutions; boil for ten minutes; set aside for the mercuric oleate to deposit; decant the supernatant liquid; wash the precipitated oleate with hot Distilled Water until the decanted liquid affords little or no reaction for chloride, and then dry it on a water-bath." *Br.* It is "a substance of unctuous consistence, having a light greyish-yellow color, liable to darken by keeping. It has a somewhat saponaceous odor." *Br.*

This oleate is now made with 25 per cent. of mercuric oxide, an increase of 5 per cent. over that of the previous pharmacopœia. Water is used in this oleate in order to facilitate combination.

This preparation was introduced by Marshall in 1872. If made from oleic acid which has been purified from the usual contaminations (palmitic and stearic acids), it is a clear yellowish liquid of a thick consistence and having the peculiar odor of oleic acid. As usually seen, however, it is of the consistence and appearance of petrolatum, due to the presence of small quantities of mercuric palmitate and stearate. (See *Acidum Oleicum,* p. 56.) The formula of a normal oleate of mercury would be $(C_{18}H_{33}O_2)_2Hg$. For its formation we should reckon for every 25 parts of mercuric oxide from 65 to 66 parts of oleic acid. Free oleic acid is intentionally present in this U. S. preparation, which is known frequently as "25 per cent. oleate of mercury." In making this preparation, care must be exercised in the selection of the oleic acid, and to avoid exceeding the degree of heat directed in the official process; indeed, our experience has been that it keeps better if made by the cold process,—*i.e.,* by simply mixing the freshly precipitated yellow oxide with the oleic acid, and allowing them to stand at ordinary temperatures until the precipitate has dissolved. The British preparation is modelled after Shoemaker's process. The precipitated mercuric oleate is difficult to free from water, and is prone to change. In time, even with the best oleic acid that can be procured, some decomposition will take place, and metallic mercury will be found at the bottom of the containing bottle. The rapidity of the change will be in proportion to the impurities in the oleic acid and the degree of heat employed. Beringer's process, by the double decomposition of potassium oleate and mercuric nitrate, is commended by Edel. (See *West. Drug.,* 1894, 85.)

Uses.—This preparation may often be substituted with advantage for mercurial ointment, which it closely resembles in its medicinal properties, except that it is more readily absorbed, and therefore more effective. It has been especially commended by Marshall in cases of *chronically inflamed joints,* and in *hordeolum, indurations after abscesses,* and various other forms of superficial local inflammations of a slow type; also in *sycosis, tinea, psoriasis, eczema,* and as a constitutional alterative in *hereditary syphilis.* For many purposes it is much improved by dissolving in every drachm of it one grain of morphine. The alkaloid itself must be used in such cases, as its salts are not soluble in oleic acid.

Off. Prep.—Emplastrum Hydrargyri, *U. S.;* Unguentum Hydrargyri, *U. S.;* Unguentum Hydrargyri Oleatis, *Br.*

OLEATUM QUININÆ. U. S.

OLEATE OF QUININE

(ō-lē-ā′tŭm quĭ-nī′næ)

Chininum Oleicum; Oléate de Quinine, *Fr.;* Chininoleat, *G.*

* "Quinine, *twenty-five grammes* [or 386 grains]; Oleic Acid, *seventy-five grammes* [or 2 ounces av., 282 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Quinine in a warm mortar with a small quantity of the Oleic Acid to a smooth paste. Then add the remainder of the Oleic Acid, previously warmed, and stir frequently, until the Quinine is dissolved." *U. S.*

This oleate was introduced into the U. S. P. (8th Rev.) to provide a convenient preparation for the local application of the alkaloid quinine.

OLEATUM VERATRINÆ. U. S.

OLEATE OF VERATRINE

(ō-lē-ā′tŭm vĕr-ą-trī′næ)

Veratrinum Oleicum; Oléate de Vératrine, *Fr.;* Oelsaures Veratrin, Veratrinoleat, *G.*

* "Veratrine, *two grammes* [or 31 grains]; Oleic Acid, *fifty grammes* [or 1 ounce av., 334 grains]; Olive Oil, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Veratrine in a tared mortar with about *five cubic centimeters* [or 81 minims] of Olive Oil, and, after warming the mortar, add the Oleic Acid, and continue stirring until the Veratrine is dissolved; then add sufficient Olive Oil to make the product weigh *one hundred grammes* [or 3 ounces av., 231 grains]." *U. S.*

This preparation is simply a solution of the alkaloid in oleic acid and olive oil. (See *Oleatum Atropinæ*). It may be used instead of ointment of veratrine, but is exactly half the strength. It is well adapted for obtaining all the advantage that can be derived from an application of veratrine by inunction. (See *Veratrina.*) When the veratrine is to be used as a counter-irritant, the ointment is preferable, because less favorable to the absorption of the alkaloid. The *oleate of morphine* is made in the same proportion and in the same way as is oleate of veratrine.

OLEORESINA ASPIDII. U. S. (Br.)

OLEORESIN OF ASPIDIUM

(ō-lę-ō-rĕs′ĭ-ną ąs-pĭd′ĭ-ī)

Extractum Filicis Liquidum, *Br.;* Oleoresina Filicis, *Pharm.* 1870; Liquid Extract of Male Fern, Oil of Fern; Oleum Filicis Maris; Extrait de Fougère Mâle, *Fr. Cod.;* Extractum Filicis, *P. G.;* Farnextrakt, Wurmfarnextrakt, Wurmfarnöl, *G.;* Estratto de felce maschio etero, *It.;* Extracto etereo de helecho macho, *Sp.*

* "Aspidium, recently reduced to No. 40 powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Acetone, *a sufficient quantity.* Introduce the Aspidium into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until the Aspidium is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. Keep the Oleoresin in a well-stoppered bottle.

Note.—Oleoresin of Aspidium usually deposits, on standing, a granular, crystalline substance. This should be thoroughly mixed with the liquid portion before use." *U. S.*

"Exhaust Male Fern Rhizome, in No. 20 powder, with Ether, by percolation; evaporate the Ether from the clear percolate on a water-bath or by distillation, until an oily Extract remains." *Br.*

This is the only preparation of male fern which should be used; in its making aspidium which is green in color and recently collected should be employed. It is a thick, dark green liquid, usually containing a granular deposit of *filicic acid,* which is regarded as the active ingredient and should not be separated. For a method of determining the percentage of filicic acid by Daccomo and Scoccianti, see *Ph. Centralh.,* 1896, 208. Wm. G. Greenewalt found both the liquid and the sediment effective tænicides, the sediment somewhat the more active. It has the odor of fern, and a nauseous, bitterish, somewhat acrid taste. According to Hayes, when an absolutely dry root and an anhydrous ether (containing but little alcohol) of a specific gravity below 0.728 are used, the oleoresin remains clear. Kramer states that a very active extract of male fern may be prepared by exhausting with ether the fresh juicy rhizomes collected in May or October freed from scales and cut into small pieces. The ethereal tincture should be kept in a cool place until wanted, when the necessary quantity should be converted into extract. One dose,

two to four drachms, of such an extract is said to have always produced satisfactory results. (*Ph. Cb.*, xxv. 578.) Oleoresin of male fern is sometimes found in the market containing noticeable proportions of copper, and in many cases it is colored green artificially.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.), administered in gelatin capsules.

OLEORESINA CAPSICI. U. S.

OLEORESIN OF CAPSICUM

(ō-lẹ-ō-rĕṣ′ị-nạ căp′sị-cī)

Oléorésine (Extrait éthéré) de Capsique, *Fr.*; Spanischpfeffer-Oelharz, Aetherisches Spanischpfeffer-extrakt, *G.*

* "Capsicum, in No. 40 powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Acetone, *a sufficient quantity.* Introduce the Capsicum into a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of percolate have been obtained. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. Then pour off the liquid portion, transfer the remainder to a glass funnel provided with a pledget of cotton, and when the separated fatty matter (which is to be rejected) has been completely drained, mix the liquid portions together. Keep the Oleoresin in a well-stoppered bottle." *U. S.*

The active principle of capsicum, called *capsicin,* is very soluble in ether, and is wholly extracted in the process. Its precise nature has not been determined. (See *Capsicum.*) After the concentration of the acetone solution, a solid fatty matter separates on standing, but a portion of fixed oil probably still remains. The preparation is a very thick liquid, capable however, of being dropped, of a dark reddish-brown color, and, though opaque in mass, yet transparent in thin layers. It has not very decidedly the odor of capsicum, but to the taste is intensely pungent. W. C. Alpers found a capsicum which yielded 16 per cent. of oleoresin; the statement has been frequently made that 5 per cent. is the usual yield. (*M. R.*, 1896, 593.) It may be usefully employed to give locally stimulant properties to substances administered internally in a pilular form, in cases of *gastric insensibility* and excessive *flatulence.* One drop given three times a day has produced cystic irritation and strangury. It may be used also as a powerful rubefacient, diluted with olive oil or soap liniment.

Dose, from one-fourth to one minim (0.015 to 0.06 Cc.).

Off. Prep.—Emplastrum Capsici, *U. S.*

OLEORESINA CUBEBÆ. U. S.

OLEORESIN OF CUBEB

(ō-lẹ-ō-rĕṣ′ị-nạ cū-bē′bæ)

Extractum Cubebæ Æthereum; Oléorésine de Cubèbe, *Fr.*; Extractum Cubebarum, *P. G.*; Aetherisches Kubebenextrakt, Kubebenextrakt, *G.*

* "Cubeb, in No. 30 powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Alcohol, *a sufficient quantity.* Introduce the Cubeb into a cylindrical glass percolator, pack the powder firmly, and percolate slowly with Alcohol, added in successive portions, until the Cubeb is exhausted. Recover the greater part of the Alcohol from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Alcohol to evaporate, with constant stirring, in a warm place. Keep the Oleoresin in a well-stoppered bottle.

NOTE.—Oleoresin of Cubeb deposits, after standing for some time, a waxy and crystalline matter, which should be rejected, the liquid portion only being used." *U. S.*

A change was made in the menstruum for this oleoresin in the U. S. P. (8th Rev.) alcohol now being used instead of ether or acetone. The use of alcohol was suggested by E. R. Squibb. This oleoresin consists mainly of the volatile oil and resin, with a portion of the cubebin and waxy matter of the cubeb. The consistence differs according to the character of the cubeb employed, its degree of fluidity being proportionate to the amount of volatile oil contained in the medicine. The color is usually blackish brown, with more or less of a greenish hue, according to the quantity of chlorophyll present, which varies with the character of the cubeb, and with that of the menstruum, pure ether extracting the green coloring matter preferably, while alcohol extracts the brown; unripe fruit or berries yield more chlorophyll than ripe fruit. Cubeb yields from one-eighth to one-fifth of its weight of the oleoresin. The preparation deposits waxy matter and crystals of cubebin on standing, which should be separated; its efficacy is not impaired on this account. It was first introduced into use by Procter. (*A. J. P.*, xviii. 168.)

From carefully conducted experiments by F. V. Heydenreich, it would appear that, of the various constituents of cubeb contained in the official oleoresin, the cubebin has no perceptible effect in the dose of the medicine ordinarily given, that the volatile oil is simply stimulant and carminative, and, finally, that the soft resin has all the diuretic properties of the cubeb. Of the last-mentioned ingredient, twenty grains (1.3 Gm.) given every two hours until five doses were taken considerably increased the secretion of urine, producing at the same time a slight burning sensation in the passage, which ceased with the diuretic action. Pushed beyond this amount,

it occasioned severe irritation of the urinary passages, with some fever. (*Ibid.* Jan. 1868, p. 42.)

This oleoresin, as it occurs in the market, often has a thin consistence. In one specimen three-eighths of its weight were lost in a short time by the spontaneous evaporation of the ether improperly left in the product.

Dose, from five to ten minims (0.3 to 0.6 Cc.), given suspended in water, or mixed with powdered sugar.

Off. Prep.—Trochisci Cubebæ, *U. S.*

OLEORESINA LUPULINI. U. S.

OLEORESIN OF LUPULIN

(ō-lę-ō-rĕs'ĭ-nȧ lū-pū-lī'nī)

Oleoresina Lupulinæ, *Pharm.* 1870; Extractum Lupulini Ætherеum; Oléorésine de Lupuline, *Fr.;* Aetherisches Lupulinextrakt, *G.*

* "Lupulin, *five hundred grammes* [or 17 ounces av., 279 grains]; Acetone, *a sufficient quantity.* Introduce the Lupulin into a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Press the powder very lightly, and percolate slowly with Acetone, added in successive portions, until the Lupulin is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. Keep the Oleoresin in a well-stoppered bottle." *U. S.*

Lupulin yields its volatile oil and resin, as well as any other active principle it may contain, to acetone, and the resulting oleoresin constitutes about three-eighths, or somewhat less than one-half, of the original drug. It is of a very thick, semi-fluid consistence, so thick, indeed, that it cannot be conveniently administered by drops. Its color is almost black in mass, but a rich reddish brown in thin layers. It has the odor and taste of lupulin, and possesses all its medicinal properties. It may be most conveniently administered in the form of pill, made with powdered licorice root, or other proper excipient.

Dose, from one to five minims (0.06 to 0.3 Cc.).

OLEORESINA PIPERIS. U. S.

OLEORESIN OF PEPPER

(ō-lę-ō-rĕs'ĭ-nȧ pĭp'ę-rĭs)

Extractum Piperis Fluidum, *U. S.* 1850; Fluid Extract of Black Pepper; Oléorésine de Poivre noir, *Fr.;* Aetherisches Pfefferextrakt, *G.*

* "Pepper, in No. 40 powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Acetone, *a sufficient quantity.* Introduce the Pepper into a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until the Pepper is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, set this aside in a warm place until the remaining Acetone has evaporated, and the deposition of crystals of piperin has ceased. Lastly, separate the Oleoresin from the piperin by straining through purified cotton. Keep the Oleoresin in a well-stoppered bottle." *U. S.*

A substance has long been in use under the name of *oil of black pepper,* consisting mainly of the volatile oil, fixed oil, and resin of the pepper, and belonging, therefore, to the oleoresins. As usually found, it is almost black and of a thickish consistence, and is a residue of the process for preparing piperin. The official oleoresin made with acetone has the same general character, but is more fluid and of more uniform strength, and should, therefore, be preferred. It contains almost all the volatile oil and acrid resin of black pepper, with little of the piperin, and, as the last-mentioned principle, when quite pure, is of doubtful efficacy, the extract may be considered as representing the virtues of the fruit. The color is greener than that of the common oil of black pepper, and not so dark, owing to the fact that the solvent dissolves the green more readily than the brown coloring matter. A pound of black pepper yields about six drachms of the oleoresin.

Dose, from one-fourth to one minim (0.015 to 0.06 Cc.), in emulsion or pill.

OLEORESINA ZINGIBERIS. U. S.

OLEORESIN OF GINGER

(ō-lę-ō-rĕs'ĭ-nȧ zĭn-gĭb'ę-rĭs)

Extractum Zingiberis Ætherеum; Oléorésine (Piperoide) de Gingembre, *Fr.;* Zingiberin, Aetherisches Ingwerextrakt, *G.*

* "Ginger, in No. 60 powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Acetone, *a sufficient quantity.* Introduce the Ginger into a cylindrical glass percolator, provided with a stop-cock, and arranged with a cover and a receptacle suitable for volatile liquids. Pack the powder firmly, and percolate slowly with Acetone, added in successive portions, until the Ginger is exhausted. Recover the greater part of the Acetone from the percolate by distillation on a water-bath, and, having transferred the residue to a dish, allow the remaining Acetone to evaporate spontaneously in a warm place. Keep the Oleoresin in a well-stoppered bottle." *U. S.*

In the U. S. formula of 1870 for this preparation alcohol was used in connection with ether, on the score of economy; it was added in order to displace the ether and thus save an unnecessary expenditure of the more

costly fluid. A little of the alcohol mixed with the ether at their surface of contact. In the present process both ether and alcohol have been replaced by the new solvent, acetone. The whole of the virtues of the root are extracted in this preparation, as the residuary ginger is nearly or quite tasteless. The oleoresin constitutes about 5 per cent. of the dried root. It is the *piperoid of ginger* of Beral. (Soubeiran's *Traité de Pharm.*, i. 371.) It is a clear, dark-brown liquid, of a thick consistence (though capable of being dropped), with the flavor of ginger, and very pungent.

Dose, one-half to one minim (0.03 to 0.06 Cc.), well diluted.

OLEORESINÆ.

OLEORESINS

(ō-lẹ-ō-rĕs′ĭ-næ)

Oléo-résines, Extraits éthérés, *Fr.*; Oelharze, Aetherische Extrakte, *G.*

The oleoresins, as a class of preparations, were introduced into the U. S. Pharmacopœia at the revision of 1860, having been previously classed with the Fluidextracts. Their peculiarity is that they consist of principles which, when extracted by means of ether, alcohol, or acetone, retain a liquid or semi-liquid state upon the evaporation of the menstruum, and at the same time have the property of self-preservation, differing from the fluidextracts in not having a definite relation of strength to the drug. They consist chiefly, as their name implies, of oil, either fixed or volatile, holding resin and sometimes other active matter in solution. Their preparation is very simple, consisting in the exhaustion of the medicine employed with acetone or alcohol by means of percolation, and the subsequent evaporation of the menstruum. In consequence of the great volatility of the solvent, it may in great measure be recovered by distillation, thus very materially diminishing the costliness of the process. It is proper not to continue the heat necessary for the distillation until the whole of the solvent is driven over, lest, towards the close, a portion of the volatile matters also should pass, and the strength of the oleoresin be impaired. Hence in every instance the last portions of the menstruum are allowed to separate by spontaneous evaporation. Petroleum benzin has been proposed as a substitute for other solvents in these preparations, but should not be permitted to supersede them until officially sanctioned. Acetone has replaced ether in most of the formulas of the U. S. P. (8th Rev.). Oleoresin of cubeb is made with alcohol.

OLEUM ADIPIS. U. S.

LARD OIL

(ō′lẹ-ŭm ăd′ĭ-pĭs)

"A fixed oil expressed from lard at a low temperature." *U. S.*

Huile de Graisse, *Fr.*; Schmalzöl, Specköl, *G.*

Lard oil is made in large quantities in this country by exposing lard to low temperatures and then subjecting it to very powerful pressure. In this way the stearin of the lard is separated from the olein, the latter oozing out from the presses in the form of a yellowish-white oil, while the stearin is thrown into the market in hard cakes, and is largely used in making soap. (See *Adeps.*) The exportation of lard from the United States for the year ending June 30, 1904, amounted to 561,302,643 pounds, valued at $46,347,520, and that of lard compounds and substitutes to 53,603,545 pounds, valued at $3,581,813. (*U. S. Treasury Statistical Reports.*)

Properties.—Lard oil is "a colorless or pale yellow, oily liquid, having a peculiar odor and a bland taste. Specific gravity: 0.905 to 0.915 at 25° C. (77° F.). At a temperature a little below 10° C. (50° F.), it usually commences to deposit a white, granular fat, and at or near 0° C. (32° F.), it forms a solid white mass. Lard oil is almost insoluble in cold alcohol and only slightly soluble in boiling alcohol; easily soluble in ether, chloroform, benzene, and carbon disulphide. If 5 Cc. of the Oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol, and adding 2 drops of nitric acid), and the mixture heated for about five minutes on a water-bath, the Oil should remain nearly or quite colorless, not acquiring a reddish or brown color (absence of more than about 5 percent. of *cotton seed oil*). The Oil should be completely saponifiable with alcoholic potassium hydroxide T.S. and the resulting soap should be completely soluble in water, without separation of an oily layer (absence of *mineral oils*). If 2 Cc. of Lard Oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, no reddish color should develop in from ten to fifteen minutes (absence of *cotton seed oil* or of *certain other fats*). Lard Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of 195 to 197 (see PART III, Test No. 99). If 0.3 Gm. of Lard Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours protected from the light, 20 Cc. of potassium iodide T.S. be added, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 56 nor more than 74 should be obtained (see PART III, Test No. 51)." *U. S.* It is not pure olein, but contains varying proportions of stearin, and is sometimes adulterated with paraffin oil. It was introduced into the U. S. P. 1880 for the

purpose of rendering the ointment of mercuric nitrate softer and smoother in consistence, but it was not retained in the process of the U. S. P. (8th Rev.) mainly owing to the difficulty of obtaining it of sufficient purity in commerce.

Uses.—Lard oil is a bland, fatty liquid, destitute of active medicinal properties, and is official solely for pharmaceutical purposes.

OLEUM ÆTHEREUM. U. S.

ETHEREAL OIL

(ō'lę-ŭm æ-thē'rę-ŭm)

"A volatile liquid consisting of equal volumes of heavy oil of wine and ether." *U. S.*

Oleum Vini; Heavy Oil of Wine; Huile d'Ether, Huile de Vin pésante, Huile volatile éthérée, *Fr.*; Schweres Weinöl, *G.*

* "Alcohol, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Sulphuric Acid, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Distilled Water, *twenty-five cubic centimeters* [or 406 minims]; Ether, *a sufficient quantity.* Add the Sulphuric Acid slowly to the Alcohol, mix them thoroughly and allow the mixture to stand, in a closed flask, for twenty-four hours, or until the liquid is clear; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure, so that the bulb shall be deeply immersed in the liquid, and, having connected the retort with a well-cooled condenser, and also having connected with the receiver a bent glass tube for conducting the uncondensed gases into water, distil, by means of a sand-bath, at a temperature between 150° and 160° C. (302° and 320° F.), until oily drops cease to come over, or until a black froth, which forms on the surface, begins to rise in the retort. Separate the yellow, ethereal liquid from the distillate, and expose it to the air for twenty-four hours, in a shallow dish. Then transfer it to a wet filter, and, when the aqueous portion has drained off, wash the oil which is left on the filter with the Distilled Water, which should be as cold as possible. When this also has drained off, transfer the oil to a graduated measure, and add to it an equal volume of Ether. Keep the product in small, glass-stoppered vials, in a cool place." *U. S.*

In the consolidation of the British Pharmacopœias this valuable remedy was omitted, partly on account of the uncertainty as to its special antispasmodic virtues, partly from its expensiveness when properly made and its liability to spontaneous change, and partly, moreover, because not only is it often adulterated, but other compounds are substituted for it. The Committee of Revision of the U. S. P. (8th Rev.) decided to retain it.

The object of allowing the mixture of acid and alcohol to stand is to allow the lead sulphate which is usually present in commercial sulphuric acid to deposit, for, according to E. R. Squibb, its presence in the retort causes the mixture to froth over, and this necessitates a suspension of the process so much sooner as greatly to lessen the amount of product the materials are capable of affording. The increase of oil resulting from this simple modification of the process is said to be one-third. The temperature has been slightly decreased. By wetting the filter, the oil is prevented from passing along with the water. Finally, the oil is now ordered to be diluted with an equal measure of stronger ether, as this has been found to be of great value in aiding in its preservation.

When alcohol is distilled with a large excess of sulphuric acid, there are formed towards the close of the distillation sulphurous acid, heavy oil of wine, olefiant gas, and resinocarbonaceous matter. The product of the distillation is generally in two layers, one consisting of water holding sulphurous acid in solution, and the other, of ether containing the heavy oil of wine. According to the experience of Squibb, the sp. gr. of these two layers is so nearly equal that sometimes one and sometimes the other is uppermost, so that the direction in the old formula to separate the supernatant liquor is incorrect, and has been superseded by the present, to separate the yellow ethereal liquid,—the color and other sensible properties being considered sufficiently distinctive. After separation, the liquid is exposed for twenty-four hours to the air, in order to dissipate the ether by evaporation, and the oil which is left is washed with water, in order to deprive it of all traces of sulphuric acid.

The nature and mode of formation of heavy oil of wine are generally believed to be the following. It has been explained in a preceding article that, in the early stages of the distillation of a mixture of sulphuric acid and alcohol, sulphovinic acid, $C_2H_5HSO_4$, is formed. During its progress this is decomposed so as to yield ether. When, however, the alcohol is distilled with a large excess of sulphuric acid, the sulphovinic acid is decomposed so as to form a small quantity of the *heavy oil of wine.* This is a mixture of ethyl sulphate, $(C_2H_5)_2SO_4$, ethyl sulphite, $(C_2H_5)_2SO_3$ (the sulphurous acid having been formed by reduction of sulphuric acid, as it always is when ethylene is formed from alcohol), with polymeric forms of ethylene, C_2H_4. Two of these forms are known: *etherin,* a solid fusing at 110° C. and boiling at 260° C., and *etherol,* a liquid. The latter is by some considered to have the formula $C_{16}H_{32}$ or $(C_2H_4)_8$, and mixed with the former constitutes the *light oil of wine,* which is produced when the heavy oil is heated with water and alkaline solutions. In this case sulphovinic acid is reproduced, and the separated *etherol* floats on the surface as an oily substance. *Light oil of wine,* as thus obtained, is a pale-yellow oil. As ordi-

narily procured in the process for preparing ether, it contains a portion of that substance, admixed, according to Hartwig (*J. Pr. Chem.* [2], 23, 449), with ketones like ethyl-amyl ketone and methyl-hexyl ketone and mixed ethers like ethyl-amyl ether. When the pure light oil of wine is kept, it deposits a stearopten (the *etherin* mentioned above) called concrete oil of wine, or oil of wine camphor; after which the oil is changed, and takes the name of etherol. *Etherol* is a pale yellow oily liquid, having an aromatic odor. Its sp. gr. is 0.921, boiling point 280° C. (536° F.), and freezing point —35° C. (—31° F.). It communicates a greasy stain to paper. *Concrete oil of wine*, or *etherin*, crystallizes in long, transparent, brilliant, tasteless prisms, soluble in alcohol and ether, insoluble in water, and having the sp. gr. 0.980. Squibb takes a different view of the composition of ethereal oil, and believes it, instead of a sulphate or a mixture of sulphate and sulphite, to be a sulphovinate of a hydrocarbon radical; and for this reason, that it fails, especially when pure and recent, to give any of the characteristic reactions of sulphuric acid or the sulphates. (*A. J. P.*, 1861.)[1]

Properties.—Ethereal oil is officially described as follows: "A transparent, nearly colorless, volatile liquid, of a peculiar, aromatic, ethereal odor, and a pungent, refreshing, bitter taste; neutral to dry litmus paper. Specific gravity: 0.905 at 25° C. (77° F.)." *U. S.* The undiluted *ethereal oil* (*heavy oil of wine*) is a yellowish neutral liquid, possessing an oleaginous consistence, a penetrating aromatic odor, and a rather sharp and bitter taste. It boils at 280° C. (536° F.). Its sp. gr. is, according to the U. S. P. 1850, 1.096; according to the London College, after Hennell's results, 1.05. The density obtained by Squibb, by following the old formula of the U. S. Pharm. 1850 exactly, was 1.129. By Dumas and Sérullas its density is stated to be as high as 1.133, which is probably the more correct number for the *pure oil*. When dropped into water it sinks, assuming the form of a globule. It dissolves sparingly in cold water, moderately in hot water, and readily in alcohol and ether. It is devoid of acid reaction, the sulphuric and sulphurous acids present in it being in the form of neutral salts. The sulphuric acid present is not precipitated by the usual reagents for this acid, because sulphovinic acid is formed, and all the sulphovinates are soluble in water. The U. S. ethereal oil of the present Pharmacopœia is the proper oil diluted with an equal volume of stronger ether. This gives it an ethereal odor in addition to that characteristic of the pure oil, and considerably reduces its sp. gr., which is now stated at 0.905 at 25° C. (77° F.). The process by which the official oil of wine is formed yields but a small product, being, according to the Pharmacopœia of 1870, only about six fluidrachms, or somewhat more than a fortieth, by measure, of the alcohol employed.

In the official ethereal oil, the heavy oil of wine is not only diluted with an equal measure of ether, but is mixed also with variable proportions of free light oil of wine. This fact accounts for the different densities assigned to the heavy oil. The heavy oil undiluted is liable to spontaneous change by time, not only being rendered brown, but also being chemically altered so as to separate into two layers. But this tendency is in great measure obviated, in the official ethereal oil, by the preservative influence of the ether. It may be kept long without other appreciable change than the acquisition of a brown hue, which does not interfere with its medicinal virtues. It should not, when tested by dry litmus paper, evince the presence of free acid.

Uses.—H. A. Hare has found that the heavy oil of wine produces in mammals a rise in the arterial pressure and pulse rate, followed after sufficient doses, by a fall. The rise in the pressure was the result of a stimulant influence upon the vasomotor centre, while the fall of the pressure appeared to be due to a widening out of the blood paths by a direct paralysis of the coats of the vessels. Hare also found that very large doses paralyze the heart by a direct action on the muscle, but he did not determine the exact influence of small doses. The toxic properties of the heavy oil of wine were shown to be very feeble, and the research seems to prove that the small quantity of the heavy oil of wine contained in Hoffmann's anodyne cannot exert a very pronounced influence upon the human system. It probably has, however, a slight stimulative, calmative effect, since clinical experience indicates that compound spirit of ether is a more persistent and powerful antispasmodic and nerve stimulant than is an equivalent amount of ether and alcohol. The article sold in commerce as heavy oil of wine is too often a mixture of alcohol and ether containing but a trace of the oil. It is used only for the preparation of compound spirit of ether; there can be no justification of the action of the chemist in furnishing a fraudulent article.

Off. Prep.—Spiritus Ætheris Compositus, *U. S.*

[1] Valuable papers have been contributed by C. Lewis Diehl and John M. Maisch on this official preparation,—the former in *Proc. A. Ph. A.*, 1864, the latter in *A. J. P.*, 1865. p. 160, to which we refer those especially interested in its manufacture. In Diehl's paper suggestions are made in reference to the mode of reheating so as properly to regulate the temperature. An important fact was stated by Maisch, that the ethereal oil, in contact with water, undergoes a decomposition into light oil of wine and sulphovinic acid, rapidly and completely if the water is hot or if the solution of an alkali or of an alkaline carbonate is used, and more slowly with cold water. Hence the inference that the washing of the ethereal oil, directed at the close of the U. S. process, should be completed as rapidly as possible. Care should be taken to protect the oil from the action of light. See a paper by I. W. Brandel in *Proc. A. Ph. A.*, 1903, 263: Kebler, *Am. Drug.*, 1900, 33; Scoville, *Am. Drug.*, 65.

OLEUM AMYGDALÆ AMARÆ. U. S.

OIL OF BITTER ALMOND

(ō'lę-ŭm ą-mŷg'dą-læ ą-mā'ræ)

"A volatile oil obtained from Bitter Almond and other seeds containing amygdalin, yielding, when assayed as directed below, not less than 85 percent. of benzaldehyde, and not less than 2 percent. nor more than 4 percent. of hydrocyanic acid. It should be kept in small, well-stoppered, completely filled, amber-colored bottles, protected from light and air." *U. S.*

Oleum Amygdalarum (Amararum) Æthereum; Oleum Amygdalæ Volatile; Volatile Oil of Almond; Huile volatile d'Amande amère, *Fr. Cod.*; Essence d'Amandes amères, *Fr.*; Bittermandelöl, *G.*; Esencia de almendras amargas, *Sp.*

When bitter almonds are expressed, they yield a bland fixed oil, and the residuary cake, reduced to powder by grinding, and submitted to distillation with water, yields a volatile oleaginous product, commonly called oil of bitter almond. This does not pre-exist in the almond, but is produced by the action of water upon the amygdalin contained in it, through the intervention of another constituent, denominated emulsin (see *Amygdala Amara*), according to the reaction:

$$C_{20}H_{27}NO_{11} + 2H_2O = C_7H_6O + 2C_6H_{12}O_6 + HCN$$

It is obtained also by the distillation of the leaves of the cherry-laurel, and of various products of the genera Amygdalus, Cerasus, Prunus, etc. Whipple obtained, upon an average, from the ground bitter almond cake, 1.35 per cent. of the oil. (*P. J.*, x. 297.) Pettenkofer has ascertained that the product is greater if the cake be macerated in water for forty-eight hours before being submitted to distillation. (*J. P. C.*, Mai, 1862, p. 432.) It is sometimes produced in France from peach kernels.

Oil of bitter almond has a yellowish color, a bitter, acrid, burning taste, and the odor of the kernels in a high degree. It is heavier than water, soluble in alcohol and ether, according to Flückiger soluble in 300 parts of hot or cold water, and deposits, upon standing, a white crystalline substance consisting chiefly of benzoic acid. It is officially described as "a clear, colorless or yellow, thin, and strongly refractive liquid, having a peculiar aromatic odor, and a bitter and burning taste. Specific gravity: 1.045 to 1.060 at 25° C. (77° F.). Boiling point: about 180° C. (356° F.). Optically inactive. Soluble in 300 parts of water at 25° C. (77° F.), in alcohol or ether in all proportions, and in an equal volume of 70 percent. alcohol; soluble in nitric acid at ordinary temperatures without the evolution of nitrous vapors. In the fresh state the Oil is neutral to litmus paper, but when kept for some time it acquires an acid reaction, due to the formation of benzoic acid, which, when isolated and purified, should correspond to the tests given under *Acidum Benzoicum*. Oil of Bitter Almond containing crystals of benzoic acid should not be dispensed. If 10 drops of the Oil, dissolved in a little alcohol, be shaken with a few drops of sodium hydroxide T.S. also with 2 drops of ferrous sulphate T.S. and 2 drops of ferric chloride T.S., then warmed, and finally mixed with a slight excess of hydrochloric acid, a blue precipitate will be produced (presence of *hydrocyanic acid*). If the looped end of a piece of clean copper wire be held in a non-luminous flame until it ceases to give a green color, then cooled, and the loop dipped into Oil of Bitter Almond, ignited and held so that the liquid burns outside of the flame, then if the loop be slowly brought into contact with the lower outer edge of the flame, no green tinge should be discernible (absence of *chlorinated products*). If a small strip of filter paper, folded in the form of a taper and saturated with Oil of Bitter Almond, be placed in a small porcelain dish, and a clean beaker, moistened on the inner surface with distilled water, be inverted over the small dish immediately after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S., or if a slight turbidity appears, it should entirely disappear upon boiling the liquid (absence of *artificial oils* containing *chlorinated products*)." *U. S.* Besides the peculiar volatile oil, it contains also hydrocyanic acid, with a small proportion of benzoic acid (produced by oxidation of the aldehyde when liberated), and of a concrete principle called *benzoin*, $C_{14}H_{12}O_2$. It may be obtained pure by agitating it strongly with calcium hydroxide and a solution of ferrous chloride, submitting the mixture to distillation, and drying the oil which comes over by digestion with calcium chloride. George Whipple states that if crude oil be redistilled into a solution of silver nitrate, and again distilled from a fresh solution of the same salt, it is obtained entirely free from hydrocyanic acid, which reacts with the silver and remains behind as silver cyanide. (See *A. J. P.*, xxvi. 348.) Thus purified, it is colorless, but still retains its peculiar odor, with a burning, aromatic taste, and is destitute of those poisonous properties of the crude oil which are dependent on hydrocyanic acid. The odor of the oil of bitter almond has been erroneously ascribed to that acid, which, on examination, will be found to have a different and more feeble odor. Like most other volatile oils, this may produce deleterious effects if taken very largely. Hippuric acid is found in the urine of animals to which the oil has been given freely. The sp. gr. of the crude oil varies from 1.052 to 1.082, and is said to be greater when the oil is distilled from salt water than when distilled by the ordinary mode. That

of the purified oil is 1.060, and its boiling point 180° C. (356° F.). It is *benzoic aldehyde*, $C_6H_5.COH$, which may also be produced by the action of oxidizing agents upon *benzyl alcohol*, $C_6H_5.CH_2OH$, and yields itself, when oxidized, *benzoic acid*, $C_6H_5.COOH$. The benzoic acid which the oil of bitter almond deposits on standing does not pre-exist in it, but results from the absorption of oxygen, as just stated. The concrete substance above referred to by the name of *benzoin* is polymeric with the oil, crystallizable in colorless shining prisms, without odor or taste, fusible at 248° F., and volatilizable unchanged at a higher temperature. It is formed abundantly in the original impure oil by the reaction of alkalies, but cannot be produced in it when deprived of hydrocyanic acid.[1] The 8th Revision of the U. S. P. provides for an assay for benzaldehyde and also one for hydrocyanic acid, see page 41.

Benzoic aldehyde is now made from toluene, C_7H_8. (See *Benzaldehydum*, page 229.) By the action of chlorine upon the hot hydrocarbon, benzyl chloride, $C_6H_5CH_2Cl$, results, and this yields benzoic aldehyde on distillation with lead nitrate and water in an atmosphere of carbon dioxide gas. More generally, however, *benzal chloride*, $C_6H_5CHCl_2$, is taken, as this, when heated under pressure with water or sulphuric acid, readily yields the benzaldehyde. The product is purified by conversion into the acid sulphite compound. Lippmann and Hawliczek have made exhaustive researches on the identity of the artificial with the natural oil of bitter almond, and have found the two oils absolutely identical, physically as well as chemically. At the present time *benzaldehyde*, or synthetic oil of bitter almond, is very largely used, its chief advantages being uniformity of composition and absence of hydrocyanic acid. To prevent the formation of benzoic acid in oil of bitter almond, Schimmel & Co. recommend the addition of 10 per cent. of alcohol to the oil.

Zeller mentions, as characteristics of the official oil by which its genuineness and purity may be known, its peculiar odor and high specific gravity,[2] its ready solubility in sulphuric acid, with the production of a reddish-brown color, but without visible decomposition, the slow action of nitric acid, the slow and partial solution of iodine without further reaction, the want of action of potassium chromate upon it, and the production of crystals when it is dissolved in an alcoholic solution of potassium hydroxide. (See *P. J.*, ix. 575.) Redwood states that a very small proportion of alcohol may be detected in the oil by the effervescence, with disengagement of nitrous vapors, which ensues when the oil thus contaminated is mixed with an equal volume of nitric acid of the sp. gr. 1.5. With pure oil no other effect is obvious than a slight change of color. (*Ibid.*, xi. 486.) If sulphuric acid produce with the oil a bright-red instead of a brownish-red color, the oil has probably been distilled with salt water, in which case it is prone, according to Ferris, to deposit a blood-red substance, occasionally complained of by druggists. (*Ibid.*, 565.)

Wm. A. Tilden has found that the introduction of a little fused calcium chloride into purified oil of bitter almond contributes to its preservation, probably by the absorption of the last traces of water contained in it. Of two specimens of the oil, which had been set aside for two years, one without addition, the other containing a fragment of the fused chloride, the former was found filled with crystals of benzoic acid, and the latter was perfectly free from crystalline deposit and quite fluid. (*P. J.*, 2d ser., viii. 325, Dec. 1866.)

J. M. Maisch proposed the following mode of detecting nitrobenzene in adulterated oil of bitter almond. Dissolve half a drachm of the suspected oil in two or three drachms of alcohol, add fifteen grains of pure fused potassium hydroxide, heat for a few minutes so as to dissolve the potassium hydroxide, reduce the liquid to one-third, and then set it aside to cool. If the oil be pure, it will remain liquid, while if nitrobenzene be present, there will, after cooling, be a sediment of azoxybenzene indicating adulteration. (*A. J. P.*, 1857, 544.) R. Wagner proposes the sp. gr. of the two oils as a test,—that of oil of bitter almond being 1.060 to 1.070 at 15° C., while that of nitrobenzene is from 1.18 to 1.201, and a mixture will have a higher sp. gr. than the pure oil. This would lead to the suspicion of the presence of nitrobenzene, which may then be separated by agitation with sodium bisulphite. The almond oil will dissolve, while the nitrobenzene will float on the surface. (*J. P. C.*, Mai, 1868, 399.) The most reliable test is undoubtedly to add zinc dust and diluted acid, whereby any nitrobenzene is reduced to aniline, which can then be detected by the violet color produced when sodium hypochlorite or potassium dichromate is added. H. Hager's plan is as follows. After the addition of 10 drops of the *pure* oil to 10 Cc. of 45 per cent. alcohol, or to a mixture of 5 Cc. of 90 per cent. alcohol and 5 Cc. of water, on closing the test tube with the finger and turning it twice upside down, the oil dissolves to a clear solution. If nitrobenzene, even as little as 1 per cent., be present, the oil of bitter almond will dissolve at once, but the nitrobenzene will separate, clouding the liquid at first, but soon collecting in very minute but easily recognizable droplets which float about in the liquid. After standing for awhile, these droplets unite to larger drops, when they become still more evident to the eye. The temperature of the

[1] *Nitrobenzol, Nitrobenzene*, or *Artificial Oil of Bitter Almond.*—This substance, which was discovered by Mitscherlich, is treated of in PART II.

[2] Schimmel & Co. (*Semi-Annual Report*, April, 1893) state that an oil of high specific gravity should be carefully examined for benzo-nitrile, C_6H_5CN, which may form by condensation from benzaldehyde and hydrocyanic acid, and when distilled even *in vacuo* will decompose into the same components.

alcohol must not exceed 16° C. (60.8° F.); it is best to keep it between 10° and 15° C. (50° and 59° F.). Any sample of oil of bitter almond which dissolves on very gentle agitation at once to a clear liquid in 20 times its volume of 45 per cent. alcohol does not contain any nitrobenzene, since only traces of the latter are dissolved by that solvent. Small quantities of nitrobenzene present (up to 3 per cent.) disappear after the mixture stands for some time, but they are always the cause of the milkiness or cloudiness of the solution at the moment of preparation. A short cloudiness even occurs with as small a quantity as ½ per cent. Since most other essential oils yield a cloudy solution with 45 per cent. alcohol, this test may also indicate the presence of foreign essential oils.

Hager's test may also be used quantitatively for the estimation of the amount of nitrobenzene present. Oil of bitter almond requires for solution 16 to 17 times its volume of 45 per cent. alcohol. 2 Cc. of the oil are agitated with 34 Cc. of the 45 per cent. alcohol, and the mixture set aside. After the lapse of a day, the nitrobenzene (all but a trace which remains in solution) will be found collected at the bottom. An important indication of the presence of a sophistication is the cloudiness produced at the first moment. (*N. R.*, Oct. 1880.)

Assay for Benzaldehyde.—"The method to be employed is identical with that given for Benzaldehyde, on page 229, using *twelve drops* of Oil of Bitter Almond." *U. S.*

Assay for Hydrocyanic Acid.—"Mix, in a 100 Cc. flask, 1 Gm. of the Oil of Bitter Almond to be tested, with sufficient water and freshly precipitated magnesium hydroxide (free from chlorides) to make an opaque mixture of about 50 Cc. Add to this 2 or 3 drops of potassium chromate T.S., and then from a burette add tenth-normal silver nitrate V.S. until a red tint is produced which does not again disappear by shaking; not less than 7.5 Cc. nor more than 14.9 Cc. of tenth-normal silver nitrate V.S. should be rquired, each Cc. corresponding to 0.002684 Gm. of hydrocyanic acid." *U. S.*

Uses.—The unpurified volatile oil of bitter almond, which is the product directed by the Pharmacopœia, acts physiologically like hydrocyanic acid. Death is said to have occurred in a man ten minutes after taking two drachms (7.5 Cc.) of the oil. It might be substituted with advantage for medicinal hydrocyanic acid, if it always contained a uniform percentage of the acid, as the acid contained in the oil is much less liable to decomposition, remaining for several years unaltered, provided the oil be preserved in well-stoppered bottles. According to Schrader, 100 parts of the oil contain sufficient acid for the production of 22.5 parts of Prussian blue, but the proportion is not constant, varying, according to Groves, from 8 to 12.5 per cent., the U. S. official standard is, however, not less than 2 per cent. and not more than 4 per cent. It has been employed externally, dissolved in water in the proportion of one minim (0.06 Cc.) to a fluidounce (30 Cc.), in *prurigo senilis* and other cases of troublesome *itching*. To facilitate the solution in water, the oil may be previously dissolved in spirit. Oil of bitter almond is sometimes used to conceal the taste of cod liver oil and of castor oil.

Dose, one-fourth to one minim (0.015 to 0.06 Cc.).

Off. Prep.—Aqua Amygdalæ Amaræ, *U. S.*; Spiritus Amygdalæ Amaræ, *U. S.*

OLEUM AMYGDALÆ EXPRESSUM. U. S. (Br.)

EXPRESSED OIL OF ALMOND

(ō'lę-ŭm ą-mŷg'dą-læ ęx-prĕs'sŭm)

"A fixed oil expressed from Bitter or Sweet Almond. It should be kept in well-stoppered containers, in a cool place." *U. S.* "The oil expressed from the Bitter or Sweet Almond." *Br.*

Oleum Amygdalæ, *Br.*; Almond Oil; Oleum Amygdalæ Dulcis, *U. S.* 1860; Oil of Sweet Almond; Huile d'Amande douce, *Fr. Cod.*; Huile d'Amandes, *Fr.*; Oleum Amygdalarum, *P. G.*; Mandelöl, *G.*; Olio di mandorle dolci, *It.*, Aceite de almendras dulces, *Sp.*

This oil is obtained equally pure from sweet and from bitter almonds. In its preparation, the almonds, having been deprived of a reddish-brown powder adhering to their surface, by being rubbed together in a piece of coarse linen, are ground in a mill resembling a coffee-mill, or bruised in a stone mortar, and then pressed in canvas sacks between plates of iron slightly heated. The oil, which is at first turbid, is clarified by rest and filtration. Sometimes the almonds are steeped in very hot water, deprived of their cuticle, and dried in a stove, previous to expression. The oil is thus obtained free from color, but in no other respect better, while it is more likely to become rancid on keeping. Bitter almonds treated in this way impart an odor of hydrocyanic acid to the oil. Boullay obtained 54 per cent. of oil from sweet almonds, Vogel 28 per cent. from bitter almonds. Munch gives 55.4 per cent. as the yield of the former, and 52 per cent. as that of the latter. (*J. P. C.*, 4e sér., iii. 400.) These figures are not realized, however, in the ordinary expression methods. Schaedler (*Technologie der Fette und Oele*, 2te Auf., 532) gives 45 per cent. as the average obtained from the sweet almonds, and 38 per cent. from the bitter almonds. Though sometimes expressed in this country from imported almonds, the oil is generally brought from Europe.

Properties.—It is "a clear, pale straw-colored or colorless, oily liquid, almost inodorous, and having a mild, nut-like taste. Specific gravity: 0.910 to 0.915 at 25° C. (77° F.). Only slightly soluble in alcohol; soluble in

ether, chloroform, and benzene in all proportions. It should remain clear at —10° C. (14° F.), and it does not congeal until cooled to nearly —20° C. (—4° F.) (absence of *olive oil* or *lard oil*). If 2 Cc. of the Oil be vigorously shaken with a mixture of 1 Cc. of fuming nitric acid and 1 Cc. of water, a whitish mixture should be formed, which, after standing for some hours at about 10° C. (50° F.), should separate into a solid, white mass and a slightly colored liquid (distinction from the fixed oils of *peach* and *apricot kernels*, which give a red color, and *sesame* and *cotton seed oils*, which are colored brown). If 10 Cc. of the Oil be mixed with 15 Cc. of a solution of sodium hydroxide (1 in 6) and 10 Cc. of alcohol, and the mixture be allowed to stand at a temperature of 35° to 40° C. (95° to 104° F.), with occasional agitation, until it becomes clear, and if then diluted with 100 Cc. of water, the clear solution thus obtained upon the subsequent addition of an excess of hydrochloric acid will set free a layer of oleic acid. This, when separated from the aqueous liquid, washed with warm water, and clarified by heating on a water-bath, will remain liquid if cooled to 15° C. (59° F.).

One volume of this oleic acid, when mixed with 1 volume of alcohol, should yield a clear solution which at 15° C. (59° F.) should not deposit any fatty acids, nor become turbid upon the further addition of 1 volume of alcohol (distinction from *olive, arachis, cotton seed, sesame,* and *other fixed oils*). Expressed Oil of Almond, saponified by alcoholic potassium hydroxide T.S., should show a saponification value of 191 to 200 (see PART III, Test No. 99). If 0.3 Gm. of Expressed Oil of Almond be dissolved in 10 Cc. of chloroform in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours protected from the light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 95 nor more than 100 should be obtained (see PART III, Test No. 51)." *U. S.* "Pale yellow, nearly inodorous, with a bland nutty taste. Soluble in *ether* and *chloroform* in all proportions. Specific gravity 0.915 to 0.920. It does not congeal until cooled to nearly —4° F. (—20° C.). If 2 cubic centimetres of the Oil be well shaken with 1 cubic centimetre of *fuming nitric acid* and 1 cubic centimetre of *water*, a whitish, not brownish-red, mixture should be formed, which after standing for 6 hours at about 50° F. (10° C.) should separate into a solid white mass and a nearly colorless liquid (absence of peach-kernel oil and other fixed oils)." *Br.* From the statement of Braconnot, it appears to contain 76 per cent. of olein and 24 per cent. of a mixture of palmitin and stearin.

According to H. Hager, the oils expressed from the large sweet and the smaller bitter almonds differ considerably, as shown by the elaidin test,—the former oil congealing rapidly, and almost completely, the latter about twelve hours later, and the smaller the bitter almond has been the more imperfectly the oil congeals. Only about one-third of the bulk congeals when the oil is from the small Oporto almonds.

Oil of almond is said to be sometimes adulterated with poppy seed oil, or other drying oils of less value. This sophistication may be detected, as suggested by Wimmec, by taking advantage of the property, belonging to the olein of the non-drying but not to that of the drying oils, of being converted into solid elaidic acid by the action of nitrous acid. By treating iron filings with nitric acid in a flask, nitrous acid is produced, which is to be conducted into water upon which the suspected oil is placed. If the almond oil contains even a small quantity of poppy seed oil, or other drying oil, this will remain in the form of drops on the surface, while the genuine oil will be converted entirely into crystallized elaidin. (*J. P. C.*, Dec. 1862, p. 500.) Colza oil, another not uncommon adulteration, may be detected, according to Schneider, by the action of silver nitrate. Dissolve the oil in twice its volume of ether, add about 30 drops of concentrated alcoholic solution of the nitrate, shake the mixture, and allow it to stand in the dark. If there be much colza oil, the lower part of the liquid will become first brown and then black; if but little, the brown color will not appear for twelve hours, but the discoloration will always be obvious on the evaporation of the ether. (*P. J.*, March, 1862.)

Peach and apricot kernel oils are very extensively used in the adulteration of almond oils and sometimes entirely replace the true almond oil in commercial samples. The close relationship of these oils makes it impossible to detect them by the quantitative reactions. (For qualitative tests see the official tests, page 832.)

According to Hager, if equal volumes of the oil and of 25 per cent. nitric acid are shaken together in a test tube, an emulsion-like mixture is produced, which separates on standing. All true almond oils yield a white mixture, and the oils remain white for many hours after separation, but the oils of *peach* and *apricot seeds* turn yellowish at once on being shaken with the acid, and the color afterwards deepens, and in half an hour is of a rather deep red-yellow. (*A. J. P.*, 1870, p. 408.) J. D. Bieber communicates the following test. Equal weights of pure concentrated sulphuric acid, red fuming nitric acid, and water are mixed, and the mixture allowed to cool. On mixing five parts of the oil with one part of this acid liquid, *pure almond oil* gives a yellowish-white liquid; *oil of peach kernels* assumes the red color of peach blossoms, turning to dark orange; *benne oil* turns pale yellowish

red, then dirty orange-red; *poppy* and *walnut oils* yield a somewhat whiter liquid than almond oil. This test permits the detection of 5 per cent. of peach kernel and benne oil. Mixed with pure nitric acid, sp. gr. 1.40, *almond oil* yields a pale-yellowish liquid, *peach kernel oil* a red, *benne oil* a yellowish green, afterwards reddish, and *poppy* and *walnut oils* a white mixture. It was found that the oil expressed, cold or warm, from either fresh almonds or from such as had been kept up to ten years, gave the same reaction. Most of the commercial oil was found to be adulterated with the oil of either peach kernels or benne seed. (*A. J. P.*, Dec. 1877.)

Oil of almond may be used for the same purposes as is olive oil, and, when suspended in water by means of mucilage or the yolk of egg and loaf sugar, forms a pleasant emulsion, useful in pulmonary affections attended with *cough*.

Dose, one fluidrachm to one fluidounce (3.75 to 30 Cc.).

Off. Prep.—Emulsum Chloroformi, *U. S.;* Emulsum Olei Terebinthinæ, *U. S.;* Linimentum Ammoniæ, *Br.;* Oleum Phosphoratum, *Br.;* Unguentum Aquæ Rosæ, *U. S., Br.;* Unguentum Cetacei, *Br.;* Unguentum Veratrinæ, *U. S.*

OLEUM ANETHI. Br.

OIL OF DILL

(ō'lę-ŭm ą-nē'thī)

"The oil distilled from Dill Fruit." *Br.*

Huile volatile d'Aneth, Essence d'Aneth, *Fr.;* Dill, Dillöl, *G.*

Oil of dill is of a pale yellow color, with the odor of the fruit, and a hot, sweetish, acrid taste. Its sp. gr. varies between 0.895 and 0.915. The fruit yields about 3.5 per cent. of it. The oil is a mixture of phellandrene, a paraffin hydrocarbon, and 40 to 60 per cent. of *d*-carvone, $C_{10}H_{14}O$, with *d*-limonene, $C_{10}H_{16}$. (See *Oleum Cari.*) "Color pale yellow, odor that of the fruit, taste sweet and aromatic. Specific gravity 0.905 to 0.920. It rotates the plane of a ray of polarized light not less than 70° to the right, at 60° F. (15.5° C.), in a tube 100 millimetres long." *Br.* R. Nietski obtained from dill, the fruit of *Anethum graveolens* a volatile oil, which commenced to boil at 155° C. (311° F.), the boiling point rising gradually to 260° C. (500° F.). About 10 per cent. of the oil consists of a hydrocarbon, $C_{10}O_{16}$, having the boiling point from 155° to 160° C., 60 per cent. boiling at from 170° to 175° C. (338° to 347° F.), of the same composition, and 30 per cent. with the boiling point from 225° to 230° C. (437° to 446° F.), composition $C_{10}H_{14}O$, and identical with carvol. The odor of the first portion of hydrocarbon is similar to that of turpentine; that of the second portion resembles oil of mace, but when mixed with a little carvol the characteristic dill odor is at once produced. (*A. J. P.*, 1874.) The oil is sometimes used for the preparation of dill water.

Dose, from three to ten minims (0.2 to 0.6 Cc.).

OLEUM ANISI. U. S., Br.

OIL OF ANISE

(ō'lę-ŭm ą-nī'sī)

"A volatile oil distilled from Anise or from the fruit of Star Anise, *Illicium verum* Hooker filius (Fam. *Magnoliaceæ*). It should be kept in well-stoppered, amber-colored bottles, protected from light, and, if it has separated into a liquid and a solid portion, it should be completely liquefied by warming, and then well shaken, before being dispensed." *U. S.* "The oil distilled from the Anise Fruit; or from the fruit of the star-anise, Illicium verum, *Hook. fil.*" *Br.*

Huile volatile d'Anis vert (Badaine), *Fr. Cod.;* Essence d'Anis, *Fr.;* Oleum Anisi, *P. G.;* Anethol, Anisöl, *G.;* Essenza di anice, *It.;* Esencia de anis, *Sp.*

The product of oil from anise is variously stated at from 1.56 to 3.12 per cent. The oil employed in this country is imported. It is colorless or yellowish, with the peculiar odor and taste of the seed. At 50° F. it crystallizes in flat tables, and it does not melt under 62° F. Its sp. gr. increases with age, and is variously given at from 0.9768 to 0.9903. It is soluble in all proportions in alcohol of 0.806; but alcohol of 0.840 dissolves at 25° C. (77° F.) only 42 per cent. Ether dissolves oil of anise in all proportions.

Properties.—"A colorless or pale yellow, thin, and strongly refractive liquid, having the characteristic odor of anise, and a sweetish, mildly aromatic taste. Specific gravity: 0.975 to 0.985 at 25° C. (77° F.). The Oil should be lævogyrate, the angle of rotation being —2° in a 100 Mm. tube, at a temperature of 25° C. (77° F.) (absence of *oil of fennel*, etc.). Soluble in an equal volume of alcohol, forming a clear solution, also in 5 volumes of 90 per cent. alcohol (absence of *petroleum*, of *most fixed oils*, and of *oil of turpentine*). An alcoholic solution of Oil of Anise is neutral to litmus paper, and should not assume a blue or brownish color on the addition of a drop of ferric chloride T.S. (absence of some *volatile oils* containing *phenols*). When the Oil is shaken with water in a narrow graduated cylinder, its volume should not be diminished (absence of *alcohol*). When tested according to the following method, the congealing point of Oil of Anise should not be below 15° C. (59° F.): Transfer about 10 Cc. of the Oil to a test-tube, placed in water cooled with ice; insert a thermometer at once into the Oil, and allow it to remain undisturbed until its temperature has fallen to

about 6° C. (42.8° F.). Induce crystallization either by rubbing the inner wall of the test-tube with the thermometer, or by the addition of a particle of solid anethol, remove the test-tube from the bath, and stir continuously during the solidification of the Oil. The highest temperature reached during the crystallization is regarded as the congealing point." *U. S.* "Colorless or pale yellow; with the odor of the fruit, and a mildly aromatic taste. It congeals, when stirred, at temperatures between 50° and 59° F. (10° to 15° C.) and should not again become liquid below 59° F. (15° C.). Specific gravity at 68° F. (20° C.) 0.975 to 0.990. It rotates the plane of a ray of polarized light slightly to the left." *Br.* It consists of a small quantity of terpene, $C_{10}H_{16}$, but mainly of *anethol,* $C_{10}H_{12}O$ (about 85 per cent.), which is present, however, in two isomeric modifications, one solid at ordinary temperatures and heavier than water (*solid anethol*), the other liquid and more volatile (*estragol* or *methyl chavicol*). *Anethol,* both in the liquid and in the solid form, is present, and is the chief constituent of the oils of *anise, star anise,* and *fennel.* The solidification test of the U. S. P. (8th Rev.) is based upon the anethol content. By oxidation, by means of nitric acid, or chromic anhydride, the different forms of anethol[1] yield *anisic acid,* $C_8H_8O_3$. Oil of anise, by exposure to air, is oxidized with the formation of *anisic aldehyde, acetic aldehyde* and *anisic acid,* and becomes less disposed to concrete.

In consequence of its high price, it is frequently adulterated with spermaceti, wax, or camphor. The first two may be detected by their insolubility in cold alcohol, the last by its odor. In one instance as much as 35 per cent. of spermaceti was found. Schimmel & Co. have found fennel stearoptene in commercial oil of anise. (*Ph. Rev.,* 1897, 94.) Procter met with a parcel, of which not less than five-sixths was alcohol. (*A. J. P.,* xxvii. 513.) Its comparative mildness adapts it to infantile cases. Most of the oil of anise of commerce is the *oil of star aniseed* (*Oleum Badiani,* or *Oleum Illicii*). Oil of anise has also been distilled from the sweet cicely, *Osmorrhiza longistylis,* of the United States and Canada. (*Ph. Rund.,* July, 1887.) For description and analysis of Russian oil of anise, see *P. J.,* 1896, 164, also 243. Anisic acid is said to be antiseptic, resembling salicylic acid in its action.

Dose, from three to five minims (0.2 to 0.3 Cc.).

Off. Prep.—Aqua Anisi, *U. S.;* Spiritus Anisi, *U. S., Br.;* Spiritus Aurantii Compositus, *U. S.;* Syrupus Sarsaparillæ Compositus, *U. S.;* Tinctura Opii Camphorata, *U. S.* (*Br.*); Tinctura Opii Ammoniata, *Br.;* Trochisci Glycyrrhizæ et Opii, *U. S.*

[1] For an account of the isomers of anethol, see Orndorff, Terrasse, and Morton, *Am. Chem. J.,* 19, 845.

OLEUM ANTHEMIDIS. Br.

OIL OF CHAMOMILE

(ō'lę-ŭm ąn-thĕm'į-dĭs)

"The oil distilled from Chamomile Flowers." *Br.*

Oleum Chamomillæ Romanæ; Essence de Camomille romaine, *Fr.;* Römisch-Kamillenöl, *G.*

This oil was introduced into the British Pharmacopœia 1885 with the direction that it should be distilled in Britain. No such restriction is found in the Pharmacopœia of 1898. It is seldom prepared in this country. Baumé obtained thirteen drachms of the oil from eighty-two pounds of the flowers; according to Brande, the average product of 100 pounds is two pounds twelve ounces. It has the peculiar odor of chamomile, with a pungent somewhat aromatic taste. When recently distilled it is of a pale sky-blue or greenish-blue color, which changes to yellow or brownish on exposure. "Specific gravity 0.905 to 0.915." *Br.* The oil was thoroughly investigated in Fittig's laboratory during the years 1878-79. It was found to consist of a mixture of *angelic* and *tiglinic esters of isobutyl, isamyl, hexyl,* and probably a higher alcohol. Angelic acid and tiglinic acid are isomeric, and have the formula $C_5H_8O_2$. The relative proportions of these two acids varied in different oils. An ester of a lower homologue of angelic acid having the formula $C_4H_6O_2$ was also obtained. Naudin obtained a small amount of a solid paraffin $C_{18}H_{36}$, melting at 63° C. to 64° C., to which the name of "*anthemen*" was given. (Gildemeister and Hoffmann, *Aetherische Oele,* p. 881.) It has sometimes been employed in spasm of the stomach, and as an adjunct to purgative medicines. Its chief use, however, appears to be as an ingredient of the extract of chamomile of the British Pharmacopœia, to which it is added in order to supply the place of the oil driven off by the heat used in its preparation. This oil must not be confounded with that of *Matricaria Chamomilla,* employed on the continent of Europe under the name of oil of chamomile. (See *Matricaria.*)

Dose, three to five minims (0.2 to 0.3 Cc.).

Off. Prep.—Extractum Anthemidis, *Br.*

OLEUM AURANTII CORTICIS. U. S.

OIL OF ORANGE PEEL

(ō'lę-ŭm âu-răn'tĭ-ī cŏr'tį-cĭs)

"A volatile oil obtained by expression from the fresh peel of the Sweet Orange. It should be kept in small, well-stoppered, amber-colored bottles, in a cool place, so as to avoid, as far as possible, the development of a terebinthinate odor. Oils that have developed such an odor should not be dispensed." *U. S.*

Oleum Aurantiorum; Essential Oil of Orange Peel, Essence of Orange; Huile volatile d'Orange, *Fr. Cod.;* Apfelsinenchalenöl, Pomeranzenschalenöl, *G.;* Essenza di arancio amara (Essenza della corteccia), *It.*

This oil is used only for flavoring purposes, and has been introduced principally because of its employment in elixirs and in *Spiritus Aurantii Compositus.*[1]

Oil of orange is prepared in Calabria and Sicily in three ways: 1, by scraping off the exterior part of the rind and submitting it to expression; 2, by putting the scrapings into hot water, depressing the pulp beneath, and skimming off the oil as it rises; 3, by distillation. The best Sicily orange oil is procured by dexterous compression, within a cask, of the fresh rind by the hand, the oil being driven out in jets. It is sometimes absorbed by a sponge. (*A. J. P.,* 1868.) It is largely made at Messina, and in the south of France. It is also extracted by the écuelle process,[2] and partly from the Bigarade and partly from the sweet or Portugal orange, the scarcely ripe fruit being in either case employed. The oil made from the former is much more valuable than that obtained from the latter, and the two are distinguished in price-currents as *Essence de Bigarade* and *Essence de Portugal.*

Properties.—Oil of orange peel consists, as has been shown by Wallach, of *d-limonene* to the extent of at least 90 per cent.; of the remainder, about 5 per cent. are the odorous constituents, among which are *citral,* traces of *citronellal,* and the methyl ester of *anthranilic acid.* The inner thick part of the rind contains also a bitter principle, called *hesperidin,* discovered by Lebreton in 1828, but more fully studied by Hoffmann (*Ber. d. Chem. Ges.,* 1876, pp. 26, 685). It is best prepared from the unripe bitter orange. Its formula is $C_{22}H_{26}O_{12}$, and it is a glucoside, as is shown by the reaction with diluted sulphuric acid, whereby it is decomposed into *hesperetin,* $C_{16}H_{14}O_6$, and glucose, $C_6H_{12}O_6$.

The U. S. Pharmacopœia describes the oil as "a pale yellow liquid, having the characteristic, aromatic odor of orange, and an aromatic taste. Specific gravity: 0.842 to 0.846 at 25° C. (77° F.). Its optical rotation should be dextrogyrate, not less than 95° in a 100 Mm. tube, at a temperature of about 25° C. (77° F.) (absence of *oil of turpentine,* etc.). When subjected to careful fractional distillation, any Oil coming over below 170° C. (338° F.) should not yield pinene nitrosochloride and nitrosopinene (derived from added oil of turpentine) when tested in the following manner: Dissolve 5 Cc. of the fraction to be tested in one-half its volume of glacial acetic acid, add 5 Cc. of amyl nitrite, cool thoroughly in a freezing mixture, and add, very gradually, 5 Cc. of a mixture of equal volumes of hydrochloric acid and glacial acetic acid. Collect any crystals which separate from the blue or greenish liquid upon standing, on a force filter, and wash them with a little alcohol. Transfer the crystals to a flask, add 5 Cc. of alcoholic potassium hydroxide T.S., and heat on a water-bath fifteen minutes. Pour the solution into cold water, collect the precipitate, and wash it with cold water. Recrystallize the dried precipitate from alcohol, and determine the melting point of the crystals. Nitrosopinene melts at 132° C. (269.6° F.), whereas nitrosolimonene or carvoxime (from limonene, one of the normal constituents of Oil of Orange Peel) melts at 72° C. (161.6° F.)." *U. S.* A waxy non-volatile substance is present in oil of orange, which interferes with the transparency of solution made with 90 per cent. alcohol. This oil is one of the most difficult to preserve. A method for its preservation, which we have used for years, is to shake the oil briskly with one-eighth of its volume of distilled water, and allow it to separate, then remove the essential oil, filter rapidly if necessary, and mix the filtered oil with 95 per cent. alcohol in the proportion of one volume of the oil to seven volumes of alcohol.

Dose, three to five minims (0.2 to 0.3 Cc.).

Off. Prep.—Spiritus Aurantii Compositus, *U. S.*

OLEUM BETULÆ. U. S.

OIL OF BETULA [Oleum Betulæ Volatile, Pharm. 1890, Oil of Sweet Birch]

(ō'le-ŭm bĕt'ū-læ)

"A volatile oil obtained by maceration and distillation from the bark of the Sweet Birch, *Betula lenta* Linné (Fam. *Betulaceæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Oleum Betulæ Lentæ; Oil of Sweet Birch; Essence de Bouleau ou Bétula, *Fr.;* Birkenrindenöl, *G.*

The *Betula lenta, cherry birch, sweet birch, black birch, mountain mahogany,* is a large American tree resembling in its dark, chestnut-brown bark, the general shape of its leaves, and its whole appearance, the garden cherry. It grows northward from New England to Ohio and southward in the Blue Ridge as far as South Carolina and Georgia. It is especially characterized by its heart-ovate, pointed, sharply and finely doubly serrate leaves, and short petioles. The underneath veins of the leaves are hairy, as are also the elliptical, thick, fruiting catkins, the lobes of whose venous scales are nearly equal, obtuse, and diverging.

[1] *Spiritus Aurantii,* U. S. 1890. *Spirit of Orange.* "Oil of Orange Peel, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Deodorized Alcohol, *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 390 minims]. Mix them." *U. S.* 1890.

This was introduced at the U. S. 1880 revision. There was very little necessity for its introduction, because of the adoption of the tincture of sweet orange peel, which is identical in properties with the spirit, although not so strong. It serves a useful purpose, however, as a means of preserving the oil. It is an excellent solution for flavoring purposes.

[2] For an illustration of the écuelle, see Remington's *Practice of Pharmacy,* Fourth Edition, p. 806.

In commerce the oil of sweet birch is chiefly sold as the oil of wintergreen. It is very largely distilled by the mountaineers or small farmers, many of whom put indiscriminately into their stills the wintergreen and the bark of the birch, or at least mix the products before selling. It is in general use, under the name of oil of gaultheria; it differs from the latter so slightly, in chemical constituents, that for practical purposes the differences may be disregarded; oil of sweet birch contains a fraction of 1 per cent. of a paraffin and an ester, $C_{14}H_{24}O_2$, not present in oil of gaultheria. For a description of the apparatus used to distil oil of sweet birch, see *A. J. P.*, 1882, 49. The so-called "light oil" of distillers, according to Kennedy, is simply the oil with water and dirt. Oil of sweet birch "is optically inactive, but otherwise has essentially the same properties as, and conforms to the reactions and tests given under, *Oleum Gaultheriæ*." *U. S.* Oil of birch does not differ in its physiological and remedial properties from oil of gaultheria.

Dose, five to thirty minims (0.3 to 1.8 Cc.).

OLEUM CADINUM. U. S., Br.

OIL OF CADE [Oil of Juniper Tar, Oleum Juniperi Empyreumaticum]

(ō'lę-ŭm cą-dī'nŭm)

"A product of the dry distillation of the wood of *Juniperus Oxycedrus* Linné (Fam. *Coniferæ*)." *U. S.* "An empyreumatic oily liquid obtained by the destructive distillation of the woody portions of Juniperus Oxycedrus, *Linn.*, and some other species." *Br.*

Juniper Tar Oil; Huile de Cade, *Fr.;* Kadeöl, Kadiöl, *G.*

The *Juniperus Oxycedrus,* Linné, *prickly cedar,* or *large brown-fruited juniper,* is a common tree in the waste places and stony hill-sides of the Mediterranean districts of Northern Africa, Spain, Portugal, and France, reaching up in its distribution as high as 3000 feet in the Apennines. It commonly attains a height of from ten to twelve feet, sometimes much more, with long spreading branches and slender drooping branchlets, covered with light-green scattered and spreading leaves of medium size, lanceolate or awl-shaped, sharply pointed, having two furrows on their upper edge. The fruits are numerous, large (half an inch in diameter), globular, shining, reddish or chestnut-brown, and marked on the apex with two white lines.

From the heart-wood of this tree the oil of cade is prepared by a process of distillation in ovens *per descensum,* similar to that practised in the making of ordinary tar. It is a brownish or dark brown liquid, much more mobile and less thick than tar, having a tar-like but distinct odor, and a smoky, acrid, bitterish, disagreeable taste. In mass it is dark and opaque, but in very thin layers clear; the oil contains phenols and a sesquiterpene termed *cadinene,* $C_{15}H_{24}$, the latter boiling at from 274° to 275° C. "A brownish or dark brown, clear, thick liquid, having a tarry odor, and an empyreumatic, burning, somewhat bitter taste. It is almost insoluble in water, but imparts to it an acid reaction; it is only partially soluble in alcohol, but it is completely soluble in ether." *U. S.* The British Pharmacopœia describes it as "A dark reddish-brown or nearly black, more or less viscid, oily liquid, with a not unpleasant empyreumatic odor and an aromatic bitter and acrid taste. Specific gravity about 0.990. It is soluble in *ether* and *chloroform;* partially soluble in cold, almost wholly in hot *alcohol* (90 per cent.). It is very slightly soluble in *water.* The filtered aqueous solution is almost colorless and possesses an acid reaction." *Br.* Yaucher recommends acetone for disguising the odor of oil of cade, and proposes an *oil of cade collodion* in which acetone is used to dissolve the pyroxylin instead of the usual solvents. (*C. D.*, 1897, 16.)

Uses.—Oil of cade has been used locally, by the peasantry, in the treatment of the cutaneous diseases of domestic animals almost from time immemorial. More recently it has been largely employed in the treatment of *chronic eczema, psoriasis,* and other skin diseases of man, and has also been found to be an efficient parasiticide in *psora* and *favus.* It is applied, sometimes of full strength, sometimes diluted with a bland oil, well rubbed into the affected parts with the fingers, or with a cloth, and is also made into ointments, and especially into soaps.[1] A glycerite is also prepared. It is very rarely, if ever, used internally, but probably resembles oil of tar in its physiological action.

Dose, one to three minims (0.06 to 0.2 Cc.).

OLEUM CAJUPUTI. U. S., Br.

OIL OF CAJUPUT

(ō'lę-ŭm căj-ų-pū'tī)

"A volatile oil distilled from the fresh leaves and twigs of *Melaleuca Leucadendron* Linné (Fam. *Myrtaceæ*), yielding, when assayed by the process given below, not less than 55 percent., by volume, of cineol. It should be kept in well-stoppered, amber-colored bottles, in a cool place." *U. S.* "The oil distilled from the leaves of Melaleuca Leucadendron, *Linn.* (Melaleuca Cajuputi, *Roxb.*)." *Br.*

Oleum Cajeputi; Essence de Cajeput, Huile volatile de Cajeput, *Fr.;* Cajeputöl, *G.;* Essenza di Cajeput, *It.;* Esencia de Cayeput, *Sp.;* Kayuputieh, *Mal.*

[1] In the *Edinb. Monthly Journ.* for July, 1852 (page 66), it is stated that the soap is made by distilling the tar, incorporating the volatile oil obtained with a fixed oil, and then saponifying this with soda. It is in the form of black balls, readily unites with water, and may be applied to the surface like any other soap. The best plan is probably to apply it at bedtime and wash it off next morning.

It was long supposed that the oil of cajuput was derived from *Melaleuca Leucadendron,* but from specimens of the plant affording it, sent from the Moluccas and cultivated in the botanical garden of Calcutta, Roxburgh concluded it to be a distinct species, and gave it the name of *M. Cajuputi.* It corresponds with the *arbor alba minor* of Rumphius, and is a smaller plant than the *M. Leucadendron.* Bentham, however, probably with correctness, considers it simply a smaller variety of *M. Leucadendron,* a tree of wide spread habitat, reaching into India, the Philippines, and even Australia. It is possible, however, that the oil may be obtained from different species of Melaleuca, as Stickel of Jena, succeeded in procuring from the leaves of *M. hypericifolia,* cultivated in the botanical garden of that place, a specimen of oil not distinguishable from the cajuput oil of commerce, except by a pale-green color. (*Ann. Pharm.,* xix. 224.) *M. viridifolia* and *M. latifolia,* large trees growing abundantly in the island of New Caledonia, yield a volatile oil very analogous to the oil of cajuput.[1] The leaves of different species of Melaleuca have been used advantageously, in the form of bath, in *chronic rheumatism.* (*Ann. Thér.,* 1861, p. 67.) An extract of *M. paraguayensis* has been used with alleged advantage in rheumatism and other diseases. (*Med. Rec.,* xvi.)

Melaleuca Leucadendron, Linné. *M. Cajuputi,* Rumphius, *Herbar. Amboinense,* tom. ii. tab. 17; Roxburgh, *Trans. Lond. Med. Bot. Soc.,* 1829; *A. J. P.,* vol. i. p. 193.—*M. minor,* De Candolle; *B. & T.* 108.—This tree grows with an erect but crooked stem, and scattered branches, the slender twigs of which droop like those of the weeping willow. The bark is of a whitish ash color, very thick, soft, spongy, and lamellated, throwing off its exterior layer from time to time in flakes. The leaves have short footstalks, are alternate, lanceolate, when young sericeous, when full-grown smooth, deep green, three- and five-nerved, slightly falcate, entire, from three to five inches long, from one-half to three-quarters of an inch broad, and when bruised exhale a strong aromatic odor. The flowers are small, white, inodorous, sessile, and disposed in terminal and axillary downy spikes, with solitary, lanceolate, three-flowered bracts. The filaments are three or four times longer than the petals, and both are inserted in the rim of the calyx. The oil is obtained from the leaves by distillation. It is prepared chiefly in Amboyna and Bouro, and is exported from the East Indies in glass bottles. The small proportion yielded by the leaves, and the extensive use made of it in India, render it somewhat costly.

Properties.—Cajuput oil is very fluid, transparent, of a fine green color, a lively and penetrating odor analogous to that of camphor and cardamom, and a warm, pungent taste. Upon rectification the green color disappears. It is very volatile and inflammable, burning without any residue. The sp. gr. varies from 0.914 to 0.9274. Its chief constituent has the formula $C_{10}H_{18}O$, and by repeated distillation over phosphoric oxide the hydrocarbon, $C_{10}H_{16}$, called *cajuputene,* can be obtained. The oil is, therefore, said to contain *cajuputene hydrate,* or *cajuputol.* The identity of cajuputol with *cineol* and *eucalyptol* from *Eucalyptus Globulus* in both chemical and physical properties was established by Wallach in 1884 and by C. Jahns. (*A. J. P.,* 1885, 237.) It boils at 175° C. (347° F.). A second constituent of the formula $C_{10}H_{18}O$ is the solid *terpineol,* which is present both in the free state and as acetic ester. A small amount of *l-pinene* and traces of aldehydes have been found, including *valeraldehyde* and *benzaldehyde.* (*Schimmel & Co.'s Report,* April, 1897.) Oil of cajuput is "a thin, colorless or greenish liquid, having a peculiar, agreeable, distinctly camphoraceous odor, and an aromatic, slightly bitter taste. Specific gravity: 0.915 to 0.925 at 25° C. (77° F.). It is miscible with alcohol in all proportions, also soluble in 1 part of 80 percent. alcohol. The alcoholic solution should be neutral. Oil of Cajuput is lævogyrate; the angle of rotation should not exceed —2° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). On shaking 5 Cc. of the Oil with 5 Cc. of water containing 1 drop of diluted hydrochloric acid, a reddish-brown color should not be produced in the acid liquid when separated from the Oil, if a drop of potassium ferrocyanide T.S. be added (absence of *copper*)." *U. S.* "Bluish-green, with an agreeable penetrating camphoraceous odor, and an aromatic bitterish camphoraceous taste. Specific gravity from 0.922 to 0.930. It should become semi-solid on being stirred, when cold, with a third or half its volume of phosphoric acid of commerce of specific gravity 1.750 (presence of a due proportion of cineol)." *Br.* The value of oil of cajuput is determined by its cineol content and the official assay is as follows:

Assay for Cineol.—"Introduce into a beaker a solution prepared by dissolving 10 Cc. of

[1] It seems to be uncertain how much of the oil of cajuput of commerce is produced by the New Caledonia trees. In the *B. G. T.,* xcvii., the volatile oil of *Melaleuca flaviflora* is said to be sent in large quantities, under the name of *miaouli,* from New Caledonia to the East. A pale-yellow oil occurring in French commerce as "*gomenol,*" or *oil of miaouli* or *essence de miaouli* is obtained from the *Melaleuca viridiflora,* which yields of it about 2.5 per cent. According to G. Bertrand, it has a density of 0.922 and deviates polarized light 0° 42′ to the right. He finds that it contains minute quantities of amylic alcohol, but is chiefly composed of a dextrogyrate terebinthene, $C_{10}H_{16}$, cineol, a hydrocarbon (probably citrene) boiling at 175° F., and a terpinol. This composition is identical with that of the terpinol of List (*C. R. A. S.,* civ. 996, cvi. 663), obtained by heating with acidulated water the terpene, $C_{10}H_{16}.2H_2O$, resulting from the spontaneous hydration of terpene, $C_{10}H_{16}$, the natural product being thus readily imitated artificially in the laboratory by extremely simple reactions. (*C. R. A. S.,* cxvi. 1070.) According to Dobousquet de Laborderies (*B. G. T.,* cxxxvi.) oil of miaouli contains sixty-six per cent. of cineol and is especially useful in *cystitis* and chronic *bronchitis.* Blanc commends it as a general therapeutic substitute for oil of cajuput. (*R. T.,* lix.)

oil of Cajuput in 50 Cc. of purified petroleum benzin; immerse the beaker in a freezing mixture and add phosphoric acid, drop by drop, with constant stirring, until the white magma of cineol phosphate formed, begins to assume a yellowish or pinkish tint; then transfer the magma to a force filter, wash it with cold purified petroleum benzin, and then dry it by pressure between two porous plates. Transfer the precipitate (cineol phosphate) to a narrow graduated cylinder, and add warm water, which will cause separation of the cineol. The volume, in cubic centimeters, of the separated oily liquid, multiplied by 10, represents the volume percent. of cineol." *U. S.* The oil is wholly soluble in alcohol. When it is distilled, a light, colorless liquid first comes over, and afterwards a green and denser one. The green color has been ascribed to a salt of copper derived from the vessels in which the distillation is performed, and Guibourt obtained two grains and a half of copper oxide from a pound of the commercial oil. But neither Brande nor Goertner could detect copper in specimens examined by them, and Lesson, who witnessed the process for preparing the oil at Bouro, attributes its color to chlorophyll or some analogous principle, and states that it is rendered colorless by rectification. Guibourt, moreover, obtained a green oil by distilling the leaves of a Melaleuca cultivated at Paris. A fair inference is that the oil of cajuput is naturally green, but that as found in commerce it sometimes contains copper, either accidentally present or added with a view of imitating or maintaining the fine color of the oil. The proportion of copper, however, is not so great as to forbid the internal use of the oil, and the metal may be separated by distillation with water, or by agitation with a solution of potassium ferrocyanide. This statement as to the frequent occurrence of copper in the cajuput oil of commerce, though at the same time its presence is not desirable, has been confirmed by experiments by Edward Histed, who found copper in all of six specimens of the commercial oil, obtained from different sources. When redistilled, the oil became perfectly colorless, but after a few days' exposure to copper filings reassumed its green color. (*P. J.*, 1872, p. 804.)

Oil of cajuput is said to be often adulterated with oils derived from other than the official species of Melaleuca. Oil of rosemary, and oil of turpentine, impregnated with camphor and colored with the resin of milfoil, are also said to be employed as adulterants. The best test, according to Zeller, is iodine, which, after a moderately energetic reaction, with little increase of temperature and but a slight development of orange vapors, occasions immediate inspissation into a loose coagulum, which soon becomes a dry, greenish-brown, brittle mass.

Uses.—This oil is highly stimulant, producing when swallowed, a sense of heat, with an increased fulness and frequency of pulse, and exciting in some instances profuse perspiration. It is much esteemed by the Malays and other people of the East, who consider it a panacea. The complaints to which it is best adapted are probably *chronic rheumatism*, and *spasmodic affections of the stomach and bowels*, unconnected with inflammation. It has been extolled as a remedy in *spasmodic cholera*, and has been used also as a diffusible stimulant in *low fevers*. It is said to have been used in the collapsed state of cholera, with unexpected success, in the dose of from fifteen grains to a drachm (1.0 to 3.9 Gm.) in a single potion. (*Ann. Thér.*, 1867, p. 71.) Diluted with an equal proportion of olive oil, it is applied externally to relieve *gouty* and *rheumatic pains*. Like most other highly stimulating essential oils, it relieves *toothache* if introduced into the hollow of the carious tooth. Delvaux, who has made extensive use of this oil, has found it beneficial, given internally, in *dyspepsia* with flatulence, in the early stages and milder forms of *cholera*, in *verminose affections* in children, in *chronic laryngitis* and *bronchitis*, in *chronic catarrh of the bladder*, in *chronic rheumatism of the joints* with little or no swelling, and in painful *chronic rheumatism of the muscles and fibro-muscular tissues*, whether external or internal. Externally applied, Delvaux has derived great benefit from it in various cutaneous diseases, as *pityriasis*, *psoriasis*, and especially in that extremely obstinate affection of the face, *acne rosacea*, which he has often succeeded in curing by the simple application of this oil three times a day. (*Ann. Thér.*, 1862, p. 38.)

Dose, from three to ten minims (0.2 to 0.6 Cc.).

Off. Prep.—Linimentum Crotonis, *Br.*; Spiritus Cajuputi, *Br.*

OLEUM CARI. U. S. (Br.)

OIL OF CARAWAY

(ō'lę-ŭm cā'rī)

"A volatile oil distilled from Caraway and rectified by steam distillation. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Caraway Fruit." *Br.*

Oleum Carui, *Br.*; Huile volatile de Carvi, *Fr. Cod.*; Essence de Carvi, *Fr.*; Oleum Carvi, *P. G.*; Kümmelöl, Carvon, *G.*

This oil is prepared to a considerable extent by our distillers. The fresh fruit as cultivated in Holland yields nearly 6 per cent. of oil, while the German fruit yields about 4 per cent. The oil of caraway is somewhat viscid, of a pale yellow color, becoming brownish by age, with the odor of the fruit, and an aromatic acrid taste. Its sp. gr. is differently given at 0.946 (Baumé), 0.931 (Brande), 0.916 (Buignet), and 0.905 to 0.915 at 25° C. (*U.*

S. P.). It is dextrogyrate in its relation to polarized light. (Buignet, *J. P. C.*, Oct. 1861, p. 261.) It consists of two liquid oils, of different boiling points, and separable by distillation:—one a hydrocarbon called *carvene*, $C_{10}H_{16}$, of the sp. gr. 0.849 and boiling point 176° C. (349° F.), now recognized as identical with *d-limonene*, the other, the valuable constituent, *d-carvone*, $C_{10}H_{14}O$, of the sp. gr. 0.9638 and boiling point 224° C. (435° F.). This latter constituent is often extracted from the oil and prepared in a pure state by taking advantage of the formation of a crystalline compound of carvone and hydrogen sulphide, which can then be decomposed by treatment with alcoholic potassium hydroxide.

Properties.—It is officially described as "a colorless or pale yellow, thin liquid, having the characteristic, aromatic odor of caraway, and a spicy taste. Specific gravity: 0.905 to 0.915 at 25° C. (77° F.). Soluble in an equal volume of alcohol; also in from 3 to 10 volumes of 80 percent. alcohol. Oil of Caraway is dextrogyrate, the angle of rotation varying from +70° to +80° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* "Colorless or pale yellow, with the characteristic odor of the fruit, and a spicy taste. Specific gravity 0.910 to 0.920." *Br.* For additional tests, see *Schim. Rep.*, 1893, 10; also *Bull. Pharm.*, 1894, 257. Kremers and Schreiner (*Ph. Rev.*, 14, 76) recommend a method of determining the value of oil of caraway based on the conversion of carvone into its oxime, and the separation of the carvoxime from the terpenes by steam distillation; it is as follows: "To a solution of 10 Gm. of oil, dissolved in 25 Cc. of alcohol, 5 Gm. of hydroxylamine hydrochloride and 6.5 Gm. of sodium bicarbonate are added. This mixture is boiled on a water bath for half an hour in a flask connected with a reflux condenser, 25 Cc. of water are then added, and the alcohol is distilled off on the water bath. Steam is then passed through the liquid until traces of carvoxime come over. The last portions of the distillate are collected separately in test tubes, and when traces of crystals of carvoxime appear on the surface, the operation is interrupted. The tube of the condenser is washed with a little hot water, and this, as well as the last collected distillate, containing some carvoxime, is returned to the flask. The contents of the flask are allowed to cool, and after the carvoxime has completely solidified, it is removed from the sides of the flask by means of a loop of stiff wire, thrown upon a force filter, washed, and dried by suction. The air-dried carvoxime is transferred to a tared glass dish and heated for 1 hour on a water bath, and when cool, weighed. To the weight thus obtained 0.100 Gm. is added, as this is about the quantity lost during heating. From the weight of the carvoxime that of the carvone may be readily calculated, 164.67 parts of the former corresponding to 149.66 parts of the latter, or the weight of carvoxime obtained, expressed in Gm., when multiplied by 0.9088, gives the weight of the equivalent amount of carvone."

When oil of caraway is distilled over glacial phosphoric acid or powdered sodium hydroxide, the distilled liquor being poured back into the retort until it ceases to have the odor of caraway, an oily liquid is obtained, having a very disagreeable odor, and a strong taste. This product, to which the name of *carvacrol* has been applied, has been found to give immediate relief to *toothache*, when inserted on cotton into the cavity of a carious tooth. (See *Am. J. M. S.*, N. S., xv. 532.) Carvacrol (isopropyl-o-cresol) is found to be of the same chemical composition as carvone and is formed from it by molecular rearrangement. Oil of caraway is much used to impart flavor to medicines, and to correct their nauseating and griping effects.

Dose, from one to ten minims (0.06 to 0.6 Cc.).

Off. Prep.—Pilula Aloes Barbadensis, *Br.*; Spiritus Juniperi Compositus, *U. S.*

OLEUM CARYOPHYLLI. U. S., Br.

OIL OF CLOVES

(ō'le-ŭm căr-ŷ-o-phŷl'lī)

"A volatile oil distilled from Cloves, yielding, when assayed by the process given below, not less than 80 percent., by volume, of eugenol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Cloves." *Br.*

Huile volatile de Girofle, *Fr. Cod.*; Oleum Caryophyllorum, *P. G.*; Nelkenöl, Eugenol, *G.*; Essenza di garofani, *It.*; Esencia de clavo, *Sp.*

This oil is obtained by distilling cloves with water, to which it is customary to add common salt, in order to raise the temperature of ebullition, and the water should be repeatedly distilled from the same cloves, in order completely to exhaust them. Scharling has found advantage from the application of superheated steam to the distillation of this oil. (*P. J.*, xi. 469.) It is essential also to use the same water over and over again, in order to avoid loss by the solution of the oil in the water. The product of good cloves is said to be about one-fifth or one-sixth of their weight. The oil was formerly brought from Holland or the East Indies, but since the introduction of the Cayenne cloves into our markets the reduced price and superior freshness of the drug have rendered the distillation of oil of cloves profitable in this country, and the best now sold is of domestic extraction. We have been informed that from seven to nine pounds of cloves yield to our distillers about one pound of the oil.

Properties.—Oil of cloves, when recently distilled, is very fluid, clear, and colorless, but becomes yellowish by exposure, and ultimately

reddish brown. It has the odor of cloves, a hot, acrid, aromatic taste, and a slightly acid reaction. Its sp. gr. is variously stated at from 1.034 to 1.061, the latter being given by Bonastre as the sp. gr. of the rectified oil. "Specific gravity: 1.040 to 1.060 at 25° C. (77° F.). Soluble in an equal volume of alcohol, this solution being slightly acid to litmus paper; also soluble in about 2 volumes of 70 percent. alcohol. When shaken with an equal volume of a concentrated solution of potassium hydroxide, or of stronger ammonia water, it forms a semi-solid, yellowish mass. If 2 drops of the Oil be dissolved in 4 Cc. of alcohol, and a drop of ferric chloride T.S. added, a bright green color will be produced; and if the same test be made with a drop of diluted ferric chloride T.S., prepared by diluting the test solution with four times its volume of water, a blue color will be produced, which soon changes to yellow. If 1 Cc. of the Oil be shaken with 20 Cc. of hot water, the water should show a scarcely perceptible acid reaction to litmus paper. If, after cooling, the aqueous layer be passed through a wet filter, the clear filtrate should yield, with a drop of ferric chloride T.S., only a transient, grayish-green, but not a blue or violet color (absence of *phenol*)." *U. S.* "Colorless or pale yellow when recent, but gradually becoming reddish-brown, having the strong odor and taste of cloves. Specific gravity not below 1.050. An alcoholic solution yields a blue color with *test-solution of ferric chloride.* Shaken with its own volume of *strong solution of ammonia* it forms a semi-solid yellowish mass." *Br.*

Oil of cloves is one of the least volatile of the essential oils and requires for congelation a temperature from zero of Fahrenheit to —4°. It is completely soluble in alcohol, ether, and strong acetic acid. Nitric acid changes its color to a deep red, and converts it by the aid of heat into oxalic acid. The same change to red is produced by nitric acid on morphine, but in this case the red is followed by yellow, which does not happen with the oil of cloves. Besides, if to a solution of morphine with nitric acid a solution of chlorinated lime be added, and the mixture be exposed for some hours to the light, the solution of morphine will retain a straw color, while if oil of cloves be treated in the same manner the color disappears. (Haselden, *B. F. M. R.*, July, 1867, 265.) It is frequently adulterated with fixed oils, and sometimes with oil of pimenta and with copaiba. When pure, it sinks in distilled water. According to E. Scherer, these adulterations may sometimes be detected by attention to the specific gravity and the boiling point, pure oil of cloves varying in specific gravity from 1.03 to 1.06, and boiling at from 240° C. (464° F.) to 255° C. (491° F.). According to Zeller, its character of congealing entirely into a crystalline mass with the alcoholic solution of potassium hydroxide, losing at the same time its peculiar odor, affords a sufficient criterion of its purity. This, however, while included among the official tests, is not sufficient, the percentage of eugenol as determined by the official assay being now a requirement. It appears to be indifferent in its rotatory effects on polarized light. (Buignet.)

Oil of cloves contains small amounts of *methyl alcohol* and *furfurol,* but is mainly composed of an unsaturated phenol termed *eugenol,* which is now an official product (see *Eugenol*) and a sesquiterpene *caryophyllene.* The U. S. Pharm., Eighth Revision, has introduced an assay process for the eugenol content, which is as follows:

Assay.—"Introduce into a flask with a long neck (graduated in tenths) 10 Cc. of the Oil of Cloves and 100 Cc. of potassium hydroxide T.S., and shake the mixture for five minutes. When the liquids have separated completely, add sufficient potassium hydroxide T.S. to raise the lower limit of the oily layer to the zero mark of the scale, and note the volume of the residual liquid, which should not measure more than 2 Cc., indicating the presence of at least 80 percent. of eugenol." *U. S.* *Eugenol,* $C_{10}H_{12}O_2$, has been shown to be the methyl ether of allyl-dioxybenzene, $C_6H_3\begin{cases} C_3H_5 \\ OCH_3 \\ OH \end{cases}$. One of its most important reactions is its conversion into *vanillin.* For this purpose it is boiled with acetic anhydride, whereby *aceteugenol* is formed, which, oxidized in weak acid solution by potassium permanganate, yields *acetvanillic acid,* and this with weak potassium hydroxide solution is changed into vanillin, which is then extracted by acidifying and shaking up with ether. (See also *Ph. Era,* 1887, 444.) For the estimation of eugenol in the form of its crystalline benzoyl compound, see *A. J. P.*, 1892, 26 and 508; also *Schim. Rep.,* April, 1892, 28. The characteristic aromatic odor of oil of cloves is due to *methyl-amylketone,* $CH_3.CO.C_5H_{11}$, which has been isolated by the chemists of Schimmel & Co., and found to be present only in minute quantity. (*Ph. Rev.,* 1897, 115.)

Uses.—The medicinal effects of the oil are similar to those of cloves, and it is used for the same purposes, but its most common employment is as a corrigent of other medicines. It is a powerful local narcotic, and is often introduced into the cavity of a *carious aching tooth. Eugenol* has been given internally in doses of forty-five grains (3 Gm.) per day dissolved in alcohol and diluted in water; it probably resembles phenol in its physiological action, and has been used as an antiseptic and antipyretic. According to the experiments of Leubuscher (*W. M. Bl.,* 1889), it is a feeble local anæsthetic.

Dose, from two to six minims (0.12 to 0.4 Cc.).

Off. Prep.—Pilula Colocynthidis Composita, *Br.*

OLEUM CHENOPODII. U. S.

OIL OF CHENOPODIUM [Oil of American Wormseed]

(ō'lę-ŭm ċhĕn-o-pō'dĭ-ī)

"A volatile oil distilled from *Chenopodium anthelminticum* Linné (Fam. *Chenopodiaceæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Huile volatile d'Ansérine vermifuge, *Fr. Cod.;* Essence de Chénopode anthelmintique, *Fr.;* Amerikanisches Wurmsamenöl, Chenopodiumöl, *G.*

This oil is peculiar to the United States. It is largely distilled in Maryland. (See *Chenopodium.*) It is of a light-yellow color when recently distilled, but becomes deeper yellow and even brownish by age. Its reaction is neutral. It has in a high degree the peculiar odor of the plant. "Specific gravity: about 0.965 to 0.985 at 25° C. (77° F.). It should be soluble in 5 volumes of 70 percent. alcohol. It is lævogyrate; the angle of rotation should not exceed —5° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* When freshly prepared, it has the sp. gr. 0.908, which, according to S. S. Garrigues, is increased by time to 0.960. A portion examined by him, which was of a brownish-yellow color, had the sp. gr. 0.959 at 61° F., boiled at 374° F., and was freely soluble in alcohol and ether. He found it to be composed of two distinct oils, separable by distillation; one of these has the formula $C_{10}H_{16}$, and is probably limonene; the other is heavier, and possesses the formula $C_{10}H_{16}O$. (*A. J. P.,* xxvi. 405.) Wormseed oil is used as an anthelmintic, given morning and evening for three or four days, and then followed by a brisk cathartic. Oil of wormseed has in various cases acted as a lethal poison. For fatal cases in children of three years of age, caused by a dose of one-half drachm, see *M. M. J.,* 1897, *T. G.,* xii; see also *B. M. S. J.,* xlv.

Dose, two to six minims (0.12 to 0.4 Cc.).

OLEUM CINNAMOMI. U. S., Br.

OIL OF CINNAMON [Oil of Cassia]

(ō'lę-ŭm cĭn-nạ-mō'mī)

"A volatile oil distilled from Cassia Cinnamon (Fam. *Lauraceæ*), yielding, when assayed by the process given below, not less than 75 percent., by volume, of cinnamic aldehyde. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Cinnamon Bark." *Br.*

Oleum Cinnamomi Cassiæ; Oil of Chinese Cinnamon, Essence de Cannelle de Chine, Huile volatile de Cannelle, *Fr.;* Oleum Cinnamomi, *P. G.;* Zimmtöl, Zimmtkassienöl, *G.;* Essenza di Cannella, *It.*

There are two oils of cinnamon in commerce, one procured from the Ceylon cinnamon, the other from the Chinese cinnamon, and often distinguished by the name of *oil of cassia.* There is no essential difference in the two oils, and that of the Chinese cinnamon, as much the cheaper and more abundant of the two, will probably continue to be generally employed, notwithstanding that the Ceylon product has the finer flavor.[1] The U. S. P. (8th Rev.) and the German Pharmacopœia recognize as oil of cinnamon only that obtained from cassia. The British Pharmacopœia and French Codex make Oil of Ceylon Cinnamon official.

Preparation.—Oil of cinnamon of Ceylon is distilled from inferior kinds of cinnamon, of insufficient value to pay the export duty. The following account of the method of extraction is given by Marshall. The bark, having been coarsely powdered, is macerated for two days in sea water, and then submitted to distillation. A light and a heavy oil come over with the water, the former of which separates in a few hours and floats upon the surface, the latter falls to the bottom of the receiver, and continues to be deposited for ten or twelve days. In future distillations, the saturated cinnamon water is employed with sea water to macerate the cinnamon. Eighty pounds of the freshly prepared bark yield about 2.5 ounces of the lighter oil, and 5.5 of the heavier. From the same quantity kept for several years in store, about half an ounce less of each oil is obtained. The two kinds are probably united in the oil of commerce. The oil is also distilled in Ceylon from the leaves, but the product is said to be too small to yield a fair profit. (*C. D.,* 1888.) The exportation of cinnamon chips from Ceylon has assumed large proportions, amounting in 1904 to 2,135,220 lbs. (*Schim. Rep.,* May, 1905.)

Properties.—Oil of Ceylon cinnamon is of a light-yellow color, becoming deeper by age, and ultimately red. Pereira stated that the London druggists redistilled the red oil, and thus obtained two pale-yellow oils, one lighter and the other heavier than water, with a loss of about 10 per cent. in the process. The oil has the flavor of cinnamon, and when undiluted is excessively hot and pungent. It is said sometimes to have a peppery taste, ascribable to an admixture of the leaves with the bark in the preparation of the oil. *Oil of Ceylon cinnamon* has "a slightly acid reaction. Sp. gr. about 1.040. It is readily soluble in alcohol. When cooled to —10° C. (14° F.), it remains clear, but at a lower temperature a solid portion separates from it." *U. S.* 1880. The

[1] Schimmel & Co. (*Schim. Rep.,* April, 1892) have shown that *cinnamon leaf oil* (from *Cinnamomum zeylanicum*), instead of being a thick, viscid oil, as frequently stated, is a bright, limpid oil, and is identical with the oil formerly exported from Ceylon in large quantities and thought to be produced from the roots of the cinnamon shrub. It has a sp. gr. of 1.05 to 1.06, and contains about 87 per cent. of eugenol and about 0.1 per cent. of cinnamic aldehyde; from this composition the cloves and cinnamon-like odor which it possesses may be understood. Safrol is also present in small amounts. Von Romburgh (*Schim. Rep.,* Oct. 1892) has prepared the true cinnamon root oil, and finds it to contain large amounts of camphor, to which its odor is obviously due.

British Pharmacopœia 1898 recognizes oil of Ceylon cinnamon only, and gives the following description and tests: "Yellow when freshly distilled, but gradually becoming reddish; having the odor and taste of the bark. Specific gravity 1.025 to 1.035. 1 cubic centimetre dissolved in 5 cubic centimetres of *alcohol* (90 per cent.), and *test-solution of ferric chloride* added, should afford a pale green, but not a decided blue coloration (absence of cinnamon-leaf oil). If 10 cubic centimetres be well shaken with 50 cubic centimetres of a boiling 30 per cent. solution of *sodium hydrogen sulphite*, an oily layer separates, which, when cooled to 60° F. (15.5° C.), should not measure more than 5 cubic centimetres (absence of more than 50 per cent. of constituents other than aldehydes)." *Br.*

Chinese oil of cinnamon is imported from Canton and Singapore. It is pale yellow, becoming red with age. Its flavor is similar to that of the Ceylon oil, though inferior, and it commands a much lower price. It is officially described as "a yellowish or brownish liquid, becoming darker and thicker by age and exposure to the air, having the characteristic odor of cinnamon, and a sweetish, spicy, and burning taste. Specific gravity: 1.045 to 1.055 at 25° C. (77° F.). The Oil (or if it be dark, its distillate) should be optically almost inactive; it should not be more than one degree dextrogyrate or lævogyrate when viewed through a 100 Mm. tube. Soluble in 2 volumes of 70 per cent. alcohol. When shaken with a saturated solution of sodium bisulphite, it solidifies to a crystalline mass. If 4 drops of the Oil, contained in a test-tube, be cooled to 0° C. (32° F.), and then shaken with 4 drops of fuming nitric acid, crystalline needles or plates will be formed. If a portion of the oil be shaken with hydrogen sulphide T.S., it should not assume a dark color (absence of *lead* and *copper*). If 1 Cc. of the Oil be mixed with 3 Cc. of a mixture of 3 volumes of alcohol and 1 volume of water, a clear solution should result; and if to this solution there be gradually added 2 Cc. of a saturated solution of lead acetate in a mixture of 3 volumes of alcohol and 1 volume of water, no precipitate should be produced (absence of *petroleum* and of *rosin*)." *U. S.* The researches of Schimmel & Co. seem to show that the Chinese cassia oil of commerce is distilled from the leaves, leaf-stalks, and young twigs of the cassia plant,—probably with broken bark and various refuse products from the tree; also that much of the oil is adulterated with rosin and petroleum. (See official tests above.) The value of cassia oil depends upon the percentage of cinnamic aldehyde which it contains. (See *Cinnaldehydum* and the official assay of oil of cinnamon for the percentage of cinnamic aldehyde.) In a series of analyses made by Schimmel & Co. of oils having a specific gravity of 1.064 to 1.065, the proportion of aldehyde varied from 73.5 to 88 per cent. In the distillation by Schimmel & Co. the various portions of the cassia plant obtained from China yielded the following results. 1. Cassia bark, *Cassia lignea* of commerce: yield of essential oil 1.5 per cent.; aldehyde in oil 92 per cent.; sp. gr. 1.035. 2. Cassia buds, *Flores Cassiæ* of commerce: yield of essential oil 1.550 per cent.; aldehyde in oil 80.4 per cent.; sp. gr. 1.026. 3. Cassia budsticks: yield of essential oil 1.64 per cent.; aldehyde in oil 92 per cent.; sp. gr. 1.046. 4. Cassia leaves, leaf-stalks, and young twigs mixed: yield of essential oil 0.77 per cent.; aldehyde in oil 93 per cent.; sp. gr. 1.055. Zeller states that oil of cassia is heavier, less liquid, and sooner rendered turbid by cold, and that in the Ceylon oil, iodine dissolves rapidly, with a considerable increase of heat, and the production of a tough residue, like an extract, while in oil of cassia the reaction is slow, quiet, and with little heat, and the residue is soft or liquid.

When exposed to the air, the oil absorbs oxygen, and is slowly converted into cinnamic acid, two distinct resins, and water. Of the two resins, one is soluble both in hot and in cold alcohol; the other readily in the former, but sparingly in the latter. *Cinnamic acid,* $C_9H_8O_2$, is colorless, crystalline, sourish, volatilizable, slightly soluble in water, readily dissolved by alcohol, and convertible by nitric acid with heat into benzoic acid. It is sometimes seen in crystals in oil of cinnamon which has been long kept. Like benzoic acid, it is said when swallowed to cause the elimination of hippuric acid by the urine. (*J. P. C.,* 3e sér., iii. 64.) It may be obtained by distilling the balsam of Tolu. Oil of cinnamon is almost wholly converted by nitric acid, slowly added, into a crystalline mass, producing a compound of the oil and the acid. These several facts are explained when it is found that oil of cinnamon contains from 75 to 90 per cent. of *cinnamic aldehyde,* C_9H_8O, which by moderate oxidation yields the corresponding cinnamic acid, $C_9H_8O_2$, but by more energetic oxidation yields benzoic acid, $C_7H_6O_2$. The oil has been produced artificially by Strecker from styrone, a derivative from styrax (see *Styrax*), and more recently from benzaldehyde and acetaldehyde, a mixture of which is saturated with hydrochloric acid gas, when a condensation takes place, as follows:

$$C_6H_5COH + CH_3COH = C_6H_5.CH:CH.CHO + H_2O$$

Ordinary sodium hydroxide will also bring about the reaction between the two aldehydes, and is to be preferred to hydrochloric acid for this purpose. The only other constituent of the cassia oil is cinnamyl acetate. Ceylon cinnamon oil, on the other hand, is said to contain some eugenol and phellandrene in addition to the cinnamic aldehyde.

Assay for Cinnamic Aldehyde. U. S. (8th Rev.)—"Introduce into a flask with a long graduated neck (cassia-flask), by means of a measuring-pipette, 10 Cc. of the Oil of Cinnamon, add 10 Cc. of a 30 percent. solution of sodium bisulphite, shake the flask, and heat it in a water-bath containing boiling water until the

contents are liquefied; add successive portions (10 Cc. each) of the bisulphite solution, shaking and heating as before, after each addition, until the flask is three-fourths filled. Continue to heat it in the water-bath until the odor of cinnamic aldehyde is no longer perceptible, cool the flask to about 25° C. (77° F.), and add enough of the bisulphite solution to raise the lower limit of the oily layer to the zero mark of the scale. The residual liquid should not measure more than 2.5 Cc., corresponding to at least 75 percent., by volume, of cinnamic aldehyde." *U. S.*

Oil of cinnamon is said to be frequently adulterated with oil of cloves, which, according to Ulex, cannot be detected by the odor or taste. Thus sophisticated, it is stated, on the same authority, to evolve a very acrid vapor when a drop is heated on a watch glass, to swell up and evolve red vapors if treated with fuming nitric acid, to remain liquid with concentrated potassium hydroxide, and to assume an indigo-blue color when ferrous chloride is added to its alcoholic solution, none of which reactions occur with pure oil.

Uses.—This oil has the cordial and carminative properties of cinnamon, without its astringency, and is much employed as an adjuvant to other medicines, the taste of which it corrects or conceals, while it conciliates the stomach. As a powerful local stimulant, it is sometimes prescribed in *gastrodynia, flatulent colic,* and *gastric debility.* Mitscherlich found six drachms to kill a moderate-sized dog in five hours, and two drachms one in forty hours. Inflammation and corrosion of the gastro-intestinal mucous membrane were observed after death.

Dose, one to three minims (0.06 to 0.2 Cc.).

Off. Prep.—Acidum Sulphuricum Aromaticum, *U. S.;* Aqua Cinnamomi, *U. S.;* Spiritus Cinnamomi, *U. S., Br.*

OLEUM COPAIBÆ. U. S., Br.

OIL OF COPAIBA

(ō'lę-ŭm cọ-pā'į-bæ)

"A volatile oil distilled from Copaiba. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Copaiba." *Br.*

Oil of Copaiva; Oleum Balsami Copaivæ; Essence de Copahu, *Fr.;* Copaivaöl, *G.*

The oil constitutes from one-third to one-half or more of the copaiba. From one specimen of recent copaiba as much as 80 per cent. has been obtained. (*A. J. P.,* xxii. 289.) It is prepared largely by the application of steam heat. As it first comes over it is colorless, but the later product is of a fine greenish hue. By redistillation it may be rendered wholly colorless. It has the odor and taste of copaiba, a neutral reaction, boils at 252° to 256° C. (485.6° to 492.8° F.), solidifies, partly crystalline, at —15° F. (Gmelin), is soluble in ether and in an equal weight of absolute alcohol. The oil consists chiefly of *caryophyllene,* a sesquiterpene, $C_{15}H_{24}$. "A colorless or pale yellow liquid, having the characteristic odor of copaiba, and an aromatic, slightly bitter, and pungent taste. Specific gravity: 0.895 to 0.905 at 25° C. (77° F.), increasing with age. It is lævogyrate. Soluble in 2 volumes of alcohol." *U. S.* "Colorless or pale yellow, with the odor and taste of copaiba. Specific gravity 0.900 to 0.910. It turns the plane of a ray of polarized light to the left, and is soluble in its own volume of *absolute alcohol* (distinction from African copaiba oil)." *Br.* From its want of oxygen, it answers even better than naphtha for preserving potassium, a fact first observed by Durand of Philadelphia. It dissolves sulphur and phosphorus.

Its effects on the system are those of copaiba. From the experiments of C. Mitscherlich, it is one of the least injurious of the volatile oils to the animal system, six drachms of it having been introduced into the stomach of a rabbit without causing death. Externally it produces much less irritation than does oil of turpentine. It may be used for the same purposes as copaiba.

Dose, five to fifteen minims (0.3 to 0.9 Cc.).

OLEUM CORIANDRI. U. S., Br.

OIL OF CORIANDER

(ō'lę-ŭm cō-rį-ăn'drī)

"A volatile oil distilled from Coriander. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Coriander Fruit." *Br.*

Essence de Coriandre, *Fr.;* Koriander öl, *G.*

This oil may be obtained by distillation with water from the bruised fruit in the manner directed in the U. S. Pharm. 1870 for volatile oils. The average yield of oil from coriander grown in different countries is from 0.2 to 1 per cent. It is pale yellow and colorless, and has the characteristic odor and taste of coriander, and a neutral reaction. Its sp. gr. is from 0.863 to 0.878 at 25° C. (77° F.), *U. S.,* and its boiling point 302° F. It is an oxygenated oil, consisting chiefly of a compound, *coriandrol,* $C_{10}H_{18}O$. According to Semmler (*Ber. d. Chem. Ges.,* 24, 206), coriandrol boils between 194° and 198° C., is optically dextrogyrate, and has a sp. gr. of 0.8679 at 20° C. Coriandrol is now known as dextrogyrate *linalool.* Schimmel & Co. (*Schim. Rep.,* April, 1892) have also found in coriander oil about 5 per cent. of *dextropinene.* The characteristic odorous principle or principles are unknown. It is officially described as "a colorless or slightly yellow liquid, having the characteristic, aromatic odor of coriander, and a warm, spicy taste. Specific gravity: 0.863 to 0.878 at 25° C. (77° F.). It should be soluble in 3 volumes of 70 percent. alcohol; also soluble in all proportions in 80

percent. and 90 percent. alcohol. It is dextrogyrate, the angle of rotation varying from +7° to +14° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* "Colorless or pale yellow, having the odor and flavor of the fruit. Specific gravity 0.870 to 0.885. If 1 cubic centimetre of the Oil be mixed with 3 cubic centimetres of *alcohol* (70 per cent.), a clear solution results (absence of oil of turpentine and added terpenes)." *Br.* Oil of coriander is extensively adulterated with colorless rectified oil of orange, which can be detected by its insolubility in 90 per cent. alcohol, in which pure coriander oil dissolves in every proportion; equal parts of oil of orange and 90 per cent. alcohol make a turbid mixture. (*A. J. P.*, Sept. 1878.) The oil has the medicinal properties of the fruit, and, like the aromatic oils generally, may be used to cover the taste or correct the nauseating or griping properties of other medicines. It has the great advantage of being more stable and retaining its agreeable odor longer than any other oil of its class.

Dose, three minims (0.2 Cc.).

Off. Prep.—Confectio Sennæ, *U. S.*; Spiritus Aurantii Compositus, *U. S.*; Syrupus Sennæ, *U. S.*, *Br.*

OLEUM CUBEBÆ. U. S., Br.

OIL OF CUBEB

(ō'lę-ŭm cū-bē'bæ)

"A volatile oil distilled from Cubeb. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Cubebs." *Br.*

Oleum Cubebarum; Oil of Cubebs; Huile volatile (Essence) de Cubèbe, *Fr.*; Kubebenöl, *G.*

The oil is obtained from cubeb by grinding the berries, and then distilling with water. From ten pounds Schönwald procured eleven ounces of oil, and this result very nearly coincides with the experiments of Christison, who obtained 7 per cent.; but by better methods of distillation 10 to 18 per cent. have been obtained. When recently distilled from the fruit, the oil is somewhat greenish, becoming yellowish by age, but when carefully redistilled it is colorless. It has the odor of cubeb, a warm, aromatic, camphoraceous taste, and a neutral reaction, is of a consistence approaching that of almond oil, is lighter than water, having the sp. gr. 0.920 (0.910 to 0.930, *Br.*), and when exposed to the air is said to thicken without losing its odor. It is soluble in an equal weight of alcohol. It is described in the U. S. P. (8th Rev.) as follows: "A colorless, pale green, or yellow liquid, having the characteristic odor of cubeb, and a warm, camphoraceous, aromatic taste. Specific gravity: 0.905 to 0.925 at 25° C. (77° F.). An alcoholic solution of Oil of Cubeb is neutral to litmus paper. It is lævogyrate, the angle of rotation varying from —25° to —40° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* The oil consists chiefly of sesquiterpenes which distil over between 250° C. and 280° C., one of which is *cadinene*, $C_{15}H_{24}$, with some *dipentene*, and probably *pinene* or *camphene*. Upon standing, it sometimes deposits rhomboidal prismatic crystals of a stearopten. This camphor of cubeb has the formula $C_{15}H_{26}O$, is fusible at from 66° to 68° C., and volatilizes without change at from 148° to 150° C. According to Schmidt, it does not pre-exist in the cubeb, but is formed by the prolonged action of the air. (*J. P. C.*, Juin, 1875.) The oil has the aromatic properties of cubeb, but it is probably not the sole active ingredient, as it is much less pungent than the fluidextract or the oleoresin. It may, however, often be advantageously substituted for the powder, the dose to be gradually increased until its effects are obtained, or until it proves offensive to the stomach. It may be given suspended in water by means of sugar, in the form of emulsion, or enclosed in capsules of gelatin.

Dose, five to fifteen minims (0.3 to 0.9 Cc.).

OLEUM ERIGERONTIS. U. S.

OIL OF ERIGERON [Oil of Fleabane]

(ō'lę-ŭm ę-rĭg-ę-rŏn'tĭs)

"A volatile oil distilled from the fresh, flowering herb of *Erigeron canadensis* Linné (Fam. *Compositæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Oleum Erigerontis Canadensis, *U. S.* 1870; Oil of Canada Fleabane; Essence d'Erigeron, *Fr.*; Erigeronöl, *G.*

Oil of erigeron is limpid, of a light straw color, a peculiar, aromatic, persistent odor, and a characteristic taste. By exposure it becomes darker and thicker. Its reaction is neutral. Its sp. gr. is about 0.850, increasing with age (0.855 to 0.890, *Schim. Rep.*). It consists chiefly of dextrogyrate *limonene*, together with some *terpineol*. (*A. J. P.*, 1893, 420.) It is officially described as "a pale yellow, limpid liquid, rapidly becoming darker and thicker by age and exposure to the air, having a peculiar, aromatic, persistent odor, and an aromatic, slightly pungent taste. Specific gravity: 0.845 to 0.865 at 25° C. (77° F.). Soluble in an equal volume of alcohol (distinction from *oil of fireweed* derived from *Erechthites hieracifolia* Rafinesque (Fam. *Compositæ*) and from *oil of turpentine*). It is dextrogyrate, the angle of rotation being about +50° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* When distilled without water, it comes over colorless, and a little resinous matter is left behind, probably resulting from the oxidation of one or both of the constituent oils. It is readily soluble in alcohol. It is slowly reddened by potassium hydroxide, combines with iodine without ex-

plosion, is instantly decomposed by sulphuric acid, and is acted on by strong nitric acid, slowly at ordinary temperatures, but with heat explosively. (Procter, *A. J. P.*, xxvi. 502.) The plant yields 0.2 to 0.4 per cent. of oil. When exposed to the air, the oil darkens and rapidly resinifies. For an account of the difference in properties between this oil and that from *Erechthites hieracifolia*, see a paper by Albert M. Todd, *A. J. P.*, 1887, p. 302.

It was first brought into notice by the so-called eclectic physicians, who use it in *diarrhœa, dysentery,* and the *hemorrhages,* and certainly it is a very valuable remedy in *hæmoptysis* when there is no fever or other marked evidence of constitutional irritation. As long ago as 1854 it was commended highly by E. Wilson in *uterine hemorrhage,* while J. W. Moorman speaks of it most highly in all forms of hemorrhage, in *diarrhœa of debility,* in *dysentery* after sufficient evacuation of the stomach and bowels, and especially in *hemorrhage from the bowels during typhoid fever.* (*Am. J. M. S.*, Oct. 1865, p. 396.) It probably acts like the oil of turpentine as a hæmostatic, but is much less irritant and stimulating.

Dose, ten minims to half a fluidrachm (0.6 to 1.8 Cc.), repeated every hour or two.

OLEUM EUCALYPTI. U. S., Br.

OIL OF EUCALYPTUS

(ō'lę-ŭm eū-cą-lĭp'tī)

"A volatile oil distilled from the fresh leaves of Eucalyptus, rectified by steam distillation, and yielding, when assayed by the process given below, not less than 50 percent., by volume, of cineol (eucalyptol). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from the fresh leaves of Eucalyptus Globulus, *Labill.*, and other species of Eucalyptus." *Br.*

Oil of Eucalyptus Globulus; Huile volatile (Essence) de Eucalyptus, *Fr. Cod.;* Eucalyptusöl, *G.;* Esencia de eucalipto, *Sp.*

Various species of the genus Eucalyptus, grown in Australia and Algeria, yield volatile oils in sufficient quantity to be commercial products. Probably the most important of these plants are the *E. amygdalina,* whose volatile oil was at one time supposed to be destitute of eucalyptol, but has been shown by Gildemeister (*Ph. Ztg.*, 1888) to contain that principle, and to have phellandrene for its chief constituent; *E. odorata,* the oil of which is affirmed to be extremely rich in eucalyptol, but to contain no phellandrene; and *E. oleosa,* the oil of which is stated to be so rich in eucalyptol that at a low temperature it becomes pasty. Under these circumstances the revisers of the U. S. Pharm. acted very properly in rejecting all those oils which contain enough phellandrene to respond to the sodium nitrite test. Oil of eucalyptus is officially described as "a colorless or pale yellow liquid, having a characteristic, aromatic, somewhat camphoraceous odor, and a pungent, spicy, and cooling taste. Specific gravity: 0.905 to 0.925 at 25° C. (77° F.). Soluble, in all proportions, in alcohol; also soluble in 3 volumes of 70 per-cent. alcohol. Its alcoholic solution should be neutral to litmus paper. It is dextrogyrate, the angle of rotation being not more than +10° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). If 2 Cc. of the oil be mixed with 4 Cc. of glacial acetic acid, and 3 Cc. of a saturated, aqueous solution of sodium nitrite be gradually added, the mixture, when gently stirred, should not form crystals of phellandrene nitrite (absence of *eucalyptus oils* containing much *phellandrene*)." *U. S.* "Specific gravity 0.910 to 0.930. It should not rotate the plane of a ray of polarized light more than 10° in either direction in a tube 100 millimetres long, and it should become semi-solid on being stirred, when cold, with a third or half its volume of phosphoric acid of commerce of specific gravity 1.750 (presence of a due proportion of cineol). If to 1 cubic centimetre of the Oil there be added 2 cubic centimetres of *glacial acetic acid* and 2 cubic centimetres of a saturated aqueous solution of *sodium nitrite,* the mixture, when gently stirred, should not form a crystalline mass (exclusion of eucalyptus oils containing much phellandrene)." *Br.*

Assay for Cineol.—"Introduce into a beaker a solution prepared by dissolving 10 Cc. of Oil of Eucalyptus in 50 Cc. of purified petroleum benzin; immerse the beaker in a freezing mixture and add phosphoric acid, drop by drop, with constant stirring, until the white magma of cineol phosphate formed, begins to assume a yellowish or pinkish tint; then transfer the magma to a force filter, wash it with cold purified petroleum benzin, and then dry it by pressure between two porous plates. Transfer the precipitate (cineol phosphate) to a narrow graduated cylinder, and add warm water, which will cause separation of the cineol. The volume, in cubic centimeters, of the separated oil, multiplied by 10, represents the volume percent. of cineol (eucalyptol). This should correspond to the properties and tests given under *Eucalyptol.*" *U. S. Eudesmol,* $C_{10}H_{16}O$ (possibly a ketone), is the name given to a crystalline camphor obtained from the oil from *E. piperita;* H. G. Smith and R. T. Baker isolated this product, and later H. G. Smith read a paper upon it before the Royal Society of New South Wales. It proved to be isomeric with camphor, but chemically it is shown to have its oxygen atom combined in a different way. Power has modified the test for phellandrene so as to make it more delicate. According to his directions, 1 Cc. of the oil is mixed with 5 Cc. of petroleum benzin, 1 or 2 Cc. of a concentrated solution of sodium nitrite added, and subsequently glacial

acetic acid added, a drop or two at a time, with vigorous agitation after each addition. If phellandrene is present in any considerable amount, its crystalline nitrosite, $C_{10}H_{16}(NO)NO_2$, will separate from the benzin solution. It contains *cymene,* $C_{10}H_{14}$, *pinene,* $C_{10}H_{16}$, and *eucalyptol* (or *cineol*), $C_{10}H_{18}O$. Schimmel & Co. also state (*Ber. d. Chem. Ges.,* April, 1888) that they have obtained several of the aldehydes of the fatty series, notably *valeraldehyde,* and probably *butyraldehyde* and *capronaldehyde,* in their distillation of the oil from *Eucalyptus Globulus.* The medicinal value of the oil of eucalyptus has been believed to depend upon the eucalyptol present in it, but we have no definite knowledge as to the physiological action of phellandrene, and it may well be that the phellandrene oils act similarly to the eucalyptol. As eucalyptol is now official, it may be preferred by the practitioner as being of definite strength and character, the percentage of eucalpytol even in the best oils varying considerably.

Dose, ten to fifteen minims (0.6 to 0.9 Cc.), best administered in capsules.

Off. Prep.—Unguentum Eucalypti, *Br.*

OLEUM FŒNICULI. U. S.

OIL OF FENNEL

(ō'lę-ŭm fœ-nĭc'ù-lī)

"A volatile oil distilled from Fennel. It should be kept in well-stoppered, amber-colored bottles, in a cool place, and, if it has partly or wholly solidified, it should be completely liquefied by warming and then well shaken before being dispensed." *U. S.*

Huile volatile de Fenouil, *Fr. Cod.*; Essence de Fenouil, *Fr.;* Oleum Fœniculi, *P. G.;* Fenchelöl, *G.*

Fennel seeds yield about 2.5 per cent., or, according to Zeller, from 3.4 to 3.8 per cent., of oil. That used in this country is imported. "A colorless or pale yellow liquid, having the characteristic, aromatic odor of fennel, and a sweetish, mild, and spicy taste. Specific gravity: 0.953 to 0.973 at 25° C. (77° F.). Soluble in an equal volume of alcohol, the solution being neutral to litmus paper; also soluble in 10 volumes or less of 80 percent. alcohol. An alcoholic solution of Oil of Fennel is neutral to litmus paper, and is not colored by the addition of a drop of ferric chloride T.S. (absence of some volatile oils containing *phenols*). When tested according to the following methods, the congealing point of Oil of Fennel should not be below 5° C. (41° F.). Transfer about 10 Cc. of the Oil to a test-tube placed in a freezing mixture; insert a thermometer at once into the oil, and allow it to remain undisturbed until its temperature has fallen to about —5° C. (23° F.). Induce crystallization either by rubbing the inner wall of the test-tube with the thermometer or by the addition of a particle of solid anethol, and stir continuously during the solidification of the Oil. The highest temperature reached during the crystallization is regarded as the congealing point." *U. S.* It congeals below 50° F. into a crystalline mass, separable by pressure into a solid and a liquid portion, the former heavier than water, and less volatile than the latter, which rises first when the oil is distilled. It contains *d-pinene, phellandrene, dipentene, fenchone,* $C_{10}H_{16}O$ (a liquid ketone), and *anethol,* $C_{10}H_{12}O$ (a phenol-ether forming a white solid melting at 21° C.), (see *Oleum Anisi*), the latter usually in amounts of about 60 per cent. (*Power's Catalogue of Essential Oils,* 1894.) *Schimmel's Report* for April, 1897, mentions *limonene* as also at times present as a constituent. Umney finds that Japanese oil contains about 75 per cent. of anethol and 10 per cent. of fenchone, besides terpenes. (*Proc. A. Ph. A.,* 1897, 516.) There is reason to believe that much of the commercial oil is adulterated with oil from which the anethol or crystalline constituent has been separated; the official solidifying point not below 5° C. (41° F.) should be required. Flückiger states (*Pharm. Chem.,* 2d ed., 1888, 422) that it contains more hydrocarbon than oil of anise, and notably that from Nîmes, in Southern France, contains much less anethol, and hence has a milder and sweeter taste. As found in commerce, therefore, the oil of fennel is not uniform, and a specimen examined by Montgomery did not congeal at —5.5° C. (22° F.). (See *Oleum Anisi.*) It is slightly dextrogyrate.

Dose, three to five minims (0.2 to 0.3 Cc.).

Off. Prep.—Aqua Fœniculi, *U. S.;* Pulvis Glycyrrhizæ Compositus, *U. S.;* Spiritus Juniperi Compositus, *U. S.*

OLEUM GAULTHERIÆ. U. S., Br. Add.

OIL OF GAULTHERIA [Oil of Wintergreen]

(ō'lę-ŭm gâul-thē'rĭ-æ)

"A volatile oil distilled from the leaves of *Gaultheria procumbens* Linné (Fam. *Ericaceæ*), rectified, if necessary, by steam distillation. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Oil of Teaberry, Oil of Partridge-berry; Huile volatile (Essence) de Winter-green, *Fr. Cod.;* Essence de Gaulthérie, *Fr.;* Wintergrünöl, Bergtheeöl, *G.*

The volatile oil of gaultheria is largely obtained in the United States by distillation of the plant. It probably does not exist in the plant, but is formed by a reaction between water and a neutral principle analogous to amygdalin, to which Procter has given the name of *gaultherin.* (*A. J. P.,* xv.) This substance, which was called by Schneegans *bétulase,* probably exists in all the numerous plants which yield methyl salicylate on distillation. The oil occurs in various of our native plants, and has been detected in *Polygala paucifolia, Spiræa Ulmaria, Spiræa lobata,* and

Gaultheria chiogenes. T. E. de Vrij found it in considerable proportion in the *Gaultheria leucocarpa* and *G. punctata,* plants which are abundant in the volcanic regions of Java (*A. J. P.,* 1879); while Bourquelot (*C. R. S. B.,* iii. 1896) detected it in *Monotropa Hypopitys,* in *Polygala Senega,* and in other species of Polygala. (See also *A. J. P.,* 1898, 412.) Much of the commercial oil of wintergreen is obtained from *Betula lenta.*

Oil of gaultheria when freshly redistilled is nearly colorless, but as found in commerce has a brownish-yellow or reddish color.[1] "A colorless or almost colorless liquid, having a characteristic, strongly aromatic odor, and a sweetish, warm, and aromatic taste. Specific gravity: 1.172 to 1.180 at 25° C. (77° F.). Boiling point: 218° to 221° C. (424.4° to 429.8° F.). It is slightly lævogyrate, up to —1° in a 100 Mm. tube, at 25° C. (77° F.). In other respects it has the same properties as, and conforms to the reactions and tests given under, *Methylis Salicylas." U. S.* It is stated to have been largely adulterated with chloroform. This and other impurities are to be detected by a comparison of the specific gravities and boiling points, or by fractional distillation. It is readily soluble in alcohol. When heated to about 80° C. (176° F.), the oil should not yield a colorless distillate having the characteristics of chloroform or of alcohol (*A. J. P.,* 1873, p. 521). Another distinguishing property is that in aqueous solution it gives a purple color with ferric salts. Oil of sassafras may be detected by the separation of a deep-red resinous mass on treatment with nitric acid in the cold. Japanese oil of camphor and other light volatile oils used as adulterants can be detected by simply dropping the suspected oil in water; if pure, it sinks in a few seconds; if adulterated, some minutes are required. Procter proved that oil of gaultheria has acid properties and contains *salicylic acid.* (See *Salix.*) Cahours confirmed this, and stated that one-tenth of the oil consists of a peculiar hydrocarbon, which he called *gaultherilene,* and the remaining nine-tenths of *methyl salicylate* or the methyl ester of salicylic acid, $CH_3.C_7H_5O_3$. A product having the properties of the latter compound was obtained by distilling a mixture of methyl alcohol, salicylic acid, and sulphuric acid. (*A. J. P.,* xiv. 211, xv. 241.) Trimble and Schroeter (*Ibid.,* 1889, 398) found that the amount of the hydrocarbon *gaultherilene* was much less than that stated by Cahours,—in fact, only 0.3 per cent. By analysis and vapor density determination they fixed its formula as $C_{15}H_{24}$, but they state that it may consist of a solid and a liquid portion. Power and Kleber (*Fritzsche Bros. Circ.,* No. 7) assert that this hydrocarbon belongs to the paraffin series, and state that it is probably *triacontane,* $C_{30}H_{62}$. They also find in the oil an aldehyde or ketone, with an odor like œnanthic aldehyde, an apparently secondary alcohol, $C_8H_{16}O$, and an ester, $C_{14}H_{24}O_2$. To the alcohol and the ester are attributed the characteristic odor of the oil. True oil of gaultheria contains about 99 per cent. of methyl salicylate. *Artificial oil of wintergreen* is now extensively manufactured and used instead of the natural oil. For a process by H. T. Thayer, see *A. J. P.,* 1895, 244. (See *Methylis Salicylas,* p. 778.)

Uses.—Oil of gaultheria is largely used on account of its pleasant flavor; it may, however, be employed as a substitute for salicylic acid with excellent results. One hundred and sixty-nine grains of the oil contain one hundred and fifty-two grains of methyl salicylate, and are therefore equivalent to one hundred and thirty-eight grains of salicylic acid. An elaborate research by H. C. Wood (*T. G.,* vol. ii. p. 76) proved that this drug acts physiologically like salicylic acid. When taken in moderate amounts it is, like that acid, broken up in the system and eliminated as salicyluric acid, etc. It is capable of causing fatal poisoning. Half an ounce produced in a boy severe vomiting, purging, epigastric pain, hot skin, frequent pulse, slow and labored respiration, and dulness of hearing; the boy recovered. (*Medical Examiner,* N. S., viii.) Two ounces caused in an adult, intense sweating, violent uncheckable diarrhœa, rapid and very irritable pulse, intense itching, and death from exhaustion in forty-one hours. (*N. Y. M. R.,* vol. lviii.) A woman survived after having taken half an ounce (*N. Y. M. J.,* 1875), but the same amount has caused death (*Ibid.,* 1867).

Dose, fifteen to thirty minims (0.9 to 1.8 Cc.).

[1] *Distillation of Oil of Gaultheria.*—Isaac Edward Leonard states that oil of wintergreen, first made in Luzerne County, Pa., in 1863, has since been distilled there in large quantities. The entire plant is employed, and it gives the greatest yield during the months of July and August.

The still is generally a wooden box, about eight feet long, four feet wide, four feet high, with a copper bottom and stayed with bolts. The head of the still is copper, and connecting with this is a circular worm of the same material or of tin, placed in a barrel. The still being filled with wintergreen to within about twelve inches of the top, a sufficient quantity of water is added, and this is allowed to macerate from ten to twelve hours. The fire being started, the distillation commences, and continues for about eight hours; but during the first two or three hours ninety per cent. of the oil has passed over. For collecting the distillate, most of the distillers use a wide-mouthed bottle, fitted with a large cork having two holes. A small funnel is put into one of the holes, so that the beak is below the shoulder of the receiving vessel, and connected with the other hole is a suitable pipe forming an outlet. The oil and the water separate, the oil going to the bottom, and the water passes into a larger receptacle, where it is reserved for a subsequent operation (cohobation).

Occasionally the oil is very highly colored, and the wholesale dealers have three ways of "cleaning" it,—redistillation, filtration, and decolorization. The oil to be decolorized is put into a bottle, crystals of citric acid are added, and the whole is allowed to stand, agitating occasionally, until the oil is colorless, or nearly so. On experimenting with nine quarts of wintergreen fruit, the author found it contained one and one-half drachms of oil. In experimental distillation he found that the lower specific gravity is due to the separating of the oil from the water too quickly, and that the higher specific gravity is obtained by letting the distillate stand for twenty-four to forty-eight hours before separating the oil from the water. (*A. J. P.,* 1884, p. 264.)

Off. Prep.—Emulsum Olei Morrhuæ, *U. S.;* Emulsum Olei Morrhuæ cum Hypophosphitibus, *U. S.;* Liquor Antisepticus, *U. S.;* Spiritus Gaultheriæ, *U. S.;* Syrupus Sarsaparillæ Compositus, *U. S.*

OLEUM GOSSYPII SEMINIS. U. S.

COTTON SEED OIL

(ō′lẹ-ŭm gọs-sўp′ĭ-ī sĕm′ị-nĭs)

"A fixed oil expressed from the seeds of *Gossypium herbaceum* Linné, or of other species of *Gossypium* (Fam. *Malvaceæ*), and subsequently purified. It should be kept in well-closed containers." *U. S.*

Oleum Gossypii; Cotton Oil; Huile de Semences de cotonnier, *Fr.;* Baumwollsamenöl, Cottonöl, *G.*

This fixed oil has no other medicinal properties than those of a bland neutral oil, and has been introduced especially on account of its use in official liniments. The amount of cotton seed crushed in 1905, according to the census report, was 3,308,930 tons, and the production of crude cotton seed oil amounted to 132,051,801 gallons, valued at $31,011,905. Of this production, about one-fourth goes into the manufacture of "compound lard" and "cottolene," a still larger amount is exported as cotton seed oil, and the remainder is used in admixture with drying oils and for soap stock. The oil cake is largely exported to England, where it is used as food for cattle, and the oil to France, Italy, and other olive growing countries of Europe, whence much of it returns to us mixed with olive oil. The exportation of cotton seed oil for 1903 amounted to 35,642,994 gallons, valued at $14,211,244; for 1904 to 29,014,417 gallons, valued at $10,717,280. For a description of the process of extraction, see *A. J. P.*, 1896, 42; also 1898, 497.

This oil is obtained by expression from the seeds previously deprived of their shells. In this state they yield two gallons of oil to the bushel. As first obtained, it is thick and turbid, but it deposits a portion of its impurities on standing. Besides this crude oil, there are three varieties in commerce, more or less purified, recognized as the *clarified,* the *refined,* and the *winter bleached.* The last mentioned is of a pale straw-color, a mild peculiar odor, and a bland sweetish taste, not unlike that of almond oil. The oil is used in the preparation of woolen cloth and morocco leather, and for oiling machinery. It has been found to be an excellent substitute for almond and olive oils in most pharmaceutical preparations in which they are employed, but it does not answer well in the formation of lead plaster. Citrine ointment carefully prepared with it, too great heat being avoided, retains a rich orange color and proper unctuous consistence.

Properties.—It is officially described as "a pale yellow, oily liquid, without odor, and having a bland, nut-like taste. Specific gravity: 0.915 to 0.921 at 25° C. (77° F.). Very sparingly soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide. On cooling the Oil to a temperature below 12° C. (53.6° F.), particles of solid fat will separate. At about 0° to —5° C. (32° to 23° F.), the Oil becomes nearly or quite solid. If sulphuric acid (specific gravity 1.6 to 1.7) be added to the Oil, preferably diluted with carbon disulphide, a reddish-brown color is rapidly produced. If 6 Gm. of the Oil be thoroughly shaken in a test-tube for about ten minutes with a mixture of 1.5 Gm. of nitric acid and 0.5 Gm. of water, then heated in a bath of boiling water for not more than fifteen minutes, the Oil will assume an orange or reddish-brown color, and after standing for twelve hours at the ordinary temperature, will form a semi-solid mass. If 5 Cc. of the Oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol and adding 2 drops of nitric acid), and if the mixture be heated for about five minutes on a water-bath, the Oil will assume a red or reddish-brown color. If 2 Cc. of the Oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, a red color will develop in from ten to fifteen minutes. Cotton Seed Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 191 to 196 (see PART III, Test No. 99). If 0.3 Gm. of Cotton Seed Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours protected from the light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S. an iodine value of not less than 102 nor more than 108 should be obtained (see PART III, Test No. 51)." *U. S.*

Cotton seed oil has been examined by A. Adriani (*Chem. News,* Jan. 7, 1865, p. 5). The product of the expressed seeds is from 15 to 18 per cent. In its impure state it is dark reddish-brown, not quite clear, and contaminated with mucilage and albumen. When boiled with an alkaline solution, crude cotton seed oil is saponified, and the resultant soap rapidly oxidizes on exposure to air, with production of a fine purple or violet-blue coloration.[1] This reaction is characteristic of crude

[1] "Cotton seed blue" is stated by Kuhlmann to have the composition $C_{17}H_{24}O_4$. It is amorphous, readily destroyed by oxidizing agents, insoluble in water, diluted acids, and alkalies, soluble in alcohol and ether. The unoxidized coloring matter of cotton seed oil has also been investigated by J. Longmore, who finds it to be a pungent, golden-yellow product, which dyes fabrics very well, the color being perfectly fast on wool and silk. (Allen, *Com. Org. Anal.,* 2d ed., 1887, p. 113.)

cotton seed oil. The sp. gr. of the crude oil varies from 0.928 to 0.930; that of the refined oil, from 0.922 to 0.926.

The oil is clarified by first boiling it with water, to separate the mucilage, and then heating it with a weak solution of sodium hydroxide, which combines with the coloring matter and saponifies a part of the oil. The mixture becomes filled with black flocks, which deposit on standing and leave the oil but slightly colored. The loss in refining is usually from 4 to 7½ per cent., but occasionally amounts to 12 or 15. As this oil is much used for adulterating olive oil, tests to distinguish it are very desirable. The tests most depended upon are those with an alcoholic solution of silver nitrate (Bechi's test) and with a mixed solution of amyl alcohol and carbon disulphide containing 1 per cent. of dissolved sulphur (Halphen's test). These are given in the official tests.

Dose, two to six fluidrachms (7.5 to 22.5 Cc.).

Off. Prep.—Linimentum Ammoniæ, *U. S.;* Linimentum Camphoræ, *U. S.*

OLEUM HEDEOMÆ. U. S.

OIL OF HEDEOMA [Oil of Pennyroyal]

(ō'lę-ŭm hĕd-ę-ō'mæ)

"A volatile oil distilled from the leaves and flowering tops of Hedeoma. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Essence de Hédéoma, Essence de Pulliot américaine, *Fr.;* Pennyroyalöl, Amerikanisches Poleiöl, *G.*

This oil, though analogous in properties to the oil of European pennyroyal, is derived from a distinct plant (*Hedeoma pulegioides*), peculiar to North America. "A pale yellow, limpid liquid, having a characteristic, pungent, mint-like odor and taste. Specific gravity: 0.920 to 0.935 at 25° C. (77° F.). It should form a clear solution with 2 volumes or more of 70 percent. alcohol. It is dextrogyrate, the angle of rotation varying from about +18° to +22° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* Its chemical composition was investigated by E. Kremers (*A. J. P.,* 1887, p. 535) and F. W. Franz (*Ibid.,* 1888, p. 161). Each of them found a body of the composition $C_{10}H_{18}O$, boiling at 217° to 218° C. (constituting, according to Franz, about 33 per cent. of the oil). For this the name *hedeomol* was proposed. Franz also found a body of the composition $C_{10}H_{17}O$, boiling at 220° to 225° C., and constituting 12 per cent. of the oil; likewise a body of the composition $C_6H_{12}O$, boiling at 165° to 170° C., and constituting about 0.7 per cent. of the oil. Both investigators found *formic* and *acetic acids,* and Kremers considers *isoheptoic acid* also to be present. Beckmann and Pleissner (*Ann. Ch. Ph.,* 262, p. 1) found in American as well as in Spanish and Algerian pennyroyal oil a ketone, $C_{10}H_{16}O$, to which they gave the name of *pulegone.* This compound forms with hydroxylamine an oxime, $C_{10}H_{16}NOH.H_2O$, crystallizing in beautiful needles melting at 157° C., and with hydrogen bromide a crystalline compound melting at 40.5° C. The two compounds of the formula $C_{10}H_{18}O$, discovered by Kremers (*Ph. Rund.,* ix. p. 130), are also ketones and yield corresponding oximes. The oil may be used as a remedy in flatulent *colic* and *sick stomach,* to correct the operation of nauseating or griping medicines. It is also much employed as a domestic remedy in *amenorrhœa.*

Dose, two to ten minims (0.12 to 0.6 Cc.).

OLEUM JUNIPERI. U. S., Br.

OIL OF JUNIPER

(ō'lę-ŭm jū-nĭp'ę-rī)

"A volatile oil distilled from the fruit of *Juniperus communis* Linné (Fam. *Coniferæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from the full-grown unripe fruit of Juniperus communis, *Linn.*" *Br.*

Oleum Fructus (vel Baccæ) Juniperi; Oil of Juniper Berries; Huile volatile (Essence) de Genièvre, *Fr.;* Oleum Juniperi, *P. G.;* Wachholderöl, Wachholderbeeröl, *G.;* Essenza di ginepro, *It.*

The proportion of oil which juniper berries afford is stated very differently by different authors. Trommsdorff obtained 1 per cent. The highest quantity given in the table of Recluz is 2.34, the lowest 0.31 per cent. Zeller gives as the product of the fresh ripe fruit 1.3 per cent., of that a year old 0.86 per cent. The berries are most productive when bruised. The oil of juniper consumed in this country is brought from Europe, and is believed to be procured chiefly from the tops of the plant, being sold for a price which is altogether incompatible with the idea that it is prepared from the fruit alone. "A colorless, faintly green or yellow liquid, having the characteristic odor of juniper, and a warm, aromatic, somewhat terebinthinate and slightly bitter taste. Specific gravity: 0.860 to 0.880 at 25° C. (77° F.). Soluble in 10 volumes of 90 percent. alcohol." *U. S.* "Specific gravity 0.865 to 0.890. The Oil is soluble, with slight turbidity, in 4 times its own volume of a mixture of equal parts of *absolute alcohol* and *alcohol* (90 per cent.)." *Br.* According to Flückiger (*Pharm. Chem.,* 2d ed., 1888, 402), it is composed essentially of two hydrocarbons, the more abundant of which, boiling at 160° C., has been shown by Wallach to be *pinene,* $C_{10}H_{16}$. Above 175° C. another oil is obtained, which seems to be *cadinene,* $C_{15}H_{24}$. It also contains a small amount of an ester to which the peculiar juniper-like odor and taste was supposed to be due, but this cannot be the case, as the odor persists after the complete

saponification of the small amount of ester. *Juniper camphor* is also present, its melting point is 165° C. to 166° C. Oil of turpentine is often fraudulently added, but may be detected by the specific gravity of the mixture being less than that of the unadulterated oil of juniper.

The oil is stimulant, carminative, and diuretic, and is very useful in combination with other remedies in debilitated *dropsical* cases. To it Holland gin owes its peculiar flavor and diuretic power.

Dose, five to fifteen minims (0.3 to 0.9 Cc.), which may be considerably increased.[1]

Off. Prep.—Spiritus Juniperi, *U. S., Br.;* Spiritus Juniperi Compositus, *U. S.*

OLEUM LAVANDULÆ. Br.

OIL OF LAVENDER

(ō'lę-ŭm lą-văn'dŭ-læ)

"The oil distilled from the flowers of Lavandula vera, *DC.*" *Br.*

Huile volatile de Lavande officinale, *Fr. Cod.;* Essence de Lavande, *Fr.;* Oleum Lavandulæ, *P. G.;* Lavandelöl, *G.;* Essenza di lavanda, *It.;* Esencia de espliego, *Sp.*

This oil is usually distilled from the flowers and flower stems conjointly, though of finer quality when obtained from the former exclusively. (See the next article, *Oleum Lavandulæ Florum.*) Dried lavender flowers are said to yield from 1 to 1.5 per cent. of oil. According to Zeller, the fresh flowers yield 1.03, the dried 4.3, the whole fresh herb in flower 0.76 per cent. It is stated that the lavender produced by an acre of ground under cultivation will yield from 10 to 12 pounds of the oil. (*P. J.,* 1864, p. 257.) The oil is very fluid, of a lemon-yellow color, with the fragrance of the flowers and an aromatic, burning taste. That met with in commerce has the sp. gr. 0.898 at 68° F., which is reduced to 0.877 by rectification (Berzelius), or 0.886 (Buignet). It is lævogyrate. According to Brande, the sp. gr. of the oil obtained from the whole herb is 0.9206. Alcohol of 0.830 dissolves oil of lavender in all proportions, that of 0.877 only 42 per cent. (Berzelius.) Proust states that when allowed to stand in imperfectly stoppered bottles it lets fall a crystalline deposit, which often amounts to one-fourth of its weight. This has been found by Dumas to have the same point of volatilization and the same composition as true camphor, but to differ in the total want of rotatory power. It is said that the portion of oil first distilled is most fragrant, and is often kept separate, and sold at a higher price. "Pale yellow or nearly colorless, with the fragrant odor of the flowers, and a pungent bitter taste. Specific gravity not below 0.885. It should dissolve in 3 times its volume of *alcohol* (70 per cent.)." *Br.* The principal constituent is an alcohol, $C_{10}H_{18}O$, identical with the *linalool* discovered by Semmler in linaloe oil. This alcohol boils at from 197° to 199° C., and has a sp. gr. of 0.869 at 20° C. Besides linalool, lavender oil contains *linalyl acetate* (from 30 to 45 per cent. in the oil from French flowers, and from 7 to 10 per cent. in the oil from English flowers), the *butyric ester* of the same alcohol, *geraniol,* a very small amount of *cineol,* and traces of a sesquiterpene.

Oil of Spike is procured from the broad leaved variety of lavender which grows wild in Europe, the *Lavandula Spica* of De Cavanilles. Its odor is less fragrant than that of common oil of lavender, and is somewhat analogous to that of oil of turpentine, with which it is said to be often adulterated. It is used by artists in the preparation of varnishes. The oil of spike contains about 30 per cent. of cineol and but small quantities of esters. Flückiger states (*A. J. P.,* 1885, p. 132) that from *Lavandula vera* 80,000 to 100,000 kilogrammes of oil are produced at Grasse every year, and from *Lavandula Spica* 20,000 to 25,000 kilogrammes. It is used chiefly as a perfume, though possessed of carminative and stimulant properties, and sometimes useful in cases of *nervous languor* and *headache.*

Dose, from one to five minims (0.06 to 0.3 Cc.).

Off. Prep.—Linimentum Camphoræ Ammoniatum, *Br.;* Spiritus Lavandulæ, *Br.;* Tinctura Lavandulæ Composita, *Br.*

OLEUM LAVANDULÆ FLORUM. U. S.

[OIL OF LAVENDER FLOWERS

(ō'lę-ŭm lą-văn'dŭ-læ flō'rŭm)

"A volatile oil distilled from the fresh flowering tops of *Lavandula officinalis* Chaix (Fam. *Labiatæ*). It should be kept in amber-colored, well-stoppered bottles, in a cool place, protected from light." *U. S.*

This superior kind of oil of lavender has been introduced into the Pharmacopœia because it was desirable that an inferior sort should not be used in the preparations into whose composition it enters. The properties of the oil are noticed in the preceding article. It is officially described as "a colorless or yellow liquid, having the fragrant odor of lavender flowers, and a pungent and slightly bitter taste. Specific gravity: 0.880 to 0.892 at 25° C. (77° F.). It is soluble in 3 parts of 70 percent. alcohol.

[1] *Antiseptic Catgut.*—Kocher of Berne, stated that a very fine antiseptic catgut may be made by first soaking the catgut for 24 hours in pure oil of juniper, and then immediately transferring it to alcohol of 95 per cent., in which it is preserved under tension, being wound (tightly stretched) upon a flat reel about 10 inches long. If the gut be placed for a day in glycerin before it is laid in the alcohol, it will become more pliable. The gut must be cut at the point of turning the edges of the reel, and for this reason the latter is chosen of such a size that the cut pieces of catgut shall be of the proper length. (*N. R.,* 1881, p. 270.) The catgut must be preserved in closed containers.

When the oil is shaken with water in a narrow graduated cylinder, its volume should not be diminished (absence of *alcohol*)." *U. S.*

Dose, one to six minims (0.06 to 0.4 Cc.).

Off. Prep.—Linimentum Saponis Mollis, *U. S.;* Spiritus Ammoniæ Aromaticus, *U. S.;* Spiritus Lavandulæ, *U. S.;* Tinctura Lavandulæ Composita, *U. S.;* Unguentum Diachylon, *U. S.*

OLEUM LIMONIS. U. S., Br.

OIL OF LEMON

(ō'lę-ŭm lį-mō'nĭs)

"A volatile oil obtained by expression from fresh Lemon Peel, yielding, when assayed by the process given below, not less than 4 percent. of aldehyde, calculated as citral. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil obtained from fresh Lemon Peel." *Br.*

Oleum Limonum; Huile volatile de Citron, *Fr. Cod.;* Essence de Citron, *Fr.;* Oleum Citri, *P. G.;* Citronenöl, *G.;* Olio de limone, *It.;* Esencia de limon, *Sp.*

The exterior rind of the lemon abounds in a volatile oil, which, being contained in distinct cells, may be separated by simple expression. The rind is first grated from the fruit, and then submitted to pressure in a bag of fine cloth. The oil thus obtained is allowed to stand till it becomes clear, when it is decanted, and kept in stoppered bottles. By a similar process, the oil called by the French *huile de cédrat* is procured from the citron. (See *Oleum Bergamottæ,* PART II, and *Limonis Succus.*) These oils may also be obtained by distillation, but thus procured, though clearer, and, in consequence of the absence of mucilage, less liable to change on keeping, they have less of the peculiar flavor of the fruit, and the mode by expression is generally preferred. A third method of separating the oil, used in Calabria and Sicily, is to put the grated rind into hot water and skim off the oil as it rises to the surface. (*A. J. P.,* 1868, p. 27.) The method employed to obtain the finest oil is, however, that known as the écuelle process. The écuelle is an instrument usually made of tinned copper, bowl-shaped, and armed with concentric rows of short spikes. Attached to the bottom of the bowl is a hollow handle, closed at the bottom. This acts as a reservoir for the oil as the fruit is rubbed by the workmen over the sharp teeth. The oils are brought from Italy, Portugal, or Southern France.

The oils of lemons and oranges, as well as those of the other Aurantiaceæ, will keep indefinitely upon admixture with a small proportion of alcohol (one ounce to a pound of the oil).[1] When wanted for use, a quantity of water equal to that of alcohol, added to the mixture, will unite with the alcohol, and subside, leaving the oil free of the alcohol for all practical purposes. (Carl Früh, *A. J. P.,* 1871, 201.) The great extent of the production and export of Sicilian and Calabrian essential oils (lemon, orange, bergamot, etc.) may be seen from the Italian official statistics, according to which the number of trees producing in 1896 was 17,084, 569, yielding 3,337,000,000 fruits. Of these 1,897,000,000 were exported, leaving 1,439,555, 000 fruits for home consumption inclusive of those used in the manufacture of essences. (*Schim. Rep.,* Oct. 1897, 23.)

Properties.—Oil of lemon is "a pale yellow, limpid liquid, having the fragrant odor of lemon, and an aromatic, somewhat bitter taste." *U. S.* As commonly procured, it is yellow, but by distillation it is rendered colorless, and, if three-fifths only are distilled, its sp. gr. is reduced to 0.847 at 71° F. "Specific gravity: 0.851 to 0.855 at 25° C. (77° F.). It is dextrogyrate; its optical rotation should not be less than +60° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). The angle of rotation of the first 10 percent. of oil obtained by fractional distillation should not differ more than 2° from that of the original Oil." *U. S.* "Specific gravity 0.857 to 0.860. It should rotate the plane of a ray of polarized light not less than 59° to the right in a tube 100 millimetres long; and if 100 volumes be fractionally distilled, the 10 volumes first collected should not produce a rotation differing by more than 2° from that produced by the original Oil." *Br.*

Assay for Citral. U. S. (8th Rev.).—"Introduce into a counterpoised 150 Cc. flask, by means of a pipette, about 15 Cc. of Oil of Lemon, and note the exact weight; add 5 Cc. of distilled water and a few drops of phenolphthalein T.S., and then neutralize the liquid exactly by the cautious addition of tenth-normal sodium hydroxide V.S. Add 25 Cc. of a neutral solution of sodium sulphite (1 in 5), and immerse the flask in a water-bath containing boiling water. From a burette add, as needed, just sufficient half-normal hydrochloric acid V.S. to maintain the neutrality of the mixture, keeping the flask continuously heated and frequently agitated, and adding a drop or two of phenolphthalein T.S. When a permanent condition of neutrality is reached, note the number of cubic centimeters of the half-normal hydrochloric acid V.S. consumed. Carry out a blank test, identical with the foregoing, except that the Oil of Lemon is omitted, and note the amount of half-normal hydrochloric acid V.S. consumed. Subtract the number of cubic centimeters re-

[1] *Spiritus Limonis.* U. S. 1890, *Spirit of Lemon.* [*Essence of Lemon.*]—"Oil of Lemon, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Lemon Peel, freshly grated, *fifty grammes* [or 1 ounce av., 334 grains]; Deodorized Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 390 minims]. Dissolve the Oil of Lemon in *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Deodorized Alcohol, add the Lemon Peel, and macerate for twenty-four hours. Then filter through paper, and add, through the filter, enough Deodorized Alcohol to make the Spirit measure *one thousand cubic centimeters* [or 33 fluidounces, 390 minims]." *U. S.* 1890.

This spirit is used chiefly for flavoring mixtures.

quired in the blank test from the number required in the original test; each Cc. of this difference corresponds to 0.03802 Gm. of citral. To find the percentage, multiply the above difference by 0.03802, and this product by 100, and divide by the weight of the Oil of Lemon taken." *U. S.*

Oil of lemon contains a small amount of *pinene,* with dextrogyrate *limonene,* about 7 to 8 per cent. of *citral,* $C_{10}H_{16}O$, an aldehyde yielding geraniol upon reduction, and a small amount of *citronellal,* $C_{10}H_{18}O$, also an aldehyde. Of these the citral is the constituent to which the oil chiefly owes its aroma and value. Umney and Swinton (*P. J.,* 1898, 196) state that citral, citronellal, and an ester of geraniol are all necessary to form the true odor of oil of lemon. Citral boils under normal atmospheric pressure at from 228° to 229° C. without decomposition if pure, and, like aldehydes, forms stable compounds with alkaline bisulphites. Schimmel & Co. now prepare the citral in a pure state, and recommend its use for enriching the ordinary oil of lemon.

Oil of lemon is often adulterated by the fixed oils and by alcohol, but in this country one of the most frequent sophistications is with purified oil of turpentine, which is difficult of detection from its similar composition and specific gravity. One of the tests for the presence of this oil is the terebinthinate odor produced when the adulterated oil is evaporated from heated paper; the official quantitative test defining the percentage of citral will be of service in detecting these adulterations. The most dangerous adulteration of oil of lemon is the use of *citrene,* the terpene left after the extraction of citral from oil of lemon which has been used in making terpeneless oil. Oil of lemon procured by expression is apt to let fall a deposit and to undergo chemical change. J. S. Cobb has found no method so effectual to obviate this result, and at the same time to retain unimpaired the flavor of the oil, as to shake it with a little boiling water and allow the mixture to stand. A mucilaginous matter separates, and floats on the surface of the water, from which the purified oil may be decanted. (*Ann. Pharm.,* ii. 86.)

Uses.—Oil of lemon has the stimulant properties of the aromatics, but is used chiefly to impart flavor to other medicines.

Dose, three to six minims (0.2 to 0.4 Cc.).

Off. Prep.—Linimentum Potassii Iodidi cum Sapone, *Br.;* Spiritus Ammoniæ Aromaticus, *U. S., Br.;* Spiritus Aurantii Compositus, *U. S.;* Tinctura Guaiaci Ammoniata, *Br.;* Tinctura Valerianæ Ammoniata, *Br.*

OLEUM LINI. U. S., Br.

LINSEED OIL [Oil of Flaxseed]

(ō'lę-ŭm lī'nī)

"A fixed oil expressed from Linseed. It should be kept in well-stoppered containers. Linseed Oil which has been 'boiled' should not be used nor dispensed." *U. S.* "The oil expressed from Linseed at ordinary temperatures." *Br.*

Huile de Semence de Lin, *Fr.;* Oleum Lini, *P. G.;* Leinöl, Leinsamenöl, *G.;* Olio di lino, *It.;* Aceite de linaza, *Sp.*

This oil is obtained by expression from the seeds of *Linum usitatissimum,* or common flax, which, according to Berjot, contain 34 per cent. (*J. P. C.,* Avril, 1863, p. 277.) In its preparation on a large scale, the seeds are usually roasted before being pressed, in order to destroy the gummy matter contained in their coating. The oil is thus obtained more free from mucilage, but more highly colored and acrid, than when procured by cold expression. For medicinal use, therefore, it should be prepared without heat, and, as it is apt to become rancid quickly on exposure, it should be used as soon after expression as possible. It may, however, be rendered sweet again by agitation with warm water, rest, and decantation. It is said to be obtained purer and in larger proportion by treating the crushed seeds with carbon disulphide, than by expression. (*A. J. P.,* xxvi. 265.)

Oil of flaxseed is "a yellowish,[1] oily liquid, having a peculiar odor and a bland taste. When exposed to the air, it gradually thickens, darkens in color, and acquires a strong odor and taste; if spread in a thin layer on a glass plate and allowed to stand in a warm place, it is gradually converted into a hard, transparent resin (absence of *non-drying oils*). Specific gravity: 0.925 to 0.935 at 25° C. (77° F.). It does not congeal at temperatures above —20° C. (—4° F.). It is soluble in about 10 parts of absolute alcohol, and in all proportions in ether, chloroform, petroleum benzin, carbon disulphide, and oil of turpentine. It should not more than slightly redden blue litmus paper previously moistened with alcohol (limit of *free acid*). The Oil should be completely saponifiable with alcoholic potassium hydroxide T.S., and the resulting soap should be completely soluble in water without leaving an oily residue (absence of *mineral oils* and *rosin oil*). If 2 Cc. of the Oil be warmed and shaken in a test-tube with an equal volume of glacial acetic acid, and if to this mixture, after cooling, 1 drop of sulphuric acid be added, a greenish color should be produced (a violet color under these circumstances indicates the presence of *rosin* or *rosin oils*). Linseed Oil saponified by alcoholic potassium hydroxide T.S. should show a saponi-

[1] The following method of bleaching flaxseed, rapeseed, and poppyseed oils was recommended by C. Puscher. He mixed 100 kilogrammes of the oil with 2 kilogrammes of a mixture of equal weights of sulphuric acid and alcohol of 96 per cent. The sulphuric acid mixes uniformly with the oil; the mixture soon assumes a green turbidness, which afterwards becomes black, and in 24 or 48 hours the liquid becomes clear by the deposition of a black sediment. It is necessary to wash the oil with hot water, to separate the little remaining acid. Linseed oil in bulk shows merely a yellowish tint; the other oils mentioned become quite colorless. (*A. J. P.,* 1873, p. 110.)

fication value of from 187 to 195 (see PART III, Test No. 99). If 0.15 Gm. of Linseed Oil be dissolved in 10 Cc. of chloroform in a 250 Cc. flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for sixteen hours protected from the light, 20 Cc. of potassium iodide T.S. be introduced and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 170 should be obtained (see PART III, Test No. 51)." *U. S.* "Viscid, yellow, with a faint but distinct odor, and bland taste. Specific gravity 0.930 to 0.940. It is soluble in 10 parts of *alcohol* (90 per cent.), and in Oil of Turpentine. It gradually thickens by exposure to the air, forming, when spread in a thin layer on glass, a hard transparent varnish. It does not congeal above —4° F. (—20° C.)." *Br.* It has the property of drying or becoming solid on exposure to the air, acquiring during the process a strong odor and taste, and increasing as much as 12 per cent. of its weight, owing to the formation of *linoxyn* by atmospheric oxidation. The drying property resides in a constituent which, to distinguish it from the olein of the non-drying oils, is named *linolein,* and is the glyceride of *linoleic acid.* Linseed oil contains about 10 to 15 per cent. of glycerides of solid fatty acids and 85 to 90 per cent. of liquid glycerides. Hazura (*J. Soc. Chem. Ind.,* 1888, 506) states that the liquid fatty acids consist of about 5 per cent. of *oleic acid,* $C_{18}H_{34}O_2$, 15 per cent. of *linoleic acid,* $C_{18}H_{32}O_2$, 65 per cent. of *isolinolenic acid,* $C_{18}H_{30}O_2$, and 15 per cent. of *linolenic acid,* $C_{18}H_{30}O_2$. Boiled with litharge, red lead, manganese dioxide, and other so-called "driers," it absorbs oxygen still more rapidly, and gains 14 per cent. in weight. Its acrimony is owing to the presence of a small proportion of an acrid oleoresin. From its drying property, it is useful in painting and in making printers' ink. The chief adulteration of linseed oil is with mineral oils and rosin oil. For their detection see official tests already given.

It is said that crude cod liver oil has been used for the adulteration of the oil of flaxseed, especially where the latter is intended for preparing printers' ink. Aug. Morell detects the adulteration by the following method. Take 10 parts by weight of the suspected oil, mix it in a small cylindrical glass tube with 3 parts of crude nitric acid, agitate the mixture well, and allow it to rest. If cod liver oil be present, the oily layer at top will assume a dark-brown to blackish-brown color, while the acid at bottom will vary from bright orange to orange or dark yellow. So little as 3 per cent. of cod liver oil may thus be detected. If the flaxseed oil be pure, it will become, during the agitation, first sea green, and afterwards dirty greenish yellow, the acid being bright yellow.

Uses.—The oil is laxative in the dose of a fluidounce (30 Cc.), but, on account of its disagreeable taste, is seldom given internally. It has, however, been highly recommended as a cure for *piles,* in the dose of two fluidounces (60 Cc.) of the fresh oil morning and evening. It is sometimes added to purgative enemata.[1]

Dose, one to two fluidounces (30 to 60 Cc.).

Off. Prep.—Ceratum Resinæ Compositum, *U. S.;* Linimentum Calcis, *U. S.;* Liquor Cresolis Compositus, *U. S.;* Sapo Mollis, *U. S.*

OLEUM MENTHÆ PIPERITÆ. U. S., Br.

OIL OF PEPPERMINT

(ō'lę-ŭm mĕn'thæ pĭp-ę-rī'tæ)

"A volatile oil distilled from the fresh or partly dried leaves and flowering tops of Peppermint, rectified by steam distillation, and yielding, when assayed by the process given below, not less than 8 percent. of ester, calculated as menthyl acetate, and not less than 50 percent. of total menthol (free and as ester). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from fresh flowering peppermint, Mentha piperita, *Sm.*" *Br.*

Huile volatile de Menthe poivrée. *Fr. Cod.;* **Essence de Menthe poivrée.** *Fr.;* **Oleum Menthæ piperitæ,** *P. G.;* **Pfefferminzöl.** *G.;* **Essenzia di menta,** *It.;* **Esencia de menta piperita,** *Sp.*

Peppermint varies exceedingly in the quantity of oil which it affords. Four pounds of the fresh herb yield, according to Baumé, from a drachm and a half to three drachms of the oil. Zeller gives as the product of the fresh herb, from 0.37 to 0.68 per cent., of the dried 1.14 per cent. The yield is generally less than 1 per cent. This oil is largely distilled in the States of Michigan, Indiana, and New York. For a valuable account of its method of production in Michigan, by A. M. Todd, see *A. J. P.,* 1888, 328. The oil is also largely produced in Japan. (See illustrated paper, *C. D.,* 1896, 601.) Gildemeister and Hoffmann (*Aetherische Oele,* p. 836) estimate the world's production of peppermint oil at 175,000 kilos, of which the United States furnishes 90,000 kilos, and Japan 70,000 kilos. It is offi-

[1] *Oiled Paper.*—A substitute for waxed cloth for the dressing of wounds and ulcers, prepared in the following manner by Gauthier of Geneva, with flaxseed oil, has been highly recommended. To facilitate its drying, 3 liters (about 6.4 pints) of the oil are boiled for an hour or two with 30 grains of lead acetate, 30 grains of litharge, 15 grains of yellow wax, and 15 grains of turpentine. Thus prepared, the oil is spread upon silk-paper by means of a brush on both surfaces. On the top of the first sheet another is then placed so as to overlap it at one corner. The lower surface of the second sheet thus becomes impregnated with the oil, which now requires to be applied only to the upper. Any desired number of sheets may be thus successively superimposed. They are then separated, and suspended in a drying apartment, attached to a cord by means of hooks or pins. When dry, they should be sprinkled with powdered talc, to prevent adhesion, and packed away. (*J. P. C.,* Mai, 1860, p. 363.)

cially described as "a colorless liquid, having the characteristic, strong odor of peppermint, and a strongly aromatic pungent taste, followed by a sensation of cold when air is drawn into the mouth. Specific gravity: 0.894 to 0.914 at 25° C. (77° F.). It forms a clear solution, neutral to litmus paper, with an equal volume of alcohol; also soluble in 4 volumes of 70 percent. alcohol, the solution showing not more than a slight opalescence. It is lævogyrate, the angle of rotation varying from —25° to —33° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). If from 25 Cc. of Oil about 1 Cc. be distilled and the distillate poured on an aqueous solution of mercuric chloride, a white film should not form at the zone of contact after a short time (absence of *dimethyl sulphide* found in non-rectified oils)." *U. S.* "Specific gravity 0.900 to 0.920. It should dissolve in four times its volume of *alcohol* (70 per cent.). If a portion of the Oil be cooled to 17° F. (—8.3° C.) and a few crystals of Menthol be added, a considerable separation of menthol should take place." *Br.*

Assay.—"Introduce into a tared flask 10 Cc. of Oil of Peppermint, and note the exact weight; add 25 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 25 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 9.834, and divide the product by the weight of the Oil of Peppermint taken to find the percentage of menthyl acetate. Wash the residual oil repeatedly with water, transfer it to a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 1 Gm. of anhydrous sodium acetate, and boil gently during one hour. Allow it to cool, wash the acetylized oil with distilled water, and afterwards with sodium hydroxide T.S., until the mixture is slightly alkaline to phenolphthalein T.S., and then dry it with the aid of fused calcium chloride, and filter.

Transfer to a tared 100 Cc. flask 5 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 50 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 7.749, and divide the product by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of menthol in the Oil of Peppermint.

NOTE.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide V.S. consumed by the acetylized oil." *U. S.*

Upon cooling or long standing it deposits a stearopten. Berzelius stated that at —8° F. the oil deposits small capillary crystals. These, which are called *peppermint camphor* or *menthol*, $C_{10}H_{19}OH$, melt at 42° C. (107.6° F.), boil at 212° C. (413.6° F.), volatilize unchanged, and, when distilled with phosphoric anhydride, yield a peculiar aromatic product, denominated *menthene*, $C_{10}H_{18}$. A complete summary of the composition of American peppermint oil, on the authority of Power and Kleber, given in *Schimmel & Co.'s Report* for April, 1897, shows the following constituents: acetaldehyde, isovaleraldehyde, dimethyl sulphide, amyl alcohol, isovaleric acid, pinene, phellandrene, cineol, limonene, *menthone*, $C_{10}H_{18}O$, menthol, the acetate and isovalerate of menthyl, *a-lactone*, $C_{10}H_{16}O_2$, and cadinene. Menthol, its oxidation product menthone, and the acetic and isovaleric esters of menthyl have been identified as present in English and French peppermint oils, which probably also contain most of the other constituents mentioned above. Menthol and its esters are regarded as the main constituents of oil of peppermint and an official assay for determining the percentage of menthol will be found above. The polariscope has been shown to be an uncertain guide in determining the quality of oil of peppermint. (A. B. Stevens, *Proc. A. Ph. A.*, 1888, p. 97.)

Flückiger discovered that from 50 to 70 drops of peppermint oil, shaken with one drop of nitric acid, sp. gr. 1.2, turn faintly yellowish brown, and after an hour or two a most beautiful blue violet or greenish blue by transmitted light, or copper color by reflected light. Either a greater amount of acid or heating hastens the reaction. The color is very persistent. The presence of 5 per cent. of turpentine does not interfere with the reaction. (*P. J.*, Feb. 1871.) This oil is frequently adulterated with alcohol, and occasionally, there is reason to believe, with oil of turpentine, and even oil of copaiba. Oil of turpentine is detected by its odor, by its difficult solubility in cold alcohol, and by its imparting the property of exploding with iodine. According to H. Martin, the copaiba is to be detected by the mass acquiring the consistence of butter when heated to boiling with concentrated sulphuric acid. (*N. R. Pharm.*, xvii. 635.) It is stated by Hotchkiss that in much of the land under culture with peppermint in this country other oil producing plants are carelessly allowed to grow, which, being gathered and distilled with the peppermint, contaminate the product. (*A. J. P.*, xxvii. 222.) The plant which has proved most troublesome to the mint growers is of the Erigeron family, and Vigier and Cloez have given the following tests to detect oil of erigeron, which will indicate the presence of eight or ten per cent. of it. Concentrated po-

tassium hydroxide does not saponify erigeron oil, but colors it orange-red in the cold; on heating, the color deepens until part of the oil separates as a reddish-purple viscid mass. This reaction does not show itself with oil freshly distilled at 170° C. Pure mint oils do not give this reaction; in the cold, potassium hydroxide converts them into a white emulsion; on heating, the mixture acquires a faint, clear, yellow tinge; but, if a few drops of erigeron oil are introduced, the orange-red color appears quickly on shaking, and develops instantly if the tube is warmed. Mint oil is completely soluble, erigeron oil is completely insoluble, in its own volume of 85 per cent. alcohol at 15° C. (59° F.). If a suspected sample be agitated with an equal volume of 85 per cent. alcohol, a milky fluid will be produced if erigeron oil be present, and the insoluble essence will separate in the course of twenty-four hours. The oils of Eucalyptus Globulus and turpentine behave in much the same way, and the points which would distinguish the three substances have not yet been determined. But a specimen of mint oil which rotates the polarized ray feebly to the left, makes a turbid mixture with its own volume of 85 per cent. alcohol, and takes an orange-red tint with potassium hydroxide, may be safely rejected. (*N. R.*, Jan. 1882; from *L'Union Pharmaceutique.*) Since menthol has been prepared largely from American peppermint oil, much of the latter has been put upon the market deprived of its menthol. To detect this fraud, Fritzsche Brothers recommend that a test tube partially filled with the oil and corked should be placed in a freezing mixture of ice and salt for ten or fifteen minutes. At the end of that time, if the oil has not been tampered with, it will have become cloudy, thick, or of a jelly-like consistence. If then four or five small crystals of menthol be added, and the tube be replaced in the freezing mixture, the oil will in a very short time form a solid mass of crystals. For another method of testing dementholized oil, see a paper by E. C. Federer, *Ph. Era*, 1887, 36; also 1887, 97.

Power and Kleber first proposed (*Ph. Rund.*, 1894, 157) to estimate the menthol in oil of peppermint by acetylizing a sample and saponifying an exactly weighed portion of the acetylized oil after washing, drying, and filtering the same. Kebler (*A. J. P.*, 1897, 192) proposed to take instead a weighed quantity of the oil, acetylize it, and then saponify the product after washing and neutralizing it. In *Schimmel & Co's Report* for October, 1897, Kleber criticises Kebler's modification, and claims greater accuracy for the original method. Of course this determination gives the total menthol; a determination of the combined menthol is had by titrating with alcoholic alkali. Quetting & Co. furnish the following test for detecting the presence of oil of pennyroyal: "Take one drachm hydrated chloral and half a drachm C. P. sulphuric acid; mix them in a glass mortar, add a few drops of alcohol, and stir until it becomes clear. Then use this mixture in equal proportions with the suspected oil in a small porcelain dish, and mix thoroughly together. The result will be a fine cherry-red color, if the oil be pure; otherwise, if mixed with pennyroyal, it will turn a dark olive-green, more or less according to the extent of adulteration." (*N. R.*, Jan. 1882.) Such impurities may usually be detected by the altered odor of the oil. Flückiger has found that hydrated chloral develops only a slightly brown or yellow color, while anhydrous chloral changed some specimens of the oil to brown and others to green. He also found great differences in the action of sodium bisulphite, the coloring varying from green to rose-red or violet. (*A. J. P.*, 1874, 274.) According to Trebault, when picric acid is added in the cold no change occurs for half an hour, when a green color suddenly develops. The green produced has a showy red fluorescence. Sulphuric acid develops a rose color, passing through reddish yellow to reddish brown; hydrochloric acid a rose color, rather slowly; nitric acid a rose color, then red, becoming greenish. (For further particulars, see *P. J.*, June, 1874, p. 977.) C. Roucher states that when to acetic acid is added one-twentieth of its weight of oil of peppermint, with agitation, in an hour the liquid becomes deep blue by transmitted and a cinnabar-red by reflected light. The coloration is not stable, but passes through green to yellow in the light. To detect alcohol, Hager puts ten to fifteen drops of the oil in a test tube with a piece of tannic acid the size of a pea; if even one-half per cent. of alcohol be present, after two or three hours the tannin will be softened or dissolved. (*A. J. P.*, xliv. 104.)

Chinese Oil of Peppermint has not found its way to any extent into commerce, yet it has at times attracted much attention. According to John Mackey, some of it has reached London in cylindrical tin canisters, and it is to be obtained in San Francisco. Some specimens resemble the ordinary oil, but become solid in cold weather; others remain liquid and show no tendency to deposit a camphor, while others are solid crystalline masses at all temperatures. It seems probable that the original Chinese oil contains a great excess of menthol, and constitutes the variety first spoken of, and that the solid and liquid oils are prepared by separating it into its two constituents. The solid oil Flückiger states not to differ from American menthol. (See *P. J.*, v. 366, 825.)

Oil of peppermint is stimulating and carminative, and is much used in *flatulence, nausea, spasmodic pains* of the stomach and bowels, and as a corrigent or adjuvant of other medicines. In *neuralgia* it is one of the best external remedies at our command, and is said to have been used in China from time immemorial. A cloth wet with it is to be laid upon the affected part, evaporation being restrained by oiled muslin or other covering. In *rheumatism* also it is a very useful anodyne counter-

irritant. It is most conveniently given rubbed with sugar and then dissolved in water. The oil is frequently employed dissolved in alcohol, in the form of *essence of peppermint;* the official spirit of peppermint should alone be used. (See *Spiritus Menthæ Piperitæ.*)

Dose, two to ten minims (0.12 to 0.6 Cc.).

Off. Prep.—Aqua Menthæ Piperitæ, *U. S., Br.;* Cataplasma Kaolini, *U. S.;* Liquor Antisepticus, *U. S.;* Pilulæ Catharticæ Vegetabiles, *U. S.;* Pilulæ Rhei Compositæ, *U. S.* (*Br.*); Spiritus Menthæ Piperitæ, *U. S., Br.;* Tinctura Chloroformi et Morphinæ Composita, *Br.*

OLEUM MENTHÆ VIRIDIS. U. S., Br.

OIL OF SPEARMINT

(ō'lę-ŭm mĕn'thæ vīr'ĭ-dĭs)

"A volatile oil distilled from the fresh or partly dried leaves and flowering tops of Spearmint, rectified by steam distillation. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from fresh flowering spearmint, Mentha viridis, *Linn.*" *Br.*

Huile volatile (Essence) de Menthe verte. *Fr.;* Römischminzöl, Krauseminzöl, *G.*

According to Lewis, ten pounds of spearmint yield an ounce of oil; by others the product is stated not to exceed one part from five hundred. The oil is largely distilled in this country, the whole plant being used. It is pale yellow or greenish when recently prepared, but becomes red with age, and ultimately almost of a mahogany color. Its flavor is analogous to that of oil of peppermint, but less pungent. It is officially described as "a colorless, yellow, or greenish-yellow liquid, having the characteristic, strong odor of spearmint, and a hot aromatic taste. Specific gravity: 0.914 to 0.934 at 25° C. (77° F.). With an equal volume of 80 percent. alcohol it forms a clear solution, which upon further dilution becomes turbid. It is lævogyrate, the angle of rotation varying from —35° to —48° in a 100 Mm. tube, at a temperature of 25° C. (77° F.)." *U. S.* "Specific gravity 0.920 to 0.940. The Oil forms a clear solution with its own volume of a mixture of equal parts of *absolute alcohol* and *alcohol* (90 per cent.)." *Br.* Gladstone (*Jahresb.,* 1863, 548) states that it contains a terpene, $C_{10}H_{16}$, and a compound, $C_{10}H_{14}O$, identical with carvone, which boils at 225° C. (437° F.) and has the sp. gr. 0.9515. Henry Trimble (*A. J. P.,* 1885, 484) confirmed these results, working with authentic samples of American oil. Baeyer found lævogyrate carvone in both German and American oils to the amount of from 35 to 56 per cent. (*A. Pharm.,* 212, 283.) Schimmel & Co., in an investigation of Russian oil, found from 5 to 10 per cent. of carvone only, but 50 to 60 per cent. of linalool, together with some cineol and lævogyrate limonene. (*Schim. Rep.,* April, 1898.) It is used for the same purposes as the oil of peppermint.

Dose, two to six minims (0.12 to 0.4 Cc.). An *essence of spearmint,* prepared by dissolving the oil in alcohol, is sold in commerce, but the official spirit should be exclusively used. (See *Spiritus Menthæ Viridis.*)

Off. Prep.—Aqua Menthæ Viridis, *U. S., Br.;* Spiritus Menthæ Viridis, *U. S.*

OLEUM MORRHUÆ. U. S., Br.

COD LIVER OIL [Oleum Jecoris Aselli]

(ō'lę-ŭm mŏr'rhŭ-æ)

"A fixed oil obtained from the fresh livers of *Gadus morrhua* Linné, and of other species of *Gadus.* It should be kept in a cool place, in well-stoppered bottles, which have been thoroughly dried before filling." *U. S.* "The oil extracted from the fresh liver of the cod, Gadus Morrhua, *Linn.,* by the application of a temperature not exceeding 180° F. (82.2° C.); and from which solid fat has been separated by filtration at about 23° F. (—5° C.)." *Br.*

Oleum Hepatis Morrhuæ; Cod Oil; Huile de Foie de Morue. *Fr. Cod.;* Huile de Morue. *Fr.;* Oleum Jecoris Aselli. *P. G.;* Leberthran, Stockfischleberthran, Dorschleberthran, Kabliauleberthran. *G.;* Olio di fegato di merluzzo. *It.;* Aceite de higado de bacalao. *Sp.*

Gadus morrhua, Linn., *Syst. Nat.,* ed. Gmelin, i. p. 1162; Cuvier, *Règne Animal,* ii. 212, Bloch, *Ichthyologie,* pl. lxiv.—*Morrhua vulgaris,* Storer, *Synopsis of Fishes of N. Am.,* p. 216.—The *common cod* is between two and three feet long, with brown or yellowish spots on the back. The body is moderately elongated and somewhat compressed, and covered with soft rather small scales, of which the head is destitute. Of the fins, which are soft, there are three on the back, two anal, and a distinct caudal, and the fin under the throat is narrow and pointed. The jaws are furnished with pointed irregular teeth, in several ranks. The gills are large, with seven rays. This species of cod inhabits the Northern Atlantic, and is especially abundant on the Banks of Newfoundland, where it finds food adapted to its wants.

Besides the common cod, several other species of Gadus, frequenting the seas of Northern Europe and America, contribute to furnish the cod liver oil of commerce. Among these De Jongh mentions *Gadus callarias,* or *dorsch* (*Morrhua americana* of Storer), *G. molva,* or *ling, G. carbonarius,* or *coal fish,* and *G. pollachius,* or *pollack,* as affording the oil on the coast of Norway, where from 17,000,000 to 35,000,000 of codfish are annually taken,[1]

[1] For an account of the mode of fishing for cod and of preparing the oil practised in Norway and Denmark, see *P. J.,* Jan. 1868, p. 312, also April, 1877, p. 810; *N. R.,* March, 1878; *J. P. C.,* 4e sér., iv. 324, 1866; *Ph. Ztg.,* 1900, 261; *Ph. Era,* 1904, 111; *C. D.,* 1904, 21.

while on our own coast, in addition to the pollack above mentioned, it is obtained also from the *hake* (*G. merluccius*) and the *haddock* (*G. æglefinus*). It is largely produced on our coast north of Boston.[1]

Preparation.—Fishermen have long been in the habit of collecting this oil, which is largely consumed in the arts, particularly in the preparation of leather. Upon the coasts of Newfoundland, Nova Scotia, and New England, the boats which fish near the shore, being small, soon obtain a load, and, running in to land, deliver their cargoes to persons whose business it is to cleanse and salt the fish. The oil is prepared either in the huts of the fishermen or more largely at establishments to which the livers are conveyed in quantities. These are put into a boiler with water, and heated until they are broken up into a pultaceous mass, which is thrown upon a strainer covering the top of a cask or tub. The liquid portion passes, and upon standing separates into two parts, the oil rising to the surface of the water. The oil is then drawn off, and, having been again strained, is prepared for the market. Another and improved method, which has come into use since the extensive employment of the oil as a medicine, is to heat the livers in a wooden butt by means of low pressure steam. The pultaceous mass resulting is drained as before mentioned,—the livers themselves containing, besides oil, a considerable portion of aqueous fluid, which passes off with it in the form of emulsion and separates on standing. In the case of the finest American varieties, the oil, which is made only in the winter months, is drawn off by taps from the bottom of the cooking butt, and then put into a cooling house to freeze. The solid frozen mass is put into canvas bags, and submitted, while at a low temperature, to severe pressure, whereby the pure liquid oil is forced out, leaving a whitish, tallow-like mass, composed of stearin and liver débris. This residue is sold to the soap makers, and the oil bottled without further process. The oil thus variously procured is called *shore oil*, and is the purest kind. The manufacture of refined oil by improved processes is developing rapidly in Newfoundland. (See *West. Drug.*, 1897, 13.)

The crews of the larger boats, which fish upon banks far from land, cleanse the fish on board, and, throwing the offal into the sea, put the livers into barrels or other receptacles, where they undergo a gradual decomposition, the oil rising to the surface as it escapes from the disintegrating tissue. The oil which first rises, before putrefaction has very decidedly commenced, approaches in purity to the shore oil, but is somewhat darker and less sweet. This is sometimes drawn off, constituting the *straits oil* of the fishermen. The remaining mass, or the whole, if the portion which first rises is not separated, continues exposed for a variable length of time to the heat of the sun, undergoing putrefaction, until the boat, having completed her cargo, returns to port. The contents of the casks are then put into boilers, heated with water, and treated as already described. Before being finally put into barrels, the oil is heated to expel all its water. Thus prepared, it is denominated *banks oil*, and is of the darkest color, and most offensive to the taste and smell. Much of the oil prepared by the fishermen is collected by the wholesale dealers, who keep it in very large reservoirs of masonry in their cellars, where it becomes clarified by repose, and is pumped into barrels as wanted for sale. By the further exposure, however, which it thus undergoes, it acquires a still more offensive odor, while that which has been originally introduced into barrels, and thus kept secluded from the air, is better preserved. For further details, see *A. J. P.*, xxiii. 97, xxvi. 1. Large quantities of Norwegian cod liver oil are sold in the United States; the method of extraction depending on the action of steam does not differ greatly from that used in America. Another oil is made by the cold process and B. Rauitz, *Ph. Ztg.*, 1900, 261, furnishes the following account: The fresh livers, separated from the gall-bladder, are placed in a wooden tub, 5 ft. in height by 7 ft. in diameter, until the tub is nearly full, which is then left exposed to the action of the sun, shining day and night in these high latitudes. After about three weeks the extraction is completed, and, owing to the favorable atmospheric conditions and the evident absence of germs in this far polar region, not the slightest evidence of decomposition manifests itself during this process. The oil runs off pure and simply has the odor characteristic of cod liver oil, and while the "steam cod liver oil" requires refining, that obtained by the "cold process" described is ready for the market as run off from the tubs. This explains why in more southerly latitudes it is impossible to prepare a satisfactory cod liver oil; the cold process is not available, while the steam process does not yield a desirable oil.

The oil is sometimes procured by expression. Donovan recommends the following plan, which affords a very fine oil. The livers, perfectly sound and fresh, are to be placed in a clean iron pot over a slow fire, and stirred until they assume the condition of a pulp, care being taken that the mass be not heated beyond 192° F. When this temperature is attained, the pot is to be removed from the fire, and its contents

[1] *Dugong Oil.*—An oil has been brought into notice, as a substitute for cod liver oil, obtained from two species of *Halicore, H. australis*, Owen, and *H. dugong*, Illig, cetaceous animals inhabiting the rivers and bays of Northern and Eastern Australia and many of the East India islands. The flesh of these animals is said to be delicate and palatable and valued for food. The oil is obtained by boiling the superficial fat. It is bland and sweet, and free from disagreeable taste and odor, so that it may be taken more freely than cod liver oil, which it is thought to equal in virtues. It was introduced into use by W. Hobbs, a surgeon of Brisbane. (*Chem. News*, Jan. 28, 1860, p. 87, and *A. J. P.*, 1858, p. 335, 1860, p. 230.)

introduced into a canvas bag, through which water and oil will flow into a vessel beneath. After twenty-four hours, the oil is to be decanted and filtered through paper. In this state it is pale yellow, with little odor, and a bland not disagreeable taste.

Properties.—Three varieties of cod liver oil are known in the market, the *white* or *pale yellow,* the *brownish yellow,* and the *dark brown,* corresponding to the three commercial varieties already mentioned. These varieties differ in no essential character, but simply from the mode of preparation, the pale being prepared from fresh sweet livers, the dark brown from livers in a state of putrefaction, and the brownish yellow from those in an intermediate state, and the three varieties run together by insensible shades. The color of the pale is from the slightest tint of transparent yellow to a fine golden yellow, that of the light brown very similar to the color of Malaga wine, and that of dark brown what its name implies, with opacity in mass, but transparency in thin layers. They are of the usual consistence of lamp oil, and have a characteristic odor and taste, by which they may be distinguished from other oils. This odor and taste are familiar to most persons, being very similar to those of shoe leather,—at least as prepared in this country, where the curriers make great use of cod liver oil. We regard these sensible properties as the most certain tests of the genuineness of the oil. They are much less distinguishable in the pale than in the dark brown varieties, but we have met with no specimen which did not possess them in some degree. In the purest they are scarcely repulsive, in the dark brown they are very much so. When a decided odor of ordinary fish oil is perceived, the genuineness may always be suspected. It is quite distinct from that peculiar to the cod liver oil. The taste of all, except the very finest varieties, is more or less acrid, and in the most impure is bitterish, and somewhat empyreumatic. The pale yellow oil is now exclusively used for medicinal purposes. The sp. gr. at 72° F., as ascertained by Procter, varied from 0.915 to 0.9195,— the first being that of the *hake* oil, the second that of the *haddock,* while the sp. gr. of the purest oil from the common cod was 0.917. De Jongh found the sp. gr. at 63° F. of the pale 0.923, of the light brown 0.924, of the dark brown 0.929. The oil from the cod does not congeal at 14° F., though that of *G. carbonarius* and that of the livers of different species of Raja let fall at that temperature a solid fatty matter, supposed to be palmitin. Alcohol dissolves from 2.5 to 6 per cent., water from 0.637 to 1.28 per cent., of different varieties, the pale yielding least to these solvents. (*J. P. C.,* Jan. 1854, p. 39.) The official description is as follows: "A pale yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor, and a bland fishy taste. Specific gravity: 0.918 to 0.922 at 25° C. (77° F.). Very slightly soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide; also in 2.5 parts of acetic ether." *U. S.* "Specific gravity 0.920 to 0.930. Readily soluble in *ether* and *chloroform,* and slightly soluble in *alcohol* (90 per cent.)." *Br.*

The chemical composition of the glycerides in cod liver oil appears to be very complicated. As palmitic and stearic acids have been isolated, the occurrence of palmitin and stearin is certain. But the so-called "stearin" separating from cod liver oil on cooling contains but little true stearin, as the cod liver stearin has a very high iodine value (113.4, Heyerdahl; 94, Lewkowitsch). The glycerides of the lower fatty acids, such as acetic, butyric, valeric, and capric acids, stated by various authors to occur in cod liver oil, are, according to Salkowski and Steenbuch, secondary products due to the putrefaction of the livers. The researches of Heyerdahl (*Cod Liver Oil and Chemistry,* P. Möller, London, 1895) give as present in the mixed fatty acids about 4 per cent. of palmitic acid, 20 per cent. of *jecoleic acid,* $C_{19}H_{36}O_2$, and 20 per cent. of *therapic acid,* $C_{17}H_{28}O_2$. Besides these the "stearin" contains some unknown unsaturated acid or acids. Heyerdahl states that in the fresh state cod liver oil contains no hydroxy-acids.

A characteristic constituent of cod liver oil is *cholesterol,* which can be isolated by saponifying the oil and exhausting the soap with ether. The quantity of cholesterol, according to Allen and Thomson, is from 0.46 to 1.32 per cent. By reaction with ammonia in distillation the oil yields a volatile alkaloid, *trimethylamine,* C_3H_9N, which has a strong pungent odor, recalling that of herring pickle, of which the same alkaloid is an ingredient. No other official fatty oil yields a similar product. (See *A. J. P.,* xxiv. 343.) Gautier has obtained from cod liver oil the leucomaines *butylamine, iso-amylamine, hexylamine,* and *dihydrolutidine,* and two fixed bases, *aselline,* $C_{25}H_{33}N_4$, and *morrhuine,* $C_{19}H_{27}N_3$. Aselline was found by its discoverer to be relatively feeble physiologically; morrhuine, of which about 2 milligrammes are believed to exist in a tablespoonful of ordinary cod liver oil, is affirmed to have the properties of exciting the appetite and acting as a powerful diuretic and diaphoretic. Besides these bases, an acid containing nitrogen has been found. This acid, *morrhuic acid,* $C_9H_{13}NO_3$, is probably identical with De Jongh's *gaduine.* Some have been disposed to ascribe the virtues of cod liver oil to its iodine and bromine, but these are in too small proportion for much effect, and the oil has produced results which have never been obtained from iodine and bromine themselves. The presence of iodine cannot be detected by the usual tests. It is necessary to convert the oil into a soap, and to carbonize this, before it will give evidence of iodine. The proportion never exceeds 0.05 per cent., or 1 part in 2000, and it is by no means certain

that iodine is always, if ever, present in pure oil. The proportion of iodine present has been investigated by E. C. Stanford (*P. J.* [3], xiv. 353), who found it to be extremely minute, ranging from 0.00138 to 0.00433 per cent., with an average of 0.00322 per cent. The oil is capable of dissolving a larger proportion of iodine, and, if any specimen contain more than 0.05 per cent., there is reason to suspect that iodine has been added. Cod liver oil becomes rancid so easily that it contains varying amounts of free fatty acids, frequently showing their presence, even when freshly rendered. Medicinal oils, however, should not show more than from 0.3 to 0.7 per cent. of free acid, calculated as oleic acid.

Tests of Purity.—In consequence of the great demand for this oil, it has not unfrequently been adulterated with other fixed oils, and occasionally others have been fraudulently substituted for it. The importance, therefore, is obvious of ascertaining some mode of testing its purity and genuineness. The official tests are as follows. "If 1 drop of the Oil be dissolved in 20 drops of chloroform and the solution shaken with 1 drop of sulphuric acid, the solution will acquire a violet-red tint, rapidly changing to rose-red and, finally, brownish-yellow. If a glass rod moistened with sulphuric acid be drawn through a few drops of the Oil, on a porcelain plate, a violet color will be produced. Cod Liver Oil should be only very slightly acid to blue litmus paper which has been previously moistened with alcohol (limit of *free fatty acids*). If 2 or 3 drops of fuming nitric acid be allowed to flow alongside of 10 or 15 drops of the Oil, contained in a watch-glass, a red color will be produced at the point of contact. On stirring the mixture with a glass rod, this color becomes bright rose-red, soon changing to lemon-yellow (distinction from *seal oil,* which shows at first no change of color, and from *other fish oils,* which become at first blue and afterwards brown and yellow). Cod Liver Oil, saponified by alcoholic potassium hydroxide T.S. should show a saponification value of 175 to 185 (see PART III, Test No. 99). If 0.3 Gm. of Cod Liver Oil be dissolved in 10 Cc. of chloroform in a 250 Cc. flask or bottle, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 140 nor more than 150 should be obtained (see PART III, Test No. 51)." *U. S.* "A drop of *sulphuric acid* added to a few drops of the Oil on a porcelain slab develops a violet coloration. When *nitric acid* is carefully poured into some of the Oil contained in a test-tube, a precipitate of coagulated albumen should be formed at the surface of contact of the two liquids. No solid fat should separate on exposure of the Oil for two hours to a temperature of 32° F. (0° C.)." *Br.* There is reason to believe that all the oils from the livers of the Gadidæ have analogous properties. They have been indiscriminately used, and upon the results of their employment is based, in part, the present reputation of the medicine. They may, therefore, be considered as in fact one oil, so far as their medicinal use is concerned. Unfortunately, chemistry has yet discovered no perfectly reliable test. The furthest it has gone is to point out certain reactions, which may be considered as evidences of the presence of biliary principles in the oil, thus indicating its hepatic origin. Among these probably the most characteristic is that of Hager and Salkowski, in which a drop of sulphuric acid, added to fresh cod liver oil, on a porcelain plate, causes a centrifugal movement in the oil, and gives rise to a fine violet color, soon passing into a yellowish or brownish red. Sometimes, instead of assuming the violet hue, the color immediately becomes a clear red or a dark brownish-red. This is said to be especially the case with those specimens of the oil which have been prepared by boiling the livers with water. Shark liver oil responds in like manner to the test of sulphuric acid, but is said to have the sp. gr. 0.866, which is much lower than that of any variety of the genuine oil. Rauitz (*Ph. Ztg.,* 1900, 261) states that Norwegian oil prepared by the cold process is often adulterated with the oil from a species of shark, *Scymnus vulgaris.* According to Kremel, fuming nitric acid causes instantly, when agitated with cod liver oil, a pinkish or rose-red color, which soon becomes brown, while no such effect is produced on other animal or vegetable oils. According to Winckler, the oil should afford the odor of herring pickle when heated with potassium hydroxide, lime, and ammonium chloride. But the most reliable tests are the sensible properties of odor and taste. If there be none of the peculiar shoe leather odor and taste, or if a strong lamp oil odor be perceptible, the oil may be suspected. Little of importance can be inferred from the color. Some have been disposed to prefer the dark offensive oil, but our own experience accords with that of those who have found the pale or light brown equally efficient, and for facility of administration and acceptability to the stomach the latter is greatly preferable. It is important that the oil should be secluded from the air, which effects a gradual change, no doubt impairing its efficiency; hence the vessels containing it should be full, and it should be kept in bottles well-stoppered, holding about the quantity generally wanted for use at one time, and not exposed to the sunlight.

Uses.—Cod liver oil has long been popularly employed in Northern Europe in *rheumatic* and *strumous diseases.* It was first brought to the notice of the profession gener-

ally by German practitioners, and had acquired great reputation on the Continent before it was used to any extent in Great Britain. At Manchester, in England, it was employed by the medical profession in the treatment of *chronic rheumatism* and *gout* as early as 1766, but it was not until the appearance of the treatise of Bennett of Edinburgh, in 1841, that it came into general notice in Great Britain and the United States. The diseases in which it has proved most efficient are *chronic rheumatism* and *gout*, and the various morbid affections connected with a scrofulous diathesis, such as *external glandular scrofula, diseases of the joints and spine, carious ulcers, tabes mesenterica, rickets*, and *phthisis*. It has been found useful also in *chronic cutaneous eruptions, lupus*, and *chronic pectoral diseases* not tuberculous, and may be employed with the hope of good in almost all chronic cases in which there is impaired assimilation and nutrition. In *pulmonary consumption* it is of supreme value. It is necessary, however, to persevere for four or six weeks before looking for any decidedly favorable results, though the change does often begin earlier.

As to its mode of action, there has been much difference of opinion. Some consider it merely a nutritive agent, having the advantage over other oleaginous substances of a readier entrance into the system and more easy assimilation. But we cannot agree with this opinion. Other oleaginous substances, certainly not less nutritious, have not been equally efficient, though taken in much larger quantities. If this be the true explanation, persons living chiefly on milk, which abounds in oil, or on fat pork, ought to show a special exemption from scrofulous complaints. The probability appears to us to be that, in consequence of some peculiar principle or principles it contains, it exercises a stimulant and alterative influence on the processes of assimilation and nutrition, thereby aiding in the production of healthy tissue.

A tablespoonful (15 Cc.) three or four times a day may be given to adults, a teaspoonful (3.75 Cc.) repeated as frequently to children, which dose may be gradually increased as the stomach will permit, and continued for a long time. It may be taken alone or mixed with some vehicle calculated to conceal its taste and obviate nausea. For this purpose recourse may be had to any of the aromatic waters, to the aromatic tinctures, as the tincture of orange peel, diluted with water, or to a bitter infusion, as that of quassia. It may be given floating on the vehicle, or mixed with it by means of gum or the yolk of egg,[1] with sugar, in the form of an emulsion. Perhaps the best vehicle, when not contra-indicated, is the froth of porter. Let a tablespoonful of porter be put into the bottom of a glass, upon the surface of this the oil, and over all some of the froth of the porter. A small piece of orange peel may be chewed before and after taking the medicine.[2] Various other methods have been adopted to conceal or correct the taste and favor administration. Common salt has been recommended, but nothing, perhaps, so effectually destroys the taste as oil of bitter almond, of which one part will answer for 200 parts of the oil. A good plan is to shake strongly, in a flask, one measure of the oil with from one to two of bitter almond water, according to the degree of offensiveness, and to separate the liquids after they have been allowed to stand for twenty-four hours. The oil should be filtered if not quite clear. The medicine is now very largely given in capsules. Dufourmantel prepared a jelly by dissolving half a drachm of ichthyocolla in as little hot water as possible, and then gradually mixing with it a fluidounce of the oil with four drops of the oil of anise, taking care not to exceed the heat of 75° F. (*J. P. C.*, Juin, 1864, p. 72.) Bouchut incorporated the oil with wheat flour, and had this made into bread, which, he said, was in no degree disagreeable. (*N. R.*, Oct. 1873, p. 522.)[3] The oil is sometimes applied externally by friction, and in cases of *ascarides* or *lumbricoides* is injected into the rectum. It has been recommended locally in *chronic articular affections*, in various *chronic cutaneous eruptions*, and in *opacity of the cornea* after the subsidence of inflammation. In the last mentioned affection, one or two drops of the oil are applied by means of a pencil to the cornea, and diluted, if found too stimulating, with olive or almond oil.[4] It is often advantageously combined with lime salts, especially in *rickets*.[5]

[1] *Glyconin Emulsion of Cod Liver Oil.*—The formula proposed by Close, and at one time largely used by Andrews, Beard, and others, is as follows. Cod Liver Oil 4 fluidounces, Glyconin 9 fluidrachms, Aromatic Spirit of Ammonia 1 fluidrachm, Sherry Wine 2 fluidounces, Diluted Phosphoric Acid 4 fluidrachms, Essence of Bitter Almond (made by dissolving 1 fluidrachm of the volatile oil in half a pint of alcohol) 2 fluidrachms. The cod liver oil is to be added *very slowly* to the glyconin with brisk stirring, and the other ingredients added in the order named. *Glyconin* or *Glyceritum Vitelli* is made by mixing 45 Gm. of fresh yolk of egg with 55 Gm. of glycerin.

[2] The following is Carlo Pavesi's formula for deodorized cod liver oil. Cod liver oil 1000 parts, ground roasted coffee 50 parts, animal charcoal 25 parts. Place the ingredients in a flask, which is to be well closed, and digest on a water bath during the space of one hour; then set it aside for three days, occasionally shaking the contents, and filter. This preparation has a peculiar coffee flavor, and is quite pleasant to take, the only objection being the liability to cultivate in the patient a distaste for using coffee as a beverage. (*N. R.*, Jan. 1876.)

[3] *Phosphorized cod liver oil* may be made by dissolving one grain of phosphorus in four fluidounces of cod liver oil.

[4] *Cod Liver Oil and Ferrous Iodide.*—The following formula is that of a commission appointed by the Netherlands Pharmaceutical Society. Iodine 1 part; Pulverized Iron 1 part; Pale Cod Liver Oil 80 parts. Triturate the pulverized iron in a mortar with the iodine and one-fourth of the oil, and heat the mixture in a water bath, with constant stirring, until the brown color of the iodine has entirely disappeared and given place to a deep purple color, showing that the ferrous iodide has been formed and dissolved. Then add the remainder of the oil, mix carefully, and, after standing, decant into dry bottles, which are to be completely filled. (*N. R.*, Aug. 1876.)

[5] *Cod Liver Oil with Lactophosphate of Lime.* Take of Cod Liver Oil, 1 pint; Oil of Bitter Almond,

The *olein* of cod liver oil has been recommended by Arthur Leared, when the oil itself disagrees with the stomach. He has found it to produce the same remedial effects, and to be borne much better. It may be given in the same dose. A *solution of quinine in the oil* may be made by heating the freshly precipitated alkaloid with the oil, in the proportion of two grains to a fluidounce, by means of a water bath, until the mixture becomes quite clear.

Dose, four fluidrachms (15 Cc.).

Off. Prep.—Emulsum Olei Morrhuæ, *U. S.;* Emulsum Olei Morrhuæ cum Hypophosphitibus, *U. S.*

OLEUM MYRISTICÆ. U. S., Br.

OIL OF MYRISTICA [Oil of Nutmeg]

(ō'lę-ŭm mȳ-rĭs'tĭ'cæ)

"A volatile oil distilled from Myristica. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Nutmeg." *Br.*

Volatile oil of Nutmeg; Oleum Myristicæ Ætherеum, Oleum Nucis Moschati, Oleum Nucistæ Ætherеum; Huile volatile (Essence) de Muscade, *Fr.;* Oleum Macidis, *P. G.;* Aetherisches Muskatöl, Aetherisches Muskatnussöl, *G.*

This oil is obtained from the powdered nutmegs by distillation with water. A better method, according to J. Cloez, is to exhaust the powder with carbon disulphide or ether, distil off the solvent by means of a water bath, and expose the butter-like residue to a current of steam, the vapor being conveyed into a refrigerated receiver, where it condenses. (*J. P. C.,* Fév. 1864.) Schimmel & Co. (1899) state that oil of nutmeg is made from the light, worm-eaten nuts, of which large quantities are rejected in sorting the different qualities in Holland. The worm most strangely robs the nutmeg of its fat oil, while the essential oil remains in the nut in full. Oil of myristica is colorless or of a pale straw color, limpid, lighter than water, soluble in an equal volume of glacial acetic acid, in alcohol and ether, with a neutral reaction, a pungent spicy taste, and a strong odor of nutmeg. It is "a thin, colorless or pale yellow liquid, having a characteristic odor of nutmeg, and a warm, spicy taste. Specific gravity: 0.862 to 0.910 at 25° C. (77° F.). Soluble in an equal volume of alcohol; also soluble in 3 volumes of 90 percent. alcohol. It is dextrogyrate, the angle of rotation varying between +14° and +28° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). When 2 or 3 Cc. of Oil are evaporated on a water-bath, no residue which crystallizes on cooling should be left." *U. S.* "Specific gravity 0.870 to 0.910. The Oil forms a clear solution with its own volume of a mixture of equal parts of *absolute alcohol* and *alcohol* (90 per cent.). A little evaporated on a water-bath should not leave a residue which crystallizes on cooling (absence of concrete oil of nutmeg)." *Br.* The mixture of volatile and fixed oils obtained by powerfully expressing nutmegs between heated plates may be separated by agitation with water. Upon standing, the latter deposits a crystalline solid, which was called by Playfair *myristin.* From its solution in alcohol he obtained it in extremely light crystalline scales, which, after repeated crystallization, had still the odor of nutmeg, were fusible at 31° C. (87.8° F.), soluble in the ordinary menstrua of substances of the same class, and, as just said, insoluble in water. By glacial acetic acid it was first colored red. (*P. J.,* March, 1874, 714.) It was identified as the glyceride of myristic acid, $C_{14}H_{28}O_2$, and had, therefore, the formula $C_3H_5(C_{14}H_{27}O_2)_3$. Besides the myristin or solid fat, there is present about an equal amount of a liquid fat containing free acid. The essential oil consists chiefly of pinene with probably some dipentene, also *myristicol,* $C_{10}H_{16}O$, and *myristicin,* $C_{12}H_{14}O_3$. (*Power's Catalogue of Essential Oils,* 1894.) Semmler (*Ber. d. Chem. Ges.,* 1890, 1803) examined an oil of myristica of sp. gr. 0.8611 which contained only terpenes; these boiled at about 50° C. under a pressure of 8 Mm. The oil may be used for the same purposes as myristica.

Dose, five to ten minims (0.3 to 0.6 Cc.), but the oil is not often employed.

Off. Prep.—Pilula Aloes Socotrinæ, *Br.;* Spiritus Ammoniæ Aromaticus, *U. S., Br.;* Spiritus Myristicæ, *Br.;* Tinctura Guaiaci Ammoniata, *Br.;* Tinctura Valerianæ Ammoniata, *Br.*

OLEUM OLIVÆ. U. S., Br.

OLIVE OIL

(ō'lę-ŭm ǫ-lī'væ)

"A fixed oil expressed from the ripe fruit of *Olea europæa* Linné (Fam. *Oleaceæ*). It should be kept in well-stoppered bottles, in a cool place." *U. S.* "The oil expressed from the ripe fruit of Olea europæa, *Linn.*" *Br.*

Sweet Oil; Huile d'Olive, *Fr. Cod.;* Oleum Olivarum, *P. G.;* Olivenöl, *G.;* Olio di olive, *It.;* Aceite de olivas, *Sp.*

Olea europæa, L., *Sp. Pl.* (1753) 8; Willd., *Sp. Plant.* i. 44; *B. & T.* 172.—This valuable tree is usually from fifteen to twenty feet in height, though sometimes much larger, especially in Greece and the Levant. It has a solid, erect, unequal stem, with numerous straight branches, covered with a grayish bark. The

Oil of Peppermint, Oil of Wintergreen, each, 10 drops; Powdered Gum Arabic, 4 oz. tr.; Powdered Sugar, 6 oz. tr.; Solution of Lactophosphate of Lime (60 gr. to 1 fl. oz.) 6½ fl. oz.; Lime Water, 6½ fl. oz. Mix the gum and sugar in a capacious mortar, and make a smooth mucilage with the lime water and three ounces of the solution of lactophosphate of lime. Add the volatile oils to the cod liver oil, and gradually triturate them with the mucilage until a perfect emulsion is formed. Finally, add the rest of the solution of lactophosphate of lime, and mix thoroughly. Dose, from one-half to one fluidounce (15 to 30 Cc.). (J. T. Shinn, *A. J. P.,* March, 1873.)

leaves, which stand opposite to each other on short footstalks, are evergreen, firm, lanceolate, entire, two or three inches in length, with the edges somewhat reverted, smooth and of a dark green color on their upper surface, whitish and almost silvery beneath. The flowers are small, whitish, and disposed in opposite axillary clusters, about half as long as the leaves, and accompanied with small, obtuse, hoary bracts. The fruit, or olive, is a smooth, oval drupe, greenish at first, but of a deep violet color when ripe, with a fleshy pericarp, and a very hard nut of a similar shape. Clusters of not less than thirty flowers yield only two or three ripe olives.

The olive tree, though believed by some to have been originally from the Levant, flourishes at present in all the countries bordering on the Mediterranean, and has been cultivated from time immemorial in Spain, the south of France, and Italy. It begins to bear fruit after the second year, is in full bearing at six years, and continues to flourish for a century. There are forty varieties, distinguished by the form of the leaves and the shape, color, and size of the fruit. The variety *longifolia* of Willdenow is said to be chiefly cultivated in Italy and the south of France, and the *latifolia* in Spain. The latter bears much larger fruit than the former, but the oil is less esteemed. The olive is largely cultivated in the north of Africa, especially in the vicinity of Tunis, and considerable quantities of the oil are exported from that city. (*P. J.*, Sept. 1873, 204.) The tree has been introduced into South Australia, and the oil will probably become of commercial importance there.

Olives are cultivated especially in Spain in the district of Cadiz. Two classes are produced, the one known as the Queen olive, a large olive, which is mostly exported to the United States; the other the Manzanillo, or small olive, which is chiefly consumed in Spain, South America, and Cuba. The olive is largely cultivated in California, where it grows luxuriantly. As long ago as 1897 there were said to be 2,500,000 olive trees in California, but the production of the oil is not very large at present on account of the greater cheapness of labor in France and in Italy.[1] The imports of oil into the United States are annually between eight and nine hundred thousand gallons.

Pickled olives made by soaking green olives first in dilute solution of sodium hydroxide and then in salt water are largely used as an article of food; the ordinary green olive of commerce has been picked before ripening. The ripe olive, which, in the United States, is chiefly obtained from California, is dark-purple, often almost black, very different in taste from the ordinary unripe pickled fruit, and is said to contain about 50 per cent. of olive oil, so that it affords an excellent method of administering fat.

The leaves and bark of the olive tree have an acrid and bitterish taste, and have been employed as substitutes for cinchona, though with no great success. Attention has been called, in France, to a hydro-alcoholic extract of the leaves, as having considerable febrifuge powers. In the quantity of from ten to twenty grains daily, in divided doses, it has been found useful in preventing the hectic paroxysms. In hot countries, a substance resembling the gum-resins exudes spontaneously from the bark. It was thought by the ancients to possess useful medicinal properties, but is not now employed. Analyzed by Pelletier, it was found to contain resin, a little benzoic acid, and a peculiar principle analogous to gum, which has been named *olivile*. But the fruit is by far the most useful product. In the unripe state it is hard and insupportably acrid, but when macerated in water or an alkaline solution, and afterwards introduced into a solution of common salt it loses these properties, and becomes a pleasant and highly esteemed article of diet. Mannite has been found in all parts of the tree while in vital activity, as in the green leaves and unripe fruit, but cannot be detected in the yellow fallen leaves or in the perfectly ripe fruit. (*A. J. P.*, 1866, p. 179.) The pericarp, or fleshy part of the ripe olive, abounds in a fixed oil, which constitutes its greatest value, and for which the tree is chiefly cultivated in Southern Europe. In the unripe olive a peculiar green substance, together with mannite, has been found by S. de Lutz, both of which disappear as the fruit ripens, being probably converted into oil, which now takes their place. (*J. P. C.*, Juin and Déc. 1862.) The olives ripen from November to March, and the oil is obtained by first bruising them in a mill and then submitting them to pressure. The product varies much, according to the state of the fruit and the circumstances of the process. The best, called *virgin oil*, is obtained from the fruit picked before perfect maturity, and immediately pressed. It is distinguished by its greenish hue. The common oil used for culinary purposes and in the manufacture of the finest soaps is procured from very ripe olives, or from the pulp of those which have yielded the virgin oil. In the latter case the pulp is thrown into boiling water, and the oil removed as it rises. An inferior kind, employed in the arts, especially in the preparation of the coarser soaps, plasters, unguents, etc., is afforded by fruit which has been thrown into heaps, and allowed to ferment for several days, or by the marc left after the expression of the finer kinds of oil, broken up, allowed to ferment, and again introduced into the press. The remarks made under the head of *Oleum Myris-*

[1] There are many varieties of the olive grown in California. J. L. Howland of Pomona, reports the following percentage of oil yielded by each variety as cultivated in California as the result of two years' test; Pendulina, 21; Rubra, 18.5; Oblonga, 18; Mission, 17.9; Uvaria, 17.5; Nevadillo Blanco, 16.5; Columella, 16.5; Precox, 14; Picholine, 10; Manzanillo, 8.5. For further information concerning the subject the reader is referred to the various Proceedings of the California State Convention of Olive Growers.

ticæ in relation to the extraction of the fixed oil by means of solvents are applicable also to olive oil.

Olive oil is imported in glass bottles, or in flasks surrounded by a kind of net-work of grass and usually called Florence flasks. The best comes from Southern France, where much care is exercised in the choice of the fruit.

Properties.—The pure oil is an unctuous liquid, or "a pale yellow or light greenish-yellow oily liquid, having a slight peculiar odor, and a nut-like, oleaginous taste, with a faintly acrid after-taste. Specific gravity: 0.910 to 0.915 at 25° C. (77° F.). Very sparingly soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide." *U. S.*

The concrete portion, about 28 per cent. of the oil, which separates at a freezing temperature, consists chiefly of the glyceride of *palmitic acid,* $C_{16}H_{32}O_2$, together with a smaller amount of *arachidic acid,* $C_{20}H_{40}O_2$ (stearic acid is stated by Hehner and Mitchell to be absent entirely); the liquid portion is essentially olein, $C_3H_5(O.C_{18}H_{33}O)_3$, with a small amount (seven parts for ninety-three of olein) of the glyceride of the less saturated linolic acid. According to Braconnot, the oil contains 72 per cent. of olein and 28 of palmitin. A small quantity of *cholesterin,* $C_{26}H_{44}O$, has also been found in the oil. Olive oil is solidified by nitrous acid and mercuric nitrate, and converted into a peculiar fatty substance, called *elaidin.* The olein of all oils which have not the drying property undergoes the same change when acted on by nitrous acid.

The greenish color is owing to the presence of a trace of chlorophyll, and a trace of cholesterin is also extracted by repeated agitation with glacial acetic acid.[1]

Olive oil, when exposed to the air, is prone to become rancid, acquiring a disagreeable odor, a sharp taste, and a thicker consistence; it also loses its color, and the change is promoted by heating it. It is officially tested as follows: "When cooled to from 8° to 10° C. (46.4° to 50° F.), the Oil becomes somewhat cloudy from the separation of crystalline particles, and at 0° C. (32° F.), it forms a whitish, granular mass. If 2 Cc. of Olive Oil be shaken vigorously with an equal volume of nitric acid (sp. gr. 1.37), the Oil should retain a light yellow color, not becoming orange or reddish-brown, and after standing for six hours should change into a yellowish-white solid mass and an almost colorless liquid (absence of appreciable quantities of *cotton seed oil* and *most other seed oils*). If 5 Cc. of the Oil be thoroughly shaken in a test-tube with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 0.1 Gm. of silver nitrate in 10 Cc. of alcohol and adding 2 drops of nitric acid), and the mixture be heated for about five minutes in a water-bath, the Oil should retain its original pale color, not becoming reddish or brown, nor should any dark color be produced at the line of contact of the two liquids (absence of more than about 5 percent. of *cotton seed oil*). If 2 Cc. of the Oil be mixed in a test-tube with 2 Cc. of equal volumes of amyl alcohol and carbon disulphide containing 1 percent. of sulphur in solution, and the test-tube be immersed to one-third or one-half its depth in boiling salt water, no reddish color should develop in from ten to fifteen minutes (absence of *cotton seed oil*). If 2 Cc. of the Oil be mixed with 1 Cc. of hydrochloric acid (sp. gr. 1.18) containing 1 percent. of sugar, and the mixture be shaken for half a minute and allowed to stand for five minutes, and then 3 Cc. of water added and the whole again shaken, the acid layer should not show a pink color (absence of *sesame oil*). Olive Oil, saponified by alcoholic potassium hydroxide T.S. should show a saponification value of 191 to 195 (see PART III, Test No. 99). If 0.3 Gm. of Olive Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 80 nor more than 88 should be obtained (see PART III, Test No. 51)." *U. S.* "At 50° F. (10° C.) it is liable to become of a pasty consistence, and at 32° F. (0° C.) to form a nearly solid granular mass. If 10 cubic centimetres of the Oil be shaken with 2 cubic centimetres of a reagent prepared by dissolving 1 gramme of *silver nitrate* in 100 cubic centimetres of *absolute alcohol,* with the addition of 20 cubic centimetres of *ether* and one drop of *nitric acid,* no blackening should occur when the mixture is heated on a water-bath for ten minutes (absence of cotton-seed oil)." *Br.* It is frequently adulterated with the cheaper fixed oils, especially with cotton seed oil, arachis oil, sesame oil and poppy seed oil; the adulteration may sometimes be detected by reducing the temperature to the freezing point. As other oils are less readily congealed than is the olive oil, the degree of its purity will be indicated by the degree of concretion. Another mode has been indicated by Poutet, founded on the property possessed by mercuric nitrate of solidifying the oil of olives, without a similar influence upon other oils. Six parts of mercury are dissolved at a low temperature in seven and a half parts of nitric acid of the sp. gr. 1.35, and this solution is mixed with the suspected oil in the proportion of one part to twelve, the mixture being occasionally shaken. If the oil is pure, it will be converted after some hours into a yellow solid mass; if it contains a minute proportion, even so small as a twentieth, of poppy or cotton seed oil, the resulting mass will be much less firm, and a tenth will prevent a greater degree of consistence than oils usually

[1] For discussion of the spectra of olive oil, see *P. J.*, 3d series, vii. 22, 110.

acquire when they concrete by cold. Lewkowitsch (*Chemical Analysis of Oils, Fats, and Waxes,* 2d ed., 1898, 462) says that the color reactions proposed by various authors are altogether unreliable and yield no definite results, with the exception of the color test (Baudoin's test, see *Oleum Sesami*) for sesame oil and perhaps Bechi's and Milliau's or Halphen's for cotton seed oil (see below). For a method of detecting the *oil of arachis* (*ground nut oil*) in olive oil, see *J. P. C.,* Janv. 1872, 48. The Bureau of Chemistry of the U. S. Agricultural Department investigated 157 samples purchased throughout the country; 11 out of 72 samples of French oil, 10 out of 67 samples of Italian oil, and 2 out of 15 samples of California oil, were found to be impure. The same authorities conclude that but little cotton seed oil is found in olive oil as imported, but is added to it in the United States. Arachis oil, however, which is produced in large quantities in Marseilles, was found in numerous samples of imported olive oil. According to Tambon, the present-day adulterations do not consist in the addition of a single cheaper oil, but of ingeniously prepared mixtures of different oils in such proportions to each other that on analysis it becomes difficult or impossible to distinguish the adulterated from the genuine oil by the chemical and physical constants accepted for the latter. The chief adulterants are benne, peanut and cotton seed oil. Of these, benne is easily recognized; for peanut oil there is as yet no reliable color reaction, and while Bechi's reaction may, under certain conditions, answer well for the detection of cotton seed oil, this, under others, has also proven unreliable. (*Ph. Ztg.,* 1904, 104.) According to Kreis and Grob (*S. W. P.,* 1901, 88) Billier's test is very sensitive. It is carried out by shaking the suspected oil with a solution of resorcinol in benzene and afterwards with nitric acid. Olive oil under these circumstances remains unchanged in color, cotton seed and nut oil become red violet and maw seed oil is turned brown red. Bechi's test for ascertaining the admixture of cotton seed oil with olive oil has received the approval of the Commission of Florence after most exhaustive experiments, and is as follows. One grain (0.065 Gm.) of silver nitrate is dissolved in fifteen minims (0.9 Cc.) of water, and six and a half fluidounces (200 Cc.) of alcohol are added. Two fluidounces (or 60 Cc.) of ether may be added to render the solution more easily miscible with the oil, but it is not absolutely necessary. A solution of eighty-five parts of amyl alcohol and fifteen parts of rape seed oil is prepared. These reagents should not be kept on hand any length of time. To ten Cc. of the oil to be examined one Cc. of the solution of silver nitrate is added, and then from eight to ten Cc. of the amyl alcohol reagent; the mixture is agitated strongly, and heated on a water bath for five or ten minutes. In the case of pure oils the color is unaltered by the addition of the reagents; if cotton seed oil be present, a brownish color or turbidity, varying from a light brown to a deep maroon or black (according to the extent of the adulteration), will be produced. (*A. J. P.,* 1887.) See also the official silver nitrate test. Milliau's test is a modification of the foregoing. If the fatty acids instead of the oil itself are treated with the same reagents, the same reduction of the silver salts occurs and the same brown color as in the Bechi test. Halphen's test with a mixture of amyl alcohol and carbon disulphide containing about 1 per cent. of sulphur in solution is now regarded as the most distinctive for cotton seed oil. For details see the official test.

Uses.—Olive oil is nutritious and mildly laxative, and is occasionally given as a feeble purgative in cases of irritable intestines. Taken into the stomach in large quantities, it serves to involve acrid and poisonous substances and mitigate their action. It has also been recommended as a remedy for *worms,* and is a very common ingredient in laxative enemata. The value of large doses of olive oil in the treatment of *gall stones,* as originally suggested by Kennedy, has received much confirmation, and the experiments of Rosenberg go to show that the remedy does increase not only the amount but also the fluidity of the bile. From six to seven ounces of it may be given in from four to eight portions, during not less than three hours, in aromatized emulsion. Externally applied, it is useful in relaxing the skin and in sheathing irritated surfaces from the action of the air, and it is much employed as a vehicle or diluent of more active substances; but the most extensive use of olive oil in pharmacy, is as a constituent of liniments, ointments, cerates, and plasters.

Dose, as a laxative, from one to two fluidounces (30 to 60 Cc.).

Off. Prep.—Emplastrum Ammoniaci cum Hydrargyro, *Br.;* Emplastrum Hydrargyri, *Br.;* Emplastrum Picis, *Br.;* Emplastrum Plumbi, *Br.;* Linimentum Ammoniæ, *Br.;* Linimentum Calcis, *Br.;* Linimentum Camphoræ, *Br.;* Oleatum Atropinæ, *U. S.;* Oleatum Cocainæ, *U. S.;* Oleatum Veratrinæ, *U. S.;* Unguentum Capsici, *Br.;* Unguentum Diachylon, *U. S.;* Unguentum Hydrargyri Compositum, *Br.;* Unguentum Hydrargyri Nitratis, *Br.;* Unguentum Resinæ, *Br.*

OLEUM PHOSPHORATUM. Br.

PHOSPHORATED OIL

(ō'lę-ŭm phŏs-phọ-rā'tŭm)

Huile phosphorée, *Fr. Cod.;* Liniment phosphoré, *Fr.;* Phosphorhaltiges Oel, *G.;* Aceite fosforado, *Sp.*

"Heat Almond Oil in a porcelain dish to about 300° F. (149° C.), and keep it at this temperature for about fifteen minutes, then let it cool, and filter it through paper. Put ninety-nine parts by weight into a stoppered bottle, capable of holding rather more than this quantity, and add to it one part by weight of dry

Phosphorus. Immerse the bottle in hot water until the mixture has acquired the temperature of 180° F. (82.2° C.), removing the stopper two or three times to allow the escape of expanded air; then shake until the Phosphorus is entirely dissolved." *Br.*

Phosphorated oil was not retained in the U. S. P. (8th Rev.). The process of the U. S. P. 1890 is appended.[1]

The U. S. 1890 process did not differ essentially from that of the Br. Pharm. Both are one per cent. solutions; the British formerly contained but 0.75 per cent.[2] The object of heating the oil is to expel air and traces of water, which would aid in oxidizing the phosphorus. The ether not only assists in the preservation of the finished preparation, but is also of use in rendering the oil less disagreeable to the taste. E. R. Squibb passes a current of carbon dioxide through the oil contained in the bottle in which it is to be kept, to expel the air and prevent oxidation. This is a clear and colorless or but slightly colored oil, not phosphorescent in the dark, and having the odor and taste of phosphorus quite distinctly. It should be perfectly free from any particles of undissolved phosphorus. It may be administered in the form of an emulsion, like the official almond emulsion, and flavored with oil of bitter almond, or preferably in capsules; each minim contains about 1-115 of a grain of phosphorus.

Dose, one to three minims (0.06 to 0.2 Cc.).

OLEUM PICIS LIQUIDÆ. U. S.

OIL OF TAR

(ō'lę-ŭm pī'cĭs lĭq'uį-dæ)

"A volatile oil distilled from tar." *U. S.*

Huile volatile de Goudron, *Fr.;* Theeröl, Pechöl, *G.*

This oil is prepared by distilling wood tar, the residue left in the still being known as pitch. It represents thoroughly the medicinal properties of tar, and is preferable on account of its less offensive taste. (See *Pix Liquida.*) It is officially described as "an almost colorless liquid when freshly distilled, but soon acquiring a dark reddish-brown color, and having a strong, tarry odor and taste. Specific gravity: about 0.965 at 25° C. (77° F.). It is readily soluble in alcohol, the solution showing an acid reaction to litmus paper." *U. S.*

Dose, one to five minims (0.06 to 0.3 Cc.), administered in capsule or in emulsion.

OLEUM PIMENTÆ. U. S., Br.

OIL OF PIMENTA [Oil of Allspice]

(ō'lę-ŭm pī-mĕn'tæ)

"A volatile oil distilled from Pimenta, yielding, when assayed by the process given below, not less than 65 percent., by volume, of eugenol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from Pimento." *Br.*

Oleum Amomi; Oil of Pimento; Huile volatile (Essence) de Piment de la Jamaïque, *Fr.;* Nelkenpfefferöl, Pimentöl, *G.*

The berries yield from 1 to more than 4 per cent. of the volatile oil, which as found in commerce is brownish-red, and has the odor and taste of pimenta, though warmer and more pungent. It has a slightly acid reaction. "A colorless, yellow, or reddish liquid, having a strong, aromatic odor of allspice, and a pungent, spicy taste. Specific gravity: 1.033 to 1.048 at 25° C. (77° F.). With 90 percent. alcohol it is miscible in all proportions. It is also soluble in 2 volumes of 70 percent. alcohol. When mixed with an equal volume of a concentrated solution of sodium hydroxide, it forms a semi-solid mass." *U. S.* "Yellow or yellowish-red when recently distilled, but gradually becomes darker. It has the odor and taste of pimento. Specific gravity not below 1.040. It should be converted into a semi-solid mass when shaken with an equal volume of *strong solution of ammonia." Br.* It consists, like oil of cloves, of two distinct portions, one a sesquiterpene, $C_{15}H_{24}$, and the other a phenol, *eugenol,* capable of extraction by shaking out with alkaline hydroxide solution. They may be separated by distilling the oil from potassium hydroxide solution. After the hydrocarbon is distilled off the phenol may be obtained by liberation from its combination with sulphuric acid and distilling. It is readily recognized as eugenol, so that oil of pimenta is analogous in

[1] *Oleum Phosphoratum.* U. S. 1890. *Phosphorated Oil.*—"Phosphorus, *one gramme* [or 15.5 grains]; Expressed Oil of Almond, Ether, each, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Introduce a *sufficient quantity* of Expressed Oil of Almond into a flask, heat it on a sand-bath to 250° C. (482° F.), and keep it at that temperature for fifteen minutes. Then allow it to cool, and filter it. Put *ninety grammes* [or 3 ounces av., 76 grains] of the filtered Oil together with the Phosphorus, previously well dried by filtering paper, into a dry, tared bottle capable of holding about *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims], insert the stopper, and heat the bottle in a water-bath until the Phosphorus melts. Then agitate it until the Phosphorus is dissolved, allow it to cool, add enough Ether to make the mixture weigh *one hundred grammes* [or 3 ounces av., 231 grains], and agitate it again. Lastly transfer the solution to small glass-stoppered vials, which should be completely filled and kept in a cool and dark place." *U. S.* 1890.

[2] It is often desirable to be acquainted with the degree of solubility of phosphorus in the different fixed oils in ordinary use, in reference to its exhibition as medicine. The following list is taken from the *Journal de Pharmacie* (Fév. 1869, p. 94), where it is given on the authority of M. C. Merc. The oils of sweet almonds, of olives, of sesamum, and of ground nuts will retain, at common temperatures, 1-80 of their weight of phosphorus. It may even descend to 1-78 for almond and ground nut oils; but it is not prudent, in practice, to keep too near the limits of saturation. The oils of colza and flaxseed, brown cod liver oil, and neat's foot oil, retained 1-70 of their weight, even after eight days' exposure in a cellar. Castor oil is far removed from these figures, 105 parts of it being required to dissolve one part of phosphorus. The author has observed no sensible difference in the dissolving power of overheated and not overheated oils.

its constitution to oil of cloves (see *Oleum Caryophylli*). Nothing is known of the constituents which give oil of pimenta its characteristic odor. The U. S. P. (8th Rev.) furnishes an assay to determine the proportion of eugenol as follows:

Assay for Eugenol. U. S. (8th Rev.).—"Introduce into a flask with a long neck (graduated in tenths) 10 Cc. of the Oil of Pimenta and 100 Cc. of potassium hydroxide T.S., and shake the mixture for five minutes. When the liquids have separated completely, add sufficient potassium hydroxide T.S. to raise the lower limit of the oily layer to the zero mark of the scale, and note the volume of residual liquid, which should not measure more than 3.5 Cc., indicating the presence of at least 65 percent. of eugenol." *U. S.* Oil of pimenta is given for the same purposes as are the other stimulant aromatic oils.

Dose, from three to six minims (0.2 to 0.4 Cc.).

OLEUM PINI. Br.

OIL OF PINE

(ō'lę-ŭm pī'nī)

"The oil distilled from the fresh leaves of Pinus Pumilio, *Haenke.*" *Br.*

Pine Needle Oil; Latschenkieferöl, Krummholzöl, *G.*

The British Pharmacopœia 1898 replaced fir wood oil by making oil of pine official. This was largely due to the investigations of J. C. Umney (*P. J.*, 1895, 161, 173, 542), who found that the *Pinus Pumilio* (*Mountain Pine*) furnished an oil of fairly constant character and superior to that from the *Pinus sylvestris* (*Scotch Fir*) of the Br. Ph. 1885. It is described as "colorless or nearly so, with a pleasant aromatic odor and pungent taste. Specific gravity 0.865 to 0.870. It should rotate the plane of a ray of polarized light from 5° to 10° to the left at 60° F. (15.5° C.) in a tube 100 millimetres long. Not more than 10 per cent. should distil below 329° F. (165° C.)." *Br.* It resinifies on exposure, and in medicinal qualities resembles oil of turpentine, but is milder. Pine oil contains *lævo-pinene, lævophellandrene, sylvestrene, bornyl acetate,* and in the last portions of the distillate, *cadinene.* (Gildemeister and Hoffmann, *Aetherische Oele,* p. 338.) It is supposed that the pine oil owes its odor to the presence of the acetic ester of borneol, which is ordinarily present to the amount of about 3.5 per cent., and Schimmel & Co. (*Schim. Rep.* for Oct. 1897) found in a sample of American fir oil as much as 12.1 per cent. It has been used internally in the treatment of *chronic rheumatism* in doses of from ten to twenty minims (0.6 to 1.3 Cc.), but it is especially employed for the purposes of inhalation. The leaves of the *Pinus sylvestris,* with those of other European firs and pines, by pounding are converted into a fibrous substance, known as *fir wool* (*Fichtenwolle*), which is much used in Germany as a local application in *chronic rheumatism,* the affected part being enveloped in a thick batting of the fir wool, which is also sometimes made into clothing for rheumatic persons. An extract of the leaves is also sold under the name of *fir wool extract,* for use in rheumatism.

OLEUM RICINI. U. S., Br.

CASTOR OIL

(ō'lę-ŭm rĭç'ĭ-nī)

"A fixed oil expressed from the seed of *Ricinus communis* Linné (Fam. *Euphorbiaceæ*). It should be kept in well-stoppered containers." *U. S.* "The oil expressed from the seeds of Ricinus communis, *Linn.*" *Br.*

Huile de Ricin, *Fr. Cod.;* Oleum e semine Ricini, *Fr.;* Oleum Ricini, *P. G.;* Ricinusöl, *G.;* Olio di ricino, *It.;* Aceite de ricino; Oleum Palmæ Christi, *Sp.*

Ricinus communis, Willd., *Sp. Plant.* iv. 564. The castor oil plant, or *palma Christi,* attains in the East Indies and Africa the character of a tree, and rises sometimes thirty or forty feet. In the temperate latitudes of North America and Europe it is annual, though Achille Richard saw in the south of France, in the vicinity of Nice, on the sea coast, a small wood consisting entirely of what he supposed to be this species of Ricinus.[1] The following description applies to the plant as cultivated in cool latitudes. The stem is of vigorous growth, erect, round, hollow, smooth, glaucous, somewhat purplish towards the top, branching, and from three to eight feet or more in height. The leaves are alternate, peltate, palmately six to eleven lobed, the lobes acute or acuminate and serrate, smooth on both sides, and of a bluish-green color. The flowers are monœcious, stand upon jointed peduncles, and form a pyramidal terminal raceme, of which the lower portion is occupied by the male flowers, the upper by the female. Both are destitute of corolla. In the male flowers the calyx is divided into five oval, concave, pointed, reflected, purplish segments, and encloses numerous stamens, united into fasciculi at their base. In the female the calyx has three or five narrow lanceolate segments, and the ovary, which is roundish and three-sided, supports three linear, reddish stigmas, forked at their apex. The fruit is a roundish, glaucous capsule, with three projecting sides, covered with tough spines, and divided into three cells, each containing one seed, which is expelled by the bursting of the capsule. This species of Ricinus is a native

[1] While at Montpellier, in France, in the spring of 1861, Geo. B. Wood was assured by Martius, professor of botany in the university of that city, that the species seen by Richard was not the *Ricinus communis,* but the *Ricinus africanus,* also that all the plants of the genus Ricinus growing wild on the borders of the Mediterranean were the *R. africanus.*

of the East Indies and Northern Africa, naturalized in the West Indies, and cultivated in various parts of the world, in few countries more largely than in the Middle and Western United States. The flowers appear in July, and the seeds ripen successively in August and September. A decoction or poultice of the leaves is sometimes used as a local galactagogue, and an infusion has been given internally for a similar purpose. (*L. L.*, Dec. 1859.)

1. The Seeds.—These are about as large as a small bean, oval, compressed, obtuse at the extremities, very smooth and shining, and of a grayish or ash color, marbled with reddish brown spots and veins. At one end of the seed is a small yellowish tubercle, from which an obscure longitudinal ridge proceeds to the opposite extremity, dividing the side upon which it is situated into two flattish surfaces. In its general appearance the seed is thought to resemble the insect called the *tick*, the Latin name of which has been adopted as the generic title of the plant. Its variegated color depends upon a very thin pellicle closely investing a hard, brittle, blackish, tasteless, easily separated shell, within which is the kernel, highly oleaginous, of a white color, and of a sweetish taste succeeded by a slight degree of acrimony. The seeds easily become rancid, and are then unfit for the extraction of the oil, which is acrid and irritating. In 100 parts Geiger found, exclusive of moisture, 23.82 parts of envelope, and 69.09 of kernel. These 69.09 parts contained 46.19 of fixed oil, 2.40 of gum, 20.00 of starch and lignin, and 0.50 of albumen. Henry Bower could find no starch, but separated from the seeds an albuminoid principle, which acted with amygdalin and water like emulsin, producing the odor of oil of bitter almond, though in a less degree. (*A. J. P.*, xxvi. 208.) It is highly probable that it is this principle which, acting as an enzyme on the oily matter of the seeds, gives rise to changes in its nature which render them rancid. (See *Olea Fixa*, p. 810.) G. J. Scattergood found the odor of castor oil to be developed in the beans when bruised with water, and much more powerfully in those long kept than in the fresh. The water distilled from the seeds has a peculiar nauseous odor, quite distinct from that of the oil. (*Ibid.*, xxvii. 207.)

Taken internally the seeds are powerfully cathartic, and often emetic. Two are sufficient to purge with great violence, and three have produced fatal gastro-enteritis in the adult. After expression of the oil, and treatment with pure alcohol, Calloud found the residue to be powerfully emetic in the quantity of 30 grains, taken in two doses. (*J. P. C.*, 3e sér., xiv. 190.) According to Guibourt, the toxic property pervades the whole kernel, the integuments being inert. The experiments of Scattergood, who found that the water distilled from the seeds is emetic and cathartic, would seem to show that the active principle is volatile, but the researches of Stillmark indicate that it is an enzyme, *ricin*, which is a so-called phytalbumose and has been obtained as a white amorphous powder, and is best dissolved in a 10 per cent. salt solution. The aqueous solution of the pure ricin has a neutral reaction. It is a violent poison. E. L. Boerner (*A. J. P.*, 1876, p. 481) obtained butyric acid by macerating the exhausted marc of the seeds with water until decomposed.

2. The Oil.—This may be extracted from the seeds in three ways: 1, by decoction; 2, by expression; 3, by the agency of alcohol or other solvent.

The process by decoction, which has been practised in the East and West Indies, consists in bruising the seeds, previously deprived of their husk, and then boiling them in water. The oil, rising to the surface, is skimmed or strained off, and afterwards again boiled with a small quantity of water to dissipate the acrid principle. The seeds, it is said, are sometimes roasted, to increase the product. But by a temperature much above 212° F. the oil is rendered brownish and acrid, and the same result takes place in the second boiling, if care is not taken to suspend the process soon after the water has been evaporated; hence it happens that the West India oil has generally a brownish color, an acrid taste, and irritating properties.

The oil is obtained in this country by expression. The following, we have been informed, are the outlines of the process usually employed by those who prepare it on a large scale. The seeds, having been thoroughly cleansed from the dust and fragments of the capsules with which they are mixed, are conveyed into a shallow iron reservoir, where they are submitted to a gentle heat insufficient to scorch or decompose them, and not greater than can be readily borne by the hand. The object of this step is to render the oil sufficiently liquid for easy expression. The seeds are then introduced into a powerful hydraulic press. A whitish oily liquid is thus obtained, which is transferred to clean iron boilers supplied with a considerable quantity of water. The mixture is boiled for some time, and, the impurities being skimmed off as they rise to the surface, a clear oil is at length left upon the top of the water, the mucilage and starch having been dissolved by this liquid, and the albumen coagulated by the heat. The latter ingredient forms a whitish layer between the oil and the water. The clear oil is now carefully removed, and the process is completed by boiling with a minute proportion of water, and continuing the application of heat until aqueous vapor ceases to rise, and until a small portion of the liquid, taken out in a vial, continues perfectly transparent when it cools. The effect of this last operation is to clarify the oil, and to render it less irritating by driving off the acrid volatile matter. But much care is requisite not to push the heat too far, as the oil then acquires a brownish hue and an acrid peppery taste. After the completion of the process, the oil is put into barrels

and sent into the market.[1] See article on the preparation of castor oil (*A. J. P.*, 1879, p. 481).[2] There is reason, however, to believe that much of the American oil is prepared by merely allowing it to stand for some time after expression, and then drawing off the supernatant liquid. One bushel of good seeds yields five or six quarts, or about 25 per cent. of the best oil. If not carefully prepared, it is prone to deposit a sediment upon standing, and the apothecary may find it necessary to filter it through coarse paper before dispensing it. Perhaps this may be owing to the plan just alluded to of purifying the oil by rest and decantation. We have been told that the oil in barrels usually deposits in cold weather a copious whitish sediment, which is redissolved when the temperature rises. A large proportion of the oil consumed in the eastern section of the Union has been derived, by the way of New Orleans, from Illinois and the neighboring States, where it has been at times so abundant that it has been used for burning in lamps and for lubricating machinery.[3]

The process for obtaining castor oil by means of alcohol has been practised in France, but the product is said to become rancid more speedily than that procured in the ordinary mode. Such a preparation has been employed in Italy, and is asserted to be less disagreeable to the taste, and more effective, than the common oil obtained by expression. According to Parola, an ethero-alcoholic extract and an ethereal or alcoholic tincture of the seeds operate in much smaller doses than the oil, and with less disposition to irritate the bowels or to cause vomiting. (See *Am. J. M. S.*, N. S., xiii. 143.)

[1] Owing to the presence of ricin, "*castor pomace*" or the oil cake obtained by the extraction of castor oil, is unfit for animal food. For the process of removing the poisonous principle see *P. J.*, lxviii. 213.

[2] For a particular account of the mode of cultivating the castor oil plant and preparing the oil in the Western States, see a paper by Procter in *A. J. P.* (xxvii. 99).

[3] *Italian Castor Oil.*—The castor oil plant is cultivated throughout Italy, but especially in the neighborhood of Verona, where the oil is prepared with great care and is remarkably free from the peculiar odor and taste which render this medicine so repulsive to many palates. As it is highly desirable, for certain purposes, that the oil should be as free from these properties as possible, though as a mere purgative perhaps less powerful when deprived of them, it is a point worthy of investigation, why it is that the Italian oil is superior to most if not all other commercial varieties of the oil in these respects. The following facts in relation to the mode of preparing the oil practised at Verona, published by H. Groves of Florence, acquire on this account a special value. One point of importance is that the seeds are used fresh, as the oil rapidly becomes rancid in them when kept. Another fact is that the seeds are entirely deprived of their coating before being submitted to pressure. This is effected by passing them between two revolving wooden rollers, with a winnowing machine beneath, and, to secure the complete absence of integument, they are afterwards assorted by the hand, all being rejected which are not perfectly decorticated. They are then put into hempen bags, which are arranged in layers with a sheet of iron heated to 90° F. between them, so as to enable the oil to flow. Lastly, they are submitted to pressure in hydraulic presses. The oil which now flows is of the finest quality. An inferior kind is obtained by pressing the marc at a somewhat higher heat. (*P. J.*, Oct. 1866.)

Properties.—Pure castor oil is a thick, viscid, colorless liquid, with little or no odor, and a mild though somewhat nauseous taste, followed by a slight sense of acrimony. As found in commerce it is often tinged with yellow and has an unpleasant odor, and parcels are sometimes, though rarely, met with of a brownish color and hot acrid taste. It does not readily congeal by cold. When exposed to the air it slowly thickens, without becoming opaque. When exposed to the air in a thin layer, it slowly dries to a varnish-like film. It is heavier than most of the other fixed oils, its sp. gr. having been stated to be 0.969 at 55° F. or "0.945 to 0.965 at 25° C. (77° F.)." *U. S.* It differs also from most other fixed oils in being soluble in all proportions in cold absolute alcohol. "Soluble in an equal volume of alcohol, and in all proportions in absolute alcohol or in glacial acetic acid; also soluble, at 25° C. (77° F.), in 3 times its volume of 92.5 percent. alcohol (absence of more than about 5 percent. of *most other fixed oils*). With an equal volume of petroleum benzin, it forms at 15° C. (59° F.) a turbid mixture, but at 17° C. (62.6° F.) it yields a clear solution. When cooled to 0° C. (32° F.) it becomes turbid, with the separation of crystalline flakes, and at about —18° C. (—0.4° F.) it congeals to a yellowish mass. If 3 Cc. of the Oil be shaken for a few minutes with 3 Cc. of carbon disulphide and 1 Cc. of sulphuric acid, the mixture should not acquire a blackish-brown color (absence of *foreign oils*). Castor Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of 179 to 180 (see PART III, Test No. 99). If 0.3 Gm. of Castor Oil be dissolved in 10 Cc. of chloroform, in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for eight hours, protected from light, 20 Cc. of potassium iodide T.S. be introduced, and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 86 nor more than 89 should be obtained (see PART III, Test No. 51)." *U. S.* "Specific gravity 0.950 to 0.970. Soluble in an equal volume of *absolute alcohol*, and in five times its volume of *alcohol* (90 per cent.). It dries slowly to a varnish when exposed to the air in a thin layer. If 3 cubic centimetres of the Oil be shaken with an equal volume of *carbon bisulphide*, and 1 cubic centimetre of *sulphuric acid* be then added, the mixture on being shaken should not become brown (absence of various fixed oils, including cotton-seed oil). Equal volumes of Castor Oil and *petroleum spirit* do not yield a clear mixture if kept at 60° F. (15.5° C.), but they yield a perfectly clear solution if other fixed oils be present." *Br.*

Weaker alcohol, of the sp. gr. 0.8425, takes up about three-fifths of its weight. It has been supposed that adulterations with other fixed

oils might thus be detected, as the latter are much less soluble in that fluid, but Pereira has shown that castor oil has the property of rendering a portion of other fixed oils soluble in alcohol, so that the test cannot be relied on. (*P. J.*, ix. 498.) Such adulterations, however, are seldom practised in this country.[1] Castor oil is soluble also in ether, and in its weight of glacial acetic acid. Its proximate composition[2] has been repeatedly investigated. The bulk of it is *ricinolein*,[3] $C_3H_5(C_{18}H_{33}O_3)_3$, which is the *ricinoleic acid* ($C_{18}H_{34}O_3$) glyceride. At the same time it also contains a small quantity of tristearin and of the glyceride of dihydroxystearic acid, together with from 0.30 to 0.37 per cent. of unsaponifiable matter. Ricinoleic acid, as obtained from the decomposition of the glyceride, is a viscid oil, which solidifies below 0° C., does not solidify in contact with the air by absorption of oxygen, and is not homologous with oleic or linoleic acid, neither of which is found in castor oil. On warming with 1 part of starch and 5 parts of nitric acid (sp. gr. 1.25) castor oil thickens, owing to the formation of *ricinelaidin*. From this *ricinelaidic acid* may be obtained in brilliant crystals. Ricinoleic acid is converted by potassium hydroxide into caprylic alcohol and sebacic acid, with disengagement of hydrogen, and the same products are obtained by the reaction of potassium hydroxide with the oil itself. (See *J. P. C.*, Août, 1885, 113.) Its purgative property is supposed by Bussy and Lecanu to belong essentially to the oil, and not to any distinct principle which it may hold in solution. According to O. Popp, castor oil differs from most other fixed oils in turning the plane of polarized light to the right. (*A. J. P.*, Aug. 1871, 354; from *A. Pharm.*, 1871.) Various substances containing coloring principles which they yield to castor oil produce beautiful fluorescence in that fluid when heated with it, such as logwood, turmeric, camwood, etc. (Charles Horner, *P. J.*, Oct. 1874, p. 282.)

By the action of concentrated sulphuric acid upon castor oil is formed a valuable product known as "*Turkey-red oil*," much used in dyeing and printing with madder and alizarine. The water-soluble portion of this Turkey-red oil is *ricinoleo-sulphuric acid*, $C_{18}H_{33}O.O.HSO_3$. Turkey-red oil acts as a fixing agent, imparting a superior lustre to the fibre dyed with its aid.

Castor oil which is acrid to the taste may sometimes be rendered mild by boiling it with a small proportion of water. If turbid, it should be clarified by filtration through coarse paper. On exposure to the air it is apt to become rancid, and is then unfit for use.

Uses.—Good castor oil is a mild and speedy cathartic, usually operating with little griping or uneasiness, and evacuating the contents of the bowels without much increasing the alvine secretions. Hence it is particularly applicable to *constipation* from collections of indurated fæces, and to cases in which acrid substances have been swallowed or acrid secretions have accumulated in the bowels. From its mildness it is also especially adapted to diseases attended with irritation or inflammation of the bowels, as *colic, diarrhœa, dysentery,* and *enteritis*. It is habitually resorted to in cases of *pregnant* and *puerperal women*, and is decidedly, as a rule, the best and safest cathartic for children. Infants usually require a larger relative dose than adults.

The *dose* for an infant is from one to three or four fluidrachms (3.75 to 11.25 to 15 Cc.). It is difficult of administration, from its peculiarly disagreeable taste and from its clamminess and adhesiveness to the mouth. In a few cases, the disgust which it excites is utterly unconquerable by any effort of resolution. A common method of disguising the taste is to give it floating in mint or cinnamon water, but that which we have found, upon the whole, the least offensive is to give it floating on the froth of sarsaparilla syrup mixed with carbonic acid water. Some take it in wine, or spirituous liquors, or the froth of porter, but these are often contra-indicated by their stimulant property. An excellent method is to mix it with an equal amount of glycerin and strongly aromatize with a volatile oil. It separates on standing, but can readily be reincorporated by shaking. When the stomach is unusually delicate, the oil may be made into an emulsion with mucilage or the yolk of an egg, loaf sugar, and an aromatic water. Tragacanth has been recom-

[1] *Cohesion figures as a means of testing liquids.* A mode of testing oily or resinous liquids has been proposed by Charles Tomlinson, which is applicable to this oil, and may succeed when purely chemical methods fail. When one liquid is dropped on the surface of another, there are often curious figures produced, as the drop spreads out on the surface of the liquid upon which it falls, occasioned by the conflict between the cohesion of the drop and the forces which cause its diffusion. These the author called *cohesion figures*. As a rule, each liquid has its own characteristic figures, which are modified by the admixture of other liquids, and thus the means are afforded of testing not only the identity of any suspected liquid, but also its purity. To one not acquainted with the characteristic cohesion figures, it would be sufficient to try the experiment with a specimen known to be pure, and then to compare with the figure it forms, those formed by the specimen to be tested. The experiment should always be made under precisely similar circumstances. In reference to castor oil, it should be dropped from the end of a glass rod upon the surface of perfectly clear water, in a glass vessel scrupulously clean, as any imperfection in these respects might interpose a physical impediment to the success of the experiment. (*Chem. News*, Feb. 13, 1864, p. 79. See also *A. J. P.*, July, 1864.)

Effect on light.—Another test for castor oil is its influence on polarized light. The fixed oils generally have little or no power. Castor oil deviates the plane of polarization to the right, but loses this property if heated to 270° C. (518° F.). (*J. P. C.*, Nov. 1861, p. 339.)

[2] When distilled in vacuo it yields at first about one-third of its volume of nearly pure œnanthol, and after this, with great rise of temperature, a crystallizing body belonging to the oleic acid group and having the formula $C_{11}H_{20}O_2$. (*A. J. P.*, 1878, p. 182.)

[3] Buchheim believes the active principle of castor oil to be *ricinoleic acid*: this has been confirmed by the experiments of Hans Meyer (*A. E. P. P.*, xxviii. 1890), who finds that both pure ricinoleic acid and the ricinoleate of glycerin are active purgatives. Ricinelaidic acid, which Buchheim believed to be inactive, Meyer finds when given in fine emulsion to act as powerfully as does castor oil.

mended as producing a better emulsion than gum arabic. Tincture of opium may be added in cases of intestinal irritation. Castor oil may also be beneficially used as an enema, in the quantity of two or three fluidounces (60 or 90 Cc.), mixed with some mucilaginous liquid. It has been recommended as a local application to the breasts of nursing women, to promote the secretion of milk.

Though prone to become rancid by itself, it loses much of its susceptibility when mixed with lard, and some druggists are said to use it as a substitute for olive oil in ointments and cerates.

Dose, half a fluidounce to two fluidounces (15 to 60 Cc.).

Off. Prep.—Collodium Flexile, *U. S., Br.;* Linimentum Sinapis, *Br.;* Mistura Olei Ricini, *Br.;* Pilula Hydrargyri Subchloridi Composita, *Br.*

OLEUM ROSÆ. U. S., Br.

OIL OF ROSE

(ō'lę-ūm rō'ṣæ)

"A volatile oil distilled from the fresh flowers of *Rosa damascena* Mueller (Fam. *Rosaceæ*), having, when assayed by the process given below, a saponification value of not less than 10 nor more than 17. It should be kept in well-stoppered, amber-colored vials, in a cool place, protected from light. When dispensed, it should be completely liquefied by warming, if necessary, and well mixed by agitation." *U. S.* "The oil distilled from the fresh flowers of Rosa damascena, *Linn.*" *Br.*

Oleum Rosarum; Attar or Otto of Rose; Huile volatile de Rose pâle, *Fr. Cod.;* Essence de Rose, *Fr.;* Oleum Rosae, *P. G.;* Rosenöl, *G.;* Essenza de rose, *It.*

This is commonly called *attar, otto,* or *essence of roses.* It is prepared on a large scale in Turkey in Europe, especially in the Balkan Mountains, in Egypt, Persia, Cashmere, India, and other countries of the East, but European and American commerce is at present supplied chiefly from the region constituting the southern slope of the Balkans. The Bulgarian production of rose oil for 1903 amounted to 6200 kilos, for 1904 to 5000 kilos, while for 1905 the yield was estimated at 4150 kilos (*Schim. Rep.,* Nov. 1905). The roses are gathered in May, and are distilled with the green leaves of the calyx. They are put, to the amount of 30 or 60 pounds, into a tinned copper boiler of the capacity of about 150 pounds. The heat is applied over an open fire, and a boiling temperature is continued for two hours, when the first part of the distilled fluid is returned to the boiler, and the process is continued to completion. The oil collects on the top of the water in the receiver, when it is removed from time to time as it accumulates. (*P. J.,* June, 1872, p. 1051.) In the south of France it is prepared in small quantities by distilling the petals of the rose with water. The oil concretes and floats upon the surface of the water when it cools. The precise species of rose from which the oil is extracted is not in all instances certainly known, but it is said to be obtained from *R. damascena* in Northern India, *R. moschata* in Persia, and *R. centifolia* (*provincialis*) in the north of European Turkey. Hochstell of the Vienna University, who travelled in the region of the rose culture, and from whose paper the facts just mentioned were chiefly derived, states that the most important species cultivated in the valley of Kazanlik are *R. damascena, R. sempervirens,* and *R. moschata.* It is furnished in very minute proportion, not more than three drachms having been obtained by Polier in Hindostan, from 100 pounds of the petals. It is usually imported in small bottles, and is very costly.[1] Oil of rose was at one time prepared in Macedonia by crushing the petals in mills, expressing the fluid part, filtering it, and then exposing it to the sun in small glass vessels. The oil gradually collects on the surface of the liquid, and is removed. (*Ph. Cb.,* 1847, p. 783.) Landerer states that at Damascus and in other parts of Asia Minor the oil is prepared by dry distillation. The buds, being collected before sunrise, are placed in a glass retort, and the distillation is effected by a salt water bath, care being taken so to regulate the heat as not to scorch the petals. The water of the fresh roses and their oil come over together, and the latter, floating on the top, is readily separated.[2]

Oil of rose is nearly colorless, or presents some shade of green, yellow, or red, but, according to Polier, the color is no criterion of its value. Its odor is very powerful and diffusive. At 32.2° C. (90° F.) its sp. gr. is 0.832. Alcohol dissolves it, though not freely when cold. It is officially described as "a pale yellowish, transparent liquid, having the strong, fragrant odor of rose, and a mild, slightly sweetish taste. Specific gravity: 0.855 to 0.865 at 25° C. (77° F.). The addition of 70 per cent. alcohol precipitates the paraffin hydrocarbons of the Oil, but forms a clear solution with its other constituents, the solution being slightly acid to litmus T.S. The congealing point, when determined according to the following method, should be between 18° and 22° C. (64.4° and 71.6° F.). Introduce about 10 Cc. of Oil into a test-tube of about 15 Mm. diameter; insert a thermometer in such a manner that it touches neither the bottom nor the sides of the tube. Raise the temperature of the Oil in the tube from 4° to 5° above the

[1] For an account by R. Bauer of Constantinople, of oil of rose, its production, properties, adulteration, etc., see *P. J.,* Dec. 1867, 286; also *A. J. P.,* 1881, 367.

[2] The experiments of Schimmel are said to indicate that the oil of rose can be prepared from German-grown flowers with commercial success. It is affirmed that the product is superior to the Turkish oil in fineness and strength of aroma, and also that it differs in having a higher congealing point, German oil solidifying at 32° C., Turkish oil at 20° C. For an account of its production, see *P. J.,* Aug. 1886; also *P. J.,* 1893, 262.

saturation point by grasping it in the hand, and shake the tube gently. Allow the Oil to cool, and when the first crystals appear, note the temperature. This is regarded as the congealing point; a second test should be made for confirmation." *U. S.* "A pale yellow crystalline semi-solid, with the strong fragrant odor of rose and a sweet taste. Specific gravity 0.856 to 0.860 at 86° F. (30° C.). The congealing and melting points vary according to the proportion of crystalline matter, but should lie between 67° and 72° F. (19.4° and 22.2° C.)." *Br.* The U. S. P. (8th Rev.) regards the saponification value as of sufficient value to incorporate it as an official test, as follows:

Assay.—"Place in a weighing-bottle about 2 Cc. of the Oil of Rose, and weigh it accurately. Transfer it, with the aid of a little alcohol, to a 100 Cc. flask, and add 20 Cc. of half-normal alcoholic potassium hydroxide V.S. Connect the flask with a reflux condenser, and boil the mixture during thirty minutes on a water-bath. When cool, add 50 Cc. of distilled water and a few drops of phenolphthalein T.S., and titrate with half-normal sulphuric acid V.S. Subtract the number of Cc. of half-normal sulphuric acid V.S. required, from 20 (the 20 Cc. of half-normal alcoholic potassium hydroxide V.S. taken), multiply the difference by 27.87, and divide by the weight of the Oil to obtain the saponification value." *U. S.*

Oil of rose consists of two portions, one liquid, the other concrete at ordinary temperatures. These may be separated by freezing the oil and compressing it between folds of blotting paper, which absorbs the liquid oil and leaves the concrete stearopten. The liquid portion is oxygenated, while the solid portion, which is odorless when pure, consists of a mixture of several hydrocarbons, one of which melts at from 35.5° to 36.5° C., and is a paraffin of the formula $C_{16}H_{34}$. A sample of oil of rose distilled in Leipsic in 1884 yielded 28 per cent. of this stearopten, an inferior oil distilled in London gave 68 per cent., and a very good oil from the Balkans gave 9.20 per cent. The oxygenated portion consists of the two alcohols, $C_{10}H_{18}O$ and $C_{10}H_{20}O$, the former constituting 75 per cent. of the oil. This alcohol is now recognized as identical with the *geraniol* of palmarosa oil, while the compound $C_{10}H_{20}O$ corresponds to that obtained by the reduction of citronellal and has been named by Dodge, its discoverer, *citronellol.* The rhodinol of Eckart was a mixture of these two alcohols. (*Schim. Rep.*, April, 1898, 40.) While these two alcohols are mainly found in rose oil in the free state, esters of the same are also present in amounts varying from 2.5 to 3.5 per cent. (Gildemeister and Hoffmann, *Aetherische Oele*, p. 565.)

Oil of santal, other volatile oils, fixed oils, spermaceti, etc., are said to be added almost universally as adulterations. The volatile additions may be detected by their not being concrete; the fixed, by the greasy stain they leave on paper when heated. Guibourt has offered certain tests by which he thinks the purity of the oil may be determined. (See *A. J. P.*, xxi. 318.) A. Ganswindt recommends the following tests. Agitate 1 drop of the oil with 45 Gm. of warm water, and sprinkle the solution in a moderately warm room, which will soon be filled with a rose odor, in which foreign odors may be detected without difficulty. An adulteration with a fixed oil produces a permanent grease stain upon paper, and spermaceti is left behind on the evaporation of a few drops of the oil from a watch crystal in a water bath. On mixing a few drops of pure oil of rose with an equal bulk of sulphuric acid, the rose odor is not changed, but oils used for adulteration change their odor, which becomes apparent in the rose odor. Or 5 drops of the oil are mixed in a dry test tube with 20 drops of pure concentrated sulphuric acid; when the mixture is cool it is agitated with 20 Gm. of absolute alcohol, when a nearly clear solution should be obtained, which, heated to boiling, remains clear yellowish brown on cooling. In the presence of the oils of rose geranium, palmarosa, etc., the alcoholic mixture is turbid, and on standing separates a deposit without becoming clear. (*Seifens. Ztg.*, 1881, p. 32; *A. J. P.*, May, 1881.) The oil of one of the sweet scented Pelargoniums, perhaps the *rose geranium,* is much employed in Turkey for the purpose of adulteration. According to Hanbury, who appears to have thoroughly investigated the subject, two substances especially are used in Constantinople for adulterating the oil,—one spermaceti, the other a volatile oil produced by certain grasses in the East Indies belonging to the genus Andropogon, large quantities of which are exported from Bombay, partly directly to Europe, partly through the Arabian Gulf, whence it reaches Constantinople. The same oil is imported into London under the name of *Turkish essence of geranium,* or *geranium oil.*[1] Tedermann (*Zeit. An. Chem.*, 1895, 5) reached the conclusion, after much experimenting, that there is no reliable chemical or physical test for the adulteration of oil of rose with geranium oil. The sense of smell, according to Conroy, furnishes the best means of determining the quality; he recommends the dissolving of one drop of oil of rose in twenty drops of alcohol, pouring the solution in one fluidounce of warm water, shaking, and comparing the odor with that of a standard sample treated in the same way. (*P. J.*, 1896, 474; see also *C. D.*, 1897, 53.) O. Helm (*A. Pharm.*, 1885) states that the test with a mixture of five parts of chloroform and twenty parts of alcohol cannot be relied upon, as no separation of crystalline scales took place in four different rose oils which were doubtless genuine. But

[1] *Oil of Rhodium.*—This is said to be the oil from the wood of *Convolvulus scoparius* or *Genista canariensis.* It is used to adulterate oil of rose. An oil of rhodium is sold to rat catchers as a lure for rats, which is made by mixing one part of oil of rose with twenty parts of oil of copaiba.

Flückiger, on the other hand, stated that in an experience of many years it had never failed. For the other tests for oil of rose, see *N. R.*, 1883; *D. C.*, 1886. According to Bauer, the best tests of the purity of the oil are found in its congealing, in five minutes, at a temperature of 12.5° C. (54.5° F.), and its crystallizing, as a solid mass, in light, shiny plates, present everywhere throughout the liquid. These crystals are truncated semi-sided prisms, the angles of which are unequal, and which must be classed in the rhombic system. This stearoptene melted and allowed to cool, crystallizes in a manner so complete that the microscope can readily reveal the presence of foreign substances, such as spermaceti, fatty bodies, wax, and other analogous amorphous substances.

Oil of rose may be added, as a grateful perfume, to various spirituous preparations for internal use, and to cerates and ointments.

Off. Prep.—Unguentum Aquæ Rosæ, *Br.*

OLEUM ROSMARINI. U. S., Br.

OIL OF ROSEMARY

(ō'le-ŭm rŏs-ma-rī'nī)

"A volatile oil distilled from the fresh flowering tops of *Rosmarinus officinalis* Linné (Fam. *Labiatæ*), yielding, when assayed by the process given below, not less than 5 percent. of ester, calculated as bornyl acetate, and not less than 15 percent. of total borneol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from the flowering tops of Rosmarinus officinalis, *Linn.*" *Br.*

Oleum Rorismarini, Oleum Anthos; Huile volatile de Romarin, *Fr. Cod.*; Essence de Romarin, *Fr.*; Oleum Rosmarini, *P. G.*; Rosmarinöl, *G.*; Essenza di rosmarino, *It.*; Esencia de romero, *Sp.*

The fresh leaves of rosemary yield, according to Baumé, 0.26 per cent. of volatile oil, but the product is rated much higher by others. Schimmel & Co. obtained by distillation from dry French rosemary flowers 1.4 per cent. of oil.

This oil is colorless, with an odor similar to that of the plant, though less agreeable. Its sp. gr. is said to be 0.911, but reduced to 0.8886 by rectification (0.895 to 0.915, *U. S.*). Buignet gives the sp. gr. of the rectified oil at 0.896, and states that it is moderately dextrogyrate. Its reaction is neutral. It is soluble in all proportions in alcohol of 0.830, but requires for solution at 64° F. forty parts of alcohol of 0.887. (Berzelius.) It is officially described as "a colorless or pale yellow, limpid liquid, having the characteristic, pungent odor of rosemary, and a warm, somewhat camphoraceous taste. Specific gravity: 0.894 to 0.912 at 25° C. (77° F.). The Oil should be dextrogyrate, the angle of rotation being not more than +15° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). The first 10 percent. obtained by fractional distillation should also be dextrogyrate. Soluble in about one-half volume or more of 90 percent. alcohol; also in 2 to 10 volumes of 80 percent. alcohol." *U. S.* "Specific gravity 0.900 to 0.915. It should dissolve in twice its volume of *alcohol* (90 per cent.), and should not rotate the plane of a polarized ray of light more than 10° to the right in a tube 100 millimetres long (absence of oil of turpentine)." *Br.* The U. S. P. (8th Rev.) furnishes the following assay for the borneol-content:

Assay.—"Introduce into a tared flask 10 Cc. of Oil of Rosemary, and note the exact weight; add 25 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 25 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference of 9.734, and divide the product by the weight of the Oil of Rosemary taken to find the percentage of bornyl acetate. Wash the residual oil repeatedly with water, transfer it to a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 1 Gm. of anhydrous sodium acetate, and boil gently during one hour. Allow it to cool, wash the acetylized oil with distilled water, and afterwards with sodium hydroxide T.S., until the mixture is slightly alkaline to phenolphthalein T.S., and then dry it with the aid of fused calcium chloride, and filter. Transfer to a tared 100 Cc. flask 5 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil the mixture during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. required from the 50 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 7.649, and divide the product by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of borneol in the Oil of Rosemary.

NOTE.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide V.S. consumed by the acetylized oil." *U. S.*

Kane gives its sp. gr. at 0.897, its boiling point at 365° F. Kept in bottles imperfectly stoppered, it deposits a *stearoptene*, sometimes amounting, according to Proust, to one-tenth of the oil. Both Gladstone and Flückiger find that most of the oil consists of a hydrocarbon of the composition $C_{10}H_{16}$, boiling at 165° C. (329° F.), and Schimmel & Co. (*Schim.*

Rep., Oct. 1889) identified this hydrocarbon as *pinene,* but there is a smaller fraction boiling at from 200° to 210° C. (392° to 410° F.), which at low temperatures deposits a camphor, $C_{10}H_{18}O$, identified as borneol. Weber examined oil of rosemary in Wallach's laboratory (*Ann. Ch. Ph.,* 238, 89 to 108), and found that the fraction boiling between 176° and 182° C. contains *cineol,* $C_{10}H_{18}O$. The oil is therefore recognized at present as containing *dextrogyrate pinene, camphene, cineol, borneol,* and *camphor.* According to Flückiger (*A. J. P.,* 1885, 132), from 20,000 to 25,000 kilogrammes of oil of rosemary were produced in Grasse every year. It is said to be sometimes adulterated with oil of turpentine, which may be detected by mixing the suspected liquid with an equal volume of pure alcohol, the oil of rosemary is dissolved, and that of turpentine left. This oil is stimulant, but is employed chiefly as an ingredient in rubefacient liniments. For a case of fatal poisoning, see *A. J. P.,* xxiii. 286.

Dose, three to six minims (0.2 to 0.4 Cc.).

Off. Prep.—Linimentum Saponis, *U. S., Br.;* Spiritus Rosmarini, *Br.;* Tinctura Lavandulæ Composita, *U. S., Br.*

OLEUM SABINÆ. U. S.

OIL OF SAVIN

(ō'lę-ŭm są-bī'næ)

"A volatile oil distilled from the fresh tops of Savin. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Huile volatile (Essence) de Sabine, *Fr.;* Sadebaumöl, *G.*

According to the more recent authorities, the proportion of volatile oil obtained from savin varies as much as from 1 to 2.5 per cent. "A colorless or yellowish liquid, having a peculiar terebinthinate odor, and a pungent, bitter, and camphoraceous taste. Specific gravity: 0.903 to 0.923 at 25° C. (77° F.). The Oil is dextrogyrate, the angle of rotation varying between +40° and +60° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). Soluble in about one-half volume or more of 90 percent. alcohol." *U. S.* According to Schimmel & Co. (*Schim. Rep.,* April, 1897), its specific gravity is from 0.91 to 0.925, optical rotation +45° to +60°, and it contains *pinene,* $C_{10}H_{16}$, *cadinene,* $C_{15}H_{24}$, and an alcohol, $C_{10}H_{16}O$, *sabinol,* which is present both in the free state and as acetic ester. With iodine it becomes heated, detonates, and gives off yellow and violet-red vapors. (Flaschoff.) The oil of savin is a powerful local irritant, producing, when persistently applied to the skin or the mucous membrane, violent inflammation. It has been much used for the purpose of producing criminal abortion, and in a number of such cases has caused death, the symptoms being violent abdominal pain, bloody vomiting and purging, diminution or suppression of urine, disordered respiration, unconsciousness, convulsions, and fatal collapse. It is a powerful stimulant to the uterine system, and has been given with alleged success in *atonic amenorrhœa* and *menorrhagia.*

Externally, Pincus used it successfully, in the proportion of from five to thirty minims in a fluidounce of alcohol, for the cure of *alopecia pityroides.* He applied it by rubbing it on the head and also by means of compresses.

Dose, two to five minims (0.12 to 0.3 Cc.).

OLEUM SANTALI. U. S., Br.

OIL OF SANTAL [Oil of Sandalwood]

(ō'lę-ŭm săn'tą-lī)

"A volatile oil distilled from the wood of *Santalum album* Linné (Fam. *Santalaceæ*), yielding, when assayed by the process given below, not less than 90 percent. of alcohols, calculated as santalol. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "The oil distilled from the wood of Santalum album, *Linn.*" *Br.*

Oleum Ligni Santali; Oleum Santali Flavi; Oil of Sandal Wood; Huile volatile (Essence) de Santal, *Fr.;* Oleum Santali, *P. G.;* Ostindisches Sandelholzöl, Santelöl, *G.;* Esencia de sandalo, *Sp.*

Under the name of sandal wood various drugs of diverse origin and character find their way into commerce. Of these, the wood of the *Pterocarpus santalinus* is described in this book under its official name of *Santalum Rubrum,* or *Red Saunders. Sandal wood bark,* which is believed by H. Stieren to be obtained from some species of Myroxylon or Myrospermum, is described as occurring in irregular, more or less smooth or unevenly corrugated pieces, of a light, whitish-cinnamon color, with dark, hard epidermis, and of an agreeable, custard-like odor, and an aromatic, slightly acrid, balsamic, bitterish taste. From it Stieren obtained over fifteen per cent. of a clear substance resembling Peruvian balsam. This bark is used for burning in churches as a substitute for frankincense, and bears no relation to sandal wood proper. (*P. J.,* xv. 680.) A sandal wood is yielded by the *Fusanus spicatus* (*S. Cygnorum*) and *F. acuminatus* (*S. acuminatum*) of Australia, whence it is shipped in large quantities to China. An oil distilled from this wood, now coming into the European market, is said to be less odorous than the official product.

Other varieties of sandal wood are collected in the Hawaiian Islands from *Santalum freycinetianum,* Gaud., and *S. pyrularium,* A. Gray; in the Feejee Islands from *S. Yasi,* Seem.; in New Caledonia from *S. austrocaledonicum,* Vieillb.; and in Queensland from *Eremophila Mitchelli.* For an account of the sandal wood oil industry of Western Australia, see *C. D.,* 1898, 708. For elaborate microscopic descriptions of the sandal woods, method

of obtaining the oil, etc., see various papers in the *P. J.*, vol. xvi.; also *Bull. Pharm.*, 1895, 55. West Australian sandal wood is derived according to Parry (*C. D.*, 1898, 11) from four species of the genus, *S. Cygnorum, S. lanceolatum, S. acuminatum* and *S. persicarum. Venezuelan sandal wood,* the source of the so-called *West Indian sandal wood* of commerce, is, according to E. M. Holmes (*P. J.*, 62), obtained from the *Schimmelia oleifera,* Holmes. A tree-like shrub, *Osyris tenuifolia,* Engl., belonging to the Santalaceæ, and a native of East Africa, is said to yield a wood which is very similar to that of the genuine Indian sandal wood. (*P. J.*, 60.)

The *Santalum album,* which yields the official oil, is a small tree twenty or thirty feet high, a native of the mountainous portions of India and of various islands of the Eastern Archipelago, but cultivated in India for the sake of its oil. J. L. Pigot furnished an interesting account of sandal wood cultivation accompanied by a map. (*Schimmel's Report,* 1900.)

Oil of santal is distilled in the United States, Germany, England, and India. According to the Indian Pharmacopœia the yield of oil is about 2.5 per cent. Oil of santal is habitually adulterated, castor oil and other fixed oils being added, and on the continent of Europe by the volatile *oil of cedar,* which is obtained by distilling the chips left in the making of lead pencils. Chapoteaut (*Bull. Soc. Chim.*, 37, p. 353) found two constituents, one of which he calls *santalol,* $C_{15}H_{26}O$, boiling at 310° C., and the other *santalal,* $C_{15}H_{24}O$, boiling at 300° C. Both of these are decomposed by distilling over phosphoric anhydride, the one yielding $C_{15}H_{24}$, boiling point 260° C., and the other $C_{15}H_{22}$, boiling point 245° C. Sesquiterpenes are also believed to be present in oil of santal. A specimen of oil of santal from South Australia, examined by Schimmel & Co. (*Schim. Rep.*, Oct. 1891), afforded a white crystalline principle, melting at 104° to 105° C., which crystallized out in the oil. Parry (*P. J.*, 55, p. 118) found that a portion of the oil was saponifiable, so he assumed the presence of esters of santalol. The U. S. Pharmacopœia describes the oil of santal as "a pale yellow, somewhat thick liquid, having a peculiar, aromatic odor, and a pungent, spicy taste. Specific gravity: 0.965 to 0.975 at 25° C. (77° F.). The Oil is lævogyrate; its angle of rotation should be not less than —16° nor more than —20° in a 100 Mm. tube, at a temperature of 25° C. (77° F.) (absence of *other varieties* of *sandalwood oil,* etc.). Readily soluble in alcohol, the solution being slightly acid to blue litmus paper. It is soluble in 5 volumes of 70 percent. alcohol. The presence of chloroform may be detected in the following manner: If a small strip of filter paper folded in the form of a taper and saturated with Oil of Santal be placed in a small porcelain dish, and a clean beaker, moistened on the inner surface with distilled water, be inverted over the small dish immediately after igniting the taper, a part of the products of combustion will be absorbed by the water; if the beaker be then rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity upon the addition of a few drops of silver nitrate T.S. (absence of *chlorinated products*)." *U. S.* "Somewhat viscid in consistence, pale yellow in color, having a strongly aromatic odor and a pungent and spicy taste. Specific gravity 0.975 to 0.980. It forms a clear solution with six times its volume of *alcohol* (70 per cent.) (absence of cedar wood oil). It rotates the plane of a ray of polarized light to the left, through an angle of not less than 16° and not more than 20°, in a tube 100 millimetres long (absence of other varieties of sandal wood oil.)" *Br.* The percentage of santalol [1] furnishes the basis for the official test, which is as follows:

Assay for Santalol. U. S. P. (8th Rev.) "Introduce 10 Cc. of Oil of Santal into a flask provided with a ground-glass tube-condenser (acetylization flask), add 10 Cc. of acetic acid anhydride and about 2 Gm. of anhydrous sodium acetate, and boil the mixture gently during one hour and a half. Allow it to cool, wash the acetylized oil with distilled water, and afterwards with sodium hydroxide T.S., until the mixture is slightly alkaline to phenolphthalein T.S., and then dry it with the aid of fused calcium chloride, and filter. Transfer to a tared 100 Cc. flask 3 Cc. of the dry acetylized oil, note the exact weight, add 50 Cc. of half-normal alcoholic potassium hydroxide V.S., connect with a reflux condenser, and boil gently during one hour. After cooling, titrate the residual alkali with half-normal sulphuric acid V.S., using phenolphthalein T.S. as indicator. Subtract the number of cubic centimeters of half-normal sulphuric acid V.S. re-

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[1] According to L. Kebler (see also *Schim. Rep.*, Oct. 1895), the degree of purity of oil of sandal wood can readily be made out by estimating, by the process which follows, the percentage of santalol. This percentage probably varies in pure oils from 93 to 98. The official assay is based upon this method.

Into a flask, provided with a reflux condenser, place 20 grammes of the oil, add an equal volume of acetic anhydride (not anhydrous acetic acid) and 2 grammes of fused sodium acetate; then gently boil for about two hours. Wash the mixture first with water, then with a solution of sodium hydroxide, then with water again; finally dry the resulting oil with anhydrous sodium sulphate. Of this dried product, place from 2 to 5 grammes into a flask provided with a reflux condenser, add an excess of normal alcoholic potassium hydroxide, and boil for half an hour. Ascertain the amount of alkali consumed by titrating back the excess, with normal sulphuric acid. From the data thus obtained the amount of santalol is readily calculated by the following formula:

$$P = \frac{a \times 22.2}{s - (a \times 0.042)}$$

P, Santalol; a, number of Cc. of normal alkali consumed; and s, the amount in grammes of the acetylized oil used for saponification.

The following equations represent the reactions involved:

$$C_{15}H_{25}OH + (C_2H_3O)_2O = C_{15}H_{25}OCOCH_3 + CH_3CO_2H$$

Santalol + Acetic anhydride = Santalol acetate + Acetic acid

$$C_{15}H_{25}O.COCH_3 + KOH = C_{15}H_{25}OH + CH_3CO_2K.$$

Santalol acetate + Potassium hydroxide = Santalol + Potassium acetate.

quired from the 50 Cc. of half-normal alcoholic potassium hydroxide V.S. taken, multiply the difference by 11.026, and divide by the weight of the dry acetylized oil taken, less the above difference multiplied by 0.021; the quotient will represent the percentage of santalol in the Oil of Santal.

NOTE.—The difference referred to above represents the number of cubic centimeters of half-normal alcoholic potassium hydroxide V.S. consumed by the acetylized oil." *U. S.*

The Indian Pharmacopœia gives the sp. gr. of the oil at 0.98, the British at 0.96, while in a number of specimens examined by E. M. Holmes (*P. J.*, xvi. 821) the sp. gr. varied from 0.96 to 0.99. The sp. gr. of the oil of cedar wood, according to Ince, is 0.948. A large percentage of it may be added to the oil of santal without affecting its density sufficiently to be detected. Holmes states that the presence of more than 10 per cent. of the cedar oil can be recognized through the different solubilities of the oils in alcohol. (See *P. J.*, xvi. 820.) R. A. Cripps, after a thorough examination of the oils in the London market (see *P. J.*, 1892, 461), gives this test: "Two drops of the oil added to six drops of nitric acid, sp. gr. 1.5, on a white tile, should give a yellow to bright reddish-brown coloration, without any green, indigo, or violet tint at the edges during five minutes. For complete saponification in alcoholic solution, it requires not more than 1 per cent. of potassium hydrate." (See also *A. J. P.*, 1893, 20; *Schim. Rep.*, Oct. 1893; *P. J.*, 1895, 118; *West. Drug.*, 1897, 262.) West India oil can be distinguished from the genuine oil by its deviating the plane of polarization to the *right* instead of to the *left*. (*Pharmacographia.*) In two specimens of oil of santal, sp. gr. 0.9649 and 0.9573, F. H. Alcock found strong fluorescence. (*P. J.*, 1886, 923.)

Uses.—The oil of santal is used chiefly as a perfume, but it is also a very valuable remedy in the treatment of *chronic* and *subacute inflammations* of the *mucous membrane*, especially in *bronchitis* and in *gonorrhœa* when the first period of severe acute inflammation has passed. It is in concentrated form a local irritant, and probably is capable of causing more or less systemic excitement, although the effects of large doses of it upon the general organism are not well known. It was first recommended by Thos. B. Henderson in gonorrhœa, who, however, is said to have used the oil of *S. myrtifolium*.

Dose, fifteen to twenty minims (0.9 to 1.3 Cc.), in emulsion, or preferably in capsule, three or four times a day.

OLEUM SASSAFRAS. U. S.

OIL OF SASSAFRAS

(ō'lę-ŭm sās'są-frăs)

"A volatile oil distilled from the root, especially the root bark, of *Sassafras variifolium* (Fam. *Lauraceæ*). It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Huile volatile (Essence) de Sassafras, *Fr.*; Sassafrasöl, *G.*; Esencia de sasafras, *Sp.*

The proportion of oil yielded by the root of sassafras is variously stated at from less than 1 to somewhat more than 2 per cent. The bark of the root, directed by the U. S. Pharmacopœia, would afford a larger amount. Very large quantities of the oil were at one time distilled in Maryland and sent to Baltimore. The usual yield is said by Sharp to be one pound from three bushels of the root. From fifteen to twenty thousand pounds were sent annually, before 1861, to the Baltimore market. (A. P. Sharp, *A. J. P.*, Jan. 1863, p. 53.) At Richmond, Va., in 1871, it was being manufactured at the rate of forty gallons of pure oil per week. The root, chopped fine by machinery, has steam forced through it in a closed tub, and the oil is then distilled in the ordinary way. 800 pounds of unrectified oil are said to be obtained from 40,000 pounds of root. (*M. S. Rep.*, Aug. 26, 1871.) The oil is of a yellow color or colorless, becoming reddish by age. It has the fragrant odor of sassafras, with a warm, pungent, aromatic taste, and a neutral reaction. It is among the heaviest of the volatile oils, having the sp. gr. of 1.094, or 1.087 at 15° C. on the authority of Buignet, who states also that it is very slightly dextrogyrate. It is officially described as "a yellow or reddish-yellow liquid, having the characteristic odor of sassafras, and a warm, aromatic taste. Specific gravity: 1.065 to 1.075 at 25° C. (77° F.). The Oil is dextrogyrate, but should not deviate the ray of polarized light more than +4° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). Soluble in all proportions in 90 percent. alcohol, the solution being neutral to litmus paper." *U. S.* The most complete investigation of sassafras oil is that made by Power and Kleber in 1896. (*Schim. Rep.*, April, 1896.) They find it to have the following composition: safrol, $C_{10}H_{10}O_2$, about 80 per cent.; pinene and phellandrene, $C_{10}H_{16}$, about 10 per cent.; dextrogyrate camphor, $C_{10}H_{16}O$, about 6.8 per cent.; eugenol, $C_{10}H_{12}O_2$, about 0.5 per cent.; a high boiling portion consisting of cadinene and residue, 3 per cent. They say that the hydrocarbon constituent of sassafras oil, to which Grimaux and Ruotte gave the name of safrene, is, as just stated, a mixture of pinene and phellandrene. Safrol, which is now official, crystallizes well in hard four- or six-sided prisms, with the odor of sassafras. It liquefies at 11° C. (51.8° F.), boils at 232° C. (449.6° F.), has a sp. gr. of 1.106, and is destitute of rotatory power. Variation in the sp. gr. of oil of sassafras may often arise through the congelation and separation of safrol, or through stratification. (La Wall and Pursel, *A. J. P.*, 1898, 340.) Flückiger ascertained that safrol was one of those

remarkable bodies which are capable of existing either in a solid or in a fluid condition long after they have passed their freezing or their melting point. Chemically, it has been found to be the *methylene ether of allyl-dioxybenzene.* Safrol appears to be widely distributed in the vegetable kingdom, probably existing in the bark of the *Mespilodaphne Sassafras,* also in the *Puchury* or *Sassafras nuts,* both of Brazil, as well as in the barks of *Atherosperma moschatum* and of *Beilschmiedia obtusifolia* of Australia,[1] and in the bark of *Doryphora Sassafras* of New Caledonia. It is now commercially extracted from oil of camphor, and it probably could be obtained from the oil of various species of the genus *Cinnamomum.* (See *Safrolum;* also *P. J.,* June, 1887.)

Uses.—Oil of sassafras is chiefly used for flavoring purposes, but has physiological properties similar to those of the oil of cloves and other allied volatile oils, and may be used for similar purposes. A teaspoonful of it produced in a young man vomiting, collapse, somewhat dilated pupils, and pronounced stupor. (*Cincinnati Lancet-Clinic,* Dec. 1888.) According to the experiments of A. Heffter (*Atti Dell' XI. Congres. Med. Internaz.,* iii. 1894), safrol is slowly absorbed from the alimentary canal, and escapes through the lungs unaltered and through the kidneys oxidized into *piperonalic acid.* When taken in sufficient dose, it quickly kills by a centric paralysis of respiration, preceded by great depression of the circulation, and when taken in smaller yet toxic amount, it causes death by wide-spread fatty degeneration of the heart, liver, kidneys, etc. Its isomer, *isosafrol,* is in warm-blooded animals much less active as a poison than is safrol, and is chiefly eliminated as *piperonalic acid.*

Dose, of oil of sassafras, three to six minims (0.2 to 0.4 Cc.).

Off. Prep.—Syrupus Sarsaparillæ Compositus, *U. S.;* Trochisci Cubebæ, *U. S.*

OLEUM SINAPIS VOLATILE. U. S., Br.

VOLATILE OIL OF MUSTARD

(ō'lę-ŭm sį-nā'pīs vǫ-lăt'į-lē)

"A volatile oil obtained from Black Mustard (freed from its fatty oil) by maceration with water and subsequent distillation, yielding, when assayed by the process given below, not less than 92 percent. of allyl iso-thiocyanate. It should be carefully kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.* "Distilled from Black Mustard seeds after maceration with water." *Br.*

Oleum Sinapis, *Br.* 1885; Oleum Sinapis Ætherеum; Oil of Mustard; Huile volatile (Essence) de Moutarde, *Fr.;* Oleum Sinapis, *P. G.;* Senföl, Aetherisches Senföl, *G.;* Essenza di senape, *It.;* Esencia de mostaza negra, *Sp.*

[1] The bark described by Dymock as that of *Beilschmiedia fagifolia,* according to the researches of E. S. Hooper, contains saponin and probably is not derived from Beilschmiedia or any other genus of the Lauraceæ. (*P. J.,* lxxii.)

The *volatile oil of mustard* is usually obtained from seeds which have been deprived of their fixed oil by pressure. It is "a colorless or pale yellow, limpid, and strongly refractive liquid, having a very pungent and acrid odor. *Great caution should be exercised when smelling this Oil;* it should not be tasted without being highly diluted. Specific gravity: 1.013 to 1.020 at 25° C. (77° F.). Miscible with alcohol in all proportions, forming a clear solution. If to 3 Gm. of the Oil 6 Gm. of sulphuric acid be gradually added, the liquid being kept cool, the mixture, upon subsequent agitation, will evolve sulphur dioxide, but it will remain of a light yellow color, and although at first clear, it will afterwards become thick and occasionally crystalline, and the pungent odor of the Oil will disappear. If a portion of the Oil be heated in a flask connected with a well-cooled condenser, it should distil completely between 148° and 152° C. (298.4° and 305.6° F.), and both the first and the last portions of the distillate should have the same specific gravity as the original Oil (absence of *alcohol, chloroform, petroleum, fatty oils,* or more than traces of *carbon disulphide*). If a small portion of the Oil be diluted with 5 times its volume of alcohol, and a drop of ferric chloride T.S. be added, no blue or violet color should be produced (absence of *phenols*)." *U. S.* "Specific gravity 1.018 to 1.030. It distils between 297° F. (147.2° C.) and 306° F. (152.2° C.), and the first and last portions of the distillate should have the same specific gravity as the original Oil (absence of ethylic alcohol and petroleum)." *Br.* The U. S. P. (8th Rev.) furnishes the following assay process:

Assay.—"Weigh accurately about 2 Gm. of Volatile Oil of Mustard, and dilute this with sufficient alcohol to make 50 Cc. of the solution represent 1 Gm. of the Oil; of this solution, 5 Cc. are transferred to a 100 Cc. measuring flask, and 30 Cc. of tenth-normal silver nitrate V.S. and 5 Cc. of ammonia water are added. The flask is well-stoppered and set aside in a dark place for twenty-four hours. The contents of the flask are diluted with water to the 100 Cc. mark and filtered. To 50 Cc. of the filtrate, 4 Cc. of nitric acid and a few drops of ferric ammonium sulphate T.S. are added, and finally sufficient tenth-normal potassium sulphocyanate V.S. to produce a permanent red color; not more than 5.6 Cc. of the latter reagent should be required (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 0.00492 gramme of allyl iso-thiocyanate)." *U. S.*

Will considers volatile oil of mustard to be *allyl isosulphocyanate,* $CSNC_3H_5$ (*allyl isothiocyanate*), the compound radical being the same as that of oil of garlic, which is considered a sulphide of allyl. (*Chem. Gaz.,* Nos. 62 and 64.) It is the principle upon which black mustard seeds depend for their activity. Volatile oil of mustard was first produced artificially by Berthelot and S. de Luca, by treating allyl

iodide, C_3H_5I, with an alcoholic solution of potassium sulphocyanate. It is now extensively manufactured artificially by this method. What first forms is allyl sulphocyanate, which is not identical with, but only an isomer of, mustard oil (allyl isosulphocyanate). But if the sulphocyanate be heated to its boiling point (161° C.) the thermometer sinks rapidly to 150° C., because of the change into the isosulphocyanate, or mustard oil. This change also takes place spontaneously at summer temperature. A small quantity of carbon disulphide seems always to be produced at the same time.[1] Allyl iodide is procured by treating glycerin with phosphorus iodide, and differs from volatile oil of garlic (allyl sulphide) only in containing iodine instead of sulphur. (*J. P. C.,* Août, 1855, p. 124.) According to Zeller, the seeds yield from 0.33 to 0.63 per cent. of the oil. Will and Koerner in 1863 explained the occurrence of this allyl isosulphocyanate in mustard oil. It does not occur ready formed in the seeds, but is produced by the decomposition of a compound, *sinigrin* (*potassium myronate*), occurring there. This sinigrin, $C_{10}H_{18}KNS_2O_{10}$, is decomposed under the influence of *myrosin,* an albuminous ferment which is present, and yields as products of decomposition C_3H_5CNS (allyl isosulphocyanate), $HKSO_4$ (acid potassium sulphate), and $C_6H_{12}O_6$ (glucose). "The aqueous solution of myrosin coagulates at 60° C. (140° F.), and then becomes inactive; hence mustard seed which has been heated to 100° C. (212° F.), or has been roasted, yields no volatile oil, nor does it yield any if powdered and introduced at once into boiling water." (*Pharmacographia,* p. 67.) As it is often adulterated with other oils, a test has been proposed consisting of concentrated sulphuric acid, 50 drops of which are to be mixed with 5 drops of the suspected oil in a small glass tube. If the oil be pure, little change of color will be produced, but if any adulterating oil be present, a red or brown color will soon appear. Rectified oil of petroleum is the only exception, as the color of this is not affected by the acid, but it would be recognized by its insolubility in sulphuric acid. (See *A. J. P.,* July, 1865, p. 285.) Ammonia converts the mustard oil into *thiosinamin,* according to the reaction

$$CSNC_3H_5 + NH_3 = C_4H_8N_2S$$

which separates in colorless rhombic crystals, melting at 70° C., and soluble in water, alcohol, and ether. The reaction is stated by Flückiger (*Pharm. Chem.,* 2d ed., 1888, p. 20) to be quantitative. Adulteration with alcohol is readily detected by its much lower boiling point, which also enables it to be separated by distillation. It has been adulterated with considerable quantities of carbon disulphide, which may be detected by distillation at a temperature not exceeding 80° C. and mixing the distillate with sulphuric acid, when the carbon disulphide rises to the surface. Oil of mustard naturally contains about 0.56 per cent. of carbon disulphide. (*A. J. P.,* 1881, p. 572.)

White mustard seeds yield different products. When deprived of fatty oil they yield to boiling alcohol colorless crystals of *sinalbin,* an indifferent substance readily soluble in cold water, but sparingly so in cold alcohol. According to Will, it breaks up under the action of myrosin into *acrinyl sulphocyanate,* $C_7H_7O.CNS$, *sinapine sulphate,* $C_{16}H_{25}NSO_9$, and *glucose,* $C_6H_{12}O_6$. This acrinyl sulphocyanate is a nearly colorless, non-volatile oil, and the rubefacient and vesicating principle of white mustard. *Sinapine* has not yet been isolated, but it is an unstable alkaloid.

Uses.—An application of the principles developed in the foregoing paragraphs has been suggested by Lebaigue, who proposes applying to one sheet of paper a concentrated solution of *potassium myronate,* and to a second a concentrated solution of *myrosin,* and drying them. When used, the leaves are to be moistened and applied to the surface, one over the other. Volatile oil of mustard is formed by the reaction of the two principles, and a sinapism is obtained. (*J. P. C.,* Août, 1868, p. 118.) From the foregoing account of the chemical relations of mustard, it is obvious that admixture with alcohol or the acids, or the application of a boiling heat, can only have the effect of impairing its medicinal virtues, and that the best vehicle, whether for external or internal use, is water at common temperatures. The volatile oil of mustard has been employed as a substitute for the mustard plaster. For this purpose one part may be mixed with sixty parts of alcohol, and the mixture applied sprinkled not too thickly on piline or muslin, covered with waxed paper. It acts speedily and efficiently.

The oil is too pungent and irritating to be given internally.

Off. Prep.—Linimentum Sinapis, *Br.*

OLEUM TEREBINTHINÆ. U. S., Br.

OIL OF TURPENTINE

(ō'lē-ŭm tĕr-ē-bĭn'thĭ-næ)

"A volatile oil recently distilled from turpentine. It should be kept in well-stoppered bottles." *U. S.* "The oil distilled, usually by the aid of steam, from the oleo-resin (turpentine) obtained from Pinus sylvestris, *Linn.,* and other species of Pinus; rectified if necessary." *Br.*

Essence de Térébenthine, *Fr. Cod.;* Huile volatile de Térébenthine, *Fr.;* Oleum Terebinthinæ, *P. G.;* Terpentinöl, *G.;* Essenza di trementina, *It.;* Esencia de trementina, Aceite volatil de trementina, *Sp.*

This oil is commonly called *spirits* (or *spirit*) *of turpentine.* It is prepared by distillation

[1] *Allyl Bromide.*—This compound of allyl was first prepared by Wurtz in 1857 (*Ann. Ch. Ph.,* li. 91) by the reaction of allyl iodide on one and a half times its weight of bromine. It is a colorless liquid, soluble in ether boiling at 170° C., and having a specific gravity of 2.436. De Fleury (*A. Pharm.,* Aug. 1886) affirms that in doses of five drops, two to four times a day, in capsules, it is a valuable remedy in *hysteria, asthma,* and *convulsions.*

from our common turpentine, though equally afforded by other varieties. It may be distilled either with or without water, but in the latter case a much higher temperature is required, and the product is liable to be empyreumatic. To obtain it quite pure it should be redistilled from a solution of potassium hydroxide. The turpentine of *Pinus palustris* is said to yield about 17 per cent. of oil, while that from *Pinus Pinaster* affords 25 per cent., and that from *Pinus sylvestris* 32 per cent. Large quantities are distilled in North Carolina. The exportations from the United States for the year ending June 30, 1903, amounted to 16,378,787 gallons, valued at $8,014,322, and for the year ending June 30, 1904, to 17,202,808 gallons, valued at $9,446,155.

Pure oil of turpentine is "a thin, colorless liquid, having a characteristic odor and taste, both of which become stronger and less pleasant by age and exposure to the air. Specific gravity: 0.860 to 0.870 at 25° C. (77° F.). When Oil of Turpentine is distilled, the larger part should pass over between 155° and 162° C. (311° and 323.6° F.). Soluble in 3 times its volume of alcohol. If 5 Cc. of Oil of Turpentine be shaken with an equal volume of potassium hydroxide T.S., its color should not become darker than a light straw-yellow upon standing twenty-four hours. If 1 Cc. of the Oil be evaporated in a small dish on a water-bath, it should leave not more than a very slight residue (absence of *petroleum, paraffin oils,* or *rosin*). Three drops of Oil of Turpentine, placed on a sheet of clean white filter paper and exposed to the air, should evaporate entirely without leaving a permanent stain (absence of *kerosene* or *rosin oil*). If 5 Cc. of Oil of Turpentine be placed in a small beaker, and 20 Cc. of sulphuric acid be gradually added, with agitation, while the beaker is cooled by immersion in cold water, and the contents, after cooling and renewed agitation, be transferred to a burette, graduated in tenths, the clear layer which forms after the dark mass has settled should not measure more than 0.35 Cc. (absence of *petroleum benzin, kerosene,* or *similar hydrocarbons*)." *U. S.* "Limpid, colorless, with a strong peculiar odor, which varies in the different kinds of Oil, and a pungent and somewhat bitter taste. It is soluble in its own volume of *glacial acetic acid.* It commences to boil at about 320° F. (160° C.), and almost entirely distils below 356° F. (180° C.), little or no residue remaining." *Br.* As found in commerce, it always contains oxygen, but when perfectly pure it consists exclusively of carbon and hydrogen, and is composed of one or more *terpenes.* (See p. 812.) The English or American oil (prepared from *Pinus australis*) is composed of *dextro-pinene,* while the French oil (prepared from *Pinus Pinaster*) is composed of *lævo-pinene.* On the other hand, the Russian turpentine contains, in addition to *pinene, dipentene* (or *cinene*) and *sylvestrene,* and the Swedish turpentine contains *pinene* and *sylvestrene.* Both the American and the French oil of turpentine boil at about 156° C. (312.8° F.). On heating oil of turpentine to about 300° C. (572° F.) in a sealed tube for several hours it is converted into a polymer called *iso-terebenthene,* $C_{20}H_{32}$, which is so oxidizable that it is converted into a viscid mass on exposure to the air for a few hours. It has, moreover, a marked odor, resembling oil of lemon, and boils at 176° to 177° C. (348.8° to 350.6° F.). On treatment with a small portion of sulphuric acid, oil of turpentine yields an optically inactive liquid, which boils at 160° C. (320° F.). This is a mixture resolvable by repeated fractional distillation into *terebene,* $C_{10}H_{16}$, boiling at 150° C. (302° F.); *cymene,* $C_{10}H_{14}$, boiling at 175° C. (347° F.); a small quantity of a camphor-like body, boiling at 200° C. (392° F.); *colophene,* $C_{20}H_{32}$, boiling at 318° C. (604.4° F.), and a mixture of semi-solid products of higher boiling point. Oil of turpentine absorbs hydrochloric acid gas, forming with it two compounds, one a red dense liquid, the other a white crystalline substance resembling camphor, and hence called *artificial camphor.* Both are *mono-hydrochlorides,* $C_{10}H_{16}.HCl$, but the latter is much more stable, and can be purified by crystallization from alcohol or ether. When turpentine oil is left in contact with concentrated hydrochloric acid a *dihydrochloride* is formed, $C_{10}H_{16}.2HCl$. This forms rhombic plates, insoluble in water, and decomposed by boiling with alcoholic potash, with formation of *terpinol* $(C_{10}H_{18})_2.H_2O$. (Allen, *Com. Org. Anal.,* vol. ii. p. 51.) Nitric acid converts oil of turpentine into resin, and by long boiling into *terebic acid,* $C_7H_{10}O_4$. Mixed with water and chlorinated lime, and then distilled, the oil yields a liquid which Chautard found to be identical with chloroform (*Ibid.,* 3e sér., xxi. 88). Turpentine oil and other terpenes unite with water to form crystals of *terpin hydrate,* $C_{10}H_{18}(OH)_2.H_2O$, which sublimes often from turpentine oil which has long stood in contact with water and has then been heated to water bath temperature. These crystals are sometimes found in nature also. The presence of alcohol with the water and turpentine oil facilitates their formation. Thus, a mixture of 1 part of nitric acid, 1 part of alcohol, and 4 parts of turpentine oil, spread out in flat dishes, will yield within a few days crystals amounting to 20 per cent. of the oil taken. If these crystals be fused at 116° C. they will lose water, and *terpin,* $C_{10}H_{18}(OH)_2$, will remain in crystalline needles, fusing at 104° C., and boiling at 258° C. If either of the hydrates just mentioned be boiled with sulphuric, phosphoric, or glacial acetic acid, *terpineol,* $C_{10}H_{17}OH$, will be formed along with hydrocarbons of the formula $C_{10}H_{16}$, such as *terpinene, terpinolene,* and *dipentene.* Terpineol is a thick, colorless, optically inactive liquid, with a pleasant hyacinthine odor and a bitter, feebly pungent taste. It is used extensively in perfumery. Baeyer (*Ber. d. Chem. Ges.,* 26, p. 826) has also pre-

pared the methyl ether of terpineol. Oil of turpentine may be made to yield cymene identical with that existing in the oil of cumin and with that obtained by dehydrating camphor. (See *Cumin Seed,* in PART II.) Exposed to the air the oil absorbs oxygen, becomes thicker and yellowish, and loses much of its activity, owing to the formation of resin. A small proportion of formic acid is said also to be generated. Hence the Edinburgh College directed the oil to be rectified by distilling it with about four measures of water. But the process is difficult, in consequence of the great inflammability of the vapor, and its rapid formation, which causes the liquid to boil over. In this country it is scarcely necessary, as the recent oil can be obtained at an expense less than that which would be incurred by redistillation on a small scale. Another mode of purifying the oil is to agitate it with one-eighth of alcohol, which dissolves the resinous portion. About one-fifth of the alcohol is retained by the oil, but is readily separated by agitation with water. (See *Oleum Terebinthinæ Rectificatum.*) For tests, see *Proc. A. Ph. A.,* 1893, 156.

C. T. Kingzett has shown that the atmospheric oxidation of turpentine is accompanied by the formation of a body having the formula $C_{10}H_{14}O_4$, which he regards as *camphoric peroxide.* This substance, by the action of water, is converted into hydrogen peroxide and camphoric acid. The disinfectant known as *"Sanitas"* is produced by passing air through Russian oil of turpentine in contact with warm water. Berthelot has shown that oil of turpentine has, under certain conditions, the power, while undergoing oxidation itself, of causing the oxidation of other bodies, to which it imparts a portion of the oxygen absorbed from the air. All that is necessary to give this power to the oil is that soon after distillation it should be exposed to the air, as in a bottle half filled. Solar light assists, but is not essential to, the change, which goes on even in the dark. The oil retains indefinitely the property thus acquired, but may be deprived of it by exposure to a boiling heat, or by agitation with certain other substances, as potassium pyrogallate. No other chemical or physical change can be detected in the oil. (*J. P. C.,* Mai, 1860, 351.)

In this country the oil of turpentine is frequently adulterated with petroleum distillates. The adulteration is best detected by the treatment with sulphuric acid followed by steam distillation of the oil layer remaining above the sludge acid; this treatment with acid and after-distillation to be repeated if necessary. The sulphuric acid will thus completely polymerize and resinify the essential oil, leaving the paraffin hydrocarbons unaffected in the residual oily layer. A shorter and more readily executed test with sulphuric acid, though not so complete, is now given in the official test of the U. S. Pharm. 8th Rev.

Considerable quantities of a turpentine obtained by steam distillation of the so-called "lightwood" or resin saturated stumps and pieces of pine wood, have been offered in recent years. For an experimental study of this process and an account of the product see an article by Walker, Wiggins and Smith (*Chemical Engineer,* Dec. 1905, p. 78).

The several species of pine indigenous to California and the slopes of the Sierra Nevada appear to yield quite different products. Wenzell (*A. J. P.,* March, 1872) described, under the name of *abietene,* an oil distilled from the exudation of the *Pinus sabiniana* (*Nut Pine* or *Digger Pine*). He found it to have a sp. gr. of 0.694, and to boil at 101° C. (213.8° F.). Sadtler (*A. J. P.,* April, 1879, p. 176) examined an oil of turpentine from California said to have been obtained from the *Pinus ponderosa* (*Heavy Pine*), and found it to agree substantially with Wenzell's abietene. It had a sp. gr. at 16.5° C. (62° F.) of 0.6974, boiled at 101° C. (213.8° F.), and was slightly lævogyrate. It gave negative results when treated with hydrochloric acid for the formation of a hydrochloride, did not form a hydrate, and was not acted upon by sulphuric acid or by nitrosyl chloride. These anomalous results were at once explained by the publication of a study of the abietene which had been made by Thorpe, who showed (*A. J. P.,* 1879, p. 293) that this exudation of the California pine is almost pure *heptane,* C_7H_{16}, one of the chief constituents of American petroleum. His results were also confirmed by Schorlemmer, who established the identity of the pine heptane with that from petroleum naphtha.

Uses.—Oil of turpentine is stimulant, diuretic, occasionally diaphoretic, anthelmintic, in large doses cathartic, and externally rubefacient. Swallowed in moderate quantities it produces a sense of warmth in the stomach, accelerates the circulation, and increases the heat of the skin, without especially affecting the functions of the brain. In small doses frequently repeated it stimulates the kidneys, augmenting the secretion of urine, and often producing, especially if long continued, painful irritation of the urinary passages, amounting sometimes to violent strangury. At the same time it imparts the odor of violets to the urine, and this effect is also produced by its external application, or even by breathing the air of an apartment impregnated with its vapors. In large doses it occasions slight vertigo, or a sense of fulness in the head, sometimes amounting to intoxication, attended frequently with nausea, and succeeded generally, though not always, by speedy and brisk catharsis. When this effect is experienced, the oil is carried out of the bowels, and, no time being allowed for its absorption, is less prone to irritate the kidneys and bladder than if given in small and repeated doses. In some constitutions it produces, even when taken internally, an erythematous eruption on the skin. Persons who inhale its vapor are liable to strangury and even bloody urine. Hæmaturia is sometimes caused in seamen on

board vessels loaded with turpentine. A woman was found dead after having swallowed a large quantity of the oil, probably about six ounces. (*Am. J. M. S.*, Oct. 1858.)

The oil is employed in numerous diseases. As a stimulant it sometimes proves serviceable in *low forms of fever.* We have found it extremely useful in the advanced stage of *typhoid* or *enteric fever,* and especially in cases in which the tongue has partially or completely thrown off its fur in flakes, and afterwards become dry, with a surface destitute of its ordinary papillary appearance, and often contracted and fissured. The remedy has in our hands proved almost uniformly successful under these circumstances. With small doses of the oil frequently repeated, the tongue becomes moist and again coated, the tympanitic state of the bowels disappears, and the patient goes on to recovery as in a favorable case of fever. Its efficiency, however, in typhoid fever is ascribable not so much to its stimulant properties as to an alterative influence upon the ulcerated surface of the bowels characteristic of that disease, and the remedy is often of great service when during the convalescence from typhoid fever diarrhœa due to slow healing of the ulcers occurs. In *chronic rheumatism,* particularly *sciatica* and *lumbago,* the oil has often been given with great benefit. It has also been much extolled as a remedy in some forms of *puerperal fever,* in *neuralgia,* in *passive hemorrhages,* particularly from the bowels, in *chronic dysentery* and *diarrhœa,* in obstinate *gleets* and *leucorrhœa,* in *retention* and *incontinence of urine* from debility, in *chronic nephritic* and *calculous affections,* and in various conditions of *whooping cough.* In certain cases of *dysentery,* whether acute or chronic, when the tongue is quite dry, and smooth as if from defect of the papillary structure, no remedy has proved so efficient in our hands as oil of turpentine. We have seen it also very beneficial in *hæmoptysis.* As a vermifuge it is highly esteemed, especially in cases of *tænia.* It appears to destroy or debilitate the worm, which, losing its hold upon the bowels, is then easily discharged. In cases of *worms in the stomach* this oil is very useful, and in *amenorrhœa* from torpor of the uterine vessels it is occasionally of service. (*A. J. P.*, March, 1869.)

The dose for ordinary purposes is from five to thirty minims (0.3 to 1.8 Cc.), repeated every hour or two in acute, and three or four times a day in chronic diseases. In rheumatism it is recommended by some in the dose of a fluidrachm (3.75 Cc.) every four hours. As a remedy for tape worm the dose is from one-half to one fluidounce (15 to 30 Cc.), followed by castor oil in half an hour. It has also proved successful in tænia in the dose of thirty minims (1.8 Cc.), twice a day, continued for a considerable time. In ordinary cases of worms, the usual dose may be given. It may be administered on sugar, or in emulsion with gum arabic, loaf sugar, and cinnamon, or mint water. As its taste is very disagreeable to some persons, it may be administered in capsules.[1]

In the form of enema, the oil is highly useful in cases of *ascarides,* of *obstinate constipation,* and especially of *tympanites.* From half a fluidounce to two fluidounces (15 to 60 Cc.) may be administered in some mucilaginous fluid.

Externally applied, oil of turpentine irritates and speedily inflames the skin, and is one of the most efficacious rubefacients; it is used in *rheumatic affections,* and in various internal inflammations. When only a slight impression is desired, it may be diluted with olive oil, but in some constitutions, even in this state, it produces such violent inflammation of the skin, with extensive eruptions, as to render its external use in any shape improper. Applied to recent *burns,* it is thought by some to be highly useful in allaying the burning pain and promoting a disposition to heal. For this purpose, however, it is usually mixed with rosin cerate (*basilicon ointment*), so as to form a liniment capable of being spread upon linen rags. (See *Linimentum Terebinthinæ.*)[2] Beullard has found it useful in *eczema,* applied directly to the affected part. It causes immediately severe pain and much swelling, and in a few minutes must be removed, and followed by cooling and demulcent measures. A modification of the disease is thus produced, which renders ordinary applications successful that had been previously useless. (*Ann. Thér.*, 1865, p. 138.) It is thought by von Erlach and Lucke of Berne, to be peculiarly efficacious in *parasitic affections* of the scalp, by destroying the parasites and preventing the development of the spores. (*Am. J. M. S.*, July, 1869, p. 248.)

Oil of turpentine has been recommended, in the form of bath, in affections in which its constitutional impression is desired. For this purpose, T. Smith of Cheltenham, England, employs from five to ten fluidounces of the oil, with half a fluidounce of oil of rosemary, and two pounds of sodium carbonate, in each bath. The breath becomes strongly impregnated with the terebinthinate odor. (*Braithwaite's Retrospect,* xxi. 355.) Applied in vapor, the oil is said to be a very speedy cure for the *itch.*

[1] It has been objected to the form of capsule, that, in consequence of the breaking of its coating, the oil may come undiluted in contact with the mucous membrane, and thus produce undue irritation. Lacambre gives the following process for making a pill of the oil. Take of oil of turpentine 8 grammes, white wax 20 grammes, powdered sugar 9 grammes, oil of lemon 2 drops. Melt the wax in the oil of turpentine, pour into a mortar, allow to cool, then add the sugar and oil of lemon, and form a mass to be divided into pills of 25 centigrammes (3 or 4 gr.) each. Roll them in powdered starch, and keep in a well-stoppered bottle. (*J. P. C.*, Sept. 1873, p. 223.)

[2] The following is the formula adopted by the Philadelphia College of Pharmacy for the rubefacient liniment known as *British Oil.* Oil of Turpentine, Linseed Oil, of each 8 fl. oz., Oil of Amber, Oil of Juniper, of each 4 fl. oz., Barbados Petroleum 3 fl. oz., Crude American Petroleum 1 fl. oz.

The bed and night clothes are sprinkled with thirteen fluidrachms of the oil, and on awaking in the morning the patient is usually cured. (*Am. J. M. S.*, July, 1857, p. 232.) Baths of the vapor of turpentine are stated to be very beneficial in chronic rheumatism. They are said to be borne well, for twenty-five minutes, at a temperature of from 60° to 71.1° C. (140° to 160° F.). (*A. G. M.*, 4e sér., xxviii. 80.) Inhalation of the vapor has been recommended by Skoda in *gangrene of the lungs*. For internal use the rectified oil should be used. (See *Oleum Terebinthinæ Rectificatum.*)

Dose, five minims to one fluidrachm (0.3 to 3.75 Cc.).

Off. Prep.—Linimentum Terebinthinæ, *U. S.*, *Br.*; Linimentum Terebinthinæ Aceticum, *Br.*; Oleum Terebinthinæ Rectificatum, *U. S.*

OLEUM TEREBINTHINÆ RECTIFICATUM. U. S.

RECTIFIED OIL OF TURPENTINE

(ō'lę-ŭm tĕr-ę-bĭn'thį-næ rĕc-tį-fį-cā'tŭm)

Essence de Térébenthine purifiée, *Fr.*; Oleum Terebinthinæ Rectificatum, *P. G.*; Gereinigtes Terpentinöl, *G.*

"Oil of Turpentine, *a convenient quantity;* Solution of Sodium Hydroxide, *a sufficient quantity.* Shake the Oil of Turpentine thoroughly with an equal volume of Solution of Sodium Hydroxide, and introduce the mixture into a copper still connected with a well-cooled condenser. Recover about *three-fourths* of the Oil by distillation, separate the clear Oil from the water, and filter. Keep the product in well-stoppered, amber-colored bottles, in a cool place. Rectified Oil of Turpentine should always be dispensed when oil of turpentine is required for internal use." *U. S.*

When oil of turpentine is distilled in contact with sodium hydroxide solution, the distillate comes over purified and freed from the products which give the commercial oil the disagreeable odor and taste which are inseparable by ordinary distillation; hence this rectified oil is much preferable for internal administration. In the U. S. P. (8th Rev.) solution of sodium hydroxide was preferred to lime water, which was used in the U. S. P. 1890 to furnish an alkali to combine with resinous substances in commercial oil of turpentine. It has in other respects the same properties as Oleum Terebinthinæ. "A thin, colorless liquid, which should conform to the properties and tests given under *Oleum Terebinthinæ*. Specific gravity: 0.860 to 0.865 at 25° C. (77° F.). If about 10 Cc. of the Oil be evaporated in a dish on a water-bath, no weighable residue should be left." *U. S.*

Dose, five minims to one fluidrachm (0.3 to 3.75 Cc.).

Off. Prep.—Emulsum Olei Terebinthinæ, *U. S.*

OLEUM THEOBROMATIS. U. S., Br.

OIL OF THEOBROMA [Butter of Cacao, Cacao Butter]

(ō'lę-ŭm thē-ǫ-brō'mą-tĭs)

"A fixed oil expressed from the roasted seeds of *Theobroma Cacao* Linné (Fam. *Sterculiaceæ*)." *U. S.* "A concrete oil obtained by pressing the warm crushed seeds of Theobroma Cacao, *Linn.*" *Br.*

Oleum Theobromæ, *U. S.* 1880; Cocoa butter (improperly); Beurre de Cacao, *Fr. Cod.*; Oleum concretum e semine Theobromæ Cacao, *Fr.*; Oleum Cacao, *P. G.*; Kakaobutter, *G.*; Manteca de coco, Aceite de coco, *Sp.*

Theobroma Cacao, Linn., *Sp. Plant.* 1100; Hayne, *Darstel. und Beschreib.*, ix. 35; *B. & T.* 38.—This is a handsome tree, from twelve to twenty feet in height, growing in Mexico, the West Indies, and South America. It is largely cultivated in all tropical countries, particularly in Guayaquil, Venezuela, Mexico, Trinidad, and the Philippines. The fruit is an oblong-ovate capsule or berry, six or eight inches in length, with a thick, coriaceous, somewhat ligneous rind, enclosing a whitish pulp, in which numerous seeds are embedded. These are ovate, somewhat compressed, about as large as an almond, and consist of an exterior thin shell and a brown oily kernel. Separated from the matter in which they are enveloped, they constitute the *cacao*, or *chocolate nuts*, of commerce. The cacao tree is usually cultivated in large estates, where it is grown in the shade of the banana or other large plant, and develops its pods from the stem continually, so that the harvest goes on all the time, although the product is greater in the spring and in the autumn. The pods are cut off, opened, and the beans contained in the glutinous sweet acid pulp are allowed to ferment, during which process the outer integument comes off easily and falls. The beans are finally carefully dried, commonly in the sun, sometimes by means of a steam drying shed. If the sweating process is carried too far, or the beans during drying are wetted by rain, they blacken and are much lowered in value. These blackened beans are sometimes artificially whitened. Cacao beans have a slightly aromatic, bitterish, oily taste, and, when bruised or heated, an agreeable odor. (See *Am. Drug.*, 1897, 311; also *Ph. Ztg.*, 1900, 756.)

The average of a number of analyses of raw nuts gave H. Weigmann (*König's Nahrungs- und Genussmittel*, 3d ed., vol. i. 1019) water, 7.93 per cent.; nitrogenous matter, 14.19 per cent.; theobromine, 1.49 per cent.; fatty matter (cacao butter), 45.57 per cent.; starch and other carbohydrates, 22.92 per cent.; crude fibre, 4.78 per cent.; pure ash, 3.99 per cent.; sand, 0.62 per cent. The coloring matter is probably the result of chemical change, as the fresh seeds are white. Theobromine has been found also in the shells in the proportion of

about 1 per cent. (*A. J. P.*, 1862, 509.) The latter impart to boiling water a taste analogous to that of chocolate, but weaker, and are used for making a table beverage.

Theobromine was discovered by Woskresensky, who obtained it by the following method. The kernels are exhausted with water by means of the water bath; the solution is strained through linen, precipitated by lead acetate, and filtered; the filtered liquor is freed from lead by hydrogen sulphide, and evaporated; the brown residue is treated with boiling alcohol, and the liquor filtered while hot. Upon cooling, the theobromine is deposited in the form of a reddish-white powder, which is rendered colorless by repeated crystallization. Keller obtained it still purer by heating the powder between two watch glasses, by which a brilliant white sublimate was obtained. According to O. Donker and C. Treumann, theobromine is contained not only in the cotyledons but also in the shells of the cacao seeds. Four kilos of the latter yielded 13.5 Gm. of pure theobromine. (*A. Pharm.*, July, 1878.) Theobromine is a crystallizable alkaloid, capable of forming salts with the acids, very bitter, volatilizable without change, freely soluble in hot alcohol, sparingly so in hot water, and is very closely related to caffeine, this latter being the methyl derivative of theobromine. Its formula is $C_7H_8N_4O_2$. It has been converted into caffeine by Strecker, and afterwards E. Fischer (*Ber. d. Chem. Ges.*, 1882, p. 453) obtained theobromine from xanthine, $C_5H_4N_4O_2$, which is easily obtained from the guanine of guano, $C_5H_5N_5O$, by the action of nitrous acid. (See *Theobromine*, PART II.) For Emminger's method of determining theobromine in cacao, see *P. J.*, 1896, 289.

Chocolate is differently prepared in different countries. In Great Britain and the United States it is usually made, when pure, exclusively of the kernel of the cacao or chocolate nuts, which are first roasted, then deprived of their shells, and lastly reduced, by grinding between heated stones, to a paste, which is moulded into oblong cakes. Not unfrequently rice flour or other farinaceous substance, with butter or lard, is added, but these must be considered as adulterations. On the continent of Europe, sugar is generally incorporated with the paste, and spices, especially cinnamon, are often added. Vanilla is a favorite addition in America, France, and Spain. Cacao, wrongly called *cocoa*, is often sold in powder, which is sometimes mingled with other ingredients, such as ground rice, barley flour, sugar, etc. Chocolate is prepared for use by reducing it to powder and boiling it in milk, water, or a mixture of these fluids. In this state it is much employed as a drink at breakfast and tea, and serves as a substitute for coffee in dyspepsia. It is also a good article of diet for convalescents, and may sometimes be given advantageously as a mild nutritive drink in acute diseases. Hagenbuch examined several commercial brands of chocolate, and found that the amount of fat or cacao butter present varied from 12 to 45.8 per cent. (*A. J. P.*, 1885, p. 276.) From this it would seem that manufacturers do not uniformly extract the fat from commercial chocolate.

Oil of Theobroma. Cacao Butter.—This is the fixed oil of the chocolate nut. It is extracted either by expression, decoction, or the action of a solvent. Soubeiran recommends that the seeds, previously ground, be mixed with one-tenth of their weight of water and then pressed between hot plates of tinned iron. It is advisable that the heat should not exceed that of boiling water, and even a lower heat will answer. When the method of decoction is used, the cacao should be slightly roasted before boiling. As a solvent, carbon disulphide has been found to answer well, as recommended in the preparation of the expressed oil of nutmeg. (See *Oleum Myristicæ*.) Upon the whole, the method of expression is perhaps preferable. The presence of water in the ground seeds is said greatly to facilitate the process. The expressed oil, now made largely in Philadelphia, occurs in the shape of oblong cakes, like those of chocolate, weighing about half a pound each. It is "a yellowish-white solid, having a faint, agreeable odor, and a bland, chocolate-like taste. Specific gravity: 0.970 to 0.976 at 25° C. (77° F.). Oil of Theobroma should be brittle at temperatures below 15° C. (59° F.), and should melt at 30° to 35° C. (86° to 95° F.) to a clear liquid. It is readily soluble in ether, chloroform, or benzene; also soluble in 100 parts of cold absolute alcohol, and in 20 parts of boiling absolute alcohol; the solutions should be neutral to test paper. If 1 Gm. of Oil of Theobroma be dissolved in 3 Cc. of ether in a test-tube at a temperature of 17° C. (62.6° F.), and the tube frequently plunged into water at 0° C. (32° F.), the liquid should not become turbid nor deposit white flakes in less than three minutes; and if the mixture after congealing be again brought to 15° C. (59° F.), it should gradually form a perfectly clear liquid (absence of *wax, stearin, tallow*, etc.). Oil of Theobroma, saponified by alcoholic potassium hydroxide T.S., should show a saponification value of 188 to 195 (see PART III, Test No. 99). If 0.8 Gm. of Oil of Theobroma be dissolved in 10 Cc. of chloroform in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S. an iodine value of not less than 33 nor more than 38 should be obtained (see PART III, Test No. 51)." *U. S.* "A yellowish-white solid, breaking with a smooth fracture; odor resembling that of cocoa; taste bland and agreeable; free from rancidity. It softens at 80° F. (26.6° C.) and

melts at temperatures between 88° and 93° F. (31.1° and 33.9° C.). If 1 gramme be dissolved in 3 cubic centimetres of *ether*, in a test-tube, at 62° or 63° F. (or 17° C.), and the tube be placed in water at 32° F. (0° C.), the liquid should neither become turbid nor deposit a granular mass in less than three minutes; and if the mixture after congealing be exposed to a temperature of 60° F. (15.5° C.) it should gradually afford a clear solution (absence of other fats)." *Br.* Cacao butter consists chiefly of the glycerides of stearic, palmitic, and lauric acids, and, further, of small quantities of the glycerides of arachidic, linolic, formic, acetic, and butyric acids. The percentage of stearic acid obtainable is from 39.9 to 40.6. Kingzett believes it to contain in addition a peculiar acid which he calls *theobromic*, and to which he gives the formula $C_{64}H_{128}O_2$, but his results have not been confirmed by subsequent investigators. From its large proportion of stearin, it is one of the best fats for the preparation of stearic acid. It is said to be frequently adulterated with animal fats, which, according to E. Lamhofer, may be detected by attention to the fact that pure cacao butter dissolves entirely in ether or petroleum benzin, separating out in minute granular crystals when immersed in water of 0° C. (32° F.), the liquid portion remaining transparent for 30 or 40 minutes, when the whole solidifies. After solidification, if the oil be kept at a temperature of about 14.4° C. (58° F.), it will redissolve without turbidity. (*A. J. P.*, 1877, p. 238.) G. Ramsperger concludes, as the result of much experimentation, that ether affords the best test of purity. Dissolving the suspected cacao butter in 2 parts of ether, if it become turbid after standing or form on spontaneous evaporation little crystals or grains not soluble in 2 parts of ether at common temperature, it is impure and should be rejected.

Butter of cacao is used as an ingredient in cosmetic ointments, and in pharmacy for coating pills, and preparing suppositories. For the last purpose it is well adapted by its consistence and blandness, and is now largely consumed. It was, indeed on this account chiefly that it was introduced into the U. S. Pharmacopœia of 1860.[1] F. Bringhurst prepared a *lip salve* by melting together 28 ounces of cacao butter, 4 ounces of yellow wax, and a drachm, each, of balsam of Peru and benzoic acid, straining, adding perfuming oils, as those of rose, bergamot, and bitter almond, in sufficient quantity, and finally, when nearly cool, an ounce of glycerin. (*A. J. P.*, July, 1867, p. 348.)

Owing to its great insolubility, pure theobromine acts very slowly and uncertainly upon the animal organism, but its soluble salts (notably the *salicylate of sodium and theobromine*[2]) are active diuretics, acting desirably upon the secreting tissue and have been much used in various dropsies. They are said not to irritate the kidneys, and have been highly commended not only in *chronic* but even in *acute Bright's disease*. Their action upon the circulation has not been determined; what evidence we have, however, indicates that large therapeutic doses have no effect upon the blood pressure, though it may increase the rapidity of the pulse. The toxic dose lowers the arterial pressure, according to Bock, by a direct action upon the cardiac muscle. Usually their action is not accompanied by any systemic disturbances, but headache, irregularity of the pulse, vomiting, and diarrhœa have been noticed in various cases, and, according to W. Schmieden, hæmaturia.

Off. Prep.—Suppositoria Acidi Carbolici, *Br.;* Suppositoria Acidi Tannici, *Br.;* Suppositoria Belladonnæ, *Br.;* Suppositoria Iodoformi, *Br.;* Suppositoria Morphinæ, *Br.;* Suppositoria Plumbi Composita, *Br.*

OLEUM THYMI. U. S.

OIL OF THYME

(ō'lę-ŭm thȳ'mī)

"A volatile oil distilled from the leaves and flowering tops of *Thymus vulgaris* Linné (Fam. *Labiatæ*), and containing, when assayed by the process given below, not less than 20 percent., by volume, of phenols. It should be kept in well-stoppered, amber-colored bottles, in a cool place, protected from light." *U. S.*

Huile volatile de Thym, *Fr. Cod.;* Essence de Thym, *Fr.;* Oleum Thymi, *P. G.;* Thymianöl, *G.;* Esencia de tomillo, *Sp.*

In the south of France thyme grows wild in great abundance, and is largely collected for distillation. The oil is taken from France to England, and thence reaches this country under the name of *oil of origanum*, having, probably from its greater cheapness, been substituted for the genuine oil. For all the purposes for which oil of origanum was used, that of thyme is not less useful, and is more agreeable.

Thymus vulgaris is a very common plant, indigenous to Southern Europe, and cultivated in our gardens. It possesses a subcampanulate two-lipped calyx, villous in the throat; corolla limb two-lipped, the upper erect and

[1] *Mafurra Tallow.*—This is a fat obtained from the fruit of a tree, *Trichilia emetica*, Vahl., Fam. *Meliaceæ*, growing in Mozambique and the islands of Madagascar and Bourbon, and bears a close resemblance in properties to cacao butter. The kernel of the fruit is described as of the size of the cacao bean, having the same characteristic odor when bruised, and a bitter taste. The fatty matter is extracted by boiling the kernels in water. It is of a firm, solid consistence, less fusible than tallow, of a yellowish color and of the odor of cacao butter. It agrees, moreover, with that substance in containing olein and palmitin, and yields palmitic acid largely when saponified. (*A. J. P.*, xxviii. 163.)

[2] A mixture of a compound of sodium theobromine and sodium salicylate has been introduced under the trade name of *diuretin*. It is a white powder, soluble in less than half its weight of water when warmed. It should contain 49.7 per cent. of theobromine and 38.1 per cent. of salicylic acid.

emarginate, the lower spreading, three-cleft. It is a low under-shrub, procumbent at the base, with ovate-linear, revolute leaves, the flowers in a whorled spike. The herbaceous portion, which should be gathered when the plant is in flower, has a peculiar, strong, aromatic, agreeable odor, not lost by drying, and a pungent, aromatic, camphoraceous taste. Its active constituent is the volatile oil, which is obtained separate by distillation with water.

The oil, as prepared in the south of France, is, after one distillation, of a reddish-brown color, and called the *red oil,* but when again distilled is colorless, and in this condition is distinguished as the *white oil.* Oil of thyme is officially described as "a colorless liquid, having a strong odor of thyme, and an aromatic, pungent, afterwards cooling taste. Specific gravity: 0.900 to 0.930 at 25° C. (77° F.). It is slightly lævogyrate; not more than —3° in a 100 Mm. tube, at a temperature of 25° C. (77° F.). Oil of Thyme is soluble in half its volume of alcohol, also in 1 to 2 volumes of 80 percent. alcohol. With a drop of ferric chloride T.S. it yields a greenish-brown color, which changes to reddish. If 1 Cc. of Oil of Thyme be shaken with 10 Cc. of hot water, and, after cooling, the liquid be passed through a wet filter, the filtrate should not assume, with a drop of ferric chloride T.S., a bluish or violet color (absence of *official phenol*)." *U. S.* The U. S. P. (8th Rev.) introduced an assay based on the phenols content as follows:

Assay.—"Introduce 20 Cc. of solution of sodium hydroxide (1 in 20) into a burette of 50 Cc. capacity (graduated in tenths). Add 10 Cc. of the Oil to be assayed, stopper the burette with a well-fitting cork, shake the mixture thoroughly, and set aside for twelve to twenty-four hours. Drops of Oil adhering to the side of the burette should be loosened by tapping and rotating the burette. After the alkaline solution has become clear, the volume of non-phenol oil remaining (which should measure not more than 8 Cc.) is noted and subtracted from the 10 Cc. of the Oil originally taken. The difference, multiplied by 10, indicates the percentage of phenols in the Oil." *U. S.* According to Zeller, one pound of the fresh herb yields 45.7 grains of the oil, of the dried herb 38 grains. The oil, as found in commerce, is of a reddish-brown color, and of an odor recalling that of thyme, but less agreeable. Its sp. gr. is stated at 0.905, but probably varies, as the oil is a complex body. The more volatile portion, that coming over below 180° C. (356° F.) in distillation, is a mixture of *cymene,* $C_{10}H_{14}$, boiling at 175° C. (347° F.), and *pinene,* $C_{10}H_{16}$, boiling at 161° C. (321.8° F.). The less volatile and most valuable portion is chiefly *thymol,* $C_{10}H_{14}O$, a white crystalline solid, melting at 50° C. (122° F.), and possessing a pungent taste. (See *Thymol.*) *Carvacrol* is also present, at times replacing part or all of the thymol, and in addition *linalool* and *bornyl acetate* have been found in small amount. (See *Proc. A. Ph. A.,* 1897, 637.) The Oil is commonly adulterated with the oil of turpentine, the *white oils* being especially impure. The presence of oil of turpentine according to Duyk (*J. P. A.,* 1899, 41) is due to the fact that the French peasants place in the body of the still as a foundation for the herbs a layer of pine and fir branches. According to both Duyk and Kebler (*J. P. C.,* 5, 13, 593, 1886) the genuine oil of thyme should contain from 20 to 30 per cent. of phenol bodies and as a test for the purity of the oil of thyme based upon the amount of phenol bodies that should be in it, Kebler proposes the following: Partially fill a 100 Cc. nitrometer with a 5 per cent. solution of sodium hydroxide, then introduce 10 Cc. of the oil to be examined, shaking well for five minutes, and finally setting aside for twenty-four hours. The drops adhering to the nitrometer can be, in part, loosened by rotating or tapping the nitrometer. When the solution has become clear the non-phenol oil can readily be read off and the percentage calculated. See the official assay. The annual production of oil of thyme at Grasse, according to Flückiger (*A. J. P.,* 1885, 132), amounted to 40,000 kilogrammes. According to Camperdon, in doses of from three to fifteen grains (0.2 to 1.0 Gm.), oil of thyme causes mental excitement, and is a valuable diffusible stimulant in *collapse.* It is certainly an antiseptic. (See *Thymol.*)

Dose, three to five minims (0.2 to 0.3 Cc.).

Off. Prep.—Liquor Antisepticus, *U. S.*

OLEUM TIGLII. U. S. (Br.)

CROTON OIL

(ō'le-ŭm tĭg'lĭ-ī)

"A fixed oil expressed from the seeds of *Croton Tiglium* Linné (Fam. *Euphorbiaceæ*). It should be kept in small, well-stoppered bottles, and should be handled with caution." *U. S.* "The oil expressed from the seeds of Croton Tiglium, *Linn.*" *Br.*

Oleum Crotonis, *Br.;* Huile de Croton Tiglium, *Fr. Cod.;* Huile de Graines de Tilly, *Fr.;* Oleum Crotonis, *P. G.;* Krotonöl, *G.;* Olio di crotontiglio, *It.;* Aceite de croton tiglio, Acelte de grano tiglio, *Sp.*

Croton Tiglium, Willd., *Sp. Plant.* iv. 543; *B. & T.* 239.—This species of Croton is a small tree or shrub, with a few spreading branches, bearing alternate petiolate leaves, which are ovate, acuminate, serrate, smooth, of a dark-green color on the upper surface, paler beneath, and furnished with two glands at the base. The flowers are in erect terminal racemes, scarcely as long as the leaf,—the lower being female, the upper male, with straw-colored petals. The fruit is a smooth capsule, about the size of a filbert, with three cells, each containing a single seed.

The tree is a native of Hindostan, Ceylon, the Moluccas, and other parts of India. It is

pervaded by an acrid purgative principle, probably analogous to that found in other plants belonging to the family of Euphorbiaceæ. Rumphius says that the root is employed in Amboyna, in the dose of a few grains, as a drastic purge in dropsy, and, according to the same author, the leaves are so acrid that when chewed and swallowed they excite inflammation in the lips, mouth, and throat, and along the whole course of the alimentary canal. The wood is said in small doses to be diaphoretic, in larger, purgative and emetic. But the seeds are the most active part. These have been long used in India as a powerful purgative, and were employed so early as 1630 in Europe, under the names of *grana Molucca* and *grana tiglia*. But in consequence of their violent effects they fell into neglect, and had ceased to be ranked among medicines, when, at a comparatively recent period, attention was again called to them by the writings of some English physicians in India. They are now imported for their oil, which is the only official product of the plant. It is probable that most if not all of the Crotons are purgatives. The oil of the Mexican *Croton morifolius* is said to be mildly purgative in doses of two or three minims (0.12 to 0.2 Cc.). In India, under the name of *Kowli seeds* (*Kuli seeds*),[1] are used certain beans, which have been referred by authorities to the *Croton oblongifolius,* Roxb., and also to the *C. persimilis,* Müll.-Arg. (See *Ph. Rev.,* Oct. 1896.)

These seeds are rather larger than a grain of coffee, oblong, rounded at the extremities, with two faces, the external considerably more convex than the internal, separated from each other by longitudinal ridges, and each divided by a similar longitudinal ridge, so that the whole seed presents an irregular quadrangular figure. Sometimes, as in the coffee grain, their internal surface is flat, with a longitudinal groove, owing to the presence of only two seeds in the capsule, the groove being produced by the central column or axis. The shell is covered with a soft, yellowish-brown epidermis, beneath which the surface is black and smooth, and, as the epidermis is often partially removed by friction during their carriage, the seeds as they come to us are frequently mottled, and sometimes nearly black. The kernel or nucleus is yellowish brown, and abounds in oil. In India the seeds are prepared for use by submitting them to slight torrefaction, by which the shell is rendered more easily separable. In the dose of one or two grains (0.065 or 0.13 Gm.) the kernel purges severely.

[1] Kowli seeds reach a length of two and one-tenth Cm., a breadth of one and two-tenths Cm., a thickness of eight-tenths Cm., ovate, having pointed ends with a marked caruncle. The outer side shows the grayish-brown crusty seed coat with irregular rough longitudinal stripes; the cross-section shows a large endosperm, in the middle the embryo of considerable size with flat cotyledons. Besides the fatty oil and protoplasm, the cells of the endosperm show longitudinally very large aleurone grains, which contain a considerable number of small globoids and badly formed crystalloids.

The oil is obtained by expression from the seeds, previously deprived of the shell. It may also be separated by decoction in water, or by the action of ether, or carbon disulphide, which dissolves the oil and leaves it behind when evaporated.[2] Guibourt recommends, after the first expression, to digest the residue with alcohol at a temperature of 48.8° to 60° C. (120° to 140° F.), and then submit it to a new expression. The alcohol is to be separated by distillation from the oil, which is then to be mixed with the first product. Great care must be used, during this distillation, to prevent blistering the unprotected skin of the operator.

Properties.—The seeds consist of 64 per cent. of kernel and 36 of envelope. From the seeds imported into England, about 22 per cent. of oil is obtained by simple expression. Guibourt, by his process, obtained 52 per cent. from the kernels, equivalent to about 35 per cent. from the seeds. Croton oil consists chiefly of the glycerides of stearic, palmitic, myristic, lauric, and oleic acids. There are also present, in the form of glycerin ethers, the more volatile acids, as formic, acetic, isobutyric, and isovalerianic acids. The volatile part of the acid yielded by croton oil contains, moreover, an acid of the oleic series, named by Geuther and Frölich *tiglic* or *tiglinic acid,* $C_5H_8O_2$. It is isomeric with angelic acid, but the melting points (angelic acid 45° C., tiglic acid 64° C.) and the boiling points (angelic acid 185° C., tiglic acid 198.5° C.) differ. *Crotonic acid,* $C_4H_6O_2$, was thought by Schlippe to be present, but later investigation does not confirm the statement. *Crotonol,* announced by Schlippe as the vesicating principle of the oil, has likewise been found only by the discoverer.

In 1823 John Nimmo of Glasgow, found that about 45 per cent. of croton oil is soluble in alcohol, the insoluble 55 per cent. being inert. Recent researches have shown that the percentage of soluble portion varies greatly. (See also below.) According to Senier, confirmed by Binz, Kobert, and others, it increases with the age, freshly expressed oil containing only 20 per cent., oil over four years old 60 per cent. In this soluble portion Buchheim found

[2] *Extraction by ether.*—Having washed and dried the seeds, grind them in a coffee mill, and form a soft paste with ether. Introduce this into a narrow percolation tube, and gradually pour ether upon it until it is exhausted. Evaporate the ether by means of a water bath, and filter the remaining oil. (*J. P. C.*, Août, 1862.)

Extraction with carbon disulphide.—The seeds, well bruised, are introduced into a bottle with three times their weight of carbon disulphide, well rectified; the mixture is allowed to stand, with frequent agitation, for 24 hours; the whole is then poured upon a cloth and rapidly expressed. The residue is similarly treated with twice its weight of the disulphide, and expressed, after standing as before. The products of the two macerations are mixed, then filtered in a covered funnel, and finally submitted to distillation, by means of a water bath, in a glass retort, at the temperature of 71.1° or 76.6° C. (160° or 170° F.). The disulphide should be recovered by condensing its vapor in a refrigerated receiver. The oil is to be poured into a dish, to show that it contains none of the disulphide, and then introduced into a bottle and closely stoppered. (*J. P. C.*, 3e sér., xxxi. 28.)

an acid, *crotonolic acid* or *crotonoleic acid*,[1] which he believed to be the active principle. It is an oily substance, readily decomposable, having the character of a weak acid, and forming various salts. It is freely soluble in alcohol, and is extremely irritant to the skin and the mucous membrane. As pointed out in 1889 by Stillmark and Kobert, croton seeds contain one or more toxic albuminoids, which have been especially studied under the name of *crotin* by Elfstrand.[2] Dunstan and Boole (*Proc. Roy. Soc. London*, lxiii., 1895) found that crotonoleic acid, prepared by the method of Kobert and Hirscheydt, is a mixture of inactive oily acids and a resinous substance having extraordinary power as a vesicant, for which they have proposed the name of *croton resin*, assigning to it the empirical formula $C_{13}H_{18}O_4$, and the molecular formula $(C_{13}H_{18}O_4)_2$, or $C_{26}H_{36}O_8$. It is described as a hard, pale yellow resin, nearly insoluble in water and benzene, but readily dissolved by alcohol, ether, and chloroform. It is neither a glyceride, a ketone, nor an aldehyde.

Croton oil, as found in commerce, varies greatly in color, from a pale yellow to a dark reddish brown. That imported from India is usually pale, that expressed in Europe dark, like the deepest-colored sherry. Its consistence is rather viscid, and is increased by time. Its odor is faint, but peculiar, its taste hot and acrid, leaving in the mouth a disagreeable sensation which continues for many hours. It is officially described as "a pale yellow or brownish-yellow, somewhat viscid, and slightly fluorescent liquid, having a slight fatty odor, and a mild, oily, afterwards acrid and burning taste (*great caution is necessary in tasting*). When applied to the skin, it produces rubefaction, or a pustular eruption. Specific gravity: 0.935 to 0.950 at 25° C. (77° F.). It reddens blue litmus paper moistened with alcohol. When fresh it is soluble in from 55 to 60 parts of alcohol, the solubility increasing by age; freely soluble in ether, chloroform, carbon disulphide, and in fixed or volatile oils. When gently heated with twice its volume of absolute alcohol, it forms a clear solution from which the Croton Oil should separate on cooling. If to 2 Cc. of Croton Oil 1 Cc. of fuming nitric acid and 1 Cc. of water be added, and the mixture vigorously shaken, it should not solidify either completely or partially, after standing for one or two days (absence of *other non-drying oils*). Croton Oil saponified by alcoholic potassium hydroxide T.S. should show a saponification value of from 212 to 218 (see PART III, Test No. 99). If 0.3 Gm. of Croton Oil be dissolved in 10 Cc. of chloroform in a 250 Cc. bottle or flask, and 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S. and alcoholic mercuric chloride T.S. added, and if, after standing for four hours, protected from light, 20 Cc. of potassium iodide T.S. be added and the mixture diluted with 50 Cc. of water, on titrating the excess of iodine with tenth-normal sodium thiosulphate V.S., an iodine value of not less than 102 nor more than 105 should be obtained (see Part III, Test No. 51)." *U. S.*

"Specific gravity 0.940 to 0.960. Entirely soluble in *absolute alcohol*. Freely soluble in *ether* and *chloroform*. An alcoholic solution should not redden moistened *blue litmus paper*. If to 2 cubic centimetres 1 cubic centimetre of *fuming nitric acid* and 1 of *water* be added, and the mixture be shaken vigorously, it should not solidify, either completely or partially, but only thicken slightly, after standing for two days (absence of other non-drying oils)." *Br.*

The oil is wholly soluble in ether and oil of turpentine. Its relations to pure alcohol differ somewhat with the variety of the oil. That obtained by expression in England was formerly wholly and readily soluble, but, according to Harold Senier, the croton oil now produced acts towards alcohol as do foreign oils (*P. J.*, 3d ser., xiv. 704), forming a solution which is permanent at ordinary temperatures, while the India or pale oil forms an opaque mixture, which becomes clear and uniform upon being heated, but separates on standing into two portions, one consisting of alcohol somewhat diminished in bulk, the other of the oil correspondingly increased in bulk by retaining a portion of the alcohol. It is probable that the difference in color, and in their relations to alcohol, between the India and English oils may be owing to a change in the kernels from being kept, and to the age of the oil. It is known that croton oil is often adulterated with other fixed oils. In the Br. Pharm. of 1864 it was given as a test of the purity of the oil expressed from the imported seeds, that when agitated with an equal volume of alcohol and gently heated it forms a clear solution, from which about three-fourths of the oil separates on cooling; but the statement is asserted to be untrue of the English expressed oil, though correct of the imported. The test was intended to detect the presence of castor oil, which would be dissolved by the alcohol and thus occasion a diminution of the bulk. It has been omitted in the present British Pharmacopœia.[3]

[1] *Crotonoleic acid* may be readily prepared by treating the portion of croton oil soluble in alcohol with a hot saturated solution of baryta in a water bath, washing the stiff white paste that forms with cold distilled water to remove excess of baryta and barium compounds with acetic, butyric, and tiglic acids, repeatedly treating with water, and lastly agitating with ether, which takes up only the barium oleate and crotonoleate. The crotonoleate is separated by dissolving it out in alcohol, decomposing it carefully with sulphuric acid, and the solution containing the free acids carefully evaporated. See also *Kobert's Arbeiten*, 1890, p. 30.

[2] Crotin is described as a yellowish powder, yielding about 21 per cent. of ash, soluble in water, and possessed of such active poisonous properties that the subcutaneous lethal dose for the rabbit is from 0.05 to 0.08 Gm. per kilo. It attacks the blood corpuscles as well as the centric nervous system, and, indeed, probably affects all protoplasm. (*On Some Toxic Albumins*, Upsala, 1897.)

[3] Maisch detected croton oil in any mixture by the following plan. The suspected oil is agitated with an alcoholic solution of sodium or potassium hy-

(See U. S. official test, page 886.) For tests for croton oil, including iodine and acid numbers, see *Ph. Rev.*, 1897, 113.

According to M. Burrough, who was for some time in India, much of the oil there prepared is derived from the seeds of *Jatropha Curcas*, or *Curcas purgans*, the so-called *Barbados nuts*. This oil, though weaker than the genuine, was said by Burrough to be an efficient cathartic in the dose of three or four drops (0.15 or 0.2 Cc.). Hamilton states that croton seeds are afforded by *Croton pavana*, growing in Ava and Bengal, and probably a portion of the croton oil of commerce is obtained from these seeds. These facts may explain some of the discrepancies which have been observed in the effects of the oil.

Uses.—Croton oil is a powerful drastic purgative, in large doses apt to excite vomiting and severe griping pains, and capable, if immoderately taken, of producing fatal effects. It acts with great rapidity, frequently evacuating the bowels in less than an hour, and generally exciting a rumbling sensation in half that period. It possesses also great advantage in the minuteness of the dose, on account of which it may frequently be given when we should fail with more bulky medicines, as in *mania, coma,* and the cases of children. A drop placed on the tongue of a comatose patient will generally operate. Though long used in India, and known for two centuries to the Dutch physicians, it did not attract general notice till about 1820, when it was introduced into England by Conwell. It is chiefly employed in cases of *obstinate constipation*, in which it often produces the happiest effects after the failure of other medicines, but it may also be advantageously used in almost all cases in which powerful and speedy purging is demanded, especially where an irritation of the gastric mucous membrane and a derivative action are desired. The seeds are said to have been used successfully in India, in *amenorrhœa*. Applied externally, the oil produces inflammation of the skin, attended with pustular eruption, and has been used in this way in *rheumatism, gout, neuralgia, glandular* and other *indolent swellings,* and *laryngeal* and *pulmonary diseases*. It should be diluted with three parts of olive oil, soap liniment, oil of turpentine, or other convenient vehicle, and applied as a liniment twice or oftener in twenty-four hours. Sometimes the insusceptibility of the skin is such as to require its application undiluted. The oil may also be applied externally, in the form of a plaster, made by incorporating one part of it with four parts of lead plaster, melted by a very gentle heat. Sometimes it appears to produce inflammation in parts distant from those to which it was directly applied. It has been said that four drops, used externally by friction around the umbilicus, will produce a purgative effect, but this is denied by Barlai of Tuscany, who states that it is only when the oil is applied to the skin divested of the cuticle that it will operate upon the bowels. *Nævus* has been cured by the introduction of croton oil into the little tumor by means of needles.[1] The oil is most conveniently administered in the form of pill. A safe and convenient plan is to make two drops into four pills with crumb of bread, and to give one every hour until they operate. The oil may also be given in capsules, cachets, or emulsion.

Crotonoleic acid has been shown by Kobert to be a very active irritant poison, much more harsh and severe in its influence than croton oil itself. Hirscheydt has found that its salts injected into the blood are extremely powerful depressants to the circulation. It has appeared in commerce, but after trial has been found by Hirscheydt to act badly as a practical remedy. It probably also varies greatly in purity. Ten milligrammes were found by Hirscheydt to be very uncertain in their purgative effect, while large doses commonly produced excessive gastro-intestinal irritation. The superiority of croton oil over the acid probably depends upon the fact that the acid exists in it chiefly in combination with glycerin, and that this crotonoleic glyceride acts with comparative kindness because of the slow decomposition and setting free of the acid which occur in the intestines. This being the case, it follows as a corollary that old, acid croton oil must be more irritant than the fresher and nearly neutral oil. Kobert has confirmed this conclusion by actual trial, and asserts that the neutral oil should always be preferred in practice, and that the acid oil, which is official in the German Pharmacopœia, should be rejected.

Dose, one-half to two minims (0.03 to 0.12 Cc.).

Off. Prep.—Linimentum Crotonis, *Br.*

droxide, and the solution, having been separated, is saturated with hydrochloric or sulphuric acid. If croton oil be present, its acrid principle will rise to the surface in the form of an oil, which when applied to the skin will produce the peculiar eruptive affection excited by croton oil. (*A. J. P.*, 1860, 307.)

[1] *Croton Oil Crayons.*—In order to prevent the spreading of croton oil beyond the limits intended, Limousin prepared crayons by melting 1 part each of cacao butter and white wax in a small glass flask, and then adding 2 parts of croton oil, taking care to close the orifice of the flask at once with a cork. When the mixture begins to get thick, it is poured into cylindrical moulds, where it speedily solidifies. These crayons may be made of a thickness of about 8 or 9 millimeters (⅓ inch), and may be covered with tin foil to protect them from change. (*N. R.*, May, 1877.)

OPII PULVIS. U. S.

POWDERED OPIUM

(ō′pĭ-ī pŭl′vĭs)

"Opium dried at a temperature not exceeding 85° C. (185° F.) and reduced to a very fine powder. Powdered Opium, for pharmaceutical and medicinal purposes, when assayed by the process given under *Opium,* should yield not

less than 12 percent. nor more than 12.5 per-cent. of crystallized morphine. Powdered Opium of a higher percentage may be brought within these limits by admixture with Powdered Opium of a lower percentage or powdered sugar of milk in proper proportions." *U. S.*

Poudre d'Opium, *Fr. Cod.;* Opiumpulver, *G.;* Polvo de opio, *Sp.*

The strength of powdered opium has been altered in the last revision, the U. S. P. 1890 requiring that it should yield not less than 13 nor more than 15 per cent. of crystallized morphine when assayed by the U. S. P. 1890 process. The U. S. P. (8th Rev.) requires that it shall yield not less than 12 per cent. nor more than 12.5 per cent. of crystallized morphine. It will be observed that the range has been reduced and figures lowered, but the assay process is now more rigid and a purer morphine is demanded. For assay and preparations see pp. 903, 910.

Dose, one-half to one grain (0.032 to 0.065 Gm.).

OPIUM. U. S., Br.

OPIUM

(ō'pĭ-ŭm)

"The concrete milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné (Fam. *Papaveraceæ*), and yielding, in its normal, moist condition, not less than 9 percent. of crystallized morphine when assayed by the process given below." *U. S.* (See page 903.) "The juice obtained by incision from the unripe capsules of Papaver somniferum, *Linn.,* inspissated by spontaneous evaporation. Any suitable variety of opium may be employed as a source of Tincture of Opium and Extract of Opium of the respective official alkaloidal strengths, provided that when dry it contains not less than 7½ per cent. of anhydrous morphine; but, when otherwise used for officially recognized purposes, opium must be of such a strength that when dried, and powdered, the powder heated to 212° F. (100° C.) until it ceases to lose moisture, and the product tested by the appended method, such dry powder shall yield not less than 9½ per cent., and not more than 10½ per cent., of anhydrous morphine. Opium yielding when dried more than 10 per cent. of anhydrous morphine may be diluted to that percentage with any opium containing when dry between 7½ and 10 per cent. of anhydrous morphine, or with Milk Sugar." *Br.*

Lachryma Papaveris, Meconium, Succus Thebaicus, Thebaica; Opium, *Fr. Cod.;* Opium, *P. G.;* Mohnsaft, *G.;* Oppio, *It.;* Opio, *Sp.;* Affioni, *Turk.;* Ufyoon, *Arab.;* Sheerikhaskash, *Pers.;* Ufeem, *Hindost.*

Opium is generally believed to be derived exclusively from *Papaver somniferum,* though every species of poppy is capable of yielding it to a greater or less extent, and some authors assert that *Papaver orientale* is its real source. The United States, British, and French Pharmacopœias recognize only the first-mentioned species.

Papaver somniferum, L., *Sp. Pl.* (1753) 508; Willd., *Sp. Plant.* ii. 1147; *B. & T.* 18.—There are several varieties of this species, of which the two most prominent are distinguished by the titles of the white and the black poppy, derived from the color of their seeds. It is the former (var. *P. album,* DC.) which is usually described as the proper opium plant. The *white poppy* is annual, with a roundish, smooth, erect, glaucous, often branching stem, usually rising two or three feet in height, but sometimes five or even six feet in favorable situations. The leaves are large, variously lobed and toothed, and alternately disposed on the stem, which they closely embrace. The flowers are terminal, very large, and of a white or silver-gray color. In India they appear in February, in Europe and the United States not earlier than June, July, or August. The calyx is smooth and composed of two leaves, which fall when the petals expand. These are usually four in number, but there is a variety in which the flower is double. The ovary is smooth and globular, supports a radiated stigma, and is surrounded by numerous short and slender filaments, with erect, oblong, compressed anthers. The capsule is smooth and glaucous, rounded, from two to four inches in diameter, somewhat flattened at the top and bottom, and crowned with the persistent stigma, the diverging segments of which are arranged in a circle upon the summit. It contains numerous minute white seeds, which when perfectly ripe escape through small openings beneath the stigma. In the *black poppy,* the flower, though sometimes white, is usually violet-colored or red, the capsule somewhat smaller and more globular, and the seeds of a brown or blackish color.

All parts of the poppy contain a white, opaque, narcotic juice, but the leaves, analyzed by Blondeau, yielded none of the active principles by which opium is characterized. (*J. P. C.,* vii. 214.) It is in the capsule that the juice most abounds and the virtues of the plant chiefly reside. Hence this part is sometimes employed medicinally. (See *Papaver.*) The seeds are destitute of narcotic properties, and are even used as food. The Romans employed them in the preparation of various dainties. They abound with a bland oil, called commercially *poppy seed oil,* which may be extracted by expression. It is of a straw-yellow color, without odor, and of a pleasant almond taste. It is without narcotic properties, and much resembles olive oil, as a substitute for which and an adulterant of which it is very largely used on the continent of Europe. It has a low congealing point, thickening only at —15° C. (5° F.) and solidifying at —20° C. (—4° F.). The black variety is specially used for the expression of oil, as its culture is easier, and the oil percentage in both varieties is practically the same, ranging between 50 and 60 per

cent. As the oil cake generally retains about 8 per cent. of the oil, the yield by expression is from 42 to 50 per cent. Poppy oil contains the glycerides of stearic and palmitic acids, together with those of linolic, linolenic, and oleic acids. Of the liquid fatty acids, linolic constitutes about 65 per cent., oleic 30 per cent., and linolenic 5 per cent. Myristic and lauric acid seem to be absent. The oil is an article of much importance on the continent of Europe, particularly in France and Germany, where it is employed for culinary and pharmaceutical purposes, in painting and the manufacture of soap, and in other ways, as a substitute for olive oil. The poppy does not appear to elaborate the milky fluid in which its narcotic properties reside before a certain period of its growth, for we are told that, in Persia, the young plants which are pulled up to prevent too thick a crop, are used as potherbs, and the *μήκων* of the Greeks, which is believed to be identical with the *Papaver somniferum,* is said by Hippocrates to have been nutritive.

Though generally believed to be a native of Asia, this species of poppy grows wild in the south of Europe, and even in England, whither its seeds are supposed to have been brought at a very early period. It was cultivated by the ancient Greeks, and is mentioned by Homer as a garden plant. It is at present cultivated very extensively in India, Persia, China, and Asiatic Turkey, for opium, and in certain parts of Europe chiefly for its seeds. Attempts have been made both in Europe[1] and the United States to produce opium from the poppy, but although it is possible to obtain the product, commercial success has not been and probably never will be achieved in America because of the cost of labor. A very good quality of opium is said to have been produced in Australia. (See *Australian Journal of Pharmacy,* Nov. 1887.)

[1] Various attempts have been made in England to cultivate the poppy, all of which have resulted in commercial failure. (For particulars, see Seventeenth edition U. S. D.; also *Edinb. Phil. Journ.,* i. 258.) The same may be said of the attempts to cultivate opium in France, which have apparently ceased since the death of Aubergier, who devoted much time and money to the subject. (For particulars see 15th ed. U. S. D.; also *P. J.,* xv. 693.)

In spite of the prohibitions of the Imperial government, the production of opium is said to be greatly on the increase in China, the cultivation of the poppy paying much better than that of wheat. (*P. J.,* ix. 1878.)

In 1865, P. Robertson of Campbell Co., Virginia, produced opium which yielded to the analysis of I. J. Grahame 4 per cent. of morphine, besides narcotine. (*A. J. P.,* 1867, p. 50.) H. Black of Bolivar, Tennessee, produced an opium from which E. S. Wayne obtained 10.2 per cent. of morphine. (*Ibid.,* Jan. 1868.) In 1868 considerable interest was aroused by the statements of W. C. Wilson, which were, however, proved by Procter to be incorrect. (See 14th and 15th eds. U. S. D.) Very fine opium has been produced by J. H. Flint of California (*A. J. P.,* 1874, p. 105); also in Minnesota, by E. Weschke (*Contributions Dep. Pharm. University of Wisconsin,* 1886), but in the opinion both of Flint and of Weschke the high price of labor forbids the profitable production of opium in the United States. For an account of North Carolina opium, see *Proc. A. Ph. A.,* 1894, 286; also *A. J. P.,* 1896, 435; also *Proc. A. Ph. A.,* 1904, 438.

The opinion that a hot climate is not necessary for the production of the narcotic principles has the support of Guibourt (*J. P. C.,* Sept. 1867, p. 222), and would seem to be established by the facts that the opium of Anatolia is richer in morphine than that of the much hotter regions of Bengal and Upper Egypt, and that, while Smyrna opium seldom yields more than 12 per cent. of morphine, that produced in the north of France yields from 20 to 24 per cent. (Bussy, *Ibid.,* p. 221.)

Opium is obtained from the capsule of the poppy in a manner almost the same as that described by Dioscorides eighteen hundred years ago. A few days after the petals have fallen from the flower, when the capsule is approaching maturity, horizontal incisions into the capsule are made, usually with a several-bladed knife, care being taken not to penetrate the cavity. The white juice which exudes is allowed to harden for twenty-four hours, when it is scraped off by means of a large, blunt knife, a portion of the epidermis of the capsule being removed and constituting about six to ten per cent. of the product. In some places the poppy-head yields opium but once, but in Persia and probably other very hot countries the operation is repeated two or three times after periods of rest. The quality of the product depends largely upon the weather; if this is very hot and dry, the juice will be scanty and very thick, but if the weather is moist the product will be larger but more aqueous. After gathering, the poppy juice is worked up into opium in a manner which differs in different producing countries. An opium-like substance has been in past times, and perhaps even is at present in some districts, produced by making an aqueous extract from the nearly ripe capsules of the poppy. According to the writings of Dioscorides the ancient Greeks were acquainted with both processes of producing the drug from the poppy capsule. The term *ὀπίον,* derived from *ὀπος, juice,* they applied to the substance procured by incisions, which answers precisely to the modern opium. The inspissated expressed juice they called *μηκώνιον,* from *μήκων,* the name of the plant.

Commercial History.—Commerce is supplied with opium chiefly from Hindostan, Persia, Egypt, and Asiatic Turkey.[1] Immense quantities are produced in the Indian provinces of Bahar and Benares, and in the more interior province of Malwa. The opium of Hindostan is distributed extensively through continental and insular India, where it is habitually employed as a narcotic-stimulant. Great quantities are also sent to China, into which it finds an easy entrance, notwithstanding prohibitory laws.[2] Much was formerly imported by the

[1] For an elaborate account of methods of opium production in India, see *P. J.,* vol. xx. 178, also in Turkey and Asia Minor, see *J. P. C.,* 3e sér., xiii. 105; *P. G.,* March, 1854; *A. J. P.,* 1863, 362; also 14th edition *U. S. D.*

[2] The India-Chinese opium trade, which has given rise to so many wars and controversies, is, according

East India Company into England, through which a small proportion reached our own country. For various reasons India opium no longer enters Western commerce to any extent. It is produced in Hindostan chiefly under government supervision. The drug as first obtained is semi-liquid, owing to the excessive dews, but is allowed to drain and dry by spontaneous evaporation until only 30 per cent. of moisture is left, when it is taken to the government factories. Great care is exercised to prevent adulteration. In the factories it is worked up with the drainings (known as *passēwā*), poppy petals, and ground poppy plant into balls of standard strength. These are called *"cakes,"* are about six inches in diameter, and are prevented from adhering by being rolled in the ground poppy plant. *Malwa* opium is a variety not made in Hindostan proper nor under government supervision. Its quality varies greatly. Of the opium produced in Persia, very little is brought to this country. Much was formerly produced in Upper Egypt, especially in the district of ancient Thebes, which was supposed to yield it in greatest perfection, hence the term *Opium Thebaicum*, and the old name of laudanum, *Tinctura Thebaica.*

Turkey opium is produced in Anatolia, and shipped chiefly from the port of Smyrna. It is brought to the United States either directly from the Levant or indirectly through different European ports. The amount of crude opium imported in 1904 was 573,055 lbs., valued at $1,255,115, and of opium prepared for smoking, 142,813 lbs., valued at $1,094,988. Turkey opium usually comes to us in masses of irregular size and shape, generally more or less flattened, covered with leaves or the remains of leaves, and with the reddish fruits of some species of *Rumex*, which are said to be absent in the inferior kinds, and may therefore be considered as affording some indication of the purity of the drug. We may account for this circumstance upon the very probable supposition that these fruits are removed during the operation which the masses undergo in the hands of the merchants after leaving those of the cultivators. We are told by some French writers that extensive frauds are practiced at Marseilles in this branch of commerce. The opium taken thither from the Levant is first softened, and then adulterated with various matters which are incorporated in its substance. To use a strong expression of Guibourt, they make the opium over again at Marseilles. According to A. T. Thomson, one-fourth part of Turkey opium generally consists of impurities. Sand, ashes, the seeds of different plants, extracts of the poppy, *Lactuca virosa, Glycyrrhiza glabra*, and *Chelidonium glaucum*, gum arabic, tragacanth, salep, aloes, even small stones and minute pieces of lead and iron, are mentioned among the substances employed in the sophistication of the drug. Tschirch (*A. J. P.*, 1898, 488) proposes the use of the Roentgen ray in detecting such adulterations. Landerer of Athens, was informed by a person who had been engaged in the extraction of opium, that grapes, freed from their seeds and crushed, were almost universally mixed with the poppy juice, and that another adulteration consisted of the epidermis of the capsules and stem of the plant, pounded in a mortar with the white of an egg. (*A. J. P.*, xv. 238.) According to Wilkins, who witnessed the collection of opium, the inspissated juice of the grape, thickened with flour, is often used for the same purpose. (*P. J.*, xiv. 400.)[1]

to the English consul at Shanghai, "likely to disappear by a sort of painless extinction," the importation from India into China having fallen from nearly ten millions of pounds annually to less than seven millions. This change is not the result of any lessening in the use of opium as an intoxicant by the Chinese, but to the increase of poppy cultivation throughout the Celestial empire. As much as 1,300,000 pounds of Chinese opium were in 1895 received in the Shanghai market from Western China alone. The cost of the native drug to the consumer is said to be exactly half that of the India opium. The importance of this matter is shown by the fact that in the season of 1894-95, 537,556 acres of land were under poppy cultivation in British India. The comparatively low price of the Chinese opium seems not to depend upon differences in quality. The percentage of morphine does not decide the value of smoking opium, certain opiums being preferred by the Chinese, although they contain a very small percentage of morphine. On examination of the Chinese opium, Frank Brown found it remarkably free from foreign materials. The percentage of morphine varies from 4.3 in the Kwie-chu opium to 11.3 in the Szechuen opium. For further details, see *P. J.*, iv. and lvii.

[1] The great importance of opium renders it desirable that all its commercial varieties should be accurately described, and their relative value, so far as possible, ascertained. The varieties of this drug may be discussed according to the countries in which they are produced, an arrangement which we here adopt.

I. TURKEY OPIUM.—This title belongs to the opium produced in the Turkish province of Anatolia, and exported from Smyrna and Constantinople. According to some authorities, there is no essential difference between the parcels of the drug brought from these two ports. Others maintain that they are distinct varieties, differing in their interior structure, and probably also in the precise place of their production and the mode of their collection. The truth probably is that most of the opium shipped at Constantinople is produced in the more northern parts of the opium districts of Anatolia, while that from Smyrna is collected in the provinces more convenient to the latter city, and, though it is possible that an identical drug may often be brought from the two ports, yet there are grounds for arranging it under different varieties, as derived from these different sources. There can be little doubt also that a portion of opium which is taken to Constantinople is produced in Macedonia in Europe, which must, therefore, be added to the opium producing regions.

1. *Smyrna Opium.*—This is the variety which is, beyond all comparison, most abundant in our markets, and it is from this that the ordinary descriptions of opium are drawn up. It comes to us in masses of various size, usually from half a pound or somewhat less to a pound in weight, sometimes, though rarely, as much as two or even three pounds, originally, perhaps, of a globular form, but variously indented, and rendered quite irregular in shape by the pressure to which they have been subjected, while yet soft, in the cases which contain them. Sometimes they are even pressed out into flat cakes. As brought into market, the lumps are usually hard on the outside, but still soft within. They are covered externally with the remains of leaves, and with the reddish fruits of a species of Rumex, which have no doubt been applied in order to prevent the surfaces from adhering. Notwithstanding, however, this coating, the masses sometimes stick together, and two or more become consolidated into one. In this way the fact may be accounted for, that the seeds of the Rumex are occasionally found in the interior of the masses. In the finer parcels of Smyrna opium the

The adulteration of opium has given rise to much complaint on the part of pharmacists, and various plans of customs legislation have been suggested by which it has been thought that these adulterations could be prevented. It is, however, obviously impossible to pronouncedly

color internally is light brown; in the inferior it is darker. A peculiar character of this variety is that, when a lump of it is cut into and then carefully torn, numerous minute shining tears are observable, particularly under a microscope, bearing some resemblance to small seeds, but readily distinguishable by pressure between the fingers. They are undoubtedly formed from the drops of juice which escape from the incisions in the capsules, and which, according to Bélon, are allowed to concrete before they are removed. From the account of the same author it appears that after the juice has been collected it is not subjected to the process of kneading or beating, as in the case of other varieties of the opium; so that the tears preserve their original shape in the mass. It is probably owing to the peculiar mode of collecting Smyrna opium, that minute pieces of the skin of the poppy capsules are found intermingled in the mass, these being separated in the process of removing the adhering tears. In the best specimens of Smyrna opium, these fragments of the capsules are the only impurities. This variety of the drug is of very different qualities, the finest kinds yielding, according to Merck, as much as 13 per cent. of pure morphine, while from some very bad parcels he could not procure more than 3 or 4 per cent. In these inferior specimens the color is darker, the odor is often musty, and there is very generally more or less mouldiness both upon the surface and in the interior of the masses, indicating perhaps too much moisture in the opium originally, or its subsequent exposure to an injurious degree of dampness. Good Smyrna opium ought to yield 10 to 11 per cent. of morphine. Christison, however, states that he has not been able to procure more than 9 per cent. from the finest Smyrna opium. According to Landerer, little of the opium is produced in the immediate neighborhood of Smyrna, the greater portion being brought, on the backs of camels, from a distance of from ten to eighteen days' journey. (*J. P. C.*, 3e sér., xxiii. 33.) The same writer states that the opium is chiefly prepared at Kara-Hissar, near Magnesia. The incisions are generally made before sunrise. The juice is partly caught in mussel-shells, and dried in the sun. This is considered the best. Every evening the juice which has dried upon the capsules is scraped off, with a portion of the epidermis. The poppy is then cut down, and stripped of its leaves, which are boiled in water, and the liquor is evaporated to the consistence of an extract. With this the inspissated juice is incorporated, and the mixture is then formed into cakes, wrapped in poppy leaves, and placed on shelves to dry. (See *A. J. P.*, xxiii. 251.) It is very evident, from the interior structure of the *best Smyrna opium*, that it has not been prepared in the way described by Landerer, though his account is probably true in reference to inferior varieties.

2. *Constantinople Opium.*—Most of the Constantinople opium is in lumps from half a pound to two and a half pounds in weight, and scarcely distinguishable in exterior appearance from those of the former variety, being equally irregular in shape, and in like manner covered with the fruits of the Rumex. According to Merck, however, it often differs strikingly from the Smyrna opium in its interior constitution, being wholly destitute of the tears which characterize that variety. This would indicate some difference in the mode of collecting and preparing the juice. In the case of the Constantinople opium it is probably removed from the capsules before concretion. Merck says that he has not discovered in this variety those minute portions of the poppy capsules which are usually present in Smyrna opium. The average quality of the Constantinople opium, as above described, is about equal to that of the drug from Smyrna, but it appears to be occasionally purer, as Merck obtained from one specimen as much as 15 per cent. of pure morphine. R. Bauer of Constantinople, in 1867 denied that any of the varieties produced near Smyrna contain tears, except the single one from Magnesia. (*N. R. Pharm.*, xvi. 751.)

In an account, by Bourlier, of the culture of the poppy and collection of opium in Bithynia, a province of Asia Minor, near Constantinople, it is stated that the lumps, when formed out of the concrete juice, are enveloped in poppy leaves, and no mention is made of the use of the Rumex fruits to prevent adhesion. It is the opium here collected which, according to Bourlier, is known throughout the Levant and in Europe as Constantinople opium. The same authority states that the yolk of egg is sometimes largely used for adulterating opium,—a fraud which may be detected by the large proportion of fatty matter which the adulterated drug yields to ether, and by the impossibility of drying it so as to fit it for pulverization. (*Ann. Thér.*, 1859, p. 4.)

Guibourt describes another variety of Constantinople opium of much inferior character. "It comes," he observes, "in small, flattened cakes, sufficiently regular and of a lenticular shape, from two to two and a half inches in diameter, and always covered with a poppy leaf, the midrib of which divides the surface into two equal parts. It has an odor similar to that of the preceding variety, but feebler, and it blackens and dries in the air. It is more mucilaginous than Smyrna opium, and contains only half as much morphine." These characters are obviously those of Egyptian opium, and, though the parcels which came under the notice of Guibourt may have been imported directly from Constantinople, it is highly probable that they were originally from Alexandria. Stettner of Trieste, though well acquainted with the opium commerce of that port, recognizes no such Constantinople opium as that described by Guibourt. (*Ann. Pharm.*, xxiv. 65.) According, however, to Bauer, the opium collected in the districts nearest Constantinople is mostly in small pieces, often of only two or three ounces, which are always invested with poppy leaves, or more rarely with grape leaves, generally smooth, and without Rumex fruits, and this description corresponds with Guibourt's. (*N. R. Pharm.*, xvi. 754.)

A number of varieties of opium produced in European and Asiatic Turkey circulate more or less in Austria and other parts of Germany, which have been described by C. Finckh in *Buchner's Repertory* (vol. xvi., p. 749), and of which we propose to give a brief account here:

Opium of Géwé or *Gévé* is gathered from a poppy with red flowers, and comes in the form of small rounded cakes, weighing 2 or 3 ounces, enveloped in the leaves of the poppy, with a smooth and shining surface, which seems to be divided into two halves by the median nerve of the leaf. The interior is in layers of light- and deep-colored opium; and its yield of morphine is from 12 to 15 per cent.

Opium of Amasia differs from the preceding only in this, that there are two enveloping poppy leaves, placed crosswise, and with their lower surface outward, so as to give a rugose appearance to the cakes. In the interior the mass is homogeneous, but is very analogous to the *Géwé* opium.

Opium of Malatia is in small loaves, round or somewhat oval, from 4 to 5 ounces in weight, made with the greatest care, and enveloped in poppy leaves, with a rugose surface, and the median line corresponding to the middle of the loaves. The borders of these are frequently deprived of the leaf. The substance of the loaf is homogeneous, but generally poor in morphine.

Opium of Magnesia is in irregular cakes or loaves, from 1 to 4 ounces in weight. They are covered first with a layer of Rumex fruits, and afterwards with poppy and vine leaves, and owe their irregular form to the envelopes, for originally they are rounded. The interior is composed of agglutinated tears, and is of excellent quality.

Opium of Salonica, or of *Kutchina*, has a strong analogy in all respects with that of Géwé, for which it is often substituted. (See analysis by A. R. L. Dohme, *Proc. A. Ph. A.*, 1893.)

The following represent the varieties in which Smyrna opium appears in the market:

The *Opium of Balukhissar*, which is the chief source of the Smyrna opium, is in cakes of from 4 to 12 ounces, irregular, though originally globular-ovoid. They are covered with Rumex fruits and present, besides, on their surface, poppy leaves irregularly applied. The mass is formed of tears lighter or deeper colored, and is so rich in morphine as to cause this variety to be always sought for in the market. (See analysis by A. R. L. Dohme, *Proc. A. Ph. A.*, 1893.)

The *Opium of Cataya* is generally in lumps half as large as the preceding, which it approaches closely in its characters and in its yield of the alkaloid.

The *Opium of Taushan* or *Taushanly* is in irregular lumps, twice as long as broad, and weighing from 3 to 5 ounces. The mass consists of tears, and is carelessly enveloped with the poppy leaf and a few Rumex fruits. This variety is rich in morphine.

affect the action of the semi-barbarians who are engaged in the cultivation of opium, by any American legislation. Usually the substances which are used to adulterate the drug are inert, and therefore do no harm except by weakening its activity. The U. S. Custom House requires

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The *Opium of Angora* or *Engiri* is readily known by its under surface being covered with only one leaf of the poppy. The masses, being almost spherical, appear to have been originally in balls. Their weight is from 6 to 8 ounces, the interior homogeneous, and the quality inferior.

The *Opium of Kara-Hissar* is in balls, flattened beneath, of the weight of 6 or 8 ounces, and covered with poppy leaves and Rumex fruits. Though carefully prepared, this variety formerly, from its deficiency in morphine, was of inferior quality; but it has improved of late years. (See analysis by A. R. L. Dohme, *Proc. A. Ph. A.*, 1893.)

The *Opium of Cigusti* is in irregular loaves, 6 or 8 ounces in weight, enveloped in poppy leaves and Rumex fruits. Though rarely falsified, it often contains fragments of the poppy capsules, and forms a mass sometimes of distinct tears, sometimes not. Occasionally rich, it is almost always mixed with the various forms of Smyrna opium.

Finckh has noticed the following adulterations: opium of Macedonia, with clay; of Angora, with wax; of Amasia, with gum; of Taushan, with licorice; of Balukhissar, with melted pitch. He has even found an opium evidently made almost entirely of clay and cow dung. The opiums of Macedonia are most frequently adulterated. (*J. P. C.*, Nov. 1869, 377.)

Bulgarian Opium has been met with in European commerce. (*C. D.*, 1893, 733.)

II. EGYPTIAN OPIUM.—This formerly occurred in flat roundish cakes, of various dimensions, sometimes as much as six inches in diameter and a pound in weight, usually, however, much smaller, and sometimes not weighing more than half an ounce. These cakes were either wrapped in a poppy leaf, so placed that the midrib divided the surface into two equal parts, or exhibited vestiges of such a covering. Occasionally the brown color of the opium was seen through the leaf, and the surface appeared as if uncovered, while the leaf was still present. The fracture was conchoidal and of a waxy lustre, and small fragments of it were translucent. Its color was usually redder than that of Smyrna opium, though sometimes dark. Some of the pieces, on exposure to the air, became damp and sticky on the surface, indicating the fraudulent addition of a deliquescent substance. The odor was similar to that of Smyrna opium, but weaker. It was an inferior variety, as the best of it, examined by Merck, yielded only 6 or 7 per cent. of morphine, and a specimen of it was found by J. Evans of Philadelphia, to contain not more than 3.55 per cent.

At one time there was a considerable exportation of opium from Egypt to Italy, but in 1903 the production of the drug in Egypt was practically abandoned, so that Egyptian opium is no longer a commercial variety.

III. INDIA OPIUM.—Little if any of this opium reaches our market. There appear to be two chief varieties of it,—one produced in Bahar and Benares, in the Bengal Presidency, and called *Bengal opium*, the other in the interior provinces, and designated by the name of *Malwa opium*. For minute description of Indian opium, see *P. J.*, xi., xii., abstracted *A. J. P.*, xxiv. 118; also *Pharmacographia*.

1. *Bengal Opium, Benares Opium, Patna Opium.* It is in round balls, weighing three pounds and a half, invested by a coating half an inch thick, composed of agglutinated leaves and poppy petals. The interior of the mass is of a brownish-black color, of the consistence of a stiff paste, and possessed in a high degree of the characteristic odor and taste of opium. The analyses of India opium vary decidely in their results: Eatwell, 2.17 to 3.67 per cent. of morphine, 3.85 to 5.70 per cent. of narcotine; Procter (Patna opium), morphine, 5 per cent.; Flückiger and Hanbury (Khandesh opium), morphine, 6.07 per cent. (Patna opium), morphine, 8.6 per cent., narcotine, 4 per cent.; Solly (Khandesh opium), morphine, 7 per cent.; Watson (a number of varieties), 3.5 to 6.1 per cent. of morphine. (*P. J.*, xi. 362; *A. J. P.*, xxi. 194; *Pharmacographia*, 2d ed., p. 61.) India opium is, therefore, much inferior to the best Smyrna opium in its yield of morphine, while it is richer in narcotine. Its inferior character is possibly, in some degree, owing to the circumstance that the juice, after collection, is kept for some time before it is made up, and consequently undergoes fermentation. (See *P. J.*, 1895, 208; *Ph. Centralh.*, 1895, 589; also *C. D.*, 1896, 134.)

Garden Patna Opium is prepared in Bahar with peculiar care, from juice which has not been suffered to undergo fermentation. It is in cakes three or four inches square, and about half an inch thick, which are packed in cases with a layer of mica between them. These cakes are without covering, hard, dry, and brittle, of a uniform shining fracture, and not unlike an extract in appearance. The color is sometimes almost black, and sometimes of a light brown, not unlike that of Egyptian opium. Christison states that it is much superior to the globular Bengal opium, and that some specimens are little inferior to Turkey opium in the proportion of morphine.

2. *Malwa Opium.*—This sometimes occurs in flat, roundish cakes, five or six inches in diameter, and from four to eight ounces in weight. In other instances it is in rectangular masses called bricks, or even in roundish balls. It seems never to be encased in poppy remnants. They are commonly quite hard, dry, and brittle, of a light-brown color, a shining fracture, a compact homogeneous texture, and free from mechanical impurities. The quality is very variable. A specimen of Malwa Opium described by Carson (*A. J. P.*, xxi. 195) broke with a rough fracture, which was of a blackish-brown color, here and there showing irregular oily spots. Procter obtained from it 9¼ per cent. of morphine.

IV. PERSIAN OPIUM.—Opium has been produced in Persia for a great many years, but about 1870 a great stimulus seems to have been given to the cultivation of the poppy and to the improvement of the product. At that time it was described as follows: Sometimes it is in cylindrical pieces, about three and a half inches long and half an inch thick, wrapped in glossy paper, tied with a cotton thread, and each weighing about half an ounce; more frequently it is in short rounded cones weighing from 6 to 10 ounces; it also occurs in flat circular cakes. It is of a uniform consistence, but exhibits, nevertheless, under the microscope, small agglutinated tears, much less than those of Smyrna opium. It has the liver-brown color of Egyptian opium, a virose musty odor, and a very bitter taste, and, like Egyptian opium, softens in a moist atmosphere. The character of the opium has undoubtedly changed of late years. The most important local varieties of Persian opium appear to be the so called *Mesched opium*, which occurs in grayish-brown shining sticks, wrapped in paper, and *Ispahan opium*, of similar appearance, but of a purer brown color. According to the investigations of Schindelmeiser (*Ap. Ztg.*, 1904, 19) the Mesched opium, when freed from moisture, yields from 5.9 to 8.7 per cent. of morphine; while Ispahan opium has in it from 11.9 to 19 per cent. of the alkaloid. *Tschakida* of the Persians is a dark brown, blackish impure opium occurring in cakes prepared for smoking, and according to Schindelmeiser contains not more than 0.4 per cent. of morphine. Schindelmeiser states that Caucasian opium is largely adulterated with inspissated fruit juices, and frequently contains less than 2 per cent. of morphine.

According to Seidler, in 1903 the making of opium in Persia was flourishing, amounting to 3000 chests, each containing 60 kilogrammes, a year, but the drug is chiefly consumed in Persia by the opium smokers, and of that which was exported in 1903, 90 per cent. is said to have gone to Hong Kong and 10 per cent. to London and Egypt; so that very little of the Persian opium finds its way into the European market, and the last of its importation into the United States of which we have knowledge was in 1902. This opium was in irregular parallelopipedons; with a fracture smooth and almost conchoidal and showing no signs of tears; sometimes wrapped in deep-red paper, tied with yellow strings, or in other cases having a smooth oiled surface. According to Seidler, Persian opium now occurs in two forms, one in irregular masses with rugous irregularly fissured surface; the other in elongated squarish rods or masses, 0.7 to 1 centimeter in thickness, with a smooth surface and fracture. W. D. Howard examined a sample of the Persian opium sent to England as "perfectly pure," which yielded to him on analysis, without previous drying—morphine, crystallized from alcohol, 10.40 per cent.; codeine, anhydrous, 0.29 per cent.; narcotine, 2.50 per cent.; thebaine, 0.57 per cent.; cryptopine, 0.09 per cent.; papaverine, a trace. He is unable to say whether it contained any narceine. Rosengarten and Sons (now Powers-Weightman-Rosengarten Company) of

that opium, in order to enter the United States as opium, shall conform to the U. S. P. standard and contain not less than 9 per cent. of crystallized morphine. It would perhaps be better if this should be raised to 10 per cent., though it is a question whether shutting out the weakened and cheaper grades of opium does not injure the manufacture of morphine in the United States, and probably the present tariff legislation is sufficient. In China, opium is prepared for smoking by mixing it with various ingredients to give form and flavor. It occurs as a soft blackish paste and contains less than 9 per cent. of morphine, but is allowed to pass as an extract through the United States Custom House. In the fiscal year ending June, 1903, 208,043 pounds of this kind were received into America from the Chinese Empire, 4100 pounds from other countries. In 1904, 142,813 pounds were imported from the Chinese Empire, none from other countries.[1]

Opium is regarded as inferior when it has a blackish color, a weak or empyreumatic odor, a sweet or slightly nauseous and bitter taste, a soft, viscid, or greasy consistence, a dull fracture, or an irregular, heterogeneous texture, from the intermixture of foreign substances. It should not impart a deep-brown color to the saliva, nor leave a dark uniform trace when drawn over paper, nor form with water a thick viscid solution.

Properties.—Good opium has a peculiar, strong, narcotic odor, and a bitter, somewhat acrid taste. It is officially described as "in irregular, flattened, more or less rounded masses of variable size, externally grayish-brown, covered with remnants of poppy leaves and with occasional fruits of a species of *Rumex;* more or less plastic when fresh, but becoming hard on keeping; internally dark brown, somewhat lustrous; odor strong, narcotic; taste bitter and characteristic." *U. S.* When long chewed it excites much irritation in the lips and tongue, and may even blister the mouths of those unaccustomed to its use. Its color is reddish brown or deep fawn; its texture compact; its sp. gr. 1.336. When drawn over paper it usually leaves an interrupted trace of a light-brown color. It is often soft in the interior of the mass, and in this state is tenacious; but when exposed to the air it gradually hardens, and ultimately becomes brittle, breaking with a shining fracture, and affording, when pulverized, a yellowish-brown powder, which becomes adhesive upon a slight elevation of temperature. It readily inflames upon the application of a lighted taper. It yields its virtues to water, alcohol, and diluted acids, but not to ether. To all these menstrua it imparts a deep-brown color. Alcohol dissolves about four-fifths of it. Pelletier stated that the proportion taken up by water varies in the specimens. He never found the quantity of extract prepared with cold water to exceed 12 parts out of 16.

Chemical Constituents.—Much attention has been devoted to the chemical constitution of opium. It was through the researches into the nature of this substance that chemists were led to the discovery of the alkaloids, which are usually the active principles of the plants in which they are found, and have attracted much notice, and been applied so advantageously to the treatment of disease. To Sertürner, an apothecary at Eimbeck, in Germany, belongs the credit of having opened this new and most

Philadelphia, formerly used large quantities of the Persian opium in the production of morphine, obtaining from it an average of 10 per cent. of that alkaloid. In their more recent analyses the drug has yielded from 10 to 12.8 per cent. of actual morphine, the codeine in percentage varying very greatly apparently with the crop of the year; in some years the opium contained no codeine, in others 0.6 per cent.; commonly the percentage varies from 0.3 to 0.4 per cent.

V. MOZAMBIQUE OPIUM.—The poppy culture has been introduced into Mozambique for the production of opium for the Chinese market. A specimen of the product is said to have yielded 4 per cent. of morphine, 4.3 per cent. of narcotine, and 40 per cent. of moisture. (*P. J.*, x. 63.)

VI. CHINESE OPIUM.—The U. S. duty upon opium is one dollar a pound, but the custom house authorities view the Chinese variety as an extract, and levy six dollars a pound. It occurs in flat, oval cakes, wrapped first in white tissue, then in thin brown paper, labelled in Chinese characters with the name of the province and the seller. The color varies from dark brown to black; the fracture is sometimes granular, sometimes smooth; the odor usually strongly narcotic.

"BOSTON OPIUM," so called, was a sophisticated article.

The table below exhibits the results obtained by Guibourt in the analysis of various opiums. (*J. P. C.*, Janv., Fév. et Mars, 1862.)

[1] *Opium Smoking.*—By the various nations of the Orient opium is employed as an intoxicant by smoking in two ways. In Turkey and its neighboring countries it is placed upon tobacco, in a small pipe. In the East it is usually made into a very thick, almost plastic, liquid, and a drop of it is held over the flame of a small oil-lamp, and the resulting fumes inhaled through pipes of various forms. For an elaborate study of the chemistry of the opiums used for smoking in various countries, see *Ap. Ztg.*, 1903.

Moissan has found in opium smoke, morphine, pyrrol, pyridine with various homologues, acetone, and various hydropyridine bases, all of which are physiologically active. This analysis has been confirmed by Hartwich and Simon, who believe that the activity of the opium smoke depends not so much upon the morphine as upon the other products of the destructive distillation.

Table showing percentage of morphine in varieties of opium (Guibourt).

Opium.		Soft.	Hard.	Dried.
Anatolia (Smyrna)	lowest	9.60	10.82	11.70
" "	highest	18.24	19.77	21.46
" "	mean	12.40	13.57	14.78
Constantinople	lowest	10.90	13.32	14.40
"	highest	14.00	15.72	17.00
Egyptian	lowest		5.19	5.81
"	highest		11.45	12.21
Persian			10.52	11.37
Indian (Patna)	lowest		5.09	5.27
" "	highest		6.93	7.72
French	lowest		14.21	14.83
"	highest		21.10	22.88
"	mean		16.77	17.69

important field of research. In the year 1803 Derosne made known the existence of a crystallizable substance which he had discovered in opium, and which he erroneously believed to be the active principle. In the following year Seguin discovered another crystallizable body, which experience has proved to be the true narcotic principle of opium, but he did not fully investigate its nature, and no immediate practical advantage accrued from his excellent analysis. About the same time, Sertürner was engaged in a similar investigation, the results of which, very analogous to those obtained by Seguin, were published in a German journal, without, however, attracting general attention. In this state the subject remained until 1817, when Sertürner announced the existence of a saline compound in opium, consisting of a peculiar alkaline principle united with a peculiar acid, and clearly demonstrated the precise nature of a substance which, though discovered both by Seguin and himself, had been hitherto but vaguely known. To the alkaloid, in which he correctly conceived the narcotic powers of opium to reside, he gave the name of *morphium*, which has been since changed to *morphine*, in order to render it conformable with the titles of the other alkaloids. The acid he called *meconic*, a term derived from the Greek name of the poppy. The correctness of the statements of Sertürner was confirmed by Robiquet, who also satisfactorily demonstrated that the substance obtained by Derosne and called by him the *salt of opium* was a principle altogether distinct from morphine, though supposed to possess considerable influence over the system. In the belief in its narcotic powers, Robiquet denominated it *narcotine*, a title which it still retains. A number of other alkaloids have since been discovered in opium, although most of these are in very limited amount, and the existence of some is not quite definitely established. According to the views of its constitution at present accepted, it contains: 1. *Morphine*, $C_{17}H_{19}NO_3$; 2. *Codeine*, $C_{18}H_{21}NO_3$; 3. *Thebaine*, $C_{19}H_{21}NO_3$; 4. *Papaverine*, $C_{20}H_{21}NO_4$; 5. *Meconidine*, $C_{21}H_{23}NO_4$; 6. *Codamine*, $C_{20}H_{25}NO_4$; 7. *Laudanidine*, $C_{20}H_{25}NO_4$; 8. *Laudanine*, $C_{20}H_{25}NO_4$; 9. *Laudanosine*, $C_{21}H_{27}NO_4$; 10. *Lanthopine*, $C_{23}H_{25}NO_4$; 11. *Protopine*, $C_{20}H_{19}NO_5$; 12. *Cryptopine*, $C_{21}H_{23}NO_5$; 13. *Rhœadine*, $C_{21}H_{21}NO_6$; 14. *Narcotine*, $C_{22}H_{23}NO_7$; 15. *Oxynarcotine*, $C_{22}H_{23}NO_8$; 16. *Narceine*, $C_{23}H_{29}NO_9$; 17. *Pseudomorphine*, $C_{34}H_{36}N_2O_6$; 18. *Gnoscopine*, $C_{22}H_{23}NO_7$; 19. *Xanthaline*, $C_{37}H_{36}N_2O_9$; 20. *Tritopine*, $C_{42}H_{54}N_2O_7$; 21. *Hydrocotarnine*, $C_{12}H_{15}NO_3$. In addition to the above list, *Deuteropine*, *Opianine*, *Papaverosine*, and *Porphyroxine* are possible alkaloids that have been announced, but not sufficiently established as yet. Still others, like *Apomorphine* (see p. 159), can be produced from those existing in the opium. At least two acids occur in opium combined with these bases,—*meconic acid*, $C_7H_4O_7$, and *lactic acid*, $C_3H_6O_3$. This latter, supposed by T. and H. Smith to be a peculiar variety of lactic acid, and named by them *thebolactic acid*, was ascertained by Stenhouse to be the ordinary variety. Sulphuric acid is found in the ash along with the bases calcium, magnesium, and potassium. Opium also contains *mucilage*, *pectic matter*, and a *glucose sugar*. The wax gathered from the refuse of opium yielded Hesse *cerotyl palmitate* and *cerotate*. Three neutral principles have, moreover, been extracted from opium,—*meconin* (*opianyl*), $C_{10}H_{10}O_4$, *meconoisin*, $C_8H_{10}O_2$, and *opionin*, which, according to Hesse, is contained in small quantities in Smyrna opium. The first of these forms prisms which fuse under water at 77° C., or *per se* at 110° C., and boil at 155° C.; the second melts at 88° C., and the third at 227° C. None of these neutral principles contain nitrogen. All the organic bases of opium polarize to the left. (Bouchardat and Boudet, *J. P. C.*, 3e sér., xxiii. 294.)[1]

Of the principles above mentioned, *morphine* is by far the most important. It is generally admitted to exist in opium united with meconic acid in the state of meconate, and to a certain extent also as a sulphate, although A. R. L. Dohme (*A. J. P.*, 1891, p. 168) believes that the results of a dialysis of opium show that the morphine is combined with sulphuric acid alone.[2]

CODAMINE.—*Codamina*, $C_{20}H_{25}NO_4$, is isomeric with laudanine, but is readily distinguished from it by the effect of ferric chloride and nitric acid, both of which color it deep green. According to Allen, codamine also gives a dark green coloration with sulphuric acid and, in the presence of a minute quantity of ferric chloride, a greenish blue. It is in anhydrous crystals. It can be purified by taking advantage of the feeble solubility of its iodide. Having decomposed this salt by ammonia, dissolve the precipitate in ether, wash the ethereal solution with solution of sodium bicarbonate, then filter through animal charcoal. By evaporation the liquid deposits the alkaloid in beautiful colorless crystals. Codamine crystallizes also from petroleum benzin; but thus obtained it melts at 126° C. (258.8° F.), while that procured through ether melts at about 120° C. (248° F.). The acid iodide, tartrate, and oxalate are crystallizable.

CODEINE.—*Codeina*, $C_{18}H_{21}NO_3$ (or $C_{17}H_{17}NO(OH).OCH_3$), was discovered in 1832 by Robiquet in morphine hydrochloride prepared according to the process of Gregory, and was prepared synthetically by Grimaux by the action of methyl iodide and sodium hydroxide upon morphine, thus proving its chemical char-

[1] Lahens of Toulouse, found glucose in a tincture of poppy capsules, and in all the commercial varieties of opium, in proportions varying from 3 to 14.5 per cent. Its presence in opium is therefore not a proof of sophistication. (*J. P. C.*, Oct. 1854, p. 265.)

[2] *Proportionate quantity of the more important constituents of Opium.*—Smith of Edinburgh obtained from 100 parts of fine opium 10 parts of morphine, 6 of narcotine, 0.15 of thebaine, 1 of papaverine, 0.3 of codeine, 0.02 of narceine, 0.01 of meconin, 4 of meconic acid, and 1.25 of thebolactic acid. (*P. J.*, Oct. 1865, p. 183.)

acter as a morphine methyl-ether (Allen). It exists in opium combined like morphine with meconic acid, and is extracted along with that alkaloid in the preparation of the hydrochloride. (See *Morphina.*) When the solution of the mixed morphine and codeine hydrochlorides is treated with ammonia, the former alkaloid is precipitated, and the codeine, remaining in solution, may be obtained by evaporation and crystallization. It may be purified by treating the crystals with hot ether, which dissolves them, and yields the codeine in colorless crystals by spontaneous evaporation. This alkaloid and its phosphate and sulphate are now official. (See *Codeina.*) For a paper on the determination of codeine in opium by Chas. E. Caspari see *Proc. A. Ph. A.*, 1904, 386.

Cryptopine. *Cryptopina,* $C_{21}H_{23}NO_5$.—The discovery of this alkaloid was announced by T. and H. Smith of Edinburgh, in *P. J.*, 1867, p. 595. They obtained it from the weak alcoholic washings of crude morphine after precipitation, by first neutralizing the liquid with diluted sulphuric acid, and then, after recovering the alcohol by distillation, and washing out the still, copiously, with hot water, by precipitating the mixed liquor of the still and the washings by milk of lime in large excess. The liquid is then filtered off, and the pitch-like precipitate, having been thoroughly washed, is boiled with alcohol in large quantity, the solution filtered, and the alcohol distilled off. The pitchy substance which remains in the retort, and which consists mainly of thebaine, is separated from the supernatant aqueous liquid, and heated to ebullition with enough alcohol to dissolve it. The solution, having been put aside, will be found in a day to have set into a mass of crystals, which consist of crystallized thebaine. This mass is now strongly pressed in a cloth, and the residuary cake powdered and dissolved in diluted hydrochloric acid, care being taken that the acid is not in excess. The filtered liquid is evaporated and crystallized, and the process of evaporation and crystallization repeated, so as to separate all the thebaine hydrochloride. If now the mother waters are set aside, the cryptopine hydrochloride will in the course of some weeks crystallize out of them, but mixed with crystallized thebaine hydrochloride; the separation of the two is extremely difficult. But as the crystals of the two alkaloids are very different, those of thebaine being hard and strong, those of cryptopine soft and generally tufted, by careful management, and by repeating the crystallization many times, so as to get rid of most of the thebaine, the cryptopine hydrochloride may be seen forming on the surface of the harder salt in the solution. The mother liquors now being poured off, and allowed to evaporate spontaneously, the whole at length sets into a soft mass, which, being pressed in a cloth, is found to consist of almost pure cryptopine hydrochloride. To obtain the pure alkaloid, it is precipitated from solution of the hydrochloride by ammonia, washed, dried, and finally washed with ether or alcohol, which readily dissolves thebaine, but has little effect on cryptopine. It may be obtained in a crystallized state by boiling it with a large quantity of alcohol, which, on cooling, will slowly deposit the alkaloid in crystals. The quantity in opium is extremely small.

Cryptopine is without color or odor, and its salts, though at first bitter to the taste, afterward cause a sense of coolness in the mouth, like that produced by peppermint. It melts at 217° C., and, on cooling, crystallizes in radiated forms at 171° C., and, heated to redness, is decomposed, blackening and giving forth aqueous vapors, but without properly subliming. It is insoluble in water and in ether, very sparingly soluble in alcohol, requiring 1265 parts of that liquid when cold to dissolve it. Chloroform dissolves it almost as freely as narcotine. Oil of turpentine and benzene do not appear to dissolve it. It has very strong alkaline powers, and forms crystallizable salts with the acids, which are distinguishable from all the other salts of the opium alkaloids by a strong tendency to gelatinize. If the hydrochloride is dissolved in about 30 parts of hot water, and set aside, instead of crystallizing, it forms a jelly closely resembling that of pure gelatin. From all the constituents of opium, except the stronger alkaloids, morphine, codeine, and thebaine, it is distinguished by its strong alkaline properties, as it neutralizes the strongest acids. From morphine it is distinguished by its very sparing solubility in alcohol, and from codeine and thebaine by its total insolubility in ether. It differs also in the effect of strong sulphuric acid, which produces a blue color with the minutest quantity of cryptopine, a blood red with thebaine, and none with morphine or codeine. The tendency of its salts to gelatinize is another distinguishing property of cryptopine.

Deuteropine, $C_{20}H_{21}NO_3$, according to Allen, is an alleged homologue of protopine and cryptopine. It requires further examination.

Gnoscopine, $C_{22}H_{23}NO_7$, was found by T. and H. Smith in 1878. They first gave to it the formula $C_{34}H_{36}N_2O_{11}$, but in a later communication (*P. J.*, 1893, 1794) gave it the simpler formula which makes it an isomer of narcotine. It is crystallizable, melts at 233° C. (451.4° F.), with partial decomposition, is soluble in chloroform and carbon disulphide, slightly so in benzene, not in ether. The salts have an acid reaction.

Hydrocotarnine.—*Hydrocotarnina,* $C_{12}H_{15}NO_3$, is obtained from the mother waters of thebaine, after the removal of cryptopine and protopine with warm petroleum benzin, by precipitation with ammonia; laudanosine, which is also precipitated, is removed by treatment of the benzin solution with sodium bicarbonate. The hydrocotarnine is retained in solution by the benzin, from which the laudanosine has been deposited on cooling. Hydrochloric acid gas

being made to pass through this solution, hydrocotarnine hydrochloride crystallizes out. This alkaloid, as the name indicates, can be formed from cotarnine, by the action of zinc and hydrochloric acid. It also seems to result from the decomposition of narcotine. (See *Narcotine.*) If the latter be made to boil some time with baryta water, a portion of it will be decomposed, giving rise to a crystallizable substance soluble in ether, which appears to be identical with hydrocotarnine. This alkaloid is very soluble in alcohol, acetone, chloroform, benzin, and ether. It melts at 50° C. (122° F.), and loses at 57° C. the half molecule of water with which it crystallizes. Sulphuric acid dissolves it, coloring it yellow in the cold, and crimson red if heated. Nitric acid colors it yellow; ferric chloride does not affect its color. It has been physiologically studied by Stockman and Dott (*B. M. J.*, Jan. 1891), who find that it produces in the lower animals symptoms similar to those caused by narcotine.

Lanthopine.—*Lanthopina,* $C_{23}H_{25}NO_4$, differs from pseudomorphine in not becoming blue with ferric chloride, and in giving, when entirely pure, with sulphuric and nitric acids, colorless solutions. It forms colorless microscopic prisms, which fuse at about 200° C. Its acid oxalate and tartrate are crystallizable. The alkaloid is crystallizable, does not have an alkaline reaction, is sparingly soluble in hot or cold alcohol, ether, or benzene, but readily soluble in chloroform.[1] According to Allen it is obtained from the mother liquor, left from the preparation of morphine by the Robertson-Gregory process. It is a weak base, and is colored orange red by nitric acid, and pale violet by sulphuric acid, the latter color changing to a dark brown on heating.

Laudanidine, $C_{20}H_{25}NO_4$, was discovered by Hesse in 1894. It closely resembles laudanine.

Laudanine.—*Laudanina,* $C_{20}H_{25}NO_4$, as first prepared, is mixed with cryptopine, from which it is separated by dissolving it in acetic acid, and adding a slight excess of diluted solution of sodium hydroxide, by which the cryptopine is entirely precipitated. The liquid being filtered, and treated with ammonium chloride, lets fall the laudanine, which soon assumes the crystalline form. The acetate, with the addition of potassium iodide, gives rise to laudanine hydriodide, from which ammonia separates the base perfectly pure. It crystallizes from its solution in boiling alcohol in transparent granules or hexagonal prisms melting at 166° C. It is lævo-rotatory, tasteless, and poisonous, the hydrochloride resembling strychnine in its effects. It is dissolved at 18° C. (64.4° F.) by 647 parts of ether. Sulphuric acid gives with it characteristic reactions. When pure, at common temperatures it assumes a pale rose color, and at 150° C. (302° F.) a reddish violet. When ferric oxide is added, it exhibits the same changes, but with much greater intensity. Laudanine is an energetic base, and with potassium hydroxide forms a crystallizable compound. Its salts, except the neutral sulphate, oxalate, and tartrate, are crystallizable.

Laudanosine.—*Laudanosina,* $C_{21}H_{27}NO_4$, exists in the mother waters of thebaine, with cryptopine and protopine. The thebaine having been precipitated by tartaric acid, the mother water is neutralized by ammonia, and sodium bicarbonate is added. After eight days' rest, a blackish mass separates. The limpid liquid with an excess of ammonia yields a copious precipitate, which, agitated with heated petroleum benzin, gives to that liquid a mixture of several alkaloids. The benzin solution, upon cooling to 40° C. (104° F.), deposits the cryptopine and protopine. On agitation anew with heated sodium bicarbonate and subsequent complete refrigeration, the laudanosine crystallizes. It is entirely purified by ether, which dissolves it abundantly, and its hydriodide is but slightly soluble in water. It is itself insoluble in water and the alkalies, but it is

[1] O. Hesse obtained most of the alkaloids announced by him from the black mother liquors left behind in the process for procuring morphine hydrochloride, first employed by Gregory, and adopted by the British Pharmacopœia. This liquor, diluted with an equal volume of water, was precipitated by an excess of ammonia; the clear liquid was exhausted with ether, and this treated as described in *Ann. Ch. Ph.*, clxxx. 47. (*P. J.*, Jan. 1872, p. 549.) The method in which these alkaloids were first separated from opium by Hesse was as follows: An aqueous infusion is prepared, and precipitated by sodium hydroxide or lime water in excess. In the liquid, a substance is retained, which may be extracted by ether, and one of the characteristics of which is that it yields with sulphuric acid a purple color. This appears to be the porphyroxine of Merck. This Hesse found to be a mixture of several alkaloids, which he separated in the following manner. The liquid above referred to as containing the coloring matter is well shaken with ether; this, being separated, is acidulated with acetic acid, and the impure acetates are obtained by evaporating off the ether. The residue is mixed gradually with a diluted alkaline solution, and agitated so as to cause the resin which separates to form a mass. After twenty-four hours, the precipitate is separated; the liquid containing the alkaloids is mixed with hydrochloric acid in slight excess, and the alkaloids are then precipitated with ammonia. The whole is now shaken with chloroform, acetic acid is added in slight excess, the chloroform is evaporated, and the residue is neutralized with ammonia. The precipitate produced is reddish-colored, and, though at first resinoid, soon crystallizes. This, which consists of impure lanthopine, is separated by filtration, and the filtered liquid, after twenty-four hours, is mixed with sodium hydroxide, in quantity but little more than necessary to decompose the ammonia salts in solution. It is then shaken repeatedly with ether to separate codeine, which renders it turbid. This alkaloid is separated more readily by ether than the other alkaloids present, meconidine, codamine, laudanine, and another which the author designated by the letter *x*. Ether does not extract the last-mentioned bases from the solution containing fixed alkali until after ammonium chloride has been mixed with it. When the ethereal solution is allowed to evaporate very slowly, *laudanine* first crystallizes, the other three bases remaining as an almost amorphous mass when the ether has all escaped. But if, before the ether has entirely evaporated, the liquid be mixed with solution of sodium bicarbonate, crystals of *codamine* will be deposited as the ether further evaporates. If the mother liquor, from which the two alkaloids have been separated, is now treated with acetic acid and sodium chloride, *meconidine hydrochloride* is precipitated, the base *x* remaining in solution. The latter is quite separated from meconidine by repeatedly dissolving the hydrochloride in water, shaking it with sodium bicarbonate and ether, and then evaporating off the ether. (*P. J.*, Sept. 1870, p. 205.)

soluble in alcohol, acetone, and chloroform. It melts at 89° C. (192.2° F.), and is decomposed at 110° C. (230° F.). Ferric chloride does not color it. Sulphuric acid gives it a rose color in the cold, and violet when heated. Nitric acid transforms it into a nitro-base. The crystals are anhydrous. It forms crystallizable salts, which are soluble and bitter.

MECONIDINE, $C_{21}H_{23}NO_4$, was discovered by Hesse in 1870. It is brownish yellow, amorphous, alkaline, melts at 58° C. (136.4° F.), and is not stable, the salts also being easily altered. It is easily soluble in alcohol, ether, benzene, chloroform, and acetone. It is dissolved by sulphuric acid with an olive-green color, and by nitric acid with an orange-red.

MORPHINE, $C_{17}H_{19}NO_3 + H_2O$, and its preparations are treated under another head. (See *Morphina.*)

NARCEINE,[1] *Narceina,* $C_{23}H_{29}NO_9$,[2] discovered by Pelletier in 1832, is in white, silky crystals, inodorous, of a bitter taste, the fusing point of which was given as 145.2° C. (291.6° F.) according to Hesse, and as 92° C. according to Pelletier. E. Merck has shown, however (*Chem. Ztg.,* 1889, p. 525), that the ordinary commercial alkaloid of English manufacture melts between 150° and 160° C., and the pure base at 170° to 171° C. Out of water at 60° C. it crystallizes with 2 molecules of water, which it loses at 100° C., and at 140° C. another molecule of water escapes, leaving in the fused residue a mixture of bases. Soluble in 375 parts of cold and 220 of boiling water, soluble also in alcohol, and insoluble in ether. It forms a bluish compound with iodine, the color of which is destroyed by heat and the alkalies. Besides, according to Stein, the blue color is not produced when there is too much of the iodine present, which then causes a brown color with narceine, the blue color appearing, under such circumstances, only when the excess of iodine is saturated by ammonia. (*J. P. C.,* Janv. 1872, p. 59.) It is rendered blue by the action of mineral acids so far diluted as not to decompose it, but does not, like morphine, become blue by the action of ferric salts, nor red by that of nitric acid. According to P. C. Plugge, if a trace of narceine be covered in a porcelain dish with *diluted* sulphuric acid, no change will be observable; but if the dish be heated on the water bath, a blue color will be developed as soon as the acid has become sufficiently concentrated; this by prolonged heating will pass to cherry-red. If to this red liquid, after cooling, a trace of nitric acid or of potassium nitrite be added, blue-violet streaks will be produced. (*A. Pharm.,* 1887, p. 425.) It is dissolved by the acids, but was thought not to neutralize them, and, though at first considered alkaline by Pelletier, was afterwards ranked with indifferent bodies. At present, however, its alkaloidal character is admitted; it unites with sulphuric acid to form a crystallizable sulphate. (*J. P. C.,* Avril, 1864, p. 367.) Dragendorff announced that solution of narceine gives a crystalline precipitate with the double zinc and potassium iodide. This reaction may be employed with iodine as a test of narceine. If a solution of this salt, with a little iodized water, be added to solutions of narceine, and the mixture then agitated with ether to remove the iodine in excess, a solution containing a very small quantity of narceine will distinctly assume a blue color. The other alkaloids of opium are destitute of this property. (*J. P. C.,* Avril, 1870, p. 346.) Pelletier obtained it in the course of his analysis of opium. Having formed an aqueous extract of opium, he treated it with distilled water, precipitated the morphine by ammonia, concentrated the solution, filtered it, threw down the meconic acid by baryta water, separated the excess of baryta by ammonium carbonate, drove off the excess of the ammoniacal salt by heat, evaporated the liquor to the consistence of syrup, set it aside till a pulpy matter formed containing crystals, separated and expressed this pulpy matter, then treated it with alcohol, and concentrated the alcoholic solution. This, on cooling, deposited crystals of narceine, which were easily purified by repeated solution and crystallization. Meconin, which often crystallizes with it, may be separated by the agency of ether. The discordancy of the statements of physiologists and clinicians concerning the action of narceine can only be explained by the presence of impurities in the specimens used. The pure alkaloid would seem to be very feeble in its influence, Mitchell having taken five grains without any other effect than causing some headache. The narceine of commerce has been used in doses of one-third to three-fourths of a grain (0.021 to 0.048 Gm.) as a mild narcotic, probably acting through contaminating morphine.

NARCOTINE. *Narcotina,* $C_{22}H_{23}NO_7$.—It exists in opium, chiefly, at least, in the free state, and is left behind in considerable quantity when the drug is macerated with water. It is white, tasteless, and inodorous, and crystallizes in silky flexible needles, usually larger than the crystals of morphine, fusible at 176° C. (349° F.), and decomposes at higher temperature with evolution of ammonia. Heated to 220° C., the residue which remains is *hemipinic acid,* $C_{10}H_{10}O_6$, insoluble in cold water, soluble in 400 parts of boiling water, in 100 parts of cold and 24 of boiling alcohol, which deposits it upon cooling, and very soluble in ether. The fixed and volatile oils, and the diluted acids, also dissolve it; and it has been found to be soluble in the volatile oil of turpentine, which, aided by heat, will extract it from opium, and yield it in crystals by evaporation. (*J. P. C.,* 4e

[1] *Aponarceine,* $C_{23}H_{27}NO_8$, a patented derivative, is made by heating narceine with a concentrated alkali hydroxide solution, dissolving the alkaline salt produced, in alcohol, and treating this solution with an alcoholic solution of an acid.

[2] Freund and Frankforter believe that this formula of Anderson's should be modified to $C_{23}H_{27}NO_8$. (*Ann. Ph. Ch.,* 1893, 20.)

sér., ii. 156.) As it exerts no alkaline reaction upon vegetable colors, and does not prevent the acids from reddening litmus paper, there would appear to be some reason for denying it the rank of an alkaloid. But it unites with some of the acids, forming definite compounds, which may be procured in a separate state; and Robiquet obtained narcotine sulphate and hydrochloride well crystallized. (*J. P. C.*, xvii. 639, and xix. 59.) Hence it is now generally considered as a weak base, and perhaps this view of it is the most convenient. It must be admitted, however, to have a very feeble neutralizing power. With acetic acid it does not appear to form a permanent combination, for, though dissolved by cold acetic acid, it is separated by heating the solution. It is decomposed by long boiling, or by heating with nitric acid, into *cotarnine*, $C_{12}H_{13}NO_3$, and *meconin*, $C_{10}H_{10}O_4$, and by heating with water to 100° C. in sealed tubes, into *hydrocotarnine*, $C_{12}H_{15}NO_3$, and *opianic acid*, $C_{10}H_{10}O_5$, while, on the other hand, the action of nascent hydrogen (from zinc and hydrochloric acid) converts it into *hydrocotarnine* and *meconin*, and that of oxidizing agents into *cotarnine* and *opianic acid*. It may be distinguished from morphine by its insipidity, by its solubility in ether and insolubility in alkaline solutions, by not affecting vegetable colors, by assuming a yellowish instead of a blood-red color under the action of strong nitric acid, by not decomposing iodic acid, and by not producing a blue color with ferric salts. It is, however, reddened by a mixture of nitric and sulphuric acids. Hence, if to a mixture of it with strong sulphuric acid a small piece of potassium nitrate is added, a deep blood-red color is produced; while morphine, under the same circumstances, yields a brownish or olive green color. It gives a greasy stain to paper when heated upon it over a candle. Distilled with potassium hydroxide, or simply by heating to 250° C., it yields *trimethylamine*, $N(CH_3)_3$. Heated with strong hydrochloric acid, it loses two groups, CH_2, and with concentrated hydriodic acid a third, CH_2, so that the existence of three methyl groups (CH_3) in narcotine have been established. Water extracts narcotine partially from opium, in consequence of the acid which the latter contains, either free or combined with the narcotine. It is usually obtained mixed with morphine in the processes for procuring that principle, and may be separated by the action of ether, which dissolves it without affecting the morphine, and yields it upon evaporation. It may also be obtained by digesting opium in ether, and slowly evaporating the ethereal solution, which deposits crystals of narcotine. It is said that the same result may be obtained by using the oil of turpentine as the menstruum, first heating it with opium, and then evaporating the solution. Another mode of procuring it is to treat opium, exhausted by previous maceration in water, with diluted acetic acid, filter the solution, precipitate by an alkali, wash the precipitate with water, and purify it by solution in boiling alcohol, from which it crystallizes as the liquid cools. Should it still be impure, the solution in alcohol and crystallization may be repeated. The proportion of narcotine in opium [1] varies extremely in the different varieties, and in different specimens of the same variety. Thus, in Smyrna opium it has been found by different observers, in quantities varying from 1.30 to nearly 11 per cent. Though narcotine itself is tasteless, its salts are very bitter, even more so than those of morphine. (Berzelius.) Their solution reddens litmus, and yields precipitates with the alkalies and infusion of galls.[2]

Different opinions have been advanced relative to the action of narcotine on the system. Derosne believed it to be the active principle of opium; though upon experimenting with it he obtained effects but little stronger than those produced by an equal dose of opium itself. Others found it possessed different degrees of narcotic properties, and the results of various experiments which led to the conclusion may be seen in former editions of this work. But a more thorough investigation seems to have proved that it cannot be ranked among narcotic medicines. It has been asserted that narcotine is identical with *aconella*, an alkaloid said to have been extracted by the Messrs. Smith of Edinburgh, from aconite, but Groves failed to find aconella. (See page 79, U. S. D., 14th edition.) Narcotine acts feebly upon the lower animals as a convulsant. No cases of fatal poisoning from it in man are on record, and 120 grains of it are said to have been taken without producing distinct results. On the other hand, observers have seen profound narcotism caused by much smaller quantities, these results, however, being without much doubt due to impurities in the drug. According to Leubuscher (*D. M. W.*, 1892), it is a feeble sedative to intestinal peristalsis. Many years ago O'Shaughnessy of Calcutta, recommended narcotine as an antiperiodic, in doses of three grains (0.2 Gm.) three times a day, but it has failed to acquire reputation. See an elaborate paper on the pharmacology of narcotine by A. C. Crawford and A. R. L. Dohme, *Proc. A. Ph. A.*, 1902, 472.

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[1] For physiological study of the methylamide derivatives of narcotine (*narcotine methylamide*), see *V. A. P. A.*, 142, 1895.

[2] ANARCOTINE has been described as an alkaloid especially abundant in the India opium. According to Wm. Roberts (*B. M. J.*, ii. 1895), while Smyrna opium containing 8 per cent. of morphine has in it 2 per cent. of anarcotine, Bengal opium contains 4 per cent. of morphine with 6 per cent. of anarcotine. Anarcotine appears, however, to be simply pure narcotine. (*Merck's Jahresber.*, 1896, 101.) It is said to be nearly destitute of active physiological properties. In the experiments of Surveyor (*B. M. J.*, 1896), one drachm of it given subcutaneously to an anæsthetized dog produced no sensible effect. The continuous use of it in large doses seemed, however, to affect the nutrition of the dog. It was at one time largely used in India as an antiperiodic on account of its being cheaper than quinine, but has fallen into desuetude because of the present low price of the cinchona alkaloids.

OPIANINE, which has been claimed to have the formula $C_{21}H_{21}NO_7$, is now supposed to be impure narcotine.

OXYNARCOTINE. *Oxynarcotina,* $C_{22}H_{23}NO_8$. This alkaloid accompanies narceine, from which it can be separated by treating the mixture with dilute sulphuric acid. On neutralizing the solution with the theoretical amount of sodium hydroxide and heating to boiling, a part dissolves. The undissolved residue is the oxynarcotine. It can also be obtained from the mother liquors of narcotine. According to Beckett and Wright, it crystallizes out of alcohol in very fine needles, which are difficultly soluble in boiling water and boiling alcohol, insoluble in other neutral solvents. Heated to 140° or 150° C., it is carbonized. It is oxidized by ferric chloride to *hemipinic acid* and *cotarnine.* (See PART II.) It is a monacid base, and forms crystallizable salts.

PAPAVERINE. *Papaverina,* $C_{20}H_{21}NO_4$.—The discovery of this alkaloid was announced by G. Merck. It is crystallizable in needles, fusing at 147° C. (296.6° F.), insoluble in water, very sparingly soluble in cold alcohol or ether, more soluble in these liquids boiling hot, and deposited by them on cooling. With acids it forms salts, most of which are very sparingly dissolved by water. The hydrochloride crystallizes with extraordinary facility. The alkaloid is readily dissolved by moderately concentrated hydrochloric acid, from which, on the addition of more acid, the hydrochloride separates, assuming the form of an oily layer at the bottom of the vessel, which is readily converted on standing into a mass of acicular crystals. These crystals are very sparingly soluble in cold water. The hydrochloride yields with platinic chloride a yellow precipitate which is insoluble in boiling water or alcohol. By the action of hydrochloric acid at 130° C., however, it is decomposed into methyl chloride and homopyrocatechol. By the action of concentrated nitric acid there is formed, on heating, the nitrate of nitropapaverine, $C_{20}H_{20}(NO)_2NO_4.HNO_3$, which separates in crystals. The nitro-base can be separated in clear yellow flocks by the addition of ammonia. By the action of tin and hydrochloric acid there is formed a tetrahydropapaverine, $C_{20}H_{25}NO_4$. Cold concentrated sulphuric acid does not color it, but on warming a violet color is obtained; an impure papaverine is colored violet, however, with sulphuric acid even in the cold. Papaverine is prepared by precipitating the aqueous infusion of opium with soda, exhausting the precipitate with alcohol, evaporating the tincture to dryness, treating the residue with a dilute acid, filtering, precipitating by ammonia, dissolving the precipitate in hydrochloric acid, mixing sodium acetate with the solution, and treating the resulting precipitate with boiling ether. The ethereal solution deposits the papaverine on cooling. The results obtained by investigators of the physiological action of papaverine seem hopelessly discordant, and any future studies made should be prefixed by an absolute chemical examination of the alkaloid used. Leubuscher (*D. M. W.,* 1892) asserts that it acts as a sedative to intestinal peristalsis without producing other effects, and is valuable in the *diarrhœa* of children.

Dose, for a two-year-old child, two-fifths of a grain (0.024 Gm.), repeated three or four times a day.

PORPHYROXINE, according to K. L. Dey (*P. J.,* [3], xii. p. 397), is a definite basic substance, always present in Indian opium, but absent from Turkey or Smyrna opium.

PROTOPINE.[1]—*Protopina,* $C_{20}H_{19}NO_5$, is an alkaloid which Hesse separated from cryptopine. Both are precipitated as insoluble hydrochlorides by hydrochloric acid in excess; but if the precipitate be dissolved by an excess of oxalic acid, the acid cryptopine oxalate will crystallize, and protopine remain in the mother waters. The liquid is separated, precipitated by ammonia, and agitated with ether, and the ethereal solution is taken up by hydrochloric acid. Protopine hydrochloride being dense and granular, while cryptopine hydrochloride is very light, the two are separated by levigation,—eighty grammes of crude cryptopine furnishing one and a half of protopine. Separated from the hydrochloride by ammonia, protopine constitutes a crystalline powder, insoluble in water, soluble in alcohol and in hot petroleum benzin and acetone, more soluble in chloroform, insoluble in the alkalies generally, but slightly soluble in ammonia. It melts at 202° C. (395.6° F.), undergoing decomposition, and is in anhydrous crystals. Ferric chloride does not color it; nitric acid colors it yellow; sulphuric acid dissolves it, coloring it first yellow, then red, and lastly violet. The alcoholic solution has an alkaline reaction. The salts are neutral and crystallizable.

PSEUDOMORPHINE.—*Pseudomorphina,* $C_{34}H_{36}N_2O_6$, was discovered by Pelletier in 1835, and is said by Hesse to be identical with Polstorff's *oxydimorphine;* but, as it exists in small quantities, and was thought to be only an occasional ingredient in opium, little attention has been paid to it. An interesting fact, however, in relation to it, and one of some toxicological importance, is that it possesses two properties considered characteristic of morphine, those, namely, of being reddened by nitric acid and of striking a blue color with ferric salts, and yet it is without any poisonous influence upon the animal economy. (*J. P. C.,* xxi. 575.) Hesse has investigated the subject, with the following results. He found that it accompanies morphine procured by Gregory's method, and may be separated from that alkaloid by adding ammonia in excess to an alcoholic solution containing both. The morphine is precipi-

[1] E. Schmidt (*A. Pharm.,* 231 (1893), 136) states that protopine is identical with *maclayine,* an alkaloid, which had been found by Eykman in *Maclaya cordata,* and that it is also found in *Sanguinaria canadensis, Stylophorum diphyllum, Eschscholtzia californica,* and other plants.

tated, and pseudomorphine, remaining in solution, may be obtained by evaporating the mother liquid. It is tasteless, insoluble in water, alcohol, ether, chloroform, and diluted sulphuric acid, but easily soluble in solution of potassium and sodium hydroxide, and lime, and in alcoholic solution of ammonia, though sparingly in an aqueous solution of ammonia. It does not neutralize hydrochloric acid, dissolves in concentrated sulphuric acid with the production of an olive-green color, in concentrated nitric acid with an intense orange-red, and in solution of ferric chloride with a blue color. At 120° C. (248° F.) it loses two molecules of water of crystallization, and at higher temperatures is decomposed without melting. It forms sparingly soluble salts with sulphuric, nitric, oxalic, and tartaric acids, and a crystalline deposit, very slightly soluble in hydrochloric acid, with solution of corrosive sublimate. (*Chem. News*, 1867, p. 188.) Hesse is of the opinion that pseudomorphine is identical with the oxymorphine prepared by the action of oxidizing agents upon morphine by Schutzenberger.

Rhœadine, $C_{21}H_{21}NO_6$, discovered by Hesse in 1865, is crystallizable, but not distinctly alkaline. It fuses at 232° C., and can be sublimed at higher temperatures. It is nearly insoluble in ether, alcohol, benzene, chloroform, water, and ammonia. Its solutions in dilute acids acquire an intense purple color on addition of strong hydrochloric or sulphuric acid, due to the formation of a coloring matter. This is destroyed by alkalies and restored by acids, and is so intense that 1 part of rhœadine will color 10,000 parts of water purple-red, 200,000 deep rose-red, and 800,000 distinctly red, although only a portion of the base is converted into coloring matter. The solution then filtered through bone-black shows the presence of a base, *rhœagenine*, isomeric with rhœadine, but fusing at 223° C., and forming a different series of salts. This alkaloid occurs also in *Papaver Rhœas*.

Thebaine (*Paramorphina*). *Paramorphine*, $C_{19}H_{21}NO_3$ (or $C_{17}H_{15}NO(OCH_3)_2$), was discovered by Pelletier in the precipitate thrown down from an infusion of opium treated with milk of lime. The precipitate being washed with water until the liquid came away colorless, and then treated with alcohol, instead of affording morphine to this solvent, as was anticipated, yielded a new alkaloid, which was obtained separate by evaporating the alcohol, acting on the residue with ether, allowing the ethereal solution to evaporate spontaneously, and then purifying the resulting crystalline mass by dissolving it in an acid, precipitating by ammonia, and recrystallizing by means of alcohol or ether. Pelletier named it paramorphine, from its close analogy in composition with morphine, from which, however, it is quite distinct in properties. The name of *thebaine* was proposed for it by Couërbe, who was disposed to give the credit of its discovery to Thiboumery, the director of Pelletier's laboratory. It is white, crystallizable, and of an acrid and styptic rather than bitter taste, fusing at 193.4° C. (379.4° F.), and, according to Hesse, confirmed by D. B. Dott, is not sublimable. Other observers state that it sublimes at 135° C. without fusing, and is deposited in minute crystals resembling caffeine. It is scarcely soluble in water, very soluble in alcohol and ether when cold, and still more so when heated, and capable of combining with the acids, with which it forms salts not crystallizable from their aqueous solution. Alkalies precipitate it from its acid solutions, and, unless in very concentrated solution, do not dissolve it when added in excess. It is not, like morphine, reddened by nitric acid, nor does it become blue with solutions of ferric salts. From codeine it differs in never being in large crystals, in not forming crystallizable salts, in being always precipitated from its acid solutions by ammonia, and in not melting in oily drops. From narcotine, which it most resembles, it may be distinguished by its shorter crystals, which lack the pearly appearance of those of narcotine, by its different taste, by its much greater solubility in cold alcohol, of which 10 parts will dissolve 1 of this principle, while narcotine requires 100 parts, and by the action of nitric acid, which converts it into a resin-like matter before dissolving it, while the same acid instantly dissolves narcotine. Diluted sulphuric or hydrochloric acid in excess changes thebaine, according to Hesse, into two isomeric bases, *thebenine* and *thebaicine*. When heated to 90° C. under pressure with fuming hydrochloric acid, thebaine yields a base having the probable formula $C_{17}H_{15}NO(OH)_2$, and called by its discoverer, W. C. Howard (*Ber. d. Chem. Ges.*, xvii. 527, xix. 1596), *morphothebaine*, to indicate its origin and relation to morphine.

Thebaine salicylate is practically insoluble in water; hence in the assay of opium the German Pharmacopœia directs the addition of sodium salicylate to the aqueous solution, thus removing the thebaine before precipitating the morphine. Magendie and many subsequent observers agree that thebaine is a powerful spinal convulsant, resembling in its action strychnine. Leubuscher affirms that it is an intestinal stimulant. Eulenberg found one-four-hundredth of a grain sensibly active in man, and the reported failures of large amounts to produce distinct effects have probably been due to the alkaloid used being impure. On motor nerves it seems to have a paralyzing influence, though in the mammal, death takes place from tetanus.

Tritopine, $C_{42}H_{54}N_2O_7$, was discovered in 1890 by Klauder (*A. Pharm*, 228, p. 419). It resembles morphine and laudanine in being soluble in sodium hydroxide solution, but is precipitated in the form of an oil by a large excess of the reagent. Tritopine crystallizes in characteristic, anhydrous, transparent, needle-like plates, melting at 182° C., easily soluble in chloroform, but only slightly so in ether. With sulphuric acid it behaves like laudanine. It appears to be a diacid base.

Color Reactions of the more important Opium Bases (Allen, *Com. Org. Anal.*, 2d ed., vol. iii., Part II, p. 302).

Alkaloid.	Nitric Acid (sp. gr. 1.42).	Concentrated Sulphuric Acid.			Erdmann's Test (sulphuric acid with diluted nitric acid).	Fröehde's Reagent (sulphomolybdic acid).	Ferric Chloride.
		Alone.	On adding $KClO_3$ or HNO_3.	With sugar.			
Morphine	Orange-red, turning yellow on heating.	Cold; no color, or faint pink; on heating, variable (dirty green to black).	Rose-red, or blood-red.	Purple, changing to deep red.	. . . . .	Fine violet, turning blue or dirty green.	Greenish-blue.
Apomorphine . . .	Blood-red, or reddish-violet.	No color (or violet to brown).	. . . . .	No reaction.	. . . . .	Deep green, turning violet.	Rose-pink, changing to violet and black.
Pseudomorphine . .	Orange-red, changing to yellow.	Cold; no color, or olive-green; heated, dingy, green or purple, finally red.	. . . . .	Olive, then dark green, changing to brown.	. . . . .	Violet, changing to blue and green.	Blue.
Codeine	Yellow, not changing to red.	No color; dirty brownish-green on heating.	Blue on warming.	Cherry-red, changing to violet.	Blue on warming.	Dirty green, changing to blue and pale yellow.	No color.
Thebaine	Yellow.	Blood-red, turning orange-yellow; olive-green on heating.	Same as with sulphuric acid alone.	. . . . .	Orange-red.	Blood-red, turning orange-yellow and colorless.	No color.
Papaverine	Yellow.	Cold; little change; on strongly heating, violet blue, afterwards fading slowly.	No change.	. . . . .	Dull purple.	Green (changing to violet blue), becoming blue and yellow.	No color.
Narcotine	Red.	Darkens; changing to orange and brick-red on gently heating.	Carmine-red.	Fine mahogany-brown.	On warming, pink, changing to orange-red, and violet.	Pink, changing to green, yellow and orange	No color.
Narceine	Yellow, fading rapidly.	Brown, dissolving to yellow solution (changing to dark red). If impure, red or blue color.	No change.	Not characteristic.	Brown yellow, becoming mahogany-brown on heating.	Brownish-green, changing to yellow and reddish (yellow-brown to blue).	. . . . .

Table (from Stohmann and Kerl's *Chemie*, 4th ed., 1888) *showing the behavior of Opium Alkaloids with Reagents.*

	Morphine.	Codeine.	Narcotine.	Thebaine.	Papaverine.	Narceine.
Phosphomolybdic acid.	Pale-yellow flocky precipitate, soluble in ammonia with blue color.	Brown voluminous precipitate only in concentrated solution.	Brownish-yellow flocky precipitate.	Yellow flocculent precipitate.	No reaction.	Brownish-yellow precipitate, becoming resinous in concentrated solution.
Phosphoantimonic acid.	No reaction.	Dirty-white turbidity.	Pale-yellow flocculent precipitate.	White gelatinous precipitate.	White curdy precipitate.	No reaction.
Potassio-mercuric iodide.	White gelatinous precipitate.	White curdy precipitates.			Yellowish-white precipitate.	White turbidity, soon turning to resinous lumps.
Potassium iodobismuthate.	Orange precipitates.				Faint turbidity.	
Platinic chloride.	Yellow curdy precipitate, becoming crystalline.	Clear-yellow flocculent precipitates.			White precipitate.	Gradually forming yellow crystalline precipitate.
Mercuric chloride.	No reaction.	Whitish turbidity.	No reaction.	White flocculent precipitate.	Whitish turbidity.	No reaction.
Gold chloride.	Yellowish-brown precipitate, turning resinous.	Flesh-colored precipitate.	Pale-yellow flocculent precipitate.	Flesh-colored precipitate.	Pale-yellow flocculent precipitate.	Yellowish-brown precipitate, turning resinous.
Iodine in potassium iodide.	Reddish-brown precipitates with all.					
Tannic acid.	White turbidity in concentrated salt solutions only.		White flocculent precipitates.		Yellowish precipitate.	White turbidity, in concentrated solutions only.

Xanthaline, $C_{37}H_{36}N_2O_9$, is a base obtained by T. and H. Smith (*P. J.*, 1893, 772) from the acid mother liquors resulting from the crystallization of morphine or codeine hydrochloride, and purification of the product.

Meconic Acid, $C_7H_4O_7 + 3H_2O$, is in white crystalline scales, of a sour taste followed by bitterness, fusible and volatilizable by heat, soluble in four parts of boiling water, soluble also in cold water and alcohol, with the property of reddening vegetable blues and forming salts. Its compounds with the earths and heavy metallic oxides are generally insoluble in water. Its characteristic properties are that it produces a blood-red color with ferric salts, a green precipitate with a weak solution of ammoniated copper sulphate, and white precipitates, soluble in nitric acid, with lead acetate, silver nitrate, and barium chloride. It is obtained by macerating opium in water, filtering the infusion, and adding a solution of calcium chloride. Calcium meconate and sulphate are precipitated. The precipitate, having been washed with hot water and with alcohol, is treated with diluted hydrochloric acid at 82.2° C. (180° F.). The calcium meconate is taken up, and, upon the cooling of the liquid, calcium bimeconate is deposited. This is dissolved in warm concentrated hydrochloric acid, which deposits pure meconic acid when it cools. It may be freed from coloring matter by neutralizing it with potassium hydroxide, decomposing the meconate thus obtained by hydrochloric acid, and again crystallizing. When heated, it loses first its water of crystallization, and then at 120° C. a molecule of CO_2, and yields *comenic acid*, $C_6H_4O_5$; this at 260° C. or over, loses another molecule of CO_2, and yields *pyromeconic acid*, $C_5H_4O_3$. By the action of nascent hydrogen (from sodium amalgam) it yields *hydromeconic acid*, $C_7H_{10}O_7$. Meconic acid has little or no action on the system, and is not used separately in medicine; but its natural relation to morphine requires that it should be understood. The three related compounds, meconic acid, comenic acid, and pyrocomenic acid, are now considered to be derivatives of the fundamental compound *pyrone*, $CO<\begin{matrix}CH=CH\\CH=CH\end{matrix}>O$. Thus, from pyrone, $C_5H_4O_2$, are obtained *oxypyrone* (pyromeconic acid), $C_5H_3O_2(OH)$, and *oxypyrone-carboxylic* (comenic) *acid*, $C_5H_2O_2(OH)COOH$, and *oxypyrone dicarboxylic* (meconic) *acid*, $C_5HO_2(OH)(COOH)_2$. Pyrone itself is formed when comenic and chelidonic acids are heated to 250° C. Most of the pyrone derivatives are converted by the action of ammonia into pyridone and pyridine compounds.

Meconic acid was formerly recognized by the British Pharmacopœia, but was dropped at the late revision. It appears to be nearly free from active physiological properties. Sertürner took 4.5 grains of sodium meconate, and Grape and Loewer 12 grains of the pure acid, without the production of any symptoms, while, according to Mulder, Pereira, Lange, and others, 20 grains of the acid cause no sensible effect in the dog.

Meconin, $C_{10}H_{10}O_4$, a neutral principle before referred to, the existence of which was announced in 1832 by Couërbe, is identical with a substance discovered several years previously by Dublanc, Jr., but of which no account was published. It is perfectly white, in the form of acicular crystals, soluble in about 265 parts of cold and 18 of boiling water, very soluble in alcohol, chloroform, and the essential oils, but only sparingly in ether; fusible under water at 77° C., *per se* at 110° C., sublimable on careful heating, and possessed of a degree of acrimony which favors the supposition that it may not be without action upon the system. It is neither acid nor alkaline, and contains no nitrogen. Meconin is obtained by precipitating the aqueous infusion of opium with ammonia, washing the precipitate with water until the latter nearly ceases to acquire color, mixing the aqueous fluids, evaporating them to the consistence of molasses, setting them aside for two or three weeks, during which a mass of granular crystals is formed, then decanting the liquid, expressing the mass, and drying it with a gentle heat. The meconin may be separated from the mass by treating it with boiling alcohol of 36° Baumé, evaporating so as to obtain crystals, dissolving these in boiling water with animal charcoal, filtering the liquid while hot, and subjecting the crystals formed upon the cooling of the solution to the action of ether, which dissolves the meconin, and yields it in a state of purity by spontaneous evaporation.

Meconoiosin, $C_8H_{10}O_2$.—This principle was discovered by T. and H. Smith, in 1878, who obtained it from the oil-like liquid containing meconin, which, upon being left to itself for some days, sets into a mass of crystals. These crystals, upon being drained and cautiously washed with cold weak spirit, are to be boiled in a large quantity of water. The filtered liquid gives a crystallization of meconin, and the mother liquor, when concentrated, and upon being set aside for a time, yields beautiful leaf-like crystalline masses of meconoiosin, fusing at 88° C.(190.4° F.). This principle is neutral, and it may be distinguished from meconin by the following test of T. and H. Smith. "When heated with slightly diluted sulphuric acid, and when the evaporation has reached a certain point, meconin produces a beautiful green color. With meconoiosin, under the same circumstances, the coloration is deep red, becoming purple." This substance has been found by Stockman and Dott (*B. M. J.*, Jan. 1891) to be a tetanizant.

Opionin, as before stated, was found by Hesse in small quantities in Smyrna opium. It forms white needles, which melt at 227° C. These are insoluble in water, but dissolve in alkalies, alcohol, and ether.

Thebolactic Acid, which was discovered by T. and H. Smith of Edinburgh, appears to be

a constant ingredient in opium. These chemists were led to search for it by the consideration that the quantity of meconic acid present is insufficient to saturate the whole of the morphine and other bases, which must, therefore, be neutralized by some other acid. They obtained it from the impure mother liquid of morphine, after all the alkaloids had been thrown down by the addition of an alkali, by concentrating the liquors to a thick consistence, adding alcohol largely, filtering, precipitating any basic matter by sulphuric acid, filtering again, carefully neutralizing by milk of lime, distilling to recover the alcohol, and finally evaporating the residuary contents of the still to a syrupy consistence. After standing for about a week, the syrupy liquid will be seen to have set into a crystalline mass of calcium thebolactate. This, being purified by repeated solution and crystallization, and by animal charcoal, is decomposed by adding the equivalent quantity of sulphuric acid, and separating the liberated thebolactic acid by means of alcohol. Stenhouse showed that the new acid had the composition of lactic acid and was identical with the common variety, and his results were confirmed by J. Y. Buchanan. (*Ber. d. Chem. Ges.*, 1870, p. 182.) The ready crystallization of its salts with lime is a characteristic property.

Incompatibles.—The substances which produce precipitates with opium do not all necessarily affect its medicinal virtues, but the *alkalies*, and all vegetable infusions containing *tannic* and *gallic acids*, are incompatible, the former separating and precipitating the active principles, the latter forming with it an insoluble compound.

Morphiometric Assays of Opium.—The proportion of morphine which any particular specimen of opium will furnish may be considered the best test of its value, except that of actual trial upon the system. Good opium should yield not less than 9 per cent. of crystallized morphine when assayed by the official process. The U. S. Pharmacopœia directs that opium, in its normal, moist condition should contain not less than 9 per cent. of crystallized morphine, and powdered or granulated opium, dried at a heat not exceeding 85° C. (185° F.), should contain not less than 12 nor more than 12.5 per cent. of crystallized morphine when assayed by the official process, which is as follows:

Assay of Opium. U. S. P. (8th Rev.) "Opium, in any condition to be valued, *ten grammes;* Ammonia Water, *three and one-half cubic centimeters;* Alcohol, Ether, Distilled Water, Lime Water, each, *a sufficient quantity.* Introduce the Opium (which, if fresh, should be in very small pieces, and if dry, in very fine powder) into an Erlenmeyer flask having a capacity of about 300 Cc., add 100 Cc. of distilled water, stopper the flask, and agitate it every ten minutes (or continuously in a mechanical shaker) during three hours. Then pour the contents as evenly as possible upon a wetted filter having a diameter of 12 Cm., and, when the liquid has drained off, wash the residue with distilled water, carefully dropped upon the edges of the filter and its contents, until 150 Cc. of filtrate have been obtained. Then carefully transfer the moist Opium back to the flask by means of a spatula, add 50 Cc. of distilled water, agitate it thoroughly and repeatedly during fifteen minutes, and return the whole to the filter. When the liquid has drained off, wash the residue, as before, until the second filtrate measures 150 Cc., and finally collect about 20 Cc. more of a third filtrate. Evaporate carefully in a tared dish, first, the second filtrate to a small volume, then add the first filtrate, rinsing the vessels with the third filtrate, and continue the evaporation until the residue weighs 14 Gm. Rotate the concentrated solution about in the dish until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the dish with a few drops of water at a time until the entire solution, after the rinsings have been added to the flask, weighs 20 Gm. Then add 10 Gm. (or 12.2 Cc.) of alcohol, shake the flask well, add 25 Cc. of ether, and repeat the shaking. Now add the ammonia water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours, or over night.

Remove the stopper carefully, and should any crystals adhere to it, brush them into the flask. Place in a small funnel two rapidly acting filters, of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 Cc. of ether. Then pour the liquid in the flask into the filter, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when the liquid has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than 15 Cc. in all. Use a feather or rubber-tipped glass rod to remove the crystals that adhere to the flask. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother liquor, and afterwards wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc. or more, if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.) until its weight remains constant, then carefully transfer the crystals to a tared watch-glass and

weigh them. Place the crystals (which are not quite pure) in an Erlenmeyer flask, add lime water (10 Cc. for each 0.1 Gm. of morphine) and shake the flask at intervals during half an hour. Pass the liquid through two counterpoised, rapidly acting, plainly folded filters, one within the other (the triple fold of the inner filter being laid against the single fold of the outer filter), rinse the flask with more lime water and pass the washings through the filter until the filtrate, after acidulating, no longer yields a precipitate with mercuric potassium iodide T.S. Press the filters until nearly dry between bibulous paper and dry them to a constant weight, then weigh the contents, using the outer filter as a counterpoise. Deduct the weight of the insoluble matter on the filter from the weight of the impure morphine previously found. The difference, multipled by 10, represents the percentage of crystallized morphine contained in the Opium." *U. S.*

The British Pharmacopœia directs that "any suitable variety of opium may be employed as a source of Tincture of Opium and Extract of Opium of the respective official alkaloidal strengths, provided that when dry it contains not less than 7½ per cent. of anhydrous morphine; but, when otherwise used for officially recognized purposes, opium must be of such a strength that when dried and powdered, the powder heated to 212° F. (100° C.) until it ceases to lose moisture, and the product tested by the appended method, such dry powder shall yield not less than 9½ per cent., and not more than 10½ per cent. of anhydrous morphine. Opium yielding when dried more than 10 per cent. of anhydrous morphine may be diluted to that percentage with any opium containing when dry between 7½ and 10 per cent. of anhydrous morphine, or with Milk Sugar." *Br.*

Assay of Opium. Br.—"Opium, dried at 212° F. (100° C.) and in No. 50 powder, 14 *grammes;* Calcium Hydroxide, freshly prepared, 6 *grammes;* Ammonium Chloride, 4 *grammes;* Alcohol (90 per cent.), Ether, Distilled Water, of each *a sufficient quantity.* Triturate together the Opium, *calcium hydroxide,* and 40 cubic centimetres of *water* in a mortar until a uniform mixture results; add 100 cubic centimetres of *water* and stir occasionally during half an hour. Filter the mixture through a plaited filter, about 10 centimetres in diameter, into a wide-mouthed bottle having a capacity of about 300 cubic centimetres, and marked at exactly 104 cubic centimetres, until the filtrate reaches this mark. To the filtered liquid (representing 10 grammes of opium) add 10 cubic centimetres of *alcohol* (90 per cent.) and 50 cubic centimetres of *ether;* shake the mixture; add the *ammonium chloride,* shake well and frequently during half an hour; set aside for 12 hours for the morphine to separate.[1] Counterbalance two small filters; place one within the other in a small funnel in such a way that the triple fold of the inner filter shall be superposed upon the single fold of the outer filter; wet them with *ether;* remove the ethereal layer of the liquid in the bottle as completely as possible by means of a small pipette, transferring the liquid to the filter; rinse the bottle with 20 cubic centimetres of *ether,* again transferring the ethereal layer, by means of the pipette, to the filter; wash the filter with a total of 10 cubic centimetres of *ether,* added slowly and in portions. Let the filter dry in the air, and pour upon it the contents of the bottle in portions, in such a way as to transfer the granular crystalline morphine as completely as possible to the filter. When all the liquid has passed through, wash the remainder of the morphine from the bottle with *morphinated water,*[2] until the whole has been removed. Wash the crystals with *morphinated water* until the washings are free from color; allow the filter to drain, and dry it, first by pressing between sheets of bibulous paper, afterwards at a temperature between 131° and 140° F. (55° and 60° C.), finally at 230° F. (110° C.) for 2 hours. Weigh the crystals in the inner filter, counterbalancing by the outer filter. Take 0.5 gramme of the crystals and titrate with *decinormal volumetric solution of sulphuric acid* until the liquid, after boiling, slightly reddens *blue litmus paper.* 1 cubic centimetre of this *volumetric solution* represents 0.0283 gramme of pure anhydrous morphine. The weight of pure anhydrous morphine indicated by the titration, plus 0.104 gramme (representing the average loss of morphine during the process), should amount in total to 1 gramme, that is to say, to a total of not less than 0.95 gramme and not more than 1.05 grammes, corresponding to about 10 per cent. of anhydrous morphine in the dry powdered opium." *Br.*

The U. S. 1880 and Br. methods of assay are practically identical in principle, belonging to the class of assays known as "lime processes." Experience has proved that the "lime processes" have some objectionable features, depending as they do upon the principle that opium in the presence of lime is treated with a definite quantity of water until the latter has extracted as much as possible of the soluble portions, after which a certain portion of the solution, which is *assumed to represent* a corresponding fraction of the weight of the opium, is weighed or measured off, the morphine determined in it, and the percentage calculated from the quantity found in this fraction or aliquot part. The "lime processes," in the hands of ordinary operators, "register too low," the assay being applied to a proportion of the opium

[1] Braithwaite and Farr state that, after careful experimenting, they find that two hours' maceration is just as effective as twelve hours'. (*P. J.*, 1886, 398.)

[2] *Morphinated Water.*—"Prepared by digesting pure morphine in chloroform water for seven days at a temperature of 60° F. (15.5° C.), with occasional agitation, so as to obtain a saturated solution of the alkaloid, and filtering from the undissolved morphine." *Br.* 1898.

which may or may not be an aliquot part of the whole, but is generally less than it is assumed to be, because no allowance is made for the increase in volume due to the solution of the solid constituents of the opium. The British Pharmacopœia overcomes this objection by requiring 104 Cc. of liquid to be taken instead of 100 Cc. A. B. Stevens has improved the lime method and it is conceded by many that the crystallized morphine by this process is freer from impurities than that obtained by Squibb's method, and that it takes less time to perform the assay than that required for the U. S. P. (8th Rev.) method.[1] The U. S. P. assay of 1890 was based on the method of E. R. Squibb, which requires the complete exhaustion of the sample of opium of its soluble matter, the concentration of this solution, and the determination of the morphine in it. The morphine is separated in a crystalline form from its combination with its natural acids in the opium solution, by the addition of the ammonia water; the alcohol present serves to hold up the coloring matter, while the ether facilitates the precipitation of the alkaloidal morphine in crystals, pure morphine requiring 4000 parts of ether for its solution. The U. S. P. (8th Rev.) assay is based upon Squibb's method, with the modification of the introduction of a correction, *i. e.*, the washing of the morphine crystals with lime water and deducting the weight of the impurities. Want of space prevents our giving a critical review of the other methods of assay in use; we append, however, Squibb's revised process for assaying opium (1893); it is based upon Flückiger's, and, although it has the reputation of "registering high," this is probably due to the care and attention to detail, whereby unnecessary loss is avoided.[1] Teschemacher

[1] *Stevens's Improved Method for Assaying Opium.* Take 4 grammes of opium in fine powder and triturate in a mortar with 2 grammes of fresh oxide of lime (not air slaked) and 10 Cc. of water until a uniform mixture results. Add 19 Cc. of water and stir frequently for half an hour. Filter through a dry filter, about 10 Cm. in diameter. Transfer exactly 15 Cc. of the filtrate to a 60 Cc. flask. To this add 4 Cc. of alcohol and 10 Cc. of ether and shake the mixture. Then add 0.5 gramme of ammonium chloride. Shake well and frequently during half an hour. Set aside in a cool place for twelve hours.

Remove the stopper carefully and preserve, with any adhering crystals, for future use. Pour the ethereal layer into a small funnel, the neck of which has been previously closed with a pledget of absorbent cotton. Rinse the flask with 10 Cc. of ether, and when this has passed through, pour the contents of the flask into the funnel. Without trying to remove all of the crystals from the flask, wash the flask and contents of the funnel with water previously saturated with morphine, until the washings are colorless. When the crystals have drained, add a few drops of water to replace the morphinated water. Place the funnel in the flask containing adhering crystals, and with a glass rod drawn out to a curved point, lift the cotton and rinse the crystals into the flask with 12 Cc. of tenth-normal sulphuric acid V.S., using the cotton on the end of the rod to detach any adhering crystals. Place the cotton in the flask, replace the cork and agitate until the crystals are all dissolved. Rinse the cork and funnel with water and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S.

Divide the number of Cc. of fiftieth-normal potassium hydroxide V.S. used by 5 and subtract this number from 12 (the number of Cc. of tenth-normal sulphuric acid V.S. taken), multiply the remainder by 0.03009, and then by 50; this will give the per cent. of morphine obtained; to this add 1.12 for the morphine remaining in the solution, the sum will be the per cent. of morphine contained in the opium.

Note.—The morphine may be estimated gravimetrically as follows: Proceed as above, except that a rapidly acting filter is used in place of the cotton, and the crystals are all transferred from the flask (and those adhering to the cork) to the filter. Wash as above, dry at a temperature not exceeding 60° C. and weigh. The weight of morphine multiplied by 50 will give the per cent. of morphine obtained. To this add 1.12 for the morphine remaining in the solution, the sum will give the percentage of morphine contained in the opium.

[1] *Squibb's Method of Assaying Opium* (revised 1893).—*Sampling.*—Every fifth lump of a case of opium—except the very small lumps, and every tenth lump of these—is separated for sampling. A cone-shaped piece is cut from each of these lumps, the apex to come from near the centre of the lump. As these are cut out, a small narrow strip is cut from the side of the cone, taking about an equal proportion from its whole length, so as to get a proper relation of quantity from the dry exterior to the moist centre. These strips are collected together in a mass, so as to lose but little moisture by drying, and the cones are returned to the lumps. After a little practice the mass of strips from each case of opium will not much exceed 25 to 30 grammes. It is rolled out into a long cylinder, the two ends doubled in to the centre, and rolled out again, this rolling out and folding in being repeated six times. If the opium be very moist and sticky, a gramme of powdered starch is weighed off and used to cover the surfaces of the hands and table used in the rolling, and this starch is afterwards to be taken account of in weighing off the samples. Two portions, each representing 10 grammes of the opium, are then weighed off from the mass. One of these is flattened out into a thin cake, placed on a tared watch glass, and dried until it ceases to lose weight at 100° C. (212° F.), for the determination of moisture. The other is taken for the assay. When powdered opium is to be assayed, two portions of ten grammes each are to be weighed off, one for drying and the subsequent check assay and the other for the first assay. Powdered opium should not lose over 4 per cent. in drying at 100° C. (212° F.).

Maceration.—The 10 grammes of mass are pulled out and broken into thin pieces, and dropped into a flask of 200 Cc. capacity, 100 Cc. of water added, the whole occasionally well shaken and allowed to stand over-night, then again well shaken. When powdered opium is to be assayed, the 10 grammes of powder are well shaken with 100 Cc. of water, and then an hour or two of maceration is sufficient.

Exhaustion.—The well-shaken opium mixture is carefully poured in the centre of a well-wetted, tared filter of strong paper, of 12 Cm., or 4.8 inches diameter, so folded that the lower part of the cone hangs free in the funnel,—that is, folded for a rather more open angle than that of the funnel used. The filtrate is received in a beaker marked at 150 Cc., and the flask and residue are well washed with water until the filtrate reaches the 150 Cc. mark. By means of a spatula the residue is returned to the flask without breaking the filter, 50 Cc. of water are added, the whole is actively shaken for five minutes and is then returned to the filter, being carefully poured into the centre, so that in draining the residue may be of equal thickness on all sides. This second filtrate is received in a second beaker marked at 150 Cc., and the residue is percolated and washed until the filtrate reaches the mark. In both percolations a large part of the water is dropped from a pipette, held at a height of 5 or 6 inches, upon the edges of the filter and the surface of the residue. When finally drained, the filter and residue are pressed between folds of bibulous paper, dried until they cease to lose weight at 100° C. (212° F.), and weighed, the weight to be stated by percentage for insoluble residue.

Evaporation of the solution.—The weaker solution is evaporated first in a tared capsule of 250 Cc. capacity, on a water bath, to about 10 Cc. The stronger solution is then added to this, and the evaporation continued until the whole is reduced to 14 grammes. This is rinsed round the capsule by a rotary motion until all the rings of extract formed during the evaporation are dissolved, and it is then poured into a tared flask of 100 Cc. capacity. The capsule is then rinsed into the flask with three rinsings of about 2 Cc. of water each time, and

and Smith (*Chem. News*, 1888, pp. 93, 103) criticise severely several well known methods of assay, and recommend their own, which does not vary greatly from others in use; indeed, it is difficult to resist the conclusion that the differences in the results arrived at by various operators are largely chargeable to personal error and unfamiliarity with other processes than their own. The U. S. P. (8th Rev.) assay method is unquestionably the most practical and accurate that has yet been devised. (See *Ephem.*, June, 1888, 1113; *A. J. P.*, 1887, 74; Prescott's *Organic Analysis*, 1887, 375; Lyons's *Handbook on Assaying Drugs*, 1899, 201; Allen's *Com. Org. Anal.*, vol. iii. Part II, p. 342.)

For other methods of assay, and comments, see U. S. Dispensatory, 14th edition, 675, and 15th edition, 1072; *A. J. P.*, 1876, 358; 1878, 184; 1879, 369; 1894, 445; 1897, 244; *N. R.*, Feb. 1880, Dec. 1880, 1881, 174; *West. Drug.*, 1885, 231, also 1886, 442; *Am. Drug.*, 1885, 221, also 1886, 203; Dieterich's method modified by Schlickum, *Ph. Era*, 1887, 325, also 1888, 9; assay adopted by U. S. Laboratory in New York, *Ph. Era*, 1887, 151; *B. C. D.*, 1894, 372; *P. J.*, 1897, 542.

Moerk recommended the treatment of the crystallized morphine with lime water; see U. S. P. (8th Rev.) assay. (*Proc. Penn. Pharm. Assoc.*, 1897, 65.) Gordin and Prescott propose a volumetric assay based on the estimation of morphine as periodide, after separation by treatment with benzene, acetone, and lime water. (*M. R.*, 1898, 526.) See also *C. D.*, 1898, 20; *D. C.*, 1902, 161; *Ph. Archiv*, 1898, 121; 1901; 1902, 81, 87; *Proc. A. Ph. A.*, 1899, 263; 1902, 425; 1904, 369; *P. J.*, 1903, 909; 1904, 719; *Chem. News*, 1903, 286.

Tests of Opium.—It is sometimes highly important to be able to ascertain the presence or absence of opium in any suspected mixture. As meconic acid and morphine have been found only in the products of the poppy, if either or both of them be shown to exist in any substance, very strong evidence will be afforded

finally with enough water in addition to make the entire solution in the flask weigh 20 grammes.

Precipitation.—To the 20 grammes of concentrated solution is then added half its weight, or 10 grammes, of alcohol of not less than 91 per cent. (sp. gr. 0.815), and the mixture is well shaken. Then 25 Cc. or 17.5 grammes of ether of not less than 93 per cent. (sp. gr. 0.725) is added, and the mixture again well shaken. To this 3.5 grammes or 3.5 Cc. of water of ammonia of 10 per cent. strength (sp. gr. 0.960) are added, and the mixture is vigorously shaken for ten minutes. Usually within two minutes from the commencement of this shaking out of the morphine, and often within one minute, a sudden change in the sound of the shaken mixture occurs. From a soft, rather oily sound the change is to a sharp rattle, and coincidently with this change a very large proportion of the morphine crystallizes out in crystals as large as particles of fine sand. At the end of ten minutes' shaking the flask is set aside over-night or for not less than six hours.

Separation and washing.—The ether layer is poured off as closely as possible, and 20 Cc. of fresh ether are added to the contents of the flask and rinsed round without shaking. This is poured off as closely as possible, and 20 Cc. more of fresh ether added, rinsed round, and poured off as before, and this is repeated with a third portion of 20 Cc. of fresh ether. A pair of counterbalanced filters 9 Cm., or 3.6 inches, in diameter, folded at an angle slightly wider than the funnel, and well wetted with ether, then receive the contents of the flask, the upper ether layer being slowly poured in first, so that it may pass through before the paper becomes wetted with the aqueous solution. When the liquid has nearly drained through from the crystals on the filters, those from the flask are washed out on to the filters by repeated portions of water, about 3 Cc. at a time, until all the crystals are upon the filters. Then water is applied, drop by drop, from a pipette held 3 or 4 inches above the funnel, to the edges of the filters and the surface of the crystals until they are fairly clean and the mother liquor and washings together do not exceed 50 Cc. Then 5 Cc. of a saturated solution of morphine in 91 per cent. alcohol is dropped from a pipette, first upon the crystals on the point of the filter, and then upon the edges of the filters, so as to displace all the aqueous solution and leave them saturated with the alcoholic liquid. Then, before this has time to dry, it is displaced by dropping on, in the same way, 5 Cc. or more of ether. When this has drained through, the filters are closed together upon the crystals in the original folds and pressed between folds of bibulous paper, under weights, for half an hour. The filters are then opened, and when the morphine is spread out upon the inner one they are dried at 60° C. (140° F.) until they cease to lose weight. This is the crude morphine, and if a small portion of it is found to be entirely and quickly soluble in one hundred times (or more) its weight of lime water, the weight of the morphine multiplied by 10 is accepted as the percentage of morphine yielded by the opium.

Correction or control of results.—When the preliminary testing of a small quantity of the precipitate shows that it is not all entirely soluble in lime water, 0.5 gramme is weighed off, put into a graduated cylinder, and 50 Cc. of lime water added by pouring down the side of the inclined cylinder. The contents of the cylinder are then tilted backward and forward without shaking, so as to avoid the formation of froth on the surface, until all that is soluble is dissolved. Whenever there is doubt as to when the solvent action is complete, the agitation is continued until the undissolved particles cease to diminish in size or number. The solution is then filtered through a pair of counterbalanced filters about 7 Cm., or 2.8 inches, in diameter, and the filters and residue are well washed, first with 5 Cc. of lime water and then with 5 Cc. of water, and when drained they are closed up, pressed between folds of bibulous paper, dried until they cease to lose weight at 100° C., and weighed. Then as 0.5 gramme of the crude morphine is to the weight of this residue, so is the weight of all the crude morphine to the total amount of insoluble residue it would have yielded if the whole had been subjected to the action of 100 times its weight of lime water. The weight thus obtained, subtracted from the total weight of crude morphine, gives the net weight of pure morphine; and this multiplied by 10 gives the corrected percentage.

The lime water solution of 0.5 gramme of morphine and washings are tinted with 10 drops of solution of phenolphthalein, and oxalic acid decinormal solution is dropped in from a burette until the color is discharged. The amount of oxalic acid required indicates the amount of lime water present in the proportion of 40 Cc. of decinormal oxalic acid to 100 Cc. of lime water. The burette is then refilled to the 0 mark for the saturation of the morphine present, and the oxalic acid is dropped in until neutral litmus paper is just slightly reddened. The quantity of the decinormal oxalic acid required should not be less than 16.4 Cc., which indicates, according to the molecular weight of 305.25 for morphine, a degree of purity equal to 100 per cent., or, according to a molecular weight of 303, of 99.4 per cent. These figures and results will, of course, apply only to those assays wherein there are no residues insoluble in lime water. Whenever a correction has to be made, of course the titration applies not to 0.5 gramme of morphine, but to 0.5 gramme less the correction, and then the decinormal solution required will be proportionately less. In general practice, perhaps nineteen times out of twenty the lime water testing will show an insignificant amount of insoluble residue, and then the assay process may well end there, so far as concerns its general practical value and the correction and control of results; and the titration is merely held in reserve for exceptional cases and unusual varieties of opium. (*Ephem.*, vol. iii., p. 1152.)

of the presence of opium. The test should, therefore, be applied in reference to the detection of these two principles. If an aqueous infusion of the substances examined yields a red color with the tincture of ferric chloride, there is presumptive evidence of the presence of meconic acid. Greater certainty may be obtained by the following process. Add in excess to the filtered liquor a solution of lead acetate. If opium be present, there will be a precipitate of lead meconate, and the morphine and lead acetates will remain in solution. The precipitate is then to be suspended in water, and decomposed, either by adding a little diluted sulphuric acid, which forms lead sulphate and leaves the meconic acid in solution, or by passing through it a stream of hydrogen sulphide, removing by filtration the precipitated lead sulphide, and heating the clear liquor, so as to drive off the hydrogen sulphide. With the clear liquor thus obtained, if it contain meconic acid, the tincture of ferric chloride will produce a striking red color, ammoniated copper sulphate a green precipitate, and lead acetate, silver nitrate, and barium chloride, white precipitates soluble in nitric acid. Potassium sulphocyanate, which, according to Wright, is an invariable constituent of saliva (*Simon's Chemistry,* ii. 6), produces a red color with ferric salts, resembling that produced by meconic acid, but, according to Everitt, this color is entirely and at once destroyed by a solution of corrosive sublimate, which has no effect on the red color of iron meconate. (*A. J. P.,* xii. 88.) On the contrary, gold chloride reddens a solution of sulphocyanic acid or a sulphocyanate, but not of meconic acid. Pereira says the acetates also redden ferric salts, but do not afford the results just mentioned with lead acetate and barium chloride. To test for the presence of morphine, the liquid from which the lead meconate has been precipitated, and which may be supposed to contain the morphine and lead acetates, must be freed from the lead by a stream of hydrogen sulphide, and then from the hydrogen sulphide by heat, after which the following reagents may be applied,—viz., 1, nitric acid, which colors the morphine red; 2, iodic acid, which is decomposed by the morphine with the extrication of iodine, which colors the liquid reddish brown, and, if starch is present, unites with it to form a blue compound; 3, solution of ammonia, which, if carefully added, so as not to be in excess, throws down a precipitate of morphine soluble in a great excess of that alkali or of potassium hydroxide; and, 4, tannic acid, which precipitates morphine tannate. If the precipitate thrown down by ammonia affords a deep-red color becoming yellow with nitric acid, and a blue color with ferric chloride, the proofs may be considered complete.[1]

Though opium is little injured by time if well kept, yet it does undergo spontaneous change, and Guibourt found less morphine in a specimen which had been in his possession nearly twenty years than it had yielded in its recent state. There was also more coloring matter, due to the darkening by age. (*Ann. Thér.,* 1863, p. 5.)

Among the adulterations of opium, starch has been detected in a specimen examined by J. T. King. The drug was unduly brittle, and evidences of starch were afforded both by the microscope and by iodine. From the size and form of the granules, King inferred that the starch was that of the bean. (*A. J. P.,* Jan. 1869, p. 1.) The probability is that powdered beans were the substance used.

Uses.—Opium is a stimulant narcotic. Taken by a healthy person in moderate dose, it increases the force, fulness, and frequency of the pulse, augments the temperature of the skin, invigorates the muscular system, quickens the senses, animates the spirits, and gives new energy to the intellectual faculties. Its operation, while thus extending to all parts of the system, is directed with peculiar force to the brain, the functions of which it excites sometimes even to intoxication or delirium. In a short time this excitation subsides; a calmness of the corporeal actions, and a delightful placidity of mind, succeed, and the individual, insensible to painful impressions, forgetting all sources of care and anxiety, submits himself to a current of undefined and unconnected but pleasing fancies, and is conscious of no other feeling than that of a quiet and vague enjoyment. At the end of half an hour or an hour from the administration of the narcotic, all consciousness is lost in sleep. The soporific effect, after having continued for eight or ten hours, goes off, and is often succeeded by more or less nausea, headache, tremors, and other symptoms of diminished or irregular nervous action, which soon yield to the recuperative energies of the system, and, unless the dose is frequently repeated, and the powers of nature worn out by over-excitement, no injurious consequences will ultimately result. Such is the obvious operation of opium when moderately taken, but other effects, very important from a remedial point of view, are also experienced. All the secretions, with the exception of that from the skin, are in general either suspended or diminished; the peristaltic motion of the

[1] Merck has proposed a test of opium, founded on the property, which characterizes porphyroxine, of assuming a red color when heated in diluted hydrochloric acid. The suspected liquid is first carefully evaporated, a few drops of solution of potassium hydroxide are added, and the mixture agitated with ether. The ethereal solution being filtered off, a slip of unsized paper is to be dipped into it and dried, and the moistening and drying should be repeated several times. The paper thus prepared is to be moistened with diluted hydrochloric acid, and then exposed to the vapor of boiling water. If it become reddened, opium may be inferred to exist in the liquid tested. Heusler states that this test is not applicable to the aqueous solution or extract of opium, because porphyroxine is insoluble in water, but Robertson of Rotterdam, has found it to succeed with the aqueous extract, and infers that the porphyroxine is so combined in opium as to render it in some measure soluble. (*J. P. C.*, 3e sér., xxii.)

bowels is lessened; pain and inordinate muscular contraction, if present, are allayed, and general nervous irritation is composed.

In doses insufficient to produce the full soporific effect, the stimulant influence upon the mental functions continues longer, and the subsequent calming effect is sustained for hours, sleep being not unfrequently prevented, or rendered so light and dreamy that, upon awaking, the patient will scarcely admit that he has slept at all. From large doses the period of excitement and exhilaration is shorter, the soporific and anodyne effects are more intense and of longer duration, and the succeeding symptoms of debility are more obvious and alarming.

By quantities sufficient to destroy life, after a brief excitement, the pulse is reduced in frequency, though not in force, muscular strength is diminished, and feelings of languor and drowsiness supervene, which soon eventuate in a deep apoplectic sleep. A stertorous respiration, a dark suffusion of the countenance, a full, slow, and laboring pulse, an almost total insensibility to external impressions, and, when a moment of consciousness is obtained by violent agitation or irritating applications, a confused state of intellect, and an irresistible disposition to sink back into comatose sleep, are symptoms which, for the first few hours, attend the operation of the poison. The pulse is slow, but is full and strong. In the space of a few hours, varying according to the quantity of the narcotic taken and the powers of the patient's constitution, a condition of debility ensues, and this condition will be hastened in point of time, though it will be more under the control of remedies, if the opium be evacuated from the stomach. Called to an individual laboring under the influence of a fatal dose of opium, at a period from six to twelve hours after it has been swallowed, the practitioner will generally find him with a cool, clammy skin, cold extremities, a pallid countenance, a feeble, thread-like, scarcely perceptible pulse, a slow, interrupted, almost gasping respiration, a torpor little short of absolute death-like insensibility, with narrowly contracted pupils. Death soon follows, unless relief be afforded.

After death from opium there are no characteristic lesions discoverable. The active principles of opium are undoubtedly absorbed, and act directly upon the nerve centres, affecting in man chiefly the cerebrum, but in some of the lower animals the spinal system more profoundly than the brain. The slow, full pulse found early in poisoning is due to an excitement of the pneumogastric centres in the medulla, while the rapidity of the pulse late in the poisoning is probably, in part at least, the result of a paralysis of these centres. The great feebleness of the pulse seems to be partially produced by vasomotor paralysis, partially by exhaustion of the intra-cardiac ganglia. The contraction of the pupil is caused by stimulation of the oculo-motor centres, while the sudden dilatation which immediately precedes dissolution seems to have its origin in a giving out of these centres. The immediate cause of death is failure of respiration, which is due to a direct action of the poison upon the respiratory centre in the medulla oblongata.

On some individuals opium produces peculiar effects, totally differing from the ordinary results of its operation. In very small quantities it occasionally gives rise to excessive sickness and vomiting, and even spasm of the stomach; in other cases it produces restlessness, headache, and delirium, and we have known it, even in large doses, to occasion obstinate wakefulness. The headache, want of appetite, tremors, etc., which usually follow, in a slight degree, its narcotic operation, are uniformly experienced by some individuals to such an extent as to render the use of the medicine very inconvenient. It is possible that some of these disagreeable effects may arise not from the meconate of morphine contained in the opium, but from some other of its ingredients, and those which do result from the meconate may not be produced by other salts of morphine. It is very commonly believed that narcotine is the most depressant of all the active principles. As water does not dissolve it, aqueous preparations of opium are least likely to cause unpleasant after effects.

An occasional effect of opium, which has not yet been mentioned, is a disagreeable itching or sense of pricking in the skin, sometimes attended with a species of miliary eruption. We have found the effect to result equally from all the official preparations of this narcotic.

The local effects of opium are similar in character to those which follow its general operation. An increased action of the part is first observable, then a diminution of its sensibility and contractility, and the latter effect is more speedy, more intense, and of longer continuance, the larger the quantity applied.

In all parts of the world, opium is habitually employed by many with a view to its exhilarating and anodyne influence. This is particularly the case among the Mohammedans and Hindus, who find in this narcotic the most pleasing substitute for alcoholic drinks, which are interdicted by their religion. In India, Persia, and Turkey it is consumed in immense quantities, and many nations of the East smoke opium as those of the West smoke tobacco. This is not the place to speak of the fearful effects of such a practice upon both the intellectual and the bodily faculties.

The use of opium as a medicine can be clearly traced back to Diagoras, who was nearly contemporary with Hippocrates, and it was probably employed before his time. Its extensive applicability to the cure of disease will be rendered evident by a view of the indications which it is calculated to fulfil. 1. It is excitant in its primary action. In *low or typhoid fevers,* requiring a supporting treatment, it

exalts the action of the arterial and nervous systems, and, in moderate doses frequently repeated, may be employed with advantage in conjunction with other stimulants. 2. It is still true that as a general analgesic opium is the most effectual drug known, although in some forms of *neuralgia,* in *migraine* and other *nervous headaches,* as well as in the fulgurant *pains* and *crises* of spinal scleroses, antipyrine, acetphenetidin and other coal tar products, especially in combination with caffeine, are often preferable to it. When the pain is severe the opium should be given in the form of a morphine salt, hypodermically injected. 3. Opium is an important somnifacient, and when the *sleeplessness* is produced by pain is the most useful drug of the class. In ordinary insomnia, trional, sulphonal, hydrated chloral, or other of the modern hypnotics are usually to be preferred. Very frequently, as in *delirium tremens,* the combination of opium with these narcotics is espcially effective. 4. Opium acts as an antispasmodic, probably by benumbing the sensitiveness of the peripheral or centric nerve system, and hence is useful in *tetanus, colic, gouty spasm of the stomach, cholera, nephritic* and *hepatic colic,* and in various convulsive affections. 5. It is useful in allaying various irritations, such as produce excessive *cough, nausea, tenesmus, strangury,* etc. In this way it is valuable in various *internal hemorrhages* in combination with more directly acting remedies. 6. It is often very serviceable in checking morbid discharges, as in serous or other forms of *diarrhœa* with very large liquid stools, also in *diabetes,* in which disease, however, it probably acts by influencing the nervous centres. 7. Combined with ipecac, it is often useful as a diaphoretic (see *Pulvis Ipecacuanhæ et Opii*) in *forming colds, subacute rheumatism, grippe,* etc. 8. Opium although naturally producing constipation by arrest of secretion, is often of service in those cases in which the constipation is dependent upon a very severe local irritation from undigested food or other cause. In all cases of mucous inflammation, as in *bronchitis* or *enteritis* in the first stages when there is dryness of the mucous membrane, opium is contra-indicated on account of its tendency to increase the dryness and prevent secretion through which relief to the congestion is naturally produced.

The dose of opium varies enormously according to the circumstances. We have seen an opium habitué take eight grains of morphine at a dose with no sensible effect other than a little restfulness. Children, especially infants, bear the remedy very badly and we have seen one and a half grains of Dover's powder produce an almost fatal poisoning in a child nearly a year old. Disease also greatly influences the dose; in diarrhœas one-fourth of a grain (0.016 Gm.) may suffice. In tetanus, enormous doses are well borne and in acute peritonitis we have seen 75 grains (5 Gm.) given during the 24 hours with advantage to one unaccustomed to opium. Whenever opium is given in heroic doses it should be administered hypodermically, at least in part, while whatever is given by the mouth should be in a liquid preparation so as to promote rapid absorption, and should be administered in divided doses at short intervals, the patient being closely watched, and the remedy suspended whenever narcosis appears.

Opium may often be administered with great advantage by the rectum. In this way it operates most advantageously in *obstinate vomiting, painful nephritic* and *uterine affections, strangury* from blisters, and *dysenteric tenesmus.* It may be employed as a suppository, or in the form of enema made with laudanum and a small quantity of viscid liquid, as flaxseed tea, mucilage of gum arabic, or starch prepared with hot water. Absorption takes place more slowly from the rectum than from the stomach, and a one-half larger dose may be given.

Opium was formerly much used as a local anesthetic in collyria, urethral injections, poultices, etc., but it has very little effect and is not comparable at all in its power with the modern local anesthetics. In the form of laudanum it makes an excellent dressing for minor *wounds,* but probably acts chiefly through the alcohol of the preparation.

Treatment of Opium Poisoning.—The value of potassium permanganate as a chemical antidote to opium seems to be thoroughly established. It acts by oxidizing and so destroying the alkaloid. It is evident that to exert this influence it must be brought in contact with the alkaloid, and all our physiological knowledge goes to show that potassium permanganate is not absorbed as such in the blood, but always undergoes decomposition by the organic fluids or even tissues with which it is brought in contact. Further, the allegation that potassium permanganate given hypodermically is an efficient antidote in opium poisoning does not seem to be sustained by the clinical records. It is, in fact, a chemical antidote to be administered by the mouth. Recent researches have, however, shown that poisonous alkaloids after their absorption are eliminated by the stomach and upper intestines, to be reabsorbed, so that it is important in a case of opium poisoning not to be satisfied with the primary administration of the permanganate, but to continue giving it in small doses until marked abatement of the symptoms is obtained. In the absence of potassium permanganate, tannic acid should be used as the next best antidote. The stomach should be emptied either by the stomach tube or, when this is not attainable, by the more active mechanical emetics, such as mustard flour, zinc sulphate, or copper sulphate, conjoined with ipecac. Emetics are uncertain in their action, but preferable to the stomach tube when opium has been swallowed in substance, as the lumen of the tube may be insufficient to permit the passage of the masses in which the poison is sometimes taken. The operation of

the emetic should be promoted by a very free use of warm drinks, by irritating the fauces with a feather, by keeping the patient in motion, and, if the insusceptibility to the action of the remedy is very great, by dashing cold water upon the head and shoulders. Very frequently, before the practitioner has reached the patient the narcotism will have progressed so far that it is impossible to cause vomiting at once. Owing to the great disturbance of respiration, two poisons are circulating in the blood, namely, opium and accumulated carbon dioxide. By arousing the patient, and forcing him to supplement the disabled involuntary breathing by voluntary efforts, or, in extreme cases, by artificial respiration, the blood may be so far purified that the nervous centres recover sufficiently their sensitiveness to enable the emetic to act. The great cause of death is failure of respiration, the keeping the patient awake, and the procedures already spoken of, are for the purpose of preventing this failure.

Peremptory orders to breathe should be continually shouted in the ear of the patient. Shaking, forcing to walk, and the galvanic brush, or even flagellations, should be made use of to get the rousing effects of action and pain. Atropine, strychnine, and cocaine should always be used by hypodermic injection as respiratory stimulants. The dose of the alkaloids depends upon the amount of the poison swallowed. Of these alkaloids strychnine is probably the most serviceable, but certainly a much better effect is obtained from the combination of the alkaloids than from any one of them alone. One-seventieth to one-fiftieth of a grain of atropine sulphate may be given but should not be incautiously repeated, lest its secondary depressing effect occur; one-thirtieth to one-twentieth of a grain of strychnine sulphate should be given hypodermically and repeated at short intervals *pro re nata.* One-sixth grain of a cocaine salt is often serviceable when the more powerful alkaloids have already been used freely. It should be remembered that these alkaloids have no mysterious or complete antagonism to morphine, that they do good chiefly by their action upon the respiration and that their influence upon the pupil is no proof of antagonism to morphine and no sufficient guide as to the amount of the alkaloid required. They are used especially to act upon the respiration and their effect upon this function is the chief guide to their administration, although their action upon the pupil and circulation should always be considered. No more of the alkaloids should be used than is necessary to bring and sustain the respiration sufficiently near the normal. In the cardiac debility of the advanced stage of opium poisoning, digitalis and strychnine are the chief reliances. Ammonia may sometimes be employed with advantage and alcohol may be used but in very moderate quantities. It is often well to administer the tincture of digitalis hypodermically before the cardiac failure is established. Coffee is a very serviceable remedy all through opium poisoning. It acts by relieving the stupor and also as a respiratory stimulant. It should be given *ad libitum,* and as strong as it can be made, or the alkaloid caffeine may be used in five-grain doses repeated *pro re nata.* In rare cases bleeding, in the early stages of the poisoning, when evidences of brain congestion have been very pronounced, has been of distinct advantage. When other measures fail, forced artificial respiration should always be resorted to, to be kept up until the heart beats have certainly ceased.

Dose, from one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—*From opium.*—Extractum Opii Liquidum, *Br.* (from extract); Linimentum Opii, *Br.* (from tincture); Opii Pulvis, *U. S.;* Opium Granulatum, *U. S.;* Tinctura Camphoræ Composita, *Br.* (from tincture); Tinctura Opii, *Br.;* Tinctura Opii Ammoniata, *Br.* (from tincture).

From powdered opium.—Acetum Opii, *U. S.;* Emplastrum Opii, *Br.;* Extractum Opii, *U. S.;* Opium Deodoratum, *U. S.;* Pilulæ Opii, *U. S.;* Pilula Plumbi cum Opio, *Br.;* Pilula Saponis Composita, *Br.;* Pulvis Cretæ Aromaticus cum Opio, *Br.;* Pulvis Ipecacuanhæ et Opii, *U. S.* (*Br.*); Pulvis Kino Compositus, *Br.;* Pulvis Opii Compositus, *Br.;* Suppositoria Plumbi Composita, *Br.;* Tinctura Opii Camphorata, *U. S.;* Trochisci Glycyrrhizæ et Opii, *U. S.;* Unguentum Gallæ cum Opio, *Br.*

From granulated opium.—Tinctura Ipecacuanhæ et Opii, *U. S.* (from tincture); Tinctura Opii, *U. S.;* Tinctura Opii Deodorati, *U. S.;* Vinum Opii, *U. S.*

OPIUM DEODORATUM. U. S.

DEODORIZED OPIUM

(ō'pī-ŭm dẹ-ō-dọ-rā'tŭm)

Opium Denarcotisatum, *U. S.* 1880; Denarcotized Opium.

* "Powdered Opium, *five hundred grammes* [or 17 ounces av., 279 grains]; Purified Petroleum Benzin, *a sufficient quantity.* Macerate the Powdered Opium for twenty-four hours in a wide-mouthed, well-closed bottle, with sufficient Purified Petroleum Benzin to completely cover it, shaking occasionally. Decant the liquid as closely as possible and repeat the treatment with Purified Petroleum Benzin. Again decant the liquid and pour the contents of the bottle into a plain filter contained in a glass funnel which should be well covered, drain, and then slowly percolate the residue with Purified Petroleum Benzin until the latter passes without color. Remove the filter containing the Opium from the funnel and expose the powder to the open air, so that it may dry thoroughly. Deodorized Opium should be kept in well-stoppered bottles, and, when assayed by the process given under *Opium,* should be found to yield not less than 12 percent. nor more than 12.5 percent. of crystallized morphine. Opium in coarser powder may be deodorized in the same manner as directed above." *U. S.*

The use of purified petroleum benzin (in place of ether) in the U. S. P. (8th Rev.) process is an improvement. The use of benzin has often been proposed by Ebert and others, but the objection has always been that it was difficult to obtain it of sufficient purity.

This preparation represents the medicinal properties of opium without the presence of the narcotic and odorous principles, which are believed by many physicians to play an important part in the nausea and depression produced in some people by opium.

Dose, one to two grains (0.065 to 1.3 Gm.).

OPIUM GRANULATUM. U. S.

GRANULATED OPIUM

(ō′pĭ-ŭm grăn-ụ-lā′tŭm)

"Opium dried at a temperature not exceeding 85° C. (185° F.) and reduced to a coarse (No. 20) powder. Granulated Opium, when assayed by the process given under *Opium,* should yield not less than 12 percent. nor more than 12.5 percent. of crystallized morphine. Granulated Opium of a higher percentage may be brought within these limits by admixture with Granulated Opium of a lower percentage in proper proportions." *U. S.*

This form of opium has been introduced into the U. S. P. (8th Rev.) because on account of its being in coarse powder, it is better fitted for use in making the liquid preparations of opium. (See *Opium.*)

For official preparations of granulated opium see page 910.

OXYMEL. Br.

OXYMEL

(ŏx′y-mĕl)

Oxymel Simplex; Mel Acetatum, Mellite de Vinaigre, *Fr. Cod.;* Oxymellite simple, Acétomel, *Fr.;* Sauerhonig, *G.;* Oximiel simple, *Sp.*

"Clarified Honey, liquefied, 40 *ounces* (Imperial) or 800 grammes; Acetic Acid, 5 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Clarified Honey with the Acetic Acid and about *five fl. ounces* (Imp. meas.) or one hundred cubic centimetres of Distilled Water, or sufficient to produce Oxymel having the specific gravity 1.320." *Br.*

This mixture of honey and vinegar forms a pleasant addition to gargles, and is sometimes used as a vehicle of expectorant medicines and to impart flavor to drinks in febrile diseases.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

OXYMEL SCILLÆ. Br.

OXYMEL OF SQUILL

(ŏx′y-mĕl sçĭl′læ)

Mellite de Vinaigre Scillitique, Oxymel Scillitique, *Fr. Cod.;* Oxymel Scillæ, *P. G.;* Meerzwiebelhonig, *G.;* Ossimiele scillitico, *It.;* Oximiel escilítico, *Sp.*

"Squill, bruised, 2½ *ounces* (Imperial) or 75 grammes; Acetic Acid, 2½ *fl. ounces* (Imp. meas.) or 75 cubic centimetres; Distilled Water, 8 *fl. ounces* (Imp. meas.) or 240 cubic centimetres; Clarified Honey, liquefied, *a sufficient quantity.* Digest the Squill for seven days in a mixture of the Acetic Acid and Distilled Water. Press strongly; filter. Mix the product, which should measure approximately *ten fluid ounces* (Imp. meas.) or three hundred cubic centimetres, with about *twenty-seven fluid ounces* (Imp. meas.) or eight hundred and ten cubic centimetres of the Clarified Honey, or sufficient to produce Oxymel of Squill having the specific gravity 1.320." *Br.*

After a long vogue, this preparation fell into such neglect that it was abandoned by the Pharmacopœias. Its reintroduction, however, into the Br. Pharmacopœia indicates that it is still prescribed. It has the virtues of squill, but is in no respect superior to the syrup. It is chiefly used as an expectorant in *chronic catarrh, humoral asthma, whooping cough,* and generally in those states of the pulmonary organs in which the bronchial tubes are loaded with a viscid mucus of difficult expectoration.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.). In large doses it is emetic, and as such is sometimes used in *infantile croup.*

PANCREATINUM. U. S.

PANCREATIN

(păn-crē-ạ-tī′nŭm)

"A mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog (*Sus scrofa,* var. *domesticus* Gray), or the ox (*Bos taurus* Linné), and consisting principally of amylopsin, myopsin, trypsin, and steapsin, and proved to be capable, when assayed by the process given below, of converting not less than 25 times its own weight of starch into substances soluble in water." *U. S.*

Pancréatine médicinale, Pancreatina, *Fr. Cod.;* Pancreatina, *Sp.*

The term "pancreatin" has been variously used for many different preparations from the pancreatic gland, and has long been popularly employed for the purpose of distinguishing preparations more or less of the nature of extracts made from the gland. The *pancreatic juice* is an albuminous, transparent liquid, odorless, alkaline, and containing about eight per cent. of organic matter. It is now generally recognized that there are present in it three or, perhaps, four different soluble ferments (enzymes); *trypsin,* whose function it is, when in alkaline solution, to convert albuminous bodies into peptones; *amylopsin,* a diastatic ferment, closely allied to, if it is not identical with, the ptyalin of the saliva, and possessed of the power to convert raw or boiled starch into sugar (chiefly maltose); *steapsin,* which has the power of splitting up fats into glyc-

erin and fatty acids; and a *peculiar substance,* not very well known, which acts as a coagulant of milk. Besides its digestive properties the pancreatic juice has the power of emulsifying fats. This emulsifying property is possessed by an alkaline aqueous infusion of the gland, and is therefore present in properly prepared pancreatic extracts. Rachford's experiments appear to prove that pancreatic juice in the presence of an equal quantity of bile and 0.25 per cent. of hydrochloric acid developed its highest efficiency. (*J. Chem. S.,* 1891, 948.)

The pancreatin of the U. S. Pharmacopœia is composed of all these ferments, with more or less extraneous matter. It is officially described as "a cream-colored, amorphous powder, having a faint, peculiar, not unpleasant odor, and a somewhat meat-like taste. Slowly soluble in water, and containing not more than 10 percent. of substances insoluble in this solvent; insoluble in alcohol. Pancreatin digests albuminoids and converts starch into sugar, dextrin, or maltose; it exhibits its peculiar activities in neutral, faintly alkaline, and faintly acid media; more than traces of mineral acids or large amounts of alkalies render it inert. Alkali carbonates exert slightly inhibitory power upon Pancreatin. The digestive power of Pancreatin is injured by contact with pepsin in solution. If 0.28 Gm. of Pancreatin and 1.5 Gm. of sodium bicarbonate be added to 100 Cc. of tepid water contained in a flask, and if 400 Cc. of fresh cows' milk, which has been previously heated to 38° C. (100.4° F.), be then added, and the temperature of the mixture maintained at this point for thirty minutes, the milk should be so completely peptonized that, if a small portion of it be transferred to a test-tube and mixed with some nitric acid, no coagulation should occur." *U. S.* R. H. Jones found commercial pancreatin unable to withstand the U. S. P. 1890 tests, which he stated were too stringent; he suggested the addition of a starch digestion test. (*P. J.,* 1896, 194.) (See official assay of pancreatin.)

The French Codex directs that pancreas gland purified by separating foreign matter is to be cut into small pieces, macerated in chloroform water, then expressed, the liquid filtered and rapidly evaporated at a temperature not exceeding 45° C. Choay (*P. J.,* 1898, 505) criticizes the temperature for evaporation and recommends evaporation *in vacuo* at 38° C. Biernacki (*A. J. P.,* 1892) previously stated that digestive ferments require for their efficient action a temperature little over that of the human body, 39° C. (102.2° F.).

Pancreatin extracts are prepared by different processes by several manufacturers. The process described by R. V. Mattison, based on the method of Scheffer for obtaining pepsin, is as follows: Macerate the cut-up pancreas in water acidulated with hydrochloric acid for forty-eight hours; filter until clear. Add a saturated solution of sodium chloride, and allow to stand until pancreatin rises to the top; skim this, drain on a muslin filter, wash with a less concentrated solution of salt, and press until nearly dry; then rub up with sugar of milk, dry thoroughly, without heat, and dilute with sugar of milk until ten grains just emulsify two drachms of cod liver oil. The mixed pancreatic enzymes may be extracted from the gland by means of glycerin, and such an extract may be preserved indefinitely. A useful and permanent extract may also be obtained by exhausting the finely divided pancreas with water containing about 2 per cent. of boric acid and 1 per cent. of borax. (Allen, *Com. Org. Anal.,* 2d ed., vol. iv. 354.) As the power of pancreatin cannot be judged of accurately by its physical appearance, it is very important to have some test which will rigidly decide as to its value. If pancreatin be added to fresh milk without an alkali, in the course of a few minutes the liquid acquires the property of curdling abundantly upon boiling, and Wm. Roberts (*Digestive Ferments,* London, 1881) estimates the value of a pancreatin by the number of cubic centimeters of milk which are transformed by one cubic centimeter of the sample at a temperature of 40° C. to the curdling point in five minutes. (See *Liquor Pancreatis,* p. 728.)

A method of determining the value of pancreatin has been made official and is as follows:

Assay of Pancreatin. U. S. P. (8th Rev.) "Pancreatin, *three-tenths of a gramme;* Starch, dry and in fine powder, *seven and one-half grammes;* Distilled Water, Tenth-normal Iodine V.S., each, *a sufficient quantity.* Introduce the starch into a flask, add 120 Cc. of distilled water, and boil until a translucent mixture results. Cool the resulting paste to 40.5° C. (105° F.), and add to it the Pancreatin, previously dissolved in about 10 Cc. of distilled water at 40.5° C. (105° F.). Shake the flask well, maintaining the temperature of the mixture at 40.5° C. (105° F.) during five minutes; at the end of this time all of the starch should be converted into substances soluble in water, and a thin liquid be produced. Mix 2 drops of tenth-normal iodine V.S. with 60 Cc. of distilled water, and add to it 2 drops of the warm converted starch solution; no color should result, or, at most, a wine-red color, showing the presence of dextrin and maltose. The appearance of a blue or purple color indicates the presence of *unconverted starch* and that the Pancreatin is below the standard,—*i. e.,* that of converting not less than 25 times its own weight of starch into substances soluble in water." *U. S.*

Uses.—Pancreatin was first used in medicine on account of its emulsifying properties. Horace Dobell, noticing that consumptives are very likely to have a dislike for fat, conceived the idea that this was due to lack of pancreatic digestion, and administered an emulsion made with the fat of beef stirred in milk with the pancreatic juice of the pig. A little later, pancreatic preparations of cod liver oil were prepared, and still have much vogue. Be-

sides this employment, pancreatin has two distinct uses; first, as a ferment to be administered in dyspepsia; second, as a valuable means for the pre-digestion of food. As pancreatin acts in an alkaline solution and pepsin in an acid one, it would seem *a priori* not probable that pancreatin given by the stomach would be of avail in cases of feeble digestion. Nevertheless, as the experiments of Schweitzer, which have been confirmed by Gross, seem to show, some hours digestion is necessary for the pancreatin to be destroyed by acid solutions. It is therefore probable that when given internally pancreatin may escape from the stomach into the intestines and the combination of pepsin and pancreatin in *dyspepsia* is not unphilosophical. In the pre-digestion of food by pancreatin, five grains of commercial pancreatin of good quality, with twenty grains of sodium bicarbonate, in an ounce of warm water, may be added to a pint of milk, and kept at the temperature of 110° F. for an hour. As the thoroughly peptonized or pre-digested food is very bitter, when the milk is to be given by the mouth it is better to arrest the peptonizing process by boiling the milk after digestion has continued for twenty to thirty minutes, unless the milk can be used at once. For receipts for preparing various peptonized foods, see H. C. Wood's *Therapeutics.* Nutritive enema should be thoroughly pancreatized.

Dose, seven and a half to fifteen grains (0.5 to 1 Gm.).

Off. Prep.—Liquor Pancreatis, *Br.*

PAPAVERIS CAPSULÆ. Br.

POPPY CAPSULES

(pa-pā'vẹ-rīs căp'sù-læ)

"The nearly ripe dried fruits of Papaver Somniferum, *Linn.*" *Br.*

Papaver, *U. S.,* 1870; Capsules de Pavot blanc ou Pavot officinal, *Fr. Cod.;* Fructus Papaveris immaturi, *P. G.;* Unreife Mohnköpfe, Kapseln des Weissen Mohns, Mohnkapseln, Mohnköpfe, *G.;* Papavero, *It.;* Cabezas de amapola, *Sp.*

In England the poppy is cultivated chiefly for its capsules, which are gathered as they ripen, and taken to market enclosed in bags. The Br. Pharmacopœia directs them to be collected before they are quite ripe, as they then contain more of the active milky juice, but, cut at this period, they are apt to lose their juice through the wounded surface, unless carefully kept inverted upon their crown while drying, and even when thus treated, they are, according to the observations of Buchner, less active than the capsules collected after perfect maturity, while they contain more of useless saccharine and mucilaginous matter. (*Buchner's Repert.,* 3 R., viii. 289 and 326.) Meurein states, as the result of his experiments, that the richest are those collected just before the maturity of the seeds, when the capsules have passed from their glaucous green to a yellowish-green color. (*J. P. C.,* 3e sér., xxiii. 341.) They are occasionally imported, but, as no effect is produced by them which cannot be as well obtained from opium, they are little employed.

Dried *poppy capsules* vary in size from the dimensions of a small egg to those of the fist. They differ also in shape according to the variety of the poppy from which they are procured. On the Continent two sub-varieties of the white poppy are recognized, the *long,* and the *round* or *depressed.* Of these, according to Aubergier, the long are richest in morphine, and his conclusions are confirmed by Meurein, who also found the largest capsules most efficient. Those commonly found in commerce are spheroidal, flattened below, and surmounted by a crown-like expansion—the persistent stigma—which is marked by numerous diverging rays that rise somewhat above the upper surface and appear to be prolongations of partial septa, or partitions, proceeding along the interior circumference of the capsule from the top to the bottom. In the recent state, the seeds, which are very numerous, adhere to these septa, but in the dried capsule they are loose in its cavity. The capsules of the black poppy are smaller and more globular than those of the white, and contain dark instead of light-colored seeds. There appears to be no essential difference in their properties. Both kinds, when fresh, are glaucous, but when dried are of a dirty-white or purplish-brown color, of a consistence somewhat like that of paper, inodorous, and with little taste, unless long chewed, when they are decidedly bitter. They contain principles, in very small quantities, similar to those of opium, which they yield to water by decoction, and have been employed in France for obtaining morphine.

On the continent of Europe, the poppy is cultivated largely for its seeds, which yield about fifty per cent. of an excellent fixed oil on expression. *Poppy seed oil* is of a pale golden color, liquid at 5.5° C. (42° F.), easily dried, inodorous, and of a pleasant flavor. It is bleached by exposure in thin layers to the sun. (*P. J.,* March, 1874, p. 731.) It belongs to the class of drying oils, ranking after linseed and hemp seed oils in power. For chemical composition, the reader is referred to *Opium,* page 888.

Uses.—Dried poppy heads, though analogous to opium in medicinal properties, are exceedingly feeble. They are nevertheless asserted to have proved fatal, in the form of decoction, to a child. The case, reported by F. L. Winckler, was that of a babe, in the stomach of which he found a little morphine, but no meconic acid. (*N. R. Pharm.,* 1867, xvi. 38.) They are sometimes employed in decoction, as an external emollient and anodyne application, and, in emulsion, syrup, or extract, are used internally, in Europe, to calm irritation, promote rest, and produce generally the narcotic effects of opium.

PARAFFINUM. U. S. (Br.)

PARAFFIN

(păr-ą̆f-fī'nŭm)

"A mixture of solid hydrocarbons, chiefly of the methane series; usually obtained by chilling and pressing the distillates from petroleum having high boiling points, and purifying the solid press cake so obtained." *U. S.* "A mixture of several of the harder members of the paraffin series of hydrocarbons; usually obtained by distillation from shale, separation of the liquid oils by refrigeration, and purification of the solid product." *Br.*

Paraffinum Durum, *Br.*, Hard Paraffin; Paraffin Wax. Solid Paraffin; Paraffine, *Fr. Cod.*; Paraffinum solidum, *P. G.*; Festes Paraffin, Gereinigtes Erdwachs, *G.*; Parafina, *Sp.*

The name paraffin, often spelled *paraffine*, was originally bestowed by Baron von Reichenbach upon a waxy substance obtained through the destructive distillation of wood. He derived it from *parum affinis*, and thus intended to indicate its very neutral character. The name is now popularly applied to a solid white diaphanous substance, resembling white wax, which is procured from petroleum or bituminous shales by distillation, or from ozokerite by purification. (See *Ozokerite, Ceresin*, in PART II.) In the manufacture from petroleum, as carried out in the United States, the residuum from the distillation of crude petroleum for illuminating oil is taken. This is redistilled from what are called "tar stills," in which the distillation is pushed until only coke remains. The paraffin oil distillate obtained in this way is treated with from 4 to 5 per cent. of sulphuric acid, washed, and treated with caustic soda, the mixture being kept liquid by the aid of steam coils. After settling, the paraffin oil goes to the "chill-rooms," where, by the aid of the ammonia refrigerating machines and the circulation of cooled brine, the whole mass is brought to a semi-solid condition. This is subjected to powerful pressure, and the refined heavy oil which drains off is collected as lubricating oil. Its specific gravity should be about 32° B. The press cake may be broken up, melted, and allowed to solidify, and then submitted to still greater pressure at a higher temperature (70° F.) than before, when the product is known as "refined wax." To convert it into block paraffin it must be washed with petroleum benzin, pressed, melted, and filtered through bone black or other medium, when it solidifies in a hard, translucent, colorless block.

Properties.—Paraffin, in its pure condition, is a white, waxy, inodorous, tasteless substance, harder than tallow, softer than wax, with a specific gravity of 0.890. Its melting point is variable, depending somewhat upon its origin. It ranges between 43° and 65° C. (109° and 151° F.). An ultimate analysis yields, on the average, carbon 85 per cent. and hydrogen 15 per cent. It is insoluble in water, is indifferent to the most powerful acids, alkalies, and chlorine, and can be distilled unchanged with strong oil of vitriol. Warm alcohol, ether, oil of turpentine, olive oil, benzene, chloroform, and carbon disulphide dissolve it readily. It can be mixed in all proportions with wax, stearin, palmitin, and resin. As stearin is less soluble in benzene than paraffin, Vogel proposes this reaction as a method for detecting the adulteration of paraffin with stearin. (Joy.) It is officially described as "a colorless, more or less translucent mass, crystalline when separating from solution; without odor or taste, and slightly greasy to the touch. Specific gravity: from 0.890 to 0.905 at 25° C. (77° F.). Insoluble in water or alcohol; slightly soluble in absolute alcohol; readily soluble in ether, petroleum benzin, benzene, carbon disulphide, volatile oils, and in warm fixed oils. Its alcoholic solution should not redden moistened blue litmus paper. When heated, it melts at from 51.6° to 57.2° C. (125° to 135° F.), and on stronger heating ignites, burning with a luminous flame and depositing carbon, but leaving no permanent residue. If 0.5 Gm. of Paraffin be heated in a dry test-tube with an equal weight of sulphur, the mixture will become black from the separated carbon, with the evolution of hydrogen sulphide gas. Paraffin is not acted upon or colored by concentrated sulphuric acid or nitric acid in the cold. If 0.5 Gm. of Paraffin be heated and 0.1 Gm. of powdered fuchsin added to the fused mass, the latter should not assume a pink or red color (absence of *stearic acid*)." *U. S.* The Br. Pharm. describes it as "colorless, semi-transparent, crystalline, inodorous and tasteless, slightly greasy to the touch. Specific gravity 0.82 to 0.94. Insoluble in water, slightly soluble in absolute alcohol, almost entirely soluble in ether. An alcoholic solution should not redden litmus. It melts at 130° to 135° F. (54.4° to 57.2° C.), and burns with a bright flame, leaving no residue." *Br.* The fact that solid paraffin wax is essentially made up of a mixture of hydrocarbons of the series C_nH_{2n+2} was established by Gill and Meusel, who studied the action of bromine upon it. The fact that when paraffin wax is oxidized by concentrated nitric acid or by chromium trioxide mixture we obtain *paraffinic acid*, $C_{24}H_{48}O_2$, and *cerotic acid*, $C_{27}H_{54}O_2$, shows that it is essentially made up of hydrocarbons between $C_{24}H_{50}$ and $C_{27}H_{56}$. For *Soft Paraffin*, or *Paraffinum Molle*, see *Petrolatum*, p. 922.

It would be beyond the scope of this work to give all the uses of this very valuable substance. The largest quantity is consumed in candles. It is said that meat may be preserved by immersing it in melted paraffin. Lemons may also be kept in this way. It is used to saturate paper to make it impervious to moisture, as a lubricator, for adulterating chocolate and candies, in large quantities as a basis for chewing gum, to coat pills, etc. (*A. J. P.*, 1895, 422.)

Off. Prep.—Ceratum Plumbi Subacetatis, *U. S.;* Unguentum Acidi Borici, *U. S.;* Unguentum Creosoti, *Br.;* Unguentum Eucalypti, *Br.;* Unguentum Paraffini, *Br.*

PARALDEHYDUM. U. S., Br.

PARALDEHYDE

(pa-răl-de-hȳ'dŭm)

$C_6H_{12}O_3 = 131.10$

"A polymer of acetaldehyde [$CH_3.COH = 43.70$]. Paraldehyde should be kept in well-stoppered, dark amber-colored bottles, in a cool place." *U. S.* "Paraldehyde, $C_6H_{12}O_3$, is a product of the polymerization of aldehyde by various acids and salts." *Br.*

Paraldéhyde, Elaldéhyde, *Fr. Cod.;* Paraldehydum, *P. G.;* Paraldehyd, *G.;* Paraldehido, *Sp.*

Small quantities of acids like hydrochloric and sulphuric, and of certain salts like zinc chloride, $ZnCl_2$, convert aldehyde at ordinary temperatures into its polymer paraldehyde. Its properties are thus described officially: "A colorless, transparent liquid, having a strong, characteristic, but not unpleasant or pungent odor, and a burning and cooling taste. Specific gravity: 0.990 at 25° C. (77° F.). Soluble in 8 parts of water at 25° C. (77° F.), and in 16.5 parts of boiling water; the cold aqueous solution becomes turbid on being boiled. Paraldehyde is miscible, in all proportions, with alcohol, ether, and fixed or volatile oils. When cooled to near 0° C. (32° F.), Paraldehyde solidifies to a crystalline mass, which becomes liquid again at 10.5° C. (51° F.). It boils at 123° to 125° C. (253.4° to 257° F.), evolving inflammable vapors. Paraldehyde is neutral, or slightly acid to litmus paper. When distilled with a small portion of sulphuric acid, Paraldehyde is converted into acetaldehyde, boiling at about 21° C. (69.8° F.). On warming in a test-tube some silver ammonium nitrate T.S. saturated with Paraldehyde, a silver mirror will form on standing. On heating some Paraldehyde on a water-bath, it should completely volatilize, without leaving any disagreeable odor (absence of *impurities* derived from *fusel oil*). One Cc. of Paraldehyde should form, with 10 Cc. of water, a clear solution, free from oily drops (absence of *amyl alcohol,* etc.), and portions of this solution, when acidulated with nitric acid, should not be affected by silver nitrate T.S. (absence of *hydrochloric acid*), or barium chloride T.S. (absence of *sulphuric acid*). A mixture of 8 Cc. of Paraldehyde and 8 Cc. of alcohol with 1 drop of phenolphthalein T.S. should acquire a pink color upon the addition of 0.5 Cc. of normal potassium hydroxide V.S. (limit of *free acid*)." *U. S.*

The British Pharmacopœia gives the following properties and tests: "Soluble in 10 parts of *water* at 60° F. (15.5° C.); less soluble in hot *water*. Miscible, in all proportions, with *alcohol* (90 per cent.) and with *ether*. An aqueous solution should not affect *solution of litmus*. Specific gravity 0.998. Boiling point 255.2° F. (124° C.). It may be congealed to a clear crystalline mass which melts at about 50° F. (10° C.). It affords no coloration on standing for two hours mixed with *solution of potassium hydroxide* (absence of aldehyde), and should yield no characteristic reaction with the tests for sulphates or for chlorides." *Br.*

Uses.—Paraldehyde produces sleep in the frog and also in mammals, with complete muscular relaxation and loss of sensibility. The heart is not affected until late in the poisoning, and death results from paralysis of the respiratory centres. Not only the brain but also the whole lower nervous system is influenced by the toxic dose of paraldehyde, which decreases the functional activity of the spinal cord, of the motor and sensory nerve trunks, and even of the muscles. It is eliminated by the urine, to which it imparts its odor, and according to Gordon it increases the excretion of urea. Henoque states that the intravenous injection of paraldehyde markedly affects the spectrum of oxyhemoglobin, and Quinquaud that methemoglobin appears in the blood after fatal poisoning by it. Death is alleged to have been produced by four ounces, but in cases in which eight to nine hundred grains have been taken there have been produced no more serious symptoms than many hours of sleep with general muscular relaxation; Probst reports one instance in which nearly five ounces of paraldehyde taken within sixty hours caused profound coma, marked lividity, vomiting, slight fall of temperature but no pronounced circulatory disturbance, and with recovery by the seventh day. After the long continued use of paraldehyde intractable nasal ulcers, skin eruptions and various evidences of disturbed nutrition have been noted. Paraldehyde is a very useful hypnotic in mild insomnia occurring in *neurasthenia* and as an adjuvant to more powerful drugs in *delirium tremens* and in serious forms of morbid wakefulness not dependent upon pain. It has been found especially useful in *asthma* (*L. L.*, vol. i. 1899). The chief disadvantages connected with its use are its tendency to cause gastric disturbance and its inability to relieve pain. It is best administered in a considerable quantity of cold water.

Dose, one-half to one and a half fluidrachms (1.8 to 5.5 Cc.).

PAREIRA. U. S. (Br.)

PAREIRA [Pareira Brava]

(pa-rei'ra)

"The dried root of *Chondrodendron tomentosum* Ruiz and Pavon (Fam. *Menispermaceæ*)." *U. S.* "The dried root of Chondrodendron tomentosum, *Ruiz and Pavon.*" *Br.*

Pareiræ Radix, *Br.,* Pareira Root; Pareira Brava, *Fr., G.*

Under the name of Pareira Brava there are three distinct drugs met with in our market. Of these the rarest is the product of the *Cissampelos Pareira,* L. Allen and Hanburys obtained from Jamaica a considerable quantity of this drug, the bulk of it composed of stems, which are described as being cylindrical, varying from the thickness of a quill to that of the forefinger, with a light brown bark. The roots which we have met in American commerce are rarely more than three-fourths of an inch in diameter, are much contorted, and irregularly cylindrical, with a dark brown exterior, which is longitudinally much wrinkled or furrowed. On section they are seen to be composed of a thick corky bark enclosing a woody cylinder consisting of a number (10 to 20) of convergent vascular bundles separated by wedge shaped, very porous, medullary rays. There are no concentric layers of wood. The color is a light yellowish fawn tint, the taste a pure bitter. This is the Pareira Brava of the Br. Pharmacopœia of 1870, the present Br. Pharmacopœia agreeing with the U. S. Pharmacopœia in recognizing the root of *Chondrodendron tomentosum.*[1]

The ordinary pareira brava of our markets is that which was exhibited at Philadelphia in the Centennial Exhibition of 1876 by the Brazilian government as the product of *Cissampelos Pareira,* but which is now recognized as being obtained from *Chondrodendron tomentosum.* It consists of great pieces of roots, some of them four inches in diameter and three feet long. They are irregularly cylindrical, often somewhat four sided, with a thin, brownish, closely adherent bark, often grayish in color, and not so closely wrinkled as in some specimens.

On section, the root is seen to consist of from three to nine concentric or excentric rings of growth of a breadth of from one-eighth to one-third of an inch. There is not a distinct continuous series of medullary rays, but each zone is composed of wedge shaped masses, formed of divergent lines of dense woody tissue arched exteriorly over the porous parenchyma. The stems have a similar structure, but with an obvious pith. This is the Pareira Brava of the present U. S. Pharm., which describes it as follows. "Subcylindrical, knotty, and somewhat tortuous, cut into pieces of various lengths, 1 to 6 Cm. in diameter; externally blackish-brown, with transverse ridges and fissures and longitudinal furrows; hard, heavy, and tough; when freshly cut having a waxy lustre, internally yellowish- or brownish-gray, the dried transverse sections exhibiting several inequilaterally concentric circles of interrupted, porous wood-wedges projecting beyond the markedly retracted intervening tissue of the rather large medullary rays; odor slight; taste bitter." *U. S.*

Under the name of *Common False Pareira,* Flückiger and Hanbury describe a drug which they state to be a common drug of the Brazilian and English markets. "It consists of a ponderous, woody, tortuous stem and root, occurring in pieces from a few inches to a foot or more in length, and from 1 to 4 inches in thickness, coated with a thin, hard, dark-brown bark. The pieces are cylindrical, four-sided, or more or less flattened,—sometimes even to the extent of becoming ribbon-like. The stem differs from the root externally in being less tortuously and more sparingly marked with transverse ridges and constrictions or cracks, also in the longitudinal furrows being more regular. In transverse section of the stem a well-defined pith will be found to occupy the centre of the first-formed wood, which is a column about ¼ of an inch in diameter. This is succeeded by 10 to 15 or more concentric or oftener eccentric zones, 1-10th to 2-10ths of an inch wide, each separated from its neighbor by a layer of parenchyme, the outermost being coated with a true bark. In pieces of *true root,* the pith is reduced to a mere point." (*Pharmacographia,* p. 29.) This false pareira is not often seen in America. It is stated that in it Wiggers discovered pelosine in 1839. Its botanical source is unknown, but is believed to be a Menispermum.[1]

Chondrodendron tomentosum, Ruiz and Pavon.—*Cocculus Chondrodendron,* De C.—*Botryopsis platyphylla,* Miers.—This is a climbing, woody vine, which attains often a considerable height, and is remarkable for the size of its leaves. These are about a foot long, broadly ovate or rounded, slightly cordate, with a smooth upper surface, and on the under surface, between the veins, covered with a fine close wool of an ashy hue. The racemose fruits are of the size of large grapes, oval and black. This plant inhabits both Brazil and Peru.

[1] A *West African False Pareira Brava* which has appeared in the London markets is of a chocolate-brown color externally, and of a yellow and brownish-yellow internally. Its woody zones are numerous, and in the larger pieces are arranged excentrically. The root portions have a star of small size in the centre with a variable number of straight rays. The woody wedges are narrow, and their vessels, seen by the microscope, small in diameter. For an elaborate description of the finer microscopical characters of this root as contrasted with that of the Chondrodendron, see *P. J.,* 17, 218.

[1] *White Pareira Brava,* the stems and root of *Abuta rufescens,* is described by Flückiger and Hanbury as consisting "of short pieces of a root half an inch to three inches thick, covered with a rough blackish bark, and also of bits of stem having a pale, striated, corky bark cut transversely. The root displays a series of concentric zones of white amylaceous cellular tissue, each marked with narrow wedge-shaped medullary rays of dark porous tissue."

Yellow Pareira Brava, derived from *Abuta amara,* Aublet, highly esteemed in Brazil, is described as consisting "of portions of a hard, woody stem, from one to six inches in diameter, covered with a whitish bark. Internally it is marked by numerous regular concentric zones, is of a bright-yellow color and a bitter taste." It contains berberine.

The root of *Cocculus Cæba,* G. P. et Rich., a native of Northern India, Afghanistan, and Arabia, according to Heckel and Schlagdenhauffen, resembles in appearance and medicinal properties Pareira brava, and contains about 2 per cent. of pelosine with 3 per cent. of a new alkaloid, *sangoline.* This melts at 188° F., and in alcoholic or chloroformic solution rotates the plane of polarized light to the right. It is thrown down by water from its alcoholic solution, and does not give the color reaction that is obtainable from pelosine with sulphuric acid and an oxidizing agent. The root also contains *columbin,* and is used in India as a substitute for hops.

Cissampelos Pareira, Willd., *Sp. Plant.* iv. 861; Woodv., *Med. Bot.* 3d ed., p. 167, t. 65. This is a climbing plant, with numerous slender, shrubby stems, and roundish, entire leaves, indented at the top, covered with soft hair upon their under surface, and supported upon downy footstalks, inserted into the back of the leaf, The flowers are very small, and disposed in racemes, of which those in the female plant are longer than the leaves. The plant is a native of the West Indies and South America. According to Auguste St.-Hilaire, true pareira is obtained from another species of the same genus growing in Brazil, *C. glaberrima.*[1]

The British Pharmacopœia Addendum defines *Cissampelos* as "the root of Cissampelos Pareira, *Linn.,*" and describes the root as occurring "in slightly compressed undulating pieces, usually having a diameter of about half an inch (twelve millimetres). It is covered with a dark brown bark, easily separable from the underlying fibrous wood, marked with broad shallow longitudinal furrows and fine transverse cracks. A transverse section exhibits a narrow bark surrounding a yellowish-brown woody column consisting of a single ring of from ten to twenty radial woody wedges separated from each other by distinct narrow medullary rays; the vessels of the xylem are large and may be seen with the naked eye. The fracture is fibrous. The root has no odor; it has a very bitter taste." *Br.* The British Pharmacopœia Addendum contains processes for the decoction and liquid extract of Cissampelos, see footnote.[2]

Properties.—The root imparts its virtues readily to water. Feneuille found in it a soft resin, a yellow bitter principle, a brown substance, a nitrogenous substance, fecula, acid calcium malate, potassium nitrate, and various other salts. He considers the yellow bitter substance as the active principle. It is soluble in water and alcohol, and precipitated from its solution by tincture of galls. Wiggers announced in 1838 the existence in pareira brava of an alkaloid, for which he proposed the name of *pelosine* or *cissampeline.* Peretti of Rome, and Pelletier afterwards, separated from the root an alkaloid characterized by assuming a beautiful purple color upon contact with strong nitric acid. (*J. P. C.,* xxvi. 162.) In Christison's *Dispensatory* it is stated to be uncrystallizable, insoluble in water, soluble in ether, alcohol, and the acids, and of an intensely bitter and sweetish taste. Flückiger (*P. J.,* 1870, p. 192) found an alkaloid in pareira, and, having thoroughly determined its origin, investigated its properties, and fixed its composition at $C_{18}H_{21}NO_3$, showed its identity with the *bebeerine* of nectandra and the *buxine* of *Buxus sempervirens* obtained by Walz. Ringer and Brooke (*A. J. P.,* 1892, 255) proved that the true chondrodendron root contained a larger quantity of chemical and extractive principles than do the substitutes. (See also Dohme's paper, *D. C.,* 1896, 296.)

Uses.—Pareira is said to be tonic, aperient, and diuretic. It was introduced into European practice so long ago as 1688, and at one time enjoyed considerable reputation as a lithontriptic. It has been recommended in *calculous affections, chronic inflammation* and *ulceration of the kidneys and bladder, leucorrhœa, dropsy, rheumatism* and *jaundice.* It is at present chiefly employed for the relief of *chronic inflammations of the urinary passages,* in which it was originally found by Brodie to be very useful. Advantage may very frequently be derived from combining it with belladonna or hyoscyamus. In Brazil it is used in the cure of the *bites of poisonous serpents,*—a vinous infusion of the root being taken internally, while the bruised leaves of the plant are applied to the wound. The dose of pareira in substance is from thirty grains to a drachm (2.0 to 3.9 Gm.). The infusion (1 oz. in 1 pint of boiling water) is useful. A tincture, made by macerating one part of the root in five parts of diluted alcohol, has been given in the dose of a fluidrachm (3.75 Cc.). The aqueous extract may be given in the dose of from ten to thirty grains (0.65 to 2.0 Gm.). There is now an official fluidextract, of which the dose is half a fluidrachm to a fluidrachm (1.8 to 3.75 Cc.).

Dose, thirty to sixty grains (2.0 to 3.9 Gm.).

Off. Prep.—Fluidextractum Pareiræ, *U. S.* (*Br.*).

[1] *Pareira Bark.*—Though the root is the official part, the bark is probably possessed of similar virtues. A specimen at the International Exhibition at London in 1862 was in flat pieces, from two to four inches broad, about a line thick, extremely fibrous, so tough that it could be bent without breaking, of a very light dirty-yellowish color, and covered with a light-colored epidermis.

[2] *Decoctum Cissampeli.* Br. Add. *Decoction of Cissampelos.*—"Cissampelos, thinly sliced, 2½ ounces (Imp. meas.) or 125 grammes; Distilled Water, a sufficient quantity. Boil the Cissampelos with twenty-four fluid ounces (Imp. meas.) or twelve hundred cubic centimetres of Distilled Water, in a suitable vessel, for fifteen minutes; strain; if necessary, pour more Distilled Water over the contents of the strainer, so as to produce one pint (Imp. meas.) or one thousand cubic centimetres of the strained Decoction. *Dose,* ½ to 2 fluid ounces." *Br. Add.*

Extractum Cissampeli Liquidum. Br. Add. *Liquid Extract of Cissampelos.*—"Add to Cissampelos, in No. 40 powder, rather more than an equal bulk of boiling Distilled Water and set aside for twenty-four hours; then pack in a percolator and pass boiling Distilled Water slowly through it until the percolate amounts to about ten times the weight of the Cissampelos or until the latter is exhausted. Ascertain the proportion of extractive matter in the percolate by evaporating a small weighed quantity in a counterpoised dish on a water-bath to a firm consistence, and weighing the product. Then evaporate the bulk of the percolate until the residual liquid contains one-third of its weight of such extractive matter; mix with this residual liquid enough Alcohol (90 per cent.) to produce from three volumes of the evaporated liquid four volumes of the Liquid Extract. Filter, or otherwise clarify, if necessary. *Dose,* ½ to 2 fluid drachms." *Br. Add.*

PELLETIERINÆ TANNAS. U. S.

PELLETIERINE TANNATE

(pĕl-lę-tī-ę-rī'næ tăn'năs)

"A mixture in varying proportions of the tannates of four alkaloids (punicine, iso-punicine, methyl-punicine, and pseudo-punicine),

obtained from *Punica Granatum* Linné (Fam. *Punicaceæ*). It should be kept in small, well-stoppered, dark amber-colored vials." *U. S.*

Pelletierinum Tannicum, Punicinum Tannicum; Punicine Tannate; Tannate de Pelletiérine, *Fr. Cod.*; Gerbsaures Pelletierin, Punicin, *G.*

Preparation.—The bark of *Punica Granatum* is ground, and mixed with milk of lime; the mixture is percolated with water, the percolate shaken with chloroform, and the separated chloroformic liquid which contains in solution the mixed alkaloids, is treated with a weak solution of sulphuric acid; upon the addition of a solution of tannic acid to the neutralized acid solution of the alkaloids, tannates are precipitated; these are washed and dried.

Properties.—The alkaloidal mixture known as Pelletierine Tannate is officially characterized as follows: "A light yellow, odorless, amorphous powder, having an astringent taste, and a weak acid reaction. Soluble in 235 parts of water, 12.6 parts of alcohol, and in 300 parts of ether at 25° C. (77° F.); insoluble in chloroform; soluble in warm diluted acids. Pelletierine Tannate, when dried over sulphuric acid and heated, turns brown at 150° C. (302° F.), softens at about 165° C. (329° F.), and when heated to a higher temperature, decomposes and chars without melting. It leaves no residue on ignition. Ferric chloride T.S. colors aqueous solutions of the salt blue-black. In aqueous solutions of Pelletierine Tannate, soluble lead, mercury, and zinc salts produce white precipitates. Platinic chloride T.S. produces no precipitate. Ammonia water produces a white precipitate, soluble in excess of the precipitant, forming a yellowish-red solution. Aqueous solutions of Pelletierine Tannate immediately reduce silver nitrate T.S., or gold chloride T.S., to metallic silver or gold, respectively, the former as a black precipitate, and the latter as a thin, purplish mirror on the test-tube. Sulphuric acid gives a yellow color; the liquid, on being heated, turns slowly to green, and finally to purple. Nitric acid produces no color. Sulphuric acid containing a trace of selenous acid produces a light bluish-green color, gradually becoming dark green, and developing a pink border." *U. S.*

Uses.—Pelletierine tannate represents the tænicidal properties of Granatum, see page 598.

Dose, four grains (0.26 Gm.).

PEPO. U. S., Br. Add.

PEPO [Pumpkin Seed]

(pē'pō)

"The ripe seed of *Cucurbita Pepo* Linné (Fam. *Cucurbitaceæ*)." *U. S.* "The prepared fresh ripe seeds of cultivated plants of Cucurbita maxima *Duchesne,* also known as C. Pepo *Linné*." *Br. Add.*

Cucurbitæ Semina Præparata, Melon Pumpkin Seeds, *Br. Add.*; Semen Peponis, Semina Cucurbitæ: Semences de Potirons ou de Courge, *Fr.*; Kürbissamen, Kürbiskörner, Graumontsamen, *G.*; Calabaza (Semilla), *Sp.*

The *Cucurbita Pepo,* or *common pumpkin,* is a plant almost too well known to need description. The seeds are the part used. These are oval, extended into a blunt point at one end, flattish but somewhat swollen in the middle, with a distinct groove on both sides near the edge from one end to the other, when of full size about 9 lines long by 5 or 6 in breadth where broadest, of a light brownish-white color, and a slightly sweetish, somewhat aromatic odor and taste. They consist of a firm brittle coating and a white oily kernel, composed of a short, conical radicle and two flat cotyledons: "Broadly ovate, flat, somewhat biconvex, about 20 Mm. long and 2 Mm. thick; externally whitish or yellowish-white, nearly smooth, with a shallow groove parallel to, and within 1 Mm. of, the margin; seed-coat consisting of a white coriaceous outer layer, and a membranaceous inner layer; embryo whitish, straight, with a conical hypocotyl and two plano-convex cotyledons; slightly odorous when contused; taste bland and oily." *U. S.* The British Pharmacopœia Addendum describes them as follows: "The seeds, which must not be more than one month old, should have been freshly deprived of their yellowish membranous envelope or testa, and of the inner thin brownish rind or tegmen. Anthelmintic. Contain fixed oil, free fatty acids, an aromatic principle, sugar, starch, and the alkaloid *cucurbitine*." *Br. Add.* They contain a fixed oil, consisting of the glycerides of palmitic, myristic, and oleic acids, with some free fatty acid, an aromatic principle, chlorophyll, sugar, starch, and, according to Dorner and Wolkowich, an alkaloid, *cucurbitine.* Deprived of their coating, and exhausted by ether, they yield 30 per cent. of fixed oil. (*Ann. Thér.*, 1862, p. 176.) The researches of Dorner and Wolkowich have not received confirmation, and their alkaloid probably has no existence. Pumpkin seed oil has a sp. gr. at 15° C. of 0.923, and solidifies at —15° C. The cold drawn oil is used for culinary purposes and the lower qualities for burning. The oil dries very slowly. (Lewkowitsch, *Chem. Analysis of Oils,* etc., 2d ed., 1898, 372.) Sieker obtained 30 per cent. of the oil from the seeds; it was reddish-yellow in color, soluble in ether, benzene, and carbon disulphide, but insoluble in alcohol.[1] (*Proc. A. Ph. A.,* 1897, 545.) J. C. Lyons used an ounce of it with success in a case of tapeworm (*A. J. P.,* 1865, 253), but

[1] *Oil of Pumpkin Seed.*—Willard Graham endeavored to prepare this oil by expression, but failed to obtain appreciable quantities even under a pressure of 3,000 pounds. By extraction with acetone the ground seed yielded 25 per cent. of oil, clear reddish, limpid, and of agreeable odor and taste. Its sp. gr. at 15° C. was 0.9208; saponification number, 192.5; acid number, 18.9; ether number, 173.6; soluble in all proportions of carbon disulphide, ether, chloroform, and in twenty parts of absolute alcohol, and drying on standing to a tough, yellowish, transparent mass. These properties and constants agree well with a commercial specimen, evidently also obtained by extraction. The latter, however, had a lower acid number, 3.5, while the ether number was somewhat higher, 191.7. (*A. J. P.,* 1901, 352.)

Wolff has found it inert when pure and free from resin, which he prepares by extracting the oil from the powdered seeds by means of petroleum benzin, then treating the remaining powder with ether, chloroform, and alcohol, which yields on evaporation a soft greenish-brown resinous liquid resembling the oleoresin of male fern. Heckel was the first to assert that the active principle is a resin, and in this he has been corroborated by L. Wolff (pamphlet, Phila. 1882), who found the resin to be efficient in doses of fifteen grains (1 Gm.), given in pill, followed in two or three hours by castor oil, and who recommends an alcoholic fluidextract as the best preparation of the drug after the resin. W. E. Miller (*A. J. P.*, 1891, 585) analyzed both the shells and the kernels of pumpkin seed. He also found a resin soluble in alcohol, and a dark reddish fixed oil.

Uses.—It is said that in Italy the seeds of the *Cucurbita maxima*, and in the West Indies those of *C. occidentalis*, have been long used in doses of an ounce and a half as tænifuges. In the *Dictionary of Materia Medica* by Mérat and De Lens (ii. 493) it is stated that Hoarau had reported that in the Isle of France the seeds of a small variety of pumpkin were used against the *tapeworm*, and with never-failing success. In the year 1820, Mongeney, a physician of Cuba, published the results of his experience with the flesh of the pumpkin in the same disease. He had discovered the remedy by accident, and found it uniformly successful. He gave to the patient, in the morning, fasting, about three ounces of the fresh pumpkin in the form of a paste, and followed it at the end of an hour by about two ounces of honey, which latter was twice repeated at intervals of an hour. So far as we know, attention was first directed to it in this country by Richard Soule. (*B. M. S. J.*, Oct. 1851.) Since this time the drug has steadily grown in favor, and, properly used, is one of our most efficient and harmless tænifuges. The patient should be allowed only a light supper of bread and milk, in the morning early should take an ounce and a half of the seeds, a cup of tea or coffee an hour later, but no food, at 10 A. M. a brisk cathartic, and two hours later a substantial meal. We have obtained excellent results from the exhibition of the beaten seeds in the form of an electuary strongly flavored with oil of cinnamon or of gaultheria.

Dose, one to two ounces (31 to 62 Gm.).

PEPSINUM. U. S., Br.

PEPSIN

(pĕp-sī′nŭm)

"A proteolytic ferment or enzyme, obtained from the glandular layer of the fresh stomach of the hog (*Sus scrofa*, var. *domesticus* Gray), and proved to be capable, when assayed by the process given below, of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumin. If it is desired to use a diluent for reducing Pepsin of a higher digestive power to that required by the Pharmacopœia, sugar of milk should be employed for this purpose." *U. S.* "An enzyme obtained from the mucous lining of the fresh and healthy stomach of the pig, sheep, or calf. Tested as described in the following paragraph [see p. 921], it should dissolve 2500 times its weight of hard-boiled white of eggs." *Br.*

Pepsine, *Fr. Cod.*; Pepsinum, *P. G.*; Pepsin, *G.*; Pepsina, *It.*; Pepsina medicinal, *Sp.*

The U. S. P. 1890 recognized two pepsins, one under the name "Pepsinum," the other "Pepsinum Saccharatum:" the first, or strong pepsin, should digest at least 3000 times its own weight of freshly coagulated albumin; the other is the first product diluted with enough sugar of milk to make it contain 10 per cent. of the strong pepsin. The U. S. P. (8th Rev.) retained the standard of strength of the previous Pharmacopœia for the strong pepsin but modified the assay process, and dropped Saccharated Pepsin.

The British Pharm. 1885 gave the following process for pepsin; it is that proposed by Beale of London. "The stomach of one of these animals [pig, sheep, or calf] recently killed having been cut open and laid on a board with the inner surface upwards, any adhering portions of food, dirt, or other impurity are to be removed and the exposed surface slightly and rapidly washed with a little cold water; the cleansed mucous membrane is then to be scraped with a blunt knife or other suitable instrument, with some pressure, and the viscid pulp thus obtained is to be immediately spread over the surface of glass or glazed earthenware and quickly dried at a temperature not exceeding 100° F. (37.8° C.). The dried residue is to be reduced to powder and preserved in a stoppered bottle." *Br.*

It is now clearly recognized that pepsin owes its digestive action to the presence of a ferment or enzyme, and, although many researches have been made to obtain the pure principle, the nearest approaches have resulted only in producing pepsin of increased digestive power. Pepsins having much greater digestive capacity than that chosen for the U. S. official standard have been manufactured, and the limit has not at this time (1906) been reached, but for all practical purposes the U. S. P. (8th Rev.) pepsin is sufficiently concentrated, and indeed it is usually diluted for internal administration.

Various attempts have been made to concentrate and bring to a convenient form for administration the peptic principle of the gastric juice. It must not be supposed that the substances prepared with this object and sold under the name of pepsin have any claim to be considered as the pure principle. The one

which for a long time was the best in the market was prepared by Boudault[1] by a process which was afterwards essentially adopted in a former French Codex.

The pepsin of the British Pharmacopœia is "a light yellowish-brown or white powder, or pale yellow translucent grains or scales, having a faint odor and a slightly saline taste free from any trace of putrescence, and liable to absorb moisture from the air. Moderately soluble in *water*, and soluble in about 100 parts of *alcohol* (90 per cent.)." *Br.*

The U. S. Pharmacopœia recognized pepsin for the first time in the revision of 1880, but it had then been for some years largely used by the American profession. Much of the pepsin thus employed was obtained from Europe, and was of very various quality, most of it being heavily loaded with starch, and some of it containing little or no pepsin. Several American brands have, however, been put upon the market which are superior to Boudault's pepsin. Various processes also have been recommended for obtaining pepsin. The most elaborate and valuable investigation of the subject as yet made is that of E. Scheffer (*A. J. P.*, 1872). He found that various salts, such as sodium and magnesium sulphates and sodium chloride, precipitate pepsin, and, acting upon this discovery, he devised the following processes: Mucous membrane of the pig's stomach, dissected off and finely chopped, is macerated in water acidulated with hydrochloric acid for several days, with frequent stirring. The strained liquid, if not clear, is clarified by allowing it to stand for 24 hours and decanting. Sodium chloride is then thoroughly mixed with it. After several hours the floating pepsin is skimmed from the surface and put on a cotton cloth to drain, and finally submitted to strong pressure to get rid of saline solution. This pepsin, when air dried, is very tough, parchment-like or leathery, varying in color from a dim straw-yellow to a brownish yellow. To make his *saccharated pepsin*, Scheffer added sugar of milk until a powder was obtained of which 10 grains dissolved 120 grains of coagulated albumin. After framing his original process, he increased the strength of saccharated pepsin. *Purified pepsin* he made by redissolving the pepsin in acidulated water and precipitating as before, immersing the product when perfectly dry in pure water for a short time. A half-grain of this dissolved 1500 grains of albumin. (*Ibid.*, p. 784.) The chemical relations of pepsin are so delicate and wide spread that it ought to be given by itself, or in combination only with an insoluble substance, or suspended in inert liquids. For an interesting paper by B. T. Fairchild on Animal Digestive Ferments, reader is referred to *A. J. P.*, Feb. and Mar. 1902.

[1] For the process for *Boudault's pepsin*, see U. S. D., 17th ed., 1014.

Since Scheffer's researches were made known, pepsin has been manufactured in the United States in immense quantities, the tendency having been towards strengthening and purifying the product.[2] Many other substances than sugar of milk have been used to mix with pepsin, as egg and blood albumin, fibrin, and substances which are easily converted into peptones. The process for making most commercial pepsins may be briefly stated as follows. The inner membranous linings of hogs' stomachs are washed, passed through a mincing machine, and the resulting mass digested with diluted hydrochloric acid; the solution is strained or filtered and evaporated *in vacuo* or placed on shallow trays, so that a syrupy liquid which has not been subjected to a higher temperature than 112° F. is produced; this is spread upon glass plates to dry, and the scales which are formed scraped off. The thickness of the scales may be varied by using more or

[2] *Pepsin manufacture.*—In 1904 W. H. Jenkins communicated a detailed description of the method of manufacturing pepsin on a large scale. While pepsin can be prepared from the stomachs of other animals, the mucous membrane of the stomachs of hogs is used because most available. After emptying the stomachs they are carefully washed in cold water, avoiding violent, energetic motion, as a great deal of the pepsin contained is liable to be removed and lost. The outside of the stomachs is trimmed away. The pepsin-containing membrane is chopped into small pieces and placed in a 3 or 4 per cent. aqueous solution of hydrochloric acid, the usual receptacle for this digestion being a large, open headed hogshead, in which it is allowed to remain at a temperature of 104° to 122° F., with frequent stirring, until it undergoes self-digestion. This solution or self-digestion requires from 36 to 48 hours, or sometimes longer. At this point of the process the solution is liable to decomposition, hence careful watching is necessary. An antiseptic condition is produced by passing sulphur dioxide into the solution until it smells strongly of the gas; the gas also bleaches the product. The solution is then allowed to stand and clarify itself by the precipitation of the mucus. The putrefactive changes which sometimes take place cause no material injury to the pepsin. After clarification the clear liquid is decanted or siphoned off, and to it is added common salt, a uniform temperature of 94° F. being maintained until the pepsin is separated by precipitation. This precipitate—the floating scum—is collected, pressed and dried. The residual solution contains practically all the "peptones," which may be obtained by allowing the salt to crystallize out and then evaporating the clear solution.

The *crude pepsin* thus obtained has a faint odor, a brownish-yellow color and a slightly saline taste. It is very active, and meets certain requirements of trade. To produce the so called *standard scale pepsin*, the crude pepsin, either dry or in a moist state, is dissolved in weak hydrochloric acid, and this solution subjected to dialysis until the salt has been separated; the purified solution is afterwards concentrated in a vacuum apparatus at a temperature not exceeding 100° or 105° F. The concentrated solution is then spread in thin layers on glass plates, about 15 inches wide and 20 inches long, with the projecting edge one-quarter inch high. These plates are placed on shelves, arranged to hold a number of them, in a drying room, at a temperature of 102° F., and well protected from dust, when the thin layer of solution is dried as rapidly as possible. When thoroughly dry, the product is scraped from the glass plates. So obtained, scale pepsin possesses a digestive power of 3,000. Powdered pepsin is obtained by grinding it in mills, in which it must be carefully protected from humidity on account of its hygroscopic nature. The yield of pepsin varies and depends upon the quality of hog stomachs used. In a test, 1,016 lbs. of membrane ready for digestion yielded 39 lbs. of high grade pepsin, or 2.8 lbs. from 100 stomachs. In another, the yield was only 1.8 lbs. from 100 stomachs.—*M. R.*, 1904, 156. For account of a process by C. R. Marshall, see *Bull. Pharm.*, 1903, 160.

less concentrated solutions, and the proportion of peptone is increased by extending the length of time in the digestion process and raising the temperature to the utmost safe limit. Numerous pepsins of value are upon the market, and they are so readily tested that the practitioner need not be at a loss. (See *Proc. A. Ph. A.*, 1884, 1886, and 1890; *Ph. Rec.*, 1893, 104; *West. Drug.*, 1887, 69; *Am. Drug.*, 1885, 103.)

Properties.—Pepsin is in "lustrous white, pale yellow or yellowish, transparent or translucent scales or grains, or a fine white or cream-colored amorphous powder, free from any offensive odor, and having a slightly acid or saline taste. It should be not more than slightly hygroscopic. Soluble, or almost entirely soluble, in about 50 parts of water, the solution having more or less opalescence; more soluble in water acidulated with hydrochloric acid; insoluble in alcohol, ether, or chloroform. Pepsin, when in solution, is incompatible with alkalies, alkaline earths, or alkali carbonates. The presence of hydrochloric acid of greater strength than 0.5 percent. inhibits and rapidly destroys its proteolytic activity. Its solution is precipitated by the salts of many heavy metals, and by tannic acid or gallic acid. Pepsin and pancreatin in solution are incompatible with one another; if the solution be neutral or alkaline, the pancreatin gradually destroys the Pepsin, and if acid the Pepsin destroys the pancreatin. On heating a solution of Pepsin in acidulated water to 100° C. (212° F.) it becomes milky, or yields a light flocculent precipitate, and loses all proteolytic power; in a dry state it is not injured if subjected to the above temperature. The activity of Pepsin in solution is destroyed by temperatures exceeding 70° C. (158° F.). Pepsin usually has a slightly acid reaction; it may be neutral, but should never be alkaline." *U. S.*

Assay of Pepsin.—"Pepsin, *one-tenth gramme;* Egg Albumin, boiled and disintegrated, *ten grammes;* Diluted Hydrochloric Acid, Distilled Water, each, *a sufficient quantity.* Mix 9 Cc. of diluted hydrochloric acid with 291 Cc. of distilled water, and dissolve the Pepsin in 150 Cc. of the acid liquid. Immerse a hen's egg, which should be fresh, during fifteen minutes in boiling water; remove the pellicle and all of the yolk; rub the white, coagulated albumin through a clean No. 40 sieve. Reject the first portion that passes through the sieve, and place 10 Gm. of the succeeding portion in a wide-mouthed bottle of 100 Cc. capacity. Add 20 Cc. of the acid liquid, and with the aid of a glass rod tipped with cork or black rubber tubing, completely disintegrate the albumin; then rinse the rod with 15 Cc. more of the acid liquid and add 5 Cc. of the solution of Pepsin. Cork the bottle securely, invert it three times, and place it in a water-bath that has previously been regulated to maintain a temperature of 52° C. (125.6° F.). Keep it at this temperature for two and one-half hours, agitating every ten minutes by inverting the bottle once. Then remove it from the water-bath, add 50 Cc. of cold distilled water, transfer the mixture to a narrow graduated cylinder, and allow it to stand for half an hour. The deposit of undissolved albumin should not then measure more than 1 Cc. The relative proteolytic power of Pepsin stronger or weaker than that just described may be determined by ascertaining through repeated trials the quantity of the above Pepsin solution required to digest, under the prescribed conditions, 10 Gm. of boiled and disintegrated egg albumin. Divide 15,000 by this quantity expressed in Cc. to ascertain how many parts of egg albumin one part of the Pepsin will digest." *U. S.*

"If 12.5 grammes of coagulated and firm white of fresh eggs, 125 cubic centimetres of acidulated *water* containing about 0.2 per cent. of hydrogen chloride (HCl), and 0.005 gramme of Pepsin, be digested together at 105° F. (40.5° C.) for six hours, and shaken frequently, the coagulated white of eggs dissolves, leaving only a few small flakes, in an almost clear solution. The 'white of eggs' should be prepared by boiling quite fresh eggs in water for fifteen minutes, then immersing them in cold water, and, as soon as sufficiently cool for handling, separating the whites, washing off any fragments of yolk or membrane with water, removing the water with a clean towel, then at once rubbing the whites through a sieve having twelve meshes to a centimetre, and using the product before it has lost moisture. For the 'acidulated *water*' mix the official Hydrochloric Acid with *water* in the proportion of 1 gramme to 156 cubic centimetres; this will give a solution containing about 0.2 per cent. of hydrogen chloride (HCl)." *Br.*

In estimating the proteolytic power of pepsin by any method it is very important to adhere strictly to each requirement, otherwise great variations may be expected. (*Proc. A. Ph. A.*, 1893, 411, 722; 1894, 221; 1895, 244, 338; 1896, 260, 263; 1897, 745; *Am. Drug.*, 1894, 212; 1895, 101; *D. C.*, 1896, 52; *P. J.*, 1897, 561; *Proc. A. Ph. A.*, 1899, 307; *Ap. Ztg.*, 1900, 485, 512; *D. C.*, March, 1902.)

Three distinct types of pepsin are found in commerce: 1. Pepsins insoluble in water without the addition of traces of acids; 2. Pepsins soluble in water forming transparent solutions; 3. Pepsins not entirely soluble in water or in diluted hydrochloric acid. The objection to the insoluble pepsins is, of course, the inconvenience resulting from their insolubility in water, but, on the other hand, they are not hygroscopic, do not deteriorate so rapidly, and are active in contact with the gastric juice. The objection to the soluble pepsins is that they are hygroscopic, but they are, when good, well suited for making solutions, wines, etc.

Pepsin should always be administered in its original form. The wines and elixirs which flood the market are mostly worthless preparations, although it has been proved that an

effective wine of pepsin can be made, and *small quantities of alcohol* are not incompatible.[1] It is well to combine it with hydrochloric acid, and the powder is often advantageously exhibited in *infantile diarrhœa* along with bismuth subnitrate. With these exceptions, it is usually preferable to give it by itself.[2]

Uses.—Pepsin is said to have been first suggested as a remedy by Corvisart of Paris (*J. P. C.*, xxx. 169), and has been very largely used in cases of various character in which the digestive powers of the stomach have failed, for the purpose of supplying the place of the natural digestive ferment. Any influence for good which it possesses is dependent upon its solvent power, which is a measure of its value. The usual dose of pepsin is from ten to fifteen grains, and it is plain that the solvent power of less than such an amount is too trifling to be of value in sustaining the digestion of an adult. Further, a large portion of the pepsin which has been exhibited has been inert, either originally or from the method of its administration, and in the great majority of cases the good result that has been ascribed to the pepsin has been due, not to it, but to the regulation of the diet and habits of the patient and to the drugs which have been exhibited along with the animal ferment. We believe that its value has been overestimated, that it has been given to adults in ridiculously small doses, and that a drachm (3.9 Gm.) of the ordinary commercial article is a moderate dose.

It has been found much more certain in its effects in the feeble digestion of infants than of adults, due probably to its being administered in proportionately much larger doses. To a babe six months old, suffering from *indigestion* and consequent *diarrhœa*, one grain of pepsin or ten grains of saccharated pepsin may be given after each feeding with a rational expectation of benefit.

Dose, of official pepsin, may be set down as from ten to fifteen grains (0.65 to 1.0 Gm.).

Off. Prep.—Glyceritum Pepsini, *Br.*

PETROLATUM. U. S. (Br.)

PETROLATUM [Petroleum Ointment, Petrolatum Molle, Petrolatum Spissum, Pharm. 1890]

(pĕt-rō-lā'tŭm)

"A mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue." *U. S.* "A semi-solid mixture containing soft members of the paraffin series of hydrocarbons; usually obtained by purifying the less volatile portions of petroleum." *Br.*

Paraffinum Molle, Soft Paraffin, *Br.*; Adeps Petrolei, Unguentum Paraffinum; Soft Petrolatum, Cosmoline, Vaseline, Paraffin Jelly, Soft Petroleum Ointment, Hard Petroleum Ointment, Hard Petrolatum; Pétroléine, *Fr. Cod.*; Graisse minérale, Pétréoline, *Fr.*; Welches Paraffin, Paraffinsalbe, *G.*; Vaselina, *It., Sp.*

Petrolatum in its various forms has of late years acquired considerable importance, under various trade names, as a bland neutral body well fitted to take the place of lard as a base for ointments and for other purposes. It is prepared from the residue left in the stills after a distillation of petroleum *in vacuo*, or from the residue or sediment deposited in tanks containing crude petroleum, of which large quantities have collected in the storage tanks in the oil districts of Western Pennsylvania. The substances known commercially as *cosmoline* (*Unguentum Petrolei*) and *vaseline* are now

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[1] *Liquor Pepsini*, U. S. 1880, *Solution of Pepsin, Liquid Pepsin; Pepsine liquide*, Fr.: *Pepsin-lösung*, G.—"'Saccharated Pepsin, *forty parts* [or four hundred grains]; Hydrochloric Acid, *twelve parts* [or one hundred and ten minims]; Glycerin, *four hundred parts* [or seven fluidounces]; Water, *five hundred and forty-eight parts* [or twelve fluidounces], to make *one thousand parts* [or about twenty fluidounces]. Dissolve the Saccharated Pepsin in the Water, previously mixed with the Hydrochloric Acid, add the Glycerin, let the mixture stand twenty-four hours, and filter.' This preparation originated with Prof. Emil Scheffer, who suggested a process (see *A. J. P.*, 1870, p. 98), in which six pounds of the mucous membrane of hogs' stomachs were macerated with four pounds of glycerin and four pints of water containing six ounces of hydrochloric acid for thirty-six hours. The mass was then strained, and macerated with fresh water and again strained, and the operation repeated until ten pints were obtained. This process was simplified after the publication of his formula for Saccharated Pepsin, official in U. S. 1880, and is based upon his improved process. The solution contains 4 per cent. of Saccharated Pepsin, while Scheffer's original formula (*A. J. P.*, 1871, p. 5) was weaker, containing but 1.6 per cent. This liquid is transparent, either colorless, or having a yellowish color, and a sweetish, agreeable taste, which is slightly aciduous. 'It should not become mouldy, nor acquire a disagreeable, fetid odor, when kept for some time.' *U. S.* 1880. It should be freshly made, as it gradually loses its powers of digestion when long kept. This preparation, if in good condition, undoubtedly has all the remedial virtues of pepsin but is deficient in strength. The *dose* is one-half to two fluidounces (15 to 60 Cc.)." *U. S. D.*, 16th ed.

Pepsinum Saccharatum, U. S. (1890), *Saccharated Pepsin.*—"Pepsin, *ten grammes* [or 154 grains]; Sugar of Milk, recently dried, and in No. 30 powder, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 230 grains]. Triturate the Pepsin with the Sugar of Milk to a fine, uniform powder. Keep the product in well-stoppered bottles." *U. S.* As stated in the article "Pepsinum," this powder is made by diluting strong pepsin with powdered sugar of milk. It is about six times stronger than the saccharated pepsin of the U. S. P. 1880. (See above.) "Saccharated Pepsin, when tested by the process given under Pepsin (see *Pepsinum*), with the modification that 0.67 Gm. of it are to be taken in preparing solution *B*, should digest 300 times its own weight of freshly coagulated and disintegrated egg albumen." *U. S.* 1890.

[2] Gastric juice was many years ago employed by P. S. Physick, the celebrated surgeon of Philadelphia, with considerable success, as a local application to cancers and sloughing ulcers, with the view of removing the dead bone and flesh, correcting the offensive odor, and yielding a healthful stimulus to the diseased surface. It was also used with success, by Ellsworth of Hartford, Connecticut, for dissolving a portion of tough animal food which had become impacted in the œsophagus of a lad affected with stricture of that passage. The gastric juice of a pig was used. (*B. M. S. J.*, April 17, 1856.) The inner coat of the gizzard of the South American ostrich is said, in the state of powder, to be used in Buenos Ayres as a remedy in dyspepsia (E. S. Wayne, *A. J. P.*, March, 1868, p. 123), and the dried crops and gizzards of chickens and turkeys have long been used in some portions of this country as a domestic remedy. For an account of *Rennet*, see PART II.

made on a large scale from residues, but more largely from what are termed "reduced oils," that is, crude oils from which the lighter fractions (those included under the heads of petroleum benzin, naphtha, illuminating and paraffin oils) have been removed by distillation. This process of reducing would leave an increasing amount of black pyrogenous products in the residue, were it not that the reducing is carried out under diminished pressure, by what is termed the "vacuum process," in which, moreover, the heat is not applied directly to the still bottoms, but by means of coils of pipe, through which superheated steam is made to pass. These reduced oils can be brought to 337.7° C. (640° F.) fire-test without acquiring the slightest pyrogenous odor. They are then filtered through well-dried bone black, in chambers kept at a temperature of from 43.3° to 54.4° C. (110° to 130° F.), or in some cases higher. The first portions of the filtrate are colorless, and then pass from a light straw or amber color to a color red by transmitted light and light green by reflected light. The latter product is known as "cylinder stock," and is highly prized as a lubricating oil. The clearer portion of the filtrate is then brought to the proper melting point, if necessary, by the addition of pure block paraffin, which dissolves perfectly in the warm liquid oil. The crude oil tank residues are purified in a similar manner. The "B. S. Oil," or "rod wax," as it is technically termed, is placed in a still, heat applied, and after the lighter products have distilled over, and indications of congelation are noticed when a portion of the distillate is allowed to cool, the heat is withdrawn, and the contents of the still, after having cooled, are transferred gradually to a percolator which contains recently heated animal charcoal. In place of bone black, clay has in recent years been quite largely used for clarifying purposes, the same being revivified by heat. A somewhat different process is used in Germany; the crude product is derived from crude *ozokerite,* obtained from Alsace and Galicia, or American residue is sometimes used. 1. The oil is heated by steam to about 30° C. (86° F), mixed, at this temperature, with 10 per cent. of its weight of sulphuric acid of 60° B., stirred for half an hour, and then allowed to stand at rest, so that the carbonized portions may separate. 2. When clear, the oil is washed with an aqueous solution of potassium dichromate, whereby any remaining excess of sulphuric acid is at the same time removed. 3. The residue from the acid treatment is mixed with lime, neutralized, and disposed of to fertilizer factories. 4. The clear oil from the second step of the process, after being washed, is heated by steam to 80° C. (176° F.), mixed with 10 per cent. of its weight of granular animal charcoal, and then allowed to stand at rest, to permit the animal charcoal to settle. 5. After the latter is separated, the liquid portion is filtered through filters heated by steam. 6. The residuary magma of animal charcoal is subjected to hydraulic pressure, the expressed oil filtered, and the solid residue again used in the next operation, a sufficient quantity of fresh animal charcoal being added to make up for any loss or waste. (*Ph. Centralh.,* 1881, No. 42; *N. R.,* Feb. 1882.)

The commercial varieties of petrolatum may be classed under two heads: 1. Those which, like the American vaseline, are obtained as a ready formed mixture of hydrocarbons of gelatinous consistence; 2. Those made by directly mixing solid paraffin of low melting point with heavy lubricating oil, such as are known in Germany as "artificial vaseline." The latter varieties are less homogeneous, and are liable to deposit granules of paraffin on keeping, and hence are not so suited for the preparation of ointments as true American petrolatum.

In warm ether, American petrolatum dissolves freely to a clear solution exhibiting a strong blue fluorescence, and the liquid remains clear, or at most becomes only slightly turbid, on cooling. German petrolatum, on the contrary, is said to form a thick solution with warm ether, and to give a considerable deposit on cooling. Russian petrolatum is stated to dissolve completely in warm ether and give a clear solution which becomes turbid on cooling. (Allen, *Com. Org. Anal.,* 2d ed., 1887, ii. p. 408.) In the U. S. P. (8th Rev.) there are three forms of Petrolatum as follows: Petrolatum, Petrolatum Album, and Petrolatum Liquidum. In the British Pharmacopœia there are three as follows: Paraffinum Liquidum, Paraffinum Molle, and Unguentum Paraffini. The Petrolatum of the U. S. P. (8th Rev.) corresponds with the Petrolatum Spissum of the U. S. Pharm. 1890. The Paraffinum Molle of the British Pharmacopœia resembles the Petrolatum Molle of the U. S. P. 1890, but is somewhat softer in consistence.

Chemical Constitution.—Petrolatum, as made from American petroleum, consists mainly of the higher members of the paraffin series, but undoubtedly contains also the higher olefines. These may possibly alter in time, and give rise to rancidity, although this is not certainly established. The paraffins, which make up the bulk of it, are not capable of direct oxidation, and are therefore not affected by atmospheric influences. Petrolatum contains hydrocarbons of the paraffin series, like $C_{16}H_{34}$, $C_{17}H_{36}$, $C_{18}H_{38}$, etc., up probably to $C_{32}H_{66}$, together with hydrocarbons of the olefine series, $C_{16}H_{32}$, $C_{17}H_{34}$, etc. These latter are less concrete than the corresponding paraffin hydrocarbons, and give petrolatum its oleaginous characters.

Properties.—The U. S. Pharmacopœia describes Petrolatum as follows: "An unctuous mass, of about the consistence of an ointment, varying in color from yellowish to light amber, having not more than a slight fluorescence, even after being melted, transparent in thin layers,

completely amorphous; without odor or taste, but giving off, when heated, a faint petroleum-like odor. If a portion of Petrolatum be liquefied and brought to a temperature of 60° C. (140° F.), it should have a specific gravity of from 0.820 to 0.850. Petrolatum is insoluble in water; scarcely soluble in cold or hot alcohol, or in cold, absolute alcohol, but soluble in boiling absolute alcohol, and readily soluble in ether, chloroform, carbon disulphide, oil of turpentine, petroleum benzin, benzene, and fixed or volatile oils. The melting point of Petrolatum ranges between 45° and 48° C. (113° and 118.4° F.). If heated on platinum foil to a still higher temperature, Petrolatum should be completely volatilized without emitting any acrid odor. If melted Petrolatum be well shaken with water the latter should not redden blue litmus paper. If 10 Gm. of Petrolatum be digested at 100° C. (212° F.) for half an hour with 10 Gm. of sodium hydroxide and 50 Cc. of water, the aqueous layer separated and supersaturated with sulphuric acid, no oily or solid substance should separate (absence of *fixed oils* or *fats* of *animal* or *vegetable origin* and of *rosin*). If 2 volumes of concentrated sulphuric acid be added to 1 volume of melted Petrolatum in a test-tube placed in hot water, and the contents occasionally agitated during fifteen minutes, the acid should not acquire a deeper tint than brown nor lose its transparency (limit of *readily carbonizable organic impurities*)." *U. S.* The British Pharmacopœia describes it as "white or yellow, translucent, soft, unctuous to the touch, free from acidity, alkalinity, or any unpleasant odor or flavor, even when warmed to 120° F. (48.9° C.). Specific gravity at the melting point 0.840 to 0.870. Melts at 96° to 102° F. (35.5° to 38.9° C.) or even somewhat higher, volatilizes without giving off acrid vapors, and burns with a bright flame, leaving no residue. Insoluble in *water*, slightly soluble in *absolute alcohol*, freely soluble in *ether, chloroform*, and *benzol*. After treating with boiling *solution of sodium hydroxide* the aqueous liquid yields no precipitate or oily matter on adding excess of acid (absence of fixed oils, fats, and resin)." *Br.* As it is found in the market, petrolatum varies in color, odor, and melting point. The statement frequently made by the manufacturers that it is unalterable in the air is incorrect, as we have frequently noticed that exposure to light and air causes it to assume a disagreeable odor resembling that of crude petroleum. It has been observed to have at times irritating properties. These may be due to imperfect removal of the sulphuric acid or similar agents used, but are more probably caused by rancidity or decomposition of the higher olefines.

Uses.—Petrolatum is used exclusively as a bland neutral protective dressing, and as a substitute for fatty materials in ointments. M. M. Griffith (*N. R.*, May, 1880) asserts that the crude semi-solid petroleum (*rod wax*), as it accumulates on the casings, etc., about oil wells, is an invaluable remedy in *chronic bronchitis* and *incipient phthisis*. It is readily formed into three-grain pills, and may be given until it produces eructations. He has used the following formula with advantage: Petroleum mass, 480 gr.; Pulv. Cubebæ, Pulv. Doveri, āā 360 gr., to make pill mass (pills 5 gr.). *Huile de Gabian* is a similar product, which has long been famous in France as a remedy in lung diseases. N. Randolph has shown that when taken internally, in doses of from one to four drachms (3.9 to 15.5 Gm.), cosmoline acts simply as a feeble laxative and soothes irritation, so as to be advantageous in inflammations of the gastro-intestinal mucous membrane.

Off. Prep.—Emplastrum Adhæsivum, *U. S.;* Unguentum Creosoti, *Br.;* Unguentum Eucalypti, *Br.;* Unguentum Hydrargyri Dilutum, *U. S.;* Unguentum Hydrargyri Nitratis Dilutum, *Br.;* Unguentum Hydrargyri Oxidi Flavi, *U. S., Br.;* Unguentum Hydrargyri Oxidi Rubri, *U. S.;* Unguentum Zinci Oleatis, *Br.;* Unguentum Paraffini, *Br.*

PETROLATUM ALBUM. U. S.

WHITE PETROLATUM

(pĕt-rọ-lā'tŭm ăl'bŭm)

"A colorless mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue." *U. S.*

Preparation.—White petrolatum was introduced for the first time into the U. S. P. (8th Rev.) under its present official title; there are reasons for believing that much that is in the market is not the natural product deprived of its color by treatment with animal charcoal, but an artificial compound made by melting together paraffin wax and liquid petrolatum, and stirring until cold.

Properties.—It is officially described as "a white unctuous mass, of about the consistence of an ointment, transparent in thin layers, completely amorphous; without odor or taste. In other respects White Petrolatum has the characteristics of, and should respond to the tests given under, *Petrolatum*." *U. S.*

Uses.—See *Petrolatum*.

Off. Prep.—Ceratum, *U. S.;* Ceratum Camphoræ, *U. S.;* Ceratum Plumbi Subacetatis, *U. S.;* Unguentum Acidi Borici, *U. S.;* Unguentum Hydrargyri Ammoniati, *U. S.;* Unguentum Phenolis, *U. S.;* Unguentum Zinci Stearatis, *U. S.*

PETROLATUM LIQUIDUM. U. S. (Br.)

LIQUID PETROLATUM

(pĕt-rọ-lā'tŭm lĭq'uị-dŭm)

"A mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off most

of the lighter and more volatile portions from petroleum, and purifying the liquid residue." *U. S.* "A clear oily liquid, obtained from petroleum, after the more volatile portions have been removed by distillation." *Br.*

Paraffinum Liquidum, *Br.*, Liquid Paraffin; Paraffine liquide, Huile de Paraffine, *Fr.;* Flüssiges Paraffin, Paraffinöl, *G.;* Aceite de parafina, *Sp.*

Preparation.—Liquid petrolatum is made by distilling the residuary liquid boiling between 330° and 390° C., obtained after removing the lighter hydrocarbons from petroleum. It is purified and decolorized by first treating it with sulphuric acid and then with caustic soda and passing it while hot, though animal charcoal. By cooling, some solid paraffins will separate; the liquid is then redistilled, and the portion boiling below 360° C. rejected. It has been sold under various proprietary names as *albolene, glycoline,* etc., and since its introduction into the U. S. P. 1890 has been largely used in medicine and for pharmaceutical purposes.

Properties.—It is described officially as "a colorless, or very slightly yellowish, oily, transparent liquid, without odor or taste, but giving off, when heated, a faint odor of petroleum. Specific gravity: about 0.870 to 0.940 at 25° C. (77° F.). It is insoluble in water; scarcely soluble in cold or hot alcohol, or in cold absolute alcohol, but soluble in boiling absolute alcohol, and readily soluble in ether, chloroform, carbon disulphide, oil of turpentine, petroleum benzin, benzene, and fixed or volatile oils. When heated on platinum foil, Liquid Petrolatum is completely volatilized without emitting acrid vapors. If a test-tube be half filled with Liquid Petrolatum and a piece of moistened blue litmus paper be introduced, upon shaking the liquid vigorously the paper should not be reddened (absence of *acid impurities*). In other respects Liquid Petrolatum has the characteristics of, and should respond to the tests given under, *Petrolatum.*" *U. S.* The British Pharmacopœia describes it as "colorless, odorless, tasteless, not fluorescent. Boiling point not below 680° F. (360° C.). Specific gravity from 0.885 to 0.890. 3 cubic centimetres, heated with an equal volume of *sulphuric acid* in a test-tube placed in boiling water for 10 minutes, with frequent agitation, should not color the separated layer of acid of a deeper tint than pale brown. *Alcohol* (90 per cent.) boiled with Liquid Paraffin should not redden *blue litmus paper* (absence of acid). A mixture of 4 cubic centimetres with 2 of *absolute alcohol,* and 2 drops of a clear saturated solution of Lead Oxide in *solution of sodium hydroxide,* should remain colorless when kept at 158° F. (70° C.) for 10 minutes (absence of sulphur compounds)." *Br.*

Uses.—Liquid petrolatum is much used as a soothing local application in inflammation of the mucous membrane in the nose, throat, larynx, and even bronchial tubes. It is usually applied by means of an atomizer, and can be made the vehicle for carrying medicinal substances. It has also been used internally, preferably in the form of emulsion.[1]

Off. Prep.—Ceratum Cantharidis, *U. S.*

PHENOL. U. S. (Br.)

PHENOL [Carbolic Acid, Acidum Carbolicum, Pharm. 1890]

(phē'nōl)

$C_6H_5OH = 93.34$

"Hydroxybenzene, obtained either from coal-tar by fractional distillation and subsequent purification, or made synthetically. It should contain, when assayed by the process given below, not less than 96 percent. of absolute Phenol. It should be kept in dark amber-colored, well-stoppered bottles." *U. S.* "Phenol, C_6H_5OH, commonly termed carbolic acid, is obtained from coal-tar oil by fractional distillation." *Br.*

Acidum Carbolicum, *Br.*, also *U. S.* 1890; Acidum Phenicum s. Phenylicum Crystallisatum; Phenic Acid, Phenylic Acid, Phenylic Alcohol, Phenic Alcohol, Benzophenol; Phénol, Acide carbolique, Acide Phénique, *Fr. Cod.;* Hydrate de Phényle, *Fr.;* Acidum carbolicum, *P. G.;* Karbolsaure, Phenylsaure, Phenylalkohol, *G.;* Fenolo cristallizzato, Acido carbolico, *It.;* Acido fenico, *Sp.*

This important medicine was discovered in 1834, in the tar of coal, by Runge, who gave it the name of carbolic acid. When on the subject of its composition, we shall have occasion to show that, although more closely related chemically with the alcohols than the acids, it belongs to a peculiar class known in common as *phenols.* The U. S. P. (8th Rev.) dropped the names Acidum Carbolicum and carbolic acid and adopted the correct title of Phenol for this substance. The British Pharmacopœia recognizes the name Acidum Carbolicum, but uses "phenol" as the English name for this substance.

Preparation.—For the commercial preparation of phenol the light oil fraction is collected until a sample of the oil that runs from the still sinks in water. This fraction, with a sp. gr. of from 0.94 to 0.99, boils between 90° and 250° C. and contains from 4 to 10 per cent. of acids, and therefore nearly all the true phenol which boils at 182° C. The oil from which the phenol is to be extracted is agitated with a weak solution of sodium hydroxide, 10 per cent.

[1] *Emulsions of Liquid Petrolatum.*—E. Fullerton Cook proposed the following formulas:

Emulsion of Liquid Petrolatum is made by mixing 4 fl. oz. of liquid petrolatum with 2 oz. of powdered acacia in a dry mortar, adding 4 fl. oz. of water all at once, and triturating until a perfect emulsion results; then add 32 minims of oil of wintergreen and enough water to make 1 pint.

Emulsion of Liquid Petrolatum with Hypophosphites is made in the same way initially, but dissolving in 6 fluidounces of the water to be finally added, 330 grains of calcium hypophosphite and 110 grains each of potassium and sodium hypophosphite. Both formulas have proven satisfactory. The vegetable oil, supposed by some to be necessary, is not necessary or advantageous. (*A. J. P.*, 1903, 260–264.)

strength being strong enough. If a stronger solution is used many impurities, like naphthalene, are dissolved and contaminate the finished product. After agitation, the mixture, on standing, separates into two layers, the upper consisting of the extracted oil and the lower the solution of sodium phenolate. To this solution, after separation from the oily layer, an amount of hydrochloric or diluted sulphuric acid calculated from a special test with a small portion, as just sufficient, is then added in order to set the phenol free. It separates as an oily layer upon the surface, and, after being washed with a saturated solution of sodium chloride, is dried over calcium chloride and again distilled. The product thus obtained crystallizes out largely on a cooled surface, and, after removing the crystals from adhering liquid, and drying them by pressure, they are again submitted to the same process of distillation. Only by such a detailed procedure can phenol be separated from its homologues, like cresol (cresylic acid), $C_6H_4(CH_3)OH$, which accompany it, smell much like it, and boil between 185° C. (365° F.) and 200° C. (392° F.).

Church (*Chem. News*, Oct. 13, 1871) proposed to prepare *pure* phenol by agitating the best commercial product with 20 parts of water, siphoning off the clear solution from the undissolved portion which retains the impurities, and adding to the solution pure sodium chloride to saturation, when the purified phenol rises to the top, and may afterwards be dehydrated by distillation with lime.

Within recent years German manufacturers have put upon the market "*synthetical phenol*," for which is claimed a greater purity than that extracted from coal tar. It may be made synthetically in one of two ways,—either from benzene, which is converted into *benzene-sulphonic acid*, the sodium salt of which is then fused with an excess of sodium hydroxide, producing sodium phenolate and sodium sulphite, from which, on the addition of sulphuric or hydrochloric acid, the phenol separates and may be distilled off; or a pure aniline oil is taken, neutralized with sulphuric acid, and to the acid solution sodium nitrite is added. The nitrous acid liberated forms at first *diazobenzene sulphate*, but this at once decomposes into phenol, sulphuric acid, and nitrogen, the reactions being as follows:

$$(C_6H_5NH_2)_2H_2SO_4 + 2HNO_2 = (C_6H_5N{=}N)_2SO_4 + 4H_2O$$

$$(C_6H_5N{=}N)_2SO_4 + 2H_2O = 2C_6H_5OH + H_2SO_4 + 4N$$

The synthetic phenol melts at 41° to 42° C., and boils at 178° C. (352.4° F.). It is as yet considerably dearer than the coal tar product.

Commercial Forms.—In one of his publications in reference to phenol, F. Crace Calvert, to whom probably more than to any other person is due the introduction of this substance into use in Great Britain and the United States, informed us that the phenol obtained by Laurent, melting at 34° C. (93° F.), and boiling at 186° C. (367° F.), was not quite pure. By successive steps of improvement in the process employed by the manufacturing house of Manchester with which he was connected, they had at length succeeded in preparing the pure crystallized acid, without color or sulphurous odor, but, unfortunately, this statement was not accompanied with an account of the means by which the end had been attained. As the products of this factory are those now generally used, a brief notice, derived from the same source, of the forms of the drug prepared by them, and now circulating in the market, is desirable. 1. A pure phenol is prepared, crystallizing in white prismatic crystals, but, as usually sold, in a white, hard, fused mass, which differs from Laurent's in being soluble in 20 parts of water instead of 33 parts, fusible at 41° C. (106° F.) instead of 34° C. (93° F.), and boiling at 182° C. (359° F.) instead of 186° C. (367° F.). This should be preferred for internal use. 2. The second form is less pure. Like Laurent's, it is white, solid, and fusible at 34° C. (93° F.), and may be employed for external purposes, whether in medicine or surgery. 3. A third quality is known in commerce as solution No. 4, which is not crystallizable at ordinary temperatures, and contains at least 10 per cent. of water, with varying quantities of homologous acids. 4. The fourth and cheapest form is that of a nearly colorless liquid, which is a mixture of phenols and cresols. Diluted with 100 parts of water or more, it may be used for the coarser antiseptic and disinfecting purposes out of doors, as in cess-pools and sewers. Besides these forms of phenol, which issue from the manufacturing establishment of Calvert, there are others from different sources, generally in the liquid state, which are usually of a brownish color, and consist of mixtures of phenol with cresol, coloring matter, etc., and of which phenol often constitutes but a small proportion. These are often imported from Germany. They should not be used internally; but for disinfectant and antiseptic purposes they are probably equal to solutions of the pure phenol, as the cresol is said to be quite as powerfully disinfectant as the phenol, if not more so. Phenol of excellent quality is now made in the United States.

These impure liquors are sold sometimes under the improper name of *coal tar creosote*. They were formerly recognized in the U. S. Pharmacopœia (Acidum Carbolicum Crudum [1]

[1] *Acidum Carbolicum Crudum, Crude Carbolic Acid*, U. S. 1890, was officially described as "a nearly colorless, or reddish, or brownish-red liquid, of a strongly empyreumatic and creosote-like odor; having a benumbing, blanching, and caustic effect upon the skin or mucous membrane; and gradually turning darker on exposure to air and light. The aqueous solution of Crude Carbolic Acid has a slightly acid reaction on litmus paper. In an aqueous solution of the Acid, bromine water produces a white precipitate. Crude Carbolic Acid should not be soluble in less than 15 parts of water at 15° C. (59° F.), and the aqueous solution should not have an alkaline reac-

U. S. 1890), but are now introduced in a purified form and called *Cresol* in the U. S. P. (8th Rev.).

Properties.—Phenol, in its pure state, is a solid at ordinary temperatures, crystallizing in minute plates or long rhomboidal needles, white or colorless, of a peculiar odor recalling that of creosote, and an acrid burning taste. Its sp. gr. is 1.065. (Lemaire.) It is likely to be colored pinkish or brown under the influence of light and air. This reddening has been ascribed to various causes, such as ammonia and ammonium nitrite in the air, rust spots in tinned iron vessels, alkali in glass vessels, organic matter, etc. It is said to be due to oxidation; stannous chloride solution acquires a green color when shaken with the red colored phenol. Demant recommends the removal of the red color by adding to 89 parts of the melted substance 11 parts of alcohol, subjecting the mixture to freezing, and then draining off the portion remaining liquid. Perfectly white crystals can be thus obtained. A slight discoloration does not interfere with any of the medicinal uses of phenol. It deliquesces on exposure, and becomes liquid, and the presence of water in the smallest proportion causes it to liquefy. It is customary to add 10 per cent. of water or glycerin to phenol for dispensing, as it is more convenient to use in a liquid form. Such a form is now official (see *Phenol Liquefactum*). Its solution in glycerin is very useful, as the glycerite mixes with water very readily. (See *Glyceritum Phenolis.*) When diluted it has a sweetish taste with a slightly burning after-taste, and a faintly acid reaction. When quite pure it melts at 41° C. (106° F.), forming an oily looking, colorless liquid, and boils at 182° C. (359° F.) (Calvert); but, as often met with, its point of fusion is lower, and that of volatilization higher, than those named. The official tests and requirements are as follows: "Colorless, interlaced, or separate needle-shaped crystals, or a white, crystalline mass, sometimes acquiring a reddish tint; having a characteristic, somewhat aromatic odor; when copiously diluted with water, it has a sweetish taste, with a slightly burning after-taste, and, when undiluted, cauterizes and whitens the skin and mucous membrane. Soluble in 19.6 parts of water at 25° C. (77° F.), the solubility varying according to the degree of hydration of the Phenol; very soluble in alcohol, ether, chloroform, benzene, carbon disulphide, glycerin, fixed and volatile oils; almost insoluble in petroleum benzin. When gently heated, Phenol melts, forming a highly refractive liquid. It is also liquefied by the addition of about 8 percent. of water. If the Phenol be liquefied by a gentle heat, and then slowly cooled under constant stirring, until it is partly recrystallized, the semi-liquid mass should have a temperature (remaining stationary for a short time) not lower than 40° C. (104° F.). Phenol should have a boiling point not higher than 188° C. (370.4° F.). A lower boiling point or a higher melting point, indicates a less hydrated Phenol. When heated upon a water-bath, it should be volatilized without leaving a residue. The vapor is inflammable. Phenol is faintly acid to blue litmus paper." *U. S.* The Br. Ph. gives its melting point at not lower than 102° F. (38.8° C.), and its boiling point not higher than 359.6° F. (182° C.) Specific gravity at the melting point from 1.060 to 1.066. "Freely soluble in *alcohol* (90 per cent.), *ether, benzol, chloroform, carbon bisulphide, glycerin,* in the fixed and volatile oils, and in solutions of alkalies. Exposed to moist air it may acquire a pinkish tinge. At 60° F. (15.5° C.), 100 parts of Phenol should be liquefied by the addition of 10 parts of *water,* should form a clear liquid with 30 to 40 of *water,* and should be completely dissolved by 1200 of *water.* The aqueous solution should be clear and colorless." *Br.* Its solubility in water increases on heating the water; at 84° C. (183.2° F.) both liquids are miscible in all proportions. Its solution is, if pure, colorless, and remains so, but, if impure, is colored brownish by exposure. It is but slightly soluble in cold petroleum benzin, but dissolves largely on heating. *Sodium sulphoricinate* has been used to increase the solubility of phenol, the advantage being that it will retain 40 per cent. of phenol in solution without destroying its antiseptic power, making a solution without causticity.

"Its aqueous solution yields, with bromine water, a white precipitate of tribromphenol, which at first redissolves, but becomes permanent as more of the reagent is added, and appears crystalline when viewed under the microscope. On adding to 10 Cc. of an aqueous solution of Phenol (1 in 100) 1 drop of ferric chloride T.S., the liquid acquires a violet-blue color, which is permanent. One volume of cold, liquefied Phenol (rendered liquid by the addition of 8 percent. of water) forms, with 1 volume of glycerin, a clear liquid which is not rendered turbid by the addition of 3 volumes of water (absence of *creosote* and of *cresol*)." *U. S.* "Phenol does not immediately redden *blue litmus* paper. It does not rotate the plane of a ray of polarized light. It coagulates *solution of albumen* and *collodion,* and liquefies Camphor. *Test-solution of ferric chloride* strikes a deep purple color, and excess of *solution of bromine* gives a white precipitate, with a cold aqueous solution of Phenol. An aqueous solution of Phenol mixed with one-fourth of its volume of *solution of ammonia,* and then with a few drops of *solution of chlorinated soda,* becomes blue after a time or immediately on gently heating.

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tion (absence of *alkalies*). If 50 volumes of the Acid be thoroughly agitated with 950 volumes of water, in a capacious vessel, on allowing the mixture to separate, the undissolved portion should not exceed 5 volumes, or 10 per cent. by volume of the acid (limit of other *less soluble constituents of coal-tar*)." *U. S.* 1890. (See *Cresol.*)

One volume of Phenol, liquefied by the addition of 10 per cent. of *water*, forms with 1 volume of *glycerin* a clear liquid which is not rendered turbid by the addition of 3 volumes of *water* (absence of cresol)." *Br.*

The U. S. Pharmacopœia (8th Rev.) gives a method of assaying phenol as follows:

Assay.—" Dissolve 1.556 Gm. of the Phenol to be valued in a sufficient quantity of water to make 1000 Cc. Transfer 25 Cc. of this solution (containing 0.0389 Gm. of Phenol) to a glass-stoppered bottle having a capacity of about 200 Cc., add 30 Cc. of tenth-normal bromine V.S., then 5 Cc. of hydrochloric acid, and immediately insert the stopper. Shake the bottle repeatedly during half an hour, then remove the stopper just sufficiently to introduce quickly 5 Cc. of an aqueous solution of potassium iodide (1 in 5), being careful that no bromine vapor escapes, and immediately stopper the bottle. Shake the latter thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water, so that the washings may flow into the bottle, and then add 1 Cc. of chloroform and shake well. Add, from a burette, tenth-normal sodium thiosulphate V.S., until the iodine tint is exactly discharged, and does not reappear after thorough agitation. Note the number of Cc. of tenth-normal sodium thiosulphate V.S. consumed (which should not exceed 6 Cc.). The percentage of absolute Phenol is found by subtracting the number of Cc. of tenth-normal sodium thiosulphate V.S. used, from 30 (the number of Cc. of bromine V.S. originally added), and multiplying the remainder by 4." *U. S.* For methods of assaying Phenol see *Y. B. P.*, 1891, 190; *Chem. News*, 1891, 74; *J. P. C.*, 1894, 105; *A. J. P.*, 1892, 614; *Ph. Centralh.*, 1892, 479; *D. C.*, 1896, 158; *A. J. P.*, 1898, 369.

Though nearly neutral to test paper, it combines feebly with some bases, its salts being decomposed by carbon dioxide, and those with the alkalies having an alkaline reaction. The potassium phenolate is said to be decomposed even by water. Nitric acid converts it into picric acid, for the manufacture of which it is largely used. It reduces many metallic salts, especially those of silver and copper, and coagulates collodion. Bromine water, added in excess to a weak solution, produces a flocculent white precipitate. This precipitate, which consists of tribromophenol, $C_6H_2Br_3.OH$, with some tribrom-phenol-bromide, $C_6H_2Br_3.OBr$, is so insoluble that it separates even in the most dilute solutions, and affords an extremely delicate test. In 24 hours a solution containing but 1-60,000th of phenol gives the reaction. (Allen, *Com. Org. Anal.*, 2d. ed., vol. ii. p. 540.) If an aqueous solution of phenol be gently warmed with ammonia and solution of sodium hypochlorite (avoiding excess), a deep blue color is obtained, which is lasting, but turns to red on the addition of acids. Solutions containing 1 part of phenol in 5000 parts of water react well when 20 Cc. are employed. Much smaller quantities give the reaction after a time. (*Ibid.*, p. 539.) Ferric chloride (avoiding excess) gives a fine violet color, by which 1 part of phenol in 3000 parts of water can be detected. The presence even of neutral salts often interferes with this reaction.

The substances with which phenol is most likely to be confounded are cresol or cresylic acid and creosote, the former, like it, extracted from coal tar, the latter from wood tar exclusively. As cresol is incapable of crystallizing at ordinary temperatures, the two cannot be confounded in the solid state, and, as before observed, its presence in the liquid state is of little consequence, as its virtues are of the same kind, and at least equal. Its boiling point, however, is considerably higher than that of phenol, being about 400° F., and it may, therefore, be supposed to be present in any suspected liquid which will not crystallize at any common temperature, or boil under 202° C. (395° F.) to 204° C. (400° F.). It is also distinguished by being less soluble in water, ammonia water, glycerin, and solution of sodium hydroxide than is the case with phenol, but it is more soluble in petroleum benzin. (Allen.) (*A. J. P.*, Jan. 1879.) Creosote is distinguished by its lower density, its liquid form, and its higher boiling point; by its insolubility in strong ammonia water, or in 6 per cent. sodium hydroxide solution, as well as its insolubility in pure glycerin (see *Creosotum*); by not coagulating collodion and albumin; and by the different effects on it of strong nitric acid, which with phenol produces pure picric or trinitrophenic acid, and with creosote, oxalic acid, resinous matter, and but a small proportion of picric acid. (Calvert, *L. L.*, 1863, p. 523.) Phenol differs also in having no effect on polarized light.

The commercial phenol powders and liquids all contain not only cresol, but also nearly inactive and valueless neutral tar oils, and it is important to be able to determine the percentage of the *tar acids* and that of simple *tar oils* in a commercial sample. John Muter (*A. J. P.*, Nov. 1887, p. 581) has worked out a simple method for this, based upon the following four observed facts; 1. Phenol, cresol, and their homologues are completely soluble when shaken up with a 5 per cent. solution of sodium hydroxide; 2. Liquefied phenol and the corresponding cresol are insoluble in a saturated solution of sodium chloride; 3. In the presence of a sufficient excess of alkali even a largely diluted solution may be boiled down without the slightest appreciable loss of phenol or cresol; 4. Tar oils and naphthalene are only very slightly dissolved by alkali, and may be perfectly removed from the solution by agitating it with benzene.

E. W. Davy proposes, as a test for phenol, sulpho-molybdic acid, made by dissolving 1 part of molybdic acid in 10 or even 100 parts

of pure concentrated sulphuric acid; 3 or 4 drops of this solution are added to the phenol placed on white porcelain; a beautiful blue coloration will be produced upon standing, particularly if the liquid be gently heated; if this reagent is applied to wood creosote in aqueous solution, a brownish-red color is produced. Phenol in creosote may be detected by distilling an aqueous solution of the mixture; the first portion of the distillate will give the reaction for creosote, the last portion that for phenol. (*P. J.*, June 22, 1878.)

Composition.—The view of the composition of phenol now universally accepted is that it is the hydroxyl (OH) derivative of benzene, C_6H_6, and its formula would therefore be $C_6H_5.OH$. This would ally it to the alcohols, and it may be compared, in fact, to what are known as *tertiary* alcohols. The *primary* alcohols, like ethyl alcohol, C_2H_5OH, yield corresponding aldehydes and acids on oxidation. The counterpart of these in the aromatic series are the aromatic alcohols, like $C_6H_5.CH_2OH$, which yield benzoic acid, C_6H_5COOH, on oxidation. The name *phenols* has therefore been given to these derivatives in which H of the benzene group is replaced by OH. Phenol is commonly called *carbolic acid*, but its claims to be considered as an acid are very feeble, as, though it combines with salifiable bases, it is incapable of neutralizing the alkalies, does not affect the color of litmus, and may be separated from its combinations with great facility, sometimes, it is asserted, even by water. Shaken in the liquid form with one-fourth of water, and cooled at 40° F., it crystallizes in the form of a hydrate, $C_6H_5.OH + H_2O$, which fuses at 17° C. (62.6° F.).

Uses.—Phenol, in the liquid form, is locally, powerfully irritant and anæsthetic, and, applied undiluted to the skin, causes a sharp pain followed by numbness, and accompanied with a whiteness of the surface, due to the coagulation of albumin. In contact with mucous surfaces it acts in the same way, and if continued long enough may produce a superficial caustic effect. When applied externally or taken internally with sufficient freedom it is a most fatal, rapidly acting poison. The symptoms are usually developed very rapidly; indeed, death has occurred in two or three minutes, the patient dying in immediate coma and collapse. After small amounts the symptoms, which may be delayed for several minutes, are nausea, cold sweats, marked pallor of the skin, stupor rapidly deepening into complete insensibility, a feeble pulse, which is usually rapid, but has been in some cases much slower than normal, and great disturbance of the breathing. The respirations are usually hurried and shallow, often very irregular, sometimes paroxysmally arrested. There is usually paralysis both of sensation and motion, but in some cases violent epileptiform convulsions have occurred. An almost diagnostic symptom is a blackish coloration of the urine. In severe poisoning the latter fluid is likely to contain both albumin and tube casts. Half an ounce of phenol has caused death, and recovery has been known after one and a half ounces have been taken. When phenol is employed externally the symptoms develop slowly; the dark discoloration of the urine is especially marked, and its presence should be the signal for disuse of the remedy. Death is generally due to paralysis of the respiratory centres, although the heart is powerfully depressed and death may happen by syncope; indeed, phenol is an overpowering, paralyzing poison to all higher tissues. The lesions found after death have been whitish or blackish corrugated spots on the gastric mucous membrane, imperfect coagulability of the blood, and in some instances fatty degeneration of the hepatic cell and of the renal epithelium.

Phenol is eliminated by all the emunctories, having been found by Lemaire in the breath of animals, but especially escapes through the kidneys, chiefly as a sulpho-phenolate and glycouronic acid, but, after toxic doses, to some extent unchanged, and probably also in some part oxidized into hydrochinon, oxalic acid, and other educts.

The diagnosis of phenol poisoning can be made out by the odor of the breath, suddenness of the development and the peculiar characteristics of the symptoms, by the presence of the characteristic white patches on the mouth and lips, if the poison has been taken in a concentrated form, and especially by the peculiarities of the urine, if the patient lives sufficiently long.

Of the tests for phenol in cases of suspected poisoning by this substance, the three most characteristic are: the ammonia and hypochlorite test, the test with ferric chloride, and the bromine test. One part of phenol in 5000 of water may be shown by adding to the solution first about one-quarter its volume of ammonium hydroxide and then a small quantity of sodium hypochlorite solution, when a blue color will appear. One part of phenol in 3000 of water can be detected by the addition of a solution of ferric chloride, when a fine violet color will develop, although the color is often interfered with in complex liquid mixtures. The most satisfactory test is that with bromine water. A whitish precipitate of tribromphenol will form even in very dilute solutions on standing. One part in 60,000 can be detected in this way. This precipitate is insoluble in water and acid liquids, but soluble in alkalies, ether, and absolute alcohol.

The first indication in the *treatment* of phenol poisoning is washing out of the stomach. On account of the great solubility of the phenol in alcohol, this fluid should be used with the water to as large an extent as is compatible with the fear of over constitutional action from absorption. The free administration of oils which was at one time largely practiced is only of service as protecting the gastro-intestinal mucous membrane and the administra-

tion of saccharated lime is also of doubtful advantage. In 1878 Baumann and Hueter announced that it is possible by the exhibition of diluted sulphuric acid or soluble sulphate to convert phenol, not only in the gastro-intestinal tract, but also after absorption, into a harmless sulpho-phenolic acid. As the result of various researches upon this subject it appears that soluble sulphates when given either through the gastro-intestinal canal or injected hypodermically are distinctly antidotal to phenol, but that there is a limitation to their power, so that if too much of the phenol has been taken the sulphates will prove of no practical value. They should always, however, be used freely in phenol poisoning. Alcohol has very recently been highly recommended by Phelps, Fraser, and others, as an efficient antidote against phenol. It certainly is valuable in local poisoning by phenol, but there is no reason to believe that there is any chemical or physiological antagonism between it and phenol, its usefulness being due to its dissolving the poison and diluting or removing it. In all cases of local phenol poisoning the parts should be washed with diluted alcohol, but in systemic poisoning alcohol should not be relied upon solely as an antidote. Strychnine and probably digitalis appear to be the only drugs which can be of much service in combating the constitutional action of phenol, and these must be used as indicated in each case.

Even the largest therapeutic dose of phenol produces no distinct symptoms when given internally, and there is no general disease in which the drug has achieved any reputation at all except *tetanus*. In this affection from five to fifteen grains (0.32 to 1 Gm.) of the pure drug may be given in the course of twenty-four hours hypodermically in a two per cent. aqueous solution. As a local remedy phenol, given by the mouth, is useful in various conditions of nervous irritability of the gastro-intestinal mucous membrane, especially when there is imperfect digestion and consequent tendency to fermentation of the gastro-intestinal contents. In *nervous vomiting* and in *gastrodynia* it is often serviceable in doses of from one to three grains (0.065 to 0.2 Gm.) repeated at intervals varying from fifteen minutes to an hour *pro re nata*. In *diarrhœas* of irritation as well as of relaxation it is a valuable remedy, especially when used in combination with bismuth or other remedy of that class.

Externally, phenol has been largely used as a germicide in all forms of local infection and also in surgery for the prevention of infection. There can be no doubt, however, that many deaths have been produced by this use of the drug, the fatal result having been due to absorption and consequent constitutional poisoning. Moreover, in numerous cases the local use of phenol has been followed by severe local symptoms, especially gangrene, so that care is essential. In *burns, irritable painful ulcerations*, and in *infected wounds* the two per cent. solution of phenol, in oil, is often very serviceable, not only as a germicide but relieving the pain by the benumbing influence on the peripheral nerve fibres. In the treatment of *carbuncles, boils* and various local *inflammations* including *synovitis* even of the larger joints, and *glandular swelling*, the so-called parenchymatous injection has been practised, the 1 or 2 per cent. solution being injected deeply into the centre of the affected area. The local use of phenol and the very wide spread employment of it as a general disinfectant depends upon its poisonous effect upon the lower grades of organic life. There can be no doubt, however, that its germicidal properties have been largely over estimated. As a germicide its activity as compared with corrosive sublimate as closely as can be estimated, is as 1 is to 20, with formaldehyde (37 per cent. solution) as 1 is to 2, with chlorinated lime as 1 is to 3.5.

When employed for sanitary purposes the 5 per cent. solution should commonly be used; less than 2 per cent. is ineffective. In the cleaning of drains, sinks, pipes and in various similar uses it is preferable to corrosive sublimate because it is not so readily chemically influenced by alkalies and various substances found in organic filth. The strength of the solution of phenol to be used externally varies from 1 per cent. up to the pure phenol, according to the effect desired. The 1 per cent. solution is scarcely germicidal; it inhibits, however, the growth of pathogenic organisms, and is a stimulant, and a slight local anesthetic to the tissue upon which it is placed. Concentrated phenol is a powerful escharotic and should always be used with care, lest its effect should be too far reaching.

Various fabrics are impregnated with phenol for surgical use. *Lister's gauze* may be made by soaking a loose cotton cloth with a mixture of 5 parts rosin, 7 parts paraffin, and 1 part phenol. Bruns improves upon this, making a more flexible dressing, by dissolving 400 grammes of powdered rosin in 2 liters of alcohol, adding 40 grammes of castor oil and 100 grammes of phenol; this will impregnate 2 pounds of the gauze, which is to be dried by spreading it out in the air. (See also Lund's process, *A. J. P.*, Feb. 1874.) *Carbolized jute* may be made by Rosenwasser's process by soaking in a percolator 1 pound of jute with a solution of crystallized phenol 700 grains, paraffin 700 grains, rosin 2800 grains, petroleum benzin 3 pints. (*A. J. M. S.*, 1879, p. 458. See also *N. R.*, April 1879, and April, 1880.) For burns and scalds 1 part of phenol in 6 parts of olive oil may be applied on lint. For the dressing of cancerous and other foul ulcers, a cerate (ten grains to the ounce) may be used. There is an official ointment. A phenol paper, used in packing fresh meats, in order to preserve them, may be prepared by melting 5 parts of stearin with a gentle heat, stirring in thoroughly 2 parts of phenol, adding 5 parts of melted paraffin, stirring the

mixture till it cools, and finally melting, and applying in the usual manner to the paper in quires. (*C. D.*, Dec. 1871.)

The impure liquid phenol sold in the shops usually contains from 70 to 90 per cent. of phenol and cresols jointly (Squibb), and, as the latter are quite equal to the former in disinfecting power, yields, if dissolved in water in the proportion of 1 to 80 parts, a solution equivalent on the average to that produced by dissolving 1 part of the pure phenol in 100 parts of water.

Administration.—When it is desired to get an immediate action upon the stomach phenol should be given in solution; when, however, it is intended to affect the intestines, it should always be exhibited in capsules mixed with starch or other inert substance, unless it be directed to be mixed with some dry medicinal powder.

Dose, one to three grains (0.065 to 0.2 Gm.).

Off. Prep.—Glyceritum Phenolis, *U. S.* (from liquefied phenol) (*Br.*); Injectio Ergotæ Hypodermica, *Br.;* Phenol Liquefactum, *U. S.* (*Br.*); Suppositoria Acidi Carbolici, *Br.;* Trochiscus Acidi Carbolici, *Br.;* Unguentum Phenolis, *U. S.* (*Br.*).

PHENOL LIQUEFACTUM. U. S. (Br.)

LIQUEFIED PHENOL

(phē'nŏl lĭq-uę-făc'tŭm)

"A liquid composed of not less than 86.4 percent., by weight, of absolute Phenol [$C_6H_5OH = 93.34$], and about 13.6 percent., by weight, of water." *U. S.* "Phenol to which distilled water has been added in the proportion of ten parts by weight of the water to one hundred parts by weight of the Phenol. It is commonly termed liquefied carbolic acid." *Br.*

Acidum Carbolicum Liquefactum, *Br.;* Liquefied Carbolic Acid; Acidum carbolicum liquefactum, *P. G.;* Verflüssigte Karbolsaure, *G.;* Fenolo liquido, *It.;* Acido fenico liquido, *Sp.*

* "Phenol, *a convenient quantity;* Distilled Water, *a sufficient quantity.* Liquefy the Phenol by placing the unstoppered container in a water-bath, and apply heat gradually until the crystals have melted; transfer the liquid to a tared vessel and weigh; then add for each *nine grammes* [or 139 grains] of Phenol *one gramme* [or 15 grains] of Distilled Water and mix thoroughly. It should be kept in dark amber-colored, well-stoppered bottles." *U. S.*

It is officially described as "a colorless liquid, which may develop a slight reddish tint upon keeping, having a characteristic, somewhat aromatic odor, and when copiously diluted with water, a sweetish taste with a slightly burning after-taste, and, when undiluted, cauterizing and whitening the skin and mucous membrane. Specific gravity: about 1.065 at 25° C. (77° F.). Soluble in 12 parts of water at 25° C. (77° F.). Miscible with alcohol, ether, and glycerin in all proportions. One part of Liquefied Phenol acquires a permanent cloudiness when mixed respectively with 2 parts of chloroform, 1.5 parts of benzene, 2.5 parts of carbon disulphide, 2 parts of oil of turpentine, or 2.5 parts of olive oil. Liquefied Phenol begins to crystallize when the temperature of the liquid is lowered to about 13.5° C. (56.3° F.). When heated, Liquefied Phenol begins to boil at about 115° C. (239° F.), and upon continuing the heat the boiling point rises; it should not exceed 188° C. (370.4° F.). When thus deprived of water, it should respond to the tests given under *Phenol.*" *U. S.* It is described as "a liquid at first colorless, but usually acquiring a pinkish hue. It forms a clear solution on the addition of 18 to 27 per cent. of *water* at 60° F. (15.5° C.). Specific gravity 1.064 to 1.069 at 60° F. (15.5° C.). Boiling point gradually rising to a temperature not higher than 359.6° F. (182° C.)." *Br.* Peter Boa prefers to replace a portion of the water used for liquefying the phenol with alcohol, and he found the following mixture to remain fluid even at a temperature of 40° F.; 100 parts of phenol, 7½ parts of water, and 2½ parts of alcohol. Two minims (0.12 Cc.) are practically equivalent to one grain of the phenol.

Dose, one to three minims (0.06 to 0.2 Cc.).

Off. Prep.—Glyceritum Phenolis, *U. S.*

PHENYLIS SALICYLAS. U. S. (Br.)

PHENYL SALICYLATE [Salol, Pharm. 1890]

(phē'nŷl-ĭs săl-ĭ-cȳ'lăs)

$C_{13}H_{10}O_3 = 212.47$

"The salicylic ester [$C_6H_4(OH)COOC_6H_5$ 1 : 2] of phenyl." *U. S.* "Salol, or phenyl salicylate, $C_6H_4.OH.COO.C_6H_5$, is prepared by the interaction of salicylic acid and phenol, or of their sodium salts with phosphoryl chloride or carbonyl chloride." *Br.*

Salol, *Br., U. S.* 1890; Salicylate de Phénol, Salicylate de Phényle, *Fr. Cod.;* Phenylum salicylicum, *P. G.;* Phenylsalicylat, Salicylsaurephenylester, *G.;* Salolo, *It.;* Salicilato de fenol, *Sp.*

Preparation.—Phenyl salicylate was first produced by Nencki of Basel, and introduced to the medical profession by Sahli, of the same place. It is prepared by heating salicylic acid with phenol in the presence of phosphorus pentachloride or phosphorus oxychloride; the action dehydrates and withdraws the elements of water, and unites the phenyl group with the salicylic acid radical. According to Ernert, nearly the theoretical yield of phenyl salicylate may be obtained by heating salicylic acid to a temperature between 160° C. and 240° C., and preventing the access of air while water is being disengaged; it is probable that salicylic anhydride is formed, and the phenyl resulting from its decomposition combines with unaltered salicylic acid to produce phenyl salicylate.

Properties.—It is described as "a white, crystalline powder, having a faint, aromatic odor, and a slight, but characteristic taste. Soluble in 2333 parts of water, and in 5 parts of alcohol at 25° C. (77° F.); very soluble in hot alcohol, and in ether, chloroform, and fixed and volatile oils. When heated to 42° C. (107.6° F.) it melts, and at a higher temperature is consumed, leaving no weighable residue. If to the alcoholic solution be added diluted ferric chloride T.S., a violet color is produced. If 0.2 to 0.3 Gm. of Phenyl Salicylate be dissolved in a little warm sodium hydroxide T.S., and the solution be then acidified with hydrochloric acid, salicylic acid separates, and the odor of phenol is recognizable. Phenyl Salicylate should not redden moistened blue litmus paper (absence of *free acids*). If 1 Gm. of Phenyl Salicylate be shaken with 50 Cc. of water, the liquid filtered, and 5 drops of ferric chloride T.S., previously diluted with 20 volumes of water, be added, the filtrate should show either no color, or at most a trace (limit of *uncombined phenol* or *salicylic acid*). If portions of the same filtrate be tested separately with barium nitrate T.S. and silver nitrate T.S., they should show no turbidity (absence of *sulphates* and *chlorides*)." *U. S.* "Colorless crystals having a faint aromatic odor and very little taste. Almost insoluble in *water*, soluble in 10 parts of cold *alcohol* (90 per cent.), very soluble in boiling *alcohol* (90 per cent.), also soluble in one-third part of *ether* or *chloroform*, and in fixed and volatile oils. Melting point 107.6° to 109.4° F. (42° to 43° C.). An alcoholic solution gives a white precipitate with *solution of bromine*. A violet coloration is produced on adding a few drops of dilute *test-solution of ferric chloride* to the alcoholic solution. On melting together Salol and *sodium hydroxide*, and then acidulating with *hydrochloric acid*, a white precipitate is produced and phenol is evolved. *Water* which has been shaken with Salol should not be affected by *test-solution of ferric chloride* (absence of free salicylic acid), and should yield no reaction with the tests for sulphates or chlorides. The alcoholic solution of Salol should be neutral to *litmus*." *Br.*

Uses.—In the small intestine phenyl salicylate is broken up by the pancreatic juice, and yields about thirty-six per cent. of phenol and sixty-four per cent. of salicylic acid. The completeness and rapidity of this action depend upon the amount of phenyl salicylate ingested and of the alkaline juice in the intestines. The change is, however, sufficient, when phenyl salicylate is freely given, for the production of salicylic acid intoxication, and for the blackening of the urine with educts from phenol. Because this change occurs in the intestines somewhat slowly, the remedy is valuable as an internal antiseptic in the treatment of *typhoid fever*, in fermentative *dyspepsia*, and in various diseases of the intestinal canal. It has been largely used in *rheumatism* as a substitute for salicylic acid, but it is much less prompt and certain in its action than is that remedy. Moreover, on account of the large proportion of phenol which it contains, it is much more dangerous than the corresponding dose of salicylic acid. Hesselbach has shown that it is prone to affect the secreting structure of the kidneys, and two fatal cases of poisoning by it have been reported. (*L. L.*, May, 1891.) It is especially dangerous when the kidneys are diseased. Phenyl salicylate has also been used externally as a substitute for iodoform, and internally, according to the method of Ewald, for the purposes of gastric diagnosis. (See H. C. Wood's *Therapeutics*.)

Dose, from five to fifteen grains (0.32 to 1.0 Gm.).

PHOSPHORUS. U. S., Br.

PHOSPHORUS

(phŏs'phŏ-rŭs)

P = 30.77

"It should contain not less than 99.5 per cent. of pure Phosphorus, and be carefully kept under water, in strong, well-closed vessels, in a secure and moderately cool place, protected from light." *U. S.* "A solid non-metallic element obtained from calcium phosphate." *Br.*

Phosphore, *Fr. Cod.*; Phosphorus, *P. G.*; Phosphor, *G.*; Fosforo, *It., Sp.*

This non-metallic element was discovered in 1669 by Brandt, an alchemist of Hamburg, who obtained it from evaporated urine by a process which remained a secret until 1737. As thus procured, it was exceedingly scarce and costly. In 1769 the Swedish chemist Gahn discovered it in bones, and shortly afterwards published a process by which it might be extracted.

Preparation.—Powdered calcined bones (calcium bone phosphate) are digested for twenty-four hours with two-thirds of their weight of sulphuric acid previously diluted with twelve times its weight of water. The sulphuric acid separates the greater part of the lime from the phosphoric acid, and precipitates as calcium sulphate, while an acid calcium phosphate, $CaH_4(PO_4)_2$, remains in solution. The liquid is then strained through a linen cloth to separate the calcium sulphate, and afterwards submitted to evaporation, which causes a fresh precipitation of sulphate, to be separated by a new straining. The strained solution is evaporated to a syrupy consistence, and then thoroughly mixed with half its weight of powdered charcoal, so as to form a mass, which is dried by being heated to dull redness. At this temperature the acid phosphate is changed into metaphosphate, $Ca(PO_3)_2$, by the loss of two molecules of water. The mass when cool is quickly transferred to a coated earthenware

retort, furnished with an adapter of copper, bent downward at right angles, so as to enter a bottle with a large neck containing water, which should rise about two lines above the orifice of the adapter. The bottle is closed round the adapter with a cork, which is traversed by a small glass tube, to give exit to the gaseous products. The retort is heated in a furnace, furnished with a dome, in the most gradual manner, so as to occupy about four hours in bringing it to a red heat. Afterwards the heat is pushed vigorously, so long as any phosphorus drops into the water, and this takes place generally for from twenty-four to thirty hours. During this part of the process the metaphosphate is decomposed, its oxygen combining with the charcoal, and the liberated phosphorus distilling over. The calcined bones of the sheep are preferred, as they contain the largest proportion of calcium phosphate and are most readily acted on by the acid. In the process as described, only two-thirds of the phosphorus is set free, the remainder being still combined. If, however, silica is added to the mixture before the distillation, all the phosphorus is liberated.

The electrolytic phosphorus process, first brought out by Readman and Parker some years ago, has now practically displaced the older methods for the production of phosphorus. Albright & Wilson, who formerly manufactured phosphorus by the distillation method at Oldbury, England, have built works at Niagara Falls, and practically control the production by the electrolytic method in the United States and England.

A mixture of calcium phosphate, carbon, and sand or kaolin is submitted to the temperature of the electric arc while packed in a covered plumbago crucible. The phosphorus is then distilled off in a current of an inert gas. It is very pure, and it is claimed that 86 per cent. is recovered. The native Redonda phosphate, an aluminum phosphate, is also taken for this process instead of the calcium phosphate, and phosphorus obtained from it without any previous purification. The great bulk of the phosphorus is consumed in the manufacture of matches, a smaller amount in the production of phosphor bronze, and another portion in making the chemical compounds of the element. The present annual production (1906) is about 3000 tons, produced in three factories: Oldbury in England, Lyons in France, and Niagara Falls in the United States.

Properties.—Phosphorus is a semi-transparent solid, without taste, but possessing an alliaceous odor. When perfectly pure it is colorless, but as usually prepared it is yellowish or reddish-yellow. It is flexible, and when cut exhibits a waxy lustre. It was said by Boettger to be easily pulverizable by agitation with a solution of urea. (*J. P. C.*, Juin, 1863, p. 488.) "A translucent, nearly colorless solid, of a waxy lustre, having, at ordinary temperatures, about the consistency of beeswax. By long keeping, the surface becomes white or red, and occasionally black. It has a distinctive and disagreeable odor and taste (*but should not be tasted, except in very dilute solution*). When exposed to the air, it emits white fumes, which are luminous in the dark, and have an odor somewhat resembling that of garlic; on longer exposure to air, it often takes fire spontaneously. Specific gravity: 1.830 at 10° C. (50° F.), and 1.820 at 25° C. (77° F.). Melting point: 44° C. (111.2° F.). Phosphorus is insoluble, or nearly so, in water, to which, however, it imparts its characteristic, disagreeable odor and taste; soluble in 350 parts of absolute alcohol at 15° C. (59° F.), in 240 parts of boiling absolute alcohol, in 80 parts of absolute ether, in about 50 parts of any fatty oil, and in about 25 parts of chloroform; it is very soluble in carbon disulphide,[1] the latter yielding a solution which must be handled with the greatest care to prevent evaporation, which would be followed by instant ignition. To test for *arsenic* and *sulphur* proceed as follows: Add 1 Gm. of Phosphorus to 10 Cc. of nitric acid diluted with 10 Cc. of distilled water, in a flask having a capacity of 50 Cc., and digest the mixture at a gentle heat on a water-bath while passing a current of carbonic acid gas into the flask over the surface of the liquid until the Phosphorus is dissolved. Transfer the solution to a dish, and evaporate it until no more nitrous vapors are given off, and then dilute the solution to 100 Cc. with distilled water. One Cc. of this solution should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). On adding barium chloride T.S. to the remainder of the liquid, not more than a slight opalescence should be produced (limit of *sulphur*)." *U. S.* "Specific gravity 1.77. It is soft and flexible at common temperatures, melts at 110° F. (43.3° C.), ignites in the air at a temperature a little above its melting point, burns with a luminous flame, and produces dense white fumes. It is insoluble in *water*, but soluble in 350 parts of *absolute alcohol*, in 80 parts of *olive oil*, in 80 parts of *ether*, in 25 parts of *chloroform*, in half its weight of *carbon bisulphide*, and in boiling *oil of turpentine*. 1 or 2 grammes should be attacked slowly and be dissolved without residue on being boiled with 5 or 10 cubic centimetres of *nitric acid* diluted with an equal volume of *water*, and the resulting solution should yield no characteristic reaction with the tests for arsenium, and only the slightest reactions with the tests for sulphates." *Br.* Its pulverization may be readily effected by melting it in hot water, and agitating until it is thoroughly cooled, and the powder is obtained finer in saline solutions than in pure water.

Phosphorus boils at 287.7° C. (550° F.), air being excluded. During its combus-

[1] According to Flückiger, carbon disulphide is capable of dissolving twenty times its weight of phosphorus without losing its fluidity.

tion it combines with the oxygen of the air, and forms phosphoric oxide. On account of its great inflammability, it must be kept under water. When exposed to the air it undergoes a slow combustion, emitting white vapors, which are luminous in the dark. It sometimes contains arsenic, and therefore, when used in forming medicinal preparations, should be tested for that metal. C. J. Rademaker obtained out of 100 parts of phosphorus about one part of arsenic. (*A. J. P.*, Nov. 1870.) It occasionally contains antimony or sulphur, the latter rendering it brittle.

When phosphorus is kept in ordinary water it becomes covered with a whitish layer, of the nature of which there are different opinions, it being looked upon by some as a phosphorus hydrate, by others as an allotropic condition of that element, and by others again as a partial crystallization, but all these opinions have apparently been disproved by Ernest Baudrimont, who seems to have demonstrated that *white phosphorus* is entirely identical with that principle in its ordinary state, and results from a kind of erosion of the surface, owing to partial oxidation by the free oxygen held in solution by the water. The change never takes place in water entirely deprived of air, and the water when it has taken place holds phosphorous acid in solution. (*J. P. C.*, 4e sér., iii. 17, 1866.)

Schroetter of Vienna, discovered an allotropic form of phosphorus, which he called *red* or *amorphous phosphorus*.[1] It is formed when ordinary phosphorus is kept long at a temperature between 215° C. (419° F.) and 250° C. (482° F.), in atmospheres which have no action on it, or in closed glass tubes. Red phosphorus is much more indifferent than the ordinary substance, and is denser, its sp. gr. being 2.11. It is much less easily acted on by the air than ordinary phosphorus, and is insoluble in carbon disulphide, alcohol, and ether, in all of which ordinary phosphorus is soluble. Solidified from the fused state, it is brittle, and breaks with a conchoidal fracture. Its hardness is considerable. Obtained by distillation in a non-acting gas, it is mixed with ordinary phosphorus, from which it may be freed by carbon disulphide, which dissolves the ordinary variety and leaves the allotropic as a deep red amorphous powder. It may also be purified by shaking it with a solution of calcium chloride of a density intermediate between that of red and that of ordinary phosphorus, and with a little carbon disulphide. The red variety will sink to the bottom, and the ordinary float on top of the solution, dissolved in the disulphide. (E. Nicklés.) Red phosphorus when pure is not poisonous. This has been proved beyond a doubt by the experiments of Reynal and Lassaigne and of L. Orfila and Rigaut. It is applicable to the manufacture of lucifer matches, and forms a much safer material than ordinary phosphorus. It does not take fire by friction at common temperatures, and therefore may be transported with the greatest safety. It has been said to be unchangeable in the air but this is not exactly true, as proved by an observation of T. B. Groves, who, having set aside some red phosphorus in a bottle that was not air tight observed for a year or more no visible change, but found at length that it had become decidedly altered, and ascertained that oxidation had taken place, with the result of forming a large quantity of phosphoric and phosphorous acids, in the proportion of 5 molecules of the former to 2 of the latter. (*P. J.*, June, 1865, p. 621.) Besides the white and red forms of phosphorus, there is another, called the *black*, first noticed by Thénard and investigated by Blondlot, who found that it is pure phosphorus, and that its production is owing to some modification in the mode of cooling, when it has been in the liquid state. (*J. P. C.*, 4e sér., i. 407, 1865.) Flückiger doubted the existence of black phosphorus, however, and, after an investigation, states that the black color is due to arsenical contamination. (*Chem. Ztg.*, 1892, 181.)

Still another modification of phosphorus has been made known by Hittorf, who obtained it by heating red phosphorus and lead together in a closed vessel. The lead on melting dissolved the phosphorus, and on cooling deposited it in the state of black crystals resembling the crystals of arsenic. In this form, phosphorus is a conductor of electricity, and its sp. gr. at 16.6° C. (62° F.) is 2.34. Hittorf distinguishes it by the name of *metallic phosphorus*, and ranks it in the same category with red phosphorus, the latter differing simply in being amorphous. (*Chem. News*, March 23, 1866, p. 133.) Blondlot has succeeded in crystallizing common phosphorus by means of sublimation, operating in an atmosphere of nitrogen. (*J. P. C.*, 4e sér., iv. 321.)

Phosphorus forms with oxygen two oxides, *phosphoric*, P_2O_5, and *phosphorous*, P_2O_3. Corresponding to the first of these are three acids, known as *orthophosphoric* (tribasic phosphoric), H_3PO_4, *pyrophosphoric*, $H_4P_2O_7$, and *metaphosphoric*, HPO_3. The first of these is formed by dissolving P_2O_5 in boiling water, or by the action of nitric acid upon phosphorus itself; the second by the heating of the tribasic phosphoric acid to 213° C. (415.4° F.); and the third by the ignition of the tribasic variety, or by dissolving P_2O_5 in cold water. To the second oxide corresponds *phosphorous*

[1] E. Q. Thornton proposes the use of the *red amorphous phosphorus* as a safe substitute for phosphorus in medicine. In his own experiments upon animals he found that in large quantities it is non-toxic, but asserts that after its administration in increasing doses until three-tenths of a grain were taken every two hours (nine doses a day), it produced mental excitement, headache, vertigo, priapism, and nocturnal emissions, followed about the twentieth day by nervous exhaustion, with return to health in about two weeks after the discontinuance of the drug. It is obvious that the red phosphorus is physiologically very different from the ordinary form of the element; whether it may prove to be a useful stimulant in cases of sexual and other forms of exhaustion is not evident.

acid, H_3PO_3, although it cannot be formed directly from the oxide. This is a dibasic acid, containing one hydrogen atom not replaceable by metal. To the hypothetical *hypophosphorous oxide,* P_2O, corresponds *hypophosphorous acid,* H_3PO_2. It is monobasic, containing two hydrogen atoms not replaceable by metal.

Uses.—Phosphorus, when given in small doses, is believed by some to act as a general stimulant. With more probability it is believed by most neurologists to act as a nutritive stimulant to the nervous system. Its usefulness in *sexual exhaustion,* in failure of the mental powers from similar causes, and indeed in all forms of exhaustion of the nerve centres, when no organic lesion has occurred, seems unquestionable, and it may even be used, with hope of advantage, in *cerebral softening.* It is sometimes of service in *neuralgia,* and has been employed with asserted advantage in *mania,* in *melancholia,* and in *chronic eczema, psoriasis,* and other *affections of the skin.* When taken in large doses it is a deadly poison. The symptoms usually do not manifest themselves until some hours after the ingestion of the phosphorus. General malaise then becomes very pronounced, and is soon accompanied by nausea, abdominal pain, and vomiting of food, mucus, and bile. On the second and third day the vomiting is likely to cease, but the abdominal tenderness remains, and there is some fever. Jaundice also sets in, both the conjunctiva and the urine betraying its onset. The yellow color rapidly involves the whole surface. Early in the poisoning there is often great anxiety, restlessness, headache, and giddiness, but now delirium appears, wild, erotic, or low and muttering. Severe vomiting of a coffee-ground liquid, free from bile and similar to the black vomit of yellow fever, is now present; the urine is scanty and albuminous, often with tyrosine and leucine in it, or it may finally be suppressed. The temperature falls markedly, and the patient sinks into a coma which ends in death. After death a peculiar fatty degeneration is found affecting almost all the soft tissues. The parts which suffer first are the liver, the gastro-intestinal mucous membrane, and the kidneys. Very often the heart muscle is also disorganized. The liver is always yellow, its cells engorged with fat globules. At first it undergoes decided enlargement, but if the patient live long enough it atrophies. Both in its symptoms and in its lesions phosphorus poisoning so closely resembles acute atrophy of the liver that only by detecting the phosphorus in the matters vomited, in the excretions, or in the tissues of the body, can a positive diagnosis be made. M. Poulet (*G. M. P.,* Aug. 1872) states that hypophosphorous acid can be detected in the urine by heating the latter with nitric acid to dryness; if the acid be present, as the latter condition is approached there will be a sudden outburst of flame.

E. Mitscherlich gave the following as a delicate test for phosphorus. The suspected substance is distilled with sulphuric acid and water from a flask, by means of a tube bent twice at right angles, into a vertical cooling-tube, passing through the bottom of a wide glass cylinder filled with water, which is constantly kept cold by passing cold water in at the bottom, while the warm water escapes at the top. Under the cooling-tube is placed a vessel to receive the distillate. If phosphorus is present, its vapor, mixed with steam, distils over, and gives rise to a distinct luminous appearance, visible in the dark, at the point where it enters the cold part of the cooling-tube. The presence of alcohol and ether prevents the occurrence of the luminous appearance until they have distilled over. Oil of turpentine has the same effect permanently, but is not likely to be present in medico-legal cases. Mitscherlich's test acts equally well in the presence of fatty matters, as has been shown by de Vrij. Roussin finds that the presence of free butyric acid prevents the luminous appearance of the phosphorus. After neutralizing with potassium carbonate, however, it can be seen. (Sonnenschein, *Gerichtl. Chem.,* 1881, p. 27.) L. Hofmann gives the following method of detecting phosphorus in the viscera in cases of poisoning. The viscera, mixed with water and a little sulphuric acid, are distilled until two drachms of liquid are obtained; to this a few drops of ammonium sulphide (ammonium sulphydrate) are to be added, and the liquid is to be evaporated to dryness in a porcelain dish. If phosphorus be present in the minutest quantity, a drop of solution of ferric chloride will produce a deep violet and brownish, though evanescent, color. (*Chem. News,* Feb. 3, 1865, p. 53.) In addition to Mitscherlich's test, Dusart's is also used. This consists in passing pure hydrogen gas, evolved in a separate vessel, through the solution supposed to contain phosphorus, which solution has been previously warmed to about 50° C. The gas then is allowed to issue from a fine jet and is lighted. If phosphorus be present, the flame will show a green color in the centre.

The treatment of phosphorus poisoning consists simply in administering the antidotes as soon as possible. Oil of turpentine was originally proposed by Andant. After much discussion, it has been finally determined that, while the pure oil has no effect upon phosphorus, the acid French oil of European commerce forms with it a crystalline, spermaceti-like mass. This is soluble in ether, alcohol, and alkaline solutions, and has received the name of *turpentine-phosphoric acid.* It is said to be eliminated by the kidneys unchanged, and to exert no deleterious influence. Köhler asserts that when German oil has not been rectified for some time it acts upon phosphorus. He believes that the oil acts partly by oxidizing the poison, and partly by converting it into the harmless turpentine-phosphoric acid. One

part of the oil must be given for 0.01 part of the phosphorus. The ordinary American oil of turpentine, as well as Canada balsam, appears to be of no antidotal value in phosphorus poisoning.

As was pointed out by Eulenberg and Guttmann, phosphorus in a solution of a soluble salt of copper becomes black immediately, owing to the formation of a phosphide of the metal. Bamberger asserts that, while this change is very rapid, that induced by turpentine is a slow one, and, from an elaborate series of experiments upon animals, he concludes that copper is much the more valuable and certain antidote. Antal found potassium permanganate an antidote in acute poisoning by phosphorus. Hajinos has successfully washed out the stomach, half an hour after the ingestion of the poison, with a pint of a one-tenth per cent. solution of the permanganate. (*Notes on New Remedies,* July, 1892.)

In human poisoning, copper sulphate should be given in dilute solution, three grains (0.20 Gm.) every five minutes until vomiting is induced. After this, if the French oil be accessible, it may be given freely in emulsion, or, probably better, a solution of potassium permanganate may be administered. Magnesium sulphate or citrate should be used as a quickly acting purge, and symptoms met as they arise.

In dogs poisoned by phosphorus, L. Orfila and Rigaut have shown that putrefaction was remarkably retarded. In a case of chronic poisoning from the copious inhalation of phosphorus vapor, the principal results were a gradual decay of the sexual function, and paralysis, terminating in death at the end of three years. Partial or general paralysis is a not uncommon result. (*L. L.,* July 7, 1866, 23.)

Dose, of phosphorus, from 1-100th to 1-80th of a grain (0.0006 to 0.0008 Gm.). Much larger doses than these have been given, but have in various cases produced unpleasant symptoms. The *elixir* (*Elixir Phosphori,* U. S. 1890) is probably the most eligible of the liquid preparations, but the *oil* (*Oleum Phosphoratum,* U. S. 1890), is very efficient, as is also the official pill (*Pilulæ Phosphori*). Great caution is necessary in the exhibition of phosphorus, and its effects should be closely watched. It ought never to be given in substance.[1]

Off. Prep.—Oleum Phosphoratum, *Br.;* Pilulæ Phosphori, *U. S.* (*Br.*).

[1] *J. Ashburton Thompson's Solution of Phosphorus.* Take of phosphorus, one grain (0.065 Gm.); absolute alcohol, five fluidrachms (18.4 Cc.). Dissolve the former in the latter by gentle heat, and add to it a previously warmed mixture of one and a half fluidounces (44.2 Cc.) of glycerin, two fluidrachms (7.4 Cc.) of alcohol, and forty minims (2.5 Cc.) of spirit of peppermint. One fluidrachm (3.75 Cc.) of this solution contains one-twentieth of a grain (0.003 Gm.) of phosphorus.

Tinctura Phosphori (*Bellevue Hospital*).—Take of clean, transparent phosphorus, thirty-two grains (2.07 Gm.); absolute alcohol, forty-six fluidounces (1360 Cc.). Digest the phosphorus in the alcohol on a water bath in a flask provided with a reflux condenser, until solution has taken place. Allow the solution to cool, and add to it one fluidounce (29.5 Cc.) of essence of vanilla, and three fluidrachms (11 Cc.) of oil of orange. Finally, make up the bulk with absolute alcohol to forty-eight fluidounces (1416 Cc.). Twelve fluidrachms (44.2 Cc.) of this solution contain one grain (0.065 Gm.) of phosphorus. (*N. R.,* April, 1876.)

Phosphorus Paste, for the destruction of vermin, is made as follows. Triturate six parts of phosphorus and one part of sulphur with six parts of water, until they liquefy. Then mix in two parts of flour of mustard, eight parts of sugar, and twelve parts of rye flour, with the aid of ten additional parts of water, and stir the whole so as to form a soft paste, which must be kept in pots closely stoppered. (*A. J. P.,* 1855, p. 473.)

Resina Phosphorata, Phosphorated Rosin, Phosphoretted Resin.—Melt together, by the aid of a sand bath, in a dry bottle having nearly the exact capacity of the ingredients, rosin free from moisture 96 parts and phosphorus 4 parts. Keep the whole at a temperature of 392° F. until the Phosphorus is dissolved, cool, and keep in bottles protected from light.

H. A. B. Dunning (*Proc. A. Ph. A.,* 1902, 573) furnishes the following process:

Phosphorus Rosin.—Oil of sweet almond, 1 part; Rosin, 8 parts; Yellow wax, 2 parts. Melt the rosin by the aid of direct heat, add the yellow wax and remove from the fire, add the oil. Strain sufficient of the mixture, while stirring into a strong wide-mouthed bottle of such size as to prevent it being more than three parts full, and then allow it to become cool. Weigh the phosphorus, four or ten per cent., under water, dry with filter paper and drop into the bottle containing the cold rosin mixture, then quickly cork and tie down with twine. Place the bottle in a water bath, so that it will not rest directly upon the bottom, and heat the water gradually to boiling. Continue the boiling until the contents are quite fluid. Now shake the bottle until the phosphorus is thoroughly distributed; continue the shaking until the contents of the bottle become too viscid to shake. After the finished product has become entirely cold, the bottle is to be broken, the mass freed from adhering glass, cut into small pieces, placed in a stock bottle and covered with water to prevent oxidation. The quantity representing the amount of phosphorus desired can be easily and carefully weighed without loss of phosphorus, and may be incorporated into pill masses with ease and certainty, as substances of like physical character are usually incorporated.

Spiritus Phosphori, U. S. 1890, *Spirit of Phosphorus* (*Tincture of Phosphorus*).—"Phosphorus, *one and two-tenths grammes* [or 18½ grains]; Absolute Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Weigh the Phosphorus in a tared capsule containing water, then dry it carefully and quickly with blotting paper, and introduce it into a flask containing *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Absolute Alcohol. Connect the flask with an upright condenser supplied with cold water, and apply the heat of the water-bath, so that the Alcohol may be kept gently boiling, until the phosphorus is dissolved. Then allow the liquid to become cold, and, if necessary, add to it enough Absolute Alcohol to make it measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Lastly, transfer the Spirit to small, dark amber-colored vials, which should be securely stoppered, and kept in a cool and dark place." *U. S.* 1890. This is the basis of the Elixir of Phosphorus, *U. S.* 1890, and is rarely directly used in medicine. It should be freshly prepared, as it is not a stable preparation. Each fluidrachm (3.75 Cc.) contains about one-fifteenth grain of phosphorus.

Elixir Phosphori, U. S. 1890. *Elixir of Phosphorus.* "Spirit of Phosphorus, *two hundred and ten cubic centimeters* [or 7 fluidounces, 48 minims]; Oil of Anise, *two cubic centimeters* [or 32 minims]; Glycerin, *five hundred and fifty cubic centimeters* [or 18 fluidounces, 287 minims]; Aromatic Elixir, *a sufficient quantity,* to make *one thousand cubic centimeters* [or

PHYSOSTIGMA. U. S. (Br.)

PHYSOSTIGMA [Calabar Bean]

(phȳ-sǫ-stig'mą)

"The ripe seed of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*), yielding, when

assayed by the process given below, not less than 0.15 percent. of alkaloids soluble in ether." *U. S.* "The ripe seeds of Physostigma venenosum, *Balfour.*" *Br.*

Physostigmatis Semen, *Br.;* Calabar Bean; Chopnut; Ordeal Bean of Calabar; Faba Calabarica; Fève du Calabar, *Fr. Cod.;* Kalabarbohne, *G.;* Haba del calabar, Eseve, *Sp.*

Physostigma venenosum, Balfour, *Trans. Roy. Soc. Edinb.,* xxii. 305; *Ed. Med. Journ.,* July, 1863, p. 34; *B. & T.* 80.—This is a climbing plant, with a ligneous stem, mounting on trees and shrubs, and frequenting especially the banks of streams, into which it often drops its fruit when ripe, and it is said that the people of Calabar derive their supply principally from the borders of the streams down which the fruits are carried. The root is spreading, with numerous fibrils, often having attached to them small succulent tubers. The flowers are in axillary, multiflorous, pendulous racemes. The corolla is papilionaceous, of a pale pink color, with a purplish tinge. The legume when ripe is about seven inches long, and contains two or three seeds. It ripens at all seasons, but is most abundant during the rainy season from June to September. The seeds are the part used. The plant, which is indigenous to Western Africa, has been introduced into India and Brazil, and is said to flourish in the latter country. Only one other species (*P. mesoponticum,* Taub.), also of tropical Africa, is known. For a paper on the botanical description, history, etc., of *Physostigma venenosum* by J. U. Lloyd see *West. Drug.,* 1897, 249.

This bean was brought to the notice of the scientific public by Daniell, in 1846. Considerable attention was attracted to the subject, and specimens of the bean were obtained by Christison from the Gold Coast. These were planted in the Botanical Garden at Edinburgh, and produced a perennial creeper. In the year 1859, specimens of the plant were sent from Calabar, which came under the observation of Balfour of Edinburgh, who was thus enabled to ascertain its botanical character.

Properties.—The seed is about the size of a large horse-bean, being somewhat more than an inch in length by three-fourths of an inch in breadth, with a very firm, hard, brittle, shining integument of a brownish-red, pale chocolate, or ash-gray color. The shape is irregularly kidney-form, with a longer convex and a shorter concave edge, two flat sides, and a furrow running longitudinally along its convex margin and ending in an aperture near one of the extremities of the seed. Within the shell is a kernel consisting of two cotyledons, weighing on an average about 46 grains, hard, white, pulverizable, odorless, and having a taste like that of the ordinary edible leguminous seeds, without bitterness, acrimony, or aromatic flavor. "Oblong, somewhat reniform, 15 to 30 Mm. long, 10 to 15 Mm. thick; externally reddish- or chocolate-brown, smooth, somewhat roughened near the brownish-black groove which extends almost the entire length of the convex edge, its reddish, rounded margins elevated and somewhat thickened; embryo whitish, with a short, curved hypocotyl and two large, concavo-convex cotyledons; having a bean-like and heavy odor when crushed; taste at first starchy, afterwards acrid." *U. S.* The bean yields its virtues to alcohol, and imperfectly to water. The shell constitutes, according to Edwards, 30 per cent., the kernel 70 per cent., of the bean. Jobst and Hesse (*J. P. C.,* Mars, 1864, p. 277) first isolated an active principle, which they found exclusively in the cotyledons. They obtained it by exhausting an alcoholic extract of the seeds with water, adding magnesia to neutralization, which is indicated by the liquid becoming brown, then concentrating, and treating with ether. The ethereal solution was shaken with a little weak sulphuric acid. The liquid separated into two layers,—the upper, ethereal, containing no alkaloid, and the lower, a solution of the sulphate in water. The latter was separated, treated with magnesia, and afterwards with ether, which yielded the alkaloid on evaporation. The substance thus obtained they proposed to name *physostigmine.* It was amorphous, soluble in ammonia, sodium hydroxide, ether, benzene, and alcohol, and less so in cold water. In 1867, Hesse (*Ann. Ch. Ph.,* 141, 82) obtained the same alkaloid in a still purer state, perfectly colorless and tasteless, fusing at 45° C. (113° F.), and decomposing at 100° C. (212° F.) with red coloration. He gives it the formula $C_{15}H_{21}N_3O_2$. In 1865 Vée and Leven (*C. R. A. S.,* 60, 1194) obtained, by treating the seeds in nearly the same manner, an alkaloid to which they gave the name *eserine,* which formed colorless tabular crystals of a bitter taste, readily soluble in ether, alcohol, or chloroform, but sparingly in water. The crystals contain 1 molecule of water, which they lose at 100° C., and the anhydrous alkaloid then fuses at from 102° to 103° C. The identity of this principle with the physostigmine of Hesse is now generally accepted. The solution of eserine acts quickly on the pupil, and a drop of a solution containing only 1 part in 1000, placed within the eyelids, causes great and lasting contraction. Of this alkaloid 1.5 milligrammes (1-40th gr.) injected under the skin of a guinea pig produced palsy of the hind legs in five minutes, and death in half

33 fluidounces, 6½ fluidrachms]. To the Spirit of Phosphorus, contained in a graduated bottle, add the Oil of Anise and Glycerin, and mix them by repeatedly inverting the bottle, until they form a clear liquid. Then add Aromatic Elixir, in several portions, gently agitating after each addition, until a transparent liquid is obtained, and the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Keep the product in dark amber-colored, well-stoppered bottles, in a cool and dark place." *U. S.*

Each cubic centimeter of this preparation represents about *one-fourth milligramme* (0.00025 Gm., or 1-260th grain) of phosphorus. A teaspoonful of the recently made elixir contains about 1-65th grain (0.001 Gm.) of phosphorus.

Dose, from twenty to sixty minims (1.3 to 3.9 Cc.).

an hour, with dilatation of the pupil at the moment of death. It is said to be capable of destroying life by absorption from the conjunctiva. A peculiarity of the alkaloid is that an aqueous solution of it, or of one of its salts, exposed to the air in the presence of potassium or sodium hydroxides, or lime, becomes red, owing to the absorption of oxygen. The coloring matter is taken up by chloroform. The color is not permanent, but gradually changes to yellow, green, or blue. This test will detect less than the hundred-thousandth part of the alkaloid. The same property is possessed by the alcoholic extract of the bean. Physostigmine was official in the Br. Pharm. 1885, and was thus described: "In colorless or pinkish crystals, slightly soluble in water, but readily soluble in alcohol and in diluted acids. The aqueous solution has an alkaline reaction, when warmed with or when shaken with dilute solution of potash becomes red, and when evaporated to dryness over a water bath leaves a bluish residue, the acidified solution of which is beautifully dichroic, being blue and red." *Br.* 1885. The percentage of physostigmine in Calabar bean forms the basis of the assay of the U. S. P. (8th Rev.). It is as follows:

Assay. U. S. (8th Rev.)—"Physostigma, in No. 60 powder, *twenty grammes;* Ether, Solution of Sodium Bicarbonate (1 in 20), Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Distilled Water, Iodeosin T.S., each, *a sufficient quantity.* Introduce the Physostigma into a Erlenmeyer flask of about 250 Cc. capacity, add 200 Cc. of ether, and shake the flask well during ten minutes. Then add 10 Cc. of an aqueous solution of sodium bicarbonate (1 in 20), and shake the mixture vigorously at intervals during four hours. Allow the powder to settle, and decant 100 Cc. of the ether-solution (representing 10 Gm. of Physostigma) into a measuring cylinder; then transfer it to a separator, introduce a small piece of blue litmus paper, and add sufficient normal sulphuric acid V.S. to render the liquid acid, and then 10 Cc. of distilled water. Shake the liquid well for several minutes, and draw off the aqueous layer into another separator. Repeat the extraction, using 2 Cc. of normal sulphuric acid V.S. and 8 Cc. of distilled water, add the acid aqueous layer to the second separator, and finally again shake out the ether solution, using 1 Cc. of normal sulphuric acid V.S. and 9 Cc. of distilled water, adding this also to the second separator. To the combined acid liquids in the second separator, add 25 Cc. of ether, a small piece of red litmus paper, and sufficient sodium bicarbonate solution (1 in 20) to render it alkaline. Shake the separator for one minute, allow the liquids to separate, and draw off the ether into a beaker. Repeat the shaking out process with 20 Cc. and again with 15 Cc. of ether added to the separator, shake each time for one minute, allow the liquids to separate, and draw off the ether into the beaker. Carefully evaporate the ether from the combined solutions by means of a water-bath, and when dry, dissolve the residue in 5 Cc. of tenth-normal sulphuric acid V.S. and 20 Cc. of ether, which must be strictly neutral, and transfer this solution to a bottle, rinsing with 80 Cc. of water; add 5 drops of iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S., until, after shaking, the aqueous liquid just acquires a pink color. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 5 (the 5 Cc. of tenth-normal sulphuric acid V.S. taken) and multiply the remainder by 0.0273, and this product by 10; the result will be the percentage of alkaloids soluble in ether contained in the Physostigma. The figure 0.0273 represents the weight in grammes of alkaloids (mainly physostigmine) required to neutralize 1 Cc. of tenth-normal sulphuric acid V.S." *U. S.*

Harnack and Witkowski, *A. E. P. P.*, v.; also x., in 1876 obtained still another alkaloid, which they named *calabarine.* It is soluble in alcohol and water, nearly insoluble in ether, melts at 132° C., and differs in physiological character from physostigmine. It is now generally known under the name of *eseridine.*[1] The formula $C_{15}H_{23}N_3O_3$ has been given to it, which differs from that of physostigmine, it will be seen, by H_2O only, and it is stated that the one can be changed into the other by the action of dilute acids. There is much reason for believing that calabarine is a decomposition product derived from physostigmine. (Husemann, *A. E. P. P.*, 1878, 14; Harnack, *A. E. P. P.*, x.)

Hesse obtained also a neutral fatty body, *phytosterin,* by exhausting the cotyledons with petroleum benzin. It is closely allied to cholesterin, but its chloroform solution is devoid of rotatory power. Its formula is $C_{26}H_{44}O + H_2O$, and its melting point is 133° C. (271.4° F.).

Uses.—Calabar bean has been used from time immemorial by the natives of Africa as an ordeal, and, when given by their head men, usually proves fatal to the accused, unless free vomiting occurs. A draught containing 19 seeds pounded and infused in water is said to have killed a man in an hour. In the experiments of Fraser, it was found that the integuments of the seeds, as well as the shell, are distinctly purgative. It is probable that in the fresh bean they are also emetic, and that the priests or chiefs who administer the ordeal take advantage of this in regulating the

[1] According to its discoverer (*D. M. Ztg.*, Dec. 1889), eseridine is a tetanizant; it has also been affirmed to cause elevation of the blood pressure and slowness of the pulse, followed by progressive paralysis and death from failure of the respiration, and to markedly increase internal peristalsis and to produce watery purging. It has been recommended by Eber, also by Ostertag (*B. Thier. W.*, Jhrg. 4, 5, Nos. 40, 43), as a laxative in veterinary medicine, but has not been used to any extent for human beings. As a poison it is said to have one-sixth the strength of *eserine.*

effects of the poison to suit their own purposes; sometimes, however, even the pure alkaloid causes vomiting. (Gubler.) Christison took about 12 grains of the kernel, which in fifteen minutes produced giddiness and a feeling of torpidity, followed by great weakness and faintness, paleness of the surface, extreme weakness and irregularity of the pulse, and indisposition or inability to make voluntary muscular effort. A peculiar epigastric sensation is often the first symptom of the action of the poison, and sometimes becomes severe. The heart often acts tumultuously or irregularly, but the pulse frequency may be reduced. Of seventy children poisoned in Liverpool by eating Calabar beans which had been thrown upon a waste heap, vomiting occurred, or was produced by emetics, in all except one, in whom four kernels caused death. The nausea and vomiting came on in about half an hour, the nervous symptoms in less than an hour.

In the lower animals Calabar bean produces muscular tremors, diminished reflex activity, contractions of the pupils, some cardiac disturbance, and a progressive paralysis ending in death from paralytic asphyxia. It has been proved by Fraser that the paralysis is due to a depressant action upon the motor tract of the spinal cord, this being the most important physiological effect of the drug. The brain, the sensory tract of the cord, and the nerve trunks are not affected, but the muscles are directly influenced; hence the muscular twitchings. Small doses somewhat increase the force but diminish the frequency of the heart beat, and cause rise of arterial pressure. Toxic doses depress the heart and lower arterial pressure. The intestinal peristalsis, and probably also the bronchial movements, are primarily increased, and, after a toxic dose, secondarily diminished. Locally applied to the eye, Calabar bean causes myosis, with disturbance of accommodation. A similar effect is usually produced by large doses taken internally; it is largely the result of a local paralysis of the peripheral sympathetic fibres in the eye, but it is probable that there is also stimulation of the oculomotor nerve terminations. The sedative influence of Calabar bean upon the motor spinal tract early led to its use in *tetanus, strychnine poisoning,* and similar conditions of spinal excitement. Clinical experience has, however, shown that it is of less value than chloral or some other depressant motors, so that it is chiefly employed as a succedaneum for these remedies. The effect of the drug upon intestinal peristalsis has led to its use in *"phantom tumor"* of the abdomen, *constipation,* and other *affections of the bowels* dependent upon muscular atony. It has also been employed with great asserted advantage in *chronic bronchitis.*

In Calabar bean poisoning the stomach should be thoroughly washed out, and atropine, which has been found by Kleinwächter, Bourneville, and Fraser to be physiologically antagonistic to Calabar bean, should be given hypodermically in doses of from one-sixtieth to one-fortieth of a grain (0.001 to 0.0015 Gm.), repeated at intervals according to the exigencies of the case. Strychnine would also probably be found useful. The best preparation of Calabar bean is the alcoholic extract. (See *Extractum Physostigmatis.*) Its maximum commencing dose may be set down as one-eighth of a grain (0.008 Gm.), representing three grains of the crude drug (0.2 Gm.). The alkaloid *physostigmine* or *eserine,* either in solution or in the form of gelatin disks containing definite quantities (from 1-5000th to 1-1000th of a grain), which are put in the eye, has entirely replaced the alcoholic extract as a local myotic.

Dose, of Calabar bean, three grains (0.2 Gm.).

Off. Prep.—Extractum Physostigmatis, *U. S., Br.;* Tinctura Physostigmatis, *U. S.*

PHYSOSTIGMINÆ SALICYLAS. U. S.

PHYSOSTIGMINE SALICYLATE [Eserine Salicylate]

(phȳ-sǫ-stĭg-mī′næ săl-ĭ-cȳ′lās)

$C_{15}H_{21}N_3O_2.C_7H_6O_3 = 410.21$

"The salicylate [$C_6H_4(OH)COOH.C_{15}H_{21}N_3O_2$] of an alkaloid obtained from Physostigma. It should be kept in small, dark amber-colored, well-stoppered vials." *U. S.*

Salicylate d'Esérine, *Fr. Cod.;* Physostigminum salicylicum, *P. G.;* Physostigminsalicylat, Eserinsalicylat, *G.*

Preparation.—This salt was introduced into the Pharmacopœia of 1880 and retained in that of 1890 and the 8th Revision. It is preferred to the sulphate of the alkaloid (see page 940) on account of its greater stability. Its advantage is that it is not deliquescent. Birkenwald (*Ph. Z. R.,* 1891, 657) gives the following process: 100 parts of physostigmine sulphate are dissolved in a suitable quantity of water, and an excess of a solution of sodium bicarbonate added and agitated with several portions of absolute ether; the ethereal solutions are filtered into a beaker containing 35.5 parts of salicylic acid dissolved in ether, thoroughly mixed, and the physostigmine salicylate collected upon a filter, washed with absolute ether and dried, protected from sunlight and air. Any excess of salicylic acid that may have been present is removed by the washing with ether. The success of this method depends upon rapid manipulation and preventing exposure to sunlight, otherwise the salt obtained will be of a red color due to the decomposition of physostigmine and formation of *rubeserine;* washing the crystals with alcohol will remove any red color, but with loss of physostigmine salicylate.

Properties.—It is officially described as in "colorless, or faintly yellowish, shining, acicular, or short columnar crystals; odorless, and having a slightly bitter taste. *It should be tasted with great caution.* It acquires a reddish tint when long exposed to light and air. Soluble in 72.5

parts of water, 12.7 parts of alcohol, 175 parts of ether, and in 8.6 parts of chloroform at 25° C. (77° F.); soluble in 15 parts of water at 80° C. (176° F.), and in 4 parts of alcohol at 60° C. (140° F.). When heated, Physostigmine Salicylate begins to soften and turn slightly yellow at 160° C. (320° F.), and melts at 178.9° C. (354° F.). It leaves no residue on incineration. Its aqueous solution shows an acid reaction to litmus paper, and upon standing twenty-four hours the solution acquires a pink color. Ferric chloride T.S., produces in an aqueous solution of Physostigmine Salicylate a deep violet color; a solution of chlorinated lime added to the aqueous solution produces a red color. On evaporating an aqueous solution of the salt to dryness with a few drops of ammonia water, a blue residue is produced, which is soluble in alcohol, and when so dissolved, yields a red fluorescent solution upon the addition of acetic acid in excess. An aqueous solution of the salt is colored cherry-red by the addition of potassium hydroxide T.S., changing to a darker red, and finally to green. Platinic chloride T.S. produces no precipitate in solutions of the salt (distinction from *physostigmine sulphate*). Sulphuric acid containing in each Cc. 1 drop of solution of formaldehyde gives with Physostigmine Salicylate a bright pink color; sulphuric acid with a few particles of cane sugar produces a yellow color, turning to brown, then to purple, and finally to greenish-black. If 0.005 Gm. of the salt be dissolved in nitric acid, a yellow solution results, which, on being heated, changes to an orange-color, then to blood-red, and on evaporation to dryness yields a green residue. When exposed to the fumes of nitric acid this residue becomes violet-blue, and when a drop of nitric acid is added to it, it forms a reddish-violet solution, which soon changes to blood-red, and finally, on standing, or on dilution, becomes greenish-yellow." *U. S.*

Uses.—This salt has the medicinal properties of its base. It has long been used as a subcutaneous laxative in colic of horses, but has been chiefly employed in human medicine as a myotic. Nevertheless, it is a valuable addition to laxatives when there is intestinal muscular atony; given hypodermically, it may be of great service in acute conditions of the alimentary canal with *atonic tympany*. For ordinary ophthalmic purposes a solution of a quarter of a grain of the salt of physostigmine to the ounce is of sufficient strength, but in *glaucoma* and other severe diseases of the eyes the strength of two grains to the fluid-ounce is sometimes necessary. When a long continued use of the drug is desired, one-sixteenth grain to the ounce is usually of sufficient strength. Physostigmine solution soon acquires a pinkish color, which deepens with age, but does not sensibly affect the action of the drug upon the eye.

Dose, 1-80th to 1-30th grain (0.0008 to 0.002 Gm.).

PHYSOSTIGMINÆ SULPHAS.
U. S., Br.

PHYSOSTIGMINE SULPHATE [Eserine Sulphate]

(phȳ-sǫ-stīg-mī′næ sŭl′phās)

$(C_{15}H_{21}N_3O_2)_2.H_2SO_4 = 643.75$

"The sulphate $[SO_2(OH)_2.(C_{15}H_{21}N_3O_2)_2]$ of an alkaloid obtained from Physostigma. It should be kept in well-stoppered, dark amber-colored vials." *U. S.* "The sulphate, $(C_{15}H_{21}N_3O_2)_2,H_2SO_4,xH_2O$, of an alkaloid obtained from Calabar Bean." *Br.*

Sulfate d'Ésérine, *Fr. Cod.;* Physostigminum sulfuricum, *P. G.;* Physostigminsulfat. *G.;* Sulfato de eserina, *Sp.*

This was a new official salt in 1890; it is preferable to the salicylate on account of its greater solubility, but on exposure to the air it soon assumes an extractive consistence which renders it difficult to dispense; the salicylate is free from this objection.

Preparation.—*Physostigmine* or *eserine sulphate* is obtained by M. A. Petit in the following manner: A hydro-alcoholic extract of the bean is dissolved in four parts of distilled water, and the solution filtered. To the solution is added one gramme of potassium bicarbonate for every 20 grammes of extract, and the mixture is shaken with ether in excess. The ether, which takes up nearly all the alkaloid, is, after a few minutes' repose, separated. A little distilled water is then added, and afterwards sulphuric acid drop by drop, the liquid being shaken after each drop, and tested with litmus paper until exactly neutral. After standing, the aqueous solution is separated from the ether, which now contains none of the alkaloid. This ether is then employed as before, and the operation repeated three or four times, so as completely to exhaust the original solution, and the liquid obtained each time is added to the last aqueous solution. This contains the physostigmine sulphate nearly pure. To purify this, it should be passed through the same process as the original solution of the extract. The resulting solution may be evaporated to crystallization if desired; but usually the evaporation is carried only so far as to get rid of all the ether present. If enough water be added to the solution to make as many grammes as there were drops of sulphuric acid (H_2SO_4) employed, each gramme will represent one centigramme of the alkaloid.

Petit and Polonovski conducted experiments with the view of discovering salts of eserine which would be stable and non-hygroscopic; they made *eserine benzoate, eserine meta-cresotate, eserine citrate,* and *eserine tartrate.* Processes will be found in *J. P. C.,* 1894, 55.

Properties.—It is officially described as "a white or yellowish-white, micro-crystalline powder, odorless, and having a bitter taste. *It should be tasted with great caution.* It is

very deliquescent, and gradually turns reddish by exposure to air and light. Very soluble in water, alcohol, and chloroform; soluble in 1200 parts of ether at 25° C. (77° F.). When heated to 130° C. (266° F.), the salt becomes soft, and melts at about 140° C. (284° F.). Upon ignition, it is slowly consumed, leaving no residue. Its aqueous solution shows an acid reaction to blue litmus paper. Barium chloride T.S. produces in an aqueous solution of the salt a white precipitate, which is insoluble in hydrochloric acid. An aqueous solution of Physostigmine Sulphate yields, with alkalies, a white precipitate, which quickly turns pink, and dissolves in an excess of the alkali, forming a pink or red solution, which soon fades to yellowish-green. Gold chloride T.S. gives with aqueous solutions of the salt a purple color. Platinic chloride T.S. produces in aqueous solutions of the salt a yellowish-white precipitate (distinction from *physostigmine salicylate*). Sulphuric acid with Physostigmine Sulphate yields only a faint yellow color. Sulphuric acid containing a crystal of potassium iodate, on being added to a crystal of the salt, gives a light purple color, immediately changing to yellowish-red. If 0.005 Gm. of the salt be dissolved in nitric acid, a yellow solution results, which, on being heated, changes to an orange-color, then to blood-red, and, on evaporation to dryness, yields a green residue. When exposed to the fumes of nitric acid, this residue becomes violet-blue, and when a drop of nitric acid is added to it, it forms a reddish-violet solution, which soon changes to blood-red, and finally, on standing, or on dilution, becomes greenish-yellow." *U. S.* "When shaken with dilute *solution of potassium hydroxide* it becomes red; and when mixed with *solution of ammonia* and evaporated to dryness on a water-bath, it leaves a bluish residue, the solution of which in very dilute acids is dichroic, being red by reflected and blue by transmitted light. A minute fragment dissolved in a few drops of *fuming nitric acid* yields a yellow liquid, which on evaporation on a water-bath darkens in color, the residue when completely dried being of a green color. A dilute aqueous solution applied to the eye causes contraction of the pupil. It leaves no ash when burned with free access of air." *Br.*

The medicinal properties, uses, and dose are the same as those of *Physostigminæ Salicylas.*

Off. Prep.—Lamellæ Physostigminæ, *Br.*

PHYTOLACCA. U. S.

PHYTOLACCA [Poke Root, Phytolaccæ Radix, Pharm. 1890]

(phȳ-tǫ-lăc'cą)

"The dried root of *Phytolacca decandra* Linné (Fam. *Phytolaccaceæ*), collected in autumn." *U. S.*

Phytolacca Root; Racine de Phytolaque, *Fr.*; Kermesbeerenwurzel, *G.*

Phytolacca decandra, L., *Sp. Pl.* (1762) 631; Willd., *Sp. Pl.* ii. 822; Bigelow, *Am. Med. Bot.,* i. 39; Barton, *Med. Bot.,* ii. 213—This is an indigenous plant, with large perennial root, often five or six inches in diameter, divided into two or three principal branches, soft, fleshy, fibrous, whitish within, and covered with a brownish cork. The stems, which are annual, frequently grow to the height of six or eight feet and divide into numerous spreading branches. They are round, very smooth, green when young, but purple after the berries have ripened. The leaves are scattered, ovate-oblong, entire, pointed, smooth, ribbed beneath, and on short footstalks. The flowers are numerous, small, and in long racemes, which are sometimes erect, sometimes drooping. The corolla consists of five ovate, concave, whitish petals, folding inward. There are ten stamens and the same number of pistils. The raceme of flowers becomes a cluster of dark purple, almost black shining berries flattened above and below, and divided into ten cells, each containing one seed.

The poke is abundant in all parts of the United States, flourishing along fences, by the borders of woods, and especially in newly cleared and uncultivated fields. The muck thrown up from the ditches of swamps is peculiarly favorable to it, and a bed of muck may almost always be recognized by the luxuriant growth of poke with which it covers itself. It also grows spontaneously in Northern Africa and Southern Europe, where, however, it is supposed to have been introduced from America. Its flowers begin to appear in July, and the fruit ripens in autumn. The magnitude of the poke weed, its large rich leaves, and its beautiful clusters of purple berries, often mingled upon the same branch with the green unripe fruit and the flowers still in bloom, render it one of the most striking of our native plants. The young shoots are much used as food early in the spring, boiled in the manner of spinach. The ashes of the stems and leaves contain a very large proportion of potassium salts, yielding, according to Braconnot, not less than 4.2 per cent. of the pure caustic alkali. In the plant the potassium hydroxide is combined with an acid closely resembling malic acid, though differing from it in some respects. The leaves, berries, and root are used, but only the latter is now mentioned in the Pharmacopœia. The root is most active. It should be dug up late in November, cut into thin transverse slices, and dried with a moderate heat. As its virtues are diminished by keeping, a new supply should be procured every year. The berries should be collected when perfectly ripe, and the leaves about the middle of summer, when the footstalks begin to redden.

The *berries,* formerly official (*Phytolaccæ Fructus, U. S.* 1890, *Phytolaccæ Baccæ, U. S.* 1880, *Poke berry*), contain a succulent pulp, and yield upon pressure a large quantity of

fine purplish red juice. They have a sweetish, nauseous, slightly acrid taste, with little odor. They were officially described as "a depressed-globular, dark purple, compound berry, about 8 Mm. in diameter, composed of ten carpels, each containing one lenticular, black seed; juice purplish-red; inodorous; taste sweet, slightly acrid." *U. S.* 1890. The coloring principle is evanescent, and cannot be applied to useful purposes in dyeing, from the difficulty of fixing it. Alkalies render it yellow, but the original color is restored by acids. The juice contains saccharine matter, and, after fermenting, yields alcohol by distillation.

The *dried root* is branched, of a light yellowish-brown color externally, very much wrinkled, and, when in transverse slices, exhibits on the cut surface numerous concentric rings, formed by the projecting ends of fibres, between which the intervening matter has shrunk in drying. The structure internally in the older roots is firm and almost ligneous; the color yellowish white, alternating with darker circular layers. The fracture is fibrous, the wood-bundles in several distinct, concentric circles. There is no odor. The taste is slightly sweetish, and at first mild, but followed by a sense of acrimony.

Properties.—By the U. S. Pharm., it is described as "cylindrical, somewhat tapering, sparingly branched, 3 to 7 Cm. thick, mostly in transverse or longitudinal slices, externally yellowish-brown, finely longitudinally or spirally wrinkled and thickly annulate with lighter colored, low ridges; fracture fibrous, characterized by alternating layers of fibrovascular tissue and parenchyma, the layers of the latter being much retracted; odor slight; taste sweetish, afterwards highly acrid." *U. S.* The active matter is imparted to boiling water and alcohol. From the analysis of Edward Donnelly, the root appears to contain tannic acid, starch, gum, sugar, resin, fixed oil, and lignin, besides various inorganic substances. (*A. J. P.*, xv. 169.) Claussen (*Pharm.*, 1879, p. 466) prepared from the seeds of *Phytolacca decandra*, by extraction with alcohol, evaporation to dryness, and taking up with chloroform or ether, after washing the residue with petroleum benzin, a neutral principle in silky lustrous crystals, insoluble in water, soluble in alcohol, ether, and chloroform, which he named *phytolaccin*. A. Tereil (*C. R. A. S.*, 91, 856) obtained from the berries an acid (*phytolaccic acid*) as an uncrystallizable yellowish-brown mass of gummy consistency. It was soluble in water and alcohol, slightly soluble in ether, of acid reaction, and gelatinizing with hydrochloric and sulphuric acids. W. F. Wagner (*A. J. P.*, 1887, p. 69) found tannin in the berries, but not in the root. W. A. Partee (*A. J. P.*, 1888, p. 123) made a proximate examination of poke root and found crystals deposited from a solution of an alcoholic extract in absolute alcohol; he also discovered traces of tannin, glucose, and indications which pointed to the presence of a glucosidal principle. Frankforter and Ramaley (*A. J. P.*, 1897, 281) have again analyzed the root with care. They find nearly 10 per cent. of a non-reducing sugar, free acid, identified as formic acid, but no certain proof of either alkaloid or glucoside. The very bitter resin amounted to 1 per cent.; *phytolaccine*, an alkaloid, has been said to exist in minute quantity in the root.

Uses.—Phytolacca is emetic, purgative, and somewhat narcotic. As an emetic it is very slow in its operation, frequently not beginning to cause vomiting in less than one or two hours after it has been taken, and then continuing to act for a long time upon both the stomach and the bowels. The vomiting produced by it is said not to be attended with much pain or spasm, but narcotic effects have been observed by some physicians, such as drowsiness, vertigo, and dimness of vision. In overdoses it produces excessive vomiting and purging, attended with great prostration of strength, and sometimes with convulsions. A woman (*Stethoscope* for March, 1852, ii. 134) ate a double handful of the berries. Free purgation followed upon the first day, after which coma set in, with great prostration, though death did not occur until after the sixth day. A child, six years old, after having swallowed two or three fluidrachms of a tincture of the root, was seized in less than an hour with tonic spasm of the muscles, the extremities being stiff, the hands clenched, the feet extended and toes flexed, and the trunk in a condition of opisthotonos. (*A. M. S. J.*, July, 1866.) According to Roberts Bartholow, phytolacca causes in the lower animals convulsions and death from paralysis of respiration. It is not fit for use as an emetic, but has been employed as an alterative with asserted good results in the treatment of *chronic rheumatism*, *granular conjunctivitis*, and even of *cancer*. Locally it has been used in the form of ointment (a drachm to the ounce) in the treatment of *psora*, *tinea capitis*, *sycosis*, and *favus*. It occasions at first a sense of heat and smarting in the parts to which it is applied. A saturated tincture of the berries may be given in rheumatic cases, in the dose of a fluidrachm (3.75 Cc.), three times a day. Alcohol, diluted alcohol, and water, extract the virtues of poke root.

Dose, emetic, ten to thirty grains (0.65 to 2.0 Gm.); alterative, one to five grains (0.065 to 0.32 Gm.).

Off. Prep.—Fluidextractum Phytolaccæ, *U. S.*

PICROTOXINUM. Br.

PICROTOXIN

(pĭc-rō-tŏx-ĭ'nŭm)

$C_{30}H_{34}O_{13} = 597.74$

"A neutral principle obtained from the fruits of Anamirta paniculata, *Colebr.*" *Br.*

Picrotoxin was not retained in the U. S. P. 8th Revision. This substance is obtained from *Cocculus indicus* (*Anamirta paniculata*), for an account of which see PART II. The formula $C_{15}H_{16}O_6 + H_2O$ which is often given for picrotoxin belongs, according to Paterno and Oglialoro (*Gazz. Chim.*, ii. 41), to *picrotoxinin*, which with *picrotin*, $C_{15}H_{18}O_7$, is a decomposition product of the original picrotoxin, $C_{30}H_{34}O_{13}$.

Properties.—Picrotoxin was thus described in the U. S. 1890: "Colorless, flexible, shining, prismatic crystals, or a micro-crystalline powder, odorless, and having a very bitter taste; permanent in the air. Soluble, at 15° C. (59° F.), in 240 parts of water, and in 9 parts of alcohol; in 25 parts of boiling water, and in 3 parts of boiling alcohol; also soluble in solutions of the alkalies, and in acids. Very slightly soluble in ether or chloroform. Picrotoxin is neutral to litmus paper. When heated to 200° C. (392° F.), picrotoxin melts, forming a yellow liquid, and upon ignition it is consumed, leaving no residue. Concentrated sulphuric acid dissolves Picrotoxin with a golden-yellow color, very gradually changing to reddish-brown, and showing a brown fluorescence. On mixing about 0.2 Gm. of powdered sodium nitrate with 3 or 4 drops of sulphuric acid, in a small, flat-bottomed capsule, sprinkling a minute quantity of Picrotoxin over it, and then adding, from a pipette, concentrated solution (1 in 4) of sodium hydrate, drop by drop, until it is in excess, the particles of Picrotoxin will acquire a brick-red to deep red color which fades after some hours. On diluting 2 Cc. of alkaline cupric tartrate volumetric solution with 10 Cc. of water, and adding a small portion of Picrotoxin, red cuprous oxide will be separated within half an hour at ordinary temperatures, and much more rapidly upon the application of heat. The aqueous solution of Picrotoxin should remain unaffected by mercuric or platinic chloride test-solution, tannic acid test-solution, mercuric potassium iodide test-solution, or other reagents for alkaloids (absence of *alkaloids*)." *U. S.* 1890. The British Pharmacopœia describes it as follows: "It melts at 378° F. (192.2° C.). It is soluble in 330 parts of cold or 35 of boiling *water*, and in 13 of cold or 3 of boiling *alcohol* (90 per cent.). It is soluble in 10 parts of *solution of potassium hydroxide*, and the resulting liquid, on boiling, immediately reduces *Fehling's solution*. Heated on platinum foil, the crystals melt, forming a yellowish liquid, which on further heating, becomes charred, and is at length completely dissipated. It dissolves in *sulphuric acid* with a saffron-yellow color. Its aqueous solution is not precipitated by *test-solution of mercuric chloride*, *solution of platinic chloride*, or *solution of tannic acid* (distinction from alkaloids)." *Br.* E. Schmidt and Löwenhardt, who made a study of picrotoxin (*Ber. d. Chem. Ges.*, xiv. 812), found with it several principles. They identified the easily soluble body *picrotoxinin*, $C_{15}H_{16}O_6$, fusing point from 200° to 201° C., and the difficultly soluble anhydrous *picrotin*, $C_{15}H_{18}O_7$, fusing point from 240° to 245° C. Picrotoxinin shows a brick-red color, when tested with the Langley reaction,[1] while picrotin is indifferent in this case. See a paper by Meyer and Bruger, *Ap. Ztg.*, 1899, 67. To procure picrotoxin, the aqueous extract of the seeds is triturated with pure magnesia, and then treated with hot alcohol, which dissolves the picrotoxin, and yields it upon evaporation. In this state, however, it is impure. To obtain it colorless it must be again dissolved in alcohol, and treated with animal charcoal. After filtration and due evaporation, it is deposited in the crystalline form. Accompanying the picrotoxin in the seeds is *anamirtin*, $C_{19}H_{24}O_{10}$. Possibly identical with this is the *cocculin* of Löwenhardt, to which, however, the formula $C_{19}H_{26}O_{10}$ is given by its discoverer. It does not give any color with the Langley reaction. Besides picrotoxin, *Cocculus indicus* contains a large proportion of fixed oil, and other substances of less interest. In the shell Pelletier and Couërbe discovered two distinct principles,—one alkaline and named *menispermine*, $C_{18}H_{24}N_2O_2$, the other identical with it in composition, but distinguishable by its want of alkalinity, its volatility, and its solubility and crystalline form, and denominated *paramenispermine*. They found also in the shell a new acid, which they called *hypopicrotoxic*. The picrotoxin of Boullay they believed to possess acid properties, and proposed for it the name of *picrotoxic acid*. (*J. P. C.*, xx. 122.)

[1] In Europe, picrotoxin is said to be added to malt liquors in order to give them bitterness and intoxicating properties,—although the practice is forbidden by law, in England, under heavy penalties. Gunckel proposes the following mode of detecting and separating picrotoxin from liquids containing it, founded on the facts that it is soluble in dilute acids though not combining with them, and that ether extracts it from its acid solutions, but not from those in water or alcohol, even in the presence of potassium hydroxide. The substance suspected to contain it, having been brought to the consistence of paste, is to be digested with alcohol and a little tartaric acid, the liquid separated, the alcohol evaporated, the residue diluted with a little water and then treated with ether, and, finally, the ethereal solution submitted to evaporation in a watch glass. Picrotoxin, if present, is deposited, recognizable by its feathery crystallization, its bitter taste, and the property of reducing the tartrate of copper and potassium. If strychnine, which perhaps resembles it most closely in its effects, is present, it will be left behind in the acidulated solution. (*J. P. C.*, 1858, p. 78; from *A. Pharm.*, xciv. 14.) In the instance of adulterated malt liquor, in consequence of the resin of hops it contains, it might be expedient first to evaporate the liquor to dryness, and prepare an aqueous extract of the residue, and then to proceed as stated. J. W. Langley proposes, as a means of detection, the oxidation of picrotoxin. When to a little of this substance, mixed with potassium nitrate in a watch glass, a drop of sulphuric acid is added, no observable reaction takes place; but, if a very strong solution of potassium or sodium hydroxide be now added, a bright reddish-yellow color will be produced, which will be highly characteristic. A very minute quantity may thus be detected. Langley, however, thinks it probable that this phenomenon is owing to a minute quantity of some nitrogenous principle, for if picrotoxin be purified by combining it in solution with potassium hydroxide, and then precipitating it with an acid, it does not answer the test. (*Am. J. Sci.*, 1862.)

Uses.—Picrotoxin is a violent poison to all classes of animals, producing when in sufficient dose violent convulsive attacks, both epileptic and tetanic, with periodic arrest of respiration, slowing of heart beat, and finally death. An almost characteristic phenomenon is the interchange between tonic and clonic convulsions, with a peculiar, almost purposive movement in the clonic attacks; the motions of swimming, of walking, of rotation, of eating, etc., are usually some or all of them present. Vomiting sometimes occurs; the pupils are usually primarily contracted, secondarily dilated, and stupor deepens finally into coma. The convulsive movements are largely due to intense excitement of the motor cells in the medulla and spinal cord. The respiratory centres as well as the vasomotor centres share in this action, the condition of excitement being probably followed in fatal cases by one of secondary depression and exhaustion. During the period of convulsion the reflex activity is often abated, especially directly after a convulsive attack. This, taken with the fact that section of the cord high up at such a period brings on return of reflex activity, has led to the conclusion that the drug powerfully stimulates Setschenow's centre and thereby arrests reflex movement. The experiments of Gottlieb, however (*A. E. P. P.*, Bd. xxx., 1892), seem to show that small doses increase reflex activity by stimulating the motor cells, and he believes that the apparent loss of reflex activity after large doses is the result of exhaustion due to the motor discharges, the return of the reflex activity after section of the cord being due to the arrest by such section of the convulsive attacks, and consequent prevention of exhaustion. This does not, however, seem probable, and, as asserted by Kóssa (*S. J.*, Sept. 1894), the motor tract of the medulla and spinal cord is probably in the end paralyzed by the poison. Small doses of picrotoxin have a pronounced influence in increasing the blood pressure, which increase seems from the experiments of Gottlieb to be chiefly due to excitement of the vasomotor centres. The slowing of the heart produced by picrotoxin is largely owing to the extreme irritation of the inhibitory centres, but it would seem also that the poison has an influence directly upon the heart itself, since Falck has noted immediate slowing and quick arrest of the isolated frog's heart when picrotoxin solution is brought in contact with it. The final arrest of the heart is in diastole. According to Kóssa, the motor nerves and the voluntary muscle are not affected by the poison, which produces, however, violent peristalsis in the uterus and the intestinal tract.

In man, picrotoxin acts as it does in the lower animals, and a number of cases of serious or even fatal poisoning have been produced by it or by substances containing it. Planat commends it highly in *epilepsy, hystero-epilepsy, chorea,* and similar nervous disorders, and Dujardin-Beaumetz states that he has found it very useful in epilepsy in ascending doses of from one-fourth to three milligrammes. It has also been used with alleged excellent results in *night sweats,* especially by Semmola. There seems to be little reason for believing it to be of value in practical medicine, but the experiments of M. Koppen (*A. E. P. P.*, xxix., 1892) indicate that it is an active physiological antidote to poisons of the chloral group. In Kóssa's experiments (*Ungar. Arch. f. Med.*, i. 1892) it was found to increase the toxic action of morphine.

Dose, from 1-100 to 1-30 of a grain (0.0006 to 0.002 Gm.).

PILOCARPINÆ HYDROCHLORIDUM. U. S.

PILOCARPINE HYDROCHLORIDE [Pilocarpine Hydrochlorate, Pilocarpinæ Hydrochloras, Pharm.1890]

(pī-lo-cär-pī'næ hȳ-dro-ċhlōr'i-dŭm)

$C_{11}H_{16}N_2O_2.HCl = 242.81$

"The hydrochloride [$HCl.C_{11}H_{16}N_2O_2$] of an alkaloid obtained from Pilocarpus. It should be kept in well-stoppered, amber-colored vials." *U. S.*

This alkaloidal salt is usually obtained by the process given under *Pilocarpus* for the alkaloid (see page 948). Although the nitrate is more frequently found in commerce at present, the hydrochloride has been preferred, principally because of its more ready solubility in water. Schuchardt states (*N. R.*, May, 1881) that 100 parts of boiling water dissolve 66 parts of pilocarpine hydrochloride, and water at 15° C. (59° F.) dissolves nearly the same amount; of alcohol of sp. gr. 0.820 it requires 7 parts for solution at 15° C. (59° F.), while the same alcohol, boiling, easily dissolves 2½ parts of the salt. According to the same authority, pilocarpine nitrate is soluble at 15° C. (59° F.) in 8 parts of water. At 100° C. (212° F.) it has the same solubility as the hydrochloride. It requires 130 parts of alcohol of sp. gr. 0.820 at 15° C. (59° F.), and 40 parts of boiling alcohol, to dissolve it. These figures do not agree with the official solubilities.

Properties.—Pilocarpine hydrochloride is officially described as in "colorless, or white, transparent crystals, odorless, and having a faintly bitter taste; deliquescent on exposure to the air. It contains no water of crystallization. Soluble in 0.3 part of water, 2.3 parts of alcohol, and in 540 parts of chloroform at 25° C. (77° F.); soluble in 1.1 parts of alcohol at 60° C. (140° F.); insoluble in ether. After drying for several hours at 100° C. (212° F.), the salt melts at 195.9° C. (384.5° F.), and upon ignition it is entirely consumed. Its aqueous solution is neutral, or has a faintly acid reaction upon blue litmus paper. Sulphuric acid dissolves Pilocarpine Hydrochlo-

ride, with elimination of hydrochloric acid gas and the formation of a colorless liquid; upon adding to the solution a small fragment of potassium dichromate on a white porcelain surface, a bright, grass-green color is produced. If 0.01 to 0.02 Gm. of the salt be dissolved in 2 Cc. of water in a test-tube, 2 Cc. of a slightly acid solution of hydrogen dioxide added, and a small layer of benzene be carefully poured upon the liquid, then if 3 or 4 drops of a solution of potassium dichromate (1 in 300) be added and the mixture be gently shaken, the benzene layer will acquire a violet color, while the aqueous layer will remain yellow (distinction from *other alkaloids*. If more than 0.02 Gm. be used, the benzene turns blue, and the reaction is no longer characteristic). On rubbing together equal parts of Pilocarpine Hydrochloride and mercurous chloride, a black color is produced. Silver nitrate T.S. produces, in an aqueous solution of the salt, a white precipitate insoluble in nitric acid." *U. S.*

Uses.—Pilocarpine hydrochloride is superior to pilocarpus in the certainty of its diaphoretic action, and in being less disagreeable, and probably less apt to nauseate. Weber, Bardenhewer, and Auschmann agree that 0.3 of a grain of it is equal to seventy-five grains of the best leaves, but this is probably an overestimate of its powers. The hydrochloride may be used hypodermically in aqueous solution; the commencing dose is an eighth of a grain (0.008 Gm.), although much larger doses are sometimes necessary. A solution of the salt is sometimes used by oculists as a myotic. Pilocarpine is often used with advantage for the stimulation of other secretions than those of the skin. Cheron affirms that it is an active galactagogue. When given in doses of from one-twentieth to one-fifteenth of a grain (0.003 to 0.004 Gm.), at intervals of two or three hours, it frequently acts as a powerful hydragogue diuretic. According to Watowski and others, it is of value in the treatment of *catarrhal jaundice*. In the form of gelatin disks (each containing from one-twelfth to one fifteenth of a grain), allowed to dissolve slowly in the mouth, it has been used with alleged satisfaction against the exceedingly dry mouth of *phthisis* and other chronic diseases.

Dose, one-eighth to one-fourth of a grain (0.008 to 0.016 Gm.).

PILOCARPINÆ NITRAS. U. S., Br.

PILOCARPINE NITRATE

(pī-lo-cär-pī'næ nī'trăs)

$C_{11}H_{16}N_2O_2.HNO_3 = 269.20$

"The nitrate [$NO_2OH.C_{11}H_{16}N_2O_2$] of an alkaloid obtained from Pilocarpus. It should be kept in well-stoppered, amber-colored vials." *U. S.* "The nitrate of an alkaloid, $C_{11}H_{16}N_2O_2,HNO_3$, obtained from Jaborandi Leaves." *Br.*

Preparation.—This salt may be made by adding pure pilocarpine to diluted nitric acid, carefully evaporating the solution, and purifying the crystals by solution in alcohol and recrystallizing.

Properties.—This salt was recognized in the U. S. P. for the first time in the 8th Rev. and it is there described as follows: "Colorless, or white, shining crystals, odorless, and having a faintly bitter taste; permanent in the air. It contains no water of crystallization. Soluble in 4 parts of water and in 60 parts of alcohol, at 25° C. (77° F.); soluble in 16 parts of alcohol at 60° C. (140° F.); insoluble in ether and chloroform. It melts at 170.9° C. (339.7° F.). Upon ignition, it is quickly consumed, leaving no residue. The aqueous solution (1 in 100) shows an acid reaction to blue litmus paper. Sulphuric acid dissolves Pilocarpine Nitrate, forming a colorless solution, and on adding a fragment of potassium dichromate, a bright grass-green color is produced. On rubbing together equal parts of the salt and mercurous chloride, no black color is produced (distinction from *pilocarpine hydrochloride*). If 0.01 to 0.02 Gm. of the salt be dissolved in 2 Cc. of water in a test-tube, 2 Cc. of a slightly acid solution of hydrogen dioxide added, and a small layer of benzene be carefully poured upon the liquid, then if three or four drops of a solution of potassium dichromate (1 in 300) be added and the mixture be gently shaken, the benzene layer will acquire a violet color, while the aqueous layer will remain yellow (distinction from *other alkaloids*. If more than 0.02 Gm. be used, the benzene turns blue and the reaction is no longer characteristic). If to an aqueous solution of the salt, mixed with an equal volume of ferrous sulphate T.S., sulphuric acid be carefully added without shaking, a brown ring will appear at the juncture of the two layers." *U. S.* The Br. Pharm. also recognizes the *nitrate,* which it describes as "a white crystalline powder; soluble in 8 or 9 parts of cold *water;* slightly soluble in cold, freely soluble in hot *alcohol* (90 per cent.). Strong *sulphuric acid* forms with it a yellowish solution which, on the addition of *potassium bichromate,* gradually acquires an emerald-green color. A dilute aqueous solution applied to the eye causes contraction of the pupil. It leaves no ash when burned with free access of air (absence of mineral impurity)." *Br.* The medicinal properties and dose are the same as those of *Pilocarpinæ Hydrochloridum.*

PILOCARPUS. U. S. (Br.)

PILOCARPUS [Jaborandi]

(pī-lo-cär'pŭs)

"The leaflets of *Pilocarpus Jaborandi* Holmes or of *Pilocarpus microphyllus* Stapf (Fam. *Rutaceæ*), yielding, when assayed by the process

given below, not less than 0.5 percent. of alkaloids." *U. S.* "The dried leaflets of Pilocarpus Jaborandi, *Holmes*." *Br.*

Jaborandi Folia, *Br.;* Jaborandi leaves; Pilocarpi Foliola; Jaborandi, *Fr. Cod.;* Folia Jaborandi, *P. G.;* Jaborandiblätter, *G.;* Jaborandi, *It.;* Jaborandi (Hoja de), *Sp.*

Pilocarpus was first introduced to the notice of the European profession by Coutinho (*J. P. C.*, 4e sér., xx. 51) under the name of Jaborandi, a name which has adhered to the drug, although the terms Jaborandi, Iaborandi and Jamborandi are used in South America to designate various pungent, sudorific plants, most of which belong to the genus Piper, but some of which have no botanical relation at all with the peppers. Although the leaves of the Piper Jaborandi have been sent into commerce as jaborandi, none of the true jaborandies of South America have any physiological relations with the official drug, which in South America is known as *Arruda do Mato* or as *Arruda brava* and rarely as *Jamguarandi* or *Jaurandi.*

The genus Pilocarpus consists of woody shrubs belonging to the Rutaceæ and inhabits tropical and subtropical America, including Cuba, Guadeloupe, Martinique, and probably other islands. For an elaborate botanical and histological study of the commercial species of Pilocarpus by A. Duval, see *B. Sc. Pharm.*, vii., Feb. 1903. The commercially important species of the genus are as follows:

P. Jaborandi, Holmes; *P. officinalis,* Poehl. This plant inhabits the northern and northeastern part of Brazil whence its leaves find their way through Sergipe, Allogoa, Sobral and Ceará, etc., to Liverpool and Hamburg, the chief centres of European commerce in the drug. Like those of *P. selloanus* its leaves are two or three jugate and are especially separated from those of the *P. pennatifolius* by the fact that all of the leaflets except the terminal one have their bases cordate, while the bases of all the leaflets of *P. pennatifolius* are attenuate.

P. pennatifolius, Lemaire; *P. simplex,* Baillon, inhabits the southern portion of Brazil and Paraguay, whence its leaves were formerly largely exported through Buenos Ayres and Rio Janiero; at present they seem to have almost disappeared from commerce.[1] The leaves are oval, elliptical, obtuse, attenuate at the summit, which is feebly emarginate, and also attenuate at their base but not petiolated. The species is recognized in the French Codex.

P. selloanus, Engler, formerly official in the U. S. P., appears to be a variety of *P. pennatifolius,* Lemaire, from which it differs almost solely in the length of its flower stalk, which is six times as long as the flower bud, while that of *P. pennatifolius* is but three to four times as long as the bud. *P. selloanus* seems to be the more southern plant of the two, and is especially abundant in Paraguay.

P. trachylophus, Holmes.—The leaves of this species are smaller than those of the *P. Jaborandi,* and are oblong, elliptical, obtuse and emarginate at the summit with cordate bases, symmetrically and shortly petiolate. The plant grows in Northeastern Brazil, especially in the provinces of Ceará and Maranhoa and the leaves, although they contain so little of the alkaloid (about 0.2 per cent.) as to be of small value, have been sent into commerce in considerable quantities. Their color upon the surface is vivid green, below yellowish-green.

P. microphyllus, Stapf, grows in the northeastern part of Brazil whence the leaves, much mixed with the debris of the petioles, of the twigs and of the fruit, are sent to Liverpool and Hamburg. These leaves are alternate, imparipinnate with from one to five pairs of leaflets, or are often apparently simple owing to the failure of the lateral leaflets to develop. The leaflets are opposed, slightly pubescent, their petioles marked by a deep longitudinal furrow. They vary very much in form, the base usually being attenuate and feebly cordate or unequal.

P. spicatus, A. Saint-Hilaire; *P. parviflorus,* Martius et Nees, inhabits the southern and northern portions of Brazil and can be recognized at once by its having simple leaves which are from 3 to 11 Cm. long and from 1 to 4 Cm. broad, and are tender or coriaceous and more or less pubescent and dotted. *P. subcoriaceus,* Engler, is probably a variety of this species.

P. racemosus, Vahl, a native of Martinique, Cuba, Guadeloupe and probably other of the West Indian Islands, appeared first in commerce in 1903 as a new variety of jaborandi under the name of *Guadeloupe jaborandi.* The leaves are proportionately broader than those of *Pernambuco jaborandi,* more obovate in outline, of a purer green color, and are trifoliate or apparently simple. Considerable diversity of result has been obtained by chemists in the examination of the Guadeloupe jaborandi. Rocher (*A. J. P.*, 1900) obtained 1 per cent. of total alkaloids of which 0.6 per cent. was believed to be pilocarpine, the remainder jaborine. In the laboratory of Wright, Layman and Umney, only 0.34 per cent. of total alkaloids were reported as existing, while in an assay by A. J. Cownley (*P. J.*, vol. 72) 0.6 per cent. of total alkaloids was obtained, about 50 per cent. of which was believed to be isopilocarpine. The commercial cultivation of jaborandi may some day be successful as the *P. pennatifolius* has been found to grow freely in Sicily and produce a leaf containing a fair proportion of alkaloid. Pilocarpus is usually bought by assay. The variation in the percentage of alkaloid, according to the observations of A. Duval, depends not merely on the original contents of the drug but upon the fact that the alkaloid disappears when the pilo-

[1] In the original specimens of jaborandi seen by Coutinho, and also in other specimens received from the doctor's family by F. V. Greene, U. S. N., some of the leaves are hairy, although most of them are smooth, and it seems probable that the species does contribute somewhat to the jaborandi of commerce.

carpus is kept for some length of time in a moist atmosphere. It is probable that jaborandi is rarely purposely adulterated, but often there are to be found with *P. microphyllus* large quantities of the leguminous plant, *Tunatea decipiens* (Holmes), O. Kze. (*Swartzia decipiens,* Holmes). In general appearance the two leaves resemble one another, both being imparipinnate and having the leaflets about the same size and shape, but in *P. microphyllus* the leaflets are opposite and the petioles are only slightly pubescent, while in the *Tunatea* the leaflets are alternate and the petioles very pubescent. Then again, the absence of secreting hairs, the deep green of the upper and lighter green of the lower surface of the leguminous leaf serve easily to distinguish it from the true drug.

The following description of the drug is adapted from that of F. V. Greene, U.S.N., who had unquestionable specimens of the original jaborandi of Coutinho. The package contained several stems branched at an angle of about 20°, these branches being furnished with alternate leaves, which are imparipinnate, with from two to five opposite leaflets (Planchon has met with leaves having as many as seven or nine, and, more rarely, eleven leaflets) articulated to the rachis by short petiolules, thickened at the base. The leaflets, which are coriaceous in texture, vary considerably in size and outline. As a rule, they may be considered as oblong-lanceolate, and are entire, emarginate, with an unequal base. The midrib rises very little above the upper surface of the leaflet, but is very prominent and sharp on the lower. The veins, which are rather more prominent on the lower surface, leave the midrib at an angle of about 60°, pursue a parallel course across the leaflet, and finally turn up and anastomose within about a quarter of an inch of the margin. The leaflets are pellucidly punctate; the dots are the receptacles of secretion, are numerously and irregularly distributed over the whole surface, and are plainly visible when the leaflet is held up to the light.[1] The fruit consists of five carpels, of which not more than two or three are usually developed to maturity; when ripe, the carpels dehisce into two valves, and then remind one strongly of miniature cockle shells with the valves open exposing the animals. The black, shining, reniform seeds (one for each carpel) have a lancet-shaped hilum, a sharp ridge on the back near the apex, and a smooth, pale yellow endocarp surrounding it. There are in commerce at present two chief forms or varieties of jaborandi, one coming from Pernambuco and one from Para. The U. S. P. now recognizes these two varieties of pilocarpus, giving the following official descriptions of them. *Large Jaborandi; Pernambuco Jaborandi* from:

"*Pilocarpus Jaborandi.*—Very shortly and stoutly petioluled, the blades 6 to 12 Cm. long and 2 to 4 Cm. broad, oblong or oval, mostly unequal at the base, blunt and emarginate at the summit, the margin entire and narrowly revolute; yellowish-green, very smooth, shining, thick and coriaceous, the reticulate venation prominent on both sides, especially beneath; strongly pellucid-glandular; peculiarly aromatic when crushed; taste bitterish, slightly salty, aromatic, later somewhat pungent and sialagogue." *U. S.*

Para Jaborandi; Maranhao or *Maranham Jaborandi; Small Jaborandi*:

"*Pilocarpus microphyllus.*—Leaflets 1.2 to 3.7 Cm. long, 0.8 to 1.6 Cm. broad; the lateral without petiolules, rhomboidally oval to obovate, acute at the base, blunt and unequally emarginate at the summit; the terminal on short, margined petiolules, almost equally oval to obovate, rather narrower than the lateral; all thickish and rigid, with entire margin, smooth and dull green, finely pellucid-glandular; midrib stout, the veins rather coarsely reticulate, lightly prominent; almost odorless; taste similar to that of *Pilocarpus Jaborandi.*" *U. S.*

Paraguay jaborandi from *P. pennatifolius* and *P. selloanus* is an inferior variety of the drug, which reaches European commerce from Buenos Ayres and from Rio Janeiro, and is believed to be collected in Paraguay. The leaves are thinner than those of the Pernambuco jaborandi, and have only two or three, never four, pairs of leaflets. It is also noticeable in the Paraguay variety that the lateral veins are not prominent, that the base is so tapered that the widest portion is above the middle, and that the upper surface is grayish green.

In 1894 still another variety appeared in the London market under the name of *Ceará jaborandi.* It differs from those previously known by the dark brownish-green tint of the upper and the yellowish tint of the under surface of the leaflet, and by the under surface being covered with short hairs. It is yielded by *P. trachylophus,* first described by E. M. Holmes.

All of the older varieties of jaborandi are yielded by pinnate-leaved species of Pilocarpus, but in 1895 a papery, rather rigid, lanceolate, brittle leaf, of a dark, rather brownish green above, and a rather paler hue beneath, attached to a short twisted petiole, came into commerce under the name of *Aracati jaborandi.* (See table page 948.) It is the product of *P. spicatus.*

Properties.—An alkaloid was isolated in 1875 from jaborandi almost simultaneously by A. W. Gerrard and M. Hardy. To this the name of *pilocarpine* was given. Gerrard at the same time stated that there were at least two alkaloids in the leaves, and this view seemed to be confirmed when *jaborine* was discovered. He also obtained a volatile oil, tannic acid, a peculiar volatile acid, and potassium chloride. *Pilocarpine* may be prepared as follows. The

[1] According to Conroy, the leaflets yield 0.76 per cent., the leafstalks only 0.37 per cent. of alkaloid.

leaves are exhausted with 80 per cent. alcohol containing 8 grammes of hydrochloric acid in a liter, the tincture is distilled and evaporated to the consistence of a liquid extract, and this is mixed with a small quantity of water, and filtered. The filtrate is treated with a slight excess of ammonia, and then with a large quantity of chloroform. The chloroform solution is agitated with water, to which hydrochloric acid is added, drop by drop, in sufficient quantity to neutralize the alkaloid, the hydrochloride of which is obtained in long needles on evaporating the aqueous solution, while foreign principles remain dissolved in the chloroform. By dissolving the crystals in water, treating the solution with ammonia and chloroform, and evaporating the latter solution, pilocarpine is obtained as a soft viscous mass, which is only slightly soluble in water, but is freely soluble in alcohol, ether, and chloroform.

Kingzett assigned pilocarpine the formula $C_{23}H_{34}N_4O_4 + 4H_2O$. Harnack and Meyer, on the other hand, give it as $C_{11}H_{16}N_2O_2$. The latter was generally accepted, and is recognized by the U. S. Pharmacopœia. It is now definitely established as correct by the synthesis of pilocarpine afterwards effected by Hardy and Calmels. (*C. R. A. S.*, 105, pp. 68 to 71; also *A. J. P.*, 1887, p. 632.) By the action of hydrochloric acid or of barium hydroxide, pilocarpine, $C_{11}H_{16}N_2O_2$, is changed into *pilocarpidine*, $C_{10}H_{14}N_2O_2$, by the loss of a methyl group. Now Hardy and Calmels have converted β-pyridine-α-lactic acid, into *pilocarpidine*, the methyliodide of which by oxidation is converted into pilocarpine. The synthetical pilocarpidine and pilocarpine yield gummy derivatives similar to those obtained by Harnack and Meyer from the natural products. The physiological action of synthetical pilocarpine is identical with that of the natural alkaloid. Knudsen, E. Merck, and Petit and Polonovski all dispute the conclusions of Hardy and Calmels, and state that they failed to get pilocarpine by the synthetic method of these investigators. (*Proc. A. Ph. A.*, 1897, 716.) Petit and Polonovski (*J. P. C.* (6), v. 481) obtained *pilocarpic* and *pilocarpidic acids* from pilocarpine and pilocarpidine. Harnack and Meyer first stated that *jaborine* is easily formed from pilocarpine, and may be produced by simply heating the latter alkaloid. They also showed that *pilocarpine* has physiological effects analogous to those of *nicotine*, while *jaborine* resembles *atropine* in its effects. Hardy and Calmels (*J. Chem. S.*, Sept. 1886, 815) state that pure, dry pilocarpine does not yield *jaborine* when heated at 100° C. for six hours, neither can this substance be obtained by the action of alcoholic iodides upon argento-pilocarpidine. If, however, carefully dried pilocarpine be heated rapidly to 175° C., kept at this temperature for about half an hour, and the product extracted with water, made alkaline with baryta and shaken with ether, the ether will contain jaborine, the aqueous solution will contain pilocarpidine and *jaboric acid*. *Jaborine* separates from alcohol or ether in a brown mass, which changes to a brittle resinous solid. Its composition is considered to be $C_{22}H_{32}N_4O_4$; it has exactly twice the molecular formula of pilocarpine. It is insoluble in water, but dissolves readily in ether, and is soluble in jaboric acid. *Jaboric acid*, $C_{19}H_{26}N_2O_5$, is separated from pilocarpidine by precipitating with excess of silver nitrate, which forms a curdy precipitate of the composition $C_{19}H_{24}N_2O_5$, $AgNO_3$. Jaboric acid resembles jaborine in appearance, but is very soluble in water, and is not removed from its aqueous solution by ether.[1] Pilocarpine combines with acids, and a number of the salts are to be had in commerce. The nitrate has probably been used most frequently, and it and the hydrochloride are now official. Gerrard tested the solubilities of several of the salts as follows. The *nitrate* is soluble in water, sparingly in cold but freely in boiling alcohol; it is insoluble in chloroform, benzene, carbon disulphide, and ether. The *phosphate* is soluble in water, sparingly in cold, more freely in boiling alcohol, from which on cooling it crystallizes in lustrous tables; it is insoluble in ether, chloroform, benzene, and carbon disulphide. The *hydrochloride* is freely soluble in water, alcohol and chloroform; insoluble in ether, benzene, and carbon disulphide. The *acetate* is soluble in water, alcohol, chloroform, benzene, and ether; insoluble in carbon disulphide. The *hydrobromide* is soluble in water, alcohol, and chloroform; insoluble in ether and carbon disulphide. The U. S. P. (8th Rev.) introduced the following:

Assay.—"Pilocarpus, in No. 60 powder, *ten grammes;* Chloroform, Ammonia Water, Normal Sulphuric Acid V.S., Tenth-normal Sulphuric Acid V.S., Fiftieth-normal Potassium Hydroxide V.S., Cochineal T.S. or Iodeosin T.S., each, *a sufficient quantity.* Moisten the Pilocarpus with 2 Cc. of ammonia water and 3 Cc. of chloroform, and at once pack it

It may be of interest to mention here the relative percentage of alkaloids in the foregoing varieties, according to E. M. Holmes. (*P. J.*, lv.)

Jaborandi.	Per cent.
Pernambuco (*P. jaborandi*)	0.5 to 0.8 pilocarpine nitrate.
Paraguay (*P. pennatifolius*, etc.)	0.18 to 0.19 pilocarpine nitrate.
Maranham (*P. microphyllus*)	0.16 to 0.19 pilocarpine nitrate.
Maranham (*P. microphyllus*)	up to 0.8 alkaloidal nitrate.
Ceará (*P. trachylophus*)	0.02 new alkaloid (?)
Aracati (*P. spicatus* ?)	uncertain.

(See also *Proc. A. Ph. A.*, 1895, 266.)

[1] According to the researches of E. Harnack, *pilocarpidine* acts upon the animal organism in the same way as pilocarpine, but is somewhat less powerful.

firmly in a small cylindrical percolator, which has been provided with a pledget of cotton packed firmly in the neck. Percolate the powder slowly with chloroform containing about 2 percent. of ammonia water, until it is exhausted, about 100 Cc. of menstruum usually being sufficient. Pour into a separator the percolate, and shake it out with 15 Cc. of normal sulphuric acid V.S., transferring the acid aqueous layer to another separator, and repeating the shaking out of the chloroform solution with 2 Cc. of normal sulphuric acid V.S., mixed with 8 Cc. of distilled water. Add the acid layer to the second separator, and again repeat the shaking out with 10 Cc. of distilled water, and add the aqueous liquid to the second separator. Introduce into the second separator a small piece of red litmus paper, add enough ammonia water to render the liquid alkaline, and shake out the liquid with 20 Cc. of chloroform, drawing off the chloroformic solution into a beaker. Repeat the shaking out with two portions of 15 and 10 Cc. each of chloroform, and add the chloroformic solutions to the beaker. Evaporate the chloroform by means of a water-bath, and dissolve the alkaloidal residue in 7 Cc. of tenth-normal sulphuric acid V.S. Add 5 drops of cochineal T.S. or iodeosin T.S., and titrate the excess of acid with fiftieth-normal potassium hydroxide V.S. Divide the number of cubic centimeters of fiftieth-normal potassium hydroxide V.S. used, by 5, subtract the quotient from 7 (the 7 Cc. of tenth-normal sulphuric acid V.S. taken), and multiply the remainder by 0.02, and this product by 10; the result will be the percentage of alkaloids contained in the Pilocarpus. The figure 0.02 represents the weight in grammes of alkaloids (mainly pilocarpine) required to neutralize 1 Cc. of tenth-normal sulphuric acid V.S." *U. S.*

An essential oil of sp. gr. 0.875, and boiling between 180° and 290° C., has been obtained by Schimmel & Co., in Leipsic. (*Ber. d Chem. Ges.*, April, 1888.) The portions going over above 260° C. solidified on cooling, and yielded a solid hydrocarbon, which fuses at 27° to 28° C. As it decolorizes notable amounts of bromine when in solution in petroleum benzin, it probably belongs to the olefine series. The yield of oil in pilocarpus is about 0.4 per cent. In a later report (Oct. 1893) they give as a probable constituent of the lower boiling portions of the oil, *dipentene*, $C_{10}H_{16}$. The total amount of essential oil varies, according to the freshness of the plant, from 0.2 to 1.1 per cent.

Uses.—When an infusion containing sixty to ninety grains of jaborandi is given to an adult, in about ten minutes the face and neck become deeply flushed, and free perspiration and salivation commence. After a hypodermic injection of the alkaloid, the symptoms may set in in six minutes. The sweating begins on the face; both it and the salivation are excessively profuse, and last from three to five hours. There is frequently nausea, and sometimes vomiting. The pulse is generally more or less quickened, as is also usually the respiration. After the sweating has ceased, the patient is left more or less exhausted. The nasal and lachrymal secretions are very generally increased under the action of the drug, and Gubler has noted diarrhœa. There is sometimes contraction of the pupils, and even disturbance of vision. These effects of the drug are in the adult fairly constant, but subjects have been occasionally found who were not susceptible to the action of the remedy, and, very curiously, in Ringer's experiments children were found to be very insusceptible, although doses of sixty grains were employed. Schwann and subsequent observers have noticed in the lower animals that very violent intestinal peristalsis is produced by the drug. The sweat produced by jaborandi is often enormous in quantity (from nine to fifteen ounces by estimation). It is stated to be at first acid, then neutral, and finally often clearly alkaline, as is also the saliva. Not only the aqueous but also the solid portions are increased, and the elimination of urea is said especially to be affected. Usually, but not always, when the drug acts very moderately upon the skin the salivary glands are but slightly affected, and *vice versa*. The cause of the excessive secretion is a direct action upon either the gland cells or the peripheral nerve endings, most probably upon the former. In the first stages of sweating the bodily temperature sometimes rises, but it usually falls after the sweating.

When applied to the eye, pilocarpine produces great contraction of the pupil, tension of the accommodative apparatus, and an approximation of the nearest and farthest points of distinct vision, by a peripheral action. It is stated to produce less irritation than Calabar bean.

Jaborandi is the most reliable and powerful of the diaphoretics. In *dropsies* it has been widely employed, and certainly is a most efficient remedy. Great value has been ascribed to it in facilitating the removal of local aqueous effusions, such as occur in *pleurisy* and *pulmonic œdema*. In *uræmia* it is the most efficient remedy at our command. In the forming stage of subacute *rheumatism, coryza, influenza,* and similar conditions, pilocarpine may be very useful. In *acute* or *chronic Bright's disease* it is of great value, sufficing in the one case to bring about convalescence, and in the other greatly to prolong life and make it comfortable. The sweats may be repeated daily, biweekly, or weekly. Recently, the plan of giving very small doses at short intervals as a diuretic has been strongly commended.

Jaborandi is usually given in the form either of the fluidextract or of the alkaloid. The full diaphoretic dose of the fluidextract is from forty to sixty minims (2.5 to 3.75 Cc.), of a salt of pilocarpine one-sixth of a grain (0.01 Gm.). When excessive vomiting is produced by the drug, it is better to administer it

every ten minutes in fractional doses. After the second or third dose, unless contra-indicated, whisky and hot water should be given.

It has been proved by elaborate experimentation that in many of their actions upon the human system pilocarpine and atropine are directly antagonistic, and in poisoning by jaborandi or its alkaloid, atropine has the power to arrest the excessive secretion and save life. The value of pilocarpine in atropine poisoning is not quite so certain, but there is enough evidence to demand further trial of it. Purjesz of Buda-Pesth, reports (*Centralb. für Prakt. Augenhk.*, 1880) a case in which two and a half grains of atropine sulphate were said to have been taken, and relief, with final recovery, was secured by hypodermic injections of 0.4 grain of pilocarpine every ten minutes until 6.4 grains had been administered. For other similar but less striking cases, see *B. M. J.*, Jan. 1887; *L. L.*, July, 1890.

Dose, of jaborandi, from twenty to sixty grains (1.3 to 3.9 Gm.).

Off. Prep.—Fluidextractum Pilocarpi, *U. S.* (*Br.*); Tinctura Jaborandi, *Br.*

PILULÆ.

PILLS

(pil'ù-læ)

Pilules, *Fr.*; Pillen, *G.*; Pillole, *It.*; Píldoras, *Sp.*

These are globular masses of a size convenient for swallowing. They are well adapted for the administration of medicines which are unpleasant to the taste or smell, or insoluble in water, and which do not require to be given in large doses. Deliquescent substances should not be made into pills, and those which are efflorescent should be previously deprived of their water of crystallization. Care should be taken not to combine materials the mutual reaction of which may result in a change of form.

Some substances have a consistence which enables them to be made immediately into pills. Such are the softer extracts and certain gum-resins, and the addition of a little water to the former, and of a few drops of alcohol to the latter, will give them the requisite softness and plasticity, if previously wanting. Substances which are very soft, or in the liquid state, are formed into the pilular mass by incorporation with dry and inert powders, such as wheat flour, starch, and powdered gum arabic, or with crumb of bread. Powders must be mixed with soft, solid bodies, as extracts, confections, soap, etc., or with tenacious liquids, as syrup, molasses, honey, mucilage or glycerin and the last-mentioned substance has been especially recommended in connection with a little alcohol. Heavy metallic powders are most conveniently made into pills with the former; light vegetable powders with the latter. Mucilage is very often used, but pills made with it are apt when kept to become hard and of difficult solubility in the liquids of the stomach, and if metallic substances are mixed with it the mass does not work well. A mixture of syrup and powdered gum arabic is not subject to the same inconveniences, and is an excellent material for the formation of pills. Honey evaporated to about half its bulk has been highly recommended. Confection of rose and glucose are among the best excipients, when the pills are to be kept long. For the same purpose of keeping the pills soft, the addition of a small portion of some fixed oil or deliquescent salt has been recommended, but glycerin is still better. Glycerin incorporated with one-twenty-fifth of its weight of powdered tragacanth is said to cause pills to remain soluble for almost any length of time. The official mucilage of tragacanth is an excellent excipient. Martindale prepares a mass by heating together with constant stirring to 115.5° C. (240° F.) five parts by weight of glycerin and one of flour, or, when a very firm mass is required, equal parts of flour and glycerin. (*P. J.*, 3d ser., i. 412.) It has been objected that pills made with glycerin could not be handsomely gilded or silvered, the lustre of the metal disappearing. This is true, however, only of very recent pills, or of those in which an excess of glycerin has been used. Many powders require only water. Such are all those which contain ingredients capable of forming an adhesive or viscid solution with the liquid. Care should always be taken that the substance added is not incompatible with the main constituents of the pill.

The materials should be accurately mixed together, and beaten in a mortar until formed into a perfectly uniform and plastic mass. This should be of such a consistence that the pills may preserve their form, without being so hard as to resist the solvent power of the gastric fluids. As pills frequently become very hard by time, it is often convenient to keep the mass in a state fit to be divided when wanted for use. This may be done by wrapping it in waxed paper, putting it in covered pots, and occasionally moistening it as it becomes dry, or, more effectually, by keeping it in glass or well glazed jars, accurately closed with rubber cloth. The mass is made into pills by rolling it with a spatula, or with a flat, smooth piece of hard wood, into a cylinder of precisely the same thickness throughout, and of a length corresponding to the number of pills required. It is then divided as equally as possible by the hand, or, more accurately, by a machine.[1] The pills receive a spherical form

[1] The common pill machine is too well known to require description. In *A. J. P.* (xxiv. 315) the reader will find the description of a rotary pill machine, calculated to prepare large numbers of pills in a short time, and in the same journal (xxvi. 118) that of another, which is considered an improvement on the first. (See also *A. J. P.*, Jan. 1869.) For illustrations and description of pill machines for making large quantities of pills at one time, see Remington's *Practice of Pharmacy*, 4th edition, p. 1219.

by being rolled between the fingers. Mialhe describes a little instrument for rolling pills, composed of two circular plates, one about 12 inches, the other 6, in diameter, the former having a ledge at the border one-third of an inch high, the latter with a similar ledge, varying, according to the size of the pills, from less than a line to nearly two lines, and with a strap on the back by which it can be fitted to the hand. This is to be moved in a rotary manner upon the larger plate, holding the divided portions of the pill mass. (*J. P. C.*, 3e sér., xvii. 218.) Similar pill rollers made of wood are now in use. In order to prevent the adhesion of pills to one another, or to the sides of the vessel in which they may be placed, it is customary to agitate them with some dry powder, which gives them an external coating, that serves also to conceal their taste. For this purpose magnesium carbonate, rice flour, or starch may be used. Magnesium carbonate is sometimes incompatible with one of the ingredients of the pills, and licorice root is then preferable, though it occasionally becomes mouldy with very damp pills. The powder of lycopodium, which has been long in use in Europe, is now considerably employed in this country, and is perhaps one of the best substances for the purpose. It is the custom in some sections of the United States, particularly on the Pacific coast, to give the pill a coating of gold or silver leaf. This is done by agitating the pills, prepared without dusting powder, and with their surface still damp, or coated with a very small quantity of mucilage, with gold or silver leaf, in a hollow spherical wooden box made by turning two hemispheres out of hard wood, fitting each other, and provided with a short handle.

It was proposed by Garot to cover pills with gelatin, which answers the purpose of concealing their taste and odor and counteracting deliquescence or chemical change from exposure to the air, but it sometimes interferes with their solubility in the stomach. This method of coating is largely used at the present time. One of the best machines that have been devised for gelatin coating pills is that of H. Maynard of Chicago. This consists of a circular plate in which are affixed twenty fine needles; the pills are rolled into depressions, and are easily impaled on the points of the needles; they are then dipped into a solution of gelatin, gently rotated, and allowed to cool. Another plan, less effectual, but more convenient, is to introduce the pills into a spherical box, to drop on them enough syrup simply to moisten their surface, then to give a rotary movement to the box until the pills are uniformly covered, and finally to add by degrees either powdered French chalk, elm bark, or some similar substance, shaking the box with each addition, and continuing the process until nothing more will adhere to the pills. The investing material may be rendered agreeable to the taste and smell by aromatic additions, if deemed advisable. Calloud found that a good powder for coating pills, because little disposed to attract moisture, is made by boiling one part of flaxseed and three parts of white sugar with sufficient water until a thick mucilage is formed, evaporating this carefully to dryness, and then pulverizing. (*J. P. C.*, xxiii. 301.) The same writer has since suggested, as still more effective, a powder made by forming a mucilage with one part of tragacanth and two parts of water, pressing this through linen, mixing it with twenty parts of sugar of milk, spreading the paste thus made in thin layers to dry, and then powdering. The pills may be simply moistened with water and then shaken in the powder. L'hermite proposed first to agitate the pills in a mortar with a little concentrated solution of gum, and afterwards to put them into a box containing dry and very finely powdered sugar, to which a rotary motion is given. If the coating be not sufficiently thick, the process may be repeated. (*J. P. C.*, xxv. 460.) For a list of excipients for pills by J. Cohn see *Proc. A. Ph. A.*, 1900, 496 from *Ph. Ztg.*, 1900, 221.

The sugar coating of pills is now conducted upon a large scale by manufacturers, who send immense quantities both of popular and of official pills into the market thus protected. The process employed is similar to that of the confectioners in coating almonds. After having been thoroughly dried, the pills are put into a hemispherical tinned copper basin, which is suspended from the ceiling and moved quickly backward and forward with an eccentric motion, so as to cause a constant attrition among the pills. First a little very thick syrup, or syrup of gum, is introduced in order to give a thin coating to their surface, and afterwards very finely powdered and very dry white sugar is sifted or thrown over them, the motion being constantly maintained. The sugar is fixed by the moist surface of the pills, and the coating made compact and smooth by the attrition. The process is aided by a gentle heat, but the heat must be guarded, lest the pills be much softened, and thus lose their shape and even discolor the coating. Dexterous manipulation is necessary in order that the process may succeed thoroughly. For practical remarks on the sugar coating of pills, see an essay by H. C. Archibald in *A. J. P.*, 1867, p. 199, and by Wm. R. Warner, Jr., and T. S. Wiegand in *A. J. P.*, 1902, 32. On a larger scale a copper pill coater of peculiar construction, heated by steam pipes, is now used. Still another method, proposed by E. K. Durden, is to cover the pills with collodion, which completely conceals the taste. The solution employed by Durden had the sp. gr. 0.810, and two dippings gave a sufficient coating. (*A. J. P.*, xxi. 183.) It is, however, yet to be determined whether a coating of collodion would yield readily to the solvent powers of the gastric juice. Blanchard covers pills with

a solution of Tolu balsam in ether, but H. C. Baildon objects to this, that it takes too long to dry, and suggests as a substitute a solution of a drachm of the balsam in three drachms of chloroform, which dries sufficiently in twenty minutes. (*A. J. P.*, xxix. 350.) If old and solid Tolu balsam be selected, it will be less liable to the objection of drying slowly. This balsam is officially employed in coating the U. S. pills of ferrous iodide. A solution of mastic in ether has also been used for coating pills, and the white of egg has been recommended for the same purpose. (*Ibid.*, March, 1862, 137.) Pills are sometimes coated with substances which do not dissolve in the stomach, with the object of permitting the passage of the undissolved pill into the intestines; for this purpose keratin coating has been largely used. (See *Keratin*, PART II, and Remington's *Practice of Pharmacy*, Fourth edition, p. 1232.) *Salol* has also been employed, by melting it in an enamelled pan at a temperature of about 50° C. (132° F.) and dropping in the pills, rotating until covered, and then transferring to a dry pan, still rotating (to prevent adhesion) until cold. For further details, see *D. C.*, 1894, 123; *Ph. Ztg.*, xxxviii. 527.

Pills which are to be kept long should be well dried, and put into bottles with loosely fitting stoppers to prevent mouldiness. Though the U. S. Pharmacopœia, in almost every instance, orders the mass to be divided into pills, yet it should be understood rather as indicating the number of pills to be made from a certain quantity of the mass, when particular directions are not given by the physician, than as requiring the division to be made immediately after the materials have been mixed. It will be found convenient by the apothecary to retain a portion of the mass undivided, especially when it is desirable to keep the pills soft. The British Pharmacopœia furnishes formulas for pill masses, using the title of "Pilula" instead of "Massa," the title of the class adopted by the U. S. Pharmacopœia; there is, in our opinion, a decided advantage in selecting a name for the class which is not likely to be confused with that used for the divided pills.

Compressed pills are made directly from the medicinal substance without the aid of an excipient. The drug, if not already in granular powder, is made so, and then forced into pill shape by means of a powerful press. For certain substances which are crystalline in structure, such as quinine bisulphate, potassium bromide, and potassium iodide, and which have some cohesiveness and yet are of easy solubility, the process is a good one. An apparatus has been contrived by J. P. Remington for compressing pills (see 16th ed. U. S. D., and *Practice of Pharmacy*, 4th ed., page 1233). It is made of cast steel; the base has two countersunk depressions with a short post in the centre of each, and a lenticular depression is made in the upper surface of each post. A steel cylinder having a central aperture of the diameter of the post is placed in the depression, the proper quantity of powder is introduced, and the plunger, which has a corresponding lenticular depression on its lower surface, is placed on the powder and is struck a quick blow with a mallet; the powder is compressed, and the pill adheres to the cylinder; by removing the cylinder and holding it over a box and tapping the plunger again lightly, the pill is forced out and falls into a box.

Compressed tablets are now used to an enormous extent, being made by various manufacturers with machinery of ingenious construction; the fact of their requiring no excipient, the ease with which they can be tested, and their permanent character (in most cases being just as valuable years after they were made as when fresh) have caused their extensive employment. Care should be taken, however, not to use them in those few cases where very prompt action is required, as the powerful compression to which they are subjected renders them less quickly effective than the same drug administered in the form of a loose powder.

PILULÆ ALOES. U. S. (Br.)

PILLS OF ALOES

(pĭl′ū-læ ăl′ō-ēs)

Pilula Aloes Barbadensis, *Br.*; Pill of Barbados Aloes, Pill of Socotrine Aloes; Pilules d'Aloès et de Savon, *Fr. Cod.*; Pilules Aloétiques Savoneuses, *Fr.*; Aloepillen, *G.*

"Purified Aloes, in fine powder, *thirteen grammes* [or 201 grains]; Soap, in fine powder, *thirteen grammes* [or 201 grains]; Water, *a sufficient quantity*, to make *one hundred pills*. Mix the powders intimately, then incorporate sufficient Water to form a mass, and divide it into *one hundred pills*." *U. S.*

"Barbados Aloes, in powder, 2 *ounces* (Imperial) or 40 grammes; Hard Soap in powder, 1 *ounce* (Imp.) or 20 grammes; Oil of Caraway, 1 *fl. drachm* (Imp. meas.) or 2.5 cubic centimetres; Confection of Roses, 1 *ounce* (Imp.) or 20 grammes or a sufficient quantity. Mix to form a mass." *Br.*

The former British process for *Pill of Socotrine Aloes* was the same except that Socotrine was substituted for Barbados Aloes, and the volatile Oil of Nutmeg for Oil of Caraway.

The soap, in this formula, not only serves to impart a proper consistence to the aloes, but is thought to qualify its operation and diminish its liability to irritate the rectum. Five of the U. S. pills, containing ten grains (0.65 Gm.) of aloes, may be given with a view to their purgative effect, but the preparation is usually employed as a laxative in *habitual costiveness*.

Dose, one, two or three pills at bedtime. The British pill mass is of very nearly the same strength as that of the U. S. Pharmacopœia.

PILULA ALOES ET ASAFETIDÆ. Br.

PILLS OF ALOES AND ASAFETIDA

(pĭl'ŭ-lą ăl'ọ-ēṣ ĕt ăs-ą-fĕt'ị-dæ)

Pilules d'Aloès et d'Asefétide, *Fr.;* Aloe- und Asafœtida-Pillen, *G.*

A process for these pills was not retained in the U. S. P. (8th Rev.);[1] the British process is as follows:

"Socotrine Aloes, in powder, 1 *ounce* (Imperial) or 20 grammes; Asafetida, in powder, 1 *ounce* (Imp.) or 20 grammes; Hard Soap, in powder, 1 *ounce* (Imp.) or 20 grammes; Confection of Roses, 1 *ounce* (Imp.) or 20 grammes or a sufficient quantity. Mix to form a mass." *Br.*

Pills made from this mass are peculiarly adapted, by the stimulant and carminative properties of the asafetida, to cases of *costiveness* attended with flatulence and debility of the digestive organs.

Dose, about four grains (0.26 Gm.) of the mass.

PILULÆ ALOES ET FERRI. U. S. (Br.)

PILLS OF ALOES AND IRON

(pĭl'ŭ-læ ăl'ọ-ēṣ ĕt fĕr'rī)

Pilula Aloes et Ferri, *Br.;* Pilulæ Italicæ Nigræ; Pilules d'Aloès et de Fer, *Fr.;* Pilulæ Aloeticæ ferratæ, *P. G.;* Eisenhaltige Aloepillen, Aloe- und Eisenpillen, Italienische Pillen, *G.*

* "Purified Aloes, in fine powder, *seven grammes* [or 108 grains]; Exsiccated Ferrous Sulphate, *seven grammes* [or 108 grains]; Aromatic Powder, *seven grammes* [or 108 grains]; Confection of Rose, *a sufficient quantity,* to make *one hundred pills.* Mix the powders intimately, then incorporate sufficient Confection of Rose to form a mass, and divide it into *one hundred pills." U. S.*

"Exsiccated Ferrous Sulphate, 1 *ounce* (Imperial) or 20 grammes; Barbados Aloes, in powder, 2 *ounces* (Imp.) or 40 grammes; Compound Powder of Cinnamon, 3 *ounces* (Imp.) or 60 grammes; Syrup of Glucose, 3 *ounces* (Imp.) or 60 grammes or a sufficient quantity. Mix to form a mass." *Br.*

This pill differs from the preparation of the same name in the British Pharmacopœia in the substitution of aromatic powder for the compound powder of cinnamon. It is essentially an old preparation of the Edinburgh Pharmacopœia, was omitted in the original British, and re-introduced and continued in the present edition. The Br. Pharm. 1898 improved this mass by substituting exsiccated ferrous sulphate for the crystallized salt formerly employed, and by the use of syrup of glucose instead of confection of rose. It is said that the laxative power of aloes is increased, and its tendency to irritate the rectum diminished, by combination with ferrous sulphate. This pill is especially adapted to *amenorrhœa* with debility of the stomach and constipation.

Dose, from one to three pills.

[1] *Pills of Aloes and Asafetida,* U. S. P. 1890. "Purified Aloes, in fine powder, *nine grammes* [or 139 grains]; Asafetida, *nine grammes* [or 139 grains]; Soap, in fine powder, *nine grammes* [or 139 grains]; Water, *a sufficient quantity,* to make *one hundred pills.* Beat the solids together with Water, so as to form a mass, and divide it into *one hundred pills." U. S.* 1890.

PILULÆ ALOES ET MASTICHES. U. S.

PILLS OF ALOES AND MASTIC [Lady Webster Pills]

(pĭl'ŭ-læ ăl'ọ-ēṣ ĕt măs'tị-ċhēṣ)

Lady Webster's Dinner Pills; Pilules d'Aloès et de Mastic, *Fr.;* Aloe- und Mastix-Pillen, *G.*

* "Purified Aloes, in fine powder, *thirteen grammes* [or 201 grains]; Mastic, in fine powder, *four grammes* [or 62 grains]; Red Rose, in fine powder, *three grammes* [or 46 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one hundred pills.* Mix the powders intimately, then incorporate sufficient Diluted Alcohol to form a mass, and divide it into *one hundred pills." U. S.*

In the U. S. P. 1890 pill the proportion of mastic was slightly increased and that of red rose somewhat diminished. The same formula has been retained in the 8th Revision. Each of these pills contains about three grains of the solid ingredients and nearly two grains (0.13 Gm.) of aloes. They are in imitation of Lady Webster's dinner pills, and one of them may be given as a laxative at bedtime, or before a meal. The mastic has probably little other effect than to impair the solubility of the aloes, and thus give it a still greater tendency to act on the lower bowels.[1]

Dose, one to three pills.

[1] The following is the formula for the aloetic pills usually called *dinner pills* or *Lady Webster's pills.* They are the *Pilulæ Stomachicæ* of the fifth edition of the Paris Codex, 1758. Take of the best aloes six drachms; mastic and red roses, each, two drachms; syrup of wormwood sufficient to form a mass, to be divided into pills of three grains each. Common syrup may be used instead of syrup of wormwood. One or two of these pills, taken a short time before a meal, or at night, will usually produce one free evacuation.

The Philadelphia College of Pharmacy has adopted the following formulas for the compound aloetic preparations commonly called *Hooper's* and *Anderson's pills:*

"*Hooper's Female Pills.*—Barbados Aloes, 8 oz. troy; Exsiccated Ferrous Sulphate, 2 oz. troy, 90 grains (or Crystal Ferrous Sulphate, 4 oz. troy); Extract of Black Hellebore, 2 oz. troy; Myrrh, 2 oz. troy; Soap, 2 oz. troy; Canella, 1 oz. troy; Ginger, 1 oz. troy; all finely powdered. Beat the ingredients well together into a mass with water, and divide into pills, each containing two and a half grains." (*A. J. P.,* v. 25.)

"*Anderson's Scots Pills.*—Barbados Aloes, 24 oz. troy; Soap, 4 oz. troy; Colocynth, 1 oz. troy; Gamboge, 1 oz. troy; Oil of Anise, ½ fluidounce. Let the aloes, colocynth, and gamboge be reduced to a very fine powder; then beat them and the soap with water into a mass, of a proper consistence to divide into pills, each containing three grains."

PILULÆ ALOES ET MYRRHÆ. U. S. (Br.)

PILLS OF ALOES AND MYRRH

(pĭl'ū-læ ăl'ō-ēs ĕt mŭr'rhæ)

Pilula Aloes et Myrrhæ, *Br.;* Rufus's Pills; Pilules d'Aloès et de Myrrhe, Pilules de Rufus, *Fr.;* Rufussche Pillen, *G.*

* "Purified Aloes, in fine powder, *thirteen grammes* [or 201 grains]; Myrrh, in fine powder, *six grammes* [or 93 grains]; Aromatic Powder, *four grammes* [or 62 grains]; Syrup, *a sufficient quantity,* to make *one hundred pills.* Mix the powders intimately, then incorporate sufficient Syrup to form a mass, and divide it into *one hundred pills.*" *U. S.*

"Socotrine Aloes, in powder, 2 *ounces* (Imperial) or 40 grammes; Myrrh, in powder, 1 *ounce* (Imp.) or 20 grammes; Syrup of Glucose, 1½ *ounces* (Imp.) or 30 grammes or a sufficient quantity. Mix to form a mass." *Br.*

In the U. S. Pharm 1890 pill the proportion of myrrh was slightly decreased and that of aromatic powder somewhat increased. The formula has not been changed in the new Pharmacopœia. The Br. Pharm. 1898 dropped saffron, treacle, and glycerin from the formula used in former Pharmacopœias, and substituted for them syrup of glucose.

This composition has been long in use, under the name of *Rufus's Pills.* It is employed, as a warm stimulant cathartic, in *general debility* attended with *constipation,* and in *retention or suppression of the menses.*

Dose, three to six pills.

PILULA ALOES SOCOTRINÆ. Br.

PILL OF SOCOTRINE ALOES

(pĭl'ū-lą ăl'ō-ēs sŏc-ō-trī'næ)

"Socotrine Aloes, in powder, 2 *ounces* (Imperial) or 40 grammes; Hard Soap, in powder, 1 *ounce* (Imp.) or 20 grammes; Oil of Nutmeg, 1 *fl. drachm* (Imp. meas.) or 2.5 cubic centimetres; Confection of Roses, 1 *ounce* (Imp.) or 20 grammes or a sufficient quantity. Mix to form a mass." *Br.*

For properties and dose, see *Pilulæ Aloes,* p. 952.

PILULÆ ASAFŒTIDÆ. U. S.

PILLS OF ASAFETIDA

(pĭl'ū-læ ăs-ą-fœt'ĭ-dæ)

Pilules d'Asefétide, *Fr.;* Asafœtida-Pillen, *G.*

* "Asafetida, *twenty grammes* [or 309 grains]; Soap, in fine powder, *six grammes* [or 93 grains]; Water, *a sufficient quantity,* to make *one hundred pills.* Beat the solids together with Water, so as to form a mass, and divide it into *one hundred pills.*" *U. S.*

Each of these pills contains three grains (0.20 Gm.) of the gum-resin. They are a convenient form for administering asafetida, the unpleasant odor and taste of which render it very offensive in the liquid state.

Dose, one to three pills.

PILULA CAMBOGIÆ COMPOSITA. Br.

COMPOUND PILL OF GAMBOGE

(pĭl'ū-lą cąm-bō'gĭ-æ cọm-pŏs'ĭ-tą)

Pilules de Gomme-gutte composées, *Fr.;* Gummiguttpillenmasse, *G.*

"Gamboge, in powder, 1 *ounce* (Imperial) or 25 grammes; Barbados Aloes, in powder, 1 *ounce* (Imp.) or 25 grammes; Compound Powder of Cinnamon, 1 *ounce* (Imp.) or 25 grammes; Hard Soap, in powder, 2 *ounces* (Imp.) or 50 grammes; Syrup of Glucose, 1 *ounce* (Imp.) or 25 grammes or a sufficient quantity. Mix to form a mass." *Br.*

This is an active purgative pill, and may be given in the *dose* of from five to fifteen grains (0.32 to 1 Gm.). The simplified formula is that of George Fordyce.

PILULÆ CATHARTICÆ COMPOSITÆ. U. S.

COMPOUND CATHARTIC PILLS

(pĭl'ū-læ cą-thär'tĭ-çæ cọm-pŏs'ĭ-tæ)

Antibilious Pills; Pilules cathartiques composées, *Fr.;* Abführpillen, *G.*

* "Compound Extract of Colocynth, *eighty grammes* [or 2 ounces av., 360 grains]; Mild Mercurous Chloride, *sixty grammes* [or 2 ounces av., 51 grains]; Resin of Jalap, in fine powder, *twenty grammes* [or 309 grains]; Gamboge, in fine powder, *fifteen grammes* [or 231 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand pills.* Mix the powders intimately, then incorporate a sufficient quantity of Diluted Alcohol to form a mass, and divide it into *one thousand pills.*" *U. S.*

This cathartic compound was first made official in the second edition of the U. S. Pharmacopœia. It was intended to combine smallness of bulk with efficiency and comparative mildness of purgative action and a peculiar tendency to the biliary organs. Such an official preparation was much wanted in this country, in which bilious fevers, and other complaints attended with congestion of the liver and portal circle generally, so much abound. The object of smallness of bulk is accomplished by employing extracts and the more energetic cathartics; that of a peculiar tendency to the liver, by the use of calomel, and that of efficiency with mildness of operation, by the union of several powerful purgatives. It is a fact, abundantly proved by experience, that drastic cathartics become milder by com-

bination, without losing any of their purgative power. Nor is it difficult, in this case, to reconcile the result of observation with physiological principles. Cathartic medicines act on different parts of the alimentary canal and organs secreting into it. In small doses, both the irritation which they occasion and their purgative effect are proportionately lessened. If several are administered at the same time, each in a diminished dose, it is obvious that the combined purgative effect of all will be experienced, while the irritation, being feeble in each part affected, and diffused over a large space, will be less sensible to the patient, and will more readily subside. In the compound cathartic pills, most of the active purgatives in common use are associated together in proportions corresponding with their respective doses, so that an excess of any one ingredient is guarded against, and violent irritation from this cause prevented. The present official process does not differ from that of the U. S. P. 1890, except in the substitution of the resin of jalap for the extract, the latter being no longer official, and in the use of diluted alcohol as an excipient in place of water. This, however, does not alter the composition, and it makes a smaller pill. It is highly important for the efficiency of these pills that they be prepared in exact compliance with the directions, and that the *compound extract of colocynth* and the *resin of jalap* used be of good quality. When they fail, the result is generally ascribable to the substitution of jalap for the resin, or to the use of a compound extract of colocynth made with nearly inert scammony, inferior aloes, and insufficient colocynth, and altogether badly prepared. (See a paper by G. H. Chas. Klie, *A. J. P.*, April, 1878.)

Each pill weighs about 3 grains (0.194 Gm.), and contains 2.70 grains (0.175 Gm.) of active ingredients. A single pill will generally be found to operate as a mild laxative. In a full dose, the preparation acts vigorously on the bowels, producing bilious stools, generally without much pain or disorder of the stomach. It may be employed in most instances where a brisk cathartic is required, but is particularly applicable to the early stages of *bilious fevers*, to *hepatitis*, *jaundice*, and all those derangements which depend on congestion of the portal circle.

Dose, one to three pills.

PILULÆ CATHARTICÆ VEGETABILES. U. S.

VEGETABLE CATHARTIC PILLS

(pĭl'ū-læ cą-thär'tĭ-çæ vĕg-ę-tăb'ĭ-lēs)

Pilules cathartiques végétables, *Fr.*; Vegetabilische Abführpillen, *G.*

* "Compound Extract of Colocynth, *sixty grammes* [or 2 ounces av., 51 grains]; Extract of Hyoscyamus, *thirty grammes* [or 1 ounce av., 25 grains]; Resin of Jalap, in fine powder, *twenty grammes* [or 309 grains]; Extract of Leptandra, *fifteen grammes* [or 231 grains]; Resin of Podophyllum, *fifteen grammes* [or 231 grains]; Oil of Peppermint, *eight cubic centimeters* [or 130 minims]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand pills*. Mix the Compound Extract of Colocynth intimately with the Resin of Podophyllum, Resin of Jalap, and Extract of Leptandra, and then add the Oil of Peppermint. Rub the Extract of Hyoscyamus with enough Diluted Alcohol to render it plastic, then incorporate it with the mixture first prepared, using a sufficient quantity of Diluted Alcohol to form a mass, and divide it into *one thousand pills*." *U. S.*

This pill was introduced into the U. S. P. 1890 with the view of furnishing a formula for a cathartic pill without a mercurial. The U. S. P. (8th Rev.) process substituted resin of jalap for the extract and diluted alcohol for water as in the compound cathartic pill (see above). The oil of peppermint and extract of hyoscyamus are added to the cathartics to prevent griping. The dose is three pills, and they may be given in the place of compound cathartic pills.

Dose, one to three pills.

PILULA COLOCYNTHIDIS COMPOSITA. Br.

COMPOUND PILL OF COLOCYNTH

(pĭl'ū-lą cŏl-ǫ-cȳn'thĭ-dīs cǫm-pŏs'ĭ-tą)

Cochia Pills; Pilules de Coloquinte composées, *Fr. Cod.*; Pilules cochées mineures, *Fr.*; Zusammengesetzte Koloquinten-Pillen, *G.*

"Colocynth Pulp, in powder, 1 *ounce* (Imperial) or 20 grammes; Barbados Aloes, in powder, 2 *ounces* (Imp.) or 40 grammes; Scammony Resin, in powder, 2 *ounces* (Imp.) or 40 grammes; Potassium Sulphate, in very fine powder, ½ *ounce* (Imp.) or 5 grammes; Oil of Cloves, 2 *fl. drachms* (Imp. meas.) or 5 cubic centimetres; Distilled Water, *a sufficient quantity*. Triturate the Oil of Cloves with the Potassium Sulphate; add the Colocynth Pulp; mix; add the Barbados Aloes and Scammony Resin; after mixing intimately add the Distilled Water and beat to form a mass." *Br.*

This is not, like the old London pills of the same name, merely another form of the compound extract of colocynth, though containing essentially the same materials,—one great difference being that colocynth and aloes are used in substance in the pill, instead of in the state of extract. Potassium sulphate is used to promote the more complete division of the aloes and scammony. The preparation is actively cathartic.

Dose, from five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Pilula Colocynthidis et Hyoscyami, *Br.*

PILULA COLOCYNTHIDIS ET HYOSCYAMI. Br.

PILL OF COLOCYNTH AND HYOSCYAMUS

(pĭl'ŭ-lą cŏl-o-cўn'thĭ-dĭs ĕt hў-ọs-cў'ą-mī)

Pilules de Coloquinte et d'Extrait de Jusquiame, *Fr.;* Koloquinten-Bilsenkrautpillenmasse, *G.*

"Compound Pill of Colocynth, 2 *ounces* (Imperial) or 50 grammes; Extract of Hyoscyamus, 1 *ounce* (Imp.) or 25 grammes. Mix to form a mass." *Br.*

This was an official pill of the Edinburgh College. It is asserted that the compound pill and compound extract of colocynth are almost entirely deprived of their griping tendency by combination, as above, with extract of hyoscyamus, without losing any of their purgative power.

Dose, from five to twenty grains (0.32 to 1.3 Gm.).

PILULÆ FERRI CARBONATIS. U. S. (Br.)

PILLS OF FERROUS CARBONATE [Ferruginous Pills, Chalybeate Pills, Blaud's Pills]

(pĭl'ŭ-læ fĕr'rī cär-bọ-nā'tĭs)

Pilula Ferri, *Br.;* Iron Pill; Pilules Ferrugineuses de Blaud, *Fr. Cod.;* Pilules Chalybés de Blaud, *Fr.;* Pilulæ Ferri carbonici Blaudii, *P. G.;* Blaudsche Pillen, *G.;* Pillole di carbonato ferroso, *It.;* Píldoras de Blaud, *Sp.*

* "Granulated Ferrous Sulphate, *sixteen grammes* [or 247 grains]; Potassium Carbonate, *eight grammes* [or 123 grains]; Sugar, *four grammes* [or 62 grains]; Tragacanth, in fine powder, *one gramme* [or 15.5 grains]; Althæa, in No. 60 powder, *one gramme* [or 15.5 grains]; Glycerin, Water, each, *a sufficient quantity,* to make *one hundred pills.* Rub the Potassium Carbonate, in a mortar, with a sufficient quantity (about *ten drops* each) of Glycerin and Water, then add the Ferrous Sulphate and Sugar, previously triturated together to a uniform powder, and rub the mass thoroughly, until it assumes a greenish color. When the reaction has terminated, incorporate the Tragacanth and Althæa, and, if necessary, add a little more Water, so as to obtain a mass of pilular consistence. Divide this into *one hundred pills.* These pills should be freshly prepared when wanted." *U. S.*

"Exsiccated Ferrous Sulphate, in fine powder, 150 *grains* or 15 grammes; Exsiccated Sodium Carbonate, in fine powder, 95 *grains* or 9.5 grammes; Gum Acacia, in powder, 50 *grains* or 5 grammes; Tragacanth, in powder, 15 *grains* or 1.5 grammes; Syrup, 150 *grains* or 15 grammes; Glycerin, 10 *grains* or 1 gramme; Distilled Water, 20 *grains* or 2 grammes or a sufficient quantity. To the Syrup, Glycerin, and Distilled Water, previously mixed, add the Ferrous Sulphate; mix; add quickly the Sodium Carbonate; mix; set aside for fifteen minutes, or until the reaction is complete; add the Gum Acacia and Tragacanth, and incorporate thoroughly. If divided into five-grain pills, each pill will contain about 1 grain of ferrous carbonate." *Br.*

In the Br. Pharm. 1898 exsiccated ferrous sulphate and sodium carbonate replace the crystallized salts of the former authority.

In the U. S. P. 1890 the name of this pill was changed to *Pilulæ Ferri Carbonatis* and the *Pilulæ Ferri Compositæ* of the U. S. P. 1880 was dropped,[1] which sometimes led to a complication; the U. S. P. 1890 title was retained in the U. S. P. (8th Rev.) as it would lead to confusion to change the name again. It should be remembered, however, that "pills of ferrous carbonate" no longer means pills made from Vallet's Mass but Blaud's pills. Dunning and Hynson (*Proc. A. Ph. A.,* 1901, 177) prefer the formula given in the footnote for these pills.[2]

These pills are closely analogous to the *Mistura Ferri Composita* in properties and composition. They form a good emmenagogue and chalybeate tonic. As their peculiar advantages depend upon the presence of ferrous carbonate, which speedily changes into the ferric salt on exposure, it is proper that only so much of the mass should be prepared as may be wanted for immediate use. They are sometimes called *Griffith's pills.* They closely resemble *Blaud's ferruginous pills,* made originally in 1831, and celebrated in France as a remedy in *chlorosis,* prepared from equal weights of ferrous sulphate and potassium carbonate, made into a pilular mass. (See *P. J.,* 1894, 131.) The pills contain, as the result of double decomposition, ferrous carbonate and potassium sulphate. Van de Velde and Van Melckebeke prefer the sodium bicarbonate to the potassium salt. For a brief historical account of these pills see a paper by John Humphrey in *P. J.,* 1903, 643.

Dose, from two to six pills, to be taken three times a day.

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[1] *Pilulæ Ferri Compositæ, Compound Pills of Iron.* "Myrrh, in fine powder, *one hundred and fifty grains* (9.75 Gm.); Carbonate of Sodium, *seventy-five grains* (4.85 Gm.); Sulphate of Iron, *seventy-five grains* (4.85 Gm.); Syrup, *a sufficient quantity,* to make *one hundred pills.* Rub the Myrrh, first with the Carbonate of Sodium and afterward with the Sulphate of Iron, until they are thoroughly mixed; then beat them with Syrup so as to form a mass, and divide it into *one hundred pills.*" *U. S.* 1880.

[2] Ferrous sulphate, in clear crystals, 240 grains; potassium carbonate, 140 grains; sugar, 20 grains; licorice root, powdered, 100 grains; glucose, sufficient quantity; the following directions for preparation must be closely observed: Rub the ferrous sulphate into fine powder with the sugar, and mix with the potassium carbonate, previously powdered; then rub these mixed powders to a smooth paste, continuing until an almost dry powder results; add the powdered licorice root, and thoroughly mix; mass with glucose, being careful to use sufficient of the latter. Continue the working of mass until it becomes solid and of good pilular consistence, being especially careful that it is kneaded until there is no swelling of the mass. Roll out at leisure. The large amount of glucose not only prevents the pills from oxidizing, but also tends to keep them soft, while, apparently, not increasing their size.

England's formula for Blaud's Pills (*Phila. Med. Journ.,* Jan. 28, 1899) is as follows: Mass of ferrous carbonate, 36 grains; Potassium sulphate, 24 grains; Potassium carbonate, 4 grains; Powdered althea, 1 grain; Powdered acacia, sufficient. Make into 12 pills, and enclose in No. 4 gelatin capsules.

PILULÆ FERRI IODIDI. U. S.

PILLS OF FERROUS IODIDE

(pĭl'ū-læ fĕr'rī ī-ŏd'ĭ-dī)

Pilules d'Iodure ferreux, *Fr. Cod.;* Pilules de Blancard, *Fr.;* Eisenjodürpillen, *G.;* Pillole di protojoduro di ferro, *It.;* Píldoras de yoduro ferroso, *Sp.*

* "Reduced Iron, *four grammes* [or 62 grains]; Iodine, *five grammes* [or 77 grains]; Glycyrrhiza, in No. 60 powder, *four grammes* [or 62 grains]; Sugar, in fine powder, *four grammes* [or 62 grains]; Extract of Glycyrrhiza, in fine powder, *one gramme* [or 15.5 grains]; Acacia, in fine powder, *one gramme* [or 15.5 grains]; Water, Balsam of Tolu, Ether, each, *a sufficient quantity,* to make *one hundred pills.* To the Reduced Iron, contained in a small mortar, add *six cubic centimeters* [or 97 minims] of Water, and then, gradually, the Iodine with constant stirring, until the liquid ceases to have a reddish tint. Then add the remaining powders, previously well triturated together, and mix the whole thoroughly. Transfer the mass to a porcelain dish, and evaporate the excess of moisture, on a water-bath, with constant stirring, until the mass has acquired a pilular consistence. Then divide it into *one hundred pills.* Dissolve *ten grammes* [or 154 grains] of Balsam of Tolu in *fifteen cubic centimeters* [or 243 minims] of Ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally rolling them about until the drying is completed. Keep the pills in a well-stoppered bottle. Pills of Ferrous Iodide should be devoid of the smell of iodine. If a few of the pills be triturated with water, and the liquid filtered, the filtrate should not assume more than a light blue tint upon the addition of starch T.S. (absence of more than traces of *free iodine*)." *U. S.*

This process does not differ essentially from that formerly official.[1]

The pills of ferrous iodide were introduced into the U. S. Pharmacopœia at the revision of 1850. The present official pills are formed on the plan proposed by Procter, in imitation of *Blancard's pills* (*A. J. P.,* May, 1860), and are much superior to those made by the U. S. process of 1850, or by that of the British Pharm. 1885. Magnes-Lahens especially recommended the following formula: "Take of pure Iodine 4.10 grammes; Powdered Iron 1.90 grammes; Powdered Sugar 2.50 grammes; Powdered Gum Arabic 2.50 grammes; Distilled Water 2.50 grammes. Put in an iron dish the Water and the powdered Iron, add the Iodine gradually, and facilitate the reaction by stirring with a spatula of iron and by warming a little; when the reaction is complete, add the Gum and the Sugar, then heat to about 50° C. (122° F.), stirring until the mass ceases to drop when a little is taken up on the spatula. If necessary, five grammes of powdered licorice root may be incorporated into the mass, which is then to be rolled into one hundred pills." (*A. J. P.,* 1873, p. 498.) The iodine and iron unite directly to form ferrous iodide in solution, which is protected against the oxidizing influence of the air by the sugar and excess of reduced iron, while the licorice and gum serve to give due consistence and plasticity to the pilular mass. The pills are still further protected from the air by the impervious coating of balsam of Tolu, which readily yields to the softening and solvent properties of the gastric liquids. The great disadvantage of the pill of ferrous iodide, as ordinarily prepared, is that it will not keep,—crumbling by time and exposure, and evolving iodine in consequence of the oxidation of the iron. The preparation, made according to the U. S. formula of 1870, stood the test of time, and we have seen pills which, four years after their preparation, exhibited no signs of change. Each pill contains about a grain (0.065 Gm.) of ferrous iodide and two-fifths of a grain (0.024 Gm.) of reduced iron. The therapeutic uses of this preparation are the same as those of ferrous iodide. (See *Ferri Iodidum.*)

Dose, one to three pills.

PILULA GALBANI COMPOSITA. Br.

COMPOUND PILL OF GALBANUM
[Compound Pill of Asafetida]

(pĭl'ū-lą găl'bą-nī cǫm-pŏs'ĭ-tą)

Pilules de Galbanum composées, *Fr.;* Galbanumpillenmasse, *G.*

"Asafetida, 2 *ounces* (Imperial) or 50 grammes; Galbanum, 2 *ounces* (Imp.) or 50 grammes; Myrrh, 2 *ounces* (Imp.) or 50 grammes;

[1] *Pills of Ferrous Iodide.—Wm. R. Warner, Jr.'s, Process.*—Take of iodine 4634 grains; iron wire 1600 grains; sugar 4500 grains; marshmallow powder 4500 grains; gum 2200 grains; iron by hydrogen 566 grains; distilled water 3000 grains. Place the iron wire in a Florence flask, quart capacity, add the water, place on a sand bath, and gently heat; then add the iodine in such divided portions as the reaction will admit of, without raising the temperature so high as to drive off the violet fumes of iodine. Finally, add all the iodine, and continue the heat until the reaction has ceased, and the liquid shows no blue color with starch mucilage. The weight of the flask must be previously determined, and at this point the weight of the contents should be 9234 grains; if not, sufficient water must be added to make it so. Now mix thoroughly together the gum, sugar, marshmallow, and iron by hydrogen, and strain upon them the contents of the flask; mix quickly, and knead thoroughly, until a pill mass is formed, then divide it into three-grain pills, each containing one grain of ferrous iodide (iodine, iron, and water of crystallization). The pills, after being hardened in a warm, dry atmosphere, covered with starch powder, may be coated with a solution of gum mastic in ether or tolu in alcohol, in the proportion of four drachms to the fluidounce. An *extemporaneous sugar coating* may be effected to a reasonable degree of perfection in the following manner. Mix together thoroughly equal quantities of sugar, gum, and starch. Moisten the surface of the pills with an equal mixture of simple syrup and water, and then place them on the powder in a shallow dish, and give the same a centrifugal motion, so that they may be equally coated by the moisture of the syrup, which will agglutinate the particles of the powder. (*D. C.,* 1884, p. 4.)

Syrup of Glucose, 1 *ounce* (Imp.) or 25 grammes or a sufficient quantity. Heat all together on a water-bath, stirring until the mass is uniform in consistence." *Br.* This mass was formerly termed in the British Pharmacopœia *Pilula Asafœtidæ Composita.* The treacle used as an excipient has been replaced by syrup of glucose. It is given as an antispasmodic and emmenagogue in *chlorosis* and *hysteria.*

Dose, from two to four pills or from five to twenty grains (0.32 to 1.3 Gm.).[1]

PILULA HYDRARGYRI SUBCHLORIDI COMPOSITA. Br.

COMPOUND PILL OF MERCUROUS CHLORIDE

(pĭl'ŭ-lą hī-drär'gy-rī sub-ċhlō'rį-dī cǫm-pŏs'į-tą)

Pilulæ Antimonii Compositæ, *U. S.* 1890; Compound Pills of Antimony, Plummer's Pills; Pilula Calomelanos Composita, *Br.* 1864; Compound Pill of Mercurous Chloride, Compound Calomel Pill; Pilules altérantes composées, Pilules antidartreuses, Pilules de Plummer, *Fr.;* Plummersche Pillen, Zusammengesetzte Calomelpillen, *G.*

"Mercurous Chloride, 1 *ounce* (Imperial) or 25 grammes; Sulphurated Antimony, 1 *ounce* (Imp.) or 25 grammes; Guaiacum Resin, in powder, 2 *ounces* (Imp.) or 50 grammes; Castor Oil, 180 *grains* or 10.3 grammes; Alcohol (90 per cent.), 1 *fl. drachm* (Imp. meas.) or 3 cubic centimetres or a sufficient quantity. Mix to form a mass." *Br.*

Compound pills of antimony were dropped in the U. S. P. (8th Rev.); the formula for this pill in the U. S. P. 1890[2] was altered by adopting the British method of using castor oil as an excipient instead of mucilage of tragacanth; this change was of doubtful utility, the pills when kept acquiring an unpleasant odor. The oil is, however, a partial solvent for the guaiac.

We prefer the title "Compound Calomel Pill" of the former British Pharmacopœia, as not liable to any mistake, and as most expressive of the quality of the medicine. The antimonial employed, though under a different name, is identical with the old U. S. precipitated sulphide. According to Vogel a reaction takes place between the calomel and the sulphurated antimony, resulting in the production of antimony chloride and mercury sulphide. The preparation was originally introduced to the notice of the profession by Dr. Plummer, who found it useful as an alterative, and upon whose authority it was at one time much employed under the name of *Plummer's Pills.* The combination is well adapted to the treatment of *chronic rheumatism* and of scaly and other *eruptive diseases of the skin,* especially when accompanied with a syphilitic taint.

Dose, four to eight grains (0.26 to 0.5 Gm.) or more, morning and evening.

[1] The U. S. P. 1880 gave the following formula for this preparation: "Galbanum, *one hundred and fifty grains* (9.75 Gm.); Myrrh, *one hundred and fifty grains* (9.75 Gm.); Asafetida, *fifty grains* (3.25 Gm.); Syrup, *a sufficient quantity,* to make *one hundred pills.* Beat them together so as to form a mass, and divide it into *one hundred pills.*"

[2] *Pilulæ Antimonii Compositæ,* U. S. 1890. *Compound Pills of Antimony, Plummer's Pills.*—"Sulphurated Antimony, *four grammes* [or 62 grains]; Mild Mercurous Chloride, *four grammes* [or 62 grains]; Guaiac, in fine powder, *eight grammes* [or 123 grains]; Castor Oil, *a sufficient quantity,* to make *one hundred pills.* Beat the powders together with the Castor Oil, added a few drops at a time, so as to form a mass, and divide it into *one hundred pills.*" *U. S.* 1890.

PILULA IPECACUANHÆ CUM SCILLA. Br.

PILL OF IPECACUANHA WITH SQUILL

(pĭl'ŭ-lą ĭp-ę-căc-ŭ-ăn'hæ cŭm sçĭl'lą)

Pilules d'Ipécacuanha et de Scille, *Fr.;* Brechwurzel-Meerzwiebelpillen, *G.*

"Compound Powder of Ipecacuanha, 3 *ounces* (Imperial) or 30 grammes; Squill, in powder, 1 *ounce* (Imp.) or 10 grammes; Ammoniacum, in powder, 1 *ounce* (Imp.) or 10 grammes; Syrup of Glucose, *a sufficient quantity.* Mix to form a mass. This Pill contains about 5 per cent. of Opium." *Br.*

This is a good combination of expectorants, well adapted to *chronic bronchitis* with either deficient or greatly excessive expectoration, and to the advanced stages of the acute disease offering similar indications.

Dose, from five to ten grains (0.32 to 0.65 Gm.).

PILULÆ LAXATIVÆ COMPOSITÆ. U. S.

COMPOUND LAXATIVE PILLS

(pĭl'ŭ-læ lăx-ą-tī'væ cǫm-pŏs'į-tæ)

Pilulæ Aloini, Belladonnæ et Strychninæ Compositæ; Compound Pills of Aloin, Belladonna and Strychnine; Pilules laxatives composées, *Fr.;* Zusammengesetzte Laxirpillen, *G.*

"Aloin, *one and three-tenths grammes* [or 20 grains]; Strychnine, *five-hundredths of a gramme* [or ¾ grain]; Extract of Belladonna Leaves, *eight-tenths of a gramme* [or 12.3 grains]; Ipecac, in fine powder, *four-tenths of a gramme* [or 6.1 grains]; Glycyrrhiza, in fine powder, *four and six-tenths grammes* [or 71 grains]; Syrup, *a sufficient quantity,* to make *one hundred pills.* Triturate the Aloin, Strychnine, Ipecac, and Glycyrrhiza together thoroughly, so as to produce a uniform powder. Incorporate with this the Extract of Belladonna Leaves and sufficient Syrup to form a mass, and divide it into *one hundred pills.*" *U. S.*

This pill was introduced into the U. S. P. (8th Rev.) because of its large use in the United States. Each pill contains one-fifth of a grain of aloin, one hundred and thirtieth of a grain of strychnine, one-eighth of a grain of extract of belladonna leaves, one-sixteenth of a grain of ipecac, and three-fourths of a grain of powdered licorice root.

Uses.—As its name indicates, this pill is used as a laxative; similar pills are known as *A. B. S. pills, lapactic pills, evacuant pills.*

Dose, one or two pills at night.

PILULÆ OPII. U. S. (Br.)

PILLS OF OPIUM

(pĭl′ŭ-læ ō′pī-ī)

Pilula Saponis Composita, *Br.;* Compound Pill of Soap; Pilules d'Opium, *Fr.;* Opiumpillen, *G.*

* "Powdered Opium, *six and one-half grammes* [or 100 grains]; Soap, in fine powder, *two grammes* [or 31 grains]; Water, *a sufficient quantity,* to make *one hundred pills.* Mix the powders intimately, then incorporate sufficient Water to form a mass, and divide it into *one hundred pills.*" *U. S.*

This process is designated merely to furnish a convenient formula for putting opium into pilular form, preferable to the mode sometimes practised of making the pills directly from the unpowdered mass of opium as found in commerce. The soap answers no other purpose than to give a due consistence, and is therefore in small proportion. Opium pills are official in the British Pharmacopœia under the name of *Pilula Saponis Composita* (see page 961). The object of giving them this title is probably to prevent the patient from learning from the prescription that the pills contain opium. As hard old opium pills are sometimes preferred, in cases of irritable stomach, in consequence of their slow solution, it is proper for the pharmacist to keep some in this state to meet the prescription of the physician. Of the pills above directed, each contains one grain (0.065 Gm.) of powdered opium.

Dose, one pill.

PILULÆ PHOSPHORI. U. S. (Br.)

PILLS OF PHOSPHORUS

(pĭl′ŭ-læ phŏs′phŏ-rī)

Pilula Phosphori, *Br.;* Phosphorus Pill; Pilules au Phosphore, Pilules Phosphorées, *Fr.;* Phosphorpillen, *G.*

* "Phosphorus, *six-hundredths of a gramme* [or 0.93 grains]; Althæa, in No. 60 powder, *six grammes* [or 93 grains]; Acacia, in fine powder, *three grammes* [or 46 grains]; Chloroform, Glycerin, Water, Balsam of Tolu, Ether, each, *a sufficient quantity,* to make *one hundred pills.* Dissolve the Phosphorus, in a test-tube, in *five cubic centimeters* [or 81 minims] of Chloroform, with the aid of a very gentle heat, replacing from time to time any of the Chloroform which may be lost by evaporation. Mix the Althæa and Acacia in a mortar, next add the solution of Phosphorus, then immediately afterwards a sufficient quantity (about *four cubic centimeters* [or 65 minims]) of a mixture of *two volumes* of Glycerin and *one volume* of Water, and quickly form a mass; divide it into *one hundred pills.* Dissolve *ten grammes* [or 154 grains] of Balsam of Tolu in *fifteen cubic centimeters* [or 243 minims] of Ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally rolling them about until the drying is completed. Keep the pills in a well-stoppered bottle." *U. S.*

"Phosphorus, 10 *grains* or 1 gramme; White Beeswax, melted, 125 *grains* or 12.5 grammes; Lard, melted, 125 *grains* or 12.5 grammes; Kaolin, 115 *grains* or 11.5 grammes; Carbon Bisulphide, 33 *minims* or 3 cubic centimetres or a sufficient quantity. Place the melted Wax and Lard in a slightly warmed mortar, and stir until the mixture has the consistence of cream. Dissolve the Phosphorus in the Carbon Bisulphide and carefully mix the solution with the melted fats; add the Kaolin; mix well together. Keep the mixture immersed in cold water in a bottle from which the light is excluded. When dispensed, every *three grains* of the mixture is to be incorporated with *one grain* of Gum Acacia in powder; and the resulting pills should be varnished. Phosphorus Pill, including the Gum Acacia, contains 2 per cent. of Phosphorus; hence, is nearly double the strength of the Phosphorus Pill of the British Pharmacopœia of 1885." *Br.*

The increasing use of phosphorus in the free state made the introduction of phosphorus pills a necessity. The problem of preventing the oxidation of the phosphorus is believed to be solved by dissolving it in an excess of warm chloroform; this is accomplished in a stoppered test-tube, for it has been shown that no oxidation takes place in the presence of chloroform vapor. It is necessary to form the mass quickly, so that the chloroform may not all evaporate and leave the phosphorus exposed to the action of the air. Chloroform is preferred to carbon disulphide, for, although the latter is a better solvent, it is difficult to rid the mass of the disgusting odor. (See *A. J. P.,* 1875, 253, 254, 335, 501; 1876, 56; 1877, 135; 1878, 584; and *N. R.,* 1876, 189, 332; 1877, 32; *D. C.,* 1883, 180; *P. J.,* 1883, 923.)

Dose, of the British mass, four grains of the mass, including the acacia, will contain 1-12th of a grain of phosphorus (0.005 Gm.), and the *dose* is therefore one-half grain (0.032 Gm.), equivalent to 1-96th of a grain (0.0007 Gm.) of phosphorus. Each official U. S. pill contains about 1-100th of a grain (0.0006 Gm.) of phosphorus.

PILULA PLUMBI CUM OPIO. Br.

PILL OF LEAD WITH OPIUM

(pĭl′ŭ-lą plŭm′bī cŭm ō′pī-ō)

Pilules d'Acétate de Plomb et d'Opium, *Fr.;* Bleiacetat-Opiumpillenmasse, *G.*

"Lead Acetate, in fine powder, 36 *grains* or 6 grammes; Opium, in powder, 6 *grains* or 1

gramme; Syrup of Glucose, 4 *grains* or 0.7 gramme or a sufficient quantity. Mix to form a mass. This Pill contains about 12½ per cent. of Opium." *Br.*

This pill would be better left to extemporaneous prescription, the requisite proportion of opium to the acetate varying in different cases. Syrup of glucose has been substituted in the 1898 revision for confection of roses, the latter being incompatible with lead acetate. The mass contains about six parts of lead acetate in eight.

Dose, two or three grains (0.13 or 0.20 Gm.) to begin with.

PILULÆ PODOPHYLLI, BELLADONNÆ ET CAPSICI. U. S.

PILLS OF PODOPHYLLUM, BELLADONNA AND CAPSICUM

(pĭl'ŭ-læ pō-dǫ-phȳl'lī bĕl-lą-dŏn'næ ĕt kăp'sĭ-cī)

Pilules de Podophyllum, de Belladone et de Poivre de Guinée, *Fr.;* Podophyllin-, Belladonna-, und Spanisch-Pfefferpillen, *G.*

• "Resin of Podophyllum, *one and six-tenths grammes* [or 25 grains]; Extract of Belladonna Leaves, *eight-tenths of a gramme* [or 12 grains]; Capsicum, in moderately fine powder, *three and two-tenths grammes* [or 49 grains]; Sugar of Milk, in fine powder, *six and one-half grammes* [or 100 grains]; Acacia, in fine powder, *one and sixth-tenths grammes* [or 25 grains]; Glycerin, Syrup, each, *a sufficient quantity,* to make *one hundred pills.* Triturate the Resin of Podophyllum, Capsicum, Sugar of Milk, and Acacia together to produce a uniform powder. Incorporate with this the Extract of Belladonna Leaves and sufficient of a mixture of equal parts of Glycerin and Syrup to form a mass; divide it into *one hundred pills.*" *U. S.*

This pill is largely used and is based upon the formula proposed by E. R. Squibb. It was introduced into the U. S. P. (8th Rev.) for the first time. Each pill contains about one-fourth of a grain of resin of podophyllum, one-eighth of a grain of extract of belladonna leaves, one-half of a grain of powdered capsicum, sugar of milk, acacia, glycerin, and syrup.

Uses.—These pills afford an excellent means of obtaining the laxative effect of podophyllum.

Dose, one to two pills.

PILULA QUININÆ SULPHATIS. Br.

PILL OF QUININE SULPHATE

(pĭl'ŭ-lą quĭ-nī'næ sŭl-phā'tĭs)

Pilule de Quinine Sulfate, *Fr.;* Chininpillenmasse, *G.;* Píldoras de sulfato quinico, *Sp.*

"Quinine Sulphate, 30 *grains* or 3 grammes; Tartaric Acid, in powder, 1 *grain* or 0.1 gramme; Glycerin, 4 *grains* or 0.4 gramme; Tragacanth, in powder, 1 *grain* or 0.1 gramme. Triturate the Quinine Sulphate with the Tartaric Acid; add the product to the previously mixed Glycerin and Tragacanth; make a mass." *Br.*

The reason for introducing a quinine pill mass in the British Pharm. 1898 is doubtless to serve the convenience of dispensers and to save time; tartaric acid aids in solubility and in making the pills smaller, while glycerin keeps the mass from undue hardening.

Dose, two to eight grains (0.13 to 0.5 Gm.).

PILULÆ RHEI COMPOSITÆ. U. S. (Br.)

COMPOUND PILLS OF RHUBARB

(pĭl'ŭ-læ rhē'ī cǫm-pŏs'ĭ-tæ)

Pilula Rhei Composita, *Br.;* Pilules de Rhubarbe composées, *Fr.;* Rhabarber und Aloepillen, *G.*

• "Rhubarb, in No. 60 powder, *thirteen grammes* [or 201 grains]; Purified Aloes, in fine powder, *ten grammes* [or 154 grains]; Myrrh, in fine powder, *six grammes* [or 93 grains]; Oil of Peppermint, *one-half cubic centimeter* [or 8 minims]; Water, *a sufficient quantity,* to make *one hundred pills.* Mix the Oil of Peppermint intimately with the powders, then incorporate sufficient Water to form a mass; divide it into *one hundred pills.*" *U. S.*

"Rhubarb Root, in powder, 3 *ounces* (Imperial) or 60 grammes; Socotrine Aloes, in powder, 2¼ *ounces* (Imp.) or 45 grammes; Myrrh, in powder, 1½ *ounces* (Imp.) or 30 grammes; Hard Soap, in powder, 1½ *ounces* (Imp.) or 30 grammes; Oil of Peppermint, 1½ *fl. drachms* (Imp. meas.) or 3.75 cubic centimetres; Syrup of Glucose, 2¾ *ounces* (Imp.) or 55 grammes or a sufficient quantity. Mix to form a mass." *Br.*

This is a warm tonic laxative, useful in *costiveness.* If made in quantity the pills should be kept in loosely stoppered bottles. The use of glycerin favors the formation of mouldiness through the attraction of moisture, and it was replaced in the formula of the Br. Ph. 1898 by syrup of glucose. Rhubarb pills (*Pilulæ Rhei,* U. S. 1890) were not admitted to the U. S. P. (8th Rev.); the formula is appended.[1]

Dose, of the compound rhubarb pills, two to four pills, or from ten to twenty grains (0.65 to 1.3 Gm.) of the mass, twice a day.

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[1] *Pilulæ Rhei,* U. S. 1890, *Pills of Rhubarb.* "Rhubarb, in No. 60 powder, *twenty grammes* [or 308 grains]; Soap, in fine powder, *six grammes* [or 93 grains]; Water, *a sufficient quantity,* to make *one hundred pills.* Beat the powders together with Water, so as to form a mass, to be divided into *one hundred pills.*" *U. S.* 1890.

Rhubarb is so often given in the pilular form, that it is convenient both for the physician and for the apothecary to have a formula indicating the mode of preparing the pills, as well as the quantity of rhubarb to be contained in each. Soap has stood the test of long experience as a good excipient for rhubarb. If made in quantity the pills should be kept in loosely-stoppered bottles. We have found rhubarb pills made with compound tincture of cardamom, without other ingredient, to answer an excellent purpose. Each pill contains three grains (0.20 Gm.) of rhubarb.

PILULA SAPONIS COMPOSITA. Br.

COMPOUND PILL OF SOAP

(pĭl'ū-lą są-pō'nĭs cǫm-pŏs'ĭ-tą)

Pilules de Savon composées, *Fr.;* Seifenpillenmasse, *G.*

"Opium, in powder, ½ *ounce* (Imperial) or 10 grammes; Hard Soap, in powder, 1½ *ounces* (Imp.) or 30 grammes; Syrup of Glucose, ½ *ounce* (Imp.) or 10 grammes. Mix to form a mass. This Pill contains 20 per cent. of Opium." *Br.*

This pill,[1] although no longer official in the U. S. P., is useful as affording the opportunity of conveniently administering opium, in a pilular and readily soluble form, in small fractions of a grain. The name was probably intended to conceal the nature of the preparation. One grain (0.065 Gm.) of opium is contained in about one dose, five grains (0.32 Gm.), of the mass.

PILULA SCAMMONII COMPOSITA. Br.

COMPOUND SCAMMONY PILL

(pĭl'ū-lą scąm-mō'nĭ-ī cǫm-pŏs'ĭ-tą)

Pilules de Scammonée composées, *Fr.;* Scammoniumpillenmasse, *G.*

"Scammony Resin, 1 *ounce* (Imperial) or 25 grammes; Jalap Resin, 1 *ounce* (Imp.) or 25 grammes; Curd Soap, in powder, 1 *ounce* (Imp.) or 25 grammes; Tincture of Ginger, 3 *fl. ounces* (Imp. meas.) or 75 cubic centimetres. Add the Tincture of Ginger to the Soap and Resins; dissolve with the aid of slight heat; evaporate on a water-bath until the mass has acquired a suitable consistence for forming pills." *Br.*

These pills are actively purgative in *doses* of from five to ten grains (0.32 to 0.65 Gm.).

PILULA SCILLÆ COMPOSITA. Br.

COMPOUND SQUILL PILL

(pĭl'ū-lą sçĭl'læ cǫm-pŏs'ĭ-tą)

Pilules de Scille composées, *Fr.;* Meerzwiebelpillenmasse, *G.*

"Squill, in powder, 1¼ *ounces* (Imperial) or 25 grammes; Ginger, in powder, 1 *ounce* (Imp.) or 20 grammes; Ammoniacum, in powder, 1 *ounce* (Imp.) or 20 grammes; Hard Soap, in powder, 1 *ounce* (Imp.) or 20 grammes; Syrup of Glucose, 1 *ounce* (Imp.) or 20 grammes or a sufficient quantity. Mix to form a mass." *Br.*

This preparation was dropped at the 1880 revision of the U. S. Pharmacopœia.[2]

This is a stimulating expectorant compound, depending for its virtues chiefly on the squill, and applicable to the treatment of *chronic bronchitis.* From five to ten grains (0.32 to 0.65 Gm.) may be given three or four times a day. The mass should be freshly made when wanted, as the squill which it contains is liable to be injured by keeping.

PIMENTA. U. S., Br.

PIMENTA [Allspice, Pimento]

(pĭ-mĕn'tą)

"The dried, nearly ripe fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceæ*)." *U. S.*
"The dried full-grown unripe fruit of Pimenta officinalis, *Lindl.*" *Br.*

Semen Amomi, Piper Jamaicense; Pimento, Allspice, Jamaica Pepper; Piment de la Jamaïque, Toute-épice, Poivre de la Jamaïque, *Fr.;* Englisches Gewürz, Neugewürz, Nelkenpfeffer, *G.;* Pimenti, *It.;* Pimienta de la Jamaica, *Sp.*

Pimenta officinalis, Lindl. *B. & T.* 111; *Myrtus Pimenta,* Willd., *Sp. Plant.* ii. 973; *Eugenia Pimenta,* De Cand. *Prodom.* iii. 285; *Pimenta officinalis,* Berg. in Engler and Prantl.

This is a beautiful tree, about thirty feet high, with a straight trunk, much branched above, and covered with a very smooth gray bark. Its dense and ever-verdant foliage gives it at all times a refreshing appearance. The leaves, which are petiolate, vary in shape and size, but are usually about four inches long, elliptical, entire, blunt or obtusely pointed, veined, and of a deep shining green color. The flowers are small, without show, and disposed in panicles upon trichotomous stalks, which usually terminate the branches. The fruit is a spherical berry, crowned with the persistent calyx, and when ripe is smooth, shining, and of a black or dark purple color. The tree exhales an aromatic fragrance, especially during the summer months, when in flower.

It is a native of the West Indies, Mexico, and South America, and is abundant in Jamaica, whence its fruit received the name of *Jamaica pepper.* The allspice plant is cultivated in Central America and the surrounding countries, but more than half the supply to the United States comes from Jamaica, where the tree is so abundant as to form in the mountainous districts whole forests, and to require no further cultivation than the clearing out of the underbrush. The berries are gathered after having attained their full size, but while yet green, and are carefully dried in the sun. When sufficiently dry, they are put into bags and casks for exportation. The fruits of four other species of the genus Pimenta, found in Venezuela, Guiana, and the West Indies, are employed in their native countries as spices.

[1] *Pilula Saponis Composita,* U. S. P. 1870.—"Take of Opium, in fine powder, *sixty grains;* Soap, in fine powder, *half a troyounce.* Beat them together with water so as to form a pilular mass."

[2] *Pilulæ Scillæ Compositæ,* U. S. 1870. *Compound Pills of Squill.*—"Take of Squill, in fine powder, *twelve grains;* Ginger, in fine powder, Ammoniac, in fine powder, each, *twenty-four grains;* Soap, in fine powder, *thirty-six grains;* Syrup, *a sufficient quantity.* Mix the powders together; then beat them with Syrup so as to form a pilular mass, to be divided into twenty-four pills." *U. S.* 1870.

Properties.—The berries, as they reach us, are of different sizes, usually about as large as a small pea, 5 to 7 Mm. in diameter, round, wrinkled, crowned with the short, four-parted calyx or its remnants and a short style, brownish or brownish gray, and when broken present two cells, each containing a black hemispherical or reniform seed. They have a fragrant odor, thought to resemble that of a mixture of cinnamon, cloves, and nutmeg. Hence the name of *allspice,* by which they are best known in this country. Their taste is warm, aromatic, pungent, and slightly astringent. They impart their flavor to water, and all their virtues to alcohol. The infusion is of a brown color, and reddens litmus paper. They are officially described as follows: "Subglobular, 5 to 7 Mm. in diameter, crowned with a short, 4-parted calyx and a short style, or their remnants; externally dark brown; pericarp brittle, about 1 Mm. thick, glandular-punctate; 2-celled, each cell containing one reddish-brown, plano-convex, slightly reniform seed; odor and taste peculiarly and agreeably aromatic." *U. S.* They yield a volatile oil by distillation having the sp. gr. of from 1.04 to 1.05 at 15° C. (See *Oleum Pimentæ.*) Bonastre obtained from them a volatile oil, a green fixed oil, a fatty substance in yellowish flakes, tannin, gum, resin, uncrystallizable sugar, coloring matter, malic and gallic acids, saline matters, moisture, and lignin. The green oil has the burning aromatic taste of pimenta, and is supposed to be the acrid principle. Upon this, therefore, together with the volatile oil, the medicinal properties of the berries depend, and, as these two principles exist most largely in the shell or cortical portion, this part is most efficient. According to Bonastre, the shell contains 10 per cent. of the volatile and 8 of the fixed oil, the seeds only 5 per cent. of the former and 2.5 of the latter. Berzelius considered the green fixed oil of Bonastre as a mixture of volatile oil, resin, fixed oil, and perhaps a little chlorophyll. Dragendorff in 1871 announced the existence of an alkaloid in allspice. It is present in exceedingly small quantity, and has somewhat the odor of coniine. W. W. Abell obtained from 448 Gm. of pimenta leaves one-half of one per cent. of volatile oil resembling oil of bay; he also found tannic acid. (*A. J. P.,* 1886, 163.) A convention of hygienists at Vienna decided that ground allspice should not yield more than 6 per cent. of ash, of which not more than 0.5 per cent. should be soluble in hydrochloric acid.

Pimenta is sometimes adulterated by the larger and less aromatic berries of the Mexican *Myrtus Tobasco,* Mocino.

Uses.—Pimenta is an aromatic spice, used in medicine chiefly as an adjuvant to tonics and purgatives. It is particularly useful in cases attended with much *flatulence.* It is, however, much more largely employed as a condiment than as a medicine.

Dose, ten to forty grains (0.65 to 2.6 Gm.).

Off. Prep.—Aqua Pimentæ, *Br.*

PIPER. U. S. (Br.)

PEPPER [Black Pepper]

(pī'pẹr)

"The dried, unripe fruit of *Piper nigrum* Linné (Fam. *Piperaceæ*)." *U. S.* "The dried unripe fruit of Piper nigrum, *Linn.*" *Br.*

Piper Nigrum, *Br.;* Common Pepper; Poivre noir, *Fr. Cod.;* Poivre, *Fr.;* Schwarzer Pfeffer, *G.;* Pepe nero, *It.;* Pimienti negra, *Sp.;* Fifil uswud, *Arab.;* Lada, *Malay;* Maricha, *Jav.;* Sahan, *Palembang.*

Piper nigrum, L., *Sp. Pl.* (1753) 28; Willd., *Sp. Plant.* i. 159; Carson, *Illust. of Med. Bot.,* ii. 38, pl. 83; *B. & T.* 245.—The pepper vine is a perennial plant, with a round, smooth, woody, articulated stem, swelling near the joints, branched, and from eight to twelve feet or more in length. The leaves are entire, broad-ovate, acuminate, seven-nerved, coriaceous, very smooth, of a dark green color, and attached by strong sheath-like footstalks to the joints of the branches. The flowers are small, whitish, sessile, covering thickly a cylindrical spadix, and succeeded by globular berries, which are red when ripe.

The plant grows wild in Cochin-China and various parts of India. It is cultivated on the coast of Malabar, in the peninsula of Malacca, in Siam, Sumatra, Java, Borneo, the Philippines, Japan, and many other places in the East; also to some extent in the West Indies. The best pepper is affirmed to be produced in Malabar, but Europe and America derive their chief supplies from Sumatra and Java. The plant is propagated by cuttings, and is supported by props, or trees planted for the purpose, upon which it is trained. In three or four years from the period of planting, it begins to bear fruit. The plant sometimes begins to bear as early as the first year after planting, increases in its yield to the fifth or sixth year, when it produces eight or ten pounds, and begins to lose its productiveness about the fifteenth year. The berries are gathered as soon as one is seen to turn red,—*i.e.,* before they are all perfectly ripe,—and upon being dried, become black and wrinkled. The greatest production is in Sumatra, and the ports of export are principally Singapore and Penang, the Malabar pepper coming from Tellicherry. Our imports are principally through England, and not direct, and it seems that in England, at least, it is customary to mix peppers of different origin in grinding, taking Malabar for weight, Penang for strength, and Sumatra for color. (*Bulletin U. S. Dept. of Agric.,* No. 13, 1887.) The importations of unground black and white pepper for the year 1902 were 16,046,179 lbs.; for 1903, 21,832,675 lbs.; for 1904, 18,615,186 lbs. Owing to the widespread cultivation of pepper a large number of varieties exist; these receive their names from the place of their production. For a description of the most important of these varieties with the percentage of active constituents

contained in each, see J. W. Gladhill, *A. J. P.*, Feb. 1904; also Blyth, *Foods: their Composition and Analysis.*

White pepper is the ripe berry, deprived of a part of its pericarp by maceration in water and subsequent friction, and afterwards dried in the sun. It occurs as yellowish more or less broken grains with a smooth shiny surface, consisting of the perisperm alone, the episperm having been removed. It is sold in the market either as a whole white pepper or as broken white pepper; the whole peppers are very likely to have some of the perisperm or hull remaining. The removed hull is sold separately; it forms a light to dark brown powder, with a very pungent odor and taste and contains large amounts of the oleoresin of pepper, but according to Gladhill no piperine. The hulls are sometimes sold mixed with broken white pepper. This mixture contains more oleoresin and less piperine than does the pure pepper; the percentage of the two active constituents varying according to the percentage of drugs in the mixture. White pepper is much less pungent but more aromatic than black pepper.

Piper longum, L. (*Chavica longum,* Miq.), differs from its congeners in having its lower leaves cordate, petiolate, from five- to seven-nerved, its upper oblong-cordate, sessile, and five-nerved; its flowers in dense, short, terminal, and nearly cylindrical spikes and its fruit, consisting of very small one-seeded berries or grains, embedded in a pulpy matter. It is a native of Southeastern Asia, and is produced abundantly in Bengal and other parts of Hindostan. The fruit is green when immature, and becomes red as it ripens. It is gathered in the former state, as it is then hotter than when perfectly ripe. The whole spike is taken from the plant, and dried in the sun. *Long pepper,* as the fruit is called, is cylindrical, an inch or more in length, indented on its surface, of a dark-gray color, a weak aromatic odor, and a pungent fiery taste. Dulong found its chemical composition to be closely analogous to that of black pepper. Like that, it contains *piperine,* a concrete oil or soft resin upon which its burning acrimony depends, and a volatile oil to which it probably owes its odor. Its medicinal virtues are essentially the same as those of black pepper, but it is inferior to that spice, and is seldom used. *West African* or *Ashantee Pepper* is the fruit of *P. Clusii,* C. DC., which grows abundantly in tropical Africa. It does not come into Western commerce, although much used in Africa. The berry is described as resembling cubeb, but less rugose, and with a more slender pedicel, and having the odor and taste of black pepper. Stenhouse found piperine in this variety of pepper.

Kissi Pepper is a fruit yielded by the *Piper Famechoni,* Heckel, of Upper Guinea. The berries, which grow in cylindrical clusters, are small, blackish-brown, ovoidal, with a cubeb-like pedicel at their base. Their powder is very aromatic, with an especially pleasant taste. They have been found by A. Barille to contain 4.5 per cent. of volatile oil and 3.7 per cent. of piperine. (*J. P. C.,* 106, 1903.)

Properties.—The dried berries are 4 to 5 Mm. in diameter, externally blackish, reticulated, and wrinkled, internally whitish, hollow, and with an undeveloped embryo, of an aromatic odor, and a hot, pungent, almost fiery taste. They are officially described as "nearly globular, 4 to 5 Mm. in diameter, externally brownish or grayish-black; pericarp thin, coarsely wrinkled, enclosing a single whitish, more or less imperfectly developed seed; odor strong, penetrating, provoking sneezing; taste aromatic and very pungent. The starch grains present in the powder are nearly spherical and about 0.002 Mm. in diameter; ash not more than 7 percent." *U. S.* They yield their virtues partially to water, entirely to alcohol and ether. Pelletier found them to contain a peculiar principle called *piperine,* an acrid concrete oil or soft resin of a green color, a balsamic volatile oil, isomeric with oil of turpentine, a colored gummy substance, an extractive matter, like that found in leguminous plants capable of being precipitated by infusion of galls, starch, a portion of bassorin, tartaric and malic acids, lignin, and various salts. (See *Piperina.*) William Johnston (König's *Nahrungs- und Genussmittel,* 3d ed., Bd. i. 1046) finds that *piperidine,*[1] $C_5H_{11}N$, is an invariable constituent of pepper in amounts varying from 0.21 to 0.77 per cent. (See p. 965.)

The taste and medicinal activity of pepper depend mainly on the concrete oil or resin, and on the volatile oil. The concrete oil is of a deep green color, very acrid, and soluble in alcohol and ether. The volatile oil is limpid, colorless, becoming yellow by age, of a strong odor, and of a taste less acrid than that of pepper itself. Its formula is $C_{10}H_{16}$, and it forms a liquid but not a solid compound with hydrochloric acid. According to Weigle (*Ap. Ztg.,* 1893, 626), pepper contains, besides cellulose, starch, and coloring matter,—1. Volatile oil, smelling strongly of pepper, but without pungency; 2. A thick oil, tasteless and nearly odorless; 3. Odorless piperine whose solutions possess the pungency of pepper. Weigle believes that in the fresh fruit the volatile oil acts as a solvent for the piperine and he thus accounts for their pungency.

[1] According to the experiments of E. W. Tunnicliffe (*Cb. Phys.,* 1897), the injection of from 0.01 to 0.02 Gm. of the piperidine chloride will produce in a cat of about three kilogrammes' weight an enormous rise of the arterial pressure, due to narrowing of the blood paths. This is in accord with the investigations of B. Moore and R. Row (*Journ. Physiol.,* London, 1898), who find that piperidine produces paralysis of the intra-muscular part of the motor nerve, and, while slowing the heart, increases enormously the arterial pressure chiefly by causing a constriction of the arterioles by an action upon the peripheral ganglia, in this, as in other ways, resembling in its physiological effects coniine and nicotine. The authors believe that this similarity is due to the presence of a reduced pyridine ring in each molecule, and, further, that the intensification of the action is caused by the introduction of an organic radical as a side group into this ring.

The following are analyses of commercial peppers made by Blyth (*Foods: their Composition and Analysis,* 5th ed., 1903, p. 496).

For a paper on commercial peppers by J. W. Gladhill see *A. J. P.*, 1904, 71.

Adulterations.—On account of its extensive use as a condiment, pepper has been largely adulterated, especially when sold in the form of a powder. Grapestones, olivestones, cocoanut shells and various other substances have been freely used as a mixture with the true black pepper. They can be detected by the microscope with more or less ease. See *P. J.*, lxxi. 269; *P. J.*, June, 1890; *Bull. U. S. Dept. of Agriculture,* No. 13, Part II, pp. 183, 1887; *A. J. P.*, 1887, 146; but when pepper has been adulterated to the amount of 10 per cent. the discovery of the fraud is best made by determining the proportion of ash, of ether extract and of piperine present. The ash should never be above 6.5 per cent. for black and 3 per cent. for white pepper; the ether extract should be between 7.5 and 10 per cent. for black and 6 to 9 per cent. for white pepper. Piperine should be present in from 5.5 to 9 per cent. in good black pepper. The amount of oleoresin in any pepper can readily be determined by subtracting the weight of piperine from that of the mixture. Penang pepper is sometimes made to resemble the higher priced white peppers by coating the grains with an earthy matter (lime or clay). According to A. Mennechet, the fruits of *Myrsine africana* and of *Embelia Ribes* may sometimes be detected in the powder of pepper by extracting with ether and adding a little water, followed by a few drops of ammonia, when after shaking, a deep lilac-red color will appear in the aqueous layer. (*J. P. C.*, xiv. 587.)

Uses.—Black pepper is a warm carminative stimulant, capable of producing general arterial excitement, but acting with greater proportional energy on the part to which it is applied. From the time of Hippocrates it has been used as a condiment and in medicine. Its chief medicinal application is to excite the languid stomach and correct *flatulence*. It was for years occasionally administered for the cure of *intermittents*, but its employment for this purpose had passed from the profession to the laity, till a few years since revived by an Italian physician, to be again consigned to forgetfulness. Piperine has also been employed in the same disease, and has even been thought superior to quinine sulphate, but experience has not confirmed this favorable opinion. That, in its impure state, when mixed with a portion of the acrid principle, it will occasionally cure intermittents, there can be no doubt, but it is not comparable to the preparations of cinchona, and is certainly less active than the official oleoresin of pepper. In intermittent fever, pepper may be found a useful adjuvant to the more powerful febrifuge. It may be given whole or in powder, but is more energetic in the latter state.

Dose, of pepper, five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Confectio Piperis, *Br.;* Oleoresina Piperis, *U. S.;* Pulvis Opii Compositus, *Br.*

PIPERINA. U. S.

PIPERINE [Piperin, Piperinum, Pharm. 1890]

(pī-pę-rī′nạ)

$C_{17}H_{19}NO_3 = 283.04$

"A feebly basic substance [$CH_2O_2.C_6H_3.CH:CH.CH:CH.CON.C_5H_{10}$] obtained from Pepper and other plants of the *Piperaceæ*." *U. S.*

Pipérine, *Fr.;* Piperin, *G.*

It will be observed that the official title of this principle has been changed in the U. S. P. (8th Rev.) to "Piperina," thus restoring it to the class of alkaloids. It has never been claimed by chemists that piperine had all the properties of the alkaloids as a class; it was described as a "principle of feebly alkaloidal power" in the U. S. P. 1880, and this view has been retained in the U. S. P. (8th Rev.).

Piperine was discovered by Œrsted of Copenhagen, who considered it to be the active principle of pepper. Pelletier, however, denied its medicinal activity, and ascribed all the effects supposed to have been obtained from it to a portion of the acrid concrete oil with which it is mixed when not very carefully prepared. It is obtained by treating pepper with alcohol, evaporating the tincture to the consistence of an extract, submitting the extract to the action of an alkaline solution by which the oleaginous matter is converted into soap, washing the undissolved portion with cold water, separating the liquid by filtration, treating the matter left on the filter with alcohol, and allowing the solution thus obtained to evaporate spontaneously or by a gentle heat. Crystals of piperine are

	Hygroscopic Moisture.	Piperine in Pepper dried at 100° C.	Resin in Pepper dried at 100° C.	Aqueous Extract in Pepper dried at 100° C.	Ash in Pepper dried at 100° C.	
					Soluble in Water.	Total.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Penang	9.53	5.57	2.08	18.33	2.21	4.18
Tellicherry	12.90	4.67	1.70	16.50	3.38	5.77
Sumatra	10.10	4.70	1.74	17.59	2.62	4.31
Malabar	10.54	4.63	1.74	20.37	3.45	5.19
Trang	11.66	4.60	1.70	18.17	2.53	4.77
White Pepper (commercial)	10.30	5.60	2.05	. . .	0.56	1.12
Long Pepper	. . .	1.80	0.80	16.82	4.47	8.30

deposited, and may be purified by alternate solution in alcohol or ether, and crystallization. Piperine may be regarded as a *piperidine*, $C_5H_{11}N$, in which one H is replaced by the radical of *piperic acid*, thus: $C_5H_{10}N.C_{12}H_9O_3$. Piperine does not yield salts with acids. (*Buchner's Neues Rep.; A. J. P.*, Oct. 1876.) Rügheimer (*A. J. P.*, Aug. 1882, 397) has regenerated piperine by the union of piperidine and the chloride of the radical of piperic acid, thus making piperine artificially. The properties of this artificial principle are identical with those of the natural piperine.[1]

Piperidine is a powerful volatile alkaloid, soluble in all proportions in water and alcohol, and forming crystalline salts with acids. It is one of the decomposition products of piperine and is of great chemical interest as being a simple derivative of pyridine, C_5H_5N, which seems to underlie the molecular structure of so many alkaloids. Piperidine is *hexahydropyridine*, $C_5H_{11}N$, and can be easily obtained from pyridine by the action of tin and hydrochloric acid, or when sodium acts upon the alcoholic solution. Conversely, piperidine can be changed into pyridine when sulphuric acid at 300° C. or gentle oxidizing agents act upon it. Coniine, it will be remembered (see *Conium*), has been shown synthetically to be a normal propylpiperidine.

Properties.—When perfectly pure, piperine is in colorless transparent crystals, without taste, with no perceptible action on litmus paper, and fusible at 128° to 129.5° C. (262.4° to 265° F.) (Rügheimer, *A. J. P.*, Aug. 1882, p. 397), capable of being sublimed under favorable circumstances in perfect crystals (Waddington, *P. J.*, March, 1868, p. 415), insoluble in cold water, slightly soluble in boiling water which deposits it upon cooling, soluble in alcohol, ether, and acetic acid, and still more readily in chloroform, benzene, and petroleum benzin, decomposed by the concentrated mineral acids, with sulphuric becoming of a blood-red color, with nitric first of a greenish-yellow, then orange, and ultimately red. As ordinarily procured, the crystals are yellow. Piperine is generally believed to be a weak alkaloid of the formula $C_{17}H_{19}NO_3$. When boiled with strong solution of potassium hydroxide or heated with soda-lime it is converted into *piperic* (*piperinic*) *acid*, $C_{12}H_{10}O_4$, and *piperidine*, $C_5H_{11}N$.

It is officially described as "colorless or pale yellowish, glistening, monoclinic crystals, odorless, permanent in the air, and containing no water of crystallization. When put into the mouth, it is at first tasteless, but on prolonged contact it develops a sharp, biting taste. It is optically inactive. Insoluble in water; soluble in 15 parts of alcohol, 36 parts of ether, and in 1.7 parts of chloroform at 25° C. (77° F.); soluble in 4.4 parts of alcohol at 60° C. (140° F.). It melts at 130° C. (266° F.). Upon ignition, it emits alkaline vapors, and is completely consumed. Its alcoholic solution is neutral to litmus paper. Sulphuric acid dissolves Piperine with the formation of a blood-red color, which disappears on dilution with water. On heating 1 Gm. of Piperine with alcoholic potassium hydroxide, it is converted into piperinic acid and piperidine, the latter recognizable by its alkaline, pepper-like odor, and the former by its melting point, 215° C. (419° F.). On adding a crystal of Piperine to sulphuric acid containing about half its volume of solution of formaldehyde, a permanently green liquid is formed. On adding a crystal of Piperine to sulphuric acid containing a fragment of potassium dichromate, it at once acquires a purple color, and, on stirring, dissolves, forming a reddish-brown solution, which becomes greenish on adding water to it. On adding a crystal of Piperine to sulphuric acid containing a trace of selenous acid, it turns brown, changing at once to violet, and dissolves, forming a brown solution changing to green. When heated with nitric acid, Piperine is colored at first orange, then red, and the acid acquires a yellow color, deepening to reddish as the crystals dissolve. On adding to this solution an excess of potassium hydroxide T.S., the color is at first yellow, but upon boiling, it becomes blood-red." *U. S.*

Uses.—(See *Piper*, p. 962.)

Dose, three to five grains (0.2 to 0.32 Gm.).

[1] *Heliotropin.* (*Piperonal.*)—This interesting substance, although used almost exclusively in perfumery, has been recommended by Fraggani (*Ph. Centralh.*, xxviii. 253) as an antiseptic and antipyretic. It may be obtained by the oxidation of piperic acid, as follows. Piperine is made to yield potassium piperate by boiling it for twenty-four hours with an equal part of potassium hydroxide and 5 parts of alcohol. This is then dissolved in from 40 to 50 parts of hot water, and the hot solution slowly mixed, under constant stirring, with a solution of 2 parts (that is, twice the weight of the sodium piperate) of potassium permanganate. The resulting magma is put on a strainer and repeatedly washed with hot water, until it no longer has the characteristic odor of heliotropin. The united liquids are now distilled, and from the first portions of the distillate which are received separately, the larger portion of the heliotropin or rather piperonal ($C_8H_6O_3$) separates, on cooling, in crystals; the remainder may be obtained by shaking the distillate with ether. (*Chem. Ztg.*, 1884.) This piperonal is the aldehyde of piperonylic acid $C_6H_3(COOH)\begin{matrix}O\\O\end{matrix}>CH_2$, which, as the formula indicates, is the methylene ester of protocatechuic acid, $C_6H_3COOH(OH)_2$. See also *Schim. Rep.*, 1903, 133.

PIX BURGUNDICA. Br.

BURGUNDY PITCH

(pĭx bŭr-gŭn'dĭ-cą)

"The resinous exudation obtained from the stem of Picea excelsa, *Link.*, melted and strained." *Br.*

Poix de Bourgogne, Poix des Vosges, Poix jaune, *Fr. Cod.;* Poix blanche, *Fr.;* Burgundisches Pech, Burgunder Harz, Wasserharz, *G.;* Pece di Borgogna, *It.;* Pez de Borgoña, *Sp.*

The Coniferæ have been divided by Eichler, in Engler and Prantl's work, into the following suborders,—viz, *Pinoideæ*, or Conifers proper, and *Taxoideæ*. Eichler does not consider that these subdivisions are deserving of family dis-

tinction, as indicated by Lindley and followed by Britton and Brown in their Flora. The genus Pinus of Linnæus has been divided into the following genera: *Pinus* (the Pines), *Larix* (the Larches), *Picea* (the Spruces), *Tsuga* (the Hemlocks), and *Abies* (the Firs).

Picea excelsa, Link.—*Abies excelsa,* De Candolle.—*Pinus abies,* Willd., *Sp. Plant.* iv. 506; Woodv., *Med. Bot.* p. 4, t. 2.—*Pinus Picea,* Du Roi. *B. & T.* 261.—The *Norway spruce* is a lofty tree, rising sometimes one hundred and fifty feet in height, with a trunk from three to five feet in diameter. The leaves, standing thickly upon the branches, are short, obscurely four-cornered, often curved, of a dusky green color, and shining on the upper surface. The male aments are purple and axillary, the female of the same color, but usually terminal. The fruit is in pendent, purple, nearly cylindrical strobiles, the scales of which are oval, pointed, and ragged at the edges.

This tree is a native of Europe and Northern Asia. Though designated as the source of Burgundy pitch, it furnishes but a part of the substance sold under that name. Tingley asserts that the real Burgundy pitch is obtained from the *Abies Picea,* or European silver fir tree. According to Geiger, who is probably correct, it is procured from both species. To obtain the *pitch,* portions of the bark are removed so as to lay bare the wood, or perpendicular grooved channels are cut, and the flakes of concrete resinous matter which form upon the surface of the wound, having been detached by iron instruments, are melted with water in large boilers, and then strained through coarse cloths. It is called Burgundy pitch from the province of that name in the east of France, although whether it was ever produced in that province is uncertain. It is chiefly collected in Finland, the Schwarzwald, Austria, and the Bernese Alps.

From various species of pine, in different parts of Europe, a similar product is obtained and sold by the same name. It is prepared by removing the juice which concretes upon the bark of the tree, or upon the surface of incisions, called *galipot* by the French, and purifying it by melting, and straining either through cloth or a layer of straw. A *factitious Burgundy pitch* is made by melting together common pitch, rosin, and turpentine, and agitating the mixture with water, which gives it the requisite yellow color. Its odor is different from that of the genuine. Hanbury gives as a test of true Burgundy pitch that it is almost entirely soluble in twice its weight of glacial acetic acid, while the factitious article similarly treated forms a turbid mixture, quickly separating into a thick oily liquid above, and a bright solution below.[1]

As brought to this country, Burgundy pitch is generally mixed with impurities, which require that it should be melted and strained before being used. In its pure state according to the U. S. P. 1890 it is "hard, yet gradually taking the form of the vessel in which it is kept; brittle, with a shining, conchoidal fracture, opaque or translucent, reddish-brown or yellowish-brown, odor agreeably terebinthinate; taste aromatic, sweetish, not bitter. It is almost entirely soluble in glacial acetic acid, or in boiling alcohol, and partly soluble in cold alcohol." *U. S.* 1890. It is very fusible, and at the heat of the body softens and becomes adhesive. It differs from turpentine in containing a smaller proportion of volatile oil. Instead of the sylvic acid of ordinary rosin, it contains an isomeric acid, which has been called *pimaric acid,* melting at 148° to 149° C., difficultly soluble in cold but readily soluble in boiling alcohol, and also soluble in ether. According to Perrenoud, its formula is $C_{40}H_{54}O_4$, but Vesterberg (*Ber. d. Chem. Ges.,* 1885, p. 3331) showed it to be a mixture, and has since (*Ibid.,* 1886, p. 2167, and 1887, p. 3248) prepared from it two isomeric crystalline acids, a *dextropimaric acid* and a *lævopimaric acid,* both of the formula $C_{20}H_{30}O_2$; with these is mixed a varying amount of an amorphous resin acid known as *pinic acid.*

Uses.—Applied to the skin, in the shape of a plaster, Burgundy pitch acts as a gentle rubefacient, producing a slight inflammation without separating the cuticle. Sometimes it excites a papillary or vesicular eruption, and we have known it to act as a violent irritant, giving rise to severe pain, swelling, and redness, followed by vesication and even ulceration. It is used chiefly in chronic *rheumatic pains,* and in chronic affections of the chest or abdomen, which call for a gentle but long-continued revulsion of the skin.

Off. Prep.—Emplastrum Picis, *Br.*

PIX CARBONIS PRÆPARATA. Br.

PREPARED COAL TAR

(pĭx cär'bŏ-nīs præ-pą-rā'tą)

"Prepared by placing commercial coal tar in a shallow vessel, and maintaining it at a temperature of 120° F. (48.9° C.) for one hour, stirring frequently." *Br.*

Prepared coal tar was introduced into the Br. Pharm. 1898; it is the chief constituent in the preparation of *Liquor Picis Carbonis.* (See p. 728.) It has no other use in medicine.

Off. Prep.—Liquor Picis Carbonis, *Br.*

[1] The resinous exudation from *Pinus sylvestris* is sometimes offered as Burgundy pitch, but Hirschsohn (*Ph. Z. R.,* xxiv.) states that it is possible to distinguish the resin of *Picea excelsa* by its being only partially soluble in ether, chloroform, and solutions of salts of ammonium, sodium carbonate, and borax, which dissolve completely the resin of *Pinus sylvestris.* The resin of *Picea excelsa* is also precipitated by the addition of water from its sulphuric acid solution in red violet flakes, while *Pinus sylvestris* resin precipitates white.

PIX LIQUIDA. U. S., Br.

TAR

(pĭx lĭq'uĭ-dą)

"A product obtained by the destructive distillation of the wood of *Pinus palustris* Miller, or of other species of Pinus (Fam. *Pinaceæ*)." *U. S.* "A bituminous liquid, obtained from the wood of Pinus sylvestris, *Linn.*, and other species of Pinus, by destructive distillation. Known in commerce as Stockholm tar." *Br.*

Resina Empyreumatica Liquida; Goudron végétal, *Fr. Cod.*; Goudron, *Fr.*; Theer, *G.*; Pece liquida, *It.*; Brea de pino, Alquitran vegetal, *Sp.*

The tar used in this country is prepared from the wood of various species of pine, particularly *Pinus palustris* of the Southern States. (See *Terebinthina.*) The dead wood is usually selected, because, when vegetation ceases, the resinous matter becomes concreted in the interior layers. The wood is cut into billets of a convenient size, which are placed together so as to form a large stack or pile and then covered with earth as in the process for making charcoal. The stack is built upon a small circular mound of earth previously prepared, the summit of which gradually declines from the circumference to the centre, where a cavity is formed, communicating by a conduit with a shallow ditch surrounding the mound. Fire is applied through an opening in the top of the pile, and a slow combustion is maintained, so that the resinous matter may be melted by the heat. This runs into a cavity in the centre of the mound, and passes thence by the conduit into the ditch, whence it is transferred into barrels. Immense quantities of tar are thus prepared in North Carolina and the southeastern parts of Virginia, sufficient, after supplying our own consumption, to afford a large surplus for exportation.[1] Considerable quantities of tar have been prepared also in the lower parts of New Jersey, in some portions of New England, and in Pennsylvania west of the Alleghany Mountains, from the *Pinus rigida*, or pitch pine, and perhaps from some other species.

Properties.—Tar has an acid reaction, a peculiar empyreumatic odor, a bitterish, resinous, somewhat acrid taste, a color almost black, and a tenacious consistence intermediate between that of a liquid and that of a solid; by age it becomes granular and opaque. It consists of resinous matter, united with acetic acid, oil of turpentine, and various volatile empyreumatic products, and colored with charcoal. By distillation it yields an acid liquor called *pyroligneous acid* (see *Acidum Aceticum*), and an empyreumatic oil called *oil of tar;* what is left behind is *pitch.* Officially it is described as "semi-liquid, viscid, blackish-brown, non-crystalline, translucent in thin layers, becoming granular and opaque with age; odor empyreumatic, terebinthinate; taste sharp and empyreumatic. Tar is soluble in alcohol, fixed or volatile oils, or solutions of potassium or sodium hydroxide; it is heavier than water and is slightly soluble in it, the solution being of a pale yellowish-brown color and having an acid reaction." *U. S.* It is described in the Br. Pharm. as "a dark-brown or blackish semi-liquid substance, of a peculiar aromatic odor. The specific gravity varies from 1.02 to 1.15. *Water* agitated with it acquires a pale-brown color, sharp empyreumatic taste, and acid reaction, and with dilute *test-solution of ferric chloride* assumes a red color. Tar is completely soluble in ten times its volume of *alcohol* (90 per cent.)." *Br.*

The first examination of the empyreumatic oil was made by Reichenbach of Moravia, who found a variety of substances, to which he gave the names of *paraffin, eupion, creosote, picamar, capnomor,* and *pittacal.* It has been found by more careful study of wood tar that it contains a great variety of compounds, including the hydrocarbons *toluene,* C_7H_8, *xylene,* C_8H_{10}, *mesitylene* and *pseudocumene,* C_9H_{12}; phenols like common *phenol,* C_6H_6O, *cresol,* C_7H_8O, *guaiacol,* $C_7H_8O_2$, *creosol,* $C_8H_{10}O_2$, *phlorol,* $C_8H_{10}O$, and *methylcreosol,* $C_9H_{12}O_2$, the last four constituting the mixture known as creosote; and, lastly, *paraffin* in variable quantity, depending upon the temperature of distillation, *naphthalene,* $C_{10}H_8$, *pyrene,* $C_{16}H_{10}$, *chrysene,* $C_{18}H_{12}$, and *retene,* $C_{18}H_{18}$. *Pyrocatechol,* $C_6H_4(OH)_2$, is also obtained, either in the pyroligneous acid, as it is soluble in water, or in the tarry mixture. It crystallizes readily, fuses at 104° C. (219.2° F.), and sublimes at a temperature slightly above this. Tar yields a small proportion of its constituents to water, which is thus rendered medicinal, and is employed under the name of *tar water.* Tar water is of "a pale yellowish-brown color and an acid reaction, yields with ferric chloride test-solution a transient green color, and is colored brownish-red by an equal volume of calcium hydrate test-solution." Tar is dissolved by alcohol, ether, chloroform, and the volatile and fixed oils, and by a solution of potassium or sodium hydroxides. On spreading tar in a thin layer on a pane of glass it should present a homogeneous appearance. Those specimens which contain granular transparent masses should be rejected. These masses, which polarize brilliantly, are said to be *pyrocatechol.* Tar should have a specific gravity of 1.03 to 1.07; it should boil at from 250° to 400° C. Its reaction should be acid. *"Steam refined tar"* is tar which has been simply heated in steam caldrons and strained to remove foreign impurities.

Hirschsohn has suggested the following plan for the identification of different varieties of

[1] According to R. J. Dunwoody (*A. J. P.*, 1889), tar is also prepared on a small scale by wedging vertically into an iron pot the pieces of split wood, inverting over the projecting ends another iron pot, and setting fire to the wood; or by simply placing the billets of wood on the top of an inclined plane of sheet iron, setting the wood on fire, and catching the tar which runs down.

tar. 1. *Completely soluble in 95 per cent. acetic acid. Pine Tar.*—French turpentine dissolves it completely. The petroleum ether extract of the tar is colored greenish when shaken with a dilute solution of cupric acetate (1 : 1000). Chloroform and absolute ether dissolve it completely. *Beech Tar.*—Turpentine oil dissolves it only partially. The petroleum ether extract is not colored by copper acetate solution. Chloroform and absolute ether do not entirely dissolve it. 2. *Not completely soluble in 95 per cent. acetic acid. Juniper Tar.*—Turpentine oil dissolves it completely. Aniline dissolves it completely. The aqueous extract (1 : 20) yields a red coloration with dilute solution of ferric chloride (1 : 1000). *Birch Tar.*—Turpentine oil dissolves it completely. Aniline does not dissolve it completely. The aqueous extract is colored greenish by ferric chloride. Turpentine oil dissolves it only partially. *Aspen Tar.*—Benzene, chloroform, absolute ether, and olive oil dissolve it only partially. (*Ph. Ztg.*, 97, 396; *Ph. Z. R.*, 97.)

The pitch left after the evaporation of tar was formerly official with the British Colleges, under the names of *Pix nigra*, *Pix arida*, or simply *Pix*. It has a shining fracture, softens and becomes adhesive with a moderate heat, melts in boiling water, and consists of the unaltered resin of the pine and of various empyreumatic resinous products which have received the name of *pyretin*. (Berzelius, *Traité de Chimie*, vi. 641, 680.) It has been used internally in *ichthyosis* and other cutaneous diseases, and in *piles*. The dose is from ten grains to a drachm (0.65 to 3.9 Gm.), given in pill. Pitch is also used externally in the form of ointment.

Uses.—The medicinal properties of tar are similar to those of the turpentines, but it is much less irritant. It is occasionally used with advantage in *chronic catarrhal affections*, and in *diseases of the urinary passages*. Little benefit can be expected from it in genuine *phthisis*, in the treatment of which it was formerly recommended. In reference to the administration of tar, it has always been considered desirable to have it in a soluble state, so that it might be brought with facility into a liquid form if required. Besides, tar in the stomach will probably be found efficacious in proportion to its solubility. This desired end was attained when it was discovered that tar was capable of forming a definite, solid compound with sugar which was very soluble in water. Saccharated tar contains 4 per cent. of pure tar, resembles sugar in appearance, having a sweet taste and the odor of tar, and may be given in substance or solution as deemed desirable. (*P. J.*, Sept. 1871.) (See *Syrupus Picis Liquidæ*.)[1] But glycerin is a more convenient vehicle, and glycerite of tar was an official preparation in 1870. Its vapor, inhaled into the lungs, may be serviceable in *chronic bronchitis* and *phthisis*. Its effects are most conveniently obtained by placing tar or oil of tar in a tin dish containing hot water, and heating this; the fumes may be inhaled by inverting a funnel to which a rubber tube is attached, over the dish. Externally applied it is a decided stimulant, and in the state of ointment is a very efficient remedy in *tinea capitis* or *scaldhead*, and in some cases of *psoriasis*, in *chronic eczema*, and other *affections of the skin*.[2]

It may be used in the form of tar water (see *Infusum Picis Liquidæ*), or in substance made into pills with wheat flour, or mixed with sugar in the form of an electuary. Tar may be administered to the amount of one to two fluidrachms (3.75 to 7.5 Cc.) daily.

Pulverulent tar is prepared by Magnes-Lahens, by mixing, in an earthenware vessel, two parts of finely divided charcoal and one part of liquid tar. The resulting mixture resembles small grains of gunpowder, does not soil the vessel or the fingers, and yields readily to water the tar which it contains,—the most favorable temperature for solution being about 20° C. (68° F.). Magnes-Lahens recommends a syrup prepared from the powder as follows. Take of pulverulent tar 50 Gm., water 180 Gm., granulated sugar 320 Gm. Mix the tar and sugar in a mortar, then add the water, and heat the mixture by a water bath at 60° C. (140° F.). Then remove from the bath, shake until the sugar is all dissolved, and strain when hot, and afterwards again when cold. A tablespoonful of the syrup, added to a tumbler of water, yields a tar water resembling that of the French Codex. The pulverulent tar may also be used for pills, and also for fumigating purposes by throwing a few grains on a heated shovel. (*P. J.*, April, 1872, 850.)

Dose, five to twenty grains (0.32 to 1.3 Gm.).

Off. Prep.—Syrupus Picis Liquidæ, *U. S.*; Unguentum Picis Liquidæ, *U. S.*, *Br.*

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[1] *Wine of Tar* (J. B. Moore).—Pure Tar, 16 troy-ounces; Glycerin, Sherry Wine, Honey, of each, 8 fluidounces; Acetic Acid, 1 fluidounce; Boiling Water, 6 pints. Mix the glycerin, sherry wine, honey, acetic acid, and boiling water together, in a stone jug or other suitable vessel of the capacity of a gallon. To the mixture add the tar, and shake the whole vigorously for several minutes. The vessel is then to be tightly stopped and placed upon a stove or in a water bath, resting upon folds of paper, and the mixture digested, for an hour or two, at a temperature of from 150° to 160° F. During the digestion the mixture should be frequently well shaken. When the digestion is completed, the mixture is to be set aside to macerate, in a warm place, for a few days, it being well shaken occasionally during the process. Lastly, strain through muslin, and filter the strained liquid through paper.

[2] *Liquor Picis Alkalinus.*—L. D. Bulkley of New York, gives the following formula for this preparation, which was originally devised by his father. Tar, 120 grains; Caustic Potash, 60 grains; Water, five fluidrachms. Mix and dissolve for external use. This mixes with water in all proportions, and only moderately discolors the skin. It dries rapidly and leaves very little stickiness. (*Medical News and Library*, June, 1873.)

PLUMBI ACETAS. U. S., Br.

LEAD ACETATE [Sugar of Lead]

(plŭm'bī ą-cē'tąs)

$Pb(C_2H_3O_2)_2 + 3H_2O = 376.15$

"It should contain not less than 99.5 percent. of pure Lead Acetate [$(CH_3.COO)_2Pb + 3H_2O$], and should be kept in well-stoppered bottles." *U. S.* "A salt, $Pb(C_2H_3O_2)_2$, $3H_2O$, obtained by dissolving lead oxide or lead carbonate in acetic acid." *Br.*

Acetas Plumbicus, Saccharum Saturni, Cerussa Acetata; Acétate neutre de Plomb, Sucre de Plomb, Sel de Saturne, *Fr. Cod.*; Plumbi Aceticum, *P. G.*; Bleiacetat, Essigsaures Bleioxyd, Bleizucker, *G.*; Acetato neutro di piombo, Zucchero di Saturno, *It.*; Acetato plumbico neutro, Azucar de Saturno, *Sp.*

Preparation.—Lead acetate is obtained by two methods. By one method, thin plates of lead are placed in shallow vessels filled with distilled vinegar, in such a manner as to have a part of each plate rising above the vinegar, and these are turned from time to time, so as to bring different portions of the metallic surface in contact with the air. The metal, in the presence of the oxygen of the air, dissolves in the vinegar to saturation, and the solution is evaporated to the point of crystallization. This process is a slow one, but furnishes a salt which is perfectly neutral. The other method consists in dissolving, by the assistance of heat, litharge, or lead protoxide obtained by calcination, in an excess of distilled vinegar or of purified pyroligneous acid, contained in leaden boilers. The oxide is quickly dissolved, and, when the acid has become saturated, the solution is transferred to other vessels to cool and crystallize. The crystals having formed, the mother waters are decanted, and, by evaporation, made to yield a new crop. These are generally yellow, but may be rendered white by repeated solutions and crystallizations.

Lead acetate is extensively manufactured in Germany, Holland, France, and England, as well as in the United States. It is principally consumed in the arts of dyeing and calico printing, in which it is employed with alum, to form aluminum acetate, which acts as a mordant.

Properties.—"Colorless, shining, transparent, monoclinic prisms or plates, or heavy, white, crystalline masses, or granular crystals, having a faintly acetous odor, and a sweetish, astringent, afterwards metallic taste. Efflorescent, and absorbing carbon dioxide, on exposure to the air. Soluble in 2 parts of water, and in 30 parts of alcohol at 25° C. (77° F.); in 0.5 part of boiling water, and in 1 part of boiling alcohol. When heated to 40° C. (104° F.), the salt loses its water of crystallization (14.26 percent.). When heated rapidly to 75° C. (167° F.) it fuses in its water of crystallization, and at a higher temperature is converted into a pulverulent basic salt which fuses at about 280° C. (536° F.) with continued loss of acetic acid, finally decomposing with the evolution of carbon dioxide and acetone, leaving a residue of finely divided metallic lead mixed with oxide and carbonate. On heating the salt with sulphuric acid, vapors of acetic acid are evolved. The aqueous solution of Lead Acetate has a neutral or slightly alkaline reaction, and yields a black precipitate with hydrogen sulphide T.S., a yellow one with potassium iodide T.S., and a white one with diluted sulphuric acid. A solution of the salt (1 in 10), prepared with water which has been recently boiled, should be clear, or only slightly opalescent (limit of *carbonate*), and should yield, with potassium ferrocyanide T.S., a pure white precipitate (absence of *iron* and *copper*). If to the aqueous solution of the salt (1 in 10), hydrochloric acid be added until no further precipitate is produced, the remainder of the lead removed from the filtrate by hydrogen sulphide, and the liquid filtered, a portion of the second filtrate should not be affected by the addition of a slight excess of ammonia water (absence of *zinc* and *iron*). If another portion of the filtrate be evaporated to dryness, it should leave no residue (absence of *salts* of the *alkali metals*, and those of *magnesium, calcium, zinc,* and *iron*)." *U. S.* "It is soluble in less than 3 parts of cold *water,* and in 30 parts of *alcohol* (90 per cent.). Its solution in *water* slightly reddens *litmus,* and is clear, or has only a slight milkiness, which disappears on the addition of *acetic acid.* It affords the reactions characteristic of lead and of acetates. It should yield no characteristic reaction with the tests for silver, copper, arsenium, iron, zinc, calcium, sodium, potassium, ammonium, chlorides, or nitrates. Each gramme dissolved in *water* should require for complete precipitation 53.1 cubic centimetres of the *decinormal volumetric solution of sulphuric acid.*" *Br.* Exposed to the air, it effloresces slowly. In pure distilled water, free from carbon dioxide, it ought to dissolve entirely and form a clear solution. The commercial acetate is sometimes impure from the presence of lead sulphate and carbonate. In purchasing it the apothecary should select large crystalline masses. John Mackay analyzed a specimen of this salt, derived from the London market, which contained nearly 30 per cent. of lead sulphate. (*P. J.*, Jan. 1856, 316.) Sulphuric acid, when added to a solution of lead acetate, produces instantly a precipitate of lead sulphate, and the disengaged acetic acid gives rise to vapors having the odor of vinegar. An important property of lead acetate is its power of dissolving a large quantity of lead monoxide. (See *Liquor Plumbi Subacetatis.*)[1] It consists of one atom

[1] *Lead Subacetate (Crystallized).*—James Kennedy recommends this salt for preparing the cerate, as follows: Dissolve 4 parts of Lead Acetate in 4 parts of Boiling Distilled Water, add 3 parts of Litharge, boil for fifteen or twenty minutes, stirring, and occasionally adding water to replace that evaporated, allow to stand a few minutes, decant and filter the solution; concentrate by evaporation and allow to crystallize. By dissolving 25 parts of this salt in

of lead, which has replaced the two hydrogen atoms furnished by two molecules of acetic acid, $C_2H_3O_2.H$, so that its formula becomes $Pb(C_2H_3O_2)_2$, and this in crystallizing takes $3H_2O$. Its molecular weight is therefore 376.15.

Incompatibles and Tests.—Lead acetate is decomposed by all acids, and by those soluble salts the acids of which produce with lead monoxide insoluble or sparingly soluble compounds. Acids of this character are sulphuric, hydrochloric, phosphoric, tannic, citric, and tartaric. It is also decomposed by lime water, and by ammonia, potassium and sodium hydroxides; the last two, if added in excess, dissolving the precipitate at first formed. It is decomposed by hard water, in consequence of the calcium sulphate, carbonates and sodium chloride which such water usually contains.

Uses.—Lead acetate, in medicinal doses, is a powerful astringent and sedative; in overdoses, an irritant poison, which has in a number of cases caused death. Burning epigastric pain, vomiting of a white curdy matter (lead chloride), and diarrhœa or constipation with black stools (lead sulphide), and finally collapse, are the characteristic symptoms. Its antidote is any soluble sulphate, common salt, soap, or an alkali. In medicinal doses lead acetate is a powerful sedative astringent. It is especially useful in the treatment of *diarrhœas*, and even of *dysentery*, when the discharges are excessive. At one time it was very much used for the relief of *internal hemorrhages*, but it has been substituted by more effective remedies. It may be, however, effective in *gastric* or *intestinal hemorrhages*. In many cases of *chronic diarrhœa* or in diarrhœas occurring in exhaustive, uncontrollable disease, such as *phthisis*, lead acetate, combined with opium, may be a valuable palliative in checking discharges. It has been given also in *aneurism* of the aorta. The prolonged medicinal use of acetate of lead may give rise to subacute or chronic lead poisoning.

Internally, lead acetate should always be given in the form of pill, and is often combined with opium. The solution for external use may be made by dissolving from two to three drachms in a pint of water, and, if it be wanted clear, a fluidrachm of vinegar or of diluted acetic acid may be added, which immediately dissolves the lead carbonate, to which its turbidity is owing. When the skin is denuded of the cuticle, the solution should be weaker. The usual strength of the solution as a collyrium is from one to two grains (0.065 to 0.13 Gm.) to the fluidounce (30 Cc.) of *distilled* water.

Dose, one to three grains (0.065 to 0.20 Gm.).

Off. Prep.—Emplastrum Plumbi, *U. S.;* Glycerinum Plumbi Subacetatis, *Br.;* Liquor Plumbi Subacetatis, *U. S.* (*Br.*); Pilula Plumbi cum Opio, *Br.;* Suppositoria Plumbi Composita, *Br.;* Unguentum Plumbi Acetatis, *Br.*

75 parts of previously boiled water, *Liquor Plumbi Subacetatis*, corresponding to the official requirements, is obtained. (*Ph. Rec.*, 1886, p. 50.)

PLUMBI CARBONAS. Br.

LEAD CARBONATE [White Lead]

(plŭm′bī cär′bo-năs)

$(PbCO_3)_2.Pb(OH)_2 = 768.91$

"Lead Carbonate or hydroxy-carbonate, $2PbCO_3,Pb(OH)_2$, may be prepared by the interaction of lead, water, and carbonic anhydride, in the presence of vapors of acetic acid." *Br.*

Plumbum Carbonicum, Carbonas Plumbicus, Ceruse; Carbonate de Plomb, Céruse, *Fr. Cod.;* Blanc de Plomb, Blanc de Céruse, *Fr.;* Cerussa, *P. G.;* Bleiweiss, *G.;* Cerussa, *It.;* Albayalde o cerusa, *Sp.*

This compound of lead was dismissed from the U. S. Pharmacopœia (8th Rev.).

Preparation.—Lead carbonate is prepared by two principal methods. By one method it is obtained by passing a stream of carbon dioxide through a solution of lead subacetate. The dioxide combines with the lead hydroxide of the basic salt, and precipitates as lead carbonate, while a neutral acetate remains in solution. This, by being boiled with a fresh portion of oxide, is again brought to the state of basic salt, when it is treated with carbon dioxide as before. In this way the same portion of acetate repeatedly serves the purpose of being converted into subacetate and of being decomposed by carbon dioxide. The carbonate obtained is washed, dried with a gentle heat, and thrown into commerce. This process, which produces white lead of the first quality, was invented by Thénard, about the year 1802, and is that which is usually pursued in France and Sweden, and known as the "Clichy process." Benson's modification of the process of Thénard is now used by some manufacturers in England. It consists in mixing litharge with a hundredth part of lead acetate, moistening the mixture with very little water and subjecting it to a stream of carbon dioxide.

The other, called the "Dutch process" from its origin in Holland, consists in exposing lead to the vapor of vinegar, and is usually pursued in England and the United States,—but in England with some not well known modifications. We shall describe this process as employed by our own manufacturers. The lead is cast into thin sheets, made by pouring the melted lead over an oblong sheet iron shovel, with a flat bottom, and with raised edges on its sides, which is held in a slanting direction over the melting pot. As many of these sheets are then loosely rolled up as may be sufficient to form a cylinder five or six inches in diameter, and seven or eight high, which is placed in an earthen pot containing about half a pint of vinegar, and having within a few inches from the bottom three equidistant projecting knobs in the earthenware, on which the cylinder of lead is supported in order to keep it from contact with the vinegar. The pots thus prepared are placed side by side, in horizontal layers, in a building roughly constructed of boards, with interstices between them. The first layer is covered with boards,

on which a stratum of tan or of refuse straw from the stables is strewed, and fresh layers of pots, boards, and tan or straw are successively placed until the building is filled. The sides are also enclosed with straw. The layers of pots contained in one building, called a stack, are allowed to remain undisturbed for about six weeks, at the end of which time they are unpacked, and the cylinder of sheet lead in each pot, though still retaining its shape, is found almost entirely converted into a flaky, white, friable substance, which is the white lead. This is separated from the lead yet remaining in the metallic state, ground in water, whereby it is washed and reduced to fine powder, and finally dried in long shallow reservoirs, heated by steam. Pelouze has succeeded in explaining these processes on one general principle. In Thénard's process it is admitted that the same portion of lead acetate unites with oxide, and gives it up again to carbon dioxide to form the carbonate. In the modified English process, referred to above, he supposes that the one per cent. of lead acetate combines with sufficient litharge to convert it into subacetate, which immediately returns to the state of neutral acetate by yielding up its excess of base to form the carbonate with the carbon dioxide. The acetate is now ready to combine with a fresh portion of litharge, to be transferred to the carbon dioxide as before, and thus the small proportion of acetate, by combining with successive portions of the litharge, finally causes the whole of the latter to unite with the carbon dioxide. In the Dutch process, Pelouze has rendered it almost certain that none of the oxygen or carbon dioxide of the carbonate is derived from the vinegar. In this process he supposed that the heat generated by the fermentation of the tan or straw volatilizes the vinegar, the acetic acid of which, with the assistance of the oxygen of the air, forms with the lead a small portion of subacetate. This, by reacting with the carbon dioxide resulting from the decomposition of the tan or straw, or derived from the atmosphere, forms lead carbonate, and is brought to the state of neutral acetate. The neutral acetate returns again to the state of subacetate, and, by alternately combining with and yielding up the oxide, causes the whole of the lead to be finally converted into carbonate.

The temperature of the stacks of pots in the Dutch process is about 45° C. (113° F.). If it falls below 35° C. (95° F.), a part of the lead escapes corrosion, and if it rises above 50° C. (122° F.), the product is yellow. The form of acetic acid usually employed in this process is vinegar, but the variable nature of that liquid as to strength and purity is an objection to its use, and, accordingly, other forms of the acid have been substituted with advantage, as, for example, the purified acetic acid from wood in a diluted state. The German or chamber process differs from the Dutch process only in that the vessels containing the lead are placed in chambers having a perforated floor, through the openings of which the fumes of acetic acid rise, acting upon the lead, while carbon dioxide from the burning of coke is passed in and through the chamber. This process is cheaper than the Dutch method, and is said to give an equally satisfactory product. Another method, which yields a white lead of excellent covering power, is the process patented in England by Dale and Milner. This consists in carefully grinding between millstones a mixture of litharge or any insoluble basic lead salt with water and sodium bicarbonate. Milner has improved upon this method by grinding a mixture of 4 parts of finely divided litharge with 1 part of common salt and 16 parts of water. After about 4½ hours the reaction is complete. The mixture of basic lead chloride and caustic soda is then transferred to a leaden vessel, well stirred with a wooden pestle, and a current of carbon dioxide passed through it until the liquid is neutral. If the carbon dioxide be passed in too long, the product will be spoiled. (*Roscoe and Schorlemmer,* vol. ii. 1, 293.) In Carter's process, used in this country extensively, granulated metallic lead is moistened with acetic acid and submitted to the action of carbon dioxide gas in revolving barrels. The production of white lead in the United States reaches large proportions, amounting in 1904 to 123,346 short tons, valued at $13,756,929.

Properties.—According to the U. S. P. 1890, lead carbonate is " a heavy, white, opaque powder, or a pulverulent mass, without odor or taste. Permanent in the air. Insoluble in water or alcohol, but soluble in acetic or diluted nitric acid, with effervescence. When strongly heated, the salt turns yellow without charring, and, if heated in contact with charcoal, it is reduced to metallic lead. If 2 Gm. of the salt be dissolved in a mixture of 2 Cc. of nitric acid and 10 Cc. of water, it should not leave more than 0.02 Gm. of residue (limit of *insoluble foreign salts*). This solution yields a black precipitate with hydrogen sulphide test-solution, a yellow one with potassium iodide test-solution, and a white one with diluted sulphuric acid. On completely precipitating the solution with hydrogen sulphide, the filtrate should not leave more than a trifling residue on evaporation (limit of *salts of the alkalies, alkaline earths,* or of *zinc*). If 1 Gm. of the salt be strongly ignited, in a porcelain crucible, it should leave a residue of lead oxide weighing not less than 0.85 Gm." *U. S.* 1890. It is sometimes adulterated with barium, calcium, and lead sulphates, particularly the first. A mixture of equal parts of white lead and barium sulphate is known as *Venetian white,* while *Hamburg white* is a mixture of 1 part of white lead and 2 parts of barium sulphate, and *Dutch white* of 1 part to 3 of barium sulphate. Louyet has examined samples of French white lead containing considerably more than half their weight of barium sulphate. These sulphates, if present, are left undissolved by nitric acid. Chalk or whiting is another adulteration. This

may be detected by adding to the nitric solution of the white lead an excess of potassium hydroxide, which will redissolve the lead monoxide first thrown down, but leave a white powder of lime. The Br. Pharm. describes it as a soft, heavy powder, insoluble in water, entirely soluble in diluted acetic acid. Neutral lead carbonate consists of one atom of lead, one of carbon, and three of oxygen. Commercial white lead is a compound of lead carbonate and hydroxide. Its formula is generally taken as $2PbCO_3 + Pb(OH)_2$. According to Stein, white lead, when submitted to simple calcination, loses 14.5 per cent. of its weight, and a mode of determining its purity is thus afforded. (*J. P. C.*, Jan. 1859, 78.) But the fact seems to be, from the observations of Wm. Baker, that the commercial white lead contains variable proportions of the hydrated oxide, from a mere trace to the amount of 1 molecule to 3 molecules of the neutral carbonate. (*Chem. News*, Aug. 10, 1861, 74.)

Uses.—White lead is ranked in the Materia Medica as an astringent and sedative. It is employed externally only, being used, in the form of ointment, as an application to *ulcers* and to *inflamed* and *excoriated surfaces*. It was recommended in *scalds* and *burns* by Gross, and Alfred Freer has found it very useful in *erysipelas, eczema, carbuncle*, etc. (*P. J.*, Aug. 1859.) The white lead is first brought to the consistence of cream by linseed oil, as in making common white paint, and then brushed over the inflamed surface. Its free continued external use has produced lead poisoning. (Case, *N. A. Medico-Chir. Rev.*, July, 1857, p. 605.) Although highly insoluble, on account of its frequent use in the arts and of the ease of its formation when lead is exposed to chemical influences, lead carbonate probably produces chronic poisoning more often than any other preparation of the metal. The constant use of face powders and cosmetics containing lead carbonate, or "*flake white*," as it is sometimes called, has produced serious results.

Off. Prep.—Unguentum Plumbi Carbonatis, *Br.*

PLUMBI IODIDUM. U. S., Br.

LEAD IODIDE

(plŭm'bī ī-ŏd'ĭ-dŭm)

$PbI_2 = 457.15$

"It should contain not less than 99 percent. of pure Lead Iodide, and should be kept in well-stoppered bottles, protected from light." *U. S.* "Precipitated Lead Iodide, PbI_2, is obtained by the interaction of lead nitrate or acetate and potassium iodide." *Br.*

Plumbum Iodatum, Ioduretum Plumbicum, Iodure de Plomb, *Fr. Cod.*; Jodblei, *G.*; Yoduro plumbico, *Sp.*

"Take of Nitrate of Lead, Iodide of Potassium, each, *four ounces* [avoirdupois]; Distilled Water *a sufficiency*. Dissolve the Nitrate of Lead, by the aid of heat, in a pint and a half, and the Iodide of Potassium in half a pint of the Water, and mix the solutions. Collect the precipitate on a filter, wash it with Distilled Water, and dry it in a warm place." *Br.* 1885.

No process is given in the U. S. P. (8th Rev.) nor Br. Ph. 1898 for Lead Iodide. The process of the U. S. P. 1870 was identical with that of the British Pharm. 1885 given above.

The lead nitrate gives up its metal to the iodine, receiving the potassium, the operation taking place between one molecule of the lead nitrate and two molecules of the potassium iodide. The potassium nitrate thus formed remains in solution, while the lead iodide is precipitated,

$$Pb(NO_3)_2 + 2KI = 2KNO_3 + PbI_2$$

The theoretical quantities of lead nitrate and potassium iodide are 328.49 of the former and 329.52 of the latter, or almost precisely equal quantities. The proportions should be as nearly as possible those of exact saturation. An excess of the potassium iodide, independently of the waste, has the disadvantage of holding a portion of the lead iodide in solution, while, according to Christison, an excess of lead over the iodine disposes to the formation of the lemon-yellow insoluble lead oxyiodide. By the use of equal quantities of the two salts these disadvantages are avoided. As lead iodide is slightly soluble in cold water, it is desirable to use as little of the solvent as will answer, and hence the comparatively small proportion of water employed.

In the former London process lead acetate was employed instead of the nitrate, but Depaire of Brussels, ascertained that in this process a considerable amount of iodide remains in solution after the precipitation of the lead iodide, and F. Boudet states that the quantity of the iodide resulting from the process is 10 per cent. less than theory would indicate. By the addition of nitric acid to the solution, after precipitation, an additional quantity of lead iodide is obtained. Boudet ascribes this result to the formation of a portion of soluble potassium and lead iodide, whenever lead iodide and potassium acetate are in contact. By substituting lead nitrate for acetate, he found that a quantity of lead iodide was obtained as near that required by theory as the solubility of the lead iodide permits. (*J. P. C.*, 3e sér., xi. 274.) The official process is on the whole to be preferred to that in which lead acetate is used, and especially as the nitrate is more easily obtained pure. Some interesting experiments have been made by T. Huraut of Paris, on the different methods of preparing lead iodide. It may be obtained by the reaction between any of the soluble iodides and the soluble lead salts. It resulted from his observations that of the two lead salts employed, the nitrate was to be preferred, and of the various iodides, though potassium iodide yielded a very handsome product, yet calcium iodide afforded one not inferior in quality, and somewhat greater in quantity.

Upon a small scale, as the process is performed by the apothecary, the difference would be of little consequence, but it might be important to the manufacturer. (See *A. J. P.*, xxi.)

Properties.—As officially described, it is in the form of "a heavy, bright yellow powder, without odor or taste; permanent in the air. Soluble in about 1300 parts of water at 25° C. (77° F.), and in about 200 parts of boiling water, separating from the latter solution on cooling in brilliant, golden-yellow crystalline laminæ; very slightly soluble in alcohol, but soluble, without color, in solutions of the fixed alkalies, in concentrated solutions of the alkali acetates, of potassium iodide, and of sodium thiosulphate, and in a hot solution of ammonium chloride. When moderately heated, the salt fuses to a thick, reddish-brown liquid, which congeals, on cooling, to a yellow, crystalline mass. At a higher temperature it is decomposed, with the evolution of violet vapors of iodine, leaving a lemon-yellow residue of lead oxyiodide. If 1 Gm. of the salt be triturated with 2 Gm. of ammonium chloride and 2 Cc. of water, a nearly white mixture will result. If this be transferred to a test-tube, and heated in a water-bath for a few minutes, a clear and almost colorless solution should be formed (absence of *chromate* and *other insoluble foreign salts*). On cooling this solution, a solid mass of nearly colorless, fine, silky crystals will be produced, and on adding water or diluted sulphuric acid to this mass, yellow Lead Iodide will separate. Add 0.1 Gm. of the salt to 5 Cc. of water, and heat the mixture until it boils; cool the liquid and filter it into a test-tube of about 40 Cc. capacity, then add 5 Cc. of potassium hydroxide T.S. and about 0.2 Gm. of aluminum wire, insert in the upper portion of the test-tube a pledget of purified cotton, and over the mouth, place a piece of moistened red litmus paper; then if the tube be heated on a water-bath for fifteen minutes, no blue coloration of the paper should be discernible (limit of *nitrate*). If 1 Gm. of Lead Iodide be boiled for a few minutes with 20 Cc. of water, the mixture then cooled and filtered, and the lead removed from the filtrate by hydrogen sulphide, a portion of the second filtrate, after boiling to drive off hydrogen sulphide and carefully neutralizing with ammonia water, should not be colored red by a drop of ferric chloride T.S. (absence of *acetate*). Another portion of this filtrate, if evaporated to dryness, should leave no residue (absence of *soluble foreign salts*)." *U. S.* "A heavy bright-yellow powder, soluble in about 2000 parts of cold and in about 200 parts of boiling *water*, and deposited in golden-yellow crystalline scales as the latter solution cools; entirely soluble in *solution of ammonium chloride*. It affords the reactions characteristic of lead and of iodides. It should yield no characteristic reaction with the tests for nitrates or acetates." *Br.* According to Soubeiran, it is soluble in 1235 parts of cold water, and 194 of boiling water, which, on cooling, deposits it in minute, shining, golden-yellow, crystalline scales. It is freely soluble in a concentrated solution of sodium acetate (Donato Tommasi, *P. J.*, 3d series, ii. 805). It should be kept excluded from the light. It is stated by Engelhardt that iodine is separated from lead iodide by ferric and cupric chlorides, while the other metallic chlorides have no such effect, producing compounds of iodides of the metal employed with lead chlorides.

Uses.—This compound is supposed to have the resolvent properties of iodine, combined with those which are peculiar to lead, and was at one time recommended in *tuberculous diseases*, in which, however, it has proved wholly inefficient. It is said to have been usefully employed in the discussion of *scrofulous tumors* and other indolent swellings, and in the cure of obstinate *ulcers*, and for these purposes has been used both internally and locally in the form of an ointment. According to Cogswell, if given for some time in small doses, it produces the effects of lead, but not those of iodine, upon the system. (*Christison's Dispensatory.*)

Dose, half a grain to four grains (0.032 to 0.26 Gm.).

Off. Prep.—Emplastrum Plumbi Iodidi, *Br.*; Unguentum Plumbi Iodidi, *Br.*

PLUMBI NITRAS. U. S.

LEAD NITRATE

(plŭm'bī nī'trās)

$Pb(NO_3)_2 = 328.49$

"It should contain not less than 99.5 percent. of pure Lead Nitrate [$(NO_2.O)_2Pb$], and should be kept in well-closed vessels." *U. S.*

Nitrate of Lead; Plumbum Nitricum, Nitras (Azotas) Plumbicus; Azotate de Plomb, Nitrate de Plomb, *Fr. Cod.*; Salpetersaures Bleioxyd, Bleisalpeter, *G.*; Nitrato di piombo, *It.*; Nitrato plumbico, Nitrato de plomo, *Sp.*

Neither the U. S. nor the Br. Pharmacopœia gives a formula for the preparation of this salt. It may be readily prepared by the process of the old Dublin Pharmacopœia: "Take of Litharge, in fine powder, *five ounces* [avoirdupois]; Pure Nitric Acid *two fluidounces;* Distilled Water *three pints* [Imp. meas.]; Dilute Nitric Acid *a sufficient quantity*. To the Litharge, placed in a porcelain dish, add the Acid with a pint and a half of the Water, and, applying a sand heat, and occasionally stirring the mixture, evaporate the whole to dryness. Upon the residue boil the remainder of the Water, clear the solution by filtration, and, having acidulated it by the addition of a few drops of the Dilute Nitric Acid, evaporate until a pellicle begins to form. The heat being now withdrawn, crystals will form on the cooling of the solution, which should be dried on blotting-paper in a warm atmosphere, and preserved in a close bottle."

In this process the nitric acid unites directly with the lead oxide to form the nitrate.

Properties.—This nitrate is officially described as in "colorless, transparent, octahedral crystals, when obtained by the spontaneous evaporation of cold solutions, or white, nearly opaque crystals, when formed by the cooling of hot solutions; without odor, and having a sweetish, astringent, afterwards metallic, taste; permanent in the air. Soluble in 1.85 parts of water at 25° C. (77° F.), and in 0.75 part of boiling water; almost insoluble in alcohol. When strongly heated, the salt decrepitates, emits nitrous vapors, and finally leaves a residue of lead oxide. The aqueous solution of the salt has an acid reaction upon blue litmus paper, and yields a black precipitate with hydrogen sulphide T.S., a yellow one with potassium iodide T.S., and a white one with diluted sulphuric acid. The aqueous solution of the salt (1 in 10) should give, with potassium ferrocyanide T.S., a pure white precipitate (absence of *copper* and *iron*). If hydrochloric acid be added to the aqueous solution of the salt until no further precipitate is produced, and the remainder of the lead be removed from the filtrate by hydrogen sulphide, a portion of the second filtrate should not be affected by the addition of a slight excess of ammonia water (absence of *zinc* and *iron*). Another portion of this filtrate, when evaporated to dryness, should not leave a weighable residue (limit of *salts* of the *alkalies* and those of *magnesium, calcium, zinc,* and *iron*)." *U. S.* It is composed of one atom of lead, combined with two nitric acid groups, $(NO_3)_2$, without water of crystallization. This salt is largely used in dyeing and calico printing, for the preparation of mordants, and of chrome yellow.

Uses.—The effects of this salt upon the system are the same as those of the other soluble lead salts, but, though formerly employed, it is now quite out of use as an internal remedy. Externally it is occasionally applied to excoriated surfaces, and a solution made in the proportion of ten grains to an ounce of water, and colored probably with alkanet, has been used on the continent of Europe as a secret remedy in *sore nipples, chapped hands, cracked lips,* etc., and it undoubtedly, in solutions whose strength should be adapted to the individual case, is a valuable local remedy in diseases of the skin and mucous membrane, such as *leucorrhœa, gonorrhœa, ulcers,* and *chronic impetiginous affections.* It may be used to correct fetid odors dependent on the presence of hydrogen sulphide or ammonium sulphydrate, which it decomposes, but it is not a germicide or true disinfectant. *Ledoyen's disinfecting fluid* is a solution of lead nitrate in the proportion of a drachm to an ounce. Should the salt be used internally, the dose would be from one-fourth to one-half of a grain (0.016 to 0.032 Gm.). Moerlonge and Vanzette ascribe remarkable efficiency to lead nitrate in *onychia maligna,* and their statements have been confirmed by other practitioners. It is applied by sprinkling the powder on the surface, and, according to J. Scott of Belfast, Ireland, a complete cure may be relied on in from fourteen to thirty days. (*Dublin Q. J.*, Feb. 1874, p. 145.)

Dose, one-fourth to one-half grain (0.016 0.032 Gm.).

PLUMBI OXIDUM. U. S., Br.

LEAD OXIDE [Litharge]

(plŭm'bī ŏx'ĭ-dŭm)

$PbO = 221.23$

"It should contain not less than 96 percent. of pure Lead Oxide, and should be kept in well-closed vessels." *U. S.* "Lead Oxide, PbO, is prepared by the action of air on melted lead." *Br.*

Oxide of Lead; Lithargyrum, Plumbum Oxydatum, Plumbi Oxidum Semivitreum; Oxide (proto) de Plomb fondu, Litharge, *Fr. Cod.*; Protoxide de Plomb, *Fr.*; Bleiglätte, Bleioxyd, *G.*; Litargirio, *It., Sp.*

When lead oxide is rendered semi-crystalline by incomplete fusion it becomes the *semi-vitrified oxide,* or litharge. Almost all the litharge of commerce is obtained, as a secondary product, in the process for extracting silver from argentiferous galenas. After extracting the argentiferous lead from the ore, the alloy is placed upon an oval slightly concave dish, about three feet long and twenty inches wide, called a *test,* made by beating pulverized bone ash, formed into a paste with water, into a mould, the sides of which consist of an elliptical band of iron, and the bottom of strips of sheet iron, placed at short distances apart. The test is of such a size as exactly to fit an opening in the floor of a reverberatory furnace, where it is placed and adjusted to the level of the floor. On one side of the test the fireplace is situated, and exactly opposite, the chimney, while at one extremity of it the pipe of a strong bellows is placed, and at the other a vertical hole is made, communicating with a gutter leading from the test. The furnace is now lighted, and shortly afterwards the bellows are put in motion. The lead fuses and combines with oxygen, and the resulting oxide, melting also, forms a stratum which floats on the surface, and which is driven by the blast of the bellows along the gutter and through the vertical hole into a receiver below, where, upon solidifying, it crystallizes in small scales, which form the litharge. In proportion as the lead is oxidized and blown off the test, fresh portions are added so as to keep it always sufficiently full. The process is continued for eight or ten days, after which no more lead is added. The operation is now confined to the metal remaining on the test, and, the oxidation proceeding, a period at last arrives when the whole of the lead has been blown off as litharge, and the silver, known to be pure by its brilliant appearance in the fused state, alone remains. This is then removed, and the pro-

cess repeated on a fresh portion of argentiferous lead. The yellow amorphous lead oxide as a paint color is known as *massicot*, and is prepared by careful heating of lead carbonate or nitrate to a point short of the fusion of the resulting oxide.

Properties.—It is officially described as "a heavy, yellowish or reddish-yellow powder or minute scales, without odor or taste. On exposure to the air it slowly absorbs moisture and carbon dioxide. Almost insoluble in water, to which it, however, imparts a faintly alkaline reaction; insoluble in alcohol, but soluble in acetic or diluted nitric acid, and in warm solutions of the fixed alkali hydroxides. When heated, the Oxide assumes a brownish-red color, becoming yellow again on cooling; it fuses at a red heat. When heated in contact with charcoal, it is reduced to metallic lead. Lead Oxide should be soluble in diluted nitric acid, with but little effervescence (limit of *carbonate*), and without the development of the odor of nitrous acid (absence of *lead*), leaving not more than a trifling residue (limit of *silicates, barium sulphate,* etc.). The solution in diluted nitric acid, which should be colorless, when nearly neutralized by ammonia water yields with hydrogen sulphide T.S. a black precipitate, with potassium iodide T.S. a yellow one, and with diluted sulphuric acid a white precipitate, the latter two being soluble in a strong solution of sodium hydroxide. If from the solution in diluted nitric acid the lead be precipitated by sulphuric acid, the filtrate, after the addition of an excess of ammonia water, should not assume more than a slight bluish tint (limit of *copper*), nor yield more than traces of a reddish-brown precipitate (limit of *iron*). If 5 Gm. of the Oxide contained in a small flask be shaken with 5 Cc. of water, then 20 Cc. of acetic acid added, and the mixture boiled for a few minutes and filtered, the insoluble residue, when well washed and dried, should not weigh more than 0.2 Gm. (absence of more than 4 percent. of *insoluble impurities*). If, to the mixed filtrate and washings obtained in the last test, hydrochloric acid be added until no further precipitate be produced, the remainder of the lead removed from the filtrate by hydrogen sulphide, and the liquid filtered, the second filtrate, upon evaporation to dryness, should not yield a residue weighing more than 0.050 Gm. (limit of *soluble impurities*). When strongly heated in a porcelain crucible, the Oxide should not lose more than 4 percent. of its weight (limit of *carbonate* and of *moisture*)." *U. S.* "Heavy scales of a pale yellowish-red color, completely soluble in *diluted nitric acid* and in *acetic acid.* It gives the reactions of lead, but should yield no characteristic reaction with the tests for copper, iron, or carbonates." *Br.* It slowly attracts carbon dioxide from the air, and contains more of this acid the longer it has been exposed. It is on this account that it commonly effervesces slightly with the diluted acids. It has the property of decolorizing wines, when agitated with them. When heated with the fats and oils, in connection with water, it saponifies them. (See *Emplastrum Plumbi.*) Heated with charcoal, it is reduced to the metallic state. In diluted nitric acid it should be almost entirely soluble; and the solution is affected by potassium hydroxide in the same manner as that of the carbonate. (See *Plumbi Carbonas.*) As it occurs in commerce, it usually contains iron, copper, and a little silver and silica. It may be purified from iron and copper by digestion in diluted sulphuric acid. The English litharge is most esteemed, that from Germany being generally contaminated with iron and copper. In choosing litharge, samples should be selected which are free from copper and from fragments of vegetable matter. Copper is detected if upon adding potassium ferrocyanide to a nitric acid solution of the litharge a brown instead of a white precipitate is produced. Two varieties of litharge are distinguished in commerce, named from their color, and dependent on differences in the process employed. Sometimes it has a pale yellow color and silvery appearance, and is then denominated *silver litharge* or *yellow litharge;* at other times it is of a red color, and is known under the name of *gold litharge* or *red litharge.* The latter was supposed to owe its color to the presence of a portion of red lead, but Leblanc has shown that the two varieties of litharge differ in color, structure, and density only, and not in chemical composition. In this respect litharge is essentially identical with lead oxide. (See *Plumbum.*) The carbon dioxide which it contains is variable, but its average amount is about 4 per cent. Lead peroxide and red lead in litharge may be detected by heating it in a test tube with sodium chloride and potassium bisulphate and introducing a slip of paper colored blue by indigo. If either of these oxides be present, the paper will be bleached by the chlorine evolved.

Uses.—Litharge is never used internally, but is employed in several pharmaceutical operations, and forms an ingredient in various external applications, used for abating inflammation, and for other purposes. In the arts it is employed in the glazing of pottery, in painting to render oils drying, and as an ingredient in flint glass.

Off. Prep.—Emplastrum Plumbi, *Br.;* Glycerinum Plumbi Subacetatis, *Br.;* Liquor Plumbi Subacetatis, *U. S.* (*Br.*).

PLUMBUM.

LEAD

(plŭm'bŭm)

Pb = 205.35

Plomb, *Fr.;* Blei, *G.;* Lood, *Dutch;* Piombo, *It.;* Plomo, *Sp.*

Lead is not official in its metallic state, but enters into a number of important medicinal preparations. It occurs in nature as an oxide,

as a sulphide called *galena,* and in saline combinations, forming the native lead sulphate, phosphate, carbonate, chromate, molybdate, tungstate, and arsenate. The oxide is rare, but galena is exceedingly abundant, and is the ore from which nearly all the lead of commerce is extracted. The extraction is effected either by melting the ore in contact with charcoal, or, in the case of pure galenas, by what is termed the *air reduction* process. In this case the galena is first roasted, when it is in part changed into oxide, PbO, and sulphate, $PbSO_4$. The doors of the furnace are then closed, and the unchanged sulphide reacts with both the oxide and the sulphate as follows:

$$2PbO + PbS = 3Pb + SO_2$$

$$PbSO_4 + PbS = 2Pb + 2SO_2$$

whereby all the lead is obtained in the metallic state. Lead is also successfully obtained by electrolysis directly from the galena. This is reduced at the cathode of an electrolytic cell, while hydrogen sulphide is formed at the same time and may be collected or burned to form sulphur dioxide, which is then utilized. The process is now in operation at Niagara Falls. The richest and most extensive mines of galena are found in this country. The non-argentiferous lead region of the United States extends in length from Wisconsin in the north to the Red River of Arkansas in the south, and in breadth about one hundred and fifty miles, being chiefly in the State of Missouri, while Utah, Idaho, Montana, and Colorado furnish argentiferous galena. The production of lead in the United States for the year 1903 was 352,848 tons, of which 292,874 tons were from domestic ores; in 1904, 344,755 tons of which 318,679 tons were from domestic ores. Over two-thirds from domestic ores was desilverized, and the remainder non-argentiferous.

Properties.—Lead is a soft, bluish-gray, and very malleable metal, presenting a bright surface when newly melted or cut. It has a perceptible taste, and a peculiar odor when rubbed. It undergoes but little change in the air, but is acted on by the combined influence of air and rain water, which gives rise to a hydrate, which is afterwards changed, in part, into carbonate, by absorbing carbon dioxide from the atmosphere, and if in water, the carbonate is imparted to it in the state of bicarbonate, which dissolves and renders the liquid poisonous. This chemical effect on the metal is greater in proportion as the water is purer. Aqueous vapor passed through leaden pipes has a similar corroding effect, which is greater as the lead is purer. (*A. J. P.,* 1863, p. 507.) Spring and river water act on lead differently, the lead becoming slowly oxidized, and covering itself with a black coating of suboxide, which adheres strongly to the metal, and thus in some measure protects the water. (Langlois, *J. P. C.,* 4e sér., ii. 29.) Stalmann has satisfied himself, by experiment, that an extremely minute quantity of ammonia or of nitric acid will very much promote the action of water upon lead,—a millionth of ammonia being sufficient for the purpose. (*Ibid.,* iv. 467.) Metallic lead seems to be liable to the attacks of certain insects, which bore into and sometimes through it, not using it as food, but apparently in search of secure places of retreat for future development. A knowledge of this fact may sometimes be important. (*A. J. P.,* Jan. 1865, p. 72.) Its sp. gr. is 11.4, melting point 334° C. (633.2° F.), and atomic weight 205.35. Exposed to a stream of oxygen on ignited charcoal, it burns with a blue flame throwing off dense yellow fumes. The best solvent of lead is nitric acid, but the presence of sulphuric acid destroys, and that of hydrochloric acid lessens, its solvent power, on account of the insolubility of the lead sulphate and chloride. Lead forms a suboxide, Pb_2O, a monoxide, PbO, a sesquioxide, Pb_2O_3, a dioxide, PbO_2, and a compound of the monoxide and the dioxide, which has a varying composition, but is usually Pb_3O_4. The *monoxide,* called in commerce *massicot,* or *litharge,* may be obtained by calcining, in a platinum crucible, lead subnitrate, formed by precipitating a solution of the nitrate by ammonia.

On a large scale it is made by exposing melted lead to the action of the air. Its surface becomes encrusted with a gray pellicle, which, being scraped off, is quickly succeeded by another; and the whole of the metal, being in this way successively presented to the air, becomes converted into a greenish-gray powder, consisting of monoxide and metallic lead. This, on exposure to a moderate heat, absorbs more oxygen, and is converted wholly into monoxide. This oxide has a yellowish color, and is the only oxide capable of forming salts with the acids. It consists of one atom of lead and one of oxygen. *Litharge* is very much used in pharmacy, and is official in all the Pharmacopœias. (See *Plumbi Oxidum.*) The *sesquioxide,* discovered by Winckelblech, is unimportant. The *dioxide,* called also *puce* oxide, from its flea-brown color, may be obtained by treating red lead with nitric acid. The acid takes up the monoxide and leaves the dioxide, which may be purified by washing with boiling water. A more productive process is to precipitate four parts of lead acetate by three of sodium carbonate, and then to pass into the thin pasty mass of lead carbonate a stream of chlorine, which converts the monoxide of the carbonate into the brown dioxide. (F. Wöhler.) Solution of chlorinated soda may be conveniently employed to furnish the necessary chlorine. Lead dioxide is a tasteless powder, of a dark brown color. When heated to redness it loses half its oxygen and becomes monoxide. It consists of one atom of lead and two atoms of oxygen. The *red oxide,* Pb_3O_4, called in commerce *minium,* or *red lead,* is described under another head. (See *Plumbi Oxidum Rubrum.*) Lead combines with iodine, forming the official lead iodide. The acetate and nitrate are also official.

The best tests of lead are hydrogen sulphide and a solution of potassium iodide. The former produces a black precipitate of lead sulphide, the latter a yellow one of lead iodide.

Uses.—In concentrated form and sufficient amount the soluble preparations of lead are violent irritant poisons, producing burning in the œsophagus and stomach, soon involving the whole abdominal cavity, followed by vomiting and sometimes by purging, or more rarely by constipation. The insoluble preparations of lead are incapable of acting as acute irritant poisons, but are the common causes of subacute and chronic lead poisoning. The subacute form of the poisoning, the so-called *colica pictonum,* is very common among painters, makers of white lead, and other artisans who work in the metal. It is, however, also frequently seen in other persons, into whom the lead finds entrance in almost innumerable ways, especially with drinking water and food. Colica pictonum usually begins with dyspeptic symptoms and obstinate constipation, associated with violent pain of a twisting character, which seems to centre round the umbilicus; the abdominal walls are spasmodically retracted, and there is even early malaise, lassitude, depression of spirits, and failure of the general health. The stools are whitish and scanty. A characteristic symptom is a blue line situated upon the margin of the gums where they join the teeth, due to the deposit of the lead sulphide. This blue line is usually present in all forms of subacute and chronic lead poisoning, and is pathognomonic. It may, however, be absent even in the most severe cases.

The symptoms of chronic lead poisoning may conform to the regular type or may be most bizarre. They are frequently, but not always, preceded by colica pictonum. The most characteristic phenomenon is the double wrist-drop, which is due to a paralysis of the extensors of the forearm, and is associated with wasting and degenerative changes in the diseased muscles. If these symptoms progress, failure of strength and anæmia gradually develop, the extensors of the leg become affected, irregular, localized, or wide-spread tracts of anæthesia appear, and neuralgic pains occur in various parts of the body; little by little the whole muscular system becomes involved, emaciation progresses, anæmia becomes extreme, and death in a condition of cachexia ensues. Albuminuria is not a rare symptom of chronic lead poisoning; it may be due simply to the momentary irritation of the kidney, or may be the result of degenerative changes which end in complete destruction of the secreting structure, with final contraction of the organ. As the result either of primary changes in the renal organs or of a direct action of the lead upon the cerebral tissue, epileptic convulsions may occur at long intervals, or they may be associated with delirium, coma, or other evidences of cerebral disturbance. When these attacks are secondary to kidney disease they are uræmic; in saturnine cerebritis, furious convulsions, coma, and wild delirium may come on suddenly, and may prove fatal in a very few hours.

Another irregular form of lead poisoning is that in which the symptoms exactly resemble those of gout; swelling of the joints, with pain, excessive tenderness, and even secondary degeneration of the arteries, similar to that which occurs in chronic gout, may make the likeness complete. Saturnine amaurosis, due to atrophy of the optic nerve, is a rare form of plumbism. A variety of lead poisoning rarely spoken of in books, of which H. C. Wood has seen a number of instances, is that in which the symptoms closely resemble those of acute poliomyelitis; wide-spread paralysis scattered in different groups of muscles, with wasting and change in the electrical reactions of the affected parts, may very closely simulate the ordinary form of spinal disease, but almost invariably the true nature of the attack may be recognized by noticing that the bladder and the rectum are affected, and not rarely the occurrence of violent neuralgic pain points still more definitely to a saturnine origin.

The symptoms of lead poisoning may also take the form of simple progressive anæmia, with failure of health and obscure nervous phenomena, such as apparently causeless neuralgic pains, wide-spread formications, insomnia, etc. The diagnosis of the true nature of an attack of lead poisoning is of the utmost importance. In most cases it is to be readily made by noticing the blue line on the gums. When this is absent it is essential that the urine be examined chemically for lead.[1] As the

[1] The most delicate method of testing urine for lead is that devised by Lehmann as modified by John Marshall. Concentrated hydrochloric acid is added to the urine in the proportion of 10 Cc. to 100 Cc. To the boiling mixture are added from time to time small portions (0.2 Gm.) of potassium chlorate until the liquid is of a pale straw-color and the odor of chlorine strongly perceptible. The heating is then continued without further addition of potassium chlorate until the chlorine odor disappears. On cooling, the liquid is filtered and the filtrate diluted with water until its volume equals the original volume employed. The filtrate is then placed in a glass tube of about 3.5 Cm. diameter, the end of the tube being covered with parchment paper fastened with twine. (A new piece of parchment paper should be used in each analysis, and care be taken to see that it and the twine as well as the other reagents used are free from lead.) A glass tripod on which there is a piece of platinum foil about 2.5 Cm. square attached to a platinum wire is placed in a glass vessel containing distilled water very slightly acidulated with chemically pure sulphuric acid, the liquid covering the platinum foil. The parchment tube containing the urine to be examined is then set on the foil on the tripod, the parchment covered end being placed directly over the foil. Another piece of platinum foil, purposely cut round so as nearly to equal the calibre of the parchment covered tube, attached at the centre to a wire (which wire, for the purpose of insulation, passes through a glass tube about twenty-five centimeters in length, and sealed at both ends), is put into the urine, so that the platinum foil in the tube, serving as a negative pole, should lie on the parchment paper as nearly as possible over the positive platinum pole, which is under the parchment paper on the glass tripod. The wires are connected with a battery consisting of three Grove cells. The cur-

elimination takes place irregularly and is much favored by the internal administration of potassium iodide, that salt should always be given for a few days before the examination of the urine.

The treatment of cases of acute lead poisoning consists in the administration of alkaline carbonates, soap, soluble sulphates, sodium chloride, or other antidote, and in washing out the stomach with large draughts of water, the exhibition of castor oil or other non-irritating laxative if it be thought advisable to clean out the intestines, and the employment of opium, counter-irritation, and the other means habitually used against toxic gastro-enteritis. In the treatment of subacute and chronic lead poisoning the efforts are to be directed first to combating the symptoms, secondly to aiding in the entire elimination of the lead. George B. Wood was accustomed to consider alum as almost a specific remedy for the relief of painter's colic, in which disease it is also essential to employ opium for the relief of pain, and laxatives to overcome the constipation; with these latter should always be given extract of belladonna in full dose, to aid in the relaxation of the intestinal spasm. Magnesium sulphate is probably the best purgative. In chronic lead poisoning the paralysis is to be combated by hygienic means, massage, and electricity, precisely as when it arises from other causes. H. C. Wood has seen in that form of lead poisoning which resembles poliomyelitis the immediate arrest of progressive symptoms by the use of doses of strychnine continually increased until the evidences of physiological action were obtained. For the purpose of eliminating lead from the system potassium iodide should be administered continuously for weeks and months in such doses as the stomach will bear. Warm sulphur baths are also useful.[1] Lead has been found in almost all the tissues of the body in fatal cases of poisoning.

In moderate dose, or in not too concentrated solution or amount, the soluble preparations of lead act as sedative astringents. When locally applied they contract relaxed vessels or tissues. When taken internally they check secretion in the alimentary canal,—according to the views of the older therapeutists, reducing the action of the heart and of the arteries, and restraining secretions generally. The insoluble preparations of lead differ therapeutically from the soluble preparations, in being free from irritant properties and acting only as feeble astringent sedatives. The preparations of lead are at present chiefly used as local applications.

Orfila has determined, by experiments on dogs, the appearance exhibited by the mucous membrane of the stomach after the use of small doses of the salts of lead. After the action of such doses for two hours, dull white points are visible on the membrane, sometimes in rows and sometimes disseminated, and evidently consisting of the metal, united with the organic tissue. If the animal be allowed to live for four days, the same spots may be seen with a microscope; and if hydrogen sulphide be applied to the surface, they are instantly blackened. (*A. G. M.*, 3e sér., iv. 244.)

rent is kept up from one to six hours, according to the quantity of lead in the solution. A dark-gray or black deposit on the electrode in the urine indicates the probable presence of lead. The electrode upon which the deposition occurs is taken out of the urine without interrupting the electrical current, and washed by gently dipping it several times in distilled water. The foil is then placed in a small beaker, covered with nitric acid, and, after warming five or ten minutes on a water bath, taken out, washed with distilled water, and the wash water collected in the beaker containing the nitric acid. The nitric acid solution is evaporated to dryness, and the residue dissolved with a few drops of dilute potassium hydroxide solution, and then slightly acidulated with acetic acid. The solution thus prepared is tested for lead by the well known reagents, hydrogen sulphide, potassium iodide, or diluted sulphuric acid.

[1] Warm *sulphuretted baths* may be provided by dissolving four ounces of potassium sulphide in thirty gallons of water, in a wooden tub. These baths cause discoloration of the skin, from the formation of lead sulphide, and should be repeated every few days, until this effect ceases to be produced. After each bath the patient should be well washed with soap and water with the aid of a flesh brush, in order to remove the discoloration. By proceeding in this way, the lead on the skin, or in its pores, is rendered insoluble and inert, and at the same time removed.

PODOPHYLLUM. U. S. (Br.)

PODOPHYLLUM [May-Apple, Mandrake Root]

(pŏd-o-phŷl'lŭm)

"The dried rhizome of *Podophyllum peltatum* Linné (Fam. *Berberidaceæ*)." *U. S.* "The dried rhizome and roots of Podophyllum peltatum, *Linn.*" *Br.*

Podophylli Rhizoma, *Br.*; Podophyllum Root, Wild Mandrake, Devil's Apple, Umbrella Plant, Vegetable Calomel; Rhizome de Podophyllum, *Fr. Cod.*; Fussblattwurzel, *G.*; Podofillo, *It.*; Podofilo (Rizoma de), *Sp.*

For Podophylli Indica Rhizoma *Br. Add.* and its preparations see PART II.

Podophyllum peltatum, L., *Sp. Pl.* (1753) 505; Willd., *Sp. Plant.* ii. 1141; Barton, *Med. Bot.* ii. 9; Carson, *Illust. of Med. Bot.*, i. 18, pl. 11; *B. & T.* 17.—The may-apple, sometimes also called *mandrake*, is an indigenous herbaceous plant. The rhizome is perennial, creeping, usually several feet in length, about one-quarter of an inch thick, brown externally, smooth, jointed, and furnished with roots at the joints. The stem is about a foot high, erect, round, smooth. The basal leaves are centrally peltate, with six or seven wedge-shaped lobes, irregularly incised at the extremity, yellowish green on their upper surface, paler and slightly pubescent beneath. The flower-bearing stems bear from one to three similar leaves. The flower is nodding, and appears between two leaves at the apex of the stem or at the base of the upper leaf when three leaves are present. The calyx is composed of three oval, obtuse, concave, deciduous sepals. The corolla has from six to nine white, fragrant petals, which are obovate, obtuse, concave, with delicate transparent veins. The sta-

mens are from thirteen to twenty, shorter than the petals, with oblong, yellow anthers, of twice the length of the filaments. The stigma is sessile, and rendered irregular on its surface by numerous folds or convolutions. The fruit is a large oval berry, crowned with the persistent stigma, and containing a sweetish fleshy pulp, in which about twelve ovate seeds are embedded. It is, when ripe, of a lemon-yellow color, diversified by round brownish spots. Two species of the genus Podophyllum are known as growing in China while *Podophyllum Emodi,* which inhabits the interior ranges of the Himalayas and is very abundant in Cashmere, is recognized in the Br. Add. (See PART II.)

The plant has been found on Mount Togakushi, in Japan, and is extensively diffused through the United States, growing luxuriantly in moist shady woods and in low marshy grounds. It is propagated by its creeping rhizome, and is often found in large patches. The flowers appear about the end of May and the beginning of June, and the fruit ripens in the latter part of September. The leaves are said to be poisonous. The fruit has a subacid, sweetish, peculiar taste, agreeable to some palates, and may be eaten freely with impunity. From its color and shape, it is sometimes called *wild lemon.* The rhizome is the official portion, and is said to be most efficient when collected after the falling of the leaves. It shrinks considerably in drying For a paper by Smyth Ely Jelliffe on the histology of the powdered rhizome see *D. C.*, 1899, 196.

Properties.—The dried rhizome is much wrinkled lengthwise, is yellowish or reddish brown externally, and furnished with fibres of a similar but somewhat paler color. It was determined, by an experiment of Wm. Saunders, that these fibres contain as much active matter as the rhizome itself. The fracture is short and irregular, and the internal color whitish. The microscopic examination of the section shows the rhizome to be composed of loose parenchymatous tissue, with sixteen or more yellowish vascular bundles arranged in a circle, and a cortical layer of a double row of thick-walled yellowish cells surmounted by the epidermis. It is officially described as "of horizontal growth and variable length, subcylindrical, flattened above, sometimes branched, consisting of joints 5 to 10 Cm. long, the internodes 2 to 8 Mm. thick; externally pale yellowish-brown to dark brown, nearly smooth; nodes annulate, the upper surface being marked by large cup-shaped scars, the lower surface with numerous root-scars or remains of roots; fracture short, the fractured surface mealy or horny, whitish to pale brown, with a circle of small wood-bundles, and a large pith; odor slight, more pronounced and characteristic in the powder; taste sweetish and disagreeably bitter and acrid." *U. S.* The powder is light yellowish gray, resembling that of jalap. The root in its aggregate state is nearly inodorous, but in powder has a sweetish not unpleasant odor. The taste is at first sweetish, afterwards bitter, nauseous, and slightly acrid. Both the decoction and the tincture are bitter, but alcohol is said to be the best solvent of the active matter. V. Podwyssotzki (*Ph. Z. R.*, Bd. xx. 777) announced the active principle to be solely a neutral crystalline principle, *picropodophyllin.* This principle is associated with an inactive resin-acid, *picropodophyllic acid,* and the combination of the two he named *podophyllotoxin.* Picropodophyllin is in colorless, silky, extremely delicate needles, very soluble in chloroform, readily soluble in 95 per cent. alcohol, but very slightly in 75 per cent. alcohol. It is soluble in ether, and crystallizes from a warm saturated solution on cooling. It is insoluble in water, turpentine, or benzin. Podophyllotoxin is a bitter, white, resinous powder, soluble in weak alcohol and hot water. It may be precipitated from its alcoholic solution by water in large quantity. (*P. J.*, 1882, 1011.) Podwyssotzki also obtained *podophylloquercetin,* the coloring principle, which is closely allied to quercetin and is the cause of the varying color of resin of podophyllum. His results have since been corrected and supplemented by R. Kürsten (*A. J. P.*, 1891, 485), who has obtained the several principles in a purer state. The results of Kürsten's investigation are as follows. The podophyllotoxin prepared by Podwyssotzki's method was not constant in composition, and its melting point varied from 100° to 125° C.; further, the podophyllic acid of that author is composed mainly of a crystallizable, active, but very impure substance.

Podophyllotoxin, $C_{23}H_{24}O_9$, is obtained by extracting the coarsely powdered rhizome with cold, light petroleum, until freed from fat; after drying in the air, the extraction is continued with chloroform, until the liquid comes away almost free from yellow color. As it is not possible to work with alcohol-free chloroform, too prolonged extraction with chloroform would yield a more impure extract. The chloroform extract is distilled and the residue is dried over a not too warm water bath, partially dissolved in benzene, filtered, and the filtrate allowed to remain from three to eight days, when a brownish-yellow mass of well-formed, thick, strongly refractive prisms is produced, which is purified by washing with a 50 per cent. alcohol, then with ether, recrystallizing first from boiling benzene, and finally from solution in hot 45 per cent. alcohol; the compound is thus obtained in long, well-formed prisms.

Podophyllotoxin, when oxidized in an alkaline solution in the cold by means of potassium permanganate, yielded, besides a little carbonic anhydride and a brown amorphous substance, principally two compounds, the more considerable of which was *podophyllic acid,* obtained as well-formed, colorless crystals from solution in a mixture of benzene and alcohol. The compound is without action on

animals. It melts at from 158° to 160° C. Its aqueous solution, neutralized with aqueous potassium hydroxide, gives no precipitate with gold, calcium, or barium chlorides; silver nitrate gives a white precipitate, soluble in much water; copper acetate gives a blue precipitate. The copper salt was prepared as beautiful light green prisms and analyzed.

Picropodophyllin results from the action of alkalies on podophyllotoxin; thus, on heating the latter with aqueous ammonia, a well-crystallized product is obtained, which at first was recrystallized from strong alcohol; but this was found to be unnecessary, as the melting point, 227° C., was not affected by it. Picropodophyllin has the same composition as podophyllotoxin, but they differ in melting point and in their action on polarized light,—the former inactive, the latter lævo-rotatory; the former is less soluble in all liquids than the latter; the latter gives Millon's reaction, the former does not. By oxidation and reduction the two compounds yield the same products.

Dunstan and Henry (*Proc. Chem. Soc.*, March, 1898) find that the constituents of the Indian podophyllum (*Podophyllum Emodi*) and of the American podophyllum (*Podophyllum peltatum*) are identical. The chief constituent is the *podophyllotoxin* of Podwyssotzki and Kürsten, which is a neutral substance possessing, according to Kürsten the formula $C_{30}H_{18}O_6(OCH_3)_3 + 2H_2O$ and crystallizing in prisms melting at 94° C. It is strongly lævorotatory, and acts as a powerful purgative and intestinal irritant. When heated with alkalies, it is converted by hydration into the salt of an unstable gelatinous acid, *podophyllic acid*, $C_{18}H_{16}O_7$, of which several salts were obtained and analyzed. This acid very readily loses water, and furnishes the crystalline *picropodophyllin* of Podwyssotzki and Kürsten, which is isomeric with podophyllotoxin. It passes again into podophyllic acid when warmed with aqueous alkalies. It melts at 227° C., and is optically inactive. Podophyllotoxin and picropodophyllin furnish identical decomposition products; when oxidized with nitric acid, oxalic acid is the principal product; when fused with alkalies, *orcinol* and acetic acid are produced. Both substances contain three methyl groups and no hydroxyl. It is likely that picropodophyllin is the lactone of podophyllic acid. Picropodophyllin is therapeutically inactive. The yellow coloring matter of podophyllum, called by Podwyssotzki *podophylloquercetin*, is proved by the authors to be identical with quercetin, the yellow coloring matter of quercitron bark. An uncrystallizable resin, *podophylloresin*, was also isolated and found to exert a purgative action. A fatty oil has been separated from the rhizome of podophyllum by Dohme and Engelhardt. (See *Proc. A. Ph. A.*, 1904, 340.) Gordin and Merrell (*Proc. A. Ph. A.*, 1902, 343) propose to judge of the quality of resin of podophyllum by an assay based on the percentage of crude picropodophyllin and the following requirements. 1. Pure podophyllin must be completely soluble in about twice its weight of cold alcohol. 2. It should contain about 64 per cent. ether-soluble and about 74 per cent. chloroform-soluble matter. 3. It should yield about 22 per cent. crude picropodophyllin when assayed by the method described by them.

Manlius Smith recommended that the resin should be prepared by forming an alcoholic tincture of the root, evaporating the tincture until most of the alcohol is driven off, and throwing the residue into water, by which the resin is precipitated. The concentration should not be carried too far, as otherwise the resin separates in clots, which cannot be easily washed. According to Smith, the resin, when pure, is white, and purges actively. It has been called *podophyllin* for many years. (*A. J. P.*, xxiv. 306. See *Resina Podophylli.*) The proportion of resin contained in the root of the *P. peltatum* appears to vary very much, the variation possibly depending upon the season of the year at which the drug has been gathered. John Barclay (*P. J.*, 1903, Feb. 164) obtained a percentage of 1.6 to 3.86 per cent. stating that these figures were confirmed by the results of the manufacturers of podophyllin on a large scale, but J. C. Umney states that in five years experience working with batches of 1000 lbs. the rhizome averaged a yield of 6.6 per cent. Both observers noticed that the Indian rhizome (*P. Emodi*) contains a much larger proportion of resin, the average according to Umney being 11.4 per cent. How far the proportion of podophyllotoxin varies in the different rhizomes does not seem to have been determined. (See B. D. Dott, *P. J.*, 1903, Mar. 460.)

From the *leaves* of *P. peltatum* Thos. J. Husband, Jr., obtained berberine and a resin which was free from purgative properties, 8 grains producing no other effect than slight headache. (*A. J. P.*, 1869.)

B. F. Carter (*A. J. P.*, 1886, p. 449) also examined the leaves. He found tannin, uncrystallized sugar, coloring matter, and 6 per cent. of resin. This latter seems to be of twofold character, ether dissolving the soft resin, while the hard resin remains behind. The resin has a bitter taste and a much milder action than that of the rhizome. Fused with potassium hydroxide a small amount of protocatechuic acid seems to be formed.

Uses.—Podophyllum is a slow but active and certain cathartic, producing copious liquid discharges, often with much griping. It is generally thought by the profession to be an efficient cholagogue and the experiments of Rutherford upon dogs aid in confirming this belief. It is much employed in various parts of the country in *bilious fevers* and *hepatic congestions*, and as a general cathartic. In minute doses, frequently repeated, podophyllum has been thought to diminish the frequency of the pulse and to relieve cough, and

for these effects has been given in *hæmoptysis* and *catarrh*, but this employment of it is of doubtful advantage. In overdoses podophyllum acts as an irritant poison; an amount estimated at five grains of the resin caused death in a woman sixty years old (*N. Y. M. R.*, April, 1890); the symptoms were vomiting and purging, followed some hours after their cessation by coma, full soft pulse, slight elevation of temperature, and hæmoglobinuria.

The powdered root is rarely administered, although the U. S. P. gives the dose as 7½ grains (0.5 Gm.); the official resin is much used, under the improper name of *podophyllin*.

Dose, of the resin, from one-eighth to one-quarter grain (0.008 to 0.016 Gm.); as a purgative, from one-quarter to one-half grain (0.016 to 0.032 Gm.).

Off. Prep.—Fluidextractum Podophylli, *U. S.*; Resina Podophylli, *U. S.* (*Br.*); Tinctura Podophylli, *Br.* (from resin).

POTASSA SULPHURATA. Br.

SULPHURATED POTASSA [Liver of Sulphur]

(pŏ-tăs'sạ sŭl-phū-rā'tạ)

"A mixture of salts of potassium, of which the chief are potassium sulphides." *Br.*

Hepar Sulphuris; Potassii Sulphuretum, *U. S.* 1870; Sulphuret of Potassium, Sulphurated Potash; Sulfure (tri) de Potassium solide, *Fr. Cod.*; Sulfure de Potasse, Foie de Soufre, *Fr.*; Kalium Sulfuratum, *P. G.*; Schwefelleber, Kalischwefelleber, *G.*; Sulfuro (tri) potasico hiposulfitado, *Sp.*

This preparation is not official in the U. S. P. (8th Rev.). The U. S. P. 1890 process for its production is as follows: "Sublimed Sulphur, *one hundred grammes* [or 3 ounces av., 231 grains]; Potassium Carbonate, dried, *two hundred grammes* [or 7 ounces av., 24 grains]. Mix the powdered and dried Potassium Carbonate thoroughly with the Sublimed Sulphur, and gradually heat the mixture, in a covered crucible, which should be only about half filled with it, until the mass ceases to foam and is in a state of perfect fusion. Then pour the fused mass on a cold marble slab, and, after it has cooled, break it into pieces, and keep it in a well-stoppered bottle." *U. S.* 1890.

"Potassium Carbonate, in powder, 10 *ounces* (Imperial) or 100 grammes; Sublimed Sulphur, 5 *ounces* (Imp.) or 50 grammes. Mix the Potassium Carbonate, previously dried, and the Sulphur, in a warm mortar; introduce them into a crucible; heat this, at first gradually, until effervescence has ceased, and finally to dull redness, so as to produce perfect fusion; pour out the liquid contents of the crucible on a clean flagstone, and cover quickly with an inverted porcelain basin so as to prevent free access of air while solidification is taking place. The solid product thus obtained should, when cool, be broken into fragments, and immediately enclosed in a green glass bottle furnished with an air-tight stopper." *Br.*

These processes are essentially the same, except that a greater heat is used in the British process, which somewhat modifies the result. When potassium carbonate is melted with half its weight of sulphur, as in the U. S. P. 1890 process, the carbon dioxide is expelled. The composition varies with the heat employed. If the heat does not exceed 185° C. (365° F.), the resulting preparation will contain potassium thiosulphate; if above 300° C. (572° F.), potassium sulphate. (Fordos and Gélis.) The reaction for the preparation at the lower temperature is

$$3K_2CO_3 + 4S_2 = 2K_2S_3 + K_2S_2O_3 + 3CO_2$$

which at the higher temperature is changed as follows:

$$4K_2S_2O_3 = 3K_2SO_4 + K_2S_5$$

The potassium pentasulphide formed is decomposed at this high temperature into sulphur, which burns off, and K_2S_3. The U. S. preparation, therefore, which is made at the temperature of fusion, probably contains potassium thiosulphate, and may be represented by the formula $2K_2S_3 + K_2S_2O_3$, three molecules of CO_2 escaping, while the British, being prepared at a red heat, contains potassium sulphate, the reaction probably being

$$4K_2CO_3 + 5S_2 = K_2SO_4 + 3K_2S_3 + 4CO_2$$

Potassium carbonate from pearlash is usually employed by the manufacturer, but in the process of Henry, which is stated to be the best yet devised, the pure potassium carbonate is employed. His formula is as follows. Mix two parts of pure potassium carbonate with one of sulphur reduced to powder, and put the mixture into flat-bottomed flasks, which should be only two-thirds filled. These are placed on a sand bath, and the fire is applied so as, at first, to produce only a gentle heat, which is afterwards increased. Care must be taken that the necks of the flasks do not become obstructed. The heat is continued until the matter is brought to a state of tranquil fusion, when it is allowed to cool. The mass obtained, which is compact, smooth, and of a fine yellow color, is broken into pieces, and preserved in well-stoppered bottles. W. Elborne (*Y. B. P.*, 1896, 331) states that when commercial potassium carbonate is used in making sulphurated potassa, a product is obtained which more closely approaches the official compound (Br. Pharm. 1885) than does one made from a pure potassium carbonate. He recommends that dried commercial carbonate containing not less than 90 per cent. K_2CO_3 be employed.

Properties.—Sulphurated potassa, when properly prepared, is a hard, brittle substance, having a nauseous, alkaline, and bitter taste. Its color is liver-brown, and hence its name of *hepar sulphuris*, or *liver of sulphur*. The color of the surface of a fresh fracture is brownish-yellow. It is inodorous when dry, but emits a slightly fetid odor when moist, owing to the extrication of a little hydrogen sulphide gas. It is soluble in water, forming

an orange-yellow liquid, and exhaling the odor of hydrogen sulphide. It was officially described in the U. S. P. 1890 as follows: "When freshly prepared, Sulphurated Potassa forms irregular pieces of a liver-brown color, which, by exposure to the air, gradually absorb moisture, oxygen, and carbon dioxide, and change to a greenish-yellow and finally to a gray mass containing potassium carbonate, hyposulphite, and sulphate. The compound has a faint odor of hydrogen sulphide, and a bitter, alkaline taste. Soluble in 2 parts of water at 15° C. (59° F.), with the exception of a small residue. Alcohol dissolves only the potassium sulphide, leaving the other constituents (hyposulphite and sulphate) undissolved. The aqueous solution (1 in 10) is of an orange-yellow color, is strongly alkaline to litmus paper, and gives off the odor of hydrogen sulphide. On adding to it acetic acid in slight excess, an abundance of hydrogen sulphide is evolved, while sulphur is precipitated. In this liquid, after filtration, sodium bitartrate test-solution produces an abundant, white, crystalline precipitate. On triturating 1 Gm. of Sulphurated Potassa with 1 Gm. of crystallized copper sulphate and 10 Cc. of water, and filtering, the filtrate should remain unaffected by hydrogen sulphide test-solution, corresponding to at least 12.85 per cent. of sulphur combined with potassium to form sulphide." *U. S.* 1890. "Solid greenish fragments, liver-brown when recently broken, alkaline and acrid to the taste, readily forming with *water* a yellow solution which has the odor of *hydrogen sulphide*, and evolves it freely when excess of *hydrochloric acid* is dropped into it, sulphur being at the same time deposited. This acid liquid when boiled and filtered gives a yellow precipitate with *solution of platinum chloride*, and a white precipitate with *solution of barium chloride*." *Br.* By exposure to the air it attracts oxygen, and the potassium sulphide is gradually changed into potassium sulphate, when the preparation becomes inodorous, and white on the surface. The solution is decomposed by the mineral acids, which extricate hydrogen sulphide and precipitate the excess of sulphur. It is also incompatible with solutions of most of the metals, which are precipitated as sulphides. When boiled with an excess of hydrochloric acid and filtered, it gives a yellow precipitate with platinic chloride, and a white one with barium chloride. The preparation of the Br. Pharmacopœia yields about one-half of its weight to alcohol (90 per cent.),—the portion dissolved being potassium sulphide, and the undissolved portion potassium sulphate.

Uses.—Sulphurated potassa is a local irritant, and, in small and repeated doses, is said to increase the frequency of the pulse, heat of the skin, and different secretions, especially the mucous. Occasionally it causes vomiting and purging. It acts, moreover, as an antacid, and produces the alterative effects of sulphur. By some it is maintained to be sedative, and directly to reduce the action of the heart. It probably does so, when taken in considerable quantities, by the development of hydrogen sulphide. In overdoses it acts, according to Orfila, as a violent poison, corroding the stomach, and depressing the powers of the nervous system. Lead acetate or zinc acetate may be used as an antidote, but the latter is preferable, as less likely to act injuriously in an overdose, and having, besides, emetic properties. The diseases in which it has been most advantageously employed are *chronic rheumatism* and *gout*, and various *cutaneous affections*. It has been given also in *painter's colic, asthma*, and *chronic catarrh*, and acquired a short-lived reputation as a remedy in *croup*, after the publication of the essay to which the prize offered by Napoleon for the best dissertation on that disease was awarded. In consequence of forming insoluble sulphides with the metallic salts, it has been proposed as an antidote for some mineral poisons, but Orfila has shown that it does not prevent their effects. Dissolved in water, it has proved efficacious as an external application in *cutaneous diseases*, and in *scabies* is an almost certain remedy. It may be used for this purpose in the form of lotion, bath, or ointment. For a lotion it may be dissolved in water in the proportion of from fifteen to thirty grains to the fluidounce (1 to 2 Gm. to 30 Cc.), and for a bath the same quantity or rather more may be added to a gallon of water. A very small proportion of hydrochloric or sulphuric acid may in either case be added to the solution. The ointment is made by mixing half a drachm of the sulphide with an ounce of lard. The odor is very favorably modified, whether in solution or in the state of ointment, by incorporating with it a little oil of anise.

Dose, of sulphurated potassa, from two to ten grains (0.13 to 0.65 Gm.), repeated several times a day, and given in pill with licorice, or in solution with syrup. In *infantile croup*, from one to four grains (0.065 to 0.26 Gm.) were given every three or four hours.

POTASSII ACETAS. U. S., Br.

POTASSIUM ACETATE

(pŏ-tăs'sĭ-ī ă-cē'tăs)

$KC_2H_3O_2 = 97.44$

"It should contain, when thoroughly dried, not less than 98 percent. of pure Potassium Acetate [$CH_3.COOK$], and should be kept in well-stoppered bottles." *U. S.* "Potassium Acetate, $CH_3.COOK$, is prepared by fusing the product of the interaction of acetic acid and potassium carbonate." *Br.*

Kali Aceticum, Sal Diureticum, Acetas Potassicus, s. Kalicus, Terra Foliata Tartari; Acetate of Potassium; Acetate of Potash (Potassa), Diuretic Salt; Acétate de Potasse sec, *Fr. Cod.*; Essigsaures Kali, *G.*; Acetato di potassio, *It.*; Acetato potasico, *Sp.*

The substitution in the U. S. Pharmacopœia of 1870 [1] of potassium bicarbonate for the carbonate used in the British formula was an improvement, as it insured a purer product. The form of acid for generating the salt is official acetic acid, and a colorless solution is obtained. This is evaporated to dryness, but the Br. Pharm. 1885 directed the dry salt to be melted, so that it could be obtained as a solid mass on cooling. When fusion is resorted to, great care must be taken not to use too high a temperature as otherwise part of the acetic acid will be decomposed, and the resulting salt will be discolored. For drying the potassium acetate, Christison considers the temperature of a vapor bath too low, and that of a sand bath likely to become too high. He therefore recommends the use of a bath of calcium chloride when operating on a small scale. In conducting the evaporation, it is best to have the solution always slightly acid, for if the alkali predominate, it will react upon the acetic acid when the solution is concentrated, and give rise to discoloration. On account of the liability to discoloration, great care must be observed to avoid the contamination of iron. Some manufacturers use silver dishes.

Potassium acetate may also be obtained by double decomposition between lead acetate and potassium sulphate. When thus procured, it is very white and pure, but liable to the objection, for medicinal use, that it may possibly contain a little lead. Another method by double decomposition is between calcium acetate and potassium sulphate.

Properties.—It is officially described as "a white powder, or in crystalline masses of a satin-like lustre, odorless, and having a warming, saline taste. Very deliquescent on exposure to the air. Soluble in 0.4 part of water, and in 2 parts of alcohol at 25° C. (77° F.); with increasing temperature it becomes much more soluble in both liquids. When heated to 292° C. (557.6° F.) the salt fuses. At a higher temperature it decomposes, blackens, and evolves vapors having an empyreumatic odor (an alliaceous odor would indicate the presence of *arsenic*), and finally, if ignited on platinum, it leaves a white residue, which should be completely soluble in water. The aqueous solution (1 in 20) is alkaline to red litmus paper, but does not affect phenolphthalein T.S. The addition of sodium bitartrate T.S. to the concentrated aqueous solution of the salt causes a white, crystalline precipitate. If a few particles of the salt be added to a mixture of 1 Cc. of sulphuric acid and 1 Cc. of alcohol, acetic ether will be formed, recognizable by its odor. The addition of a little ferric chloride T.S. to a solution of the salt produces a deep red color, and, upon boiling, a pale brown, flocculent precipitate of basic ferric acetate separates." *U. S.* "Either in white foliaceous satiny masses, or in granular particles, very deliquescent, alkaline to *litmus*, soluble in half its weight of *water*, and in 2 parts of *alcohol* (90 per cent.)." *Br.* When unskilfully prepared, it is apt to be more or less colored. Its state of aggregation differs according to the manner in which it is procured. As obtained by evaporating the solution to dryness, agreeably to the directions of the U. S. Pharmacopœia of 1870, it is in the form of soft fibrous masses. As usually prepared and found in commerce, it has a foliated texture, which is given to it by fusion and cooling. On account of this appearance, it was formerly called *foliated earth of tartar.* It must always be preserved in well-stoppered bottles.

Tests.—The most usual impurities contained in it are silica, potassium sulphate, tartrate, and chloride, and the lead and copper salts. "The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Five Cc. of an aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 1 Gm. of dry Potassium Acetate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 20.1 Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator." *U. S.* Since the introduction of the cheap method of obtaining pure acetic acid from wood, this salt has scarcely been subjected to adulteration. Potassium acetate is incompatible with the mineral acids, which expel the acetic acid; with sodium and magnesium sulphates; with corrosive sublimate and silver nitrate, and with several other earthy and metallic salts. This salt exists in the juices of many plants, and especially in the sap of trees, and is the principal source of the potassium carbonate existing in the ashes of wood. It consists of one atom of potassium combined with one acetic acid group, $C_2H_3O_2$.

Uses.—In doses of from twenty grains to a drachm (1.3 to 3.9 Gm.) potassium acetate acts as a diuretic, and as a mild cathartic when given to the extent of three or four drachms (11.25 to 15 Gm.). It is employed in *dropsies*, but is not so useful as the bitartrate. J. A. Easton of Glasgow, has found it useful in several skin diseases, such as *psoriasis, eczema,* and *lepra,* in doses of half a drachm (2 Gm.) three times a day. The alkaline treatment of *acute rheumatism* which originated with Golding Bird is very well carried out by this salt, half an ounce to an ounce (15 to 30 Gm.), in dilute solution, being given during the twenty-four hours. Potassium acetate, like the other alka-

[1] "Take of Acetic Acid *a pint;* Bicarbonate of Potassium *a sufficient quantity.* Add the Bicarbonate gradually to the Acid until it is neutralized; then filter the solution, and evaporate cautiously, by means of a sand-bath, until a dry salt remains." *U. S.* 1870.

line salts containing a vegetable acid, may be given in the *uric acid diathesis*, to render the urine alkaline, for the experiments of Wöhler and others have shown that the acid of these salts undergoes decomposition in the system, leaving the alkali free to act as a carbonate. Vegetable potassium salts increase the oxidation of tissue, and may therefore be very useful as depuratives.

Dose, half a drachm to half an ounce (2 to 15.5 Gm.).

POTASSII BICARBONAS. U. S., Br.

POTASSIUM BICARBONATE

(pŏ-tăs'sĭ-ī bī-cär'bŏ-năs)

$KHCO_3 = 99.41$

"It should contain not less than 99 percent. of pure Potassium Bicarbonate [CO(OH)(OK)], and should be kept in well-stoppered bottles." *U. S.* "Potassium Bicarbonate, $KHCO_3$, may be obtained by saturating a strong aqueous solution of potassium carbonate with carbonic anhydride." *Br.*

Bicarbonas Potassicus, s. Kalicus; Potassium Hydrogen Carbonate; Acid Carbonate of Potassium; Bicarbonate of Potash; Carbonate (bi) de Potasse, *Fr. Cod.*; Bicarbonate de Potasse, *Fr.*; Kalium Bicarbonicum, *P. G.*; Kaliumbicarbonat, Doppelt-Kohlensaures Kali, *G.*; Bicarbonato di potassio, *It.*; Bicarbonato potasico, *Sp.*

The process of the U. S. P. 1870,[1] and also that of the British Pharmacopœia, for this salt were abandoned at former revisions.

Brande gives the following proportions for the preparation of potassium bicarbonate: "100 lbs. of purified potassium carbonate are dissolved in 17 gallons of water [Imperial measure], which, when saturated with carbonic acid, yield from 35 to 40 lbs. of crystallized bicarbonate; 50 lbs. of potassium carbonate are then added to the mother-liquor, with a sufficient quantity of water to make up 17 gallons, and the operation repeated." Wöhler states that charcoal, when mixed with the carbonate, facilitates by its porosity, in a remarkable degree, the formation of the bicarbonate. Thus, he found that, when crude tartar was charred in a covered crucible, and the carbonaceous mass, after having been slightly moistened with water, was subjected to a stream of carbon dioxide, the gas was absorbed with great rapidity, and heated the mass so considerably as to render it necessary to surround the vessel with cold water, to prevent the decomposition of the bicarbonate formed. When the temperature diminished, the saturation was known to be completed. The mass was lixiviated in the smallest quantity of water at the temperature of from 29.4° to 37.7° C. (85° to 100° F.), and the solution, after filtration and cooling, deposited the greater part of the bicarbonate in fine crystals. (See *A. J. P.*, x. 82.)

Behrens has proposed to obtain potassium bicarbonate by partially saturating the carbonate, dissolved in an equal weight of water, with acetic acid gradually added. Up to a certain point, no carbon dioxide is extricated, and a precipitate takes place of pure potassium bicarbonate, equal to half the weight of the carbonate employed. After the bicarbonate is separated, the saturation may be completed, and potassium acetate obtained. (*J. P. C.*, 3e sér., iv. 464.) L. Pesci dissolves purified potassium hydroxide in 80 per cent. alcohol, and passes a stream of carbon dioxide through the solution until it is saturated. The white precipitate is collected and washed with alcohol; it is free from chlorides and nitrates. (*Ber. d. Chem. Ges.*, 1876.)

According to Berzelius, the cheapest method of obtaining potassium bicarbonate is to suspend a concentrated solution of the purified carbonate, contained in a stoneware dish, within a cask, over a liquid undergoing the vinous fermentation. The alkali is thus surrounded by an atmosphere of carbon dioxide, and, by absorbing it, crystallizes into bicarbonate in the course of five or six weeks. Distillers and brewers may prepare this salt with great facility by suspending the alkaline solution in the fermenting tun. The salt in powder called *potash sal aëratus*, made principally in New England, is prepared in this way. In composition it is between a carbonate and a bicarbonate.

Properties.—Potassium bicarbonate is officially described as in "colorless, transparent, monoclinic prisms, or a colorless, odorless, granular powder, having a saline and slightly alkaline taste. Permanent in the air. Soluble in about 3 parts of water at 25° C. (77° F.), and in 1.9 parts at 50° C. (122° F.). At a higher temperature the solution rapidly loses carbon dioxide, and, after being boiled, contains only potassium carbonate. Almost insoluble in alcohol. The dry salt begins to lose carbon dioxide at 100° C. (212° F.), and this loss increases at a higher temperature, until, at a red heat, the salt has lost 30.96 percent. of its original weight, leaving a residue of carbonate. The concentrated aqueous solution of the salt is slightly alkaline to litmus paper, but neutral to phenolphthalein T.S. Tartaric acid T.S., added in excess to the concentrated aqueous solution, produces a white, crystalline precipitate. If 1 Gm. of the salt be dissolved without agitation in 20 Cc. of water at a temperature not above 15° C. (59° F.), and 0.2 Cc. of normal hydrochloric acid V.S. and 2 drops of phenolphthalein T.S. be added, a red tint should not appear immediately (limit of *carbonate*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals*

[1] "Take of Carbonate of Potassium *forty-eight troy-ounces*; Distilled Water *ten pints*. Dissolve the Carbonate of Potassium in the Distilled Water, and pass Carbonic Acid through the solution till it is fully saturated. Then filter the liquid, and evaporate that crystals may form, taking care that the heat does not exceed 160°. Lastly, pour off the supernatant liquid, and dry the crystals upon bibulous paper. Carbonic acid may be obtained from marble by the addition of dilute sulphuric acid." *U. S.* 1870.

(see PART III, Test No. 121). To neutralize 1 Gm. of Potassium Bicarbonate not less than 19.9 Cc. of half-normal sulphuric acid V.S. should be required, methyl-orange T.S. being used as indicator." *U. S.* "Colorless monoclinic prisms, not deliquescent, of a saline feebly alkaline taste. It is soluble in 4 parts of cold *water*, but almost insoluble in *alcohol* (90 per cent.). It affords the reactions characteristic of potassium and of bicarbonates. Each gramme exposed to a low red heat leaves 0.69 gramme of a white residue, which requires for exact neutralization 10 cubic centimetres of the *volumetric solution of sulphuric acid.* It should yield no characteristic reaction with the tests for lead, copper, arsenium, aluminium, calcium, magnesium, sodium, nitrates, sulphates, or sulphides, and only the slightest reactions with the tests for iron or for chlorides. 20 parts by weight of Potassium Bicarbonate are neutralized by 14 parts of Citric Acid, and by 15 parts of Tartaric Acid." *Br.* When heated to redness it loses carbon dioxide and returns to the state of carbonate, which, when thus obtained, is free from silica, and otherwise very pure. This method was adopted in the U. S. Pharmacopœia of 1870 for obtaining the pure carbonate. When a perfect bicarbonate, its solution, unless heated, does not precipitate a solution of magnesium sulphate. This negative indication, however, cannot be depended upon as showing the absence of carbonate; for, according to Christison, no precipitate will be occasioned even when 50 per cent. of this impurity is present. Potassium bicarbonate does not decompose calomel. When dissolved in 40 parts of water, it produces a white haze merely with a solution of corrosive sublimate; but if it contain so much as a hundredth part of carbonate, a brick-red precipitate is immediately produced. (Christison.) Another way of detecting the presence of carbonate is to add pure glucose to a heated solution of the suspected bicarbonate. If any carbonate be present, the mixture will turn yellow or brown. (Chevallier.) The official test (Hirsch's) given above is, however, more reliable, and admits but traces of carbonate. Potassium bicarbonate consists of one atom of potassium and one of hydrogen, in combination with one carbonic acid group, CO_3.

Uses.—The medicinal properties of this salt are similar to those of the carbonate, to which it is preferable from its milder taste and its greater acceptability to the stomach. It is, however, much more disagreeable than the salts of potassium made from the fruit acids which are now universally used when a decided effect upon the system is desired, the bicarbonate and the carbonate being employed almost exclusively as antacids.

Dose, ten grains to a drachm (0.65 to 3.9 Gm.).

Off. Prep.—Liquor Magnesii Citratis, *U. S.;* Liquor Potassii Arsenitis, *U. S.;* Liquor Potassii Citratis, *U. S.*

POTASSII BITARTRAS. U. S. (Br.)

POTASSIUM BITARTRATE [Cream of Tartar]

(pŏ-tăs'sĭ-ī bī-tär'trăs)

$KHC_4H_4O_6 = 186.78$

"It should contain not less than 99 percent. of pure Potassium Bitartrate [$C_2H_2(OH)_2(CO\,OH)\,(COOK)$], and should be kept in well-stoppered bottles." *U. S.* "Acid Potassium Tartrate, $(CHOH)_2COOH.COOK$, is obtained from the crude cream of tartar which is deposited during the fermentation of grape juice, and from the lees of wine." *Br.*

Potassii Tartras Acidus, *Br.*, Acid Potassium Tartrate, Crystals of Tartar; Tartrate de Potasse acide, Bitartrate de Potasse, Crème de Tartre, *Fr. Cod.;* Pierre de Vin, *Fr.;* Tartaras depuratus, *P. G.;* Weinstein, Kali Bitartaricum, Bitartras Potassicus, s. Kalicus, Cremor Tartari, *G.;* Tartrato acido di potassio, Cremor di tartaro, *It.;* Tartrato (bi) potasico, Cremor de tartaro, *Sp.*

During the fermentation of wines, especially those that are tart, a peculiar matter is deposited in the casks, forming a crystalline crust, called *crude tartar,* or *argol.* That deposited from red wines is of a reddish color, and called *red tartar,* while that derived from white wines is of a dirty-white color, and denominated *white tartar.* Both kinds consist of potassium, united with an excess of tartaric acid, forming acid potassium tartrate, rendered impure by calcium tartrate, more or less coloring matter, and other substances which are deposited during the clarification of the wine. The deposition of the tartar is thus explained. The acid tartrate exists naturally in the juice of the grape, held in solution by saccharine matter. When the juice is submitted to fermentation in the process for converting it into wine, the sugar disappears, and is gradually replaced by alcohol, in which the salt is insoluble. It is from argol that acid potassium tartrate is obtained by a process of purification. The importation of crude tartar, or argol, for the year 1903 was 29,966,557 lbs., valued at $2,734,027; for 1904, 24,571,730 lbs., valued at $2,550,223; and for 1905, 26,249,954 lbs., valued at $2,289,331. Although the amount of crude tartar produced in the United States is small, compared with the quantity imported from Europe, yet the amount from American wines is rapidly increasing. The process for purifying crude tartar is founded upon the greater solubility of acid potassium tartrate in hot than in cold water. The tartar, previously pulverized, is boiled with water in copper boilers. The solution, when saturated, is transferred to earthen pans, where it deposits on cooling a crystalline layer, nearly free from color. This is redissolved in boiling water, and the solution, having been mixed with 4 or 5 per cent. of pipe clay,[1] is evaporated to a pellicle. The clay precipitates with the coloring matter, and the clear solution, as it cools, deposits white

[1] Egg albumin and animal charcoal are also employed for clarifying and decolorizing solution of crude tartar.

crystals in crusts, which, upon being exposed to the air on linen for several days, acquire an increased degree of whiteness. These constitute the *crystals of tartar* of pharmacy. The salt, as met with in commerce, is generally, for greater convenience, in the form of powder, to which the name *cream of tartar* properly belongs. (See *Bull. Pharm.*, 1898, 405.) Wittstein proposes to free cream of tartar from lime by diluted hydrochloric acid, which dissolves the lime preferably, and, if not used in excess, will take up very little of the potassium salt.

Properties.—Potassium bitartrate occurs in commerce in white crystalline crusts or masses of aggregated crystals, which are usually powdered before being sold to pharmacists. It is officially described as in "colorless or slightly opaque, rhombic crystals, or a white, somewhat gritty powder, odorless, and having a pleasant, acidulous taste. Permanent in the air. Soluble in about 200 parts of water at 25° C. (77° F.), and in 16.7 parts of boiling water; very sparingly soluble in alcohol. When a small portion of the salt is heated on platinum foil, it chars and emits inflammable vapors having the odor of burning sugar. At a higher temperature, with free access of air, the carbon of the black residue is oxidized, and a white, fused mass remains, which has an alkaline reaction and effervesces strongly with acids. The aqueous solution of the salt has an acid reaction upon blue litmus paper. With sodium cobaltic nitrite T.S. the aqueous solution of the salt yields a copious yellow precipitate. In the aqueous solution of the salt, rendered neutral by potassium hydroxide T.S. silver nitrate T.S. produces a white precipitate, which, on boiling, becomes black through the separation of metallic silver. If, before applying heat, just sufficient ammonia water be added to dissolve the white precipitate, and the solution boiled, a mirror will be deposited on the sides of the test-tube." *U. S.* "A gritty white powder, or fragments of cakes crystallized on one surface, with an acid taste. Soluble in 200 parts of cold *water*, insoluble in *alcohol*. It affords the reactions characteristic of potassium and of tartrates. Each gramme of the dry salt should require for neutralization at least 5.2 cubic centimetres of the *volumetric solution of sodium hydroxide*. It should yield no characteristic reaction with the tests for lead, copper, or iron, and only the slightest reactions with the tests for calcium, magnesium, sodium, chlorides, or sulphates. The total amount of impurities should not exceed 2½ per cent. of the dried salt." *Br.* With salifiable bases which form soluble tartrates, it gives rise to double salts, consisting of neutral potassium tartrate, and the tartrate of the base added. Several of these are important medicines. Cream of tartar, though sparingly soluble in water, becomes abundantly so by the addition of borax or boric acid.[1] (See *Sodii Boras.*)

Tests.—"A solution of 0.5 Gm. of the salt in 3 Cc. of ammonia water should leave no insoluble residue (absence of *starch, kaolin, calcium phosphate*, and other *insoluble matter*). The aqueous solution of the salt, slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). The odor of *ammonia* should not be evolved on heating the salt with a slight excess of potassium hydroxide T.S. If 1 Gm. of Potassium Bitartrate be well triturated with about 1 Gm. of potassium carbonate and 0.5 Gm. of potassium nitrate, and the mixture heated gradually to dull redness in a porcelain crucible, and, if, upon cooling, the resulting mass be treated with a slight excess of diluted hydrochloric acid and filtered, the filtrate, upon being made slightly alkaline with potassium hydroxide T.S., should not yield a gelatinous precipitate soluble in excess of the reagent (absence of *alum*). If a precipitate be produced which is insoluble, it should be collected and thoroughly washed with hot distilled water and dissolved in hot diluted nitric acid; the addition of an excess of ammonium molybdate T.S. to this solution should not produce a yellow precipitate (absence of *phosphates*). If 1 Gm. of Potassium Bitartrate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 10.6 Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator." *U. S.*

The cream of tartar of commerce is now nearly pure potassium bitartrate. It has been, however, found purposely mixed with various substances, such as sand, clay, gypsum, flour, chalk, alum, and potassium sulphate. Sand, clay, and gypsum may be detected by their insolubility in a hot solution of potassium hydroxide; flour, by its striking a blue color with iodine; chalk, by its effervescing with dilute acids; alum (an unlikely sophistication), by its astringency, and any soluble sulphate, by its causing a precipitate with barium chloride, not entirely soluble in nitric acid. The action of the last-mentioned test is explained by the fact that the barium tartrate is soluble and the sulphate insoluble in nitric acid. The best security against fraud is to purchase the crystals and have them powdered. Geo. F. Payne examined commercial cream of tartar; of ten samples obtained from grocery stores, five contained no cream of tartar whatever. Some of the spurious samples were mainly composed of a mixture of dried alum and acid calcium phosphate. (*Proc. A. Ph. A.*, 1897, 695.) The U. S. Pharmacopœia (8th Rev.) admits a slight impurity. It should contain 99 per cent. of pure potassium bitartrate, and there is no difficulty

[1] *Soluble Tartar. Tartarus boraxatus, s. Kali tartaricum boraxatum, s. Cremor tartari solubilis.* Borax, 2 parts; distilled water, 20 parts. Dissolve, and add 5 parts purified cream of tartar. Agitate to dissolve, filter, evaporate to dryness, and powder.

in obtaining it in commerce of this quality. Coupland gives in *P. J.*, 1901, 282, the results of an examination of commercial cream of tartar as follows: While in 1884 the assays of cream of tartar revealed from 8 to 14 per cent. of calcium tartrate, and in 1885 from 7 to 10.5 per cent., the larger percentages being found in the smaller crystals, the average from 1886 to 1890 was 6.5 per cent.; 1891 to 1894, 5.5 per cent.; 1895 to 1897, 3.0 per cent.; 1898, 5.0 per cent.; and 1899 to February, 1901, 4.6 per cent. But cream of tartar of greater purity is by no means an exceptional article, potassium bitartrate of a quality of 98 and 99 per cent. being common, the latter coming from America. The competition among makers of "baking powders," into which it enters, explains in part the improvement in the quality of cream of tartar.

Composition.—Cream of tartar consists of one molecule of tartaric acid, $C_4H_4O_6.H_2$, in which one of the two hydrogen atoms has been replaced by an atom of potassium.

Uses.—Potassium bitartrate is a very mild saline cathartic, and an active, soothing, hydragogue diuretic. In small doses it acts as a cooling aperient and in large ones as a hydragogue cathartic, producing copious watery stools. It is much used in *dropsy*. It is frequently prescribed in combination with senna, sulphur, or jalap. (See *Confectio Sulphuris* and *Pulvis Jalapæ Compositus.*) Its solution in boiling water, sweetened with sugar and allowed to cool, forms an acid, not unpleasant, refrigerant drink, advantageously used in some *febrile affections*, and frequently employed as a domestic remedy. The beverage called *imperial* (*potus imperialis*) is a drink of this kind, made by dissolving half an ounce of the salt in three pints of boiling water, and adding to the solution four ounces of white sugar and half an ounce of fresh lemon peel. *Cream of tartar whey* is prepared by adding about two drachms of the bitartrate to a pint of milk. It may be given in dropsical diseases.

As a diuretic, cream of tartar may be administered in the dose of a drachm and a half or two drachms (5.8 to 7.7 Gm.) several times a day. It is believed to escape from the system unchanged, and hence is not available when an alkaline influence upon the blood or renal secretion is desired. In pharmacy, cream of tartar is employed to obtain the neutral potassium tartrate (soluble tartar), potassium and sodium tartrate (Rochelle salt), antimony and potassium tartrate (tartar emetic), and iron and potassium tartrate (tartarized iron). Deflagrated with potassium nitrate, or incinerated alone, it is converted into a pure form of potassium carbonate, called salt of tartar. In the laboratory it is used to procure potassium hydroxide in a pure state, and for making black and white flux. *Black flux* is prepared by deflagrating cream of tartar with half its weight of potassium nitrate, and *white flux*, by deflagrating it with twice its weight of the same salt.

Dose, aperient, one to two drachms (3.9 to 7.7 Gm.); cathartic, half an ounce to one ounce (15.5 to 31 Gm.).

Off. Prep.—Confectio Sulphuris, *Br.;* Ferrum Tartaratum, *Br.;* Pulvis Jalapæ Compositus, *U. S., Br.;* Trochiscus Sulphuris, *Br.*

POTASSII BROMIDUM. U. S., Br.

POTASSIUM BROMIDE

(pŏ-tăs'sĭ-ī brō'mĭ-dŭm)

KBr = 118.22

"It should contain not less than 97 percent. of pure Potassium Bromide, and should be kept in well-stoppered bottles." *U. S.* "Potassium Bromide, KBr, may be obtained by adding a slight excess of bromine to a strong solution of potassium hydroxide, evaporating the solution of potassium bromide and bromate to dryness, decomposing the bromate by fusing the mixture with charcoal, and purifying by crystallization." *Br.*

Bromide of Potassium; Bromuretum Potassicum, s. Kalicum; Bromure de Potassium, *Fr. Cod.;* Kalium bromatum, *P. G.;* Bromkalium, Kaliumbromid, *G.;* Bromuro di potassio, *It.;* Bromuro potasico, *Sp.*

In the first step of the U. S. process of 1870 [1] a solution of ferrous bromide was formed, and this, by the addition of the solution of potassium carbonate, was decomposed so as to produce ferrous carbonate, which precipitated, and potassium bromide, which remained in solution. By straining, the precipitated carbonate was separated, and from the strained liquor potassium bromide was obtained by due evaporation. In the Br. Pharm. 1885, by reaction between potassium hydroxide and bromine, the potassium bromide and bromate are produced in solution, and, having been obtained dry by evaporation, are exposed with the powder of charcoal to a red heat, whereby the potassium bromate is converted into potassium bromide by the separation of its oxygen. The remainder of the process consists in obtaining the bromide in crystals by solution in boiling water, which deposits it on cooling.

Properties.—Potassium bromide is in "colorless, or white, cubical crystals, or a granular powder; odorless, and having a strongly saline taste. Permanent in the air. Soluble in about 15 parts of water, and in about 180 parts of

[1] "Take of Bromine *two troyounces;* Iron, in the form of Filings, *a troyounce;* Pure Carbonate of Potassium *two troyounces and sixty grains;* Distilled Water *four pints.* Add the Iron, and afterwards the Bromine, to a pint and a half of the Distilled Water, stirring the mixture frequently with a glass rod for half an hour. Apply a gentle heat, and, when the liquid assumes a greenish color, add gradually the Pure Carbonate of Potassium, previously dissolved in a pint and a half of the Distilled Water, until it ceases to produce a precipitate. Continue the heat for half an hour, and then filter. Wash the precipitate with the remainder of the Distilled Water, boiling hot, and again filter. Mix the filtered liquids, and evaporate that crystals may form. Lastly, pour off the mother-water, and, having dried the crystals on bibulous paper, keep them in a well-stopped bottle." *U. S.* 1870.

alcohol at 25° C. (77° F.); in less than 1 part of boiling water, and in 16 parts of boiling alcohol; also soluble in glycerin. On heating the salt upon platinum foil it decrepitates; and at a temperature near 700° C. (1292° F.) it fuses without decomposing, and at a bright red heat volatilizes, communicating a violet color to the flame. Its aqueous solution (1 in 20) is neutral, or has only a scarcely perceptible alkaline reaction upon litmus paper. The addition of tartaric acid T.S., or of sodium bitartrate T.S., to a concentrated aqueous solution of the salt produces a white crystalline precipitate. Silver nitrate T.S. produces a yellowish-white precipitate, insoluble in nitric acid and in a moderate excess of ammonia water." *U. S.* "Soluble in 2 parts of cold *water*, and in 200 parts of *alcohol* (90 per cent.). It affords the reactions characteristic of potassium and of bromides. Each gramme, dissolved in *water*, requires for complete precipitation not less than 83.7 nor more than 85.4 cubic centimetres of the *volumetric solution of silver nitrate*. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, zinc, calcium, magnesium, sodium, ammonium, bromates, iodates, or cyanides, and only the slightest reactions with the tests for chlorides, iodides, or sulphates. *Test-solution of ferric chloride* should not cause a red coloration in the cold aqueous solution (absence of thiocyanates)." *Br.* According to Chas. D. Chase, the commercial salt often is decidedly alkaline, and will precipitate the alkaloids from the solution of their salts; a serious mishap from such cause is very conceivable.

Tests.—To determine the percentage of chloride in an impure bromide the process of Baudrimont, as improved by Falières, may be used. It is founded upon the fact that chlorides precipitate more silver than the bromides, because of the lower atomic weight of chlorine as compared with bromine; for an explanation see *P. J.*, 1872, p. 542. Prepare a titrated solution of 0.852 gramme of silver nitrate in 100 cubic centimeters of distilled water. It is necessary, by means of ferric chloride, salts of barium, and strong sulphuric acid in excess, to insure that there are present no other salts, such as potassium iodide, carbonate, or sulphate, or sodium nitrate, which shall interfere with the results. Then dissolve one gramme of the bromide in thirty or forty grammes of water in a stoppered bottle, and add 1.427 grammes of silver nitrate in solution. When the precipitate has subsided, add, drop by drop, from a Gay-Lussac burette the titrated solution. If the bromide be pure, no precipitate forms; otherwise the number of cubic centimeters required to completely precipitate it equals the percentage of the chloride. An iodide of alkaline metal may be detected by adding to the solution of the bromide, palladium chloride, which will precipitate all the iodine in the form of palladium iodide, while the bromide of that metal will remain in solution. (*Ibid.*) According to Bobieure and Herbelin, potassium bromide containing iodide may be purified by boiling with bromine water and evaporating, the liberated iodine and the excess of bromine being driven off during the evaporation. (*J. P. C.*, 4e sér., x. 166.) The U. S. Pharmacopœia permits the presence of 3 per cent. of chloride in potassium bromide but insists on the absence of iodide and bromate. "If 1 Gm. of Potassium Bromide be dissolved in 10 Cc. of water and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no color should be produced by the subsequent addition of a drop of phenolphthalein T.S., even after heating (limit of *alkali*). If diluted sulphuric acid be dropped upon crushed crystals of the salt, and the mixture be shaken with 1 Cc. of chloroform, the latter should not assume a yellowish-brown color (absence of *bromate*). If to 10 Cc. of the aqueous solution of the salt (1 in 20), 1 Cc. of chloroform be added, and if chlorine water, which has been diluted with an equal volume of water, be introduced cautiously drop by drop with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of *iodides*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). If 0.3 Gm. of the well-dried salt be dissolved in about 50 Cc. of water, and 2 or 3 drops of potassium chromate T.S. be added, it should require not less than 24.6 Cc. nor more than 25.85 Cc. of tenth-normal silver nitrate T.S. to produce a permanent red color." *U. S.*

Uses.—When given to either cold or warm blooded animals in repeated doses of sufficient amount, potassium bromide produces a condition of universal depression, with failure of the circulation, progressively increasing paralysis, lowering of temperature, and finally death from asphyxia or exhaustion. In man the remedy causes similar results,—the series of phenomena being known as *bromism*. The symptoms are muscular weakness, general mental and bodily sluggishness, loss of memory, often marked sleepiness, depression of spirits deepening into complete apathy, lowering of temperature, and finally a universal depression of function, the patient lying in bed scarcely more than a feeble automaton. Fetor of breath is usually well marked, and an eruption of acne may be the first indication of the constitutional action of the drug. In some cases the effects of the drug upon the skin are most marked, and the pustules, under its continuous exhibition, become furuncular or go on to ulceration. It seems to be proved that the bromide affects the whole nervous system, but

in the lower animals the portions most susceptible are those tissues of the spinal cord whose function it is to receive the impulse from without, and the peripheral ends of the afferent or sensitive nerves. Its action upon the circulation has not been clearly determined, but it is somewhat probable that in small doses it contracts, in large ones relaxes, the capillaries; in sufficient amount it lessens the force of the heart's beats. It is probably eliminated with all the secretions, having been found in the sweat, saliva, urine, and intestinal mucus. When taken largely for some time it accumulates in the system, and it has been found in the urine a month after the ingestion of the last dose. It has been employed in almost all diseases to which human flesh is heir, but experience has shown that it is chiefly valuable as a means of quieting non-inflammatory excitement of the reflex centres of the cord, of the peripheral afferent nerves, of the genital function, and of the cerebrum. It is especially valuable in *epilepsy,* in which disease, however, it is necessary to maintain its decided action for years. In various forms of *convulsions,* such as *hysterical, infantile,* and *puerperal,* it is often of great service. In *tetanus* and *strychnine poisoning,* if given with sufficient boldness, it is an excellent remedy. In general nervous excitement,—or unrest,—in *delirium tremens,* in *nymphomania, satyriasis,* and other forms of genital irritation without inflammation, and in *semi-impotence* from over-irritability of the sexual organs, it is of great service. Given with opium it will often avert the secondary nausea which that narcotic produces in some persons. In *reflex vomiting,* as that of pregnancy, it is often of advantage. According to J. T. Rothrock, it is of service in preventing the so-called *urethral fever* produced in some very susceptible males by the passage of a catheter or bougie. It was formerly used as an alterative and resolvent in *syphilis, scrofula, bronchocele,* and other affections, but this employment of it has passed entirely out of vogue.

Potassium bromide may be given, dissolved in water, in doses of from twenty grains to a drachm (1.3 to 3.9 Gm.) three times a day. In some cases much larger amounts are required. In severe strychnine poisoning a half-ounce (15.5 Gm.), properly diluted, may be exhibited at once, and in tetanus there is little use in giving less than the same amount in the twenty-four hours.

Dose, ten to twenty grains (0.65 to 1.3 Gm.).

POTASSII CARBONAS. U. S., Br.

POTASSIUM CARBONATE

(pŏ-tăs'sĭ-ī cär'bŏ-năs)

$K_2CO_3 = 137.27$

"It should contain, when thoroughly dried, not less than 98 percent. of pure Potassium Carbonate [$CO(OK)_2$], and should be kept in well-stoppered bottles." *U. S.* "Potassium Carbonate, K_2CO_3, associated with either one or two molecules of water. It may be obtained from the ashes of wood, or by interaction of crude potassium sulphate and crude calcium carbonate and carbon." *Br.*

Salt of Tartar, Carbonate of Potassa from Pearlash; Potassii Carbonas Purus, Sal Tartari; Kali Carbonicum, Carbonas Potassicus, s. Kalicus; Carbonate de Potasse pur, Sel de Tartre, *Fr. Cod.;* Kalium Carbonicum, *P. G.;* Kohlensaureskali, Kaliumcarbonat, *G.;* Carbonato di potassio, *It.;* Carbonato potasico, *Sp.*

The present U. S. Pharmacopœia does not give a process for this salt.

The object of the process[1] is to purify the impure potassium carbonate, or pearlash. This generally contains certain insoluble impurities, as well as small portions of potassium sulphate, silicate, and chloride, as explained under another head. (See *Potassii Carbonas Impura.*) By dissolving it in a due proportion of water, and filtering the solution, the insoluble impurities are disposed of, as well as the greater part of the foreign salts, which, being much less soluble than the potassium carbonate, are excluded by the superior affinity of this salt for the water. The proper way of conducting the purification is to mix the impure carbonate with an equal weight of *cold water,* and to allow the mixture to stand for a day or two, stirring it frequently to promote the action of the water. The clear liquor obtained by decantation or filtration is then evaporated to dryness. The former official process was conducted very much in this way, cold water being employed, and about equal weights of alkali and water being used. The prolonged contact of the water with the salt, and the occasional stirring of the mixture, formerly ordered by the Dublin College, were useful directions. In no case should the undissolved residue be washed with a fresh portion of water, as by such a proceeding the foreign salts, which it is the object of the process to separate, would be dissolved. Iron vessels are directed, because this metal is not acted on by the alkali, while glass is attacked by it. In granulating the salt by stirring, it is better, when the solution is brought nearly to dryness, to keep it on the fire at a reduced heat until the process is finished, than to remove it the moment it thickens. According to Berzelius, a more productive process for purifying pearlash, though the resulting salt is not so pure as when obtained in the way just described, is to dissolve the pearlash in more than its weight of water, to evaporate the solution until it has the sp. gr. 1.52, and then to put it in a cool place, that the foreign salts, principally potassium

[1] "Take of Impure Carbonate of Potassium [pearlash] *thirty-six troyounces;* Water *two pints and a half.* Dissolve the Impure Carbonate in the Water, and filter the solution; then pour it into an iron vessel, and evaporate over a gentle fire until it thickens. Lastly, remove it from the fire, and stir constantly with an iron spatula so as to form a granular salt." *U. S.* 1870.

sulphate and chloride, may crystallize. The solution is then decanted, and evaporated to dryness. To get rid of the silica, Rieckher proposes to evaporate the solution, exempt from sulphate, to dryness, to moisten the residue with solution of ammonium carbonate, and again evaporate. The silica separates, and passes into the insoluble state at the temperature necessary for evaporation. By again dissolving and evaporating, the carbonate is obtained free from this impurity. (*Chem. Cb.*, 1863, p. 158.)

Properties.—It is officially described as "a white, granular powder, odorless, and having a strongly alkaline taste; very deliquescent. Soluble in 0.91 part of water at 25° C. (77° F.), and in about 0.65 part of boiling water; insoluble in alcohol. When heated to 130° C. (266° F.), the salt loses all the water which it may have retained or absorbed; at a bright red heat it melts, and at a white heat it volatilizes, communicating to a non-luminous flame a pure violet color. Its aqueous solution (1 in 20) has a strongly alkaline reaction upon red litmus paper, and effervesces with acids. Its aqueous solution (1 in 10) yields with excess of tartaric acid T.S. a white crystalline precipitate." *U. S.* It is extremely deliquescent, and hence a portion of it, exposed to the air for some time, attracts so much water as to dissolve completely into an oily liquid, called by the older chemists *oleum tartari per deliquium.* On account of this property, potassium carbonate should be kept in bottles with accurately ground stoppers. The usual impurities are earthy matters, potassium sulphate and chloride, and silica in the state of potassium silicate.

Tests.—"No residue should be left on dissolving 1 Gm. of the salt in 20 Cc. of water (absence of *earthy impurities*). An aqueous solution of Potassium Carbonate (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 5 Cc. of the aqueous solution (1 in 20) be carefully mixed with an equal volume of concentrated sulphuric acid, and, after cooling, 3 Cc. of ferrous sulphate T.S. be poured upon it so as to form a separate layer, no brown color should appear at the line of contact (absence of *nitrate*). One Gm. of Potassium Carbonate, weighed after having been thoroughly dried at 130° C. (266° F.), and dissolved in about 50 Cc. of water, should require not less than 14.3 (14.38) Cc. of normal sulphuric acid V.S. for neutralization, methyl-orange T.S. being used as indicator." *U. S.* The official test permits the presence of 2 per cent. of impurities. It is incompatible with acids and acidulous salts, ammonium chloride and acetate, lime water, calcium chloride, magnesium sulphate, alum, tartar emetic, silver nitrate, ammoniated copper and ammoniated iron, ferrous sulphate, tincture of ferric chloride, calomel and corrosive sublimate, lead acetate and subacetate, and zinc sulphate. It is not decomposed by iron and potassium tartrate. "Each gramme should require for neutralization at least 11.9 Cc. of volumetric solution of sulphuric acid. 2 grammes, after exposure to a red heat, should leave between 1.66 and 1.7 grammes of anhydrous potassium carbonate, K_2CO_3." *Br.* A solution of the salt, on exposure to the air, or on addition of an acid, deposits flocculi consisting of hydrated silica, resulting from the decomposition of potassium silicate, which is always present as an impurity. The spontaneous deposition of silica is owing to the absorption of carbon dioxide.

Composition.—Potassium carbonate, after exposure to a red heat, is anhydrous, consisting of two atoms of potassium and one carbonic acid group, CO_3. Obtained by the usual processes, it contains two molecules of potassium carbonate and three of water. When exposed to the air, potassium carbonate absorbs sufficient water, before losing its solid form, to give it three molecules; with more it begins to deliquesce. (Pohl, *A. J. P.*, 1861, p. 532.) *Potassium percarbonate,* $K_2C_2O_6$, was made by Constans and von Hansen by electrolyzing a saturated solution of potassium carbonate, and gradually lowering the temperature. It is a bluish amorphous powder, hygroscopic and decomposing water at ordinary temperatures, bicarbonate being formed. (*Chem. News,* 1897, 170; 1898, 65.)

Uses.—Purified pearlash is the form of potassium carbonate usually employed in this country, where it is frequently, though incorrectly, called *salt of tartar,* the latter name being strictly applicable to the purer carbonate obtained by decomposing cream of tartar. It is occasionally used as an antacid in *dyspepsia,* a diuretic in *dropsy,* and an antilithic in *uric acid gravel,* but the purpose to which it was most commonly applied in former years was the formation of the *neutral mixture* and the *effervescing draught.* It is also useful in some cases of *jaundice,* directly exciting the hepatic function. It should always be administered in dilute solution. In large quantities it acts as a corrosive poison, and is capable of producing death in a few hours; three ounces in very concentrated solution have been recovered from by an adult female. (Espagne, *A. G. M.*, Fèv. 1867.) The antidotes are the fixed oils and the vegetable acids. As a local remedy in *cutaneous affections,* potassium carbonate is used in the form of bath, lotion, and ointment. From eight to sixteen ounces may be used for a single bath, the quantity being gradually increased. Lotions may be made by dissolving two or three drachms in a pint of water; and ointments, by rubbing from ten grains to a drachm with an ounce of lard.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Decoctum Aloes Compositum, *Br.;* Liquor Arsenicalis, *Br.;* Liquor Bismuthi et Ammonii Citratis, *Br.;* Mistura Ferri Composita, *U. S., Br.;* Pilulæ Ferri Carbonatis, *U. S.;* Potassa Sulphurata, *Br.;* Spiritus Ætheris Nitrosi,

U. S.; Syrupus Rhei, *U. S.;* Syrupus Rhei Aromaticus, *U. S.;* Unguentum Potassii Iodidi, *U. S., Br.*

POTASSII CARBONAS IMPURA. U. S. 1870.

IMPURE CARBONATE OF POTASSIUM

(pō-tăs'sĭ-ī cär'bō-năs ĭm-pū'rą)

Pearlash, Pearlashes, Impure Potassa; Potasse du Commerce, *Fr.;* Rohe Pottasche, *G.;* Potasch, *Dutch;* Potaske, *Dan.;* Potaska, *Swed.;* Potassa del commercio, *It.;* Cenizas claveladas, *Sp.*

The alkali called potassa is the hydroxide of the metal potassium. (See *Potassium.*) It exists in various states of purity admixed with carbonate. In its most impure state, it is the common potash or *potashes* of commerce. This, subjected to calcination, is rendered purer, and is then called *pearlash,* the form of the alkali designated by the name at the head of this article.

Natural State and Preparation.—Potash and pearlash of commerce were formerly procured largely from the ashes of wood by lixiviation, and the subsequent evaporation of the solution obtained. The alkali exists in the wood principally in the state of acetate, and, being of a fixed and incombustible nature, is left behind after the incineration. The wood is burned on the ground, in a place sheltered from the wind. The ashes consist of a soluble and an insoluble portion. The soluble part is made up of potassium carbonate, together with potassium sulphate, phosphate, and silicate, and potassium and sodium chlorides; the insoluble portion, of calcium, and aluminum salts, oxidized iron and manganese carbonate and phosphate, and a little carbonaceous matter that has escaped combustion. The ashes are lixiviated in barrels with the addition of a portion of lime, and the soluble substances above mentioned are taken up. The lixivium is then evaporated in large iron kettles, which for several days are kept constantly full. The evaporation is continued until the mass has become of a black color and of the consistence of brown sugar. It is now subjected to as powerful a heat as can be produced by the best wood fire for a number of hours, by which it is fused. During the fusion the combustible impurities are for the most part burnt out, and a gaseous matter is emitted, which agitates the more fluid part. When the fusion is complete, the liquid becomes quiescent, and looks like melted iron. It is now transferred, by means of large iron ladles, to iron pots, where it congeals in cakes. These are broken up and packed in tight barrels, and constitute the *potash* of commerce. If it is intended to make *pearlash,* the process is varied. In this case the black matter of the consistence of brown sugar, called *black salts* by our manufacturers, instead of being fused, is transferred from the kettles to a large oven-shaped furnace so constructed that the flame may play over the alkaline mass, which in the meantime is stirred by means of an iron rod. The ignition is in this way continued until the combustible impurities are burnt out, and the mass, from being black, becomes of a bluish-white color.

The ashes of plants amount generally to not more than a few parts in the hundred, and of these a portion only consists of potassium hydroxide. The different parts of the same vegetable, and, for a stronger reason, different plants, furnish variable quantities of ashes. Ligneous plants yield less than herbaceous, the trunk less than the branches, and the branches less than the leaves. The bark yields more ashes than the wood, and the leaves of trees which drop their foliage in winter yield more than the leaves of evergreens. The table below gives the number of parts of potassium hydroxide contained in the ashes of one thousand parts of the plants.

Pine	0.45	Wheat straw	4.18	Dry oak leaves	24.0
Poplar	0.75	Flax	5.0	Common nettle	25.0
Birch	1.29	Rush	5.08	Black elder	25.5
Beech	1.45	Common thistle	5.37	Vetch	27.5
Oak	2.03	Vine branches	5.5	Poke	45.6
Box	2.26	Barley straw	5.8	Wheat stalks	47.0
Willow	2.85	Beech bark	6.0	Stems of potatoes	55.0
Linden	3.27	Fern	6.2	Wormwood	73.0
Elm	3.9	Indian corn stalks	17.5	Fumitory	79.0
Maple	3.9	Sunflower stalks	19.4	Angelica	96.2

Commercial History.—Potash and pearlash have been made in those countries in which forests abound. Accordingly, the alkali has been extensively manufactured in Canada. In the United States, with the disappearance of our forests, its production has been greatly curtailed. While the exports at one time were very large, they have diminished so that in 1904 only 1,027,181 lbs., valued at $56,800, were exported, and in 1905, 548,432 lbs., valued at $31,346.

Some idea of the falling off in manufacture may be gained by comparing this output with that of 1850, the year of greatest production, when 27,000,000 lbs. were exported from Canada alone. (See an interesting report on "Canadian Potash," by T. D. Reed, *Proc. A. Ph. A.,* 1893, 126.) It is produced in considerable quantities in the northern countries of Europe, especially in Russia and on the shores of the Baltic. It is of different qualities as it occurs in commerce, and is distinguished by the country or place of manufacture, as *American, Russian, Dantzic potash,* etc. Within recent years the residues of beet root molasses, after fermentation of the sugar and distillation of the spirit, have served as a source of potash. It is thus obtained in large quantity in Germany and France.

The *suint* of sheep's wool constitutes another source of potashes. Potassium sulphate, either the crude salt from the Stassfurt deposits or that obtained from the crude potassium chloride of the same locality, is also converted into carbonate by a process analogous to Leblanc's soda process. The principle of the ammonia soda process can also be applied to the crude potassium chloride of Stassfurt, with this difference in the practical operation, that, because of the ready solubility of the acid potassium carbonate, trimethylamine is used instead of ammonia, as the chloride of this base is much more soluble than is ammonium chloride. Crude potash is now prepared in largest amount from the "abraum" salts of the German rock salt deposits, in a manner analogous to the preparation of sodium carbonate from sodium chloride. The mixture of magnesium and potassium chlorides found so abundantly in these deposits may also be saturated with carbon dioxide, when an insoluble double salt, $MgCO_3 + KHCO_3 + 4H_2O$, separates out. By heating this with water under pressure it decomposes into insoluble magnesium carbonate and soluble potassium carbonate, which remains in solution and is obtained therefrom by evaporation. Other minerals have also become the source of potassium salts, especially a deposit of mixed potassium and magnesium chlorides, overlying a bed of common salt, at Stassfurt, near Madgeburg, in Prussia. The production of the most important of these potash minerals at Stassfurt for 1904 was in metric tons as follows: potassium chloride, 297,238, valued at $8,850,500; kainite, 1,905,843, valued at $6,641,250; other potassium salts 2,179,471 tons, valued at $5, 573,500.

Properties.—Potash is in the form of fused masses, of a stony appearance and hardness, and a caustic burning taste. Its color is variegated, but reddish and dark brown are the predominant hues. When exposed to the air, it absorbs moisture and deliquesces, and, if sufficiently long exposed, finally becomes liquid. Pearlash is of a white color, with usually a tinge of blue. As it occurs in commerce, it is in tight casks, containing about three hundred and fifty pounds, in which it forms one entire, hard, concrete mass. In commerce it is found in coarse powder, intermingled with lumps as dug out of the casks, presenting an opaque granular appearance, like table salt or common sugar. It is deliquescent, and has a burning alkaline taste. It is soluble in water, with the exception of impurities. The soluble matter in 100 grains of the salt of medium quality will neutralize about 58 grains of official sulphuric acid. It differs from potash principally in containing fewer combustible impurities and in being less caustic and deliquescent. The coloring matter of both these forms of alkali is derived from carbonaceous impurities and small portions of iron and manganese.

Composition.—The basis of both potash and pearlash is potassium carbonate, but this is associated with certain salts and with insoluble impurities. Several varieties of potash found in commerce were analyzed by Vauquelin, whose principal results are contained in the table below. The quantity examined of each kind was 1152 parts.

These results, calculated for 100 parts, show that the American potash contains 74 per cent. of pure alkali hydroxide and the Russian 67 per cent. Pearlash, it is seen, is more rich in carbonic acid than potash, and this result of analysis corresponds with the qualities of the two substances as prepared in the United States,—potash being known to be far more caustic than pearlash. Besides the impurities shown by the table, potassium phosphate and silicate and sodium chloride are present. J. U. Lloyd, in the *Proc. A. Ph. A.*, 1892, p. 190, gives the results of an examination of American commercial potashes; he found that what was sold in the market as "first sorts" was largely adulterated with common salt, this addition made to the melted potash in the kettle tending to whiten the crude potash and give it increased value in the eyes of those consumers who judge merely by appearance and do not take the trouble to assay it. According to Stevenson Macadam, the potashes of commerce contain iodine and a trace of bromine, which shows that the forest trees from which the alkali is obtained must contain a very minute proportion of these nonmetallic elements.

As the potash of commerce is valuable in the arts in proportion to the quantity of real alkali which it contains, it is important to possess an easy method of ascertaining its quality in that respect. (See *Potassii Hydroxidum.*)

Pearlash, from its impurity, is never used as a medicine. Purified to a certain extent, it takes the name of potassium carbonate. (See *Potassii Carbonas.*)

POTASSII CHLORAS. U. S., Br.

POTASSIUM CHLORATE

(pŏ-tăs'sĭ-ī ȼhlō'răs)

$KClO_3 = 121.68$

"It should contain not less than 99 percent. of pure Potassium Chlorate [$ClO_2.OK$], and

Kinds of Potash.	Potassium Hydroxide.	Potassium Sulphate.	Potassium Chloride.	Insoluble Residue.	Carbon Dioxide and Water.
American potash	857	154	20	2	119
Russian potash	772	65	5	56	254
Pearlash	754	80	4	6	308
Dantzic potash	603	152	14	79	304

should be kept in well-stoppered bottles. *Great caution should be observed in handling it,* as dangerous explosions are liable to occur when it is heated or subjected to concussion or trituration with organic substances (cork, tannic acid, sugar, etc.), or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances." *U. S.*[1] "Potassium Chlorate, $KClO_3$, is obtained by passing chlorine into water holding lime or magnesia in suspension, treating the clarified liquid with potassium chloride, and subsequently crystallizing the potassium chlorate." *Br.*

Chlorate of Potash; Kali Oxymuriaticum, Kali Muriaticum Oxygenatum, Chloras Potassicus, s. Kalicus; Hyperoxymuriate of Potassa; Chlorate de Potasse, *Fr. Cod.;* Kalium Chloricum, *P. G.;* Kaliumchlorat, Chlorsaures Kali, *G.;* Clorato di potassio, *It.*

In the U. S. and Br. Pharmacopœias no processes are given for potassium chlorate.

Preparation.—The salt may be obtained by the process of Graham, which consists in mixing potassium carbonate with an equivalent quantity of calcium hydroxide before submitting it to the action of chlorine. The gas is absorbed with avidity, and the mass becomes hot, while water is given off. The lime converts the carbonate into potassium hydroxide, and the reaction then takes place between six molecules of potassium hydroxide and six atoms of chlorine, with the result of forming five molecules of potassium chloride and one of potassium chlorate, while three molecules of water are eliminated.

$$6KOH + 3Cl_2 = 5KCl + KClO_3 + 3H_2O$$

The products are, therefore, calcium carbonate, potassium chloride, and potassium chlorate. The chloride and chlorate are separated from the carbonate by solution in hot water, and the chlorate from the chloride by priority of crystallization; a large proportion of the potassium hydroxide is lost by being converted into potassium chloride. In the process now generally employed for the commercial manufacture of potassium chlorate this is obviated, as follows. Chlorine is passed into a solution of milk of lime having a specific gravity of 1.04 until the liquid is nearly saturated. The clear solution is evaporated until it has a specific gravity of 1.18, and then potassium chloride added, and the mixture boiled down until a specific gravity of 1.28 is attained. On cooling, crystals of potassium chlorate separate out. The reactions here are

$$6Ca(OH)_2 + 6Cl_2 = 5CaCl_2 + Ca(ClO_3)_2 + 6H_2O$$

$$Ca(ClO_3)_2 + 2KCl = CaCl_2 + 2KClO_3$$

Pechiney's improvement on this process is to separate the greater part of the calcium *chloride* from the calcium *chlorate* before adding the potassium chloride. For details, see *N. R.*, Feb. 1882.

The potassium chlorate of commerce is also prepared by the reaction of solutions of potassium chloride and calcium hypochlorite, with the assistance of heat. The potassium chlorate crystallizes during the refrigeration of the liquor, and calcium chloride remains in solution:

$$2KCl + 3Ca(OCl)_2.CaCl_2 = 2KClO_3 + 6CaCl_2$$

This process has been further improved in Muspratt and Eschellmann's English patents (*J. Soc. Chem. Ind.,* iii. pp. 349 and 445) by substituting magnesia for lime, as potassium chlorate is much less soluble in magnesium chloride solutions than in those of calcium chloride, and consequently much less chlorate is left in solution. The process is said to increase the production of chlorate by from 15 to 20 per cent. For a full account of the improved methods, see *Thorpe's Dictionary of Applied Chemistry,* 1891, vol. i. 531. See also *J. Chem. S.,* lxx. 517. Potassium chlorate is also now made on a commercial scale by the electrolysis of potassium chloride solution, two companies having begun operations at Niagara Falls, while several others are operating under different patents in Europe. The potassium chloride, on electrolysis in a cell without diaphragm, yields first potassium hypochlorite, but as the temperature of the bath is kept above 50° C., it is changed to a mixture of chlorate and chloride, from which, on cooling, the former crystallizes out.

Properties.—Potassium chlorate is in "colorless, lustrous, monoclinic prisms or plates, or a white, granular powder; odorless, and having a cooling, characteristic taste. Permanent in the air. Soluble in 16 parts of water at 25° C. (77° F.), and in 1.7 parts of boiling water; insoluble in absolute alcohol and but slightly soluble in diluted alcohol. At 334° C. (633.2° F.) the salt fuses, and above 352° C. (665.6° F.) it is decomposed into oxygen and potassium perchlorate; above 400° C. (752° F.) all of its oxygen is liberated, and a white residue of potassium chloride remains, amounting to 60.8 percent. of the pure Chlorate employed. This residue is readily soluble in water, and the solution yields a white, curdy precipitate with silver nitrate T.S. The aqueous solution of the salt (1 in 20) is neutral to litmus paper. With excess of tartaric acid T.S., the solution (1 in 20) slowly yields a scant, white, crystalline precipitate; with platinic chloride T.S., a yellow crystalline precipitate is produced. When heated with hydrochloric acid, the aqueous solution (1 in 20) assumes a greenish-yellow color, and evolves chlorine. The aqueous solution of the salt (1 in 20) should not become discolored upon the addition of ammonium sulphide T.S. (absence of *heavy metals*). If to 1 Gm. of Potassium Chlorate contained in a test-tube of about 40 Cc. capacity, 5 Cc. of water, 5 Cc. of potassium hydroxide T.S., and about 0.2 Gm. of aluminum wire be added, and if in the upper portion of the test-tube a pledget of purified cotton be inserted, and over the mouth there be

[1] Tablets composed of potassium chlorate and ammonium chloride have been known to explode violently after having been made some time, evidently on account of chemical decomposition and the sudden evolution of a large quantity of the gaseous constituents.

placed a piece of moistened red litmus paper, then if the tube be heated upon a water-bath for fifteen minutes, no blue coloration of the paper should be discernible (limit of *nitrates* and *nitrites*)." *U. S.* "In colorless monoclinic crystals with a cool saline taste, soluble in 16 parts of cold and 3 parts of boiling *water*. Moistened with *hydrochloric acid* it evolves a yellow gas consisting of a mixture of chlorine and chloric oxide. When heated it fuses, gives off oxygen gas, and leaves a white residue soluble in *water*, forming a solution which affords the reactions characteristic of potassium and of chlorides." *Br.* Potassium chlorate is characterized also by becoming first yellow and then red by admixture with a little sulphuric acid, and by the action of that acid evolving chlorine tetroxide (Cl_2O_4), known by its yellow color, and its explosive property when heated; by its bleaching power when mixed with hydrochloric acid and then with water, and by its property of exploding violently when triturated with a small portion of sulphur or phosphorus or kermes mineral. Potassium chlorate consists of one atom of potassium in combination with the chloric acid group. This salt is an excellent test of manganese existing in organic matter. If a small portion of such matter, containing even a trace of manganese, be thrown on the surface of the *pure* melted salt in a test-glass, after the combustion has ceased the cooled saline mass will be found to have a rose or pinkish tint, caused by the formation of potassium permanganate. (*Neues Repert.*, vi. 247.) A similar discoloration of the salt, produced by the use of pure charcoal in the same manner, will evince the presence of manganese in the chlorate as an impurity.

Uses.—Owing to the assertion of O'Shaughnessy that under the use of potassium chlorate all the blood of the body becomes florid, it was long supposed that the salt acts upon the system as an oxidizing agent. Isambert, however, has found the statement of O'Shaughnessy incorrect, and as the chlorate does not naturally part with its oxygen at the temperature of the body, and as it is eliminated from the kidneys unchanged, it is evident that it has not the specific action claimed for it. It is more irritant than most of the other potassium salts, and probably acts less powerfully as a cardiac depressant than do most of them. It is efficient in the *follicular* and even the *gangrenous stomatitis* of childhood, and in *mercurial ptyalism*, acting, however, only by its local influence, it being continually eliminated with the saliva and coming in perpetual contact with the mucous membrane of the mouth. It is much employed in *scarlatina* and *diphtheria*, but has no specific action in these affections, being useful only by its direct influence upon the mucous membrane affected. In *scurvy*, *phthisis*, and the various *dyscrasiæ* in which it was once employed, it is of no service.

As an alterative stimulant local application, potassium chlorate is often very useful in inflammations of the mucous membrane, such as *stomatitis*, *pharyngitis*, *urethritis*, *vaginitis*, *chronic cystitis*, etc., as well as in indolent *ulcers* either upon the surface of the body or in such interior portions as can be reached. Its saturated solution given by injection with laudanum, twice daily, is an excellent remedy for *hemorrhoids*. As a prophylactic in salivation five to ten grains (0.32 to 0.65 Gm.) may be given. Taken to the extent of five drachms (19.4 Gm.) in twenty-four hours, it has been found to produce diuresis, abundant salivation, and a strong saltish taste. Such an amount as this is, however, dangerous even for the adult. When used as a wash or an injection, from a drachm to half an ounce (3.9 to 15.5 Gm.) of the salt may be dissolved in a pint (472 Cc.) of water. A solution in glycerin, in the proportion of one part of the salt to ten parts of the menstruum, has been especially recommended as a dressing for *ill-conditioned wounds* and *ulcers*. The remedy has also been applied in the form of very fine powder dusted on the surface.

In overdose potassium chlorate is an active poison, four drachms of it having caused death in the adult. The symptoms produced were violent vomiting, profuse diarrhœa, excessive dyspnœa, great failure of the heart's action, and marked cyanosis. The urine is lessened in quantity, albuminous, often of a dark reddish-brown or blackish color, and containing tube casts and the débris of blood corpuscles. In some cases there have been marked nervous symptoms, such as cramps, delirium, coma, etc. The lesions found after death are those of gastro-enteritis and acute nephritis, with alteration in the character of the blood due to the development in it of methæmoglobin. On account of their irritant action on the kidneys, large doses are especially dangerous in *diphtheria*.

Dose, from five to fifteen grains (0.32 to 1.0 Gm.).

Off. Prep.—Liquor Chlori Compositus, *U. S.*; Trochisci Potassii Chloratis, *U. S.* (*Br.*).

POTASSII CITRAS. U. S., Br.

POTASSIUM CITRATE

(pŏ-tăs'sĭ-ī cī'trăs)

$K_3C_6H_5O_7 + H_2O = 322.08$

"It should contain not less than 99 percent. of pure Potassium Citrate [$C_3H_4(OH)(COOK)_3 + H_2O$], and should be kept in well-stoppered bottles." *U. S.* "Potassium Citrate, $C_3H_4.OH.(COOK)_3$, is prepared by the interaction of citric acid and potassium carbonate." *Br.*

Kalium Citricum, Citras Potassicus, s. Kalicus; Citrate of Potash; Citrate de Potasse, *Fr.*; Kaliumcitrat, Citronsaures Kali, *G.*

Potassium citrate was known formerly by the name of *salt of Riverius*. In the U. S. formula of 1870,[1] mutually saturating proportions of the acid and bicarbonate were intended to be employed, the latter ingredient being preferred to the carbonate on account of its greater purity. The potassium of the bicarbonate unites with the citric acid to form the potassium citrate, and the carbon dioxide escapes, producing effervescence. The resulting solution is directed to be evaporated to dryness, as affording the most convenient form for use. The granulation ordered has a tendency to retard the deliquescence of the citrate. The British 1885 process differed only in the use of the carbonate instead of the bicarbonate, and in providing more carefully for an exact neutralization.

Properties.—Potassium citrate is crystallizable, but, as usually seen, is in the form of a granular powder. The U. S. P. recognizes both forms, and describes it as in "transparent, prismatic crystals, or a white, granular powder, odorless, and having a cooling, saline taste. Deliquescent when exposed to the air. Soluble in about 0.5 part of water at 25° C. (77° F.), and very soluble in boiling water; sparingly soluble in alcohol. When heated above 100° C. (212° F.), the salt begins to lose water; at 200° C. (392° F.) the water of crystallization (5.55 percent.) is completely lost. At 230° C. (446° F.) the salt begins to decompose, turns brown, and at a higher temperature carbonizes and emits inflammable gases which have a very pungent, acid odor. At a red heat a blackened mass of potassium carbonate and carbon is left, which has an alkaline reaction, and strongly effervesces with acids. The aqueous solution of the salt is alkaline to red litmus paper, but does not affect phenolphthalein. An aqueous solution of Potassium Citrate yields a white, crystalline precipitate with sodium bitartrate T.S. On mixing 10 Cc. of the aqueous solution of the salt (1 in 20) with 10 Cc. of calcium chloride T.S., the liquid remains clear until it is boiled, when a white, granular precipitate is produced. The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). A solution of 1 Gm. of Potassium Citrate in 1 Cc. of water, should not deposit any precipitate on the addition of 1 Cc. of acetic acid (absence of *tartrate*). If 1 Gm. of Potassium Citrate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 18.4 Cc. of half-normal hydrochloric acid V.S., methyl orange T.S. being used as indicator." *U. S.*

The British Pharmacopœia gives the following tests of its character. "A white powder of saline feebly acid taste, deliquescent, very soluble in *water*. It affords the reactions characteristic of potassium salts and of citrates. Each gramme of the dry salt, heated to redness till gases cease to be evolved, should leave an alkaline residue, which when treated with *water*, filtered, and well washed, should yield a clear solution requiring for neutralization at least 9.7 cubic centimetres of the *volumetric solution of sulphuric acid*. It should yield no characteristic reaction with the tests for lead, iron, calcium, magnesium, sodium, carbonates, or tartrates, and only the slightest reactions with the tests for chlorides or sulphates." *Br.*

As citric acid is tribasic, this salt consists of three atoms of potassium combined with the citric acid radical $C_6H_5O_7$, and with this one molecule of water, its formula being $K_3C_6H_5O_7,H_2O$.[1]

Uses.—Potassium citrate is a grateful refrigerant diaphoretic, and has long been used in the *fevers* of this country, in the extemporaneous forms of neutral mixture and effervescing draught. As these require time and a somewhat careful manipulation in their preparation, it has been found more convenient to keep the potassium citrate ready made and dissolve it in water when wanted for use. This solution will no doubt produce the essential diaphoretic and refrigerant effects of the neutral mixture or the effervescing draught, but is less agreeable to the stomach and palate, because destitute of the carbonic acid contained in these preparations. Potassium citrate dissolved in an excess of lemon juice affords the most agreeable method of securing the influence of an alkaline salt of potassium upon the system, as in *rheumatism*, the *uric acid diathesis*, etc. It is also a very valuable remedy in the first or dry stage of *acute bronchitis*.

Dose, of the citrate, from twenty to twenty-five grains (1.3 to 1.62 Gm.). When a decided effect upon the system is desired, as much as an ounce (31 Gm.) of it may be given in twenty-four hours.

Off. Prep.—Liquor Bismuthi et Ammonii Citratis, *Br.;* Potassii Citras Effervescens, *U. S.*

[1] "Take of Citric Acid *ten troyounces;* Bicarbonate of Potassium *fourteen troyounces;* Water *a sufficient quantity*. Dissolve the Citric Acid in a pint of water, add the Bicarbonate of Potassium gradually, and, when effervescence has ceased, filter the solution and evaporate to dryness, stirring constantly, after a pellicle has begun to form, until the salt granulates. Keep it in a well-stopped bottle." *U. S.* 1870.

[1] *Sodium and Potassium Citrate.*—T. Push of Dessau, Germany, has made a complete series of citrates, corresponding to the official tartrates, with a view of finding a stable compound. He ascertained that the double sodium and potassium citrate is an extremely stable compound, even when exposed to the air for a long time. He prepares the salt by dissolving 100 parts of citric acid in water, adding 108 parts of pure potassium carbonate and 221 parts of crystallized sodium carbonate, filtering, evaporating, and crystallizing. The crystals are allowed to drain, and the mother liquor is further concentrated, until, on cooling, it solidifies to a crystalline mass, which is used in the condition of powder. (*A. Pharm.*, July, 1877, 47; *N. R.*, Sept. 1877.)

POTASSII CITRAS EFFERVESCENS. U. S.

EFFERVESCENT POTASSIUM CITRATE

(pŏ-tăs'sĭ-ī cī'trăs ĕf-fẹr-vĕs'cĕnṣ)

• "Potassium Citrate, *two hundred grammes* [or 7 ounces av., 24 grains]; Sodium Bicarbonate, dried and powdered, *four hundred and seventy-seven grammes* [or 16 ounces av., 361 grains]; Tartaric Acid, dried and powdered, *two hundred and fifty-two grammes* [or 8 ounces av., 389 grains]; Citric Acid, uneffloresced crystals, *one hundred and sixty-two grammes* [or 5 ounces av., 313 grains], to make about *one thousand grammes* [or 35 ounces av., 120 grains]. Dry the Potassium Citrate on a water-bath, until it ceases to lose weight; after powdering the dried salt, mix it intimately with the powdered Citric Acid and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated between 93° and 104° C. (199.4° and 219.2° F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has acquired a moist consistence, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles." *U. S.*

The process of the U. S. P. (8th Rev.) differs from that formerly official, mainly in the absence of sugar which has a tendency to discolor and the use of potassium citrate instead of potassium bicarbonate and citric acid.

This official effervescent salt affords an agreeable mode of administering potassium citrate.

Dose, from one to two teaspoonfuls, in cold water.

POTASSII CYANIDUM. U. S.

POTASSIUM CYANIDE

(pŏ-tăs'sĭ-ī cў-ăn'ị-dŭm)

$KCN = 64.70$

"It should contain not less than 95 percent. of pure Potassium Cyanide, and should be kept in well-stoppered bottles." *U. S.*

Cyanide of Potassium; Potassii Cyanuretum, *U. S.* 1850; Cyanuret of Potassium; Cyanure de Potassium, *Fr. Cod.*; Kalium Cyanatum, Cyanuretum Potassicum, s. Kalicum; Kaliumcyanid, Cyankalium, *G.*; Cianuro potasico, *Sp.*

The process of the U. S. P. 1870 [1] was that of F. & E. Rodgers, though generally known under the name of Liebig. It furnishes a large product, a considerable part of which is the impurity potassium cyanate. The reaction takes place between one molecule of potassium ferrocyanide and one of potassium carbonate. The iron is set free, the carbon dioxide is evolved, and five molecules of potassium cyanide and one of potassium cyanate are formed. The iron occupies the lower part of the fused liquid, and, if the latter be carefully poured out to solidify, the portion contaminated with the iron may be left behind. The reaction is explained by the following equation:

$$K_4Fe(CN)_6 + K_2CO_3 = 5KCN + KOCN + CO_2 + Fe$$

Fordos and Gélis, in an able paper contained in the *Journal de Pharmacie* for Aug. 1857, pointed out numerous causes which contribute to render the salt, as obtained by the use of potassium carbonate, impure. The commercial cyanide, which is obtained by this process, was found by these writers to be very impure, containing only from 36 to 55 per cent. of the pure salt. The potassium cyanate may be readily detected by saturating the product with an acid, which will cause an effervescence of carbon dioxide and the generation of a salt of ammonium. According to Schwarz, it may be freed from potassium cyanate and carbonate by treating the impure cyanide with carbon disulphide, which dissolves it, and may be recovered in great measure by distillation. (*Chem. News*, No. 190, p. 41.)

In the process in which the potassium ferrocyanide is ignited alone (U. S. process 1840), the salt is first deprived of its water of crystallization by exposure to a moderate heat, and then calcined at a red heat for two hours, in order to decompose the ferric cyanide. The reaction which takes place is as follows:

$$K_4Fe(CN)_6 = 4KCN + FeC_2 + N_2$$

The product of the calcination is a black, porous mass, consisting of potassium cyanide, mixed with carbide of iron and charcoal. As the cyanide is very prone to absorb oxygen, especially when hot, whereby it is decomposed, atmospheric air is excluded from the retort while it is cooling, by luting its orifice. When the whole is cold, the black mass is reduced to coarse powder, and exhausted by cold distilled water, which dissolves the potassium cyanide and leaves the carbide of iron and charcoal behind. The filtered liquor, therefore, is an aqueous solution of potassium cyanide, which is obtained in a solid state by a rapid evaporation to dryness. During the evaporation a small portion of the cyanide is decomposed, attended with the evolution of ammonia and the production of potassium formate. A portion of this salt, therefore, contaminates the cyanide, as obtained by this process; but the quantity is too small to interfere with its medicinal action. The decomposition here referred to takes

[1] *Potassium Cyanide.*—"Take of Ferrocyanide of Potassium, dried, *eight troyounces;* Pure Carbonate of Potassium, dried, *three troyounces.* Mix the salts intimately, and throw the mixture into a deep iron crucible previously heated to redness. Maintain the temperature until effervescence ceases, and the fused mass concretes, of a pure white color, upon a warm glass rod dipped into it. Then pour out the liquid carefully into a shallow dish to solidify, ceasing to pour before the salt becomes contaminated with the precipitated iron. Break up the mass while yet warm, and keep the pieces in a well-stopped bottle." *U. S.* 1870.

place between one molecule of potassium cyanide and two of water, and is represented by the following equation:

$$KCN + 2H_2O = NH_3 + HCOOK$$

This decomposition is avoided by exhausting the black mass with boiling alcohol of 60 per cent. (sp. gr. 0.896) instead of with water. The alcoholic solution, by evaporation to a pellicle, lets fall the salt upon cooling, as a crystalline precipitate, perfectly white and pure.

According to the process of the French Codex, which is that of Robiquet, this cyanide is obtained in the dry way, without the use of any solvent. The calcination is performed in a coated stoneware retort, half filled with the ferrocyanide, to which a tube is attached for collecting the gaseous products. When these cease to be disengaged, the heat is gradually raised to a very high temperature, at which it is kept for a quarter of an hour, after which the tube is closed with luting and the whole left undisturbed until quite cold. When the calcination is thus conducted, the retort, upon being broken, will be found to contain a black matter, covered with a fused layer of pure potassium cyanide, resembling white enamel. This is detached by means of a knife, and immediately transferred to a bottle with an accurately fitting stopper. The process of Wiggers consists in disengaging hydrocyanic acid from a mixture of potassium ferrocyanide and sulphuric acid and passing it into a cooled receiver containing an alcoholic solution of potassium hydroxide. The contents of the receiver ultimately form a solid magma of the cyanide, which is drained, washed several times with strong alcohol, pressed between folds of bibulous paper, and dried as quickly as possible. Potassium cyanide may be formed by passing a current of strongly heated nitrogen over charcoal impregnated with potassium carbonate and heated to a white heat. Potassium cyanide with some sodium cyanide admixture is made by the Niagara Electro-Chemical Co., who manufacture sodium by Castner's process. The manufacture of this sodium-potassium cyanide with the aid of sodium depends upon the fact that when the yellow prussiate of potash is heated with sodium neither oxygen nor alkaline carbonates are introduced, the product being an almost chemically pure mixture of sodium and potassium cyanide. This is sold in large amounts for the cyanide extraction process for gold now coming into extensive use. Still more recent is the manufacture of potassium and sodium cyanides under the patents of Adolph Frank in Germany. Calcium carbide reacts with atmospheric nitrogen to form calcium cyanamide, and this fused with alkaline chlorides or carbonates yields the corresponding cyanides. This will undoubtedly prove the cheapest manufacturing method.

Properties.—Potassium cyanide is in "white, opaque, amorphous pieces, or a white, granular powder, odorless when perfectly dry; deliquescent in the air and exhaling the odor of hydrocyanic acid. *Great caution should be used in tasting and handling this salt.* Soluble in about 2 parts of water at 25° C. (77° F.). Boiling water dissolves its own weight of the salt, but rapidly decomposes it. In alcohol it is but sparingly soluble. At a low red heat the salt fuses. Its aqueous solution (1 in 20) has a strongly alkaline reaction upon red litmus paper, and emits the odor of hydrocyanic acid. With an equal volume of sodium bitartrate T.S. the solution yields a white, crystalline precipitate. With sodium cobaltic nitrite T.S. a copious yellow precipitate is produced. A few drops of a solution of the salt (1 in 20) yields with silver nitrate T.S. a white precipitate, which is soluble in an excess of the solution of Potassium Cyanide, also in ammonia water, and in concentrated nitric acid. If 5 Cc. of a solution of the salt (1 in 20) be shaken with a few drops of ferrous sulphate T.S. and of ferric chloride T.S., and a slight excess of hydrochloric acid then added, a blue precipitate (Prussian blue) will be produced.

The addition of diluted hydrochloric acid to the aqueous solution of the salt (1 in 20) should produce not more than a slight effervescence (limit of *carbonate*). After the diluted hydrochloric acid has been added in slight excess, a drop of ferric chloride T.S. should produce neither a blue color (absence of *ferrocyanide*) nor a red color (absence of *sulphocyanate*). If 1 Gm. of Potassium Cyanide be dissolved in sufficient distilled water to measure 100 Cc., then 64.7 Cc. of this solution mixed with 5 Cc. of ammonia water and 3 drops of potassium iodide T.S. should require not less than 47.5 Cc. of tenth-normal silver nitrate V.S. before the appearance of a permanent precipitate (each Cc. of the tenth-normal silver nitrate V.S. indicating 2 percent. of pure Potassium Cyanide)." *U. S.* If yellow, it contains iron. Its solution effervesces with acids. The salt and its solutions, when exposed to the air, exhale the odor of hydrocyanic acid, and become weaker; but the change takes place slowly. Orfila found that the salt, after fourteen days' exposure, by which it was almost entirely liquefied, still possessed energetic poisonous properties; he thinks, therefore, that the bad effects of opening the containing bottle, in dispensing the medicine, have been exaggerated. Unfortunately, the salt varies in quality independently of the effects of time and exposure. Besides water, the usual impurities are potassium hydroxide, carbonate, cyanate, and formate. They sometimes amount to half the weight of the cyanide, consisting principally of the carbonate. From the extensive use at present made of potassium cyanide in electrometallurgy and photography, it is of importance to have a reliable test of its purity. Such a test has been discovered by Fordos and Gélis, founded on the fact that one molecule

of iodine rapidly reacts with one of the cyanide, so as to form a colorless compound, consisting of one molecule of potassium iodide and one of cyanogen iodide:

$$KCN + I_2 = KI + CNI$$

Accordingly, a tincture of iodine of known strength is gradually added to an aqueous solution of a given weight of the cyanide to be tested, until it assumes a permanent yellowish tinge, and the amount of iodine expended indicates the proportion of cyanide in the specimen. A necessary preliminary step, before using the tincture, is to add sufficient carbonic acid water to the solution of the cyanide to convert any potassium hydroxide or carbonate present into bicarbonate, in which state neither has any action on the iodine. This test is applicable to other cyanogen compounds which are soluble. Thornton J. Herapath's test for commercial potassium cyanide is a standard solution of copper ammonio-sulphate, the blue color of which is destroyed by a solution of the cyanide. The copper solution is added to one of the cyanide of known strength, until a faint blue coloration is produced, and the richness of the sample in pure cyanide is in proportion to the quantity of the copper solution required. Applying this test to five samples, Herapath found the proportion of pure cyanide to vary from 41 to 65 per cent. Potassium cyanide yields with silver nitrate added in excess a precipitate of silver cyanide, wholly soluble in ammonia and boiling nitric acid. It consists of one atomic group of cyanogen and one of potassium.

Besides the very extensive use of potassium cyanide in preparing electro-plating solutions for gilding and silvering by electro-deposition, and in photography, large quantities are now consumed in the extraction of gold and silver from the fine residues or "tailings" where amalgamation fails to take up the precious metals. From such solutions of gold in potassium cyanide the metal is thrown out by the action of metallic zinc.

Uses.—Potassium cyanide acts precisely like hydrocyanic acid as a poison and as a medicine. (See *Acidum Hydrocyanicum Dilutum.*) Five grains of it have repeatedly taken life, and hydrocyanic acid has been detected in the blood of a person who had been fatally poisoned by the cyanide. (Venghauss, *A. Pharm.*, clii. 138.) Potassium cyanide has the power of dissolving silver oxide and may be used for the removal of silver nitrate stains from clothing. According to Guthrie a solution of three grains (0.2 Gm.) to the ounce (30 Cc.), dropped in the eye every other day, will remove olive colored stains from the conjunctiva caused by silver nitrate. Owing to the large use of potassium cyanide for the recovery of gold, numerous accidental cases of poisoning occur in the reduction works. There is no satisfactory physiological antidote to potassium cyanide, the only remedy which offers much advantage being strychnine given hypodermically. A much used chemical antidote is hydrogen dioxide solution. In employing it, the stomach should be freely washed out with a 30 per cent. dioxide solution. Martin and O'Brien (*Int. M. J.*, 1901) found that cobalt salts give stable solutions which instantaneously react with the cyanides even in the presence of hydrocyanic acid and would probably be an effective antidote were they themselves not very poisonous. Ferrous salts administered with an abundance of alkalies are efficacious, the ferrous cyanides being formed instantaneously.[1] These salts do not act, however, in the presence of free acid, so that it is essential to administer alkalies with them, magnesium oxide being especially useful.

Dose, one-eighth grain (0.008 Gm.).

POTASSII DICHROMAS. U. S. (Br.)

POTASSIUM DICHROMATE [Potassii Bichromas, Pharm. 1890, Potassium Bichromate]

(pŏ-tăs'sĭ-ī dī-ĉhrō'măs)

$K_2Cr_2O_7 = 292.28$

"It should contain not less than 99 percent. of pure Potassium Dichromate [$Cr_2O_5(OK)_2$], and should be kept in well-stoppered bottles." *U. S.* "Potassium Bichromate, K_2CrO_4,CrO_3, is obtained by roasting chrome ironstone with lime in the presence of air, and by treating the resulting chromate with a potassium salt, and subsequently with an acid." *Br.*

Potassii Bichromas, *Br.;* Red Chromate of Potash (Potassa), Bichromate of Potash; Kali Bichromicum, Kali Chromicum Rubrum; Chromate (Bi) de Potasse, *Fr. Cod.;* Bichromate de Potasse, *Fr.;* Kalium dichromicum, *P. G.;* Kaliumdichromat, Zweifach Chromsaures Kali, Doppeltchromsaures Kali, *G.;* Bicromato di potassio, *It.;* Bicromato potasico, *Sp.*

This salt is most conveniently prepared from the neutral or yellow *potassium chromate*, by acidulating its solution with sulphuric acid and setting it aside for a day or two. In the action which follows we may suppose two reactions take place:

$$2K_2CrO_4 + H_2SO_4 = K_2SO_4 + 2KHCrO_4$$

$$2KHCrO_4 = K_2Cr_2O_7 + H_2O$$

Here the sulphuric acid, taking half the base from the two molecules of neutral chromate, changes them into two molecules of an acid chromate. This, however, is unstable, and the two molecules condense to form one of the dichromate with the elimination of one molecule of water. The yellow chromate is obtained by igniting four parts of powdered chrome-iron ore (FeO,Cr_2O_3) with one part of potas-

[1] The suggestion of Martin and O'Brien is that in all reduction works there should be kept a case containing the following: (1) 30 Cc. (1 oz.) of 23 per cent. solution of ferrous sulphate. (2) 30 Cc. (1 oz.) of 5 per cent. solution of potassium hydroxide. (3) 2 Gm. (30 grains) of powdered magnesium oxide. (4) Metal receptacle, 1 pint capacity. (5) A stomach tube. Numbers 1 and 2 being kept in hermetically sealed tubes, can be broken into the receptable with the powdered magnesium and a half a pint of water and at once swallowed. The amount of antidote is theoretically sufficient for 5 Gm. of potassium cyanide, but should always be used in excess.

sium nitrate, and lixiviating the resulting mass with water. The solution, by evaporation, yields the yellow salt in crystals. In this process, the nitric acid of the potassium nitrate furnishes oxygen to convert the chromium sesquioxide into chromium trioxide, which then unites with the potassium of the same salt. The iron, in the mean time, is sesquioxidized and rendered insoluble. Sometimes impure potassium carbonate (pearlash) is substituted for part of the potassium nitrate in the calcination. Omitting the potassium nitrate entirely, Stromeyer of Norway, in performing the ignition, has used lime along with the pearlash, with economical results. When lime is employed, calcium chromate is formed, which is extracted by lixiviation and decomposed by a soluble potassium salt, such as sulphate or carbonate, either of which will carry the lime out of solution. When desired, the dichromate may be obtained directly from the solution of potassium chromate, derived from the treatment of the ore by acidulating it with sulphuric acid, without first crystallizing it. The production of chrome ore in the United States has practically ceased, as the California deposits are no longer worked. The manufacture of potassium and sodium dichromates is therefore carried on with imported ore brought chiefly from Asia Minor and New Caledonia. The amount of the ore so imported in 1904 was 24,227 tons, valued at $348,527.

Properties.—Potassium dichromate is in "large, orange-red, transparent, triclinic prisms, or four-sided tabular crystals, odorless, and having an acidulous, metallic taste. Permanent in the air. Soluble in about 9 parts of water at 25° C. (77° F.), and in 1.5 parts of boiling water; insoluble in alcohol. The salt fuses below a red heat, without loss of weight, forming a dark brown liquid. At a white heat it evolves oxygen and leaves a residue of neutral potassium chromate and green chromic oxide. The aqueous solution of Potassium Dichromate (1 in 20) has an acid reaction upon blue litmus paper. On mixing 4 Cc. of an aqueous solution (1 in 20) with 0.5 Cc. of alcohol, and then adding 1 Cc. of sulphuric acid, the liquid should assume a green color and emit the odor of aldehyde. Sodium cobaltic nitrite T.S. produces in an aqueous solution a copious yellow precipitate." *U. S.* "Potassium Bichromate dissolved in *water* gives a yellowish-white precipitate with *solution of barium chloride,* and a purplish-red precipitate with *solution of silver nitrate,* the filtrate from either solution affording the reactions characteristic of potassium, and each precipitate being entirely soluble in *diluted nitric acid* (absence of sulphates and chlorides). The aqueous solution, digested with *sulphuric acid* and ethylic alcohol, or with many other organic compounds, acquires an emerald-green color. 5.66 grammes of *ferrous sulphate,* dissolved in a little *water* and acidulated with *sulphuric acid,* should not cease to yield a blue color with solution of *potassium ferricyanide* until such a quantity of solution as contains 1 gramme of the Potassium Bichromate has been added." *Br.*

Uses.—Potassium dichromate is an irritant caustic. It was first used internally in 1850, by Robin, as an alterative in *secondary syphilis,* in doses of one-fifth of a grain (0.012 Gm.), given in pill form, and Heyfelder of Erlangen, and Vicente afterwards employed it in the same disease with asserted encouraging results. It is said to cause salivation, but it is at present never used internally. Its saturated solution was recommended, in 1827, by Cumin, as a caustic application to *tubercular elevations, excrescences,* and *warts,* and in 1850 by Puche in *syphilitic vegetations.* It causes the morbid parts to shrivel and fall off. Dissolved in water, in the proportion of five grains gradually increased to a drachm to the fluidounce, it has been found useful in affections of the mucous membrane requiring astringents, and a solution has also been employed with advantage for correcting the fetor of *sloughing wounds.*[1]

In overdoses it operates as a violent irritative and corrosive poison, producing severe vomiting, frequent dark hemorrhagic dejections, violent abdominal pains, pronounced disturbances of the circulation, coma, heart failure, collapse, etc. Less than an ounce has caused unconsciousness in five minutes, with death thirty-five minutes later. (*B. M. J.,* ii. 1888.) Soap, an alkaline carbonate, or magnesia, is the antidote. Potassium dichromate is manufactured largely for the use of calico printers. The workmen engaged in making it are liable to painful ulcerations of the hands, and, in consequence of the acrid vapors evolved, violent irritation of the nostrils is apt to be experienced, with severe pricking sensations and excessive sneezing, followed in time by destruction of the mucous membrane and even of the septum itself. It is asserted that this result may be avoided by breathing through the mouth exclusively, the profuse secretion of saliva produced carrying off the poisonous particles. (*B. F. M. R.,* Oct. 1863.) For a full account of the manufacture of the chromium salts, for dyes and pigments, see *P. J.* (xv. 32).

Dose, one-fifth of a grain (0.012 Gm.).

POTASSII ET SODII TARTRAS. U. S. (Br.)

POTASSIUM AND SODIUM TARTRATE
[Rochelle Salt]

(pŏ-tăs'sĭ-ī ĕt sō'dĭ-ī tär'trăs)

$KNaC_4H_4O_6 + 4H_2O = 280.18$

"It should contain not less than 99 percent. of pure Potassium and Sodium Tartrate [C_2H_3

[1] *Mueller's Fluid* is used for preserving anatomical specimens. It consists of from 2 to 2.5 parts of potassium dichromate, 1 part of sodium sulphate, and 100 parts of water.

$(OH)_2(COOK)(COONa) + 4H_2O$], and should be kept in well-stoppered bottles." *U. S.* "Sodium Potassium Tartrate, $(CHOH)_2CO ONa.COOK,4H_2O$, is prepared by neutralizing Acid Potassium Tartrate with Sodium Carbonate." *Br.*

Soda Tartarata, *Br.*; Sodæ et Potassæ Tartras, *Br.* 1864, *U. S.* 1850; Sodæ Potassio-tartras, Natro-kali Tartaricum; Tartarated Soda; Sal Polychrestum Seignetti, Tartras Potassico sodicus; Tartrate de Potasse et de Soude, *Fr. Cod.*; Sel de Seignette, Soude Tartarisée, *Fr.*; Tartarus Natronatus, *P. G.*; Seignettesalz, Kaliumnatriumtartrat, *G.*; Tartrate sodico-potassico, *It.*; Tartrato sodico-potasico, *Sp.*

This salt cannot be made profitably on the small scale (for U. S. process 1870, see the footnote);[1] it is a double salt, consisting of a molecule of tartaric acid, $C_4H_4O_6.H_2$, in which one of the basic hydrogen atoms is replaced by potassium and the other by sodium. The theory of its formation is very simple, being merely the replacement of the hydrogen in the potassium bitartrate by the sodium of the sodium carbonate, the carbon dioxide of which escapes with effervescence. The quantities of the materials for mutual saturation are 123.19 parts of monohydrated carbonate and 373.56 of bitartrate, or one molecule of monohydrated sodium carbonate to two molecules of the acid tartrate.

Properties.—Potassium and sodium tartrate is in the form of "colorless, transparent, rhombic prisms, or a white powder, odorless, and having a cooling, saline taste. The crystals slightly effloresce in dry air. Soluble in about 1.2 parts of water at 25° C. (77° F.), and in less than 1 part of boiling water; almost insoluble in alcohol. When heated to 74° C. (165.2° F.), the salt fuses to a colorless liquid, which, at a higher temperature, froths, becomes brown, and gradually carbonizes, while inflammable vapors are emitted, having the odor of burning sugar. Finally, a black residue is left. The aqueous solution of the salt is feebly alkaline to litmus paper, but it does not affect phenolphthalein. An aqueous solution of the salt (1 in 10) yields, with an equal volume of acetic acid, a white, crystalline precipitate. With silver nitrate T.S. it produces a white precipitate which becomes black on boiling. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). When heated with potassium hydroxide T.S., the solution should not evolve *ammonia*. If 1 Gm. of Potassium and Sodium Tartrate be thoroughly ignited at red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require, for complete neutralization, not less than 14.1 Cc. of half-normal hydrochloric acid V.S., methyl-orange T.S. being used as indicator." *U. S.* "Trimetric prisms with hemihedral facets; it is entirely soluble in cold *water*; and has a saline taste. It affords the reactions characteristic of potassium, of sodium, and of tartrates. Each gramme, heated to redness until gases cease to be evolved, should leave an alkaline residue, which when treated with *water*, filtered, and well washed, yields a clear solution requiring for exact neutralization at least 7 cubic centimetres of the *volumetric solution of sulphuric acid*." *Br.*

When the salt is exposed to a very strong heat, it becomes blackened, and gives out inflammable gases with the odor of burnt sugar, the tartaric acid being destroyed, and a mixture of potassium and sodium carbonates left. It sometimes contains calcium tartrate, which may be removed by solution and crystallization, but when the crystals are large and well defined, it may be assumed to be pure. It is incompatible with most acids, and with nearly all acid salts except potassium bitartrate. It is also decomposed by lead acetate and subacetate, silver nitrate, and by the soluble calcium and barium salts, unless the solution of the tartrate be considerably diluted.

The way in which the acids act in decomposing potassium and sodium tartrate is by combining with the sodium, and throwing down potassium bitartrate as a crystalline precipitate. This double salt was discovered by Seignette, an apothecary of Rochelle, and hence is frequently called *Seignette's salt* or *Rochelle salt*.

Potassium and sodium tartrate consists of the tartaric acid group $C_4H_4O_6$, which is dibasic, in combination with one atom of potassium and one of sodium, together with 4 molecules of water.

Uses.—This salt is a mild, cooling purgative, well suited to delicate and irritable stomachs, being among the mildest and least unpalatable of the neutral salts. As it is not incompatible with tartar emetic, it may be associated with that salt in solution. It is an ingredient in the effervescing aperient called Seidlitz powders. (See *Pulvis Effervescens Compositus*.) When given in small and repeated doses it usually does not act as a purgative, but is absorbed and renders the urine alkaline. (Millon and Laveran, *J. P. C.*, 3e sér., vii. 222.)

Potassium and magnesium tartrate, formed by saturating cream of tartar with magnesium carbonate, has been proposed by Maillier for use as a safe, pleasant purgative. (*J. P. C.*, xiii.)

Dose, as a purge, from half an ounce to an ounce (15.5 to 31 Gm.).

Off. Prep.—Pulvis Effervescens Compositus, *U. S.* (*Br.*).

[1] "Take of Carbonate of Sodium *twelve troyounces*; Bitartrate of Potassium, in fine powder, *sixteen troyounces*; Boiling Water *five pints*. Dissolve the Carbonate of Sodium in the Water, and gradually add the Bitartrate of Potassium. Filter the solution, and evaporate until a pellicle begins to form; then set it aside to crystallize. Pour off the mother-water, and dry the crystals on bibulous paper. Lastly, evaporate the mother-water, that it may furnish more crystals." *U. S.* 1870.

POTASSII FERROCYANIDUM. U. S.

POTASSIUM FERROCYANIDE

(pŏ-tăs'sĭ-ī fĕr-rŏ-cȳ-ăn'ĭ-dŭm)

$K_4Fe(CN)_6 + 3H_2O = 419.62$

"It should contain not less than 99 percent. of pure Potassium Ferrocyanide, and should be kept in well-stoppered bottles." *U. S.*

Potassæ Prussias Flava; Ferrocyanide of Potassium; Yellow Prussiate of Potash; Cyanuretum Ferroso-potassicum; Ferrocyanuret of Potassium, Ferroprussiate of Potassa, Prussiate of Potassa; Ferrocyanure de Potassium, *Fr. Cod.*; Protocyanure jaune de Fer et de Potassium, Prussiate jaune de Potasse, *Fr.*; Kalium Ferrocyanatum, Kalium Borussicum, Cyaneisenkalium, Ferrocyankalium, Gelbes Blutlaugensalz, *G.*

The yellow double potassium and iron cyanide is the salt from which potassium cyanide is obtained by calcination at a low red heat.

Potassium ferrocyanide is prepared on the large scale by heating animal matters, such as dried blood, hoofs, chips of horn, woollen rags, old leather, the refuse of tallow chandlers called *greaves,* and other substances rich in nitrogen, with the pearlash of commerce and scrap iron, in an egg-shaped iron pot called a shell, ladling out the pasty mass called the *melt,* and, after it has cooled sufficiently, dissolving it in water, and evaporating the solution so that crystals may form. The melt, while still hot, contains potassium cyanide only, the ferrocyanide being produced solely by the action of the water. The best temperature for making the solution is between 70° C. and 80° C. (158° F. and 176° F.); and the conversion of the cyanide into the ferrocyanide is facilitated by the presence of finely divided amorphous ferrous sulphide, and of potassium hydroxide. The reactions involved in the formation of the ferrocyanide are supposed to be

$$K_2CO_3 + 4C + 2N = 2KCN + 3CO$$
$$6KCN + FeS = K_2S + K_4Fe(CN)_6$$

It has been sought to increase the yield of the ferrocyanide by avoiding the use of sulphur-containing materials and taking a relatively pure potash and fusing this first with the nitrogen-containing materials, and, after extracting with water from this fusion, to digest the liquors so obtained with ferrous hydroxide or carbonate, the reaction being

$$6KCN + FeCO_3 = K_4Fe(CN)_6 + K_2CO_3$$

Some years ago this salt was manufactured by a process which dispensed with the use of animal matter, the necessary nitrogen being obtained by a current of atmospheric air. Fragments of charcoal, impregnated with 30 per cent. of potassium carbonate, were heated to a white heat in a cylinder through which a current of air was drawn by a suction-pump. This process is understood to have succeeded in a chemical sense, but failed on the score of economy, chiefly from the circumstance that the necessary fire-clay tubes could not be made to resist the combined action of the alkali and heat. In recent years since the introduction of ferric hydroxide mass for purifying coal gas it has been found possible to extract the cyanides from the crude gas and produce from the purifying mass both yellow prussiate of potash and Prussian blue.

Properties.—Potassium ferrocyanide is in "large, soft, transparent, yellow, four-sided, monoclinic, tabular crystals or prisms; odorless, and having a mild, saline taste. Slightly efflorescent on exposure to the air. Soluble in about 4 parts of water at 25° C. (77° F.), and in 2 parts of boiling water; insoluble in alcohol. When heated to 60° C. (140° F.), the salt begins to turn white from loss of water of crystallization, and when heated at 100° C. (212° F.), it is rendered anhydrous. The aqueous solution is neutral to litmus paper. With sodium bitartrate T.S. the concentrated aqueous solution yields a white crystalline precipitate. The color of the precipitate produced by the addition of ferric chloride T.S. to the diluted aqueous solution of the salt is dark blue; that produced by copper sulphate T.S. is reddish-brown; lead acetate T.S. or silver nitrate T.S. causes a white precipitate. No effervescence should be caused by the addition of diluted sulphuric acid to a concentrated solution of the salt (absence of *carbonate*). The precipitate produced by silver nitrate T.S. in the aqueous solution, acidulated with nitric acid, should be of a white color, without a tinge of red (absence of *ferricyanide*)." *U. S.* It acts but slightly, if at all, on turmeric paper. The alkaline reaction, when it exists, is probably owing to the presence of a little potassium hydroxide. When ignited, the insoluble residue amounts to 18.7 per cent. of ferric oxide, resulting from the oxidation of the iron of the salt. It is characterized by striking a deep-blue color with ferric salts,[1] a deep-brown

[1] *Ferri Ferrocyanidum,* U. S. 1870. *Ferri Ferrocyanuretum,* U. S. 1850; *Ferrocyanide of Iron, Ferrocyanuret of Iron, Pure Prussian Blue.*—"Take of Ferrocyanide of Potassium *nine troyounces;* Solution of Tersulphate of Iron *a pint;* Water *three pints.* Dissolve the Ferrocyanide of Potassium in two pints of the Water, and add the solution gradually to the Solution of Tersulphate of Iron, previously diluted with the remainder of the Water, stirring the mixture during the addition. Then filter the liquid, and wash the precipitate on the filter with boiling water until the washings pass nearly tasteless. Lastly, dry it, and rub it into a powder." *U. S.* 1870.

In the above process the salt is decomposed by the gradual addition of the solution of potassium ferrocyanide. Three molecules of ferrocyanide and two of ferric sulphate are mutually decomposed, with the result of forming one molecule of Prussian blue, or the 3–4 ferric ferrocyanide, which precipitates, and six molecules of potassium sulphate, which remain in solution, the reaction being:

$$3FeK_4(CN)_6 + 2Fe_2(SO_4)_3 = Fe_3Fe_4(CN)_{18} + 6K_2SO_4$$

Preparation for Use in the Arts.—Prussian blue is manufactured on the large scale as follows: A mixture made of equal parts of potassium carbonate (pearlash of commerce) and of animal matter, such as dried blood, hair, the shavings of horn, etc., is calcined at a red heat, in an iron vessel, until it becomes pasty. The mass, when cold, is thrown, by portions at a time, into twelve or fifteen times its weight of water, with which it is stirred for half an hour. The whole is then put upon a linen filter, and the clear solution obtained is precipitated by a mixed solution of two parts of alum and one of ferrous sulphate. An effervescence occurs, due principally to carbon dioxide, and a very abundant precipi-

one with the salts of copper, a white one with those of zinc, the several precipitates formed being ferrocyanides of the respective metals. Heated with eight or ten times its weight of concentrated sulphuric acid, it evolves carbon dioxide. Half an ounce of the salt yields about 250 cubic inches of the gas. (C. Grimm and G. Ramdohr.) When boiled with diluted sulphuric acid, it emits the easily recognized odor of hydrocyanic acid.

Potassium ferrocyanide consists of six groups of the monad radical cyanogen (CN), saturated by four potassium atoms and one atom of the dyad iron. The potassium is more readily displaced than the iron, so that it is considered as the potassium salt of an acid called *hydroferrocyanic*. This acid in the free state would be $H_4Fe(CN)_6$. The salt is remarkably pure as it occurs in commerce.

Uses.—Pure potassium ferrocyanide is physiologically very inactive. Thus, Combemale and Dubiquet proved that in doses of twelve grains to the pound of bodily weight it is not poisonous to the lower animals, while Callies, as quoted by Pereira, found the commercial salt slightly poisonous, but the pure salt unproductive of harm in the dose of several ounces. It should be borne in mind that it is the commercial salt which is used medicinally. Westrumb and Hering proved that it passed with rapidity into the blood and urine.

This salt is manufactured on a large scale, chiefly for the use of dyers and calico printers. In pharmacy it is employed to prepare diluted hydrocyanic acid, Prussian blue, and potassium and silver cyanides.

Dose, five to ten grains (0.32 to 0.65 Gm.).

tate is thrown down of a blackish-brown color. This precipitate is washed, by decantation, by means of a large quantity of water, which is removed every twelve hours. By these washings, which last from twenty to twenty-five days, the precipitate becomes successively greenish brown, bluish, and finally deep blue. When of the latter color, it is collected and allowed to drain upon a cloth, after which it is divided into cubical masses and dried.

A preparation under the name of *Soluble Prussian Blue* has been introduced into use for injecting anatomical preparations by Schroeder van der Kolk, and is said to be much esteemed for this purpose. To obtain it there must be a great excess of the potassium ferrocyanide in concentrated solution. The iron should be in a state of sesquichloride, in the proportion of not more than one-eighth or one-tenth of the ferrocyanide employed. After their mixture, the precipitate is washed with water till it begins to become blue, when it is expressed and dried in the air. On the small scale it may be economically obtained in the following manner. Take solutions of the ferrocyanide containing 217 grammes to the liter of water, and of the sesquichloride containing one part of the solid salt in 10 parts of water. Then, taking equal volumes of the two solutions, add to each one twice its volume of a cold concentrated solution of sodium sulphate, and mix the solutions. Pour on a filter, and treat as directed above. The product dried in the air is perfectly soluble, and admirably adapted for injection. (*J. P. C.*, 4e sér., iv. 238.) For other formulæ for soluble Prussian blue, see *Ibid.*, 4e sér., xix. 227.

Properties.—Pure Prussian blue is a tasteless powder, insoluble in water and alcohol, and having a rich deep blue color. It is insoluble in dilute acids, decomposed by fuming nitric acid, and dissolved without decomposition by strong sulphuric acid, forming a white mass of the consistence of paste, from which the Prussian blue may be precipitated unchanged by water. Concentrated hydrochloric acid decomposes it, dissolving ferric oxide, and liberating hydroferrocyanic acid. When boiled with mercuric oxide, it generates mercuric cyanide. (See *Hydrargyri Cyanidum.*) By the contact of a red-hot body it takes fire and burns slowly, leaving a residue of ferric oxide. When it is heated in close vessels, water, hydrocyanic acid, and ammonium carbonate are evolved, and iron carbide is left. Its composition has been given above. The Prussian blue of commerce was discovered by accident, in 1710, by Diesbach, a preparer of colors at Berlin. It has the same general properties as the pure substance. It occurs in small rectangular masses, which are heavier than water and have a fracture presenting a bronzed appearance. Besides the constituents of pure Prussian blue, it always contains uncombined ferric oxide, and a portion of alumina, derived from the alum employed in its manufacture, which serves to give it body as a pigment. These substances may be detected by boiling the pigment with diluted hydrochloric acid and precipitating the filtered solution with ammonia. Pure Prussian blue treated in this manner yields no precipitate.

Uses.—Prussian blue has been deemed tonic, febrifuge, and alterative, but is at present very rarely used, and is probably of no medicinal value. It is sometimes employed as an application to ill-conditioned *ulcers*, mixed with simple ointment in the proportion of a drachm to the ounce. The *dose* is from three to five grains (0.20 to 0.32 Gm.), repeated several times a day, and gradually increased until some effect is produced.

POTASSII HYDROXIDUM. U. S. (Br.)

POTASSIUM HYDROXIDE [Potassium Hydrate, Caustic Potash, Potassa, Pharm. 1890]

(pŏ-tăs'sĭ-ī hȳ-drŏx'ĭ-dŭm)

$KOH = 55.74$

"It should contain not less than 85 percent. of pure anhydrous Potassium Hydroxide, and not more than 2 percent. of other inorganic substances, with the exception of water. It should be kept in well-stoppered bottles made of hard glass." *U. S.* "Potassium hydroxide, KOH, with not more than 10 per cent. of combined water and impurities, prepared by the interaction of potassium carbonate and calcium hydroxide." *Br.*

Potassa Caustica, *Br.;* Kali Purum; Caustic Potassa, Hydrate of Potassa, Potassæ (Potassii) Hydras, Kali Hydricum Fusum, Lapis Causticus Chirurgorum; Potasse caustique, *Fr. Cod.;* Potasse Fondue, Pierre à cautère, *Fr.;* Kali Causticum Fusum, *P. G.;* Kaliumhydroxyd, Kalium-Hydrat, Kaustisches Kali, Ætzkali, *G.;* Potassa caustica, *It.;* Hidrato potasico, *Sp.*

"Take of Solution of Potash *two pints* [Imperial measure]. Boil down the Solution of Potash rapidly in a [clean] silver vessel, until there remains a [clear] fluid of oily consistence, a drop of which when removed on a warm glass rod solidifies on cooling. Pour this into proper moulds, and when it has solidified, and while it is still warm, put it into stoppered bottles." *Br.* 1885. A process for potassium hydroxide is no longer in the U. S. Pharmacopœia; that of 1870 is identical with the British (1885).

The solid alkali obtained from these processes is potassium hydroxide, sufficiently pure for medicinal purposes. The solution of the alkali freed from carbonic acid having been obtained by another formula (see *Liquor Potassii Hydroxidi*), the formation of the present preparation requires merely the evaporation of this solution until nearly the whole of

its uncombined water is driven off. The evaporation must be performed in metallic vessels, as those of glass or earthenware are acted on by the alkali, and it should be completed as quickly as possible, in order to abridge the period during which the solution would be liable to absorb carbon dioxide from the atmosphere. When poured out on a metallic plate or dish, the cake, just as it solidifies, may be marked with a knife in the direction in which it is to be divided, and when cold it readily breaks in those directions. A better plan, however, is to run the fused alkali into suitable moulds, as directed in the former U. S. and British formulas. These should be made of silver or iron and have a cylindrical shape, which is the most convenient form of the alkali for surgical use. Green glass bottles with rubber stoppers are best adapted for preserving this preparation, as white flint glass is attacked by the alkali. Potassium hydroxide is now prepared at Niagara Falls, N. Y., by the electrolysis of strong potassium chloride solution. The metal at the cathode acts with water to form potassium hydroxide and free hydrogen, while chlorine is liberated at the anode.

Properties.—It is officially described as in "dry, white flakes, fused masses, or in pencils, hard and brittle, showing a crystalline fracture; odorless, or having a faint odor of lye, and of a very acrid and caustic taste. *Great caution is necessary in tasting and handling it,* as it rapidly destroys organic tissues. Exposed to the air, it readily absorbs carbon dioxide and moisture, and deliquesces. Soluble in about 0.4 part of water at 25° C. (77° F.), and in 2 parts of alcohol; very soluble in boiling water, and in boiling alcohol; slightly soluble in ether. When heated to about 530° C. (986° F.), Potassium Hydroxide melts to a clear, oily liquid, and at a bright red heat is volatilized unchanged. When introduced into a non-luminous flame, it imparts to it a violet color. A solution of Potassium Hydroxide, even when greatly diluted, gives an intensely alkaline reaction with red litmus paper. The aqueous solution (1 in 20) should be perfectly clear and colorless. A concentrated solution of Potassium Hydroxide, after acidulation with hydrochloric acid, yields a bright yellow precipitate with platinic chloride T.S. A concentrated, aqueous solution (1 in 10), when added to an excess of tartaric acid T.S., produces a white, crystalline precipitate, which redissolves when the Potassium Hydroxide is added in excess. An aqueous solution of Potassium Hydroxide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). On adding an excess of diluted sulphuric acid to 10 Cc. of an aqueous solution of Potassium Hydroxide (1 in 10), no distinct effervescence should occur (limit of *carbonate*). Introduce about 1 Gm. of Potassium Hydroxide into a stoppered weighing-bottle and weigh accurately. Dissolve this in about 50 Cc. of water and titrate the solution with normal sulphuric acid V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal sulphuric acid V.S. consumed, by 5.574, and divide this product by the weight of the Potassium Hydroxide taken; the quotient, which must be not less than 85, represents the percentage of Potassium Hydroxide present." *U. S.* "White pencils or cakes, very deliquescent, powerfully alkaline and corrosive. Soluble in half its weight of *water* and twice its weight of *alcohol* (90 per cent.). It affords the reactions characteristic of potassium. Each gramme dissolved in *water* or in *alcohol* (90 per cent.) should leave only a trace of sediment, and should require for neutralization at least 16.1 cubic centimetres of the *volumetric solution of sulphuric acid.* It should yield no characteristic reaction with the tests for lead, copper, or arsenium." *Br.* It is important that the requirements of the Pharmacopœia be complied with, and that it should contain 85 per cent. of pure potassium hydroxide and not more than 2 per cent. of other inorganic substances, with the exception of water.

The *white stick caustic potassa* as found in commerce usually contains from 15 to 28 per cent. of water, which seems to be a necessary impurity, for if a certain quantity of water is not present it is impossible to mould the stick. By heating this so as to drive off the water a purified hydroxide in cakes may be obtained. On account of its deliquescent property, and its strong attraction for carbon dioxide, potassium hydroxide requires to be kept in very accurately stoppered bottles. As formerly obtained, from solution of potassium hydroxide derived from an impure carbonate, it contained various impurities, which, however, did not interfere with its medicinal value,—such as potassium chloride and tetroxide, ferric oxide, lime, silica, alumina, potassium sulphate, and a portion of the alkali still in a carbonated state. Official potassium hydroxide may be rendered nearly pure by digestion in alcohol, which takes up only the alkaline hydroxide, evaporating the solution to dryness, and fusing the dry mass obtained. *Potassium hydroxide,* when thus procured, is called *potash by alcohol.* It is generally in flat white pieces, which are dry, hard, brittle, and extremely caustic. Its other properties are similar to those of the impure hydroxide above described. According to H. Wurtz of New York, commercial potash by alcohol usually contains a trace of potassium silicate, which appears to be taken up by the alcohol. The source of this is the potassium carbonate employed, which may be freed from this impurity by evaporating its aqueous solution, in a sheet iron dish, to dryness, and adding, from time to time, lumps of ammonium carbonate. The silicate is thus converted into the carbonate, and on dissolving the residue the silica appears in flakes, which may be separated by filtration. Potassium hydroxide may be distinguished

from the other fixed alkalies (soda and lithia) by its affording, when in solution, a crystalline precipitate (cream of tartar) with an excess of tartaric acid, and a yellow one with platinic chloride. Potassium hydroxide imparts to the flame of burning alcohol in which it is dissolved a reddish tint; sodium hydroxide colors it yellow even in the presence of potassium hydroxide; and thus a method is afforded of detecting an admixture of the latter with the former alkali. According to Bunsen, when the flame is viewed through a glass having a cobalt-blue color, only the color imparted by potassium is seen, the yellow color of the sodium flame being absorbed by the blue glass. (*J. P. C.*, Oct. 1860, p. 319.) Potassium hydroxide, KOH, is composed of one atom of potassium, united with one hydroxyl group, OH.

Uses.—This is the old *causticum commune acerrimum*, or *strongest common caustic;* see also *Potassa cum Calce.*[1] It is a powerful escharotic, quickly destroying the life of the part with which it comes in contact, and extending its action to a considerable depth beneath the surface. In this latter respect it differs from silver nitrate, or lunar caustic, to which it is, therefore, preferred in forming issues and opening abscesses. The most convenient mode of employing the caustic for the formation of an issue is to apply to the skin a piece of linen spread with adhesive plaster, having a circular opening in its centre corresponding with the intended size of the issue, and then to rub upon the skin, within the opening, a piece of the caustic previously moistened at one end.[2] The application is to be continued until the life of the part is destroyed, when the caustic should be carefully washed off with a wet sponge or wet tow, or neutralized by vinegar. In forming from it solutions of potassium hydroxide of definite strength, whether for medicinal or for pharmaceutical use, an allowance should be made for the percentage of water it always contains. (See *Liquor Potassii Hydroxidi.*)

Off. Prep.—Liquor Cresolis Compositus, *U. S.;* Liquor Potassii Hydroxidi, *U. S.* (*Br.*); Sapo Mollis, *U. S.*

POTASSII HYPOPHOSPHIS. U. S.

POTASSIUM HYPOPHOSPHITE

(pŏ-tăs'sĭ-ī hī-pŏ-phŏs'phĭs)

$KH_2PO_2 = 103.39$

"It should contain not less than 98 percent. of pure Potassium Hypophosphite [PO.H$_2$O K], and should be kept in well-stoppered bottles. Caution should be observed in dispensing Potassium Hypophosphite, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents." *U. S.*

Kali Hypophosphorosum, Hypophosphis Potassicus, s. Kalicus; Hypophosphite de Potasse, *Fr.;* Unterphosphorigsaures Kali, *G.*

This salt is prepared by mixing solutions of calcium hypophosphite and granulated potassium carbonate, in the proportion of 6 ounces of the former dissolved in four pints of water to 5.75 ounces of the latter in half a pint. As a result of double decomposition between the two salts, calcium carbonate and potassium hypophosphite are formed, the former being precipitated, and the latter held in solution. The calcium carbonate is removed by filtration, and the clear solution is evaporated until a pellicle forms, after which it is constantly stirred, with continuance of the heat, until the salt granulates. The heat employed in the evaporation should be kept considerably below 100° C. (212° F.), for fear of explosion. If the salt

[1] *Potassa Cum Calce.* U. S. 1890. *Potassa with Lime.*

Pulvis Causticus cum Calce, Pulvis Causticus Viennensis; Vienna Caustic, Vienna Paste; Caustique (Poudre) de Vienne, *Fr.;* Wiener Aetzpulver, *G.*

"Potassa, *five hundred grammes* [or 17 ounces av., 279 grains]; Lime, *five hundred grammes* [or 17 ounces av., 279 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Rub them together, in a warm iron mortar, so as to form a powder, and keep it in a well-stoppered bottle." *U. S.* 1890. This preparation is "a grayish-white powder, deliquescent, having a strongly alkaline reaction, and responding to the tests for calcium and potassium. It should be soluble in diluted hydrochloric acid without leaving more than a small residue." *U. S.* 1890. It should not effervesce on the addition of an acid. It is prepared for use by being made up into a paste with a little alcohol. The paste is applied for ten or fifteen minutes to the part to be cauterized, and is conveniently limited in its operation by a piece of adhesive plaster, in the manner explained under *Potassii Hydroxidum.* The former Edinburgh preparation, made by evaporating the solution of potassa to one-third, and adding lime enough to bring it to the state of a firm paste, was often called *causticum commune mitius*, or *milder common caustic.* Potassa with lime is a more manageable caustic than the official potassium hydroxide, on account of the presence of the lime, which renders it milder, slower in its operation, and less deliquescent, and causes it to spread less beyond the part intended to be affected. Filhos has improved this caustic by forming it into sticks. To prepare it thus, the potassium hydroxide is perfectly fused in an iron spoon, and one-third of its weight of quicklime is added in divided portions, the whole being stirred with an iron rod. The fused mass is then run into lead tubes, closed at one end, about three inches long, and from a quarter to half an inch in diameter in the clear. The sticks are kept, still enclosed in the lead tubes with the open end downward, in thick glass tubes, containing some powdered quicklime, and closed with a cork, between which and the stick some cotton is put to steady the caustic. When employed, as much of the caustic is uncovered at the end, by scraping off the lead, as it is proposed to use. This form of caustic is particularly recommended for cauterizing the neck of the uterus. M. E. Robiquet modified the caustic, by fusing the potassium hydroxide and lime at a higher heat, running the fused mass into iron moulds, and quickly coating the sticks, when cold, with melted gutta-percha. The higher heat employed renders the caustic harder and more homogeneous.

[2] At the suggestion of Maunoury of Chartres, M. E. Robiquet has prepared a paste consisting of gutta-percha and potassium hydroxide, which offers many advantages of manipulation, in the application of the latter substance. It is prepared by simply melting together equal weights of the two substances. The resulting paste can be moulded into any form that may be thought desirable, either of cylinders, plates, or lozenges, and retains its form indefinitely, even when introduced into cavities. All that is necessary, before applying it, is to dip it into alcohol for a few seconds. The resulting eschars are very precise in their form. (*J. P. C.*, xxx. 275.)

be required pure, it should be dissolved in the granulated state, in official alcohol, and the solution evaporated to a syrupy consistence and then set aside to crystallize. The calcium hypophosphite may be prepared by a formula given under the head of *Calcii Hypophosphis.*

Properties.—Potassium hypophosphite, according to the U. S. Pharmacopœia, is in "white, opaque, hexagonal plates, or crystalline masses, or a granular powder; odorless, and having a pungent, saline taste; very deliquescent. Soluble in about 0.5 part of water, and in 7 parts of alcohol at 25° C. (77° F.); in 0.3 part of boiling water, and in 3.6 parts of boiling alcohol; insoluble in ether. When heated in a dry test-tube, the salt at first loses moisture, and then evolves spontaneously inflammable hydrogen phosphide gas, which burns with a bright yellow flame. The aqueous solution (1 in 20) is neutral or slightly alkaline to litmus paper, and yields, with sodium bitartrate T.S., a white, crystalline precipitate. The diluted aqueous solution, slightly acidulated with diluted sulphuric acid, yields, with silver nitrate T.S., a white precipitate, which rapidly turns brown or black, owing to the separation of metallic silver. On gently heating an aqueous solution of Potassium Hypophosphite with copper sulphate T.S., a reddish-brown precipitate is formed. When the aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is at first formed. On further addition of an excess of the Potassium Hypophosphite solution, the precipitate becomes gray from reduction to metallic mercury. An aqueous solution of the salt (1 in 20) should not effervesce upon the addition of an acid (absence of *carbonate*). An aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 5 Cc. of an aqueous solution of Potassium Hypophosphite (1 in 10) be measured into a beaker containing 3 Cc. of nitric acid diluted with about 10 Cc. of water, and the mixture be evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.*

Uses.—This salt, and several other *hypophosphites,* as those of calcium, sodium, ammonium, etc., were brought into notice a few years since, in consequence of their supposed efficiency in the introduction of phosphorus into the system in cases in which this element might be thought to be deficient. Upon this principle they were recommended by Churchill of Paris, in the treatment of *phthisis,* and came into extensive employment, but experience has hardly confirmed the first favorable impression of their usefulness in this complaint. There seem, however, to be good grounds for their application to diseases attended with deficiency of nerve power from debility of the brain, and in certain *scrofulous affections* of children, especially those connected with a disordered condition of the bones.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Acidum Hydriodicum Dilutum, *U. S.;* Emulsum Olei Morrhuæ cum Hypophosphitibus, *U. S.;* Syrupus Hypophosphitum, *U. S.;* Syrupus Hypophosphitum Compositus, *U. S.*

POTASSII IODIDUM. U. S., Br.

POTASSIUM IODIDE

(pŏ-tăs'sĭ-ī ī-ŏd'ĭ-dŭm)

KI = 164.76

"It should contain not less than 99 percent. of pure Potassium Iodide, and should be kept in well-stoppered bottles." *U. S.* "Potassium Iodide, KI, may be prepared in the same manner as Potassium Bromide, iodine being used in place of bromine." *Br.*

Iodide of Potassium; Potassii Hydriodas; Kali Hydriodicum, Ioduretum Potassicum, s. Kalicum; Iodure de Potassium, *Fr. Cod.;* Kalium Jodatum, *P. G.;* Kaliumjodid, Jodkalium, *G.;* Joduro di potassio, *It.;* Yoduro potasico, *Sp.*

No process is given in the U. S. or Br. Pharmacopœias. That of the U. S. P. 1870 did not differ essentially from the British 1885.[1]

An aqueous solution of potassium hydroxide is treated with iodine in slight excess. The result of thus saturating potassium hydroxide with iodine is the formation of two salts, potassium iodide and iodate. Six atoms of iodine react with six molecules of potassium hydroxide, and there are formed five molecules of potassium iodide and one of potassium iodate,

$$6KOH + 3I_2 = 5KI + KIO_3 + 3H_2O$$

By evaporating the solution to dryness the mixed salts are obtained, and, if the dry mass be exposed to a red heat, the iodate will be converted into iodide, thus removing this impurity from the iodide. In the formula the mixed salts, towards the close of their evaporation to dryness, are directed to be mixed with powdered charcoal, according to the plan of

[1] "Take of Solution of Potash *one gallon* [Imperial measure]; Iodine *twenty-one ounces* [avoirdupois], or *a sufficiency;* Wood Charcoal, in fine powder, *three ounces* [av.]; Boiling Distilled Water *a sufficiency.* Put the Solution of Potash into a glass or porcelain vessel, and add the Iodine in small quantities at a time, with constant agitation, until the solution acquires a permanent brown tint. Evaporate the whole to dryness in a porcelain dish, pulverize the residue, and mix this intimately with the Charcoal. Throw the mixture, in small quantities at a time, into a red-hot iron crucible, and, when the whole has been brought to a state of fusion, remove the crucible from the fire and pour out its contents. When the fused mass has cooled, dissolve it in two pints [Imp. meas.] of boiling distilled water, filter through paper, wash the filter with a little boiling distilled water, unite the liquids, and evaporate the whole till a film forms on the surface. Set it aside to cool and crystallize. Drain the crystals, and dry them quickly in a warm place. More crystals may be obtained by evaporating the mother-liquor and cooling. The salt should be kept in a stoppered bottle." *Br.* 1885.

Scanlon, which facilitates the deoxidation of the iodate. This being accomplished by a dull red heat, the potassium iodide is dissolved out of the mass; and the solution is set aside to crystallize.

In the old Edinburgh and Dublin processes the first step was to form ferrous iodide in solution, precisely as is done in the formula for that compound, and the second to decompose it by potassium carbonate, which gave rise to potassium iodide in solution, and a precipitate of ferrous carbonate. The solution of potassium iodide was separated by filtration and washing from the precipitated carbonate, and evaporated to dryness. The dry salt was then freed from iron and other impurities by solution in boiling water or alcohol, filtration, and crystallization. An improvement on this process is to add enough iodine to the ferrous iodide solution first formed to produce ferrous-ferric iodide, $Fe_3I_8(2FeI_3 + FeI_2)$. This solution is now treated with an equivalent quantity of potassium carbonate and boiled when ferrous-ferric oxide precipitates, carbon dioxide escapes, and all the iodine goes into solution as iodide, the reaction being:

$$Fe_3I_8 + 4K_2CO_3 = Fe_3O_4 + 8KI + 4CO_2$$

According to the method of E. Sonstadt, potassium iodide is prepared directly from the mother liquors of kelp by converting the alkaline iodides into iodates by means of chlorine or potassium permanganate, precipitating the iodic acid by a soluble barium salt, heating the precipitate with solution of potassium sulphate, evaporating the resulting potassium iodate solution to dryness, and crystallizing from its solution the potassium iodide thus obtained. (*Chem. News*, xxvi. 182.) Or, these mother liquors are evaporated to dryness, the mass gently roasted to oxidize sulphides, and then extracted with water, evaporated again to dryness and extracted with alcohol, whereby sodium and potassium iodide go into solution. This is treated with potassium carbonate to change the sodium iodide into potassium iodide, and a stream of CO_2 led through to precipitate the sodium bicarbonate. The remaining solution contains potassium iodide with a little sodium bicarbonate. (Flückiger, *Pharm. Chem.*, 2d ed., 1888, p. 341.) Large quantities are now manufactured from the cuprous iodide coming from the South American sodium nitrate works. The cuprous iodide is suspended in water acidified with hydrochloric acid, and a stream of hydrogen sulphide gas led in, whereby hydrogen iodide enters into solution. This solution is filtered, neutralized with potassium carbonate, and evaporated to crystallization.

Properties.—Potassium iodide, sometimes incorrectly called *hydriodate of potassa*, is in "colorless, transparent, translucent, or opaque white, cubical crystals, or a white, granular powder, having a peculiar, faint, iodine-like odor, and a pungent, saline, afterwards bitter taste. Permanent in dry air, and but slightly deliquescent in moist air. Soluble in 0.7 part of water, and in about 12 parts of alcohol at 25° C. (77° F.); in 0.5 part of boiling water, in 6 parts of boiling alcohol; also soluble in 2.5 parts of glycerin. When heated, the salt decrepitates. At a low red heat it fuses, and at a bright red heat it is volatilized without decomposition. Its aqueous solution is neutral, or has a slightly alkaline reaction upon litmus paper. If 1 Gm. of the salt be dissolved in 10 Cc. of water, and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no color should be produced by the subsequent addition of a drop of phenolphthalein T.S., even after heating (limit of *alkali*). An aqueous solution of Potassium Iodide (1 in 20) yields a white, crystalline precipitate with sodium bitartrate T.S. If to 5 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated, and impart to the solution a light reddish-brown color. On agitating the mixture with a few drops of chloroform, the latter will acquire a violet color." *U. S.* According to T. & H. Smith of Edinburgh, it is not at all deliquescent when perfectly pure. It generally crystallizes in cubes. If solution of potassium iodide be mixed with solution of starch, and a minute quantity of solution of chlorine be added, a blue color will be produced, the chlorine combining with the potassium liberating the iodine, which forms a blue compound with starch.

Its solution is quickly decomposed by the addition of a few drops of sulphuric acid, hydriodic acid being generated, which speedily undergoes decomposition, with evolution of iodine, and, if starch be added after the lapse of a few minutes, a blue color will be produced. The starch test will not give the characteristic blue color immediately, if added simultaneously with the acid, unless the potassium iodide contains potassium iodate, which impurity causes an immediate liberation of iodine. The blue color being produced by the starch and acid, if simultaneously added, is, therefore, a sign of impurity. A very delicate test for potassium iodide and other soluble iodides is that of Grange. It consists in pouring a little of the liquid to be examined into a test tube, adding a few drops of solution of starch, and passing through the mixture a few bubbles of fuming nitrous acid. The liquid immediately assumes a pale rose color, inclining to violet, if containing 1-200,000th of its weight of the iodide, and a bright blue color if 1-100,000th is present. (See page 665.) When tartaric acid is freely added to a strong solution of the iodide, it occasions a white crystalline precipitate, and the supernatant liquid, if mixed with starch, becomes first purple, and finally blue. Platinic chloride colors its solution reddish-brown, without causing a precipitate; barium chloride but slightly affects it, and ferrous sulphate occasions no change. The non-action of the last test shows the absence of potassium carbonate.

The aqueous solution is capable of taking up a large quantity of iodine, forming a liquid of a deep brown color.

Payen has noticed a curious effect produced by potassium iodide. In saturated solution, this salt causes in starch added to it an enlargement of its granules to twenty-five or thirty times their original volume, dissolving the interior substance of the granules, and enormously distending the exterior layer. Potassium bromide produces the same effect, but the alkaline chlorides cause neither the enlargement referred to, nor a solution of the amylaceous substance, and if the saturated solution of the iodide be diluted with three and a half volumes of water or more, it is inert in reference to starch in the cold. (*J. P. C.*, 4e sér., ii. 373.) Ferières found that ether added to a solution of potassium iodide decomposes it, but it has been shown by the researches of de Vrij and of Magnes-Lahens that this does not happen with pure ether, but is due to the acetic acid which is developed by sunlight in ether. (*J. P. C.*, 4e sér., xvi. 107, 468; xvii. 116.)

Tests.—Exposed to a dull red heat, potassium iodide fuses, and on cooling concretes into a crystalline pearly mass, without loss of weight; but at a full red heat it is slowly volatilized without decomposition. The most usual impurities contained in this salt are potassium and sodium chlorides, potassium bromide, and potassium carbonate and iodate. Potassium iodide, to conform to the U. S. P. (8th Rev.), must contain 99 per cent. of the pure salt. The official tests are as follows: "No residue should be left when 1 Gm. of the salt is dissolved in 2 Cc. of diluted alcohol of specific gravity 0.928 (absence of *less soluble salts*). If to 0.5 Gm. of the salt, dissolved in 10 Cc. of distilled water, which has previously been boiled and cooled in a small flask, 2 drops of diluted sulphuric acid (free from sulphurous and nitrous acids) be added, no distinct yellow color should appear within half a minute (limit of *iodate*). An aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 1 Gm. of Potassium Iodide contained in a test-tube of about 40 Cc. capacity, 5 Cc. of water, 5 Cc. of potassium hydroxide T.S., and about 0.2 Gm. of aluminum wire be added, and if, in the upper portion of the test-tube, a pledget of purified cotton be inserted, and over the mouth there be placed a piece of moistened red litmus paper, then, if the tube be heated upon a water-bath for fifteen minutes, no blue coloration of the paper should be discernible (limit of *nitrates* and *nitrites*). Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). If 5 Cc. of the aqueous solution be gently heated with one drop of ferrous sulphate T.S. and 0.5 Cc. of potassium hydroxide T.S., no blue color should appear after acidulating the mixture with hydrochloric acid (absence of *cyanide*). If 0.2 Gm. of Potassium Iodide be dissolved in 2 Cc. of ammonia water (10 percent.), and 13 Cc. of tenth-normal silver nitrate V.S. be added, then, after thoroughly agitating and filtering, the filtrate, upon acidifying with nitric acid, should not become more than slightly turbid nor should any darkening appear within ten minutes (limit of *chlorides* and *bromides* and absence of *thiosulphate*). If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of distilled water, and about 3 drops of potassium chromate T.S. be added, it should require not more than 30.8 Cc. nor less than 30 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color (corresponding to at least 99 percent. of pure Potassium Iodide)." *U. S.* "Each gramme should require for complete precipitation not less than 59.5 and not more than 61.9 cubic centimetres of the *volumetric solution of silver nitrate*." *Br.*

The low price of potassium bromide, compared with that of the iodide, has caused the former to be used for the adulteration of the latter. When potassium bromide is sold for the iodide, the fraud may be detected by the fact that the addition of sulphuric acid produces copious reddish fumes, instead of the purple ones arising from the iodide. A very delicate test for bromide in iodide is based upon the different actions of iodide and bromide with lead dioxide. This reagent will liberate iodine from iodide on boiling, but will not decompose any bromide by boiling. Therefore, after the suspected sample has been boiled with the lead dioxide until all the iodine is driven off, and then filtered, the filtrate may be treated with fresh dioxide and a little acetic acid, when any bromine present is decomposed, and the free bromine will color carbon disulphide or answer other tests. (Flückiger, *Pharm. Chem.*, 2d ed., 1888, p. 350.) Lepage determined the amount of the bromide as follows. Dissolve one gramme of corrosive sublimate in twenty cubic centimeters of water; also one gramme of the suspected iodide in thirty grammes of pure water. Add by means of a burette the former fluid to the latter until it just ceases to cause a turbidity. If the iodide is pure, at least 16 Cc. of the mercurial solution are required; if impure, the remaining solution will exceed the volume of 4 Cc. in proportion as the potassium iodide has been replaced by bromide. For this test it is necessary that the iodide be free from chloride, carbonate, and iodate. (*A. J. P.*, xliv. 167.) In order to detect bromine, Personne first precipitated from an aqueous solution of the suspected iodide the whole of the iodine as cuprous iodide, by successively adding, in excess, a solution of copper sulphate and aqueous sulphurous acid, and then treats the filtered liquid with ether and chlorine water, the whole being shaken together and left at rest. If bromine be present, the ether which rises to the surface

will be tinged of a reddish-yellow color. Fresenius's test of gold chloride is, according to J. H. Bill, of the U. S. Army, very delicate. The iodine having been separated by palladium, and the excess of palladium by hydrogen sulphide, the solution supposed to contain bromine, if treated first with a drop of hydrochloric acid, and then with a drop of solution of gold chloride, will, if bromine be present, exhibit a decided yellowness, which will appear more obviously if the solution be compared with pure water or a weak solution of a chloride. (See *A. J. P.*, 1868, 272.) Potassium carbonate may be discovered by lime water, which causes a milkiness (calcium carbonate), and by tincture of iodine, the color of which is destroyed. The iodate may be detected by adding a solution of tartaric acid to a solution of the suspected iodide. Potassium bitartrate will be precipitated, and, if the iodide be pure, a yellow color will *soon* be developed by the action of the air on the liberated hydriodic acid; but if any iodate be present the test will give rise to both iodic and hydriodic acids, which, by their mutual action, will *instantly* develop iodine.

William Copney has pointed out an excellent test for detecting potassium carbonate and iodate, in the use of ferrous iodide, in the form of syrup of ferrous iodide, recently prepared. (See *Syrupus Ferri Iodidi.*) A drop of the syrup is added to a solution of the suspected potassium iodide. A bluish precipitate indicates the carbonate; a red one, the iodate; and a blue precipitate, followed by a red one, both impurities. An adulteration by the carbonate under 10 per cent. does not alter the crystalline appearance of the iodide, but gives it an increased tendency to deliquesce. When it is greater it renders the salt granular and highly deliquescent. As potassium iodide is soluble in rectified spirit, anything left undissolved by that solvent is impurity. (*A. J. P.*, xxvi. 293.) A seemingly better method is that of Personne, founded upon the fact that when mercuric chloride is added to a solution of the iodide in just sufficient amount to form potassio-mercuric iodide the solution remains clear, but on the further addition of the minutest quantity of the chloride a persistent reddish or rose-colored precipitate is formed. He prepares the titrating solution by dissolving 13.55 grammes of mercuric chloride and 8 to 10 grammes of common salt in 200 to 250 grammes of distilled water, and then adding sufficient distilled water to make the whole measure one liter; 10 cubic centimeters of this correspond to 0.1355 of the chloride. Of the iodide to be tested 3.32 grammes are dissolved in sufficient water to make exactly 100 cubic centimeters. The titration is performed by putting 10 cubic centimeters of this in a beaker glass, and adding from a burette, drop by drop, the mercurial liquid, keeping the beaker in a constant agitation by means of the gyratory movement with the hand. When the red color appears the titration is complete. If the iodide be pure, 10 cubic centimeters of the mercurial solution will have been used; if only 8 Cc. have been used, it is known that the iodide contains only 80 per cent. of the pure salt; 9 Cc. indicate 90 per cent.; 7 Cc., 70 per cent., and so on. The presence of potassium bromide, chloride, or carbonate is said not to interfere with this test. (*J. P. C.*, Janv. 1875, p. 5.) Potassium iodide contains no water of crystallization.

According to Payen, a saturated solution of potassium iodide, which will evince signs of decomposition by becoming orange-yellow, in the presence of atmospheric air, on the addition of small quantities of acetic, nitric, oxalic, and probably many other acids, remains unaffected by these additions if atmospheric air be excluded. It was first pointed out by Loew (*A. J. P.*, xlii. 80), and afterwards confirmed by Vidau in an elaborate series of experiments, that iodine is liberated from a solution of potassium iodide by direct sunlight; the more concentrated the solution the more energetic is the action. (*J. P. C.*, 4e sér., xx. 351.)

Potassium iodide is incompatible with a few alkaloids, calomel, mercurous and mercuric oxides, turpeth mineral, white precipitate, blue mass, and metallic mercury. Melsens observed that potassium iodide given in connection with the insoluble preparations of mercury rendered them soluble and much more active. (See *A. J. P.*, xxvi. 222.) With nitrous ether potassium iodide reacts, yielding, among other products, ethyl iodide and a little ordinary ether. (Juncadella, *C. R. A. S.*, Fév. 1859, p. 345.) At ordinary temperatures potassium iodide is slowly decomposed, with evolution of iodine, by ammonium nitrate or boric acid, and at high temperatures, in a glass test tube, with escape of violet vapors, not only by the two substances just named, but also by ammonium sulphate, oxalate, carbonate, and chloride, sodium sulphate, phosphate, nitrate, and borate, potassium and magnesium sulphates, calcium nitrate, sodium, potassium, and calcium chlorides, and silicic acid. (Ubaldini, *J. P. C.*, Oct. 1859, p. 292.) Melsens has noticed another very important fact in relation to the operation of potassium iodide. When this salt and potassium chlorate are mixed in solution, no change takes place at ordinary temperatures; but if a certain amount of a mineral acid be added to the solution of the mixed salts, a reaction occurs, attended with the escape of iodine, and evidences are presented of the existence of iodic acid in the solution. Now, Melsens has ascertained by experiments on dogs that neither of these salts, if given separately and at different times, produces an evil effect, while if given together, so as to be in the system at the same time, they act as a poison, and may cause death in a few days. Seven grammes (108 grains) of a mixture of potassium iodide and potassium chlorate, in equivalent proportions, given daily to a dog of medium size,

uniformly proved fatal in less than a month, and often as early as the fifth day. Melsens ascribed the result to the production of potassium iodate, which he has shown to be a poisonous salt. (*A. J. P.*, Nov. 1866, p. 521; from *Bull. Soc. Chim.*) With certain alkaloids potassium iodide is incompatible, and fatal results have been caused by the strychnine iodide crystallizing out of a prescription, so that the whole of it was taken at a single dose.

Uses.—The general therapeutic properties of the preparations of iodine, of which potassium iodide is the most important, have been given under the head of Iodine. By most practitioners the preparation under notice is preferred for producing the constitutional effects of iodine. When it is administered in large repeated doses it produces evidences of systemic affection, known as *iodism.* The most usual indication of its constitutional action is a pain over the brow, with coryza; in some cases a mild ptyalism, with fetor of the breath and slight swelling of the gums, is produced. In a number of cases it causes an eruption, sometimes simply of macula, but usually of acne. In unusual conditions of the system these skin affections may become very severe and ulcerations result; thus, John O'Reilly of New York, reports several cases in which, after the use of this iodide, spots like purpura were produced, invading first the face and then the trunk and extremities. These became bullæ, sometimes an inch in diameter, filled with a purple liquid, and finally sphacelated spots ending in ulcers. Great constitutional disturbance coexisted, with swollen tongue, fetor, and salivation. Bumstead (*Am. J. M. S.*, lxii. 101) and H. C. Wood have seen similar cases. When it is given in a too concentrated form, as when compressed pills are prescribed, its local irritant properties assert themselves, and severe gastro-intestinal irritation or inflammation may result.

The amount of iodine which the individual will bear varies, but in those who have not been gradually accustomed to its use the power of resisting very large doses is strong evidence of a syphilitic infection. In *periosteal nodes, specific rheumatism, diseases of the nervous system* or *large viscera,* and in other forms of advanced *secondary* or *tertiary syphilis,* potassium iodide acts as a specific, but must be given in very large doses and continuously for months or even years. It is when the symptoms are not very active, or when evidences of cachexia forbid mercurials, that it is especially indicated. In 1843, Guillot and Melsens gave potassium iodide with advantage in doses of from a drachm to a drachm and a half daily, in *mercurial tremors* and *lead poisoning.* In a memoir published in 1849, Melsens gives a full account of his experiments with it as a remedy for the affections caused by mercury and lead. He effected a number of cures of *mercurial tremors* and *lead palsy,* and during the progress of the cure these metals were found in the urine. The value of potassium iodide in various chronic metallic poisonings is now established, and there can be little doubt as to the correctness of the theory of Melsens, namely, that potassium iodide forms with insoluble metallic compounds in the tissues soluble double salts, which are taken up by the blood and eliminated by the emunctories.[1] Potassium iodide sometimes produces ptyalism, but this effect, when directly caused by the iodide, is never severe. Occasionally, however, during the taking of the iodide, furious ptyalism will occur, which is the result, as was first shown by Melsens, of the liberation from the tissues of mercury which had been previously taken, and which was enabled by being dissolved to produce constitutional effects. As this ptyalism may come on in persons who have not taken mercury for months, or perhaps for years, it would appear that that metal can long lie fixed and insoluble in the system, and finally, when liberated, produce serious constitutional symptoms. A prolonged mercurial treatment should always be followed by a course with potassium iodide. G. W. Balfour of Edinburgh, published several cases of *aneurism of the aorta* in which potassium iodide was given in the dose of thirty grains twice or thrice daily with apparently great advantage, the symptoms of the disease having not only been greatly relieved, but in some instances having entirely disappeared. (*Ed. M. J.*, July, 1868, p. 33; also April, 1871, p. 935.) The results probably were due to the aneurisms being of syphilitic origin. For the *softening of inflammatory deposits,* and for the *removal of exudations* not of syphilitic nature, potassium iodide is one of the most reliable remedies that we have. Hence it is much used in *chronic pleurisies.* In *chronic disease of the pulmonic parenchyma,* especially when tubercular, the exhibition of potassium iodide frequently has a pronounced effect in hastening softening and ulceration. Potassium iodide has been used internally by A. Beaufort with much supposed advantage for a local effect. Being largely secreted with the tears, and to a certain extent with the uterine fluids, he gives it with a view to its effects on the passages with which it thus comes in contact. In this way he explains the very good effects he has experienced from it in *chronic inflammation of the lachrymal passages,* and in *chronic metritis* with copious leucorrhœa. (*B. F. M. R.*, Oct. 1868, p. 517.)

The dose varies enormously; iodism may be produced by ten grains a day, and an ounce a day may in other cases be taken without distinct effect. In serious syphilitic cases a drachm a day may be given and rapidly increased to half an ounce (15.5 Gm.) unless iodism or the therapeutic effect is produced. When it is given in large amounts, care should be exercised to secure free dilution, and the best method of

[1] See the Memoir of Melsens, translated by Budd of Bristol, England, in the *B. F. M. R.*, Am. ed., for Jan. 1853, p. 157; also a paper by J. W. Corson, in the *N. Y. Journ. of Med.* for Sept. 1853.

administration is in solution in milk. The compound syrup of sarsaparilla will in a measure disguise the taste.

Potassium iodide passes quickly into the urine, in which it may be detected by first adding to the cold secretion a portion of starch, and then a few drops of nitric acid, when a blue color will be produced. It has been detected in six minutes after having been swallowed. According to Schottin, it passes slowly into the sweat. Taken in half-drachm doses daily, it did not appear in that secretion until five days had elapsed.

Potassium iodide is employed as an external application in the form of ointment, either alone or mixed with iodine. (See *Unguentum Potassii Iodidi* and *Unguentum Iodi.*)

Dose, five to twenty grains (0.32 to 1.3 Gm.); in special cases much larger doses may be exhibited.

Off. Prep.—Acidum Hydriodicum Dilutum, *U. S.;* Hydrargyri Iodidum Flavum, *U. S.;* Hydrargyri Iodidum Rubrum, *U. S.;* Linimentum Potassii Iodidi cum Sapone, *Br.;* Liquor Iodi Compositus, *U. S.* (*Br.*); Tinctura Iodi, *U. S., Br.;* Unguentum Iodi, *U. S., Br.;* Unguentum Potassii Iodidi, *U. S., Br.*

POTASSII NITRAS. U. S., Br.

POTASSIUM NITRATE [Nitre]

(pŏ-tăs'sĭ-ī nī'trās)

$KNO_3 = 100.43$

"It should contain not less than 99 percent. of pure Potassium Nitrate [$NO_3.OK$], and should be kept in well-stoppered bottles." *U. S.*
"Potassium Nitrate, KNO_3, may be obtained by purifying crude nitre, or by the interaction of sodium nitrate and potassium chloride." *Br.*

Potassæ Nitras; Nitrum Depuratum, Sal Petræ, s. Nitri, Nitras Potassicus, s. Kalicus; Nitrate of Potash, Nitre, Saltpetre; Nitrate de Potasse, Azotate de Potasse, *Fr. Cod.;* Nitre prismatique, Salpêtre, *Fr.;* Kalium Nitricum, *P. G.;* Kaliumnitrat, Salpetersaures Kali, Salpeter, Kalisalpeter, *G.;* Nitrato di potassio, Nitro, *It.;* Nitrato potasico, *Sp.*

Potassium nitrate or nitre, is both a natural and an artificial product. It occurs in many countries, existing in the soil, on which it forms a saline efflorescence, in the fissures of calcareous rocks, and in caves. It has been found in different parts of Europe, in Egypt, and in Chili, but the country in which it has been largely produced is India. In the United States it is found, for the most part, in caverns situated in limestone rock, called saltpetre caves, where it is associated with calcium nitrate. The earths contained in them are lixiviated, and yield, according to their richness, from one to ten pounds of crude potassium nitrate to the bushel. These caves are particularly numerous in Kentucky, and furnished a large proportion of the potassium nitrate consumed in the United States during the last war with England. According to E. S. Wayne of Cincinnati, nitre earth exists near Nashville, Tenn., which yields 15 per cent. of potassium nitrate, and is said to be sufficiently abundant to supply the demand of the United States. In Bradford County, Pa., a solid, uncrystalline deposit of very pure potassium nitrate was found in a sandstone rock. (W. H. Ellet.) "A mountain" of the salt is said to have been discovered by Harrison among the Rocky Mountains, "six miles N.E. of Crystal Peak." (*A. J. P.,* 1866, p. 87.) Potassium nitrate exists also in the vegetable kingdom, having been found in tobacco, borage, bugloss, parietaria, hemlock, and the sunflower. The artificial sources are certain mixtures of animal and vegetable substances with wood ashes and calcareous matter, called nitre-beds, and certain materials impregnated with saltpetre, consisting principally of plaster rubbish, derived from the demolition of old buildings. The ashes of tobacco stems, consisting almost exclusively of potassium carbonate and chloride, have been proposed by Commaille as an artificial source of potassium nitrate by adding them to the ordinary nitre-beds. (*J. P. C.,* Fév. 1856.)

Preparation from its Natural Sources.—In India the saline earth, which contains about seven parts of potassium nitrate in a thousand, is lixiviated in large mud filters lined with stiff clay, and furnished with false bottoms of bamboo, covered with grass mats, on which wood ashes are laid. The filters being then filled with the saline earth, water is added, and the solution filters through the wood ashes, with the effect of converting the calcium nitrate present, amounting to nearly 1 per cent., into potassium nitrate. The solution obtained is evaporated in earthen pots, filtered, and set aside to crystallize. The impure potassium nitrate thus obtained contains from 45 to 70 per cent. of the pure salt. It is redissolved and crystallized, and thrown into commerce under the name of crude saltpetre. Besides the nitre obtained in India by the filtration of the soil deposited during the overflow of the Ganges, it appears, from the report of J. W. Palmer, that much of the crude salt is procured, in the northwestern provinces of Hindostan, from the saline incrustations formed in and around the mud walls surrounding the dwellings of the natives. The scrapings from these sources are lixiviated, and the impure solution allowed to evaporate in shallow pans exposed to the sun. The impure nitre extracted from the earthy matters crystallizes out, while from 1 to 9 per cent. of sodium chloride remains in the mother liquor, and is recovered by evaporation. (*A. J. P.,* 1868, 436.) *Juar,* a plant used in India as fodder, contains in its stems during dry seasons a large quantity of potassium nitrate (17 per cent.); when in this condition it is poisonous to animals. (*P. J.,* 1896, 380.)

Within recent years potassium nitrate has been most largely manufactured from the native potassium chloride of Stassfurt and the native

sodium nitrate of Chili, two cheap and abundant crude materials, which by their reaction yield potassium nitrate. For this purpose equal molecular quantities of the two salts are dissolved in water with the aid of heat until the specific gravity of the liquor reaches 1.5. The resulting sodium chloride, being less soluble in hot water, is precipitated, and the solution on cooling and agitation deposits the saltpetre as a fine powder. This so-called "conversion saltpetre," as manufactured by Vorster & Grüneberg of Kalk, Germany, and exhibited at the Chicago Exposition, is said to be 99.9 per cent. pure nitrate.

Artificial Preparation.—The plan of making saltpetre in artificial nitre beds is principally practised in Germany, while the method of obtaining it from old plaster rubbish is followed in France. *Artificial nitre beds* are formed of animal and vegetable remains, together with ashes and calcareous earth, which are mixed up with a portion of loose soil and placed under sheds, to shelter the mixture from the rain, while the sides are left open, to admit the free access of air. The mixture is disposed in little ranges or heaps, which are frequently turned over with a spade, and sprinkled with urine, as a substance containing a large quantity of nitrogen. At the end of two or three years the nitrogen is converted into nitric acid, and this, by reacting with the potassium compounds existing in the vegetable remains, forms nitre. When the contents of the bed contain about four ounces of the salt for every cubic foot of the materials, they are deemed fit to be lixiviated. The lixiviation is performed with boiling water, which is repeatedly thrown upon fresh portions of the mass, until the solution obtained is sufficiently strong. The lixivium is of a brown color, and contains chiefly potassium nitrate, but at the same time more or less of calcium and magnesium nitrates and of sodium chloride. The earthy nitrates are then decomposed by a solution from wood ashes, the potassium carbonate of which converts them into nitre and precipitates the earths. The solution being further evaporated, the common salt rises to the surface as a scum, and is removed. The solution is then allowed to cool, and the nitrate crystallizes in dirty-white crystals, called crude nitre. Calcium nitrate may be converted into nitre by adding it to a solution of potassium sulphate. Calcium sulphate is precipitated, and potassium nitrate remains in solution.

Theory of Nitrification.—The continuous formation of nitre in nitre earths and in artificial nitre beds result from the oxidation of the nitrogen of ammonia, thus generating nitric acid, the formation of which is facilitated by the presence of alkaline and earthy bases, with which the acid unites, but in reality depends upon the presence of nitrifying micro-organisms (*Bacillus nitrificans*), so that nitrification is not strictly an oxidation process, as was at one time supposed. The ammonia is derived, for the most part, from the organic remains in the nitre earths, and from the animal matter which is an essential ingredient in the artificial mixtures. According to Schoenbein, whose statement has been confirmed by Goppelsröder, the formation of the nitric acid is always preceded by that of nitrous acid.

Purification.—Potassium nitrate, as first obtained, either from natural or from artificial sources, is called in commerce crude saltpetre, and requires to be purified before it can be used in medicine or in most of the arts. The process, which is founded principally on the fact that nitre is more soluble than common salt in hot water, is conducted in France as follows: Thirty parts of saltpetre are boiled with six parts of water, and the portion which remains undissolved or is deposited, consisting of common salt, is carefully removed. As the ebullition proceeds, a little water is added from time to time, to hold the nitre in solution. When common salt ceases to be separated, the solution is clarified with glue, and more water is added, at intervals, until the whole, including that previously added, amounts to ten parts. The clear solution is now transferred to large, shallow copper coolers, where it is agitated with wooden instruments to hasten the cooling and to cause the nitre to crystallize in small grains. The purification is completed by washing the salt with water, or a saturated solution of nitre, in a kind of wooden hopper with holes in the bottom stopped with pegs. The liquid employed is allowed to remain in contact with the nitre for several hours, after which it is permitted to drain off by taking out the pegs. The salt is now dried, and takes the name of purified nitre.

In Sweden the process of purification is conducted in a different manner. The solution of the crude nitre is boiled until a saline crust (sodium chloride) forms on its surface, and until it is so far concentrated that a small portion of it crystallizes upon cooling. The crust being removed, the solution is filtered, and diluted with 1-48th of water, with a view to retain in solution the common salt, which, being somewhat less soluble in cold than in boiling water, would otherwise be in part precipitated on refrigeration. This solution is now allowed to cool, and, at the moment the crystals begin to form, is stirred constantly, to cause the salt to crystallize in small grains. The granular salt is then washed after the French method, as before described, dried, and, being fused, is cast in sheet iron moulds so as to form masses, each weighing from ten to twenty pounds. The preparation of nitre in this manner by fusion is, according to Berzelius, attended with several advantages, such as occupying less space, losing nothing by waste in transportation, and presenting, in this state, an obvious index of its quality. This index is the character of its fracture. When the salt is perfectly pure, the fracture is radiated, the radii being generally large. The presence

of 1-80th of sodium chloride renders the radii smaller; that of 1-40th, or of a larger quantity, produces a zone in the substance of the mass devoid of the radiated structure, or causes this structure to disappear entirely. On the other hand, the melting of the salt has the disadvantage of converting it in part into nitrite if the heat be too high, and of rendering it difficult to pulverize.

Commercial History.—Nitre is sometimes received in this country from Calcutta packed in grass-cloth bags containing from one hundred and fifty to one hundred and seventy-five pounds. Its quality varies considerably. That which comes in dirty-yellow crystals is called *crude saltpetre,* while the finer lots, in small comparatively clear crystals, approaching to white, are called *East India refined.* Very little crude saltpetre is at present obtained from native sources in the United States. The *refined saltpetre* is almost exclusively prepared by our own chemists. The importations of crude potassium nitrate are at present less than one-fortieth of the amount of crude sodium nitrate imported. The amount for the year 1903 was 11,700,415 lbs., and for 1904, 13,518, 301 lbs. For an account of what is incorrectly called *South American saltpetre,* see *Sodii Nitras.*

Properties.—Potassium nitrate occurs as "colorless, transparent, six-sided, rhombic prisms, or a white crystalline powder; odorless, and having a cooling, saline and pungent taste. Slightly hygroscopic in moist air. Soluble in 3.6 parts of water at 25° C. (77° F.), and in 0.4 part of boiling water; very sparingly soluble in alcohol. When heated to 353° C. (667.4° F.) the salt melts. At a higher temperature it is decomposed, giving off oxygen at first, and then some of its nitrogen, leaving a residue of potassium nitrate, nitrite, and oxide. When thrown upon red-hot coals, the salt deflagrates. The aqueous solution is neutral to litmus paper. With sodium bitartrate T.S. the aqueous solution (1 in 20) yields a white, crystalline precipitate. If 5 Cc. of an aqueous solution (1 in 20) be agitated with an equal volume of sulphuric acid, and the liquid be cooled and a crystal of ferrous sulphate be placed in the liquid, a dark brown color should appear around the crystal. If a drop of diphenylamine T.S. be mixed with 5 Cc. of an aqueous solution, and sulphuric acid be slowly added so as to form a separate layer, a deep blue color will appear at the line of contact. An aqueous solution of Potassium Nitrate (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and if chlorine water be introduced, drop by drop, with agitation, the chloroform should not acquire a violet tint (absence of *iodide*). No yellow color should appear when 0.1 Gm. of the dry salt is sprinkled upon 1 Cc. of pure concentrated sulphuric acid (absence of *chlorate* and *perchlorate*)." *U. S.* "In white crystalline masses or fragments of striated six-sided rhombic prisms, colorless, having a cool saline taste. It is soluble in 4 parts of cold and half its weight of boiling *water.*" *Br.* It is devoid of water of crystallization, but is apt to contain a portion of liquid mechanically lodged within the substance of the crystals. This is particularly the case with the *large crystals,* and, according to Berzelius, is a source of impurity, as the liquid in question is a portion of the mother water in which they were formed. It is on this account that Berzelius recommends that the solution of the purified salt should be stirred during crystallization, so as to cause it to shoot into *small crystals.* The fused mass, when cast in moulds, or formed into little circular cakes, constitutes that form of nitre found in commerce under the name of *crystal mineral* or *sal prunelle.*[1] If the heat is increased, the salt is decomposed, evolves pure oxygen, and is reduced to the state of nitrite, which, in powder, emits orange-colored fumes of hyponitric acid, and nitrous oxide on the addition of sulphuric acid. Upon a further continuance of the heat, the nitrous acid itself is decomposed, and a large additional quantity of oxygen is evolved, contaminated, however, with more or less nitrogen. On account of the large proportion of oxygen which it affords, nitre increases the combustion of many substances in a remarkable degree. When thrown on burning coals, it deflagrates with bright scintillations. In the reaction of nitre with charcoal, carbonic acid is produced, and never carbonic oxide, and the nitric acid is variously decomposed into nitrous oxide, nitrogen dioxide, or nitrogen, according to the proportion of the charcoal and to the heat employed. (A. Vogel, Jr.)

Potassium nitrate may be very readily recognized by its effect in increasing the combustion of live coals when thrown upon them, and by evolving white or reddish vapors on the addition of sulphuric acid. If the residue in this case weighs less than the amount calculated for potassium sulphate, part of it is probably sodium sulphate, and the nitre tested may be assumed to have contained sodium nitrate. The most usual impurity is sodium chloride, which is seldom entirely absent, and which injures it for the manufacture of gunpowder. The refined or purified saltpetre of commerce is sufficiently pure for medicinal use. Potassium nitrate is composed of one atom of potassium in combination with one nitric acid group, which latter is monobasic.

[1] *Sal prunelle,* as directed to be made in the French Codex of 1837, is a mixture of potassium nitrate and sulphate. It is prepared by fusing nitre in a Hessian crucible, adding 1-128th part of sulphur, and pouring out the product on a smooth marble slab, where it is allowed to congeal. The sulphur immediately takes fire, and, by combining with oxygen from a part of the nitric acid of the nitre, becomes sulphuric acid, which then unites with a small portion of potassium to form potassium sulphate.

Uses.—Potassium nitrate, when in sufficient concentration, acts upon a raw surface or a mucous membrane as a violent irritant, and taken internally in concentrated form produces violent burning pain, vomiting, purging, and other evidences of gastro-enteritis, which may end in collapse and death. Inflammation and ulceration of the mucous membrane are commonly found at the autopsies. In its general action potassium nitrate shares the sedative influence of the potassium salts in general, and was at one time much used as a diuretic and diaphoretic, but is at present very rarely employed, except as a local remedy. It is, however, sometimes prescribed with tartar emetic and calomel, forming the so-called *nitrous powder,* which promotes most of the secretions, particularly those of the liver and skin, and is sometimes advantageous in lessening and modifying febrile excitement. The formula usually preferred is eight or ten grains (0.5 to 0.65 Gm.) of nitre, the eighth of a grain (0.008 Gm.) of tartar emetic, and from one-fourth to one-half of a grain (0.016 to 0.032 Gm.) of calomel, exhibited every two or three hours.

At one time potassium nitrate was used in very large doses in acute *rheumatism,* but the practice has passed out of vogue. It is essential always to give the remedy very freely diluted, if at all, and thus avoid its irritant influence upon the gastro-intestinal tract. An ounce taken in a little water has produced death, while recovery has been known from a dilute solution of several ounces. According to Lauter Brunton potassium nitrate has the same effect on the vascular system as the nitrite except that it is slower in its action. He recommends its use in the early stages of *arterio-capillary fibrosis* and other conditions of high arterial tension.

As a local remedy the nitrate is similar in its action to potassium chlorate, but it is probably less efficient, and certainly has been largely replaced by the chlorate in the treatment of *stomatitis, angina,* and local inflammations. In *asthma,* nitrous fumigation is often useful, performed by inhaling the fumes from burning torch paper, prepared by dipping blotting paper in a saturated solution of nitre and afterwards drying it. Such paper was official in the U. S. P. 1890. (See *Charta Potassii Nitratis,* p. 319.) Vohl has examined the vapor resulting from the burning paper thus impregnated, and found it to consist of carbon dioxide and oxide, cyanogen, ammonia, nitrogen, aqueous vapor, and potassium carbonate and nitrite, and he ascribes the beneficial results of its inhalation to the ammonia and potassium nitrite. (*J. P. C.,* 4e sér., iii. 155, 1866.)

In pharmacy, potassium nitrate was formerly employed to form crocus of antimony, to procure nitric acid, and sometimes in the preparation of spirit of nitrous ether. In the laboratory it is used to make black and white flux, as an oxidizing agent, and to yield oxygen at a red heat. It was formerly employed in the production of aqua fortis (common nitric acid) and in the manufacture of sulphuric acid, and is yet employed in the fabrication of gunpowder. The Br. Pharmacopœia 1885 used it in the purification of bismuth.

Dose, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Argenti Nitras Induratus, *Br.;* Argenti Nitras Mitigatus, *U. S., Br.*

POTASSII PERMANGANAS. U. S., Br.

POTASSIUM PERMANGANATE

(pŏ-tăs'sī-ī pĕr-măn'gą-năs)

$KMnO_4 = 156.98$

"It should contain not less than 99 percent. of pure Potassium Permanganate [$MnO_3.OK$], and should be kept in glass-stoppered bottles, protected from light. Potassium Permanganate, when in concentrated solution or in the dry condition, should not be brought in contact with organic or other readily oxidizable substances." *U. S.* "Potassium Permanganate, $K_2Mn_2O_8$, may be obtained by the interaction of potassium chlorate, potassium hydroxide, and manganese dioxide." *Br.*

Potassæ Permanganas; Kali Hypermanganicum Crystallisatum; Hypermanganas Potassicus, s. Kalicus; Permanganate of Potash; Permanganate de Potasse, *Fr. Cod.;* Kalium permanganicum, *P. G.;* Kallumpermanganat, Chamæleon, Uebermangansaures Kali, *G.;* Permanganato di potassio, *It.;* Permanganato potasico, *Sp.*

The British Pharmacopœia 1885 furnished a detailed process for this salt, as follows:

"Take of Caustic Potash *five ounces* [avoirdupois]; Black Oxide of Manganese, in fine powder, *four ounces* [av.]; Chlorate of Potassium *three ounces and a half* [av.]; Distilled Water *two pints and a half* [Imperial measure]; Carbonic Acid *a sufficiency.* Reduce the Chlorate of Potassium to fine powder, and mix it with the Oxide of Manganese; put the mixture into a porcelain basin, and add to it the Caustic Potash, previously dissolved in four [fluid]ounces of the Water. Evaporate to dryness on a sand-bath, stirring diligently to prevent spurting. Pulverize the residual mass, place the powder in a covered crucible, exposing it to a dull red heat for an hour, or until it has assumed a semi-fused condition. Let it cool, pulverize it, and boil with a pint and a half [Imp. meas.] of the Water. Let the insoluble matter subside, decant the fluid, boil again with half a pint [Imp. meas.] of the Water, again decant, saturate the united liquors with Carbonic Acid, and evaporate until a pellicle forms. Set aside to cool and crystallize. Drain the crystalline mass, boil it in six [fluid]ounces of the Water, and strain through a funnel, the throat of which is lightly obstructed by a little asbestos. Let the fluid cool and crystallize, drain the crystals, and dry them by placing them under a bell-jar over a vessel containing sulphuric acid."

By this process potassium chlorate yields oxygen to manganese dioxide, converting it into manganic acid, which unites with the potassium hydroxide to form the manganate, potassium chloride being formed at the same time; the reaction being

$$3MnO_2 + 6KOH + KClO_3 = 3K_2MnO_4 + KCl + 3H_2O$$

When this solution is boiled, the potassium manganate reacts with the water and yields potassium permanganate, according to the reaction

$$3K_2MnO_4 + 3H_2O = K_2Mn_2O_8 + H_2MnO_3 + 4KOH$$

the hydrated peroxide separating out. Hence, when exhausted by water, the solution requires the saturation of the free alkali with carbon dioxide, as stated in the process above. At best, the product is small and uncertain in amount. A cheaper commercial preparation, consisting of a mixture more or less pure of sodium manganate and permanganate, is manufactured on a large scale for disinfecting purposes. It is obtained by mixing the sodium hydroxide obtained from 1500 kilogrammes of soda ash with 350 kilogrammes of finely divided manganese dioxide in a flat vessel, and heating this mixture for forty-eight hours to dull redness. The product is then lixiviated with water, and the solution either boiled down to the requisite degree of strength or evaporated to dryness. Potassium permanganate has also been made by the electrolysis of the manganate, the products being permanganate, potassium hydroxide, and hydrogen. A still more interesting result of electrolysis is the production of potassium permanganate by the electrolysis of potassium hydroxide, in which the negative electrode is of porous copper oxide and the positive electrode a piece of manganese or ferro-manganese held immersed by a loop of platinum wire. A process for the complete conversion of manganate into permanagate has been patented in Germany. The crude manganate obtained in the usual way by melting manganese dioxide and alkali under access of air, is exhausted with water and a current of *ozonized* air is passed into and through the alkaline solution. The conversion of the manganate into permanganate is complete and rapid, whereas when ordinary oxygen is thus introduced the formation is slow and incomplete. (*Ph. Ztg.*, 1901, 517.)

Properties.—It is officially described as in "slender, monoclinic prisms, of a dark purple color, almost opaque by transmitted light, and of a blue, metallic lustre by reflected light, odorless, and having a taste at first sweet, but afterwards disagreeable and astringent. Permanent in the air. Soluble in about 15 parts of water at 25° C. (77° F.), and in 3 parts of boiling water; in contact with alcohol it is decomposed. When heated, the salt decrepitates, and at 240° C. (464° F.) it decomposes, yielding oxygen, potassium manganate, and manganese dioxide. The aqueous solution of the salt is of a deep violet-red color when concentrated, and of a rose color when much diluted, and the rose color is discharged by hydrogen sulphide, ferrous sulphate, oxalic acid, alcohol, hydrogen dioxide, and many other readily oxidizable substances, especially if the solution be first rendered acid by sulphuric acid. An aqueous solution is neutral to litmus paper. If 0.5 Gm. of Potassium Permanganate be boiled with 20 Cc. of water and 4 Cc. of alcohol until it is completely decomposed, and the liquid then filtered, the clear, colorless filtrate may be used for the following tests: If to 5 Cc. of the filtrate, acidulated with nitric acid, barium chloride T.S. be added, not more than a very slight turbidity should be produced (limit of *sulphate*). In another portion of 5 Cc., acidulated with nitric acid, silver nitrate T.S. should produce no precipitate or cloudiness (absence of *chloride*). If to another portion of 5 Cc. of the filtrate 1 drop of diphenylamine T.S. be added, and then 1 Cc. of sulphuric acid introduced, so as to form a layer beneath, no blue color should appear at the line of contact (absence of *nitrate*). If 0.1 Gm. of Potassium Permanganate be dissolved in about 100 Cc. of hot distilled water to which 1 Cc. of sulphuric acid has previously been added, the solution should require for complete decolorization not less than 31.5 Cc. of tenth-normal oxalic acid V.S." *U. S.* "Dark purple slender prismatic iridescent crystals, with a sweet astringent taste, soluble in 20 parts of cold *water*, without action on *litmus*. The crystals heated to redness decrepitate, evolve oxygen, and leave a black residue from which *water* extracts potassium hydroxide, the resulting solution affording the reactions characteristic of potassium. It should yield no characteristic reaction with the tests for lead, arsenium, iron, aluminium, calcium, magnesium, sodium, ammonium, carbonates, chlorides, or sulphates. Each gramme dissolved in *water*, and acidulated with 5 cubic centimetres of *diluted sulphuric acid*, should require for complete decolorization 31.2 cubic centimetres of an aqueous solution containing 62.58 grammes of pure crystallized *oxalic acid* per litre." *Br.*

If the solution be evaporated to dryness, the salt has the form of an intensely black powder. If suddenly heated, the crystals detonate, evolving oxygen, and leaving a black residue, which yields potassium hydroxide to water, recognized by its alkaline reaction, and by giving, when acidulated with hydrochloric acid, a yellow precipitate with platinic chloride.

Moderately heated, the crystals are partially volatilized, giving out violet vapors of a disagreeable metallic odor. (*A. J. P.*, Sept. 1862, p. 409.) The salt, in consequence of the facility with which it parts with oxygen, is one of the most powerful oxidizing agents known. It causes the combustion of certain inflammable bodies, imparts oxygen to almost

all organic substances, and in chemistry is employed to bring various compounds to a higher degree of oxidation. The readiness with which it yields oxygen in the nascent state is sufficient to account for its oxidizing power. It may be kept indefinitely if pure, and carefully secured from contact with organic substances, or other decomposing agents; but in fact, in consequence of the almost universal presence of organic matter in the air, it is generally partially decomposed, and, when dissolved, leaves a slight residue of hydrated manganese dioxide. In reference to the metals, mercury is quickly oxidized at the expense of the salt, a mixture of mercurous oxide and manganese oxide being deposited as a brown powder, and potassium hydroxide remaining in solution. Zinc remains unchanged indefinitely in a solution of the permanganate, silver is little affected, and copper not at all, even at 100° C. (212 F.). (Giles, *J. P. C.*, Mai, 1868, p. 397.)

H. B. Condy introduced (*J. Soc. Chem. Ind.*, 1885, p. 567) a permanganate disinfectant, which contains also aluminum sulphate, which is said to increase the oxidizing effect of the permanganic acid. He asserts that in this disinfectant solution all the available oxygen of the permanganic acid is utilized, whereas only 60 per cent. of this amount is utilized with the simple alkaline permanganate.

Uses.—Potassium permanganate was first brought to the notice of the profession in 1857, by Condy, as a powerful disinfectant, and has proved to be very efficient not only in lessening fetid odors from organic sources, but also in destroying the sources of the odor. It acts by oxidizing, but, as it can yield up only the oxygen within it, its powers are limited. Further, it is a comparatively expensive substance, so that it is very rarely employed when any considerable mass of material is to be affected. It also has the further disadvantage of staining the skin, clothes, etc.; but the stain may be removed with oxalic acid. It is frequently used in the treatment of *fetid* and *gangrenous ulcers, hospital gangrene, abscesses, carbuncles,* and *wounds* of all kinds, of fetid discharges from the mucous membrane, as in *ozæna, otorrhœa, gonorrhœa,* and *leucorrhœa,* and of *diphtheritic affections;* and it has proved serviceable even in *cancerous ulcers.* As a local stimulant it has also been used in *chronic* and *indolent ulcers.* In all these cases it is applied to the diseased surface in solution of various strengths, according to the effect desired. In concentrated solution it is capable of acting as a caustic and therefore requires caution. With the view to its caustic action, it may be sprinkled on the diseased surface by means of a pepper-box, or applied in saturated solution. As a disinfectant or stimulant lotion it may be of various strengths, from one to twenty grains to the fluidounce of water. In preparing any solution of permanganate for use, it is of the utmost importance to avoid organic matters. Internally, the medicine has been used in *diphtheria, scarlatina,* and various *zymoses,* and in *dyscrasia,* but is probably of no service. It is plain that any moderate amounts of the permanganate must be decomposed by the organic matters of the mouth, œsophagus, and stomach before absorption. Nevertheless, the value of the permanganate in *atonic amenorrhœa,* first asserted by Sydney Ringer, has been corroborated by Fordyce Barker and other clinicians. It should be given in doses of from one to two grains (0.065 to 0.13 Gm.), after meals, unless it produce too much gastric uneasiness. Pills made with an excipient of cacao butter or rosin cerate, or compressed tablets of the pure salt, may be employed.

Potassium permanganate acts as an oxidizant much more rapidly upon some organic substances than upon others, by virtue of which fact it is a valuable antidote, notably in the treatment of morphine-poisoning and of snake-poisoning.[1] In the latter condition a concentrated solution of it should be injected freely and immediately into the part which has been bitten. (For cases, see *Med. Rec.*, 1894.) In morphine poisoning it acts only upon the alkaloid in the stomach, but should be given from time to time during the continuance of the symptoms in order to destroy any morphine which may have been eliminated from the blood into the stomach.

Dose, from one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Benzinum Purificatum, *U. S.;* Liquor Potassii Permanganatis, *Br.*

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[1] *Treatment of Snake-bites.*—Potassium permanganate as an antidote to snake poisons was first used by Fayrer in 1869, and shown by Blythe in 1877 to be a complete chemical antidote to cobra venom when mixed *in vitro,* his results being confirmed by Lauter Brunton and Fayrer in 1878. The two last-named experimenters, together with Rogers, of the Indian medical service, have reported on a method of preventing death from snake-bites, capable of common and easy practical application, and described a simple instrument which was designed by Fayrer to meet this requirement, since it can be constantly at hand when wanted and easy of application by unskilled persons. The instrument consists simply of a small lancet about ½ inch long with a hollow wooden handle, in which crystals of permanganate are contained. The way in which it is proposed to apply the permanganate is that any one bitten by a snake should at once tear a strip from a turban, shirt, or any other article of clothing, and tie it as quickly as possible above the bite. A cut should then be made with the lancet over the site of the bite so as to convert the puncture made by the snake's tooth into a small wound. Into this the crystals of permanganate, moistened with saliva if necessary, are to be rubbed. By means of this instrument, Dr. Rogers has been able to test the effect of permanganate applied in the manner described on rabbits and cats. Five out of six animals experimented upon survived after the injection of cobra poison, and a similar number survived after the use of Daboia poison. These experiments are satisfactory, inasmuch as they show that the utility of permanganate is not confined to one class of venom, but that it acts equally well with the venom of all kinds of snakes. The results obtained five minutes after the injection of the poison were as good as half a minute after injection, so that although very rapid absorption occurs during the first few seconds, it seems probable that absorption soon becomes slow from local effusion, and that sufficient time would thus be afforded for the application of the proposed antidote. (*C. D.*, June 18, 1904, 988.)

POTASSII SULPHAS. U. S., Br.

POTASSIUM SULPHATE

(pŏ-tăs'sĭ-ī sŭl'phăs)

$K_2SO_4 = 173.07$

"It should contain not less than 99 percent. of pure Potassium Sulphate [$SO_2(OK)_2$]." *U. S.* "Potassium Sulphate, K_2SO_4, may be obtained by purifying the crude salt, or by the interaction of sulphuric acid and potassium chloride or certain other potassium salts." *Br.*

Potassæ Sulphas; Sulfas Potassicus, s. Kalicus, Tartarum Vitriolatum, Arcanum Duplicatum, Sal Duobus, Sal Polychrestum Glaseri; Sulphate of Potash, Vitriolated Tartar; Sulfate de Potasse, *Fr. Cod.*; Potasse vitriolée, *Fr.*; Kalium Sulfuricum, *P. G.*; Kaliumsulfat, Schwefelsaures Kali, *G.*; Solfato di Potassio, *It.*; Sulfato potasico, *Sp.*

Several chemical processes give rise to potassium sulphate as a secondary product. Thus, it is produced in the distillation of nitric acid from a mixture of potassium nitrate and sulphuric acid; in the decomposition of magnesium sulphate by potassium carbonate, in one of the processes for preparing magnesium carbonate; in the manufacture of sulphuric acid; in the manufacture of potassium dichromate; and in the decomposition of potassium tartrate by calcium sulphate. When nitric acid is obtained by calcining a mixture of nitre and ferrous sulphate, the residue consists of ferric oxide and potassium sulphate, the latter of which, being alone soluble, is separated by means of water, and crystallized from its solution. The impure potassium sulphate with sulphur, forming the residue of the combustion of sulphur and nitre in making sulphuric acid, is employed in the manufacture of alum. The *kainite* of the Stassfurt salt beds is a native double potassium and magnesium sulphate, combined with magnesium chloride, and the *schœnite*, a double potassium and magnesium sulphate, with 6 molecules of water. To obtain potassium sulphate, the former mineral is exposed to the air; it deliquesces, and as soon as the soluble magnesium chloride has been run off, the remaining salt is partially decomposed by boiling water, so that on cooling the difficultly soluble sulphate separates out. About 12,000 tons of the potassium sulphate so obtained are annually put upon the market for use in fertilizers. The production of *kainite* at Stassfurt, in Germany, amounted in 1903 to 1,557,243 tons, valued at $5,445,750; and in 1904 to 1,905,893 tons, valued at $6,641,250.

According to the directions of the former Br. Pharmacopœia, the acid sulphate which remains after the distillation of nitric acid is brought to the neutral state by saturation, in boiling solution, with slaked lime. The solution is then filtered, to separate the calcium sulphate, and potassium carbonate is added at the boiling temperature, to remove lime and calcium sulphate. It is again filtered, then either neutralized or rendered slightly acid with diluted sulphuric acid, and finally, having been evaporated to a pellicle, is set aside for twenty-four hours to crystallize. The manufacturer of tartaric acid who avails himself of calcium sulphate to decompose potassium tartrate forms potassium sulphate as a collateral product. For the manner in which the latter salt may be economically crystallized for use, see *A. J. P.*, xxiii. 343.

Properties.—As officially described, it is in "hard, colorless, transparent, six-sided, rhombic prisms terminated by pyramids, or a white powder, odorless, and having a somewhat bitter, saline taste. Permanent in the air. Soluble in about 9 parts of water at 25° C. (77° F.), and in 4 parts of boiling water; insoluble in alcohol. When heated, the crystals decrepitate. At a bright red heat they fuse, and at a white heat the salt suffers partial decomposition. The aqueous solution is neutral to litmus paper. The saturated aqueous solution of the salt yields a white, crystalline precipitate with excess of sodium bitartrate T.S. An aqueous solution of the salt (1 in 20) yields with barium chloride T.S. a heavy white precipitate, insoluble in hydrochloric acid. The aqueous solution of Potassium Sulphate (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "In colorless hard rhombic prisms terminated by six-sided pyramids; decrepitates strongly when heated; soluble in 10 parts of cold and 4 parts of boiling *water;* insoluble in *alcohol* (90 per cent.). The salt affords the reactions characteristic of potassium and of sulphates. Each gramme dissolved in *water* and acidulated with *hydrochloric acid*, gives, with *solution of barium chloride*, a white precipitate, which, when washed and dried, should weigh 1.339 grammes. It should not yield any characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, zinc, calcium, magnesium, sodium, ammonium, or nitrates, and only the slightest reactions with the tests for chlorides. The aqueous solution has no action on *litmus* (absence of acid potassium sulphate)." *Br.* It consists of two atoms of potassium combined with the dyad group, SO_4, characteristic of sulphuric acid.

The *plate-sulphate of potassa*, so well described by Penny of Glasgow, is, when pure, the double potassium and sodium sulphate, having the formula $3K_2SO_4 + Na_2SO_4$. It is so called from the circumstance of being crystallized in hard thick cakes, or slabs, consisting of successive crops of crystals. It is a technical product from kelp, and may be formed by allowing successive quantities of concentrated kelp-lye to run into coolers, there to crystallize in successive layers, the mother liquor being drawn off by a siphon after the deposit of each layer. (*Phil. Mag.*, Dec. 1855.) For the mode of preparing and using *Sal Polychrestum, Po-*

tassii Sulphas cum Sulphure, or *Sulphate of Potassa with Sulphur,* see U. S. D., 15th ed., p. 1187.

Uses.—Potassium sulphate is a mild purgative, operating usually without heat, pain, or other symptom of irritation. In small doses, of from twenty grains to half a drachm (1.3 to 2.0 Gm.), it operates as an aperient; in larger doses, of four or five drachms (15.5 to 19.4 Gm.), it acts slowly as a purge. On the continent of Europe it is frequently given as an aperient after delivery, and for the purpose of drying up the milk. Potassium sulphate is a powerful irritant in excessive doses, and capable of producing fatal poisoning; an ounce and a half (46.5 Gm.) of it are said to have caused death. It is, like the nitrate and the chlorate, more dangerous when not given in sufficiently dilute solution. (See *Am. J. M. S.,* N. S., vii. 88.)

Dose, twenty grains to four drachms (1.3 to 15.5 Gm.).

Off. Prep.—Pilula Colocynthidis Composita, *Br.;* Pulvis Ipecacuanhæ Compositus, *Br.*

POTASSII TARTRAS. Br.

POTASSIUM TARTRATE

(pŏ-tăs'sī-ī tär'trăs)

$K_2C_4H_4O_6.H_2O = 467.16$

"Normal Potassium Tartrate $(CHOH)_2(CO OK)_2,H_2O$, is obtained by neutralizing Acid Potassium Tartrate with potassium carbonate." *Br.*

Potassæ Tartras; Tartras Potassicus, s. Kalicus; Tartarus Tartarisatus, Tartarus Solubilis; Tartrate of Potash; Soluble Tartar; Tartrate de Potasse neutre, *Fr. Cod.;* Tartre soluble, Sel végétal, *Fr.;* Kalium Tartaricum, *P. G.;* Kaliumtartrat, *G.;* Tartrato neutro di potassio, *It.;* Tartrato potasico neutro, *Sp.*

This salt was dropped at the 1890 revision of the U. S. Pharmacopœia; it is retained in the 1898 revision of the British authority.

In the U. S. 1870 process[1] the excess of acid in the bitartrate is saturated by the potassium of the carbonate, the carbon dioxide is liberated with effervescence, and the neutral potassium tartrate is formed. On account of the greater solubility of the carbonate than of the bitartrate, the former is first dissolved, and the latter added to the solution to full saturation. As the bitartrate is gradually added, the mutual action of the salts should be promoted by constant stirring, and the addition continued so long as effervescence takes place, which is a better mode of proceeding than to add any specified quantity of the acid tartrate, since, from its variable quality, it is impossible to adjust precisely the proportions applicable to all cases. It is necessary that the solution should be exactly neutral, or a little alkaline, and hence, if inadvertently too much bitartrate has been used, the proper state may be restored by adding a little of the alkaline carbonate. When the saturation has been completed, the solution is filtered, in order to separate calcium tartrate, which appears in white flocks, and which is always present in cream of tartar as an impurity. The evaporated liquor should then be placed in *warm* earthenware vessels, to insure a slow refrigeration, and after remaining at rest for several days the crystals begin to form. In order that the crystallization should proceed favorably, it is necessary, according to Baumé, that the solution should be somewhat alkaline. Iron vessels should not be used in the process, as that metal is apt to discolor the salt.

Potassium tartrate is sometimes made in the process for preparing tartaric acid. When thus obtained, the excess of acid of the bitartrate is neutralized by means of calcium carbonate. This generates an insoluble calcium tartrate, and leaves the neutral tartrate in solution, from which it may be obtained by evaporation and crystallization. (See *Acidum Tartaricum.*)

Properties.—Potassium tartrate was officially described in the U. S. P. 1880 as in "small, transparent or white, monoclinic crystals, or a white powder, somewhat deliquescent, odorless, having a saline, slightly bitter taste, and a neutral reaction. Soluble in 0.7 part of water at 15° C. (59° F.), and in 0.5 part of boiling water; almost insoluble in alcohol. When heated, the salt melts, then chars, and evolves inflammable vapors having the odor of burnt sugar. On moderate ignition, it leaves a blackened residue of an alkaline reaction, strongly effervescing with acids. A concentrated, aqueous solution of the salt yields a white, crystalline precipitate on the addition of acetic acid. With test-solution of nitrate of silver it yields a white precipitate which becomes black on boiling." For medicinal use it should be crystallized; but as it ordinarily occurs in commerce it is a white granular powder, obtained by evaporating the solution to dryness while it is constantly stirred. In this state it is said to require four times its weight of water for solution. It is not known to be purposely adulterated, but, if obtained by evaporation to dryness, it is liable to contain an excess of potassium carbonate or bitartrate, when it will have either an alkaline or an acid reaction. It is decomposed by all the strong acids, and by many acidulous salts, which cause the precipitation of minute crystals of potassium bitartrate, by abstracting one atom of alkali from the salt. Barium chloride or lead acetate occasions a white precipitate of barium or lead tartrate, distinguishable from the sulphates of those bases by being wholly soluble in dilute nitric acid. "A 10 per cent. aqueous solution should yield no precipitate with

[1] "Take of Carbonate of Potassium *sixteen troyounces;* Bitartrate of Potassium [cream of tartar], in fine powder, *thirty-six troyounces,* or *a sufficient quantity;* Boiling Water *eight pints.* Dissolve the Carbonate of Potassium in the Water; then gradually add Bitartrate of Potassium to the solution until it is completely saturated, and boil. Filter the liquid, evaporate it until a pellicle forms, and set it aside to crystallize. Lastly, pour off the mother-water, and, having dried the crystals on bibulous paper, keep them in a well-stoppered bottle." *U. S.* 1870.

test-solution of ammonium oxalate (absence of calcium). On adding nitric acid to a one per cent. solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield no precipitate with test-solution of barium chloride (sulphate), and, at most, only a cloudiness with test-solution of silver nitrate (limit of chloride). If 2.938 Gm. of Potassium Tartrate are ignited till gases cease to be evolved, the alkaline residue should require, for complete neutralization, not less than 25 C.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure Potassium Tartrate)." *U. S.* 1880. "In small colorless four- or six-sided prisms. It is soluble in its own weight of *water*. It affords the reactions characteristic of potassium and of tartrates. Each gramme of the dry salt, heated to redness till gases cease to be evolved, should leave an alkaline residue, which, when treated with *water*, filtered, and well washed, yields a clear solution requiring for exact neutralization 8.4 cubic centimetres of the *volumetric solution of sulphuric acid*. It should yield no characteristic reaction with the tests for lead, copper, or iron, and only the slightest reactions with the tests for calcium, magnesium, sodium, chlorides, or sulphates. The aqueous solution has no action on *litmus* (absence of acid potassium tartrate)." *Br.* Potassium tartrate is composed of two atoms of potassium combined with the dyad group $C_4H_4O_6$ characteristic of tartaric acid.

Uses.—Potassium tartrate is a mild, cooling purgative, operating, like most of the neutral salts, without much pain, and producing watery stools. It is applicable to *febrile diseases*, and is occasionally combined with senna, the griping effects of which it has a tendency to obviate.

Dose, from a drachm to an ounce (3.9 to 31 Gm.).

POTASSIUM.

POTASSIUM

(pŏ-tăs'sĭ-ŭm)

K = 38.86

Potassium, *Fr.*; Kalium, Kalimetall, *G.*; Potassio, *It.*; Potasico, *Sp.*

Potassium is a metal forming the radical of potassium hydroxide, and of a number of compounds used in medicine. It was discovered in 1807 by H. Davy, who obtained it by decomposing fused potassium hydroxide by a voltaic current. It was afterwards procured in larger quantity by Gay-Lussac and Thénard, by bringing the fused alkali in contact with white-hot iron, which attracted the oxygen and set free the metal. The process of Brunner, as modified by Wöhler, consists in decomposing potassium carbonate, mixed with charcoal. The mixture of carbonate and charcoal is obtained by heating cream of tartar to redness in a covered crucible. For an account of some improvements in Brunner's process by Mareska and Donny, see *A. J. P.*, xxv. 70. Castner has also prepared it by the process invented by him for the manufacture of metallic sodium. (See *Sodium*.)

Potassium is solid, softer and more ductile than wax, easily cut with a knife, and of a silver-white color. A newly-cut surface is brilliant, but the metal quickly tarnishes by combining with the oxygen of the air, and assumes the appearance of lead. It possesses a remarkably strong affinity for oxygen, and is capable of taking that element from almost every other substance. On account of this property it must be kept in liquids, such as naphtha, which are devoid of oxygen. On the same account, when exposed with a freshly cut surface to the air, it becomes luminous through a slow combustion, like phosphorus, in the dark. (*Chem. News*, Feb. 28, 1868, p. 108.) Its sp. gr. is 0.865, melting point 62.5° C. (144.5° F.), atomic weight 38.86, and symbol K. When thrown upon water it floats, takes fire, and burns with a rose-colored flame, combining with oxygen, and generating potassium hydroxide which dissolves in the water. It forms numerous combinations, uniting with most of the non-metallic elements, and with several of the metals. It combines in three proportions with oxygen, forming a suboxide (K_4O) and a monoxide (K_2O) of a gray color, and a tetroxide (K_2O_4) of a yellowish-brown color. It also unites with chlorine, and forms official compounds with iodine, bromine, cyanogen, and ferrocyanogen, under the names of potassium iodide, bromide, cyanide, and ferrocyanide. Its monoxide is a strong salifiable base existing in nature always in combination, and forming with acids a numerous and important class of salts.

PRUNUM. U. S., Br.

PRUNE

(prû'nŭm)

"The partly dried ripe fruit of *Prunus domestica* Linné (Fam. *Rosaceæ*)." *U. S.* "The dried ripe fruits of Prunus domestica, *Linn., var.* Juliana, *DC.*" *Br.*

Prunes; Pruneau noir, *Fr. Cod.*; Pflaume, Zwetsche, *G.*

Prunus domestica, Willd., *Sp. Plant.* ii. 995; Woodv., *Med. Bot.* p. 520, t. 17.—The cultivated prune or plum tree is so well known as to render a minute description unnecessary. We give merely the specific character. "*Peduncles* subsolitary; *leaves* lanceolate-ovate, convolute; *branches* not spiny." The varieties of the tree produced by cultivation are very numerous. Nearly one hundred are to be found in the British gardens. Though at present growing wild in various parts of Europe, it is thought to have been brought originally from Asia Minor and Syria. It is the dried fruits only that are official. They are officially described as "oblong, ellipsoidal, more or less compressed, 3 to 4 Cm. long; externally brownish-black, shriv-

elled; the sarcocarp sweet and acidulous; putamen hard, smooth or irregularly ridged; the seed, shaped like that of the almond but smaller, and of a bitter-almond taste." *U. S.* The prunes brought to our market come chiefly from the south of France, the best from Bordeaux. They are derived from the variety of the tree named *Juliana* by Linnæus. The fresh fruit, called *Prune de Saint-Julien* by the French, is of an oval shape, nearly an inch in length, and of a deep violet color. It is prepared by drying in the sun, after having been exposed to the heat of an oven. The finest prunes, used on the tables in France, are prepared from the larger kinds of plums, such as the *Saint Catharine,* and *Reine Claude* or *greengage.* An inferior sort is brought from Germany.

Prunes have a feeble odor, and a sweet mucilaginous taste, which is generally also somewhat acid. They contain uncrystallizable sugar, malic acid, and mucilaginous matter. The following is given as the average of nine analyses of dried prunes. Water 29.30 per cent., nitrogenous material 2.35 per cent., fat 0.53 per cent., free acid 2.72 per cent., sugar 44.35 per cent., other nitrogen-free material 17.89 per cent., woody fibre (not including the stone) 1.48 per cent., ash 1.38 per cent. (König, *Nahrungsmittel,* ii. 397, 1880.) In Hungary a kind of brandy (*Zwetschenbranntwein*), containing about 40 per cent. of alcohol, is obtained from them, which in some districts is largely consumed. Bonneberg, a German chemist, has extracted from prunes crystallizable sugar equal to that of the cane.

Uses.—Prunes are laxative and nutritious, and, stewed with water, form an excellent diet in *costiveness.* Imparting their laxative property to boiling water, they serve as a pleasant and useful addition to purgative decoctions. Their pulp is used in the preparation of laxative confections. Too largely taken, they are apt to occasion flatulence, griping, and indigestion.

Off. Prep.—Confectio Sennæ, *U. S., Br.*

PRUNUS VIRGINIANA. U. S. (Br.)

WILD CHERRY

(prū′nŭs vĭr-ǧĭn-ị-ā′nạ)

"The bark of *Prunus serotina* Ehrhart (*Prunus virginiana* Miller) (Fam. *Rosaceæ*), which should be collected in autumn and carefully dried and preserved." *U. S.* "The bark of Prunus serotina, *Ehrh.,* collected in autumn." *Br.*

Pruni Virginianæ Cortex, *Br.,* Virginian Prune Bark; Rum, Whisky, or Cabinet Cherry, Wild Black Cherry; Ecorce de Cerisier de Virginie, *Fr.;* Wildkirschenrinde, Amerikanischer Zierstrauch, *G.*

The genus Prunus now includes the plums, almonds, peaches, apricots, and cherries, and comprises about one hundred and twenty species. They are generally distributed in the temperate regions of the northern hemisphere. In the United States there are about forty indigenous species.

Prunus serotina, Ehrhart; Watson's *Bibliographical Index.—Cerasus* (not *Prunus*) *serotina,* Loiseleur. *Nouv. Duhamel* (1812), v. 3.; De Candolle, *Prodrom.* ii. 540.—*Cerasus virginiana,* Michaux, *Fl. Bor.-Am.,* i. 285.—The name *P. virginiana* was applied by Miller (*Dict.,* ed. 8, No. 3), and not Linnæus, to *P. serotina,* Ehr. *P. virginiana,* L., commonly called *wild cherry* or *choke cherry,* is distinguished from *P. serotina,* Ehr., known more properly as *wild black cherry,* by the following characteristics: *P. virginiana,* L., has deciduous calyx lobes; oblong-obovate pointed endocarp (or stone); leaves broadly oval to oblong-obovate, and usually abruptly acuminate; inner bark with a rather disagreeable odor. *P. serotina,* Ehr., has persistent calyx lobes; the endocarp (or stone) oblong-obovate, usually gradually acuminate; leaves oblong or lanceolate-oblong, usually gradually acuminate; the inner bark and leaves possess an aromatic odor. The British name for the bark is misleading; Virginian Peach Bark or Virginian Almond Bark would have been no more of a misnomer. The official species is, according to Michaux, one of the largest productions of the American forest. Trees were observed by that botanist on the banks of the Ohio, from eighty to one hundred feet high, with trunks from twelve to fifteen feet in circumference, and undivided to the height of twenty-five or thirty feet. But as usually met with in the Atlantic States the tree is much smaller. In the open fields it is less elevated than in forests, but sends out more numerous branches, which expand into an elegant oval summit. The trunk is regularly shaped, and covered with a rough blackish bark, which detaches itself semicircularly in thick narrow plates. The leaves are alternate, oval-oblong, or lanceolate-oblong, acuminate, unequally serrate, smooth on both sides, of a beautiful brilliant green; the petioles are furnished with one or more reddish conspicuous glands. The flowers are small, white, and occur in long erect or spreading racemes. They appear in May, and are followed by globular drupes, about the size of a pea, and when ripe of a shining blackish-purple color. For a paper on the structure of species of Prunus, by E. S. Bastin, see *Proc. A. Ph. A.,* 1895, 211.

This tree is distributed from Nova Scotia south to Florida, and westward to Dakota, Nebraska, Kansas, Indian Territory, and Eastern Texas. It extends along the mountain ranges of Western Texas, Mexico, and Pacific regions of Central America, Colombia, and Peru. In the United States it was once common throughout the Appalachian region. In the neighborhood of Philadelphia it affects open situations, growing solitarily in the fields and along fences, and seldom aggregated in woods or groves. It is highly valued by the cabinet-makers for its wood, which is compact, fine-grained, susceptible of polish, and of a light red tint which deepens

with age. The leaves have been found by Procter to yield volatile oil and hydrocyanic acid on distillation, and in such proportion that a water distilled from them might with propriety be substituted for the cherry-laurel water. (*Proc. A. Ph. A.*, 1858, 325.) The fruit has a sweetish, astringent, bitter taste, and is much used in some parts of the country to impart flavor to spirituous liquors. The bark is obtained indiscriminately from all parts of the tree, though that of the roots is thought to be most active. The revisers of the Pharmacopœia believe with J. S. Perot that the bark is stronger when collected in autumn than in the spring; from a portion gathered in April Perot obtained 0.0478 per cent. of hydrocyanic acid, and from another in October 0.1436 per cent., or about three times as much. (*A. J. P.*, xxiv. 111.) The bark should be preferred recently dried, as it deteriorates by keeping. A. B. Stevens (*Proc. A. Ph. A.*, 1895, 226; 1896, 215), after testing many specimens, reached the conclusion that bark procured from different parts of the same tree varied in the yield of hydrocyanic acid, the value being in this order; 1, root; 2, twigs; 3, trunk; the bark from young trees yielding more glucoside than that from old trees. Jos. L. Lemberger (*A. J. P.*, 1872, 303) has found that the bark yields the darkest infusion in April, October, and November, and the lightest in January and August, and believes that he has demonstrated that the coloration is due to tannic acid. According, therefore, to this investigation, tannic acid is most abundant in the bark in October and November. On the other hand, Grace E. Cooley (*A. J. P.*, August, 1897) concludes that there is more tannic acid in the bark during the active growth of the spring than in the autumn. She further states that in the spring and autumn the bark contains its maximum percentage of starch; so that if the bark, whether powdered or whole, contains much starch in its parenchymatous cells, it has been collected after the time of leaf-fall in the autumn or before the unfolding of the leaves in the spring. Occasionally barks find their way into commerce as Prunus Virginiana which yield no odor of hydrocyanic acid when moistened and are probably obtained from other than the official wild cherry. (See Bastin, *A. J. P.*, 1895, and Finnemore, *P. J.*, 72.)

Properties.—Wild cherry bark is officially described as follows. "Usually in transversely curved pieces from 3 to 7 Cm. long, 0.5 to 4 Mm. thick; outer surface pale green to greenish-brown, smooth, with numerous lenticels; inner surface light brown, somewhat reticulately striate or fissured; fracture short, granular; having a bitter-almond-like odor when macerated in water; taste astringent, aromatic, and agreeably bitter." *U. S.* It is brittle and pulverizable, presenting a reddish gray fracture, and affording a fawn-colored powder. In the fresh state, or when treated with water, it emits an odor resembling that of peach leaves. Its taste is agreeably bitter and aromatic, with the peculiar flavor of the bitter almond. It imparts its sensible properties to water, either cold or hot, producing a clear reddish infusion closely resembling Madeira wine in appearance. Its peculiar flavor and its medicinal virtues are injured by boiling, in consequence partly of the volatilization of the principles upon which they depend, partly upon a chemical change effected by the heat. On microscopical examination it is seen to be chiefly composed of brown parenchymatous tissue containing numerous crystals, sometimes aggregated into tufts, and enclosing numerous groups of very thick-walled sclerenchymatous cells of irregular outline. The medullary rays are usually distinct. From an analysis by Stephen Procter, it appears to contain starch, resin, tannin, gallic acid, fatty matter, lignin, red coloring matter, salts of calcium, potassium, and iron. He obtained also a volatile oil, associated with hydrocyanic acid, by distilling the same portion of water successively from several different portions of the bark. William Procter proved that, as in the case of bitter almonds, the volatile oil and hydrocyanic acid do not exist ready formed in the bark, but are the result of the reaction of water with amygdalin, which he ascertained to be one of its constituents. In order, however, that this change may take place, the agency of another principle, probably analogous to if not identical with *emulsin* or the *synaptase* of Robiquet, is also essential, and, as this principle becomes inoperative at the boiling temperature, we can understand how decoction may interfere with the virtue of the bark. (*A. J. P.*, x. 197.) Phlorizin has not been found, so that the tonic property which is undoubtedly possessed by the bark must reside either in the portion of amygdalin which may remain undecomposed, in the pure volatile oil resulting from its reaction with water, or in some yet undiscovered principle. (*Ibid.*, xxiv. 111.) That the last of these inferences is the correct one would seem to be proved by an experiment by Procter, who found the bitterness of an extract of the bark to remain after it had been wholly deprived of amygdalin. The sedative properties of the bark depend upon the hydrocyanic acid which it yields. Stevens and Judy (*A. J. P.*, 1895, 482 and 534) found that the thick bark contains more amygdalin and consequently yields more HCN than the thin bark. The thick bark contains amygdalin, etc., 4.12 per cent., and HCN from 0.32 to 0.35 per cent.; the thin bark, amygdalin. etc., 3.16 per cent., and HCN from 0.24 to 0.27 per cent.

R. Rother (*A. J. P.*, 1887, p. 286), in searching for the fluorescent principle of wild cherry bark, obtained a reddish crystalline substance, soluble in water, chloroform, ether, and alcohol, the solution of which fluoresced strongly on addition of ammonia. Rother says that it does not agree in crystalline form with mandelic acid, but may be a derivative of it. F. B. Power and Henry Weimer, on the other hand,

state that the bark does not contain crystallizable amygdalin, that the ferment principle is not emulsin, and that it cannot be isolated by an analogous process. The bitter principle, which appears to be the fluorescent substance, has the character of a glucoside, and crystallizes in colorless needles. (*West. Drug.*, 1887, p. 331.)

Uses.—Uniting with a tonic power the property of calming irritation and diminishing nervous excitability, this bark is theoretically adapted to the treatment of diseases in which *debility of the stomach* or of the *system* is united with *general or local irritation;* and when very largely taken it diminishes the action of the heart. Thus, Eberle found copious draughts of the cold infusion, taken several times a day, and continued for nearly two weeks, to reduce his pulse from seventy-five to fifty strokes in the minute. But in the doses usually prescribed, the remedy is too feeble to exert much influence. Nevertheless, it has been much employed in this country, in the *hectic fever* of *scrofula* and *consumption*. The dose of the infusion, which is properly directed in the Pharmacopœia to be prepared with cold water, is two or three fluidounces (60 or 90 Cc.); of the fluidextract, a fluidrachm (3.75 Cc.); and of the syrup,[1] half a fluidounce (15 Cc.).

Dose, from thirty to sixty grains (2.0 to 3.9 Gm.).

Off. Prep.—Fluidextractum Pruni Virginianæ, *U. S.;* Infusum Pruni Virginianæ, *U. S.;* Syrupus Pruni Virginianæ, *U. S., Br.;* Tinctura Pruni Virginianæ, *Br.*

PULVERES.

POWDERS

(pŭl′vẹ-rēṣ)

Poudres, *Fr.;* Pulvern, *G.;* Polveri, *It.;* Polvos, *Sp.*

The form of powder is convenient for the exhibition of substances which are not given in very large doses, are not very disagreeable to the taste, have no corrosive property, and do not deliquesce rapidly on exposure. As the effect of pulverization is to expose a more extended surface to the action of the air, care should be taken to keep substances which are liable to be injured by such exposure in closely-stoppered bottles. In many instances it is also important to exclude the light, which exercises a deleterious influence over numerous medicines when minutely divided. This may be done by coating the bottles with black varnish, or by using amber-colored glass bottles which exclude the injurious rays of light.

In relation to substances most liable to injury from these causes, the best plan is to powder them in small quantities as wanted for use.[1]

Powders may be divided into the *simple,* consisting of a single substance, and the *compound,* of two or more mixed together. The latter only are embraced under the present head. In the preparation of the compound powders, the ingredients, if of different degrees of cohesion or solidity, should be pulverized separately and then mixed. Deliquescent substances, and those containing fixed oil in large proportion, should not enter into the composition of powders intended to be kept,—the former because they render the preparation damp and liable to spoil, the latter because they are apt to become rancid and impart an unpleasant odor and taste. When deliquescent substances are extemporaneously prescribed, the apothecary should enclose them before delivery in waxed paper or other impervious covering; and the same remark is applicable to volatile powders, as ammonium carbonate and camphor. The lighter powders may in general be administered in water or other thin liquid; the heavier, such as those of metallic substances, require a more consistent vehicle, as syrup, molasses, honey, or one of the confections. Resinous powders, if given in water, require the intervention of mucilage or sugar. For many powders the *cachet de pain* affords the best method of administration.[2]

[1] *Tinctura Pruni Virginianæ B. P. C.*—Take of wild-cherry bark (from *Prunus serotina,* Ehrhart, collected in autumn), in No. 20 powder, 4 ounces; distilled water, 7½ fluidounces. Macerate for twenty-four hours, in a closed vessel, and add: Rectified spirit, 12½ fluidounces. Macerate for seven days; then express, filter, and add sufficient proof spirit to make 1 pint. (*Proc. A. Ph. A.*, 1888, p. 285.)

[1] With regard to keeping powders in well-stoppered bottles, it is asserted by Hérouard, a French pharmacist, that this plan, instead of preserving *some* powders, tends to their more speedy and certain change. Whatever pains may be taken in drying drugs previously to powdering them, most of them during the process attract moisture, so as to put themselves in this respect in equilibrium with the surrounding air; and, if enclosed in this state in air-tight vessels, they are exposed to injurious influence from their own absorbed water, which, vaporized in hot weather, is in the colder seasons condensed on the inner surface of the vessel and determines a movement of fermentation, and even cryptogamic growths appear in some instances. The best method of preservation, the author thinks, is to enclose the powders in strong paper bags of a blue or gray color, so as to exclude the light, while the air has exit or entrance through the porous walls. Whatever may be our theoretical opinions on the point, Hérouard asserts the fact, as the result of observation, that powders keep best in this way, and his statement coincides with our own experience. The powders may be more likely to cake or harden into aggregate masses; but this disadvantage is easily counteracted by a new pulverization when required. (*J. P. C.*, Août, 1862, p. 98.) From these statements the inference may be drawn that, where powders are kept in air-tight bottles, they should be thoroughly dried, after pulverization, before being enclosed, and many, such as ergot, rhubarb, etc., should be kept in paper boxes or cartons.

[2] *Cachets.*—These very useful articles are wafers made of unleavened bread in such a manner that they offer a concavity, so that when two are placed face to face there is a space in which a powder may be contained. They are of different sizes and capacities, the largest readily holding as much as ten grains of quinine. In filling them, one wafer is placed upon a board, and the requisite amount of medicine is put in it; then a second wafer, whose interior margin has been wetted, is laid upon the first and pressed down upon it. When taken, they should be dipped in water, placed immediately upon a teaspoon containing a little water, and swallowed with a gulp of fluid. For most powders of disagreeable taste, cachets afford the best method of administration.

In the act of powdering, the whole substance in the mortar should not be beaten until completely pulverized, as the portion already powdered interferes with the action of the pestle upon the remainder, while the finer matter is apt to be dissipated, so that there is a loss of time and of material. The proper plan is to sift off the fine powder after a short continuance of the process, then to return the coarser parts to the mortar, and to repeat several times this alternate pulverization and sifting, until the process is completed. Care should be taken to mix thoroughly the several portions of fine powder thus obtained.

PULVIS ACETANILIDI COMPOSITUS. U. S.

COMPOUND ACETANILIDE POWDER

(pŭl'vĭs ăç-ē-tăn-ĭ-lī'dī cŏm-pŏs'ĭ-tŭs)

Poudre d'Acétanilide composée, *Fr.*; Zusammengesetztes Antifebrinpulver, *G.*

"Acetanilide, *seventy grammes* [or 2 ounces av., 205 grains]; Caffeine, *ten grammes* [or 154 grains]; Sodium Bicarbonate, *twenty grammes* [or 309 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Reduce the ingredients separately to a fine powder and mix them thoroughly." *U. S.*

This compound powder was introduced into the U. S. P. (8th Rev.) in order to afford a convenient formula for administering acetanilide.

Uses.—This formula represents the essential composition of most of the proprietary headache powders, and is useful in the treatment of *migraine* and *neuralgia*.

Dose, five to ten grains (0.32 to 0.65 Gm.).

PULVIS AMYGDALÆ COMPOSITUS. Br.

COMPOUND POWDER OF ALMONDS

(pŭl'vĭs ă-mĭg'dă-læ cŏm-pŏs'ĭ-tŭs)

Confectio Amygdalæ; Conserva Amygdalarum; Confection of Almond; Conserve d'Amandes, *Fr.*; Mandelconserve, *G.*

"Sweet Almonds, 8 *ounces* (Imperial) or 200 grammes; Refined Sugar, in powder, 4 *ounces* (Imp.) or 100 grammes; Gum Acacia, in powder, 1 *ounce* (Imp.) or 25 grammes. Steep the Almonds in water until their skins can easily be removed; when thus blanched, dry them as far as possible with a cloth, and then thoroughly by exposure in a warm place for twenty-four hours; rub them lightly in a mortar to a smooth consistence; mix the Gum Acacia and the Sugar; add this mixture, gradually, to the bruised Almonds; rub the whole to a coarse powder." *Br.*

This is the old *Almond Confection* under a new name. It is intended to afford a speedy method of preparing the almond mixture, which, when made immediately from the almonds, requires much time, and which cannot be kept ready made. But from its liability to be injured by keeping, it was omitted from the U. S. Pharm., which directs the emulsion of almond to be made immediately from the ingredients.

Off. Prep.—Mistura Amygdalæ, *Br.*

PULVIS ANTIMONIALIS. Br.

ANTIMONIAL POWDER [James's Powder]

(pŭl'vĭs ăn-tĭ-mō-nī-ā'lĭs)

Pulvis Antimonii Compositus, Pulvis Jacobi; Poudre antimoniale de James, *Fr.*; Jamessches Antimonpulver, *G.*

"Antimonious Oxide, 1 *ounce* (Imperial) or 25 grammes; Calcium Phosphate, 2 *ounces* (Imp.) or 50 grammes. Mix." *Br.*

This preparation was introduced into the U. S. Pharmacopœia 1890 as a substitute for the different forms of antimonial powder formerly official with the British Colleges, because of its revived employment at that time, but was not admitted to the U. S. P. (8th Rev.). The U. S. P. 1890 and the British preparations are identical. In order that the subject may be properly understood, it will be necessary to introduce a notice of the powder as formerly directed to be prepared by the London and Dublin Colleges; the process of the Edinburgh College was so similar to the London that it does not require special consideration.

Antimonial Powder of the London College. "Take of Tersulphate of Antimony, powdered, *a pound;* Horn shavings *two pounds.* Mix, and throw them into a red-hot crucible, and stir constantly until vapor ceases to rise. Rub the residue to powder, and put it into a crucible. Then apply heat, and raise it gradually to redness, and keep it so for two hours. Rub the remaining powder until it is as fine as possible." *Lond.*

This preparation consists mainly of calcium bone phosphate, or calcined bone, mixed with antimonous acid, and is intended to furnish a substitute for the celebrated nostrum of James, an English physician who died in 1776, and after whom the original preparation was called *James's powder.* Pearson of London, found the genuine powder, on analysis, to consist of calcium phosphate and oxidized antimony, and, guided by his results, devised the formula adopted by the London College. By burning the materials directed by the College, the sulphur is expelled in the form of sulphurous acid, and the antimony oxidized, while the horn, which is of the nature of bone, has its animal matter converted into charcoal. By the subsequent calcination the charcoal is dissipated, leaving only the calcium phosphate of the horn mixed with the antimony oxide.

The antimonial powder made by this formula is a tasteless, inodorous, gritty powder, of a dull white color. As often prepared, it is insoluble in water, but usually a small portion, consisting of antimonite and acid calcium

phosphate, dissolves in boiling distilled water. Its composition varies exceedingly, a circumstance which forms a strong objection to it as a medicine. When entirely insoluble in boiling water, it probably contains nothing but antimonous acid and calcium phosphate, for when its soluble constituents are absent the trioxide is absent also.

The only essential difference between the official and the Dublin powder is that the ingredients of the former are taken already prepared and mixed in fixed proportion, while those of the latter result simultaneously from one operation. The official powder is, of course, much more easily prepared, and less liable to uncertainty from any error in the process.[1]

Uses.—This preparation is stated to be alterative, diaphoretic, purgative, or emetic, according to the dose in which it is given. Until within a few years it was often prescribed in febrile diseases, with a view to its diaphoretic effect. According to A. T. Thomson, it is advantageously given in *acute rheumatism,* conjoined with camphor, calomel, and opium, and with calomel and guaiac in several *cutaneous affections.* The estimation in which this preparation is held varies greatly; but it is generally admitted that, as formerly prepared, it was very uncertain in the percentage of antimony trioxide, and consequently in its activity; it was this uncertainty that led to its omission from the U. S. Pharm. of 1830.

The antimonial powder at present official is exempt from the objection of irregularity of composition. Nevertheless, as it depends for its greater or less energy on the presence or absence in the alimentary canal of an acid which may form a salt with the antimonial oxide, it cannot always be relied on for a definite effect, being sometimes mild, and sometimes more active than might be desirable.

Dose, as a diaphoretic, from three to eight grains (0.2 to 0.5 Gm.) every third or fourth hour, given in the form of pill. In larger doses it is purgative and emetic. Jonathan Osborne has found the trioxide, given separately in three grain (0.2 Gm.) doses, evening and night, to cause in some cases nausea and vomiting, in others mild purgation. (*P. J.,* 1855, p. 331.)

PULVIS AROMATICUS. U. S. (Br.)

AROMATIC POWDER

(pŭl'vĭs ăr-o-măt'ĭ-cŭs)

Pulvis Cinnamomi Compositus, *Br.;* Compound Powder of Cinnamon; Poudre des Epices, P. des Aromates, Poudre aromatique, *Fr.;* Aromatisches Pulver, Gewürzpulver, *G.*

* "Saigon Cinnamon, in No. 60 powder, *thirty-five grammes* [or 1 ounce av., 103 grains]; Ginger, in No. 60 powder, *thirty-five grammes* [or 1 ounce av., 103 grains]; Cardamom, deprived of pericarps and crushed, *fifteen grammes* [or 231 grains]; Myristica, in No. 20 powder, *fifteen grammes* [or 231 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Cardamom and Myristica with a portion of the Saigon Cinnamon, until they are reduced to a fine powder; then add the remainder of the Saigon Cinnamon and the Ginger, and rub them together until they are thoroughly mixed." *U. S.*

"Cinnamon Bark, in powder, 1 *ounce* (Imperial) or 25 grammes; Cardamom Seeds, in powder, 1 *ounce* (Imp.) or 25 grammes; Ginger, in powder, 1 *ounce* (Imp.) or 25 grammes. Mix." *Br.*

The Aromatic Powder of the U. S. P. (8th Rev.) does not differ essentially from that formerly official. The British and American powders now closely resemble each other. The present British formula differs from that of 1864 in the substitution of ginger for nutmeg, cloves, and saffron, and especially in the absence of sugar, which in the latter constituted two-thirds of the whole, having probably been added in order that, by the addition of a little water to the powder, a confection might be quickly made, thus enabling the dispensing of a fresh preparation. It is obvious that this end may be as effectually attained by the addition of a little syrup to the present powder.[1] The cardamom seeds should always be deprived of their pericarps before being weighed, and the powder, when prepared, should be kept in well-stoppered bottles. The aromatic powder is stimulant and carminative, and the U. S. preparation may be given in the dose of from ten to thirty grains (0.65 to 2.0 Gm.), in cases of *enfeebled digestion with flatulence;* but it is chiefly used as a corrigent and adjuvant of other medicines. A mixture of aromatic powders in the form of a cataplasm is much used as a mild rubefacient, especially in nausea and vomiting, being applied over the epigastrium. Such mixtures are commonly called *spice plasters.* The following is a good formula. Take of ginger, cloves, cinnamon, and black pepper, each, in powder, an ounce; tincture of ginger half a fluidounce; honey a sufficient quantity. Mix the powders, and then add the tincture and honey, so as to form a stiff cataplasm; or the mixed powder may be distributed in a thin flannel bag, quilted in position, and the whole wet with bathing whisky when applied and covered with oiled silk.

Dose, ten to thirty grains (0.65 to 2.0 Gm.).

[1] Michael Donovan believes that none of the official formulas fairly represent James's powder, and gives an elaborate history of this celebrated proprietary medicine, and a method for its preparation, in *P. J.,* 1869.

[1] *Aromatic Sugar.*—Wm. L. Turner proposed a mode of obtaining the effects of the aromatic powder in certain cases where the use of the powder itself would be inconvenient. He prepared an aromatic sugar by submitting eight ounces of the freshly prepared powder to percolation with stronger alcohol to exhaustion, pouring the percolate over eight ounces of sugar, and evaporating at a low heat. The sugar thus prepared may be added to mixtures, solutions, etc., requiring aromatic addition. (*A. J. P.,* 1869, p. 118.)

Off. Prep.—Fluidextractum Aromaticum, *U. S.;* Pilulæ Aloes et Ferri, *U. S.* (*Br.*); Pilulæ Aloes et Myrrhæ, *U. S.;* Pilula Cambogiæ Composita, *Br.*

PULVIS CATECHU COMPOSITUS. Br.

COMPOUND POWDER OF CATECHU

(pŭl'vĭs kăt'ę-ȼhū cǫm-pŏs'ĭ-tŭs)

Poudre de Cashcuttle composée, *Fr.;* Zusammengesetztes Katechupulver, *G.*

"Catechu, in powder, 4 *ounces* (Imperial) or 100 grammes; Kino, in powder, 2 *ounces* (Imp.) or 50 grammes; Krameria Root, in powder, 2 *ounces* (Imp.) or 50 grammes; Cinnamon Bark, in powder, 1 *ounce* (Imp.) or 25 grammes; Nutmeg, in powder, 1 *ounce* (Imp.) or 25 grammes. Mix." *Br.*

The *dose* of this agreeable preparation is from fifteen to thirty grains (1 to 2 Gm.).

PULVIS CRETÆ AROMATICUS. Br.

AROMATIC POWDER OF CHALK

(pŭl'vĭs crē'tæ ăr-ǫ-măt'ĭ-cŭs)

Confectio Aromatica, *Lond.;* Poudre de Craie aromatique, *Fr.;* Gewürztes Kreidepulver, *G.*

"Cinnamon Bark, in powder, 4 *ounces* (Imperial) or 80 grammes; Nutmeg, in powder, 3 *ounces* (Imp.) or 60 grammes; Cloves, in powder, 1½ *ounces* (Imp.) or 30 grammes; Cardamom Seeds, in powder, 1 *ounce* (Imp.) or 20 grammes; Refined Sugar, in powder, 25 *ounces* (Imp.) or 500 grammes; Prepared Chalk, 11 *ounces* (Imp.) or 220 grammes. Mix." *Br.*

This is the former "Aromatic Powder" of the Br. Pharmacopœia, with the addition of chalk and elision of saffron. It is a warm stimulant and astringent, as well as antacid, and is well calculated for *diarrhœa* connected with acidity and without inflammation. In such a combination, however, the due proportion and even the choice of the ingredients vary so much with the symptoms that they might well be left to extemporaneous prescription.

Dose, from thirty to sixty grains (2.0 to 3.9 Gm.), in mucilage or sweetened water, frequently repeated.

Off. Prep.—Pulvis Cretæ Aromaticus cum Opio, *Br.*

PULVIS CRETÆ AROMATICUS CUM OPIO. Br.

AROMATIC POWDER OF CHALK WITH OPIUM

(pŭl'vĭs crē'tæ ăr-ǫ-măt'ĭ-cŭs cŭm ō'pĭ-ō)

Poudre de Craie Opiacée, *Fr.;* Kreidepulver mit Opium, *G.*

"Aromatic Powder of Chalk, 9¾ *ounces* (Imperial) or 39 grammes; Opium, in powder, ¼ *ounce* (Imp.) or 1 gramme. Mix. This Powder contains 2½ per cent. of Opium." *Br.*

The addition of the opium greatly increases the efficacy of the compound powder of chalk in *diarrhœa,* and its equal diffusion through the powder presents this advantage, that it may be conveniently given in minute doses applicable to infantile cases. Forty grains of the powder contain a grain of opium. In the *diarrhœa* of adults ten to twenty grains (0.65 to 1.3 Gm.) may be given for a *dose,* and repeated several times a day, or after each evacuation.

PULVIS CRETÆ COMPOSITUS. U. S.

COMPOUND CHALK POWDER

(pŭl'vĭs crē'tæ cǫm-pŏs'ĭ-tŭs)

Poudre de Craie composée, *Fr.;* Kreidepulver mit Gummi, *G.*

• "Prepared Chalk, *thirty grammes* [or 1 ounce av., 25 grains]; Acacia, in fine powder, *twenty grammes* [or 309 grains]; Sugar, in fine powder, *fifty grammes* [or 1 ounce av., 334 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Mix intimately." *U. S.*

This official powder was introduced into the U. S. P. 1890, for the purpose of having on hand, in a convenient form, the dry powders necessary to make chalk mixture. (See *Mistura Cretæ.*)

This powder will be found, however, a very convenient basis for administering chalk in powder, and it will be easy to direct the addition of morphine, kino, pepsin, bismuth subnitrate, or any other suitable agent.

Dose, one-half to two drachms (2.0 to 7.7 Gm.).

Off. Prep.—Mistura Cretæ, *U. S.*

PULVIS EFFERVESCENS COMPOSITUS. U. S. (Br.)

COMPOUND EFFERVESCING POWDER [Seidlitz Powder]

(pŭl'vĭs ĕf-fęr-vĕs'cęns cǫm-pŏs'ĭ-tŭs)

Pulvis Sodæ Tartaratæ Effervescens, *Br.;* Effervescent Tartarated Soda Powder; Pulveres Effervescentes Aperientes, *U. S.* 1870; Seidlitz Powders; Poudre Gazogène laxative, *Fr. Cod.;* Poudre gazifère purgative, Poudre de Sedlitz, *Fr.;* Pulvis aërophorus laxans, *P. G.;* Pulvis aërophorus Seidlitzensis, Abführendes Brausepulver, Seidlitzpulver, *G.;* Polvo gasifero laxante, *Sp.*

• "Sodium Bicarbonate, dried and in fine powder, *thirty-one grammes* [or 1 ounce av., 41 grains]; Potassium and Sodium Tartrate, dried and in fine powder, *ninety-three grammes* [or 3 ounces av., 123 grains]; Tartaric Acid, dried and in fine powder, *twenty-seven grammes* [or 417 grains]. Mix the Sodium Bicarbonate intimately with the Potassium and Sodium Tartrate, divide the mixture into *twelve equal parts,* and wrap each part in a separate blue paper. Then divide the Tartaric Acid into *twelve equal parts,* and wrap each part in a separate white paper. Keep the powders in well-closed containers, in a dry place." *U. S.*

"Sodium Potassium Tartrate, in dry powder, 120 *grains* or 7.77 grammes; Sodium Bicar-

bonate, in dry powder, 40 *grains* or 2.59 grammes. Mix. Wrap in blue paper. Tartaric Acid, in dry powder, 38 *grains* or 2.46 grammes. Wrap in white paper. *Dose, for a draught.*—The alkaline powder (in blue paper) dissolved in nearly half a pint of cold or warm water, and the acid powder (in white paper) then added." *Br.*

The British Pharmacopœia, under the name of *Pulvis Sodæ Tartaratæ Effervescens,* introduced in the 1885 revision those well known powders, which are universally called Seidlitz powders. Though named from the saline springs of Seidlitz, in Bohemia, Seidlitz powders do not correspond in composition with those famous waters. Of each pair of powders, one, much the smaller of the two, contains about thirty-five grains (2.25 Gm.) of tartaric acid, the other about forty grains (2.59 Gm.) of sodium bicarbonate mixed with about two drachms (7.7 Gm.) of Rochelle salt. The acid powder is usually put into a white paper, the alkaline into a blue paper, which latter should not be colored by aniline; a number of them are enclosed in a paper or tin box. They should not be kept in a damp place, as the tartaric acid is liable to be dissolved by the moisture and absorbed into the substance of the paper, thus altering the due proportion of the ingredients. We have known the whole of the contents of the white paper thus to disappear in the course of two or three years. The Rochelle salt is the ingredient upon which the aperient property mainly depends. In their administration, each powder is dissolved separately, the smaller in a fluidounce or more of water, the larger in twice or three times the quantity, and the two solutions are mixed gradually. A reaction takes place between the tartaric acid and the sodium bicarbonate, by which sodium tartrate is produced, adding somewhat to the laxative property of the draught, and carbon dioxide escapes, causing a brisk effervescence. The acid is in slight excess, and thus causes an agreeable acidity in the solution. These powders are refrigerant and aperient, and generally very acceptable to the stomach in consequence of the carbon dioxide eliminated. They are especially adapted to *febrile cases* with a somewhat irritable stomach. One pair of them will generally operate slightly, but, if required, two may be given at once, or the dose may be repeated every three or four hours until the desired effect is produced. The flavor may sometimes be advantageously improved by adding syrup of ginger, orange peel, or lemon to one of the solutions before admixture, and most persons prefer to dissolve the salts in very cold water, the saline taste being thereby greatly diminished. A lowering of the temperature always takes place, due to the solution of the salts.[1]

Dose, one set of two powders.

[1] *Pulveres Effervescentes.* U. S. 1870. *Effervescing Powders. Soda Powders. Pulvis Aërophorus Anglicus, P. G.; Poudre gazeuse, P. aërophore, P. de Seltz, Fr.; Brausepulver, G.*—"Take of Bicarbonate of Sodium, in fine powder, *three hundred and sixty grains;* Tartaric Acid, in fine powder, *three hundred grains.* Divide each of the powders into twelve equal parts, and keep the parts, severally, of the Bicarbonate and of the Acid in separate papers of different colors." *U. S.* 1870. *Soda Powders* consist, severally, of twenty-five grains (1.565 Gm.) of the acid in one paper, and thirty (1.95 Gm.) of the bicarbonate in the other. They are administered in solution. An acid and an alkaline powder may be dissolved in separate portions of water and then mixed; or they may be thrown together, or successively, into the same portion of water. The whole draught should be half a pint or somewhat less. It may be rendered more agreeable by adding two or three fluidrachms (7.5 to 11.25 Cc.) of syrup of ginger or orange peel to the water, before dissolving the powders. The rationale is simple. The tartaric acid seizes the alkali of the bicarbonate, forming a sodium tartrate, while the carbon dioxide escapes with effervescence. The effervescing powders are refrigerant and slightly laxative, and afford an agreeable and refreshing drink, suitable to febrile complaints, and generally very acceptable to the stomach.

PULVIS ELATERINI COMPOSITUS. Br.

COMPOUND POWDER OF ELATERIN

(pŭl'vĭs ē-lăt-ę-rī'nī cọm-pōs'ĭ-tŭs)

"Elaterin, 5 *grains* or 1 gramme; Milk Sugar, 195 *grains* or 39 grammes. Triturate in a mortar until a fine powder is produced." *Br.*

This official powder of the British Pharmacopœia is identical with the trituration of elaterin of the United States Pharmacopœia, except that it is of but one-fourth its strength.

The *dose* is given in the British Pharmacopœia as from one to four grains (0.065 to 0.26 Gm.).

PULVIS GLYCYRRHIZÆ COMPOSITUS. U. S., Br.

COMPOUND POWDER OF GLYCYRRHIZA [Compound Licorice Powder]

(pŭl'vĭs glĭç-yr-rhī'zæ cọm-pōs'ĭ-tŭs)

Poudre de Réglisse composée, Poudre pectorale, *Fr.;* Pulvis Liquiritiæ Compositus, *P. G.;* Brustpulver, Pulvis Pectoralis Kurellæ, *G.*

* "Senna, in No. 80 powder, *one hundred and eighty grammes* [or 6 ounces av., 153 grains]; Glycyrrhiza, in No. 80 powder, *two hundred and thirty-six grammes* [or 8 ounces av., 142 grains]; Washed Sulphur, *eighty grammes* [or 2 ounces av., 360 grains]; Oil of Fennel, *four grammes* [or 62 grains]; Sugar, in fine powder, *five hundred grammes* [or 17 ounces av., 279 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix the Oil of Fennel thoroughly with about one-half of the Sugar, then add the remainder of the Sugar and the other ingredients, and mix thoroughly. Finally, pass the powder through a No. 80 sieve, pulverize the residue if any should be left on the sieve, add to the sifted powder, and mix thoroughly. Keep it in well-closed vessels." *U. S.*

"Senna, in fine powder, 2 *ounces* (Imperial) or 50 grammes; Liquorice Root, in fine powder, 2 *ounces* (Imp.) or 50 grammes; Fennel Fruit, in fine powder, 1 *ounce* (Imp.) or 25 grammes;

Sublimed Sulphur, 1 *ounce* (Imp.) or 25 grammes; Refined Sugar, in powder, 6 *ounces* (Imp.) or 150 grammes. Mix." *Br.*

This official preparation, which was introduced into the U. S. P. 1880, was identical with that of the German Pharmacopœia, and in the 1885 revision of the British Pharmacopœia the preparation was made nearly to correspond, being slightly deficient in senna. The U. S. P. 1890 replaced the powdered fennel with oil of fennel, increasing the proportion of powdered licorice correspondingly,—which is an improvement, as powdered fennel is variable in quality; great care should be used, however, to employ only fresh oil of fennel. The object of the oil of fennel is patent, but the advantage to be gained by the use of washed sulphur in the proportion of only 8 per cent. must be purely imaginary. In our opinion, an improvement would be the substitution of two grammes each of powdered cinnamon and cloves for four grammes of the sugar, to correct the griping effect which is frequently produced.

Dose, thirty to sixty grains (2.0 to 3.9 Gm.), used as an agreeable laxative.

PULVIS IPECACUANHÆ ET OPII. U. S. (Br.)

POWDER OF IPECAC AND OPIUM [Compound Powder of Ipecac, Dover's Powder]

(pŭl'vĭs ĭp-ę-căc-ŭ-ăn'hæ ĕt ō'pĭ-ī)

Pulvis Ipecacuanhæ Compositus, *Br., U. S.* 1870; Compound Powder of Ipecacuanha; Poudre d'Ipécacuanha Opiacée, *Fr. Cod.*; Poudre de Dover, *Fr.*; Pulvis Ipecacuanhæ Opiatus, *P. G.*; Doversches Pulver, *G.*; Polvere di oppio e di ipecacuana, Polvere del Dower, *It.*; Polvo de ipecacuana opiado, Polvo de Dower, *Sp.*

• "Ipecac, in No. 60 powder, *ten grammes* [or 154 grains]; Powdered Opium, *ten grammes* [or 154 grains]; Sugar of Milk, in No. 30 powder, *eighty grammes* [or 2 ounces av., 360 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate them together thoroughly and reduce to a very fine powder." *U. S.*

"Ipecacuanha Root, in powder, ½ *ounce* (Imperial) or 10 grammes; Opium, in powder, ½ *ounce* (Imp.) or 10 grammes; Potassium Sulphate, in powder, 4 *ounces* (Imp.) or 80 grammes. Mix." *Br.* This powder contains 10 per cent. of powdered Opium.

The substitution of powdered sugar of milk for potassium sulphate in crystals as formerly used cannot be said to have improved this well-known powder, except in making it more agreeable to the taste. The U. S. process should have directed the powder to be sifted, in order to secure a thorough blending of the ingredients; the sifting should on no account be omitted by the operator. The potassium sulphate or the crystalline sugar of milk serves to promote that minute division and consequent thorough intermixture of the opium and ipecacuanha upon which the peculiar virtues of the compound depend, the potassium sulphate being preferable on account of the greater hardness of its particles. They also serve to dilute the active ingredients, and thus allow of their division into minute doses adapted to the complaints of children. This composition, though called Dover's Powder, does not precisely correspond with that originally recommended by Dover, which was prepared as follows: Four ounces of potassium nitrate and the same quantity of potassium sulphate were mixed in a red hot crucible, and afterwards very finely powdered; one ounce of opium, sliced, was then added, and ground to powder with the saline mixture; lastly, an ounce of ipecac and an ounce of licorice root, in powder, were mixed with the other ingredients. This process was adopted in a former French Codex, and has been retained with little change in the present. For a method of valuing Dover's Powder, by A. B. Prescott, see *A. J. P.*, Dec. 1878.

This powder is an admirable anodyne diaphoretic, applicable to all cases, not attended with much fever, cerebral disease, or sick stomach, in which there is an indication for diaphoresis, especially in painful affections, or in those connected with unhealthy discharges. It is admirably adapted to the *phlegmasiæ*, particularly *rheumatism* and *pneumonia, dysentery, diarrhœa*, etc., when not contra-indicated by existing symptoms. In bowel affections, and whenever the hepatic secretion is deranged, it is frequently combined with small doses of calomel. Ten grains of the powder contain one grain of opium.

Dose, from five to fifteen grains (0.32 to 1.0 Gm.), given diffused in water, or mixed with syrup, or in the form of bolus, and repeated at intervals of four, six, or eight hours, when it is desirable to maintain a continued diaphoresis. Its action may be promoted by warm drinks, such as lemonade or balm tea.

Off. Prep.—Pilula Ipecacuanhæ cum Scilla, *Br.*

PULVIS JALAPÆ COMPOSITUS. U. S., Br.

COMPOUND POWDER OF JALAP [Pulvis Purgans]

(pŭl'vĭs ją-lā'pæ cǫm-pǒs'ĭ-tŭs)

Pulvis Purgans, Pulvis Jalapæ Tartratus, Pulvis Catharticus; Poudre de Jalap composée, *Fr.*; Jalapenpulver mit Weinstein, *G.*

• "Jalap, in No. 60 powder, *thirty-five grammes* [or 1 ounce av., 103 grains]; Potassium Bitartrate, in fine powder, *sixty-five grammes* [or 2 ounces av., 128 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub them together until they are thoroughly mixed." *U. S.*

"Jalap, in powder, 5 *ounces* (Imperial) or 100 grammes; Acid Potassium Tartrate, in powder, 9 *ounces* (Imp.) or 180 grammes; Ginger, in powder, 1 *ounce* (Imp.) or 20 grammes. Mix." *Br.*

The rubbing of the bitartrate with the jalap is thought to favor its more minute division, while it increases its hydragogue effect. A combination of these two ingredients, though with a larger proportion of cream of tartar (see *Jalapa*), forms a good cathartic in *dropsy*, and in *scrofulous diseases of the joints and glands.*

Dose, of the powder, from thirty grains to a drachm (2.0 to 3.9 Gm.).

PULVIS KINO COMPOSITUS. Br.

COMPOUND POWDER OF KINO

(pŭl'vĭs kī'nō cŏm-pŏs'ĭ-tŭs)

Pulvis Kino cum Opio, *Br.* 1864; Powder of Kino and Opium; Poudre de Kino Opiacée, *Fr.;* Kinopulver mit Opium, *G.*

"Kino, in powder, 3¾ *ounces* (Imperial) or 75 grammes; Opium, in powder, ¼ *ounce* (Imp.) or 5 grammes; Cinnamon Bark, in powder, 1 *ounce* (Imp.) or 20 grammes. Mix. This Powder contains 5 per cent. of Opium." *Br.*

This is an anodyne astringent powder, useful in some forms of *diarrhœa,* but of which the composition would be better left to extemporaneous prescription, as the proportion of the ingredients should vary with the circumstances. Twenty grains contain one grain of opium.

Dose, from five to twenty grains (0.32 to 1.3 Gm.).

PULVIS MORPHINÆ COMPOSITUS. U. S.

COMPOUND POWDER OF MORPHINE
[Tully's Powder]

(pŭl'vĭs mör-phī'næ cŏm-pŏs'ĭ-tŭs)

Pulvis Camphoræ Compositus Tully; Poudre de Tully, *Fr.;* Tullysches Pulver, *G.*

* "Morphine Sulphate, *one and one-half grammes* [or 23.4 grains]; Camphor, *thirty-two grammes* [or 1 ounce av., 56 grains]; Glycyrrhiza, in No. 80 powder, *thirty-three grammes* [or 1 ounce av., 72 grains]; Precipitated Calcium Carbonate, *thirty-three and one-half grammes* [or 1 ounce av., 79.6 grains]; Alcohol, *a sufficient quantity,* to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Morphine Sulphate with the Precipitated Calcium Carbonate, added in portions of about *five grammes* each, until it is thoroughly mixed, then rub the Camphor with a little Alcohol until it is reduced to a powder, and mix intimately with the Glycyrrhiza and the other powders. Finally, pass the powder through a No. 40 sieve, pulverize the residue if any should be left on the sieve, add to the sifted powder, and mix thoroughly. Transfer it to well-stoppered bottles." *U. S.*

This official compound powder originated with Wm. Tully of New Haven, Conn., who devised it as a substitute for Dover's Powder. It is very necessary to comply strictly with the directions of Tully in its preparation, *i.e.,* to mix the ingredients thoroughly and then sift the powder, and this last direction is included in the official formula (8th Rev.). The diaphoretic action depends largely upon the intimate admixture of the ingredients. There is the one-sixty-seventh of a grain of morphine sulphate in one grain of the powder.

Dose, ten grains (0.65 Gm.), containing about one-sixth of a grain (0.01 Gm.) of morphine sulphate.

PULVIS OPII COMPOSITUS. Br.

COMPOUND POWDER OF OPIUM

(pŭl'vĭs ō'pĭ-ī cŏm-pŏs'ĭ-tŭs)

Poudre d'Opium composée, *Fr.;* Zusammengesetztes Opiumpulver, *G.*

"Opium, in powder, 1½ *ounces* (Imperial) or 30 grammes; Black Pepper, in powder, 2 *ounces* (Imp.) or 40 grammes; Ginger, in powder, 5 *ounces* (Imp.) or 100 grammes; Caraway Fruit, in powder, 6 *ounces* (Imp.) or 120 grammes; Tragacanth, in powder, ½ *ounce* (Imp.) or 10 grammes. Mix. This Powder contains 10 per cent. of Opium." *Br.*

This seems to have been introduced in order to have at hand all the dry ingredients of the Confection of Opium. (See *Confectio Opii.*) Ten grains (0.65 Gm.) of the powder contain one grain (0.065 Gm.) of opium.

PULVIS RHEI COMPOSITUS. U. S., Br.

COMPOUND POWDER OF RHUBARB

(pŭl'vĭs rhē'ī cŏm-pŏs'ĭ-tŭs)

Magnesia and Rhubarb, Gregory's Powder; Poudre de Rhubarbe composée, *Fr.;* Pulvis Magnesiæ cum Rheo, *P. G.;* Kinderpulver, Pulvis Infantum, s. P. Antacidus, *G.*

* "Rhubarb, in No. 60 powder, *twenty-five grammes* [or 386 grains]; Magnesium Oxide, *sixty-five grammes* [or 2 ounces av., 128 grains]; Ginger, in No. 60 powder, *ten grammes* [or 154 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Rhubarb and Ginger together, and finally the Magnesium Oxide, gradually added, until they are thoroughly mixed." *U. S.*

"Rhubarb Root, in powder, 2 *ounces* (Imperial) or 50 grammes; Light Magnesia, 6 *ounces* (Imp.) or 150 grammes; Ginger, in powder, 1 *ounce* (Imp.) or 25 grammes. Mix. If a less bulky powder be desired, Heavy Magnesia may be employed." *Br.*

This is a good laxative antacid, well adapted to *bowel complaints,* especially in children.

Dose, for an adult, from one-half to one drachm (2.0 to 3.9 Gm.); for a child two or three years old, from five to ten grains (0.32 to 0.65 Gm.).

PULVIS SCAMMONII COMPOSITUS. Br.

COMPOUND POWDER OF SCAMMONY

(pŭl'vĭs scăm-mō'nĭ-ī cŏm-pŏs'ĭ-tŭs)

"Scammony Resin, in powder, 4 *ounces* (Imperial) or 100 grammes; Jalap, in powder, 3 *ounces* (Imp.) or 75 grammes; Ginger, in powder, 1 *ounce* (Imp.) or 25 grammes. Mix." *Br.*

This does not appear to us a very eligible preparation.

Dose, from ten to twenty grains (0.65 to 1.3 Gm.).

PULVIS TRAGACANTHÆ COMPOSITUS. Br.

COMPOUND POWDER OF TRAGACANTH

(pŭl'vĭs trăg-ă-căn'thæ cŏm-pŏs'ĭ-tŭs)

"Tragacanth, in powder, 1 *ounce* (Imperial) or 25 grammes; Gum Acacia, in powder, 1 *ounce* (Imp.) or 25 grammes; Starch, in powder, 1 *ounce* (Imp.) or 25 grammes; Refined Sugar, in powder, 3 *ounces* (Imp.) or 75 grammes. Mix." *Br.*

This is applicable to the general purposes of the demulcents, but is chiefly employed in Great Britain as a vehicle for heavy insoluble powders.

Dose, one-half to one drachm (2.0 to 3.9 Gm.).

PYRETHRUM. U. S. (Br.)

PYRETHRUM [Pellitory]

(pȳ-rē'thrŭm)

"The root of *Anacyclus Pyrethrum* (Linné) De Candolle (Fam. *Compositæ*)." *U. S.* "The dried root of Anacyclus Pyrethrum, *DC.*" *Br.*

Pyrethri Radix, *Br.;* Radix Pyrethri Romani; Pellitory Root, Spanish Chamomile, Longwort, Pellitory of Spain; Pyrèthre officinal, *Fr. Cod.;* P. vrai, Salivaire, *Fr.;* Bertramwurzel, Römische Bertramwurzel, *G.;* Peiltre (Raiz de), *Sp.*

Anacyclus Pyrethrum, De Cand., *Prodrom.* vi. 15.—*Anthemis Pyrethrum,* Willd., *Sp. Plant.* iii. 2184; *B. & T.* 151.—The root of this plant is perennial, and sends up numerous stems, usually trailing at the base, erect in the upper portion, eight or ten inches high, and terminated by one large flower. The leaves are doubly pinnate, with narrow nearly linear segments of a pale-green color. The florets of the disk are yellow; the rays white on their upper surface, and reddish or purple beneath and at their edges.

The plant is a native of the Levant, Barbary, and the Mediterranean coast of Europe. The root is the part used under the name of pellitory, or *pellitory of Spain.* According to Hayne, the pellitory of commerce is derived from the *Anacyclus officinarum,* a plant cultivated in Thuringia for medicinal purposes. This statement, however, can apply only to Germany.

Properties.—The dried root of *A. Pyrethrum*[1] is about the size of the little finger, cylindrical, straight or but slightly curved, wrinkled longitudinally, of an ash-brown color externally, whitish within, hard and brittle, and sometimes furnished with a few radicles. It is destitute of odor, though, when fresh, of a disagreeable odor. Its taste is peculiar, slight at first, but afterwards acidulous, saline and acrid, attended with a burning and tingling sensation over the whole mouth and throat, which continues for some time and excites a copious flow of saliva. It is officially described as "somewhat fusiform, nearly simple, 5 to 10 Cm. long, 3 to 20 Mm. in diameter; externally dark brown or grayish-brown, longitudinally wrinkled and somewhat furrowed, crown somewhat annulate and sometimes tufted with coarse fibres or with soft woolly hairs; fracture short; bark dark brown, resinous, 0.5 to 1 Mm. thick, closely adhering to the light yellow, radiate, porous wood; odor distinct; taste pungent, very acrid, producing a prompt sialogogue effect." *U. S.* The fractured surface shows that the wood is traversed by large medullary rays in which, as well as in the cortex, are numerous dark resin ducts. Its analysis by Koene gives, in 100 parts, 0.59 of a brown, very acrid substance, of a resinous appearance, and insoluble in potassium hydroxide; 1.06 of a dark brown, very acrid, fixed oil, soluble in potassium hydroxide; 0.35 of a yellow acrid oil, also soluble in potassium hydroxide; traces of tannin; 9.40 parts of gum; inulin; 7.60 parts of potassium sulphate and carbonate, potassium chloride, calcium phosphate and carbonate, alumina, silica, etc., and 19.80 of lignin, besides loss. (See *A. J. P.,* viii. 175.) Buchheim (*A. E. P. P.,* 5, 458) claims to have discovered as the active principle an alkaloid, *pyrethrine,* which, treated with alcoholic potassium hydroxide, splits up like piperine, and yields *pyrethric acid.* Schneegans (*Proc. A. Ph. A.,* 1897, 736) has obtained this pyrethrine in long branched needles united in tufts, melting at 46° C. (114.8° F.), with an extremely burning taste. It is soluble in absolute alcohol, acetone, ether, strong acetic acid, chloroform, and carbon disulphide. It is also dissolved by strong sulphuric acid, yielding a yellow solution, which soon changes to red.

Uses.—Pellitory is a powerful irritant, used almost exclusively as a sialagogue in certain forms of *headache, rheumatic* and *neuralgic affections* of the face, *toothache,* etc., or as a local stimulant, in *palsy of the tongue or throat,* and in *relaxation of the uvula.* For these purposes it may be chewed, or employed as a gargle in decoction or vinous tincture. The

[1] *False Pellitory Root.*—A root which has been identified by E. M. Holmes as the product of *Corrigiola telephiifolia* has been offered in the London market as pellitory. It is readily distinguished from the true root by its being softer and more flexible, by its having a distinctly sweetish taste, and especially by the transverse section of the root, which is of a yellowish-white color, with from three to five pale opaque concentric rings, each alternating with a narrower translucent horny ring.

dose as a masticatory is from thirty grains to a drachm (2.0 to 3.9 Gm.). Its action upon the general system has not been studied to any extent, but 50 minims of a tincture of it very nearly killed a child three and a half years old. The symptoms were those of gastro-enteritis, followed by convulsions. (*London Practitioner*, Aug. 1876.) An alcoholic extract is sometimes employed by dentists as a local anæsthetic application to *carious teeth.*

Dose, twenty grains (1.3 Gm.).

Off. Prep.—Tinctura Pyrethri, *U. S., Br.*

PYROGALLOL. U. S.

PYROGALLOL [Pyrogallic Acid]

(pȳ-rọ-găl'lŏl)

$C_6H_6O_3 = 125.10$

"A triatomic phenol [$C_6H_3(OH)_3$ 1:2:3], obtained chiefly by carefully heating gallic acid. Pyrogallol should be kept in dark amber-colored bottles." *U. S.*

Acidum Pyrogallicum; Trihydroxybenzene; Pyrogallol, *Fr. Cod.;* Acide Pyrogallique, *Fr.;* Pyrogallolum, *P. G.;* Pyrogallol, Pyrogallussaure, *G.;* Pirogallolo, *It.*

Of the three triatomic phenols indicated by theory, this is the best known, phloroglucin and oxyhydroquinone being the other two. It may be prepared synthetically, but is usually obtained as one of the results of the igneous decomposition of gallic acid, and may be obtained by submitting extract of galls to the same treatment as that used for preparing benzoic acid from benzoin, the reaction being:

$$C_7H_6O_5 = C_6H_6O_3 + CO_2$$

The vapors of pyrogallol rise, and condense on the upper surface of the paper diaphragm. The chief difficulty in the process is to properly regulate the heat, as at a high temperature this acid passes rapidly into metagallic acid, and thus the product is diminished. According to Löwig, it is best prepared by heating gallic acid, previously dried at 100° C. (212° F.), in a glass retort, by means of a zinc chloride bath, to 210° C. (410° F.), when the pure acid sublimes. It is stated by De Luynes and Espandieu that in the ordinary method of obtaining pyrogallic acid much of the acid is lost. According to Pelouze, the proportion of pyrogallic acid produced ought to be very nearly 75 per cent., but the processes in use yield only 25 per cent., the pyrogallic acid itself undergoing rapid decomposition at an elevated temperature. De Luynes and Espandieu have succeeded in preventing this loss by decomposing gallic acid in water under pressure, instead of by dry sublimation. Gallic acid is introduced into a bronze boiler with twice or three times its weight of water; the temperature is raised to a point ranging from 200° C. (392° F.) to 210° C. (410° F.), and maintained at that point for half an hour, when the liquid is allowed to cool. The boiler now contains a slightly colored solution of pyrogallic acid. This is heated with a little pure animal charcoal, filtered, evaporated sufficiently, and set aside to crystallize. The crystalline mass obtained is somewhat colored. To obtain it entirely white, nothing more is necessary than to distil it in a vacuum. The product is quite 75 per cent. The carbon dioxide escapes through the joinings of the apparatus, while the aqueous vapor is retained. (*A. J. P.,* 1866, p. 22.) Another equally satisfactory procedure is that of Thorpe, for details of which see *A. J. P.,* 1881, p. 53, 236.

Properties.—It is officially described as in "light, white laminæ or fine needles, odorless and having a bitter taste; acquiring a grayish tint on exposure to air and light. Soluble in 1.6 parts of water, 1 part of alcohol, and in 1.1 parts of ether at 25° C. (77° F.); very soluble in boiling water, and in boiling alcohol. When heated to 132° C. (269.6° F.) Pyrogallol melts and sublimes unchanged. When ignited it is consumed, leaving no residue. The freshly prepared aqueous solution is neutral to litmus paper and colorless, but gradually acquires by exposure to the air a brown color and an acid reaction, due to absorption of oxygen; the absorption of oxygen and change of color take place very rapidly if the solution contains an alkali hydroxide. The aqueous solution of Pyrogallol (1 in 10) reduces solutions of the salts of silver, gold, and mercury even in the cold. When freshly prepared, 1 Cc. of the aqueous solution (1 in 20) is colored brownish-red by a few drops of ferric chloride T.S. and this color is changed to deep bluish-black on the addition of 1 or 2 drops of ammonia water. A bluish-black color is also produced in the aqueous solution of Pyrogallol by freshly prepared ferrous sulphate T.S." *U. S.* According to Rosing of Christiana, it is always partially converted, when sublimed, into metagallic acid, to which probably it owes its acid reaction as generally found in commerce; for when quite pure it has no influence on litmus paper. It is a triatomic phenol, $C_6H_3(OH)_3$, and is therefore, properly speaking, not an acid at all; hence the change in the official title to "Pyrogallol." One of its characteristic properties is its strong affinity for oxygen, in consequence of which it instantly undergoes change by contact with chlorine, iodine, bromine, and the acids which readily yield oxygen. Through the same property it rapidly reduces some of the metallic oxides, and its use in photography is based on this effect exercised on the salts of silver. Though unalterable in the air when quite dry, it is rapidly changed in alkaline solution by the absorption of oxygen, so that it may be used for ascertaining the proportion of this gas in a mixture of gases. By the action of phthalic anhydride upon pyrogallol is formed *gallein,* a dye color much used in calico printing. By the action of glacial acetic acid upon pyrogallol in the presence of zinc chloride is formed *gall-acetophenone,* $CH_3—CO—C_6H_2(OH)_3$, which has been used in medicine as a substitute for pyrogallol.

Uses.—Pyrogallol is an actively irritant substance and in concentrated form even mildly caustic. Taken internally in sufficient dose it is an active destroyer of the red corpuscles of the blood, causing the solution of the hæmoglobin and even altering this constituent into methæmoglobin. The toxic symptoms produced by it are vomiting and purging with collapse, pale or cyanosed lips, the skin often presenting a peculiar greenish hue or sometimes jaundiced; the urine is albuminous and may be brown or black from the presence of hæmoglobin or methæmoglobin. Fatty degenerations and enlargement of the liver, similar to those produced by phosphorus, have been noted by Personne (*C. R. A. S.*, Oct. 1869).

The only use for pyrogallol in medicine is as a stimulant antiseptic in various skin diseases as *lupus* and *psoriasis*. But even for this purpose the remedy is not devoid of danger, as at least two deaths are on record from its external application,[1] and Kuseh (*W. K. W.*, 1901) reports abortion in pregnant women from a ten per cent. ointment.

PYROXYLINUM. U. S., Br.

PYROXYLIN [Soluble Gun Cotton, Colloxylin]

(pȳ-rŏx-y-lī'nŭm)

"A product obtained by the action of nitric and sulphuric acids on cotton, and consisting chiefly of cellulose tetranitrate [$C_{12}H_{16}(ONO_2)_4O_6$]. It should be kept in cartons, protected from the light." *U. S.*

Pyroxylon, *U. S.* 1870; Gun Cotton, Collodion Cotton; Fulmicoton soluble, *Fr.*; Kollodiumwolle, *G.*; Piroxilina, *Sp.*

The process of the U. S. P. 1890 for making pyroxylin was not introduced into the U. S. P. (8th Rev.). It is as follows: "Purified Cotton, *one hundred grammes* [or 3 ounces av., 231 grains]; Nitric Acid, *fourteen hundred cubic centimeters* [or 47 fluidounces, 163 minims]; Sulphuric Acid, *twenty-two hundred cubic centimeters* [or 74 fluidounces, 187 minims]; Alcohol, Ether, Water, each, *a sufficient quantity*. Mix the Acids gradually in a glass or porcelain vessel, and, when the temperature of the mixture has fallen to 32° C. (90° F.), add the Purified Cotton. By means of a glass rod imbue it thoroughly with the Acids, and allow it to macerate, until a sample of it, taken out, thoroughly washed with a large quantity of Water, and subsequently with Alcohol, and pressed, is found to be soluble in a mixture of *one volume* of Alcohol and *three volumes* of Ether. Then remove the Cotton from the Acids, transfer it to a larger vessel, and wash it, first, with cold Water, until the washings cease to have an acid taste, and then with boiling Water, until they cease to redden blue litmus paper. Finally, drain the Pyroxylin on filtering paper, and dry it in small, detached pellets, by means of a water-bath or steam-bath, at a temperature not exceeding 60° C. (140° F.). Keep the Pyroxylin, loosely packed, in well-closed vessels containing not more than about 25 Gm., in a cool and dry place, remote from lights or fire." *U. S.* 1890.

"Cotton, 1 *ounce* (Imperial) or 10 grammes; Sulphuric Acid, 5 *fl. ounces* (Imp. meas.) or 50 cubic centimetres; Nitric Acid, 5 *fl. ounces* (Imp. meas.) or 50 cubic centimetres; Distilled Water, *a sufficient quantity*. Mix the Acids in a porcelain mortar, immerse the Cotton in the mixture, and after it is thoroughly wetted by the Acids stir it for three minutes with a glass rod; wash the product with Distilled Water until free from acid; drain on filtering paper, and dry the Pyroxylin on a water-bath." *Br.*

Gun cotton was discovered by Schönbein of Basel, in Switzerland. The name is applied to several closely related yet distinct products. They are not, as was at first supposed, nitro-derivatives in which the group NO_3 merely replaces hydrogen, atom for atom, but compounds in which the nitric acid residue NO_3 is present, replacing OH groups of the cellulose formula. Thus, taking the doubled formula $C_{12}H_{20}O_{10}$ for cellulose, there is produced by the action of nitric acid under different circumstances $C_{12}H_{14}O_4(NO_3)_6$, and following this, successively, $C_{12}H_{15}O_5(NO_3)_5$, $C_{12}H_{16}O_6(NO_3)_4$, $C_{12}H_{17}O_7(NO_3)_3$, and $C_{12}H_{18}O_8(NO_3)_2$. The first of these, the hexanitrate, is insoluble in alcohol and ether, and constitutes the true explosive gun cotton. The soluble gun cotton used in the preparation of *collodium* is a varying mixture of the four lower nitrates, but is chiefly made up of the tri- and tetra-nitrates. (Tollens, *Handbuch der Kohlenhydrate*, 1888.) The hexanitrate, when very thoroughly washed free from acid, is insoluble in water, alcohol, ether, and all mixtures of alcohol with ether. It constitutes the true explosive gun cotton, which when compressed in cakes and fired by a fulminate explodes with great violence. Other compounds intermediate between some of these have been described by different chemists, but Abel, the chemist of the Woolwich Arsenal in England, has shown that they were imperfectly purified preparations.

Properties.—Gun cotton has the appearance of ordinary cotton, but is harsh to the touch. When intended for solution it is best made by the joint action of sulphuric and nitric acids, or, as proposed by Ellet of the South Carolina College, of potassium nitrate and sulphuric acid. Experience has thoroughly shown that the use of the acids as practised in the 1890 official formula gives better results than the employment of potassium nitrate and sulphuric acid, which was directed in the U. S. P. 1860.[2]

[1] *Oxidized Pyrogallol* has been used in the treatment of leprosy by Unna. (*M. R.*, 1896, 132.)

[2] J. G. Flint states that he has often been unsuccessful with the official formula, and recommends the following as perfectly reliable. Place 6 parts by weight of nitric acid in a stone jar, and pour on it 12 parts by weight of sulphuric acid. When the

Care should be exercised not to let the mixture attain a temperature much above 32° C. (90° F.). It is insoluble in water, and nearly so in alcohol, but dissolves freely in acetic ether and amyl acetate. (*A. J. P.*, 1887, 275.) The following are the official description and tests. "A yellowish-white, matted mass of filaments, resembling raw cotton in appearance, harsh to the touch; exceedingly inflammable, burning, when unconfined, very rapidly with a luminous flame; less explosive than cellulose trinitrate. Slowly but completely soluble in 25 parts of a mixture of 3 volumes of ether and 1 volume of alcohol. Soluble in acetone and in glacial acetic acid, and precipitated from these solutions on addition of water. It should leave no weighable residue of mineral impurity when ignited. When kept in well-closed bottles and exposed to the light, it is decomposed with the evolution of nitrous vapors, a carbonaceous mass being deposited." *U. S.* "Readily soluble in a mixture of equal volumes of *ether* and *alcohol* (90 per cent.). It leaves no residue after ignition (absence of mineral impurity)." *Br.* Guichard proposes the use of chemically pure filtering paper as yielding a superior product to cotton. He takes 1400 parts of sulphuric acid, sp. gr. 1.82; 700 parts of nitric acid, sp. gr. 1.37; 70 parts of the paper; puts the mixed acid in a vessel surrounded by cold water to keep down the temperature, drops the paper in leaf by leaf, allows it to stand three hours, and then washes freely with water. (*J. P. C.*, 4e sér., xii. 290.) According to J. H. Gladstone of England, gun cotton is subject to spontaneous decomposition if kept for some time. The same fact was observed by James Beatson of New York, and Procter of Philadelphia. The specimen observed by Procter to undergo decomposition had not been well washed. The change is shown by the bottle in which the gun cotton is kept becoming full of nitrous acid vapor, and the substance is so far altered that it is no longer explosive or soluble in ether. Bouet states that the decomposition from exposure to light takes place sooner in gun cotton which has been prepared with potassium nitrate and sulphuric acid than where the mixed acids have been used. He says that, with both, the sides and bottom of the bottle are nearly covered with crystals of oxalic acid. (See *A. J. P.*, March, 1862, p. 187.) The official direction to keep pyroxylin "in cartons, protected from the light" is a valuable precaution against decomposition. According to Béchamp of Strasburg, the product is soluble in ether if the cotton be immersed in a mixture of nitric and sulphuric acid while still hot from their reaction, but not soluble if the cotton be added to the mixture when cold. By treating gun cotton with ferrous chloride, Béchamp caused the disengagement of nitrous oxide gas, and gave the filaments a coating of ferric oxide, which was readily dissolved by hydrochloric acid. After this treatment the gun cotton was restored to its original state of cotton. (*Chem. Gaz.*, Jan. 1, 1854, p. 11.) When kindled, gun cotton flashes off like gunpowder, burning without residue. Yet, according to Bleekrode, when wet with ether, or similar fluid, and touched with a light, the liquid will burn out of it without firing it. (*J. P. C.*, 4e sér., xviii.) Its inflaming point is at 187.7° C. (370° F.). Marx makes it lower. It has been tried as a substitute for gunpowder in fire-arms, etc., but it has not been found useful except for some special purposes. Pyroxylin, or soluble gun cotton, is now extensively used as the basis of transparent varnishes for lacquering metal and wood. The solvent employed is usually a mixture of methyl alcohol or acetone with petroleum benzin, the

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temperature has fallen to about 35° C., place the jar in a larger vessel, and surround it with broken ice. After the temperature has fallen to 15° C., take 1 part of absorbent cotton, loosen it well, and place a small portion at a time carefully on the surface of the acid and with a clean glass rod press it below the surface. Keep the thermometer in the acid, and watch the temperature closely. If at any time it rises above 16.5° or 17° C., stop the addition of cotton until the temperature has fallen to 15° C. After five hours, remove the jar from the ice, and drain off as much of the acids as possible, pressing the cotton with the glass rod. Protect the hands with rubber gloves, and take up the cotton in small portions, washing each quickly in cold water, moving the cotton about to avoid any rise in the temperature. Finally, wring out well, and spread on clean boards to dry. Hot water for the washing must never be used. As to the keeping, the author directs to keep it in an open jar under distilled water. Tightly closed containers will make trouble. The acids may be used several times over. (*West. Drug.*, 1892.)

Soluble Pyroxylin.—E. Senft, from among the many methods proposed for preparing collodion-cotton, selects that of the (German) Military-Pharmacopœia, 1891, for the purpose of exemplifying the precautions necessarily observed to produce a product permanently and uniformly soluble in a mixture of ether and alcohol. Into a mixture of 800 Gm. of crude nitric acid and 2000 Gm. of sulphuric acid 100 Gm. of purified cotton are submerged; the mixture is set aside for 24 hours at a temperature of 15° to 20° C., is then transferred to a funnel, allowed to drain during 24 hours, washed with water until the acid is completely removed, expressed, and dried at a temperature of 25° C. Although this formula is clear and explicit, a number of precautions must be observed to secure a satisfactory product. The mixture of the acids should be effected under avoidance of heat, which is best accomplished by placing the vessel containing the sulphuric acid into cold water and adding the nitric acid slowly. The cotton having then been imbued in the acid mixture, the container is placed in a shady situation, where it is protected both from the light and heat of the sun, and where the temperature will not exceed 20 to 25° C. It is of importance also that the mixture be covered as soon as it is effected. Although in the opinion of Hager and others the prolonged immersion of the cotton in the acid mixture does not affect the solubility of the pyroxylin after it has been formed, the author is of the opinion that under such conditions, as also under the influence of the sun's rays, or of higher temperature than that given, sparingly soluble nitrocelluloses are formed. An exposure of 16 hours during summer is sufficient, while in winter this may be somewhat prolonged. Instead of washing the pyroxylin upon a funnel, it is to be transferred directly from the acid mixture to the water, and well washed—observing that it is necessary to loosen the fibres of pyroxylin which have unavoidably formed into little knots, so that all parts may be completely washed and deprived of acid. So prepared and dried it should dissolve readily and completely if, as is directed for preparing collodion, 100 Gm. are first thoroughly imbued with 300 Gm. of alcohol, and then mixed with 2100 Gm. of purified ether and thoroughly shaken. If a somewhat larger proportion of alcohol is used an even handsomer preparation is obtainable. *Ph. Post*, Nov. 5, 1899, 607.

miscibility of which is effected by the addition of small quantities of compound ethers like amyl acetate.

Off. Prep.—Collodium, *U. S., Br.;* Collodium Vesicans, *Br.*

QUASSIA. U. S. (Br.)

QUASSIA

(quâs'sĭ-ą)

"The wood of *Picrasma excelsa* (Swartz) Planchon (Fam. *Simarubaceæ*), known commercially as Jamaica Quassia, or of *Quassia amara* Linné (Fam. *Simarubaceæ*), known commercially as Surinam Quassia." *U. S.* "The wood of the trunk and branches of Picræna excelsa, *Lindl.*" *Br.*

Quassiæ Lignum, *Br.;* Jamaica Quassia, Quassia Wood; Bitter Wood; Bitter Ash; Quassie Amère ou Bois amer de Surinam, *Fr. Cod.;* Bois de Quassie, Quassie de la Jamaïque, *Fr.;* Lignum Quassiæ, *P. G.;* Quassiaholz, Fliegenholz, *G.;* Quassia, Quassia della Giammaica, *It.*

The U. S. P. formerly recognized Picræna as the generic name, but in the Eighth Revision following the authority of Engler and Prantl adopted Picrasma. The genus is represented by eight species, which are found in the warmer regions of the Old and New World. They all possess a bitter wood and bark. The one most esteemed is *Picrasma excelsa* (Sw.) Planch., the wood of which furnishes the Jamaica quassia, which is official. The medicine was formerly obtained from *Quassia amara;* but more than twenty years since Lamarck stated that, in consequence of the scarcity of this tree, *Quassia excelsa* had been resorted to as a substitute.

Picrasma excelsa (Swartz), Planchon, Eng. and Prantl.—*Picræna excelsa,* Lindley, *Flor. Med.* 208; *B. & T.* 57.—*Quassia excelsa,* Willd., *Sp. Plant.* ii. 569.—*Simaruba excelsa,* De Cand., *Prodrom.* i. 733; Hayne, *Darstell. und Beschreib.,* etc., ix. 16.—As its name imports, this is a lofty tree, sometimes attaining the height of not less than one hundred feet, with a straight, smooth tapering trunk, which is often three feet in diameter near its base, and is covered with a smooth, gray bark. The leaves are pinnate, with a naked petiole, and oblong pointed leaflets standing upon short footstalks, in opposite pairs, with a single leaflet at the end. The flowers are small, of a yellowish-green color, and disposed in panicles. They are polygamous and pentandrous. The fruit is a small black drupe. The longitudinal section of the wood exhibits elongated cells containing single crystals of calcium oxalate. The transverse section exhibits medullary rays, mostly two or three cells in width. This species inhabits Jamaica and the Caribbean Islands, where it is called *bitter ash.*

Quassia amara, L., *Sp. Pl.* (1762) 553; Willd., *Sp. Plant.* ii. 567; Woodv., *Med. Bot.* 574, t. 204.—The bitter quassia is a small branching tree or shrub, with alternate leaves, consisting of two pairs of opposite pinnæ, with an odd one at the end. The leaflets are elliptical, pointed, sessile, smooth, of a deep green color on their upper surface, and paler on the under. The common footstalk is articulated and winged. The flowers, which are hermaphrodite and decandrous, are bright red, and terminate the branches in long racemes. The fruit is a two-celled capsule containing globular seeds. *Quassia amara* is a native of Surinam, and is found in Brazil, Guiana, Colombia, Panama, and the West Indies, as also in some tropical countries of the Old World. Its root, bark, and wood were formerly official. They are excessively bitter, as in fact are all parts of the plant.[1] For a paper on the botanical description and history of *Quassia amara,* by J. U. Lloyd, see *West. Drug.,* 1897, 7.

Properties.—Quassia is at first whitish, but becomes yellow by exposure, and sometimes has blackish spots or markings, due to the presence of the mycelium of a fungus. The two varieties are thus officially described:

"*Jamaica Quassia.*—Occurring in various forms, usually in chips, raspings, or billets; yellowish-white or pale yellow, and of rather coarse texture; odor slight; taste intensely bitter; medullary rays containing tetragonal prisms or small, arrow-shaped crystals of calcium oxalate. Billets of Jamaica Quassia are usually 12.5 Cm. or more in diameter; in tangential section, the medullary rays are mostly 3 to 5 rows of cells in width.

Surinam Quassia.—Occurring usually in billets not exceeding 7.5 Cm. in diameter; the wood is heavier, harder, and more deeply colored than that of Jamaica Quassia, and the medullary rays in tangential section are mostly 1 or 2 rows of cells in width." *U. S.* Quassia imparts its active properties, with its bitterness and yellow color, to water and alcohol.[2] Its virtues depend upon a peculiar bitter crystallizable principle, denominated *quassin,* which was first discovered by Wiggers, who assigned it the formula $C_{10}H_{12}O_3$. Quassin is white, opaque, unalterable in the air, inodorous, and of an intense bitterness, which in the solutions of this principle is almost insupportable. The bitterness is pure, and resembles that of the

[1] According to A. H. Hills, it is possible to distinguish the wood of Jamaica quassia from that of Surinam quassia (*Quassia amara*) by the fact that in the former the medullary rays are mostly three cells in width, and the cells are irregular in size but offer regular radial walls in tangential sections, while in Surinam quassia the medullary rays are only one cell in width, the cells are nearly uniform in size, and their radial walls wavy in tangential sections.

[2] *Syrupus Quassiæ.*—This syrup is used in the preparation of a harmless fly-poison. Macerate, during twenty-four hours, 1000 parts of quassia wood with 5000 parts of water, then boil for half an hour, set aside for twenty-four hours, and press; mix the liquid with 150 parts of molasses, and evaporate to 200 parts. A weaker decoction of quassia does not kill the flies. From this the *Fly Water* or *Fly Plate* is prepared as follows: Mix when needed, and dispense without filtering, 200 parts of syrup of quassia, 50 parts of alcohol, and 750 parts of water. It is used by moistening with the mixture a cloth or filtering paper on a plate.

wood. When heated, quassin melts like a resin. It is but slightly soluble in water, 100 parts, at 54° C. dissolving only 0.45 part, and that slowly. By the addition of salts, especially of those with which it is associated in quassia, its solubility is strikingly increased. It is also but slightly soluble in ether, but is very soluble in alcohol, more so in that liquid hot than cold, and the more so the purer it is. Quassin is perfectly neutral, though both alkalies and acids increase its solubility in water. It is precipitated by tannic acid from its aqueous solution, which is not disturbed by iodine, chlorine, corrosive sublimate, the salts of iron, sugar of lead, or even lead subacetate. Adrian and Moreaux (*A. J. P.*, 1884, p. 98) claim to have purified the quassin to a degree beyond that reached by Wiggers and Christiansen, but give no analyses of it.

Oliveri and Denaro (*A. J. P.*, 1885, p. 29) obtained quassin in a thoroughly pure, crystallized state, and made a complete study of it. They give it the formula $C_{32}H_{44}O_{10}$. It melts at 210° to 211° C., and is very soluble in alcohol, chloroform, and acetic acid, but only sparingly so in ether. Its aqueous solution becomes yellow on exposure to the air, is dextro-rotatory, excessively bitter, and reduces Fehling's solution. When quassin is heated to 90° C. for some hours with diluted sulphuric acid (4 per cent.) it yields *quasside*, $C_{32}H_{42}O_9$, a white, amorphous, bitter substance, formed from quassin by removal of H_2O; no glucose could be detected in the mother liquors. Bromine forms a derivative which seems to have the formula $C_{32}H_{41}Br_3O_9$. If quassin is heated with concentrated hydrochloric acid in sealed tubes for four hours at 100° C., methyl chloride is formed and a colorless substance deposited, which the authors call *quassic acid*, $C_{28}H_{38}O_6(COOH)_2$. This is far less soluble in alcohol than quassin, and crystallizes in silky needles, which melt at 245° C., and reduce Fehling's solution and ammoniacal silver nitrate in the cold. The authors consider quassin as the methyl ether of this quassic acid, as follows:

$$C_{28}H_{38}O_6(COOCH_3)_2 = C_{32}H_{44}O_{10}$$

The real nature of quassin is at present somewhat doubtful, it being probable that distinct substances have been confounded by chemists. Dymock and Warden believe that they have obtained quassin from the wood of *Picrasma quassioides* (Ham.), Benn. of India. According to the researches of Massute (*A. J. P.*, 1890, p. 338), *Quassia amara* contains four principles, which are different from those of *Picrasma excelsa*. By shaking an alcoholic extract of quassia wood with chloroform he obtained a mixture of crystals, from which, eventually, four bitter principles, differing in melting point and solubility, were separated. One of these melting at 210° to 211° C., and another melting at 239° to 242° C., were in too small a quantity to be further examined, but the former agreed in melting point and crystalline form with the quassin of Wiggers ($C_{32}H_{40}O_{10}$). Of the other two, one melted at 215° to 217° C., and is represented by the formula $C_{35}H_{48}O_{10}$, while the other melted at 221° to 226° C., and is represented by $C_{37}H_{50}O_{10}$. From the wood of *Picrasma excelsa* two crystalline compounds were separated by Massute, both having lower melting points than either of the compounds from *Q. amara*. One was in needles, melted at 204° C., and had the composition $C_{35}H_{46}O_{10}$, while the other was in prisms, melted at 209° to 212° C., and had the composition $C_{36}H_{48}O_{10}$. Both of these are homologues of a third crystalline principle, $C_{29}H_{34}O_{10}$, melting point 212° to 216° C., which occurs with them. When the *picrasmin*, $C_{35}H_{46}O_{10}$, above referred to, melting at 204° C., is heated with hydrochloric acid, it is changed like quassin into an acid, which in this case has the formula $C_{33}H_{42}O_{10} + 5H_2O$, and is called *picrasmic acid*. It appears, therefore, that each wood represents a different series of homologous compounds.

Uses.—Quassia has in the highest degree all the properties of the simple bitters. It is purely tonic, invigorating the digestive organs, with little excitement of the circulation or increase of animal heat. It has not been very long known as a medicine. About the middle of the last century, a negro of Surinam, named Quassi, acquired considerable reputation in the treatment of the malignant fevers of that country by a secret remedy, which he was induced to disclose to Rolander, a Swede, for a valuable consideration. Specimens were taken to Stockholm by this gentleman in the year 1756, and the medicine soon became popular in Europe. The name of the negro has been perpetuated in the generic title of the plant. But the quassia of Surinam is now comparatively little used, it having been superseded by the product of *Picrasma excelsa* from the West Indies.

Quassia is among the most powerful of the simple bitters, useful in *failure of appetite* due to gastric debility, and in overdoses capable of sufficiently irritating the stomach to produce vomiting. Its active principle, *quassin*, has been studied by Comparden, who asserts that in moderate doses it acts as a stimulant to the salivary, hepatic, and renal secretions, and in overdoses causes burning pain in the œsophagus, with headache, nausea, vertigo, vomiting, diarrhœa, and muscular cramps. It is also stated that if given in doses of six-tenths of a grain (0.04 Gm.) before meals it increases markedly the alvine discharges, and that it is especially useful in *constipation* from debility of the muscular and intestinal coats. The dose of pure quassin is three-tenths of a grain (0.02 Gm.).

Quassia is given in infusion, tincture, extract, or fluidextract, in doses respectively of one-half to one fluidounce (15 to 30 Cc.), one-half to one fluidrachm (1.8 to 3.75 Cc.), one-half to one grain (0.032 to 0.065 Gm.) and five to ten minims (0.3 to 0.6 Cc.). Some *dyspeptic*

patients who have become habituated to its bitterness, chew the wood occasionally with benefit.

Dose, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Extractum Quassiæ, *U. S.;* Fluidextractum Quassiæ, *U. S.;* Infusum Quassiæ, *Br.;* Liquor Quassiæ Concentratus, *Br.;* Tinctura Quassiæ, *U. S., Br.*

QUERCUS. U. S.

WHITE OAK [Quercus Alba, Pharm. 1890]

(quër'cŭs)

"The dried bark of *Quercus alba* Linné (Fam. *Cupuliferæ*), collected from trunks or branches ten to twenty-five years of age, and deprived of the periderm." *U. S.*

Stone Oak; Ecorce de Chêne, *Fr. Cod.;* Cortex Quercus, *P. G.;* Eichenrinde, *G.;* Quercia, Corteccia de quercia, *It.*

This genus comprises numerous species, of which about sixty-five grow within the limits of the United States. Many of these are applied to important practical purposes. In the Northern hemisphere the oak is among the most valuable and the most widely diffused of all forest trees. Notwithstanding the great number of species, few, comparatively, have found a place in the official catalogues. *Quercus Robur*, or European oak, has a very wide distribution. It is the common British oak, constitutes a large part of the European forests, and has spread itself over almost the whole northern section of Asia and along the northern coast of Africa. There are two distinct varieties of it, one, *pedunculata*, with sessile or shortly stalked leaves and the acorns on long peduncles; the other, *sessiflora*, with the leaf-stalks more or less elongated and the acorns either sessile or provided with a very short peduncle. At the late revision of the Br. Pharm. the dried bark of the smaller branches and young stems of this tree, *Quercus cortex*, Br. 1885, was dismissed from the official list. Our own Pharmacopœia recognizes only *Q. alba*, or white oak. *Q. velutina*, Lam. (*Q. tinctoria*, Bartr.), or *black oak*, which was formerly official, and various other species, afford actively astringent barks. Such are *Q. digitata* (Marsh.), Sudw. (*Q. falcata*, Michx.), or *Spanish oak*, and *Q. Prinus*, or *white chestnut oak*.

Quercus alba, L., *Sp. Pl.* (1753) 996; Willd., *Sp. Plant.* iv. 448; Michaux, *N. Am. Sylva*, i. 17; *B. & T.* 250.—Of all the American species, the *white oak* approaches nearest, in the character of its foliage and the properties of its wood and bark, to *Q. pedunculata* of Great Britain. When allowed to expand freely in the open field, it divides at a short distance from the ground into numerous widely spreading branches, and attains under favorable circumstances a magnificent size. Its trunk and large branches are covered with a whitish bark, which serves to distinguish it from most of the other species. The leaves are regularly and obliquely divided into oblong, obtuse, entire lobes, which are often narrowed at their base. When full grown, they are smooth and light green on their upper surface, and glaucous beneath. Some of the dried leaves remain on the tree during the whole winter. The acorns are large, ovate, contained in rough, shallow, grayish cups, and supported singly or in pairs upon peduncles nearly an inch long.

The white oak abounds in the Middle States, and extends also through the whole Union, though comparatively rare in the northern, southern, and western sections. It is the most highly valued for its timber of all the American oaks, except the *live oak, Q. virginiana*, Mill. (*Q. virens*, Ait.), which is preferred in ship building. The bark is sometimes used for tanning, but the barks of the *red* and *Spanish oaks* are preferred. All parts of the tree, with the exception of the epidermis, are more or less astringent, but this property predominates in the fruit and bark.

White oak bark, deprived of its epidermis, is of a light-brown color, of a coarse, fibrous texture, and not easily pulverized. It is officially described as "in nearly flat pieces, 2 to 10 Mm. thick; externally light brown, becoming darker with age, rough-fibrous; fracture uneven, coarsely fibrous; odor distinct; taste strongly astringent; not tingeing the saliva yellow when chewed." *U. S.* The English oak bark was formerly officially described as occurring "in quills covered with a smooth shining silvery or ash-gray variegated with brown corky layer; internally cinnamon-brown or brownish-red and longitudinally striated; fracture tough and fibrous; taste very astringent; no marked odor." Water and alcohol extract the active properties of oak bark. The chief soluble ingredients are tannin, gallic acid, and extractive matter. It is upon the tannin that its medicinal virtues, as well as its use in the preparation of leather, chiefly depend. The proportion of this ingredient varies with the size and age of the tree, the part from which the bark is derived, and even the season when it is gathered. It is most abundant in the young bark, and the English oak is said to yield four times as much in spring as in winter. H. Davy found the inner bark most abundant in tannin, the middle portion or cellular integument much less so, and the epidermis almost wholly destitute as well of this principle as of extractive.

The tannic acid of the oak barks is known as *quercitannic acid*, and has, according to Löwe (*Zeit. An. Chem.*, 20, p. 208), two forms, one soluble in water, of the formula $C_{28}H_{28}O_{14}$, and the other difficultly soluble, $C_{28}H_{24}O_{12}$. Both are changed by the loss of water into *oak red*, $C_{28}H_{22}O_{11}$. Neither is a glucoside.

Gerber discovered in European oak bark a peculiar bitter principle upon which he conferred the name of *quercin*. It is obtained by boiling the bark with water acidulated with one

hundredth of sulphuric acid, adding first milk of lime until the sulphuric acid is removed, and then a solution of potassium carbonate so long as a white precipitate is produced, filtering the liquor, evaporating to the consistence of a thin extract, adding alcohol, and finally evaporating the spirituous solution down to a small volume, and allowing it to rest for some days. Yellow crystals form, which may be obtained colorless by repeated crystallizations. This quercin Husemann considers to have been only impure quercite (or oak sugar).

Quercus velutina, or *black oak,* is one of our largest trees, frequently attaining the height of eighty or ninety feet. Its trunk is covered with a deeply furrowed bark, of a black or dark brown color. The leaves are ovate-oblong, pubescent, slightly sinuated with oblong, aculeate lobes. The fructification is biennial. The acorn is globose, flattened at top, and placed in a saucer-shaped cup.

Black oak bark has a more bitter taste than that of the other species, and may be distinguished also by staining the saliva yellow when it is chewed. Its cellular integument contains a coloring principle, capable of being extracted by boiling water, to which it imparts a brownish-yellow color, which is deepened by alkalies and rendered brighter by acids. Under the name of *quercitron,* large quantities of this bark, deprived of its epidermis and reduced to coarse powder, are sent from the United States to Europe, where it is used for dyeing wool and silk of a yellow color. The coloring principle is called *quercitrin,* and the formula $C_{36}H_{38}O_{30}$, was given to it by Liebermann and Hamburger. Herzig (*J. Chem. S.,* 1893, 413), however, has found that its composition is more correctly expressed by the formula $C_{21}H_{22}O_{12} + 2H_2O$, and in this he is confirmed by Rudolph (*Ph. Post,* 1893, 529). The reaction for its decomposition is

$$C_{21}H_{22}O_{12} + H_2O = C_{15}H_{10}O_7 + C_6H_{10}O_6$$

the products being *quercetin* and *isodulcite* in equal molecules.

Quercitrin forms yellowish crystals, which, pulverized, yield a citron-yellow powder. It is neutral in reaction, is odorless, and in the dry condition tasteless, but in hot aqueous or alcoholic solution has a bitter taste. It fuses at 160° to 200° C. to a resinous mass. It is almost insoluble in cold water, sparingly soluble in hot water, and easily soluble in alcohol and alkaline solution.[1] Besides this principle, the bark contains much *quercitannic acid;* but it is less used in tanning than the other barks, in consequence of the color which it imparts to the leather, and it was dropped from the U. S. P. 1890 on account of its decoction staining so decidedly.

Uses.—Oak bark is astringent and somewhat tonic; but it is not employed as an internal remedy. On account of its cheapness it is much used externally. The decoction may be advantageously used as a bath, particularly for children, when a combined tonic and astringent effect is desirable and the stomach is not disposed to receive medicines kindly. It has been employed in this way in *marasmus, scrofula, intermittent fevers, chronic diarrhœa,* and *cholera infantum.* As an injection in *leucorrhœa,* a wash in *prolapsus ani* and *hemorrhoidal affections,* and a gargle in *prolapsed uvula,* the decoction is often useful, and the infusion obtained from tanners' vats has been employed beneficially as a wash for *flabby, ill-conditioned ulcers.*

Off. Prep.—Fluidextractum Quercus, *U. S.*

QUILLAJA. U. S. (Br.)

QUILLAJA [Soap Bark]

(quĭl-lā′ją)

"The dried bark of *Quillaja Saponaria* Molina (Fam. *Rosaceæ*), deprived of the periderm." *U. S.* "The inner part of the bark of Quillaja saponaria, *Molina.*" *Br.*

Quillajæ Cortex, *Br.;* Quillaia Bark; Quillaia, *Pharm.* 1880; Panama Bark; Panama (Bois de), *Fr. Cod.;* Ecorce de Quillaya, *Fr.;* Seifenrinde, *G.*

The name of this genus is said to be derived from the popular name of the tree *Quillay,* which in turn comes from the Chilian word *quillean,* to wash.

Quillaja Saponaria, Molina.—This is a tree of moderate size, with alternate oval or oblong leaves, with entire or slightly denticulate margins. Male and female flowers grow on the same branch, are axillary, pedunculate, and without corolla. The calyx of the female flower persists in fruit, and has its limb deeply divided into five oval acute segments. The bark is thick, the wood very hard.[2] The tree is a native of Peru and Chili, but is now cultivated in Northern Hindostan, where it is said to resist well the frosts of winter, and to be flourishing.

[1] Quercitrin has been found also in various other plants, as in the leaves of *Ruta graveolens,* and the flower buds of *Capparis spinosa, Sophora japonica,* and *Æsculus Hippocastanum,* or horse chestnut. (*Chem. Gaz.,* May 2, 1859, p. 161.) As this principle is capable of assuming various colors under various chemical influences, the idea has been advanced that it might be the coloring principle of flowers. (*A. J. P.,* 1860, 222.)

Acorns, besides the bitter and astringent principles of the bark, contain a peculiar saccharine matter (*quercite*), which is insusceptible of the vinous fermentation. (*J. P. C.,* 3e sér., xx. 335.) They are sometimes used as a tonic or astringent, and a decoction made from roasted acorns has been long employed in Germany as a remedy in *scrofula.* Before roasting they should be deprived of their shells, and the cotyledons, according to Dausse, should lose, during the process, 28 per cent. of their weight (*Ph. Cb.,* Oct. 9, 1850, p. 687). From half an ounce to an ounce may be prepared and taken like coffee at breakfast. (Richter.)

[2] This tree was first described by the famous Abbé Giovanni Ignazio Molina in the *Saggio sulla Storia naturale del Chili,* published at Bologna, in 1782; second edition, 1810. (Translated into German, I. D. Brandis, Leipsic, 1786; into French, Gruvel, Paris, 1789; into English, London, 1809; also Middletown, Conn., 1880.) It is first noticed by systematic writers in the second (Gmelin's) edition of the *Syst. Nat.,* tome ii. p. 767.

Properties.—Soap bark is officially described as "in flat pieces of variable length, 3 to 8 Mm. thick, or in small chips; outer surface brownish-white, often with small patches of cork attached, otherwise nearly smooth; inner surface yellowish-white, nearly smooth, with occasional circular depressions, conical projections or transverse channels; fracture uneven and strongly fibrous, the laminæ oblique to each other; odor slight; taste acrid. The powder is strongly sternutatory, and contains calcium oxalate in monoclinic pyramids and prisms from 0.035 to 0.200 Mm. long." *U. S.* The fracture exhibits, when slightly magnified, glistening prismatic crystals. A transverse section is marked with fine radial and tangential lines. (Mitlacher, *P. P.*, 1902.) Quillaja bark is histologically distinguished and its powder recognizable, by the large and numerous prismatic calcium oxalate crystals, especially by the irregular bast fibres which are colored pale red by diluted sulphuric acid or hydrochloric acid, probably on account of the presence of phloroglucin.

When bruised and macerated in water quillaja bark imparts to that liquid the property of frothing like soap when agitated. This has been found by Fleury, Jr., and Boutron-Chalard to be owing to the existence of *saponin* in the bark, the same principle as that which gives a similar property to *Saponaria officinalis.* (See PART II.) The bark contains neither tannic acid nor any bitter principle. The formula of saponin, given by Rochleder, was $C_{32}H_{54}O_{18}$, and Schiaparelli agreed with him. Stütz, however (*Ann. Ch. Ph.*, 218, 231), gives it as $C_{19}H_{30}O_{10}$, and this is now accepted for the saponin of quillaja bark. Saponin is slowly decomposed by dilute acids into *sapogenin*, $C_{14}H_{22}O_2$, and a glucose. R. Kobert (*Chem. Central.*, 1893, i. 32) gives a list of one hundred and forty plants which contain bodies of the saponin class. He arranges them under several formulas which seem to form an homologous series. Thus, $C_{17}H_{26}O_{10}$ he terms Saponin I (*senegin* or *quillaia sapotoxin*); $C_{18}H_{28}O_{10}$ is Saponin II (Schmiedeberg's *digitonin* or *saporubrin*); $C_{19}H_{30}O_{10}$ is Saponin III (*quillain* or *quillaiac acid*); $C_{20}H_{32}O_{10}$ is *cyclamin*, Paschki's *digitoxin*, or *sarsaparill-saponin;* $C_{22}H_{36}O_{10}$ is *sarsa-saponin;* $C_{26}H_{44}O_{10}$ is *parillin.*

Saponin, as found in commerce, is a powerful poison. Kobert states, however, that *pure* saponin, $C_{19}H_{30}O_{10}$, is destitute of physiological action, and that commercial saponin depends for its activity mainly upon *quillaiac acid* and *sapotoxin*, the other substances present being saponin and *lactosin*, $C_{36}H_{62}O_{31}$. G. Melliers states that there is present in quillaja bark a carbohydrate which he has identified as *saccharose.* (*P. J.*, Feb. 1901, 161.)

Uses.—Both the active principles, quillaiac acid and sapotoxin, of quillaja bark are violent local irritants. In a case of poisoning by quillaiac acid (*T. G.*, xi.) the symptoms were violent vomiting, with epigastric pain, increased diuresis and cystic irritation, accompanied by cold sweats, feeble pulse, threatened syncope, and other evidences of collapse.

Sapotoxin, when in sufficient concentration and amount, is a fatal poison to all forms of protoplasm. Given to the lower animals in very large toxic dose it produces violent convulsions with death from failure of the respiration. When in smaller quantities it causes violent dysenteric diarrhœa, with ecchymotic hyperæmia, œdema, and necrotic destruction of the intestinal mucous membrane. The smallest lethal doses are said to produce great weakness, death occurring after some days through collapse and general paralysis without intestinal symptoms. In such cases, when the drug is administered hypodermically, a severe hemorrhagic inflammation occurs at the place of injection. Fatty preparations of sapotoxin applied to the sound skin produce redness and burning with, after repeated applications, painful pustulation. Both sapotoxin and quillaiac acid have the power of breaking down the red blood corpuscles, but it is not apparent that such destruction plays an important *rôle* in poisoning by these substances except at the point of injection after hypodermic use.

On account of the active principles of soap bark being the same as those of senega, and to some extent of sarsaparilla, Kobert has proposed the use of quillaja as a cheap substitute for these much used drugs. As a stimulating expectorant he uses a decoction (five parts to two hundred) in doses of a tablespoonful for the adult. As a substitute for syrup of senega Power suggests the *syrup of quillaja*, prepared by adding four parts of the fluidextract (made by the process for fluidextract of arnica root, see p. 524) to sufficient syrup to make twenty-five parts. (*P. J.*, Oct. 1886.)

Quillaja is much used in the arts for washing silk, cloth, and other fabrics, for which soap would not be suitable. It is an emulsifying agent, but unless ordered by the physician should never be used by the pharmacist in the preparation of emulsions, on account of its active medicinal properties.

Off. Prep.—Fluidextractum Quillajæ, *U. S.;* Liquor Picis Carbonis, *Br.;* Tinctura Quillajæ, *U. S.* (*Br.*).

QUININA. U. S.

QUININE

(quĭ-nī′nȧ)

$C_{20}H_{24}N_2O_2.3H_2O = 375.46$

"An alkaloid obtained from the bark of various species of *Cinchona* (Fam. *Rubiaceæ*). Quinine should be kept in well-stoppered, amber-colored bottles." *U. S.*

Chininum; Quinine Hydratée, *Fr. Cod.;* Chinin, *G.;* Chinina, *It.;* Quinina, *Sp.*

This alkaloid is prepared by adding to a solution of quinine sulphate a quantity of ammonia

water or solution of sodium hydroxide just a sufficient quantity to cause a precipitation of the alkaloid.

Properties.—Quinine is whitish, rather flocculent, and usually not crystalline; it may with care be crystallized from its alcoholic solution in silky needles, and Liebig obtained it from a somewhat ammoniacal aqueous solution in the same form. It is inodorous and very bitter. The crystals obtained from alcoholic solution have the composition $C_{20}H_{24}N_2O_2 + 3H_2O$, and fuse at 57° C. (134.6° F.). They may be deprived of water by warming or exposure over sulphuric acid, and they then fuse at 171.2° to 172° C. (340° to 341.6° F.). By carefully regulated heat, it may be sublimed unchanged, assuming a crystalline form. (Waddington, *P. J.*, March, 1868, p. 413.) According to Hesse, anhydrous crystalline quinine is soluble in 1960 parts of water at 15° C. (59° F.), and the trihydrate in 1670 parts. It is soluble in about 900 parts of boiling water, in about 6 parts of cold and in 2 parts of boiling alcohol, very soluble in ether, chloroform, benzene, petroleum benzin, carbon disulphide, fixed and volatile oils, and in about 200 parts of glycerin. The alcoholic solution is intensely bitter. Quinine is unalterable in the air. It forms salts with the acids which readily crystallize. The tannate, tartrate, and oxalate are said to be insoluble or nearly so, but are dissolved by an excess of acid. The acetate is so slightly soluble that it is precipitated from a solution of the sulphate by magnesium acetate and the other acetates. (*A. J. P.*, xxx. 386.) When recently precipitated quinine, diffused in water, is exposed to the action of a stream of carbon dioxide, the quinine is dissolved, and, if the solution be exposed, acicular crystals of quinine carbonate will be deposited, which effloresce in the air, are soluble in alcohol, but insoluble in ether, have an alkaline reaction, and effervesce with acids. After the deposition of the crystals has ceased, the solution yields quinine on evaporation. (Langlois, *C. R. A. S.*, Nov. 7, 1853, 727.) Freshly precipitated quinine is scarcely soluble to an appreciable extent in an excess of potassium hydroxide, but is more readily dissolved by ammonia. (Wadgymar, *A. J. P.*, Sept. 1866, 451.) Flückiger (1878) noticed that solutions of quinine exposed to sunlight rapidly turned brownish-yellow, and subsequently deposited a flocculent precipitate, which he proved to be neither quinine nor quinicine, but an entirely different substance. It lost the alkaloidal character, yet possessed the same chemical composition as quinine. He named it *quiniretin*. (*P. J.*, May, 1878.)

Quinine and its salts may be distinguished from all other alkaloids and their salts, except only quinidine and quinicine, by the beautiful emerald-green color (*thalleioquin*) which results when their solution is treated first with solution of chlorine and then with ammonia, and which changes to a white or violet upon saturation with a dilute acid. The statement which has been frequently made that the chlorine water must be fresh, was disproved by C. F. Zeller. (See *A. J. P.*, 1880, p. 385.) The least quantity of quinine may be detected by powdering the substance supposed to contain it, then shaking it with ether, and adding successively the tests just mentioned. Quinine in aqueous solution turns the plane of polarization to the left, to varying degrees, however, according to the concentration, the solvent used, etc. Acids increase the amount of deviation. In relation to the property possessed by quinine of imparting fluorescence to its aqueous solution, which is possessed also, though in less degree, by other cinchona alkaloids, and other properties common to both quinine and its sulphate, there will be occasion to speak under quinine sulphate. A singular discovery was made by Bence Jones of London, of a substance normally present in the animal system having analogous properties, and named by him "*animal quinoidine.*"

Quinine is officially described as "a white, flaky or micro-crystalline powder, odorless, having a bitter taste, and slightly efflorescent in dry air. Quinine, when freshly crystallized, should contain three molecules of water of crystallization. When heated, it fuses at 57° C. (134.6° F.), and loses two molecules of water of crystallization at 100° C. (212° F.), and the third molecule at 125° C. (257° F.); at ordinary temperatures the loss is gradual. Quinine free from water is soluble in 1750 parts of water, 0.6 part of alcohol, 4.5 parts of ether, 1.9 parts of chloroform, 158 parts of glycerin, 120 parts of benzene, 3450 parts of a solution of potassium hydroxide (1 in 20), and in 1810 parts of ammonia water at 25° C. (77° F.). It is soluble in 810 parts of water at 80° C. (176° F.). Quinine containing three molecules of water is soluble in 1550 parts of water, 0.6 part of alcohol, 1.3 parts of ether, 1.6 parts of chloroform, 212 parts of glycerin, 166 parts of benzene, 3450 parts of a solution of potassium hydroxide (1 in 20), and in 1810 parts of ammonia water at 25° C. (77° F.). It is soluble in 775 parts of water at 80° C. (176° F.). When rendered anhydrous by heating to constant weight at 125° C. (257° F.), its melting point is 174.9° C. (346.8° F.). Its aqueous solution is lævogyrate, and is alkaline to moistened litmus paper. If to 1 Cc. of an aqueous solution of quinine (1 in 100), containing just sufficient diluted sulphuric acid to effect complete solution, there be added 2 Cc. of bromine T.S., followed by 1 Cc. of ammonia water, the liquid should acquire an emerald-green color (*thalleioquin*). If 0.7 Gm. of Quinine be dissolved in a mixture of 15 Cc. of acetic acid, 6 Cc. of alcohol, and 0.5 Cc. of sulphuric acid, the solution heated to boiling, and 7 Cc. of a saturated solution of iodine in alcohol be added slowly, bronze or olive-green crystals of quinine iodo-sulphate will separate on gradually cooling the solution. These crystals are insoluble in cold water. If 0.2 Gm. of Quinine be dissolved in 1 Cc. of diluted sulphuric acid, the solution diluted with

distilled water to 20 Cc. and neutralized with ammonia water, and 1 drop of solution of hydrogen dioxide and 1 drop of copper sulphate T.S. be added, and the liquid boiled, an intensely red color should appear, which slowly changes to a blue, and finally to a green color. (Quinine and quinidine alone respond to this test.) One Gm. of Quinine should dissolve completely in a slightly warmed mixture of 6 Cc. of absolute alcohol and 3 Cc. of ether, which solution should remain clear on cooling (absence of *cinchonine* and *cinchonidine*). Quinine should not impart more than a faintly yellowish tint to sulphuric acid (limit of *readily carbonizable organic impurities*), nor produce a red color with nitric acid (difference from *morphine*). Quinine should not lose more than 14.3 percent. of water on heating to 125° C. (257° F.) (absence of *an excess of water*). When heated with 2 Cc. of potassium hydroxide T.S., no ammonia should be evolved (absence of *ammonium salts*). Dissolve 2 Gm. of Quinine, which has previously been dried at 50° C. (122° F.) for two hours in a porcelain dish, in 20 Cc. of alcohol. Add 2 drops of hematoxylin T.S., neutralize exactly with sulphuric acid, and evaporate to dryness on a water-bath. Complete the test by following the directions given on page 1046, under *Quininæ Sulphas* (Test for Other Cinchona Alkaloids, Section II.)." *U. S.*

Quinicine (*quinicia*).—When quinine and cinchonine, or quinidine and cinchonidine, or their salts, are exposed to heat, they are changed into other but isomeric alkaloids,—quinine and quinidine into *quinicine*, isomeric with themselves, and cinchonine and cinchonidine into *cinchonicine*, isomeric with its own antecedents. These new alkaloids are, therefore, products rather than educts, and generally result, in greater or less proportion, from the processes employed in extracting the other alkaloids from bark, though it is not impossible that they may pre-exist in bark to a certain extent, being formed by a natural process, from the same original alkaloids, either in the living tree, or in the barks while drying, after separation from the tree. *Quinicine* is almost insoluble in water, but very soluble in alcohol, and differs from quinine in being dextro-rotatory and uncrystallizable. *Cinchonicine* is also insoluble in water and soluble in alcohol. It agrees with cinchonine, from which it is derived, in producing deviation of the plane of polarization to the right, but differs from cinchonidine in this respect, and differs from both in being amorphous or uncrystallizable.

The study of the decomposition products of quinine and associated alkaloids so actively carried on for several years past has thrown considerable light upon its composition. It appears to be a derivative of a partially hydrogenized diquinoline, corresponding to the formula $C_9H_6(OCH_3)N - C_9H_{11}(OH)N.CH_3$. By oxidation with chromic acid it yields *quininic acid*, $C_9H_5(OCH_3)N.COOH$, which is the phenol ester of cinchoninic acid, $C_9H_6N.COOH$; by oxidation with nitric acid it yields *cinchomeronic acid*, $C_5H_3N(COOH)_2$; by the action of potassium hydroxide it yields *methoxyquinoline*, $C_9H_6N(OCH_3)$. For a summary of our knowledge upon the constitution of quinine and cinchonine, see *Guareschi's Einführung in das Studium der Alkaloide*, translated by H. Hermann Kunz-Krause, Berlin, 1896, 524 *et seq.*

The most important artificial salt of quinine is the *sulphate*, the process for procuring which, as well as its properties, will be hereafter described. The *bisulphate*, *hydrobromide*, and *hydrochloride* have been retained in the U. S. Pharmacopœia, the *valerianate* having been dismissed. The *phosphate*, *acetate*, *citrate*, *lactate*, *camphorate*, *ferrocyanate*, *tannate*, *arsenite*, *antimonate*, *urate*, *hypophosphite*, *chlorate*, *hydrochloride with urea*, *citro-thymate*, *sulphovinate*, *salicylate*, *sulpho-salicylate*, and *meconate*, have also been employed or recommended, but none of them has yet gained admittance into the Pharmacopœias, and none probably is superior to the official sulphate.[1] The first four may be

[1] *Percentage of Quinine in its Different Salts.*—According to Tanret, the salts of quinine in common use contain the following proportions of the alkaloid: acetate, 87.34 per cent.; hydrate (quinine precipitated and dried), 85.70; basic hydrochloride, 81.60; lactate, 78.26; basic hydrobromide, 76.60; valerate, 76.05; basic sulphate (the ordinary sulphate), 74.30; sulphovinate, 72.00; neutral hydrobromide, 60.00; neutral sulphate (or acid sulphate), 57.24; tannate, 20.60. The following table was compiled by Boymond of Paris:

Salts.	Percentage of			1 part soluble in water at 15° C.	1 part of water dissolves		1 part anhydrous quinine contained in
	Alkaloid.	Acid.	Water of crystallization.		Salt.	Anhydrous quinine.	
Hydroxide	85.72	. . . .	14.28	16.70	0.00059	0.00050	1.16
Acetate	84.37	15.63	. . . .	slightly	. . . .	. . . .	1.18
Hydrochloride	81.71	9.21	9.08	21.40	0.046	0.0388	1.22
Lactate	78.26	21.74	. . . .	10.29	0.097	0.0759	1.27
Hydrobromide	76.60	19.15	4.25	45.02	0.022	0.0168	1.30
Hydrobromide (acid)	60.67	30.34	8.99	6.33	0.158	0.0958	1.64
Valerate	76.06	23.94	. . . .	53.70	0.029	0.0220	1.31
Sulphate	74.31	11.24	14.45	581	0.0017	0.0012	1.34
Sulphate (acid)	59.12	17.89	22.99	8.81	0.113	0.0668	1.69
Sulphovinate	71.20	28.80	. . . .	3.30	0.303	0.215	1.39
Arsenate	69.38	15.21	15.41	slightly	. . . .	. . . .	1.44
Salicylate	68.79	29.30	1.91	863	0.0011	0.0007	1.45
Citrate	67.08	19.86	13.06	820	0.0012	0.0008	1.49
Ferrocyanide	56.25	37.50	6.25	slightly	. . . .	. . . .	1.77
Hydriodide (acid)	55.95	44.05	. . . .	. . . .	. . . .	. . . .	1.78
Tannate	22.60	67.36	10.04	800	0.0012	0.00028	4.42

prepared by saturating a solution of the acids respectively with quinine, and evaporating the solutions. The *camphorate* is recommended as a substitute for the valerate. (*A. J. P.*, July, 1865, p. 254.) The *ferrocyanide* is directed to be made by boiling together four parts of quinine sulphate and one of potassium ferrocyanide, both in concentrated solutions, pouring off the liquor from a greenish-yellow substance of an oily consistence which is precipitated, washing the latter with distilled water, then dissolving it in strong alcohol at 37.7° C. (100° F.), filtering immediately, and afterwards evaporating the solution. Pelouze believes this preparation to be pure quinine, mixed with a little Prussian blue. (*A. G. M.*, 3e sér., xv. 236.) The *tannate* may be prepared by precipitating one part of quinine sulphate, dissolved in thirty parts of water acidulated with a few drops of sulphuric acid, with a solution of three parts of tannic acid dissolved in thirty parts of cold water, and then washing and drying the precipitate. For other methods of preparing the tannate, see *West. Drug.*, 1893, 352; *Ph. Centralh.*, 1894, 155; *Proc. A. Ph. A.*, 1894, 675. It has the advantage of possessing little taste, but doubts have been repeatedly expressed about its efficiency. At best, it is a feeble preparation, containing, as found in commerce, from 22.6 to 32 per cent. of quinine. *Quinine arsenite* has been recommended by Ringdon, especially in chronic cutaneous affections. Adler prepares it by dissolving arsenic trioxide in water, with enough alkali to make the solution neutral, adding about five times its weight of silver nitrate, washing the precipitated silver arsenite, drying, and mixing with three times its weight of quinine hydrochloride, digesting the mixture for a day with 70 per cent. alcohol, filtering, and allowing the filtrate to evaporate spontaneously. The salt is crystalline, soluble in alcohol, chloroform, and ether, but sparingly so in water. The dose is one-third of a grain (0.021 Gm.), given at first twice a day, and afterwards three or four times a day. *Quinine antimonate* has been recommended by La Camera of Naples, as a febrifuge, being especially applicable to cases of doubtful periodicity. It unites, he thinks, the evacuant properties of the antimonials with the antiperiodic property of quinine. The dose is two or three grains (0.13 or 0.20 Gm.), four times a day. (*J. P. C.*, 3e sér., xxv. 471.) *Quinine urate* is thought by Pérayre of Bordeaux, to be peculiarly efficacious in obstinate intermittents. It is prepared by boiling 10 parts of crude quinine in water, adding gradually 20 parts of crystallized uric acid, and, after sufficient ebullition, filtering and evaporating. A yellow salt is obtained, sometimes amorphous, more frequently crystalline, soluble in hot and less so in cold water, and, according to the author, capable of curing intermittent fever in smaller doses than the sulphate, with less cerebral disturbance, less bitterness, and easier tolerance by the stomach. (*J. P. C.*, 3e sér., xxxvii. 139.) *Quinine hypophosphite* may be prepared by dissolving 3 parts of calcium hypophosphite in 60 parts of distilled water, and adding the filtered solution to a solution of 13 parts of quinine sulphate in 200 parts of alcohol, allowing the mixture to stand two hours, and filtering, distilling off the alcohol and evaporating the solution and setting aside to crystallize. The salt is soluble in 25 parts of cold water, in 1.5 parts of boiling water, and in 10 parts of alcohol. *Quinine glycerophosphate* exists in two conditions, basic and neutral. The basic salt, which is stable, may be made by dissolving 75.6 Gm. of quinine in 500 Cc. of ether and mixing with a solution of 17.2 Gm. of glycerophosphoric acid in 60 Gm. of alcohol (95 per cent.), collecting the white precipitate, washing with ether, and drying. (E. Fallieres, *P. J.*, 1898, 410.)

Quinine and urea hydrochloride,—"chininum bimuriaticum carbamidatum,"—discovered by Kutais (1878), is best prepared by Rice's process. 79 parts of quinine hydrochloride are dissolved in 70 parts of hydrochloric acid (sp. gr. 1.050), the solution filtered, 12 parts of urea added, and the whole warmed until the liquid is clear. It is then set aside, that crystals may form. These are soluble in an equal weight of water, and also in strong alcohol. This salt has been recommended especially for hypodermic uses. *Quinine citrothymate* is prepared by Pavesi by heating in a flask on a water bath 4 parts of quinine and 6 parts of oil of thyme, with enough alcohol to dissolve both. After standing 12 hours, 2 parts of powdered citric acid are added, and the whole heated, filtered, evaporated, and allowed to crystallize.[1] For uses of quinine see *Quininæ Sulphas.*

[1] *Quinine Chlorate* is best prepared, according to C. R. C. Tichborne, from barium chlorate. He mixes in a porcelain dish 310 grains of barium chlorate dissolved in a little boiling water with 2 ounces avoirdupois of quinine sulphate, and 12 ounces of hot water, at 90° C. (194° F.), a slight excess of the sulphate being used to insure the precipitation of all the barium. Owing to this excess, a slight pellicle of quinine sulphate floats on the surface. Apply heat, and gradually add a very little precipitated barium carbonate until the coating of sulphate is replaced by a slightly oily pellicle of alkaloid. The quinine chlorate is now obtained by evaporation and crystallization. For a mode of preparing the barium chlorate, see *A. J. P.*, 1868, p. 101.

The chlorate crystallizes from its solution in fungoid tufts, consisting of filiform, snow-white crystals, radiating from a centre. It melts with heat, and in the air at length takes fire, burning vividly and if dry sometimes with explosion, leaving a carbonaceous residue. It is very soluble in boiling water, but sparingly in cold, and is deposited from its hot solution on cooling. Gently warmed with hydrochloric acid, it emits chlorine copiously and ammonia now added in excess occasions an emerald-green color,—thus showing that it is a compound of chloric acid and quinine. (*P. J.*, 2d ser., viii. 135.)

Quinine Citrate.—Quinine, pure, 15 parts; citric acid, 8 parts. The product corresponds to 20 parts of true quinine citrate.

Quinine Hydrobromide.—Quinine sulphate, 100 parts; potassium bromide, 28 parts. The product corresponds to 100 parts of quinine hydrobromide. Quinine hydrobromide contains almost as much quinine as the sulphate, and is soluble in 54 parts of water. It has been extensively used hypodermically in the form of a ten per cent. solution in a mixture of 25 parts of alcohol and 75 parts of water. Its simple aqueous solution seems to be preferable.

Dose, one to five grains (0.065 to 0.32 Gm.).

Off. Prep.—Elixir Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Glyceritum Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Oleatum Quininæ, *U. S.;* Syrupus Hypophosphitum Compositus, *U. S.*

Quinine Hydriodide.—Quinine sulphate, 95 parts; potassium iodide, 40 parts. The product corresponds to 100 parts of quinine hydriodide.

Iodized Quinine Hydriodide.—Quinine hydrochloride, 70 parts; potassium iodide, 50 parts; iodine, 20 parts. To be triturated together with a little alcohol. Corresponds to 100 parts of the above quinine salt.

Quinine Hypophosphite.—Quinine hydrochloride, 100 parts; calcium hypophosphite, 24 parts. Corresponds to 100 parts of the above quinine salt.

Quinine Lactate.—Quinine, pure, 70 parts; lactic acid, 35 parts. To be triturated together, if necessary, with a few drops of alcohol. Corresponds to 100 parts of the above quinine salt.

Quinine Phosphate.—Quinine sulphate, 94 parts; sodium phosphate, 80 parts. Corresponds to 100 parts of the above quinine salt. (*J. P. C.,* May, 1879; *N. R.,* Nov. 1879.)

Quinine Sulphovinate, according to Carles, is prepared by dissolving 16.9 parts of sodium sulphovinate in 200 parts of hot alcohol, and 42.8 parts of quinine sulphate in 600 parts of hot alcohol. The hot solutions are mixed, cooled, and the precipitated sodium sulphate filtered out. The filtrate is distilled, and the residue evaporated and dried at a low temperature. It is soluble in 3 parts of water. Jaillari has extensively employed hypodermic injections of one part of quinine sulphovinate in nine parts of distilled water, with great satisfaction, in the severe *malarial fevers of Algiers.*

Quinine Salicylate may be prepared by Jobst's process, by double decomposition between solutions of quinine hydrochloride and ammonium salicylate, or by saturating an alcoholic solution of quinine with an alcoholic solution of salicylic acid. The crystals are soluble in 225 parts of water and in 20 parts of alcohol.

Quinine Phenate, or *carbolate,* is obtained by Jobst, having the composition $C_{20}H_{24}N_2O_2.C_6H_6O$. It is soluble in 400 parts of water, and in 80 parts of alcohol. (*P. J.,* June 12, 1875.) *Quinine sulphosalicylate,* on account of its slow solubility in water, will probably not be very useful medicinally. (See *N. R.,* 1878, p. 103.) *Quinine meconate* is prepared by mixing alcoholic solution of meconic acid and quinine.

Quinine Valerate. Quininæ Valerianas. Quinine Valerianate.—"Quinine Valerianate should be kept in well-stoppered bottles in a dark place." *U. S.* 1890.

"Take of Valerianic Acid *half a troyounce;* Sulphate of Quinia *two troyounces;* Diluted Sulphuric Acid, Water of Ammonia, Water, each *a sufficient quantity.* Dissolve the Sulphate of Quinia in a pint of Water, with the aid of Diluted Sulphuric Acid; then add Water of Ammonia in slight excess, and wash the precipitated quinia with water until freed from sulphate of ammonium. Dissolve the Valerianic Acid in five pints of Water, heated to 180° F., add the quinia to the solution, and, when it is dissolved, set the whole aside for several days to crystallize. Decant the mother-water from the crystals, dry them on bibulous paper, and keep them in a well-stoppered bottle. By evaporating the mother-water at a temperature not exceeding 120° F., more crystals may be obtained." *U. S.* 1870.

In the process of the U. S. P. 1870 quinine is first obtained by decomposing quinine sulphate by means of ammonia, and then combined directly with valerianic acid, to form quinine valerianate, which crystallizes from the solution when it cools, because much less soluble in cold than in hot water. By the late Dublin formula, which, with the salt itself, has been omitted in the British Pharmacopœia, the valerianate was obtained by double decomposition between quinine hydrochloride and sodium valerianate, resulting in the production of sodium chloride, which remained in solution, and quinine valerianate, which crystallized. The modern name for this salt is quinine valerate, the U. S. P. (8th Rev.) having adopted the word "valeric" instead of "valerianic" for the acid.

Quinine valerianate is in "white, or nearly white, pearly, lustrous, triclinic crystals, having a slight odor of valerianic acid, and a bitter taste. Permanent in the air. Soluble, at 15° C. (59° F.), in 100 parts of water, and in 5 parts of alcohol; in 40 parts of boiling water, and in 1 part of boiling alcohol. When heated to about 90° C. (194° F.), the salt melts, forming a colorless liquid. At 100° C. (212° F.), it loses its water of crystallization, and also begins to lose valerianic acid. On ignition, it is slowly consumed, leaving no residue. The aqueous solution of the salt is neutral or slightly alkaline to litmus paper. The aqueous solution, when acidulated with sulphuric acid, exhibits a blue fluorescence, and emits the odor of valerianic acid. On treating 10 Cc. of an aqueous solution (about 1 in 1300) of the salt with 2 drops of bromine water, and then with an excess of ammonia water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents, more dilute solutions will give a paler tint, while more concentrated ones will acquire a deeper color, or throw down a green precipitate. Ammonia water added to the aqueous solution throws down a white precipitate, soluble in an excess of ammonia water, and also in about 20 times its weight of ether. Quinine Valerianate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of *readily carbonizable, organic impurities*). The aqueous solution of the salt should not be rendered more than slightly turbid by barium chloride test-solution (limit of *sulphate*)." *U. S.* 1890.

This substance probably does not differ in its general medicinal action from more ordinary salts of the alkaloid, but has been thought to be efficacious in *hemicrania.*

Dose, two to fifteen grains (0.13 to 1.0 Gm.).

QUININÆ BISULPHAS. U. S.

QUININE BISULPHATE

(quĭ-nī'næ bī-sŭl'phăs)

$C_{20}H_{24}N_2O_2.H_2SO_4 + 7H_2O = 544.33$

"The acid sulphate $[SO_2(OH)_2.C_{20}H_{24}N_2O_2 + 7H_2O]$ of the alkaloid quinine. It should be kept in well-stoppered, dark amber-colored vials." *U. S.*

Chininum Bisulfuricum, Quininæ Sulphas Acidus; Acid Quinine Sulphate; Sulfate de Quinine Neutre, *Fr. Cod.;* Saures Chininsulfat, Chininbisulfat, *G.;* Bisolfato di chinina, *It.;* Sulfato quinico neutro, *Sp.*

This salt is made by suspending 100 Gm. of quinine sulphate in 500 Gm. of warm distilled water, and adding 115 Gm. of diluted sulphuric acid (U. S. P.), filtering and crystallizing. It has been introduced because of the great advantages in solubility that it possesses over the ordinary sulphate. It requires but 8.5 parts of water to dissolve it, while the sulphate requires 720. For use in the form of pills it is greatly superior on this account, while it may be administered in solution without the excess of acid which must be used when the ordinary sulphate is prescribed in order to dissolve it. Its use is rapidly extending, and when these very important practical points of superiority are fully appreciated by the profession it should be used almost exclusively. It is officially described as in "colorless, transparent or whitish, orthorhombic crystals or small needles; odorless, and having a very bitter taste. It effloresces on exposure to the air, and turns yellow on exposure to the light. Soluble in 8.5 parts of water, 18 parts of alcohol, 1770 parts of ether, 920 parts of chloroform, and in 18 parts of glycerin at 25° C. (77° F.); soluble in 0.68 part of water at 80° C. (176° F.), and in 0.5 part of alcohol at 60° C. (140° F.). When heated, this salt softens at 60° C. (140° F.), becomes semi-fluid at 70° C. (158° F.), and melts at about 160° C.

(320° F.), with decomposition. It loses all of its water of crystallization at 100° C. (212° F.). On ignition, the salt is slowly consumed, leaving no residue. Its aqueous solution has a strongly acid reaction and shows a blue fluorescence. Barium chloride T.S. produces a white precipitate, insoluble in hydrochloric acid. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.77 Gm. (corresponding to 7 molecules or 23 percent. of water of crystallization). If to 1 Cc. of an aqueous solution of Quinine Bisulphate (1 in 100) there be added 2 Cc. of bromine T.S., and then 1 Cc. of ammonia water, the liquid should acquire an emerald-green color (*thalleioquin*). Sulphuric acid should produce not more than a faintly yellow tint (limit of *carbonizable organic impurities*). Dissolve 2 Gm. of Quinine Bisulphate, which has been dried at 50° C. (122° F.) for two hours, in 20 Cc. of distilled water, carefully neutralize with diluted sodium hydroxide T.S., and evaporate the solution to dryness on a water-bath. Complete the test by following the directions given on page 1046 under *Quininæ Sulphas* (Test for Other Cinchona Alkaloids, Section II.)." *U. S.*

On account of its great solubility this salt is to be preferred to the neutral salts whenever rapid absorption is desired, and especially for hypodermic medication. Its dose is about 25 per cent. greater than that of the sulphate, on account of its greater proportion of acid.

Dose, two to ten grains (0.13 to 0.65 Gm.).

QUININÆ HYDROBROMIDUM. U. S.

QUININE HYDROBROMIDE [Quininæ Hydrobromas, Pharm. 1890, Quinine Hydrobromate]

(quĭ-nī′næ hȳ-drǫ-brō′mĭ-dŭm)

$C_{20}H_{24}N_2O_2.HBr + H_2O = 420.06$

"The hydrobromide [$HBr.C_{20}H_{24}N_2O_2 + H_2O$] of the alkaloid quinine. It should be kept in well-stoppered, amber-colored vials." *U. S.*

Bromhydrate de Quinine Basique, *Fr. Cod.;* **Monobromhydrate de Quinine,** *Fr.;* **Chininum Hydrobromicum; Chininhydrobromid, Bromwasserstoffsaures Chinin,** *G.*

This official salt may be made by suspending 10 parts of quinine sulphate in 80 parts of water, boiling, and adding 3.4 parts of barium bromide dissolved in 20 parts of water, filtering, evaporating, and crystallizing. It may also be made by Leger's process, as follows: Quinine sulphate, commercial, crystallized, 40 parts; potassium bromide, dried and powdered, 11 parts; alcohol (80 per cent.), 400 parts; distilled water, 400 parts. Dissolve the sulphate in two hundred parts of alcohol by the aid of heat, add the potassium bromide, dissolved in thirty parts of distilled water, and continue the heat five or six minutes, in order to allow the potassium sulphate, which is formed, to acquire greater compactness, so that it will more readily settle. Filter off from the precipitate, and wash four times with fifty parts of boiling alcohol. Let the alcoholic solution cool, when a further small quantity of potassium sulphate will be deposited. The solution is then again filtered through white filtering paper, and evaporated on a water bath to one hundred parts. Next, four hundred parts of distilled water are poured on, and heat is applied until the hydrobromide is completely dissolved. After allowing the solution to stand in the cold for about twenty-four hours, the dish will be found filled with a compact crystalline mass. The crystals are transferred to a filter, allowed to drain, and dried by exposure to air. Heating would cause them to fuse. The product thus obtained amounts to about thirty parts of perfectly white quinine hydrobromide. By evaporating the mother water to one-third of its volume, about six parts more may be obtained. It is absolutely necessary, as has been already pointed out by Boille, to redissolve the hydrobromide in water as above stated, if the salt is to be obtained in white and bulky crystals. The above quantity of four hundred parts should not be diminished, for, if this were done, the salt would separate at first in the form of an oily liquid, and afterwards would form a crystalline crust. (*Répert. de Pharm.,* 1880, p. 390; *N. R.,* Jan. 1881.)

Properties.—It is in "white, light, silky, needles; odorless, and having a very bitter taste. The salt effloresces on exposure to the air. Soluble in 40 parts of water, 0.67 part of alcohol, 16 parts of ether, 8 parts of glycerin, and very soluble in chloroform at 25° C. (77° F.); soluble in 3 parts of water at 80° C. (176° F.). When heated to 100° C. (212° F.) the salt loses its water of crystallization. At 152° C. (305.6° F.) it begins to fuse, forming a syrupy liquid at 200° C. (392° F.). On ignition it is slowly consumed, leaving no residue. Its solutions are neutral, or slightly alkaline to litmus paper, and when acidulated with diluted sulphuric acid show a vivid blue fluorescence. Ammonia water added to an aqueous solution of the salt produces a white precipitate, which is soluble in a large excess of the reagent. On precipitating a saturated aqueous solution of the salt with sodium hydroxide T.S., filtering, supersaturating the filtrate with acetic acid, adding chloroform and a little chlorine water, and shaking, the chloroform will separate with a yellow color. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should weigh not less than 0.957 Gm. (corresponding to 1 molecule, or 4.25 percent. of water of crystallization). If to 1 Cc. of a solution of Quinine Hydrobromide (1 in 100) 2 Cc. of bromine T.S. be added, and then 1 Cc. of ammonia water, an emerald green color should be produced (*thalleioquin*). Quinine hydrobromide should not impart more than a faintly yellowish tint to concentrated sulphuric acid

(limit of readily *carbonizable organic impurities*), nor produce a red color with nitric acid (difference from *morphine*). Aqueous solutions of the salt should not be rendered more than faintly turbid by barium chloride T.S. (limit of *sulphate*). If to 5 Cc. of a saturated aqueous solution of potassium ferricyanide 25 Cc. of water, 15 drops of ferric chloride T.S., and 5 Cc. of diluted hydrochloric acid be added, a clear brown solution should result. On adding to this 0.1 Gm. of Quinine Hydrobromide, shaking well, and allowing it to stand for five minutes, no blue color should be developed (difference from *morphine*). Dissolve 3 Gm. of Quinine Hydrobromide, which has been dried at 50° C. (122° F.) for two hours, in 30 Cc. of hot distilled water in an evaporating dish, and add 1.5 Gm. of crystallized sodium sulphate gradually, with constant stirring, and evaporate the liquid on a water-bath to dryness. Complete the test by following the directions given on page 1046, under *Quininæ Sulphas* (Test for Other Cinchona Alkaloids, Section II.), using 30 Cc. of distilled water for maceration instead of 20 Cc. as there directed." *U. S.*

Uses.—This salt is well fitted for hypodermic injection, on account of its ready solubility, but is not superior, if equal, to the bisulphate. The plan which has been advocated of injecting a hot saturated solution is to be deprecated, as tending to cause precipitation in the cellular tissue. It is very capable of causing cinchonism, but the amount of hydrobromic acid is too small to sensibly affect the system.

Dose, from two to ten grains (0.13 to 0.65 Gm.).

QUININÆ HYDROCHLORIDUM.
U. S., Br.

QUININE HYDROCHLORIDE [Quininæ Hydrochloras, Pharm. 1890, Quinine Hydrochlorate]

(quị-nī′næ hȳ-drọ-ẹhlō′rị-dŭm)

$C_{20}H_{24}N_2O_2.HCl + 2H_2O = 393.76$

"The hydrochloride [$HCl.C_{20}H_{24}N_2O_2 + 2H_2O$] of the alkaloid quinine. It should be kept in well-stoppered, amber-colored vials." *U. S.* "The hydrochloride, $C_{20}H_{24}N_2O_2,HCl, 2H_2O$, of an alkaloid obtained from the bark of various species of Cinchona and Remijia." *Br.*

Muriate of Quinine; Chlorhydrate de Quinine Basique, *Fr. Cod.;* Chlorhydrate de Quinine, *Fr.;* Chininum hydrochloricum, *P. G.;* Chininhydrochlorid, Salzsaures Chinin, *G.;* Cloridrato di chinina, *It.*

This quinine salt was recommended for admission to the Br. Ph. 1885 by W. Martindale on account of its being more soluble in water and richer in quinine than is the sulphate. It may be readily prepared by treating the alkaloid with diluted hydrochloric acid, or by double decomposition between barium chloride and quinine sulphate. Quinine hydrochloride is in "white, silky, glistening needles; odorless, and having a very bitter taste. The salt effloresces when exposed to warm air. Soluble in 18 parts of water, 0.6 part of alcohol, 240 parts of ether, 0.8 part of chloroform, and in 8 parts of glycerin at 25° C. (77° F.); soluble in 0.4 part of water at 80° C. (176° F.). When heated to 120° C. (248° F.), the salt loses its water of crystallization. At about 156° C. (312.8° F.), it begins to melt, but is not fully melted until the temperature reaches 190° C. (374° F.). On ignition it is slowly consumed, leaving no residue. Its aqueous solution is neutral or faintly alkaline to red litmus paper, and is not fluorescent except when greatly diluted, or when sulphuric acid is added to it.[1] Silver nitrate T.S. produces in aqueous solutions of the salt a white precipitate, insoluble in nitric acid. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should weigh 0.91 Gm. (corresponding to 2 molecules or 9.1 percent. of water of crystallization). If to 1 Cc. of a solution of Quinine Hydrochloride (1 in 100) 2 Cc. of bromine T.S. be added, and then 1 Cc. of ammonia water, an emerald-green color should be produced (*thalleioquin*). Sulphuric acid should produce no color (absence of *readily carbonizable organic impurities*). Aqueous solutions of the salt should not be rendered more than faintly turbid by barium chloride T.S. (limit of *sulphate*). If to 5 Cc. of a saturated solution of potassium ferricyanide 25 Cc. of water, 15 drops of ferric chloride T.S., and 5 Cc. of diluted hydrochloric acid be added, a clear brown solution should result. On adding to this 0.1 Gm. of Quinine Hydrochloride, shaking well, and allowing it to stand for five minutes, no blue color should be developed (difference from *morphine*). Dissolve 3 Gm. of Quinine Hydrochloride, which has been dried at 50° C. (122° F.) for two hours, in 30 Cc. of hot distilled water in an evaporating dish, and add 1.5 Gm. of crystallized sodium sulphate gradually, with constant stirring, and evaporate the liquid on a water-bath to dryness. Complete the test by following the directions given on page 1046, under *Quininæ Sulphas* (Test for Other Cinchona Alkaloids, Section II.), using 30 Cc. of distilled water for maceration instead of 20 Cc. as there directed." *U. S.*

"It is soluble in about 35 parts of cold *water,* in 3 parts of cold *alcohol* (90 per cent.), and very soluble in boiling *water* and *alcohol* (90 per cent.). It affords the reactions characteristic of hydrochlorides. It should yield only the slightest characteristic reactions with the tests for sulphates. When converted into quinine sulphate, by dissolving it together with an equal weight of *sodium sulphate* in ten times

[1] In explanation of this it may be stated it is only the compounds of quinine with the oxygen acids that show the fluorescence in acid solution, none of the compounds of the haloid acids showing this reaction.

its weight of hot *water,* and setting the mixture aside at 60° F. (15.5° C.), it should respond to the characters and tests that are mentioned under 'Quininæ Sulphas.' Dried at a temperature of 212° F. (100° C.), it loses 9 per cent. of water." *Br.*

Quinine hydrochloride has a decided advantage over the sulphate in its greater solubility in water. It is, however, less soluble than the acid quinine hydrochloride (see below).

Dose, two to ten grains (0.13 to 0.65 Gm.).

Off. Prep.—Tinctura Quininæ, *Br.;* Vinum Quininæ, *Br.*

QUININÆ HYDROCHLORIDUM ACIDUM. Br.

ACID QUININE HYDROCHLORIDE

(quĭ-nī'næ hȳ-drŏ-ȼhlō'rĭ-dŭm ăç'ĭ-dŭm)

$C_{20}H_{24}N_2O_2 2HCl + 3H_2O = 447.82$

"The acid hydrochloride, $C_{20}H_{24}N_2O_2,2HCl, 3H_2O$, of an alkaloid obtained from the bark of various species of Cinchona and Remijia." *Br.*

Chlorhydrate de Quinine Neutre, *Fr.;* Saures Chininhydrochlorid, Saures Chlorwasserstoffsaures Chinin, *G.*

This is an official quinine salt of the Br. Pharm. 1898. It has been introduced on account of its remarkable solubility in water,—*i.e.,* less than its own weight. It may be made by passing hydrochloric acid gas over dry quinine, but more conveniently by decomposing quinine bisulphate with barium chloride or by mixing a solution of neutral hydrochloride with one molecular proportion of hydrochloric acid and evaporating the solution at a gentle heat. It is officially described as "a white crystalline powder soluble in less than its own weight of *water,* yielding a somewhat acid liquid. It affords the reactions characteristic of hydrochlorides. It should yield only the slightest characteristic reactions with the tests for sulphates. Each gramme, when dissolved in 20 cubic centimetres of *water,* should require for its complete neutralization not more than 2.5 cubic centimetres of *volumetric solution of soda.* When converted into quinine sulphate, by dissolving it together with an equal weight of *sodium sulphate* in ten times its weight of hot *water,* exactly neutralizing this liquid with *solution of ammonia,* and setting it aside at 60° F. (15.5° C.) to cool, it should respond to the characters and tests which are mentioned under 'Quininæ Sulphas.' Dried at a temperature of 212° F. (100° C.), it loses not more than 12 per cent. of water." *Br.*

The solubility of this salt fits it for use in hypodermic and rectal injections. Its physiological and therapeutic action and its dose are those of quinine sulphate.

Dose, two to ten grains (0.13 to 0.65 Gm.).

QUININÆ SALICYLAS. U. S.

QUININE SALICYLATE

(quĭ-nī'næ săl-ĭ-cȳ'lās)

$2C_{20}H_{24}N_2O_2.C_7H_6O_3 + H_2O = 935.54$

"The salicylate $[2C_6H_4(OH)COOH.C_{20}H_{24}N_2O_2 + H_2O]$ of the alkaloid quinine. It should be kept in amber-colored, well-stoppered vials." *U. S.*

Salicylate de Quinine Basique, *Fr. Cod.;* Salicylate de Quinine, *Fr.;* Chininsalicylat, Salicylsaures Chinin, *G.;* Salicilato quinico, *Sp.*

Preparation.—Quinine salicylate may be made by adding a solution made by dissolving 3.9 parts of sodium salicylate in 30 parts of water, to a hot solution made by dissolving 10 parts of quinine sulphate in 75 parts of boiling water. The precipitate is collected, washed and dried and recrystallized from its solution in alcohol.

Properties.—It is officially described as in "colorless needles, permanent in the air, but on keeping readily assuming a pinkish color. Soluble in 77 parts of water, 11 parts of alcohol, 110 parts of ether, 37 parts of chloroform, and in 16 parts of glycerin at 25° C. (77° F.); soluble in 35 parts of water at 80° C. (176° F.), and in 11 parts of alcohol at 60° C. (140° F.). When heated, it begins to melt at 183° C. (361.4° F.), with decomposition, and at 187° C. (368.6° F.) is entirely melted to a red liquid. When ignited, it is slowly consumed, without leaving a residue. Its aqueous solution is alkaline to red litmus paper, and has a bitter taste. When treated with diluted sulphuric acid, its aqueous solution develops a blue fluorescence. Its aqueous solution, when treated with a drop of ferric chloride T.S., should give a violet color. Sulphuric acid containing about one-fifth of its volume of solution of formaldehyde gives a pink color. If to 10 Cc. of a dilute aqueous solution of Quinine Salicylate there be added 3 Cc. of bromine T.S. and then an excess of ammonia water, an emerald-green color should be produced (*thalleioquin*). When heated at 100° C. (212° F.), to constant weight, it should lose not more than 2 percent. in weight (absence of *excessive moisture*). Mix 2 Gm. of Quinine Salicylate with 10 Cc. of distilled water, in a separator, add a slight excess of ammonia water, and shake the liquid with three successive portions of 25, 20, and 10 Cc. of ether, collect the ether-solution in a porcelain dish and evaporate it to dryness on a water-bath, dissolve the residue in alcohol, add just sufficient sulphuric acid to render the liquid exactly neutral, and again evaporate to dryness. Complete the test by following the directions given on page 1046, under *Quininæ Sulphas* (Test for Other Cinchona Alkaloids, Section II.)." *U. S.*

Uses.—Quinine salicylate is believed by many practitioners to be a valuable remedy in the

advanced stages of an *acute rheumatism*, in subacute rheumatism, and in mild *gouty* conditions. When the general system is in a condition of lowered vitality ten to fifteen grains (0.65 to 1.0 Gm.) may be given daily.

Dose, from two to ten grains (0.13 to 0.65 Gm.).

QUININÆ SULPHAS. U. S., Br.

QUININE SULPHATE

(quĭ-nī'næ sŭl'phăs)

$(C_{20}H_{24}N_2O_2)_2.H_2SO_4 + 7H_2O = 866.15$

"The sulphate $[SO_2(OH)_2.(C_{20}H_{24}N_2O_2)_2 + 7H_2O]$ of the alkaloid quinine. It should be kept in well-stoppered bottles, preferably of an amber color, and in a dark place." *U. S.*
"The sulphate, $[(C_{20}H_{24}N_2O_2)_2,H_2SO_4]_2,15H_2O$, of an alkaloid obtained from the bark of various species of Cinchona and Remijia." *Br.*

Sulfas Quinicus; Disulphate or Basic Sulphate of Quinia; Sulfate de Quinine Basique, *Fr. Cod.*; Chininum Sulfuricum, *P. G.*; Chininsulfat, Schwefelsaures Chinin, *G.*; Solfato di chinina, *It.*; Sulfato quinico basico, *Sp.*

No process is given in the U. S. Pharm. for preparing quinine sulphate; that of the U. S. P. 1870 will be found in detail in the U. S. D., 17th ed., p. 1141. The process, briefly stated, is to exhaust cinchona bark by boiling with water acidulated with hydrochloric acid and adding milk of lime in excess. The quinine is precipitated with lime, and the dried precipitate digested with boiling alcohol; the alcoholic solution of quinine is evaporated, and the mass dissolved in water acidulated with sulphuric acid. The hot solution is treated with animal charcoal to decolorize it, and then set aside to crystallize.

Pelletier proposed to substitute oil of turpentine for alcohol in the ordinary process for procuring quinine sulphate. The impure quinine, precipitated by lime from the acidulous decoctions, after being washed, pressed, and dried, is digested with the oil, which dissolves the quinine. The solution thus obtained is agitated with water acidulated with sulphuric acid, by which quinine sulphate is formed. The oil, separating, rises to the top, and is removed for future use, and the aqueous solution of the salt is evaporated, and treated as in the original process. A disadvantage of this method is said to be that the oil does not completely exhaust the precipitate. A similar process has been employed here and in England, either *fusel oil* or *benzene* being substituted for oil of turpentine. In this instance, however, the solvent is added to the impure quinine, without separation from the acidulated decoction from which it was precipitated by lime. The mixture being well agitated, the fusel oil or benzene dissolves the alkaloids, and, rising to the surface of the liquid, is drawn off by a siphon. The solution thus drawn off is treated as above with water acidulated with sulphuric acid, and the process is completed in the same manner. (See *P. J.*, xiv. 29, 92, and 139.)

The importation of quinine sulphate and salts of quinine amounted in 1903 to 3,300,444 ounces, valued at $744,774; in 1904 to 3,796,139 ounces, valued at $826,791; in 1905 to 2,904,277 ounces, valued at $638,755. For a "commercial history of quinine," with statistics, see *D. C.*, 1896, 32. Quinine sulphate made in Java is now found in commerce. (*A. J. P.*, 1898, 345.)

When barks containing the alkaloids *cinchonidine* and *quinidine* are used, as their sulphates are much more soluble than that of quinine, it follows that in the mother waters left after the crystallization of quinine sulphate there will be found a portion of cinchonidine or quinidine sulphate, or of both. In fact, there is generally, under these circumstances, more or less of the sulphates of the four alkaloids, quinine, cinchonine, quinidine, and cinchonidine, all of which are contained in many barks, and, besides these, a portion of amorphous alkaloid, incapable of crystallization, probably resulting, in part at least, from the heat employed in the process. These may in a great degree be separated through their different solubilities in water. Quinine sulphate, being least soluble, will first crystallize, afterwards the cinchonidine or quinidine salt, and finally that of cinchonine, which is the most soluble, while the uncrystallizable salt will remain in solution, and may be obtained in the amorphous state by evaporation to dryness.

Properties.—"White, silky, light, flexible, glistening crystals, or hard, prismatic, monoclinic needles, making a very light and easily compressible mass, odorless, and having a persistent, very bitter taste. It effloresces rapidly when it is exposed to dry air, and then becomes lustreless; when exposed to light it acquires a brownish tint. Quinine Sulphate sometimes crystallizes with 8 molecules of water of crystallization (16.18 percent.). Soluble in 720 parts of water, 86 parts of alcohol, 400 parts of chloroform, and in 36 parts of glycerin at 25° C. (77° F.); very difficultly soluble in ether; soluble in 45 parts of water at 80° C. (176° F.), and in 9 parts of alcohol at 60° C. (140° F.). Diluted acids increase its solubility in water, and it is easily soluble in a mixture of chloroform 2 parts, and absolute alcohol 1 part. Quinine Sulphate which has been dried over sulphuric acid melts at 205° C. (401° F.). When heated to 60° C. (140° F.), or when exposed to dry air, it loses all but 2 molecules of its water of crystallization, and upon heating it to 115° C. (239° F.), the remainder is expelled. Upon ignition, the salt is slowly consumed, without leaving a residue. Its aqueous solution is neutral to litmus paper, and when acidulated with diluted sulphuric acid, develops a vivid blue fluorescence. Barium chloride T.S. produces a white precipitate, insoluble in hydrochloric acid. On treating 10 Cc. of an

aqueous solution of the salt (about 1 in 1300) with 5 drops of bromine T.S., then with an excess of ammonia water, the liquid should acquire an emerald-green color (*thalleioquin*). With proper adjustment of the reagents, more diluted solutions will give a paler tint, while more concentrated ones will acquire a deeper color, or throw down a green precipitate." *U. S.* "Filiform silky white crystals, of an intensely bitter taste. Soluble in about 800 parts of *water*, giving a solution which has a bluish fluorescence. Entirely soluble in *water* acidulated with a mineral acid. Aqueous solutions of quinine salts yield with *solution of ammonia* white precipitates, soluble in *ether* and in excess of the *solution of ammonia*. When such aqueous solutions are treated first with *solution of bromine* or *of chlorine* and afterwards with *solution of ammonia*, they become of an emerald-green color, changing to red when mineral acids are added. Exposed to dry air, Quinine Sulphate effloresces until the 15 molecules of water have been reduced to 4. It affords the reactions characteristic of sulphates." *Br.* Its cold solution is opalescent.

The acid quinine salts possess fluorescent properties with the exception of those of the haloid acids. It has also been discovered that the presence of acetphenetidin conceals the fluorescence of sulphuric acid solutions of quinine. The diluted acids, and tartaric and oxalic acids in excess, dissolve the sulphate easily. With an additional equivalent of sulphuric acid it forms another sulphate, which is more soluble in water than the official salt, and crystallizes from its solution with much greater difficulty. This is now considered by many as strictly neutral, and therefore entitled to the name of quinine sulphate, while the official salt contains two equivalents of base to one of acid, and is therefore a *quinine subsulphate* or *diquinine sulphate*. The latter name was adopted by the London College, and has been much used by chemical writers. In the U. S., Dublin, and Edinburgh Pharmacopœias, as well as in the French Codex, the name of quinine sulphate, originally given to the official salt, under the impression that it was neutral, was retained; and it has been assumed by the 1898 British Pharmacopœia. Hence has arisen a confusion of nomenclature, which must embarrass the student. The following statement may serve to clear up this confusion. There are at least three quinine sulphates that have been obtained, of which two are now official. The first of these,

$$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$$

is a "*diquinic sulphate*," but is the official salt known as quinine sulphate, or *Quininæ Sulphas*, U. S.; the second, formed by dissolving this first in dilute sulphuric acid, has the formula

$$C_{20}H_{24}N_2O_2,H_2SO_4 + 7H_2O$$

and is the official quinine bisulphate, or *Quininæ Bisulphas*, U. S.; while the third, a still more acid sulphate,

$$C_{20}H_{24}N_2O_2,2H_2SO_4 + 7H_2O$$

may be obtained from a solution of quinine in excess of diluted sulphuric acid. This salt is not official. Quinine sulphate, owing to the ease with which it parts with its water of crystallization, is apt to mislead those who seek to determine its quality. Forty samples examined by A. J. Cownley showed results varying from 8.1 to 15.95 per cent. of water of crystallization. He recommends for adoption in the Pharmacopœia the air-dried salt, which contains two molecules of water (4.6 per cent.), as being constant in composition. Farr and Wright confirm Cownley's views, and object to "anhydrous" quinine sulphate, which has been proposed by some chemists as the standard, because it has the opposite fault of absorbing moisture. (*P. J.*, 1896, 525; also *P. J.*, 1897, 203.)

Incompatibles and Tests.—"One Gm. of the salt should dissolve completely when heated to 50° C. (122° F.) in 7 Cc. of a mixture of 2 volumes of chloroform and 1 volume of absolute alcohol, and the solution should remain clear on cooling (absence of *ammonium sulphate* and *inorganic salts*). Sulphuric acid should impart to the salt not more than a faintly yellowish tint (limit of *readily carbonizable organic impurities*). Nitric acid should not produce a red color (difference from *morphine*). If 1 Gm. of the salt be dried at a temperature of 115° C. (239° F.), until it ceases to lose weight, the residue should weigh not less than 0.838 Gm. (indicating not more than *8 molecules* or *16.18 percent. of water*)." *U. S.* "2.5 grammes of the freshly prepared salt should lose 0.38 gramme of water by drying at 212° F. (100° C.). Heated to redness with free access of air, it burns without leaving any residue (absence of mineral impurity)." *Br.* The official test (see page 1046) is probably the most reliable of all to prove the presence of small quantities of other cinchona alkaloids. It is a modification of Kerner's,[1] and admits the presence of

[1] *Kerner's test* (G. Kerner, *Zeitschrift für Analytische Chemie*, 1862) distinguishes the alkaloids by their solubilities in ammonia water of given strength, which, according to Kerner, are more fixed and reliable than their solubilities in water or other ordinary solvent. The mode of application is by taking a certain quantity of the sulphate of the alkaloid dissolved in a certain quantity of water, and then adding the ammonia water gradually until the precipitated alkaloid is redissolved: the quantity of the ammoniacal liquid necessary to produce this effect indicates inversely the solubility of the alkaloid. Quinidine requires from 10 to 11 times more of the ammoniacal liquid than quinine, cinchonidine from 12 to 13 times more, while cinchonine is not dissolved by a much larger proportion than is required by either of the others, and though when mixed in very small proportion with quinine it is dissolved at first, yet it afterwards separates on standing. This test is now official, and as modified is regarded as the best test for quinine sulphate. Kerner's test has been elaborately criticised and discussed; it appears that in order to get results which are at all trustworthy it is necessary to be exceedingly careful to observe the specific gravities and temperatures ordered by the test. (See Parson's paper, *Proc. A. Ph. A.*, 1884; *Am. Drug.*, 1885, also 1888; *D. C.*, 1885; *P. J.*, 1887; *Ph. Era*, 1887, also 1888.) In *De Vrij's Chromate Test for Quinine* 5 Gm. of quinine sulphate are dissolved in 500 Gm. of water at the boiling temperature, and 1.20 Gm. of potassium chromate dissolved in a little hot water are added. The precipitate at first produced is rapidly redis-

a trace of other alkaloids. This certainly is as pure as the quinine sulphate need be. To separate the remaining trace of alkaloids entirely would more than double the cost of the salt.

"*Test for Other Cinchona Alkaloids.*—I. Dry 2 Gm. of Quinine Sulphate in a porcelain dish on a water-bath for two hours at 50° C. (122° F.). II. Transfer the residue (which should be strictly neutral to litmus paper) to a dry test-tube, add 20 Cc. of distilled water and place the test-tube in a water-bath; heat it for half an hour at 65° C. (149° F.) and then allow to cool, and keep the temperature at 15° C. (59° F.) for two hours, shaking the test-tube occasionally. Filter the liquid, transfer 5 Cc. of the filtrate, having the temperature of 15° C. (59° F.), to a dry test-tube, and carefully add ammonia water (which must be of official strength and have the temperature of exactly 15° C.) until the precipitate which forms has just redissolved; not more than 6 Cc. of ammonia water should be required to produce a clear solution. If the temperature at the end of the digestion has risen to 16° C. (60.8° F.), not more than 6.5 Cc. of ammonia water should be required; if to 17° C. (62.6° F.), not more than 7 Cc. of ammonia water should be used. (In each case a clear solution indicates the absence of excessive amounts of *other cinchona alkaloids.*)" *U. S.* For Herapath's test (*quinine iodo-sulphate*), see U. S. D., 17th ed., p. 1144. The British Pharmacopœia gives the following tests for the presence of other cinchona alkaloids:

"Quinine Sulphate when tested by the following methods should not afford any appreciable reaction characteristic of cinchonine, quinidine, cupreine, or amorphous alkaloid, and should not yield more than a total of 3 per cent. of crystals of impure cinchonidine by the following test.

Test for Cinchonidine and Cinchonine.—Dissolve 4 grammes of the Quinine Sulphate in 120 cubic centimetres of boiling *water.* Cool the solution slowly to 122° F. (50° C.), with frequent stirring. Separate, by filtration, the purified quinine sulphate which has crystallized out. Concentrate the filtrate by evaporation until it is reduced to 10 cubic centimetres or less; transfer to a small stoppered flask, and, when cold, shake with 10 cubic centimetres of *ether* and half that amount of *solution of ammonia.* Set aside in a cool place for not less than 24 hours. Collect the crystals, which consist of cinchonidine and cinchonine combined with quinine, on a tared filter, wash with a little *ether,* dry at 212° F. (100° C.), and weigh. These should not amount to more than 0.12 gramme.

Test for Quinidine.—Dissolve 1 gramme of the Quinine Sulphate in 30 cubic centimetres of boiling *water;* cool, and filter. To the solution add *solution of potassium iodide* and a little *alcohol* (90 per cent.) to prevent the precipitation of amorphous hydriodides. Collect any separated quinidine hydriodide, wash with a little *water,* dry and weigh. The weight represents about an equal weight of crystallized quinidine sulphate. None or only the slightest traces should be obtained.

Test for Cupreine.—Shake the recrystallized quinine sulphate, obtained in testing the original Quinine Sulphate for cinchonidine and cinchonine, with 25 cubic centimetres of *ether* and 6 cubic centimetres of *solution of ammonia,* and to this ethereal solution, separated, add the ethereal liquid and washings also obtained in testing the original sulphate for the two alkaloids just mentioned. Shake this ethereal liquid with 6 cubic centimetres of a 10 per cent. solution of *sodium hydroxide,* adding *water* if any solid matter should separate. Remove the ethereal solution. Wash the aqueous solution with more *ether,* and remove the ethereal washings. Add *diluted sulphuric acid* to the aqueous liquid heated to boiling, until exactly neutral. When cold, collect any crystallized sulphate of cupreine on a tared filter; dry, and weigh. None or only the slightest traces should be obtained.

Test for Cinchonine and Amorphous Alkaloids.—Dissolve 1 gramme of the Quinine Sulphate in 30 cubic centimetres of boiling *water,* add 1 gramme of *sodium potassium tartrate.* Allow to cool, with frequent stirring; filter. The solution when evaporated to small bulk should give little or no precipitate with *solution of ammonia.*" *Br.*

Quinine sulphate is decomposed by the alkalies, their carbonates, and the alkaline earths. In solution it affords white precipitates with potassium and sodium hydroxides, and ammonia, which are partly soluble in an excess of alkali. It is also precipitated by astringent infusions, the tannic acid of which forms a white insoluble compound with quinine. The soluble salts of lead and of barium occasion precipitates; and that produced by the salts of barium is insoluble in the acids. The soluble salts of acetic, oxalic, tartaric, and gallic acids occasion more or less precipitation with solution of quinine sulphate without excess of acid. A solution of chlorine added to a solution of quinine sulphate and followed by the addition of ammonia water occasions an emerald-green color, and, in certain proportions, the deposition of a green

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solved, and in from 5 to 10 seconds crystallization begins, star-shaped groups of sulphur-yellow needles of anhydrous quinine chromate— $2(C_{20}H_{24}N_2O_2)H_2CrO_4$—being formed. The separation of these crystals is practically complete when the liquid has cooled, but it is advisable not to collect the crystals before the day following their formation. They are washed with a small quantity of water, dried, and weighed; 766.5 parts of quinine chromate are equal to 648 parts of quinine or to 890 parts of quinine sulphate. The mother liquors contain the cinchonidine, together with a small quantity of quinine chromate amounting to 0.05 Gm. in 100 Gm., and to this extent the yield of quinine chromate, by weighing, must be corrected. To ascertain the amount of cinchonidine present the total filtrate and washings are rendered alkaline by soda solution and evaporated to 300 Gm. The cinchonidine separates during the heating, and, after cooling, is collected on a filter, dried at 100° C., and weighed. (*A. Pharm.,* 1886, p. 1022.)

precipitate. The green compound has received the name of *thalleioquin*. The drop of ammonia should be put in without agitation. According to Flückiger, 1-5000th part of quinine can thus be found. With bromine instead of chlorine the test is more delicate. Flückiger states that 1-20,000th part of the alkaloid can be detected. (See a paper by C. F. Zeller, *A. J. P.*, 1880, p. 385; *P. J.* 1872, p. 901.) F. S. Hyde (*Proc. A. Ph. A.*, 1897, 704) states that a solution of calcium hypochlorite gives more satisfactory results in the thalleioquin test than either chlorine or bromine water, the results being more certain and brilliant. If, previously to the use of ammonia in the chlorine test, a concentrated solution of potassium ferrocyanide be added, a dark red color is produced, which persists for several hours, but ultimately passes into green. This does not take place with cinchonine; and, though quinidine sulphate gives the same red color, this does not disappear as with the quinine salt, but is persistent. (Schwartzer, *J. P. C.*, 4e sér., iii. 475.) Quinine sulphate gives a reddish-brown precipitate with iodine dissolved in a solution of potassium iodide. It is possible that under some circumstances the galvanic current may be of service in detecting the alkaloid; a paper on the electrolysis of the salt will be found in the *J. P. C.*, 4e sér., xi. 16.[1] For valuable comments on quinine sulphate tests, see *Proc. A. Ph. A.*, 1897, 705.

Adulterations.—Quinine sulphate has often been adulterated. The effects of adulteration may be produced by the variable quantity of water which quinine sulphate may contain, without any observable alteration in its sensible properties. Millon and Commaille, having exposed quinine sulphate to a very moist atmosphere at the temperature of about 16.6° C. (62° F.), found it always to increase in weight, so that a specimen of the salt, previously deprived of all its water capable of being separated by heat, had in five days absorbed 28.77 per cent. of water, and another specimen dried after its precipitation simply by draining, and supposed to contain 18 per cent. of water, had in ten days absorbed 14 per cent. more, making its whole percentage of water 32, or about one-third of its weight. (*J. P. C.*, Nov. 1862, p. 379.) This is an important fact, and will explain to some extent the frequent variable effects from apparently the same quantity of the salt. It is easy to detect and to obviate this natural sophistication by exposing a suspected specimen to a heat of 115° C. (239° F.). The loss of weight will indicate the quantity of water not essential to the salt. Calcium sulphate,[2] and other alkaline or earthy salts, gum, sugar, mannite, starch, stearin, caffeine, salicin, phlorizin, and the cinchonine sulphate, and sulphates of other cinchona alkaloids, are among the substances which are said to have been fraudulently added. By attending to the degree of solubility of the sulphate in different menstrua, and to its chemical relations with other substances already described, there can be little difficulty in detecting these adulterations. The presence of any mineral substances not readily volatilized may be at once ascertained by exposing the salt to a red heat, which will completely dissipate the quinine sulphate, leaving the mineral behind. A volatile ammonium salt may be detected by the odor of ammonia emitted upon the addition of potassium hydroxide. The absence of organic substances may be inferred if pure cold concentrated sulphuric acid forms a colorless solution. Gum and starch are left behind by alcohol, and fatty matters by water acidulated with sulphuric acid. Sugar and mannite cause a solution of the salt in acidulated water to have a sweet taste after the precipitation of the quinine by an alkaline carbonate. Salicin imparts the property of becoming red upon the contact of sulphuric acid; but, according to Pelletier, this change of color does not take place unless the proportion of salicin exceeds one-tenth. If only in this proportion, the salicin must be isolated. To 1 part of the suspected salt, 6 parts of concentrated sulphuric acid may be added, and to the brown liquid which results, 125 parts of water. The salicin is thus separated, and may be obtained by filtration, in the form of a bitter, white powder, becoming bright red with sulphuric acid. (See *A. J. P.*, xvii. 156.) Caffeine alters the solubility of the medicine in different menstrua. According to Calvert, a saturated solution of quinine sulphate in cold water gives with a solution of chlorinated lime a precipitate soluble in an excess of the latter, while a solution of cinchonine sulphate of the same strength, treated in the same manner, gives a precipitate which is insoluble in a great excess of the reagent. The same effect is produced with lime water, and with solution of ammonia, and solution of calcium chloride, while it furnishes a precipitate with a solution of cinchonine sulphate, yields none with a solution of quinine sulphate. (*J. P. C.*, 3e sér., ii. 394.) Though commercial quinine sulphate frequently contains a portion of one or more of the other cinchona alkaloids, the salt is only slightly less efficacious on that account, as these alkaloids have been shown to possess identical therapeutic properties with those of quinine, and to be little inferior in strength to them.

[1] Morphine has been mixed with quinine with fatal results. If there be more morphine than will form 1-1000th part of the solution, the thalleioquin test will fail to develop the green color. The morphine in these cases is to be recognized by adding nitric acid or ferric chloride to the suspected powder, or, better still, iodic acid, which is decomposed by the alkaloid and forms a beautiful violet solution with chloroform. This test is said to succeed with solutions containing less than 1-10000th part of morphine. (*P. J.*, May, 1872, 901.)

[2] *Flora China.*—According to W. A. Puckner (*West. Drug.*, 1896, 393), nearly pure crystallized calcium sulphate in fine needle-shaped crystals has been exploited as quinine sulphate under the name of flora china.

Uses.—The first symptoms of cinchonism, as produced by small therapeutic doses of quinine (ten grains) in man, are usually ringing in the ears, slight fulness in the head, and perhaps some deafness. With the use of larger doses these symptoms are intensified; the deafness is very marked, disturbed vision may exist, and the flushed face, with the sense of distention in the head, may point towards a cerebral congestion, which is in some cases relieved by spontaneous epistaxis. In decided cinchonism, giddiness and staggering in walking are very common. After toxic doses, severe headache, delirium, stupor, complete deafness and blindness, dilated pupils, embarrassment of respiration, great weakness, convulsions, paralysis, and finally collapse, either comatose or delirious, may result. The deafness produced by large doses of quinine usually passes off rapidly; very rarely is there a permanent impairment of hearing. Amaurosis, with a peculiar ischæmia of the retinal vessels, has in a small number of cases been produced by very large therapeutic doses of the alkaloid. Besides its effects on the brain, quinine sulphate sometimes occasions great gastric and intestinal irritation, marked by oppression of stomach, nausea, abdominal pains, vomiting, and purging. In general, these effects of excessive doses gradually pass off, although partial deafness often continues for several days, and sometimes much longer, and permanent deafness has resulted. It is capable of taking life, although enormous amounts of it are requisite for this. Several cases of recovery are recorded after the taking of an ounce by the stomach. Probably only a portion of the drug was absorbed. Five ounces taken in ten days have caused death.

Although it is not possible at present to explain, with complete satisfaction, all the clinical uses of quinine from its known physiological action, yet it seems proper to speak here briefly of our knowledge of its influence upon the healthy organism, referring the reader for details to H. C. Wood's *Treatise on Therapeutics*. The action of the drug upon the cerebrum is somewhat uncertain. It is probable that moderate doses stimulate the brain to some extent, especially the basal ganglia connected with the special senses, and it is very certain that toxic doses overwhelm and paralyze the gray matter of the brain. Upon the spinal cord of man therapeutic doses produce no marked effect. Two facts, first pointed out by T. A. Chaperon (*Pflüger's Archiv*, 1869, p. 295), have been so abundantly substantiated that we must accept them as established. They are—quinine in *small* doses causes in the frog a lessening of the reflex activity, which is removed by section of the medulla; quinine in *large* doses produces a permanent palsy of reflex activity. The first of these actions is considered to show that the alkaloid stimulates Setschenow's centre in the base of the brain, the second is probably due to a paralysis of the spinal cord. It has been proved by Binz and subsequent observers that when the alkaloid is added to blood outside of the body in a proportion of not less than one part to four thousand it immediately checks, and finally arrests, the amœboid movements of the white blood corpuscles. How far this occurs when the medicine has been taken into the living organism has not been exactly determined, but we certainly are not able to appreciate any such effect in health or disease by therapeutic doses. The ozonizing power of the red corpuscles in drawn blood is lowered by the addition of quinine. Ordinary therapeutic doses exert, however, no perceptible influence. How far the marked antipyretic influence exerted by large doses of quinine is dependent upon its action upon the blood is at present purely a matter of conjecture. In 1765, Pringle called attention to the power of cinchona bark over putrefaction, and it has recently been experimentally proved by Binz, Hallier, Pavesi, and others, that one part of the alkaloid in three hundred parts of milk, albuminous solutions, meat, honey, syrup, etc., will keep in check for a long time putrefaction and other fermentations. Binz has shown that this is due to a poisonous influence upon the low forms of life which accompany or produce these changes. Introduced into the jugular vein or coronary artery, or in any way brought in direct contact with the heart, it lessens the force and frequency of the pulsations, and finally produces diastolic arrest. In man, very large doses of quinine (thirty to sixty grains) lower the force and frequency of the pulse; a pulse rate of forty has been noted, and in reported cases of quinine poisoning the pulse has been imperceptible at the wrist. Under the latter circumstances the pulse rate may be increased, but the cardiac force is reduced to a minimum. The evidence is conclusive that both in man and in the lower animals quinine in sufficient amount is a powerful depressant to the heart muscle or ganglia. An enormous amount has been written during the last ten years concerning the action of quinine upon the uterus. The result of it all seems to indicate positively that the alkaloid has no power to originate uterine contractions in the pregnant female, but that when once parturition has commenced the flagging pains are greatly stimulated and increased by a dose of ten grains of the drug. When abortion is threatened through malarial influence no hesitation need be felt in using the drug to avert the impending catastrophe. Any salt of quinine which escapes absorption in the stomach must be precipitated by the alkaline juices of the bowels, and be absorbed very slowly or not at all. What seems *a priori* almost inevitable has been shown to be the case by the researches of Kerner, who found the alkaloid in the fæces. The importance of giving the salt in some easily soluble form, if it is intended for all of it to be absorbed, is plain. When taken into the system, it seems to find its way into all the

secretions,—it having been found in the tears, sweat, milk, urine, and saliva. Some of it is eliminated unchanged, but, according to the researches of G. Kerner, a portion of it escapes in an amorphous uncrystallizable form and a second portion as a substance free from bitter taste, though crystallizable and having the fluorescence of quinine; for this substance he has proposed the name of *dihydroxyl-quinine.* Upon the elimination both of uric acid and of urea the salts of quinine appear to have a decided influence, decreasing it very noticeably.

Quinine sulphate may be given in pills, capsules or solution, or suspended in water by the intervention of syrup and mucilage. The form of pill is usually preferred. The solution may be readily effected by the addition of a little acid of almost any kind to the water. Eight grains (0.5 Gm.) of the sulphate will dissolve in a fluidounce (30 Cc.) of water acidulated with about twelve minims (0.7 Cc.) of the diluted sulphuric acid or aromatic sulphuric acid of the Pharmacopœias. One of the best ways of exhibiting it to children is to mix the dose quickly with half a teaspoonful of aromatic elixir or syrup of licorice and administer it before it can dissolve. A few drops of laudanum may be added if nausea or disturbance of the bowels is apprehended. J. S. Blockley ascertained that glycerin will, if gently heated, dissolve eight grains of the sulphate in each fluidrachm, and may therefore be conveniently used as a vehicle. (*Lond. Chemist,* Sept. 1857.) R. H. Thomas of Baltimore, found that one part of tannic acid will deprive five parts of quinine sulphate of bitterness, without impairing its efficacy. (*Am. J. M. S.,* N. S., xix. 541.) It is obvious that quinine tannate is thus formed, and as this, though insoluble in water, is readily dissolved in diluted acids, and consequently in the gastric liquor when acid, there can be no doubt that it will generally prove efficacious. It may, however, happen that the stomach may be quite free from acid, and that the operation of this salt may prove less certain than that of the sulphate, and such is asserted to have been the case in some instances, but a little lemonade taken after the medicine would probably obviate the difficulty.

Quinine is used in practical medicine as a tonic, antiperiodic, antipyretic, and a uterine stimulant. It is certainly the most efficient remedy known in *malarial diseases,* in which it acts by poisoning the Plasmodium malariæ first detected in the blood of persons suffering from malarial disease by Laveran, and now generally recognized as the infectious cause of the disease. It should be administered in such a way that the last dose shall be ingested about two hours before the expected return of the paroxysm, and the first dose four or five hours previous to the last. When there is sufficient time, its influence is almost always very sensibly aided by the exhibition, twelve or more hours before, of a mercurial or other purge. Quinine exerts in *febrile disease* a decided antipyretic action, which is especially manifested during those stages of disease in which the natural tendency is towards a lowering of temperature. In *typhus* and *typhoid fever, scarlatina, severe erysipelas, rheumatic hyperexia,* etc., after the use of the cold bath, twenty grains of the alkaloid are often very efficacious in preventing a rapid return of the excessive fever.

Twelve grains of quinine sulphate are equivalent to about an ounce of good bark. The dose varies exceedingly, according to the circumstances of the patient and the object to be accomplished. As a tonic simply, a grain (0.065 Gm.) may be given three or four times a day, or more frequently in acute cases. In *intermittents,* from twelve to twenty-four grains (0.78 to 1.6 Gm.) should be given between the paroxysms, divided into smaller or larger doses according to the condition of the stomach or the length of the intermission. From one to four grains (0.065 to 0.26 Gm.) may be given at once, and some even advise the whole amount. In *malignant intermittents* and *remittents,* the quantity may be increased to thirty grains (2.0 Gm.) or even ninety grains (5.8 Gm.) between the paroxysms. When the stomach will not retain the medicine, it may be administered with nearly as much efficacy by enema,—from six to twelve grains (0.4 to 0.78 Gm.) with two fluidounces (60 Cc.) of acidulated starch water, and from twenty to forty drops (1 to 2 Cc.) of laudanum, being injected into the rectum, in ordinary cases, every six hours. Should circumstances render this mode of application impracticable, the hypodermic syringe should be resorted to. If the ordinary sulphate be used, the solution for hypodermic use should be made with tartaric acid, grain for grain, and should always be carefully filtered. The sulphovinate has been especially recommended, but is of doubtful advantage. (*P. J.,* May, 1875, p. 909.) The official hydrobromide and bisulphate have been considered the best forms for hypodermic use, but it is affirmed that *Laveran's solution* (hydrochloride of quinine, 3, antipyrine, 2, distilled water, 6) affords a 50 per cent. quinine solution, of which the injection is painless.[1] Administered hypodermically, quinine acts with great promptness; but no precaution will always prevent the production of severe local abscesses and ulcerations by the hypodermic use of quinine, and even fatal tetanus has been induced, so that the method should be employed only in emergencies.

Locally applied to the mucous membrane, quinine is stimulant or irritant, according to its concentration. In meningitis, gastritis, enteritis, cystitis, or in inflammation of the middle ear, its evil effects may be very pronounced. In *whooping cough* the use of quinine by atomization has been warmly recommended. In *hay fever* a warm solution, as nearly neutral as

[1] Santesson and Sjoquist believe that a new salt is formed, to which they have given the name of *Chinopyrin.* The antimalarial powers of the solution are well attested.

possible, and of the strength of two grains to the fluidounce (0.13 Gm. to 30 Cc.), may be used with the Thudichum douche.

Dose, one to ten grains (0.065 to 0.65 Gm.).

Off. Prep.—Ferri et Quininæ Citras, *Br.;* Pilula Quininæ Sulphatis, *Br.;* Syrupus Ferri Phosphatis cum Quinina et Strychnina, *Br.;* Tinctura Quininæ Ammoniata, *Br.*

RESINA. U. S., Br.

ROSIN [Resin, Colophony]

(rę-sī'nạ)

"The residue left after distilling off the volatile oil from turpentine." *U. S.* "The residue left after the distillation of the oil of turpentine from the crude oleo-resin (turpentine) of various species of Pinus." *Br.*

Colophone ou Arcanson. *Fr. Cod.;* Résine blanche, Résine jaune, *Fr.;* Colophonium, *P. G.;* Kolophonium, Geigenharz, Fichtenharz. *G.;* Colofonia, Pece greca, *It.;* Colofonia, Pez griega, *Sp.*

After the distillation of the volatile oil from the turpentine (see *Terebinthina*), a resinous matter remains, which on the continent of Europe is called *colophony,* but with us is commonly and now officially known by the name of *rosin.* It is the *Resina* of the U. S. and British Pharmacopœias. It is sometimes called *resina flava,* or *yellow rosin.* When this, in a state of fusion, is strongly agitated with water it acquires a distinct appearance, and is denominated *resina alba,* or *white rosin.* The ports from which rosin is shipped are Wilmington, N. C., Charleston, S. C., and Savannah, Ga. The exports of rosin in 1904 amounted to 2,585,108 bbls., valued at $6,621,870; and in 1905 to 2,310,275 bbls., valued at $7,069,084.

Common or *yellow rosin,* in its purest state, is beautifully clear and pellucid, but much less so as usually found in commerce. Its color is yellowish brown with a tinge of olive, and more or less dark, according to its purity and the degree of heat to which it has been exposed in its preparation. Sometimes it is almost black. It is rather heavier than water. It is completely liquid at 152.5° C. (306° F.), begins to emit bubbles of gas at 157.5° C. (316° F.), and is decomposed at a red heat. "Usually in sharp, angular fragments, translucent, amber-colored, usually covered with a yellowish dust; at ordinary temperatures brittle, pulverizable; fracture shiny and shallow-conchoidal; odor and taste faintly terebinthinate. The specific gravity of Rosin is 1.070 to 1.080; it is easily fusible, and burns with a dense yellowish smoke, yielding no appreciable ash; soluble in alcohol, ether, benzene, carbon disulphide, acetic acid, fixed or volatile oils, and in solutions of potassium or sodium hydroxide; acid number not less than 150. (See PART III, Test No. 98.)" *U. S.* "Translucent, of a light amber color, compact, brittle, pulverizable; fracture shining; odor and taste faintly terebinthinate. It is soluble in *alcohol* (90 per cent.), *ether, benzol,* and *carbon bisulphide,* is easily fusible, and burns with a dense yellow flame and much smoke, leaving no appreciable ash." *Br.* The composition of rosin is expressed by the formula $C_{44}H_{62}O_4$, which is the formula ascribed to *abietic anhydride.* Jean, however (*Chem. News,* xxvi. 207), has separated two other resinoid substances in addition to abietic acid. Lewkowitsch (*Chem. Analysis of Oils,* etc., 2d ed., 236) states that rosin also contains varying quantities of unsaponifiable matter,—viz., hydrocarbons due to the partial breaking up of the acid on distilling the pine rosin. This may vary from 5 to 9 per cent. in the American rosin. For a paper on abietic acid by Mead and Kremers, see *Proc. A. Ph. A.,* 1893, 198. By shaking coarsely powdered rosin with dilute alcohol and warming, it is converted into *abietic acid,* $C_{44}H_{64}O_5$, obviously an hydroxide of the first. Rosin may be considered, therefore, as abietic acid anhydride, $C_{44}H_{62}O_4$. Rosin, when it is boiled with alkaline solutions, forms greasy salts of abietic acid, the so-called rosin soaps which are used in admixture with other soaps. As the acid is dibasic, these salts contain two atoms of alkali metal in combination. Rosin, distilled by itself, yields the so-called "rosin oil," of which two fractions are taken separately,—the first that distilling under 360° C. (674° F.), and the second that over 360° C. (674° F.),—and some 31 per cent. of fixed gases.[1] When distilled with superheated steam, rosin yields benzene and toluene. *Sylvic acid,* formerly considered to be a constituent of rosin, is now regarded as a decomposition product of abietic acid. Similarly *pinic* and *pimaric acids,* announced as found in rosin, are impure products, although the latter acid, or one of the same name, is found in galipot resin. Propionic acid has, according to Renard, been obtained in abundance from the tar produced by the destructive distillation of rosin. (*A. Pharm.,* 1886, p. 939.)

A. Tschirch and B. Studer determined the nature of the constituents of American rosin. According to Mohr, the principal plant yielding the turpentine from which the American rosin is obtained is *Pinus palustris,* Mill.; to some extent also, *P. heterophylla,* Ell.; rarely *P. echinata, P. Taeda* and *P. scropida.* The sample under examination (presumably from *P. palustris*) was completely soluble in the ordinary solvents for resin, including petroleum benzin, in which some other varieties of rosin are only

[1] The lighter fraction is known commercially as *rosin essence,* and is, according to Renard (*J. Chem. S.,* Aug. 1884, p. 843), composed of hydrocarbons, representing almost all series, from the paraffin series to the terpenes, including pentane and hexane, amylene and hexylene, toluene, xylene, and cumene, the tetra- and hexa-hydrides of all three of these, terebenthene and cymene. Several aldehydes and acids of the fatty series, such as isobutyric and valeric, were also recognized. The heavier fraction, or rosin oil in the stricter sense of the word, is composed of polymers of the hydrocarbons C_nH_{2n-2}, which readily resinify by the absorption of oxygen. This accounts for the use of rosin oil as an adulterant of linseed oil in the manufacture of printers' ink.

partly soluble. Its alcoholic solution is strongly acid in reaction. Its sp. gr. at 15° C. was 1.090. Its composition was proved to be as follows:

1. Acids soluble in ammonium carbonate: *α-abietinic acid,* $C_{19}H_{28}O_2$, forming an insoluble lead salt, 30 per cent. *β-abietinic acid,* $C_{19}H_{28}O_2$, not forming a lead salt, 22 per cent. 2. Acid soluble in sodium carbonate: *γ-abietinic acid,* $C_{19}H_{28}O_2$, insoluble in ammonium carbonate, 31.06 per cent. 3. Volatile oil, 0.4 to 0.7 per cent. 4. Resen, 5 to 6 per cent.

The impurities amounted only to 0.1 per cent., the loss in operation, however, to 10 per cent. Fahrion having proposed a method for the differentiation of different rosins, based upon their relative solubility in petroleum benzin, the authors determined the amount of solvent necessary to dissolve 1 Gm. of rosin, freshly powdered, and old powder; also abietinic acids and the resen in petroleum benzin, with the following results:

Rosin, old powder, 1 Gm. required...	400 Cc.
Rosin, fresh, 1 Gm. required.....	60 Cc.
α-Abietinic acid, 1 Gm. required.....	500 Cc.
β-Abietinic acid, 1 Gm. required.....	100 Cc.
γ-Abietinic acid, 1 Gm. required.....	100 Cc.
Resen	50 Cc.

These results show that all the resin-acids, as well as the rosin, are more or less soluble in petroleum benzin, and that fresh rosin is more readily soluble than the isolated acids, a peculiarity which has also been noticed in the case of other bodies. On the other hand, old rosin is much less soluble in petroleum benzin than is fresh rosin. (*A. Pharm.,* Oct. 1903, 495–522.)

White rosin differs from the preceding only in being opaque and of a whitish color. These properties it owes to the water with which it is incorporated, and which gradually escapes upon exposure, leaving it more or less transparent. A new and very interesting class of derivatives from colophony or rosin has been prepared by Eugen Schaal of Feuerbach, Germany, and introduced into commerce under the name of *ester gums.* These are the *glyceryl, methyl,* and *ethyl esters of abietic acid,* made by heating the resin acid and the alcohol under pressure until saponification takes place. The product is then distilled off under reduced pressure. These "ester gums" are now being used to advantage as substitutes for copal, damar, and kauri gums in varnish making.

Uses.—Rosin is important as an ingredient of ointments and plasters, but is rarely used internally. It has been given in *chronic enteritis,* five grains of the powder. According to Olmsted, it has the property of preventing the oxidation of fatty substances, and thus contributes to the preservation of ointments. (*A. J. P.,* xxii. 325.)

Off. Prep.—Ceratum Cantharidis, *U. S.;* Ceratum Resinæ, *U. S.* (*Br.*); Ceratum Resinæ Compositum, *U. S.;* Emplastrum Calefaciens, *Br.;* Emplastrum Cantharidis, *Br.;* Emplastrum Menthol, *Br.;* Emplastrum Picis, *Br.;* Emplastrum Plumbi Iodidi, *Br.;* Emplastrum Resinæ, *Br.;* Emplastrum Saponis, *Br.*

RESINA JALAPÆ. U. S. (Br.)

RESIN OF JALAP

(rę-sī'nạ jạ-lā'pæ)

Jalapæ Resina, *Br.;* Résine de Jalap, *Fr. Cod.;* Jalapenharz, *G.;* Resina di gialappa, *It.;* Resina de jalapa, *Sp.*

* "Jalap, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity.* Moisten the powder with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding Alcohol, until *twenty-five hundred cubic centimeters* [or 84 fluidounces, 256 minims] of percolate are obtained, or until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, by means of a water-bath, until the percolate is reduced in weight to *two hundred and fifty grammes* [or 8 ounces av., 358 grains], and add the latter slowly, with constant stirring, to *three thousand cubic centimeters* [or 101 fluidounces, 212 minims] of water. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of hot water. After having drained off all the liquid, transfer the Resin to a porcelain dish and heat it to dryness on a water-bath." *U. S.*

"Jalap, in No. 40 powder, 8 *ounces* (Imperial) or 100 grammes; Alcohol (90 per cent.), *a sufficient quantity;* Distilled Water, *a sufficient quantity.* Digest the Jalap with twice its weight of the Alcohol in a covered vessel, heating gently, for twenty-four hours; transfer to a percolator; when the tincture ceases to pass, continue the percolation with successive portions of the Alcohol until nothing more is dissolved; add to the tincture thus produced *four fluid ounces* (Imp. meas.) or fifty cubic centimetres of the Distilled Water; remove the alcohol by distillation; transfer the residue while hot to an open dish; allow it to become cold; pour off the supernatant fluid from the resin; wash this two or three times with hot Distilled Water; dry." *Br.*

The two processes probably do not differ very materially in the result, though, if jalap yields anything to alcohol that is insoluble in water besides resin, it will be necessarily found in the British preparation, while that of the U. S. Pharmacopœia will consist of resin almost exclusively. The difference arises from

the circumstance that in the Br. process, probably to enable the whole of the alcohol to be saved by distillation, the water for precipitation is added before the spirit is distilled off, while in the U. S. process it is not added until so much of the alcohol has been distilled as to leave only enough to hold the extracted matters in solution. It is obvious, therefore, that the resin of the former contains everything insoluble in water that the alcohol had extracted, while that of the latter contains nothing which water was unable to precipitate from the strong tincture left in the still.

Properties.—Resin of jalap is officially described in the U. S. Pharmacopœia as in "yellow to brown masses or fragments, breaking with a resinous, glossy fracture, translucent at the edges, or a yellowish-gray to yellowish-brown powder, having a slight, peculiar odor, and a somewhat acrid taste. Permanent in the air. Soluble in alcohol in all proportions; insoluble in carbon disulphide, benzene, and fixed or volatile oils. Its alcoholic solution has a faintly acid reaction to blue litmus paper. Not more than 10 percent. of Resin of Jalap should be soluble in ether, and not more than 35 percent. in chloroform. Slowly but completely soluble in 5 times its weight of ammonia water; when this solution is acidified with hydrochloric acid, only a slight turbidity should appear (absence of *rosin, guaiac,* and *other resins*). Resin of Jalap should not suffer any material loss of weight when heated at 100° C. (212° F.) (absence of *water*). Anhydrous Resin of Jalap melts at about 150° C. (302° F.). Water triturated with Resin of Jalap should neither become colored nor dissolve any portion of it (absence of *soluble impurities*). No greenish-blue color should be produced on adding a few drops of ferric chloride T.S. to some of the powder moistened with alcohol (absence of *guaiac*). One Gm. of Resin of Jalap when dissolved in 50 Cc. of alcohol containing 1 Cc. of phenolphthalein T.S. should require not more than 0.5 Cc. of half-normal alcoholic potassium hydroxide V.S. to produce a red color (limit of *acid resins*). If to 1 Gm. of Resin of Jalap, dissolved in 50 Cc. of alcohol in a flask, 25 Cc. of half-normal alcoholic potassium hydroxide V.S. be added, and the mixture be heated on a water-bath for one hour, and if the excess of alkali be titrated with half-normal sulphuric acid V.S., using 5 drops of phenolphthalein T.S., as indicator, at least 20 Cc. of half-normal sulphuric acid V.S. should be required (limit of *saponifiable substances*)." *U. S.* "In dark-brown opaque fragments, translucent at the edges, brittle, breaking with a resinous fracture, readily reduced to a pale-brown powder, sweetish in odor, acrid to the throat, easily soluble in *alcohol* (90 per cent.), insoluble in *oil of turpentine.* The powder yields little or nothing to warm *water,* and not more than 10 per cent. to *ether* (indicating absence of scammony resin and resin of Tampico jalap). A solution in *alcohol* (90 per cent.) is not colored bluish-green by *test-solution of ferric chloride* (absence of guaiacum resin)." *Br.*

The U. S. resin, although pure enough for practical purposes, is still colored. To obtain it colorless, the powdered jalap should be mixed, before percolation, with an equal quantity of finely powdered animal charcoal, and, previously to the introduction of this mixture into the percolator, half the quantity of animal charcoal, similarly powdered, should be packed in the bottom of the percolator. The coloring matter is thus left behind, and the resulting tincture, treated as directed in the process, yields the resin as white as starch. Resin of jalap consists of two portions, one of which is hard and insoluble in ether, the other is soft and soluble in that menstruum, the former constituting about 90 per cent. It is insoluble in oil of turpentine. (Squire.) For its chemical properties, see *Jalapa.* It was at one time supposed that the purgative properties resided chiefly, if not exclusively, in the hard resin, but experiments by John C. Long appear to prove that the soft resin is equally energetic. (*A. J. P.,* 1861, p. 489.)

Guaiac, rosin, and other resinous substances are said to be sometimes fraudulently added to the resin of jalap. Guaiac may be detected by the green color it produces when a few drops of solution of sodium or calcium chloride are added to an alcoholic solution of the suspected resin. (*J. P. C.,* 3e sér., x. 357.) When pure jalap resin is dissolved in an alkaline solution, it is not precipitated by the addition of sulphuric or hydrochloric acid, having been converted, through the agency of the alkali, into an acid soluble in water. All the adulterating resins yield precipitates under the same circumstances. The resins of scammony and of fusiform jalap act in this respect like the true jalap resin, but are distinguishable by being wholly soluble in ether, while jalap resin is not. (*N. R. Pharm.,* No. 1, 1854.)

It is now generally believed that the resin of jalap is the sole purgative principle of jalap, the gummy extractive being either simply diuretic or wholly inert. To obviate the occasional harshness of the resin, it has been advised to triturate it with milk sugar, potassium sulphate, almond emulsion, or other substance calculated to separate its particles. It may be conveniently made into pills with mucilage or alcohol. (Hasselby, *P. J.,* 2d ser., vii. 231.)

Dose, two to five grains (0.13 to 0.33 Gm.).

Off. Prep.—Pilulæ Catharticæ Compositæ, *U. S.;* Pilulæ Catharticæ Vegetabiles, *U. S.;* Pilula Scammonii Composita, *Br.*

RESINA PODOPHYLLI. U. S. (Br.)

RESIN OF PODOPHYLLUM [Podophyllin]

(rẹ-sī'nạ pŏd-o-phŷl'lī)

Podophylli Resina, *Br.;* Resin of May-Apple; Résine de Podophyllum Peltatum, *Fr. Cod.;* Podophyllinum, *P. G.;* Podophyllin, Podophyllumharz, *G.;* Podofillina, *It.;* Podofilino, *Sp.*

* "Podophyllum, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Hydrochloric Acid, *ten cubic centimeters* [or 162 minims]; Alcohol, Water, each, *a sufficient quantity.* Moisten the powder with *four hundred and eighty cubic centimeters* [or 16 fluidounces, 111 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *sixteen hundred cubic centimeters* [or 54 fluidounces, 48 minims] of percolate are obtained, or until the percolate ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, by means of a water-bath, until the percolate is reduced to the consistence of a thin syrup, and pour it slowly, with constant stirring, into *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of water, previously cooled to a temperature below 10° C. (50° F.), and mixed with the Hydrochloric Acid. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of cold Water. Spread it in a thin layer, upon a strainer, and dry the Resin by exposure to the air, in a cool place, protected from the light. Should it coalesce during the drying, or aggregate into lumps having a varnish-like surface, it should be removed, broken in pieces, and rubbed in a mortar. It should be kept in amber-colored, well-stoppered vials." *U. S.*

"Podophyllum Rhizome, in No. 40 powder, 1 *pound* (Imperial) or 400 grammes; Alcohol (90 per cent.), 3 *pints* (Imp. meas.) or 1500 cubic centimetres or a sufficient quantity; Distilled Water, Hydrochloric Acid, of each *a sufficient quantity.* Exhaust the Podophyllum with the Alcohol by percolation; place the resulting tincture in a still; recover the greater part of the alcohol; acidulate the Distilled Water with one twenty-fourth of its bulk of Hydrochloric Acid, and slowly pour the liquid which remains after the distillation of the tincture into three times its volume of the acidulated water, constantly stirring; allow the mixture to stand for twenty-four hours to deposit the resin; wash the resin on a filter with Distilled Water, and dry it at a temperature not exceeding 100° F. (37.7° C.)." *Br.*

The British Pharmacopœia (1885) abandoned the use of hydrochloric acid, as it is not necessary if the tincture is evaporated to the consistence of *thick* honey. Hydrochloric acid was directed in the 1898 revision as it seems to aid the precipitation when the tincture is not so concentrated. The color and yield of resin of podophyllum may be made to vary by adding alum, acids, or other substances to the water. It darkens if dried with the aid of heat, and its color is indeed no indication whatever of its quality. The average yield of resin is about 5 per cent.

Resin of podophyllum has usually a light-brown color, an acrid bitter taste, and a slight odor of the rhizome. It consists of two resins, one soluble both in ether and alcohol, the other in alcohol only. The resin extracted by ether constitutes, according to John W. Cadbury, 75 per cent. of the whole (*A. J. P.*, July, 1858, p. 301), according to Harvey Allen, 80 per cent. (*Ibid.*, May, 1859, p. 206.)

Properties.—It is officially described as "an amorphous powder, varying in color from grayish-white to pale greenish-yellow, turning darker when subjected to a heat exceeding 35° C. (95° F.) or when exposed to light. It has a slight, peculiar odor and a faintly bitter taste; very irritating to the mucous membrane, especially to that of the eyes. Soluble in alcohol in all proportions; not less than 75 percent. of Resin of Podophyllum should be soluble in ether, not less than 65 percent. in chloroform, and not more than 25 percent. in boiling water. A hot, aqueous solution deposits most of its contents on cooling, and if the cooled liquid be filtered, the filtrate has a bitter taste, and turns brown upon the addition of a few drops of ferric chloride T.S. Soluble in potassium or sodium hydroxide T.S., forming a deep yellow liquid, which gradually becomes darker on standing, and from which the Resin is reprecipitated by acids. Not less than 99 percent. of Resin of Podophyllum should be soluble in alcohol; the solution should be clear or, at most, slightly opalescent, and should have a faintly acid reaction. Upon incineration, Resin of Podophyllum should yield not more than 0.7 percent. of ash." *U. S.* "An amorphous powder, of a bitter taste, varying in color from pale yellow to deep orange-brown; soluble or nearly so in *alcohol* (90 per cent.) and in *solution of ammonia;* precipitated from the former solution by *water,* from the latter by acids. Partly soluble in *ether.* It should not yield more than 1 per cent. of ash upon incineration." *Br.* G. M. Beringer (*A. J. P.*, 1894, 11) obtained different results in the U. S. 1890 solubilities by testing a fresh sample. The official resin is soluble in alkaline solutions, from which it is precipitated by acids, in this respect differing strikingly from the resins of jalap and scammony. It is insoluble in oil of turpentine. The name *podophyllin,* given to it by the eclectic practitioners, who have long been in the habit of using this resin, is inappropriate, and should be abandoned.

Lohmann (*Proc. N. J. Pharm. Assoc.*, 1896, 51) states that the fresh drug does not yield as large a percentage of resin as the same drug would if tested after being stored for several years; his experiments led him to the conclusion that in the order of value of resin of podophyllum obtained by various methods, that made by precipitation with water alone came first, that made by the U. S. P. process second,

and that made by precipitation with solution of alum last, the doses being in the following order: first, one-hundredth grain; second, one-fourth to one-half grain; third, one to one and a half grains. Dohme and Kelly (*D. C.*, 1903, 251), replying to statements in a paper by Lohmann (*Proc. A. Ph. A.*, 1903, 317) regarding the yield of resin from podophyllum, state that: 1, the yield from the method of pouring an alcoholic extract into water was 5 per cent.; 2, from pouring an alcoholic extract into acidulated water 5.5 per cent., and 3, from pouring an alcoholic extract into acidulated water containing 5 per cent. of alum, 4.9 per cent. See also *Podophyllum*, page 978. The color by process 1, is grayish-white; 2, light brown; 3, greenish-yellow. The value of resin of podophyllum is accurately estimated by the percentage of podophyllotoxin that it yields. Nearly all of the resin of podophyllum in commerce is made by the alum process, has a deep yellow color and is not wholly soluble in alcohol.

Uses.—Resin of podophyllum is a powerful cathartic, occasionally producing some griping and nausea, but capable of being favorably modified by combination, and of being very usefully employed in connection with other cathartics, to give them increased energy. It is supposed to be especially cholagogue, and this belief has been confirmed by the experiments of Rutherford. There has been much difference of opinion as to the relative activity of the two resins composing it, some maintaining that both are active, others that the activity resides mainly, if not exclusively, in the resin soluble in ether. It is difficult to resist the evidence of the experiments of Cadbury, who states in the paper above referred to that, while half a grain of the ethereal resin acted energetically, and a cathartic effect was produced by even one-fourth of a grain, the portion insoluble in that menstruum was given in the dose of one grain without any effect whatever. Moreover, this evidence was subsequently confirmed by the experiments of F. B. Power. (*A. J. P.*, xlvi. 227.) It is asserted by Power, and confirmed by Maisch (*Ibid.*, 226), that the purgative principle of podophyllum is soluble in hot water.[1] The researches of Power (*A. J. P.*, 50, p. 369), Maisch (*P. J.*, 1880, p. 621), Quereschi (*Ber. d. Chem. Ges.*, 12, p. 683), and Podwyssotzki have established the fact that podophyllum does not contain berberine or any alkaloid, and that its activity is due to principles in the resins. (See *Podophyllum.*) Resin of podophyllum is a mixture of the active and inert principles of the rhizome. A small proportion of extract of belladonna or hyoscyamus mitigates its irritant action. Care must be taken in handling it in quantity, as it is a powerful irritant, frequently producing conjunctivitis.

Dose, one-eighth to one-fourth of a grain (0.008 to 0.016 Gm.).

Off. Prep.—Pilulæ Catharticæ Vegetabiles, *U. S.*; Pilulæ Podophylli, Belladonnæ et Capsici, *U. S.*; Tinctura Podophylli, *Br.*

[1] Under the name of *Podophyllin purissimum* the German chemists have put upon the market that portion of the resin of podophyllum which is soluble in ether. It should be of a pure yellow color, and should not be precipitated from its 50 per cent. alcoholic solution by the addition of 10 parts of ether.

RESINA SCAMMONII. U. S. (Br.)

RESIN OF SCAMMONY

(rē-sī'nȧ scȧm-mō'nĭ-ī)

Scammoniæ Resina. *Br.*; Résine de Scammonée, *Fr. Cod.*; Scammoniaharz, *G.*; Resina di scammonea, *It.*

"Scammony, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity.* Digest the Scammony with successive portions of boiling Alcohol until it is exhausted. Mix the liquids, filter, and reduce the mixture to a syrupy consistence by distilling off the Alcohol. Then add the residue in a thin stream, with active stirring, to *twenty-five hundred cubic centimeters* [or 84 fluidounces, 256 minims] of Water, separate the precipitate formed, wash it thoroughly with Water, and dry it at a gentle heat." *U. S.*

"Scammony Root, in coarse powder, 8 *ounces* (Imperial) or 150 grammes; Alcohol (90 per cent.), *a sufficient quantity;* Distilled Water, *a sufficient quantity.* Exhaust the Scammony Root with the Alcohol by percolation; place the resulting tincture in a still; recover the greater part of the alcohol; slowly pour the liquid which remains after the distillation of the tincture into three times its volume of the Distilled Water, constantly stirring; allow the mixture to stand for the resin to subside; then wash the resin on a filter with boiling Distilled Water and dry it on a water-bath." *Br.*

The U. S. and British resins, though the former is procured from the gum-resin and the latter from the root of the plant, are nearly identical in their effects. Indeed, the elaborate researches of H. Spirgatis (*A. J. P.*, xlvi. 421) appear to have established the identity of the two products. A. Hess, however (*Ibid.*, 1875, p. 210), states that the resin obtained from the root contains tannic acid. The advantage of the preparation is that the resin is obtained free from the inert matters with which it is often associated in the scammony of commerce. When pure virgin scammony can be procured, any preparation is unnecessary. Obtained according to the U. S. process, the resin is of a dirty greenish-brown color, with a feeble odor and taste of scammony, and is very soluble in ether, alcohol, and boiling proof spirit. When purified with animal charcoal it has a pale brownish-yellow color, and is without odor or taste, and retains its purgative property. "Yellowish-brown or brownish-yellow masses or fragments, breaking with a glossy resinous fracture at the edges; or a yellowish-white or

grayish-white powder, having a faint, characteristic odor, and a slight, peculiar taste. Soluble in alcohol in all proportions, completely soluble in oil of turpentine, and almost completely soluble in ether and chloroform. Ammonia water and solutions of alkalies dissolve it with the aid of a gentle heat, and from these solutions the Resin is not reprecipitated by acids. When incinerated, it should not yield more than 1 percent. of ash. Sulphuric acid, when stirred in a porcelain dish with an equal weight of Resin of Scammony, should not gradually turn red (absence of *rosin*)." *U. S.* "Its solution in *alcohol* does not give a blue color with *test-solution of ferric chloride,* or with *solution of hydrogen peroxide* (absence of guaiacum resin). *Ether* dissolves it almost entirely (distinction from jalap resin)." *Br.* The Br. resin is in brownish translucent pieces, with a resinous fracture, and a sweetish fragrant odor derived from the root, and wholly different from that of scammony. Its tincture does not render the freshly-cut surface of a potato blue.

The resin of scammony is liable to adulteration. Jalap resin may be detected by its partial insolubilty in rectified ether, which dissolves that of scammony in all proportions. Sulphuric acid is the best test of common rosin or colophony, producing instantaneously with this substance an intense red color, while with the resin of scammony it causes no immediate change. For the tests of guaiac, the reader is referred to that article on p. 603. (See also *A. J. P.,* xxiv. 158.) The presence of other resins may be known by the precipitates yielded when sulphuric acid is added to the alkaline solution, the resin of scammony agreeing with that of jalap in not affording a precipitate under such circumstances. Chas. Bullock has found the resins of scammony, of jalap, and of podophyllum to be insoluble in benzene, thus enabling any resin soluble in this liquid, which may be employed in the sophistication, to be readily detected. (*A. J. P.,* 1862, 114.) When rubbed with unskimmed milk, the resin of scammony forms a uniform emulsion, undistinguishable from rich milk itself. This is an excellent mode of administration. The resin should always be given either rubbed up with some mild powder or in emulsion.

Dose, four to eight grains (0.26 to 0.5 Gm.).

Off. Prep.—Extractum Colocynthidis Compositum, *U. S., Br.;* Pilula Colocynthidis Composita, *Br.;* Pilula Scammonii Composita, *Br.;* Pulvis Scammonii Compositus, *Br.*

RESINÆ.

RESINS

(rẹ-sī'næ)

The official *Resins,* with a single exception, constitute a peculiar class of preparations, made by exhausting the substances from which they are obtained by alcohol, and then precipitating the resinous matter from the tincture by the addition of water, which abstracts the alcohol by its stronger affinity. It is obvious that the resins thus prepared are different substances from the alcoholic extracts, which contain all the ingredients of the medicine which alcohol is able to take from it. This set of substances has been much employed by the practitioners styling themselves "eclectics," but with great want of discrimination. They have applied names to these resinous precipitates which, in their proper scientific use, are employed to designate neutral proximate principles of plants, generally representing more or less completely the effects of the plants respectively on the system; as we say *columbin, quassin, santonin,* etc., themselves proper proximate principles, and representing the virtues, in part at least, of calumba, quassia, santonica, etc., from which they are obtained, and from which they derive their names. By applying similar names to their precipitated resins, such as podophyllin, iridin, cimicifugin, etc., *i.e.,* to the impure resins obtained by precipitating the tinctures of podophyllum, iris versicolor, cimicifuga, etc., they justify the suspicion either that they ignorantly believe them to be in fact the active principles of these medicines respectively, or that, knowing better themselves, they seek to impose such a conviction upon the ignorant. The fact is that the substances thus obtained, and thus named, are impure resins, which may possibly contain more or less of the active principles mixed with them, but are not entitled to names which imply that they are distinct proximate principles themselves.

Resins are solid, brittle, of a smooth and shining fracture, or in powder and generally of a yellowish-brown color. When perfectly pure, they are probably inodorous and often insipid; but, as usually found, they have a slight odor, and a somewhat acrid or bitterish taste. Their sp. gr. varies from 0.92 to 1.2. They are fusible by a moderate heat, decomposed at a higher temperature, and in the open air take fire, burning with a yellow flame and much smoke. Insoluble in water, they are mostly soluble in ether and the volatile oils, and in alcohol; and their alcoholic and ethereal solutions afford precipitates upon the addition of water. With pure potassium and sodium hydroxides they unite to form soaps, which are soluble in water, and the same result takes place when they are heated with solutions of the alkaline carbonates. Concentrated sulphuric acid dissolves them with mutual decomposition, and nitric acid converts them into artificial tannin. They readily unite by fusion with wax and the fixed oils.[1]

[1] Losch recommends the following process for rendering the resins as white as possible. Boil together 5 parts of the resin, 1 of carbonate of potassium or of sodium, and 20 of water, until a perfectly homogeneous mass is obtained; allow this to cool, and pass into it sulphurous acid, which saturates the alkali, and precipitates the resin in white flakes. Finally, wash the precipitate well with water, and dry it. (*J. P. C.,* Juin, 1856, p. 465.)

RESORCINOL. U. S.

RESORCINOL [Resorcinum, Pharm. 1890, Resorcin]

(rẹ-sŏr-cĭ′nŏl)

$C_6H_6O_2 = 109.22$

"A diatomic phenol [metadihydroxybenzene, $C_6H_4(OH)_2$ 1 : 3] obtained usually by the reaction of fused sodium hydroxide upon sodium metabenzenedisulphonate. Resorcinol should be kept in dark amber-colored vials." *U. S.*

Metadioxybenzene, Metadihydroxybenzene: Résorcine, *Fr. Cod.*; Resorcinum, *P. G.*; Resorcin, *G.*; Resorcina, *It., Sp.*

Resorcinol is *metadihydroxybenzene,* while pyrocatechin is the *ortho* compound and hydroquinone the *para* compound. Hlasiwetz and Barth first obtained this organic body in 1864 by fusing galbanum resin with potassium hydroxide; it was subsequently obtained from *sagapenum, asafetida, ammoniac,* and *gum acroides.* According to Kopp, it is prepared by the destructive distillation of *brazilin,* or from the wash or mother waters obtained in its manufacture from Brazil-wood. It is now generally prepared by fusing sodium benzene-disulphonate with sodium hydroxide.

Properties.—*Resorcinol* is a diatomic phenol, isomeric with *pyrocatechin* and *hydroquinone.* It crystallizes in prismatic crystals of the rhombic system, distilling at 276.5° C. (529.7° F.), easily soluble in water, alcohol, and ether, insoluble in chloroform and carbon disulphide. A small quantity treated with fuming sulphuric acid is dissolved, with the production of, first, an orange-yellow, then a greenish-blue, and finally a pure blue color. Bromine water precipitates its aqueous solution, *tribromresorcin* separating in minute crystals. Several of the compounds of resorcinol with phthalic anhydride have assumed great technical importance as dye-colors under the names of *fluorescein, eosin,* and *uranine.* Its trinitro derivative is *styphnic acid,* $C_6H(OH)_2(NO_2)_3$, which is also formed from many of the gum-resins by the action of nitric acid.[1] It is officially described as in "colorless, needle-shaped crystals, having a faint, peculiar odor and a sweetish, followed by a bitter taste. It acquires a pinkish tint on exposure to light and air. Soluble in 0.5 part of water at 25° C. (77° F.), slightly more soluble in alcohol; very soluble in boiling water or in boiling alcohol; also readily soluble in ether and glycerin; very slightly soluble in chloroform, carbon disulphide, and benzene. When heated to 110° to 111° C. (230° to 231.8° F.) it melts and at a higher temperature is completely volatilized. It boils at 276.5° C. (529.7° F.) and is slightly volatile in a current of steam. Its aqueous solution is neutral or only slightly acid to litmus paper. On adding a few drops of ferric chloride T.S. to 10 Cc. of an aqueous solution of Resorcinol (1 in 200), the liquid assumes a bluish-violet color, changing to brownish-yellow on the addition of ammonia water (distinction from *catechol* and *quinol*). Lead acetate T.S. should produce no precipitate when added to an aqueous solution of Resorcinol (distinction from, and absence of, *catechol*). If 0.1 Gm. of Resorcinol be dissolved in 1 Cc. of potassium hydroxide T.S. and a drop of chloroform added, the mixture upon being heated will assume an intense crimson color. If a slight excess of hydrochloric acid be then added, the color will change to a pale straw-yellow. On cautiously heating 0.05 Gm. of Resorcinol with 0.1 Gm. of tartaric acid and 10 drops of concentrated sulphuric acid, a thick carmine-red liquid will be formed, becoming pale yellow when diluted with water. A concentrated aqueous solution of Resorcinol (1 in 2) should be colorless (absence of *empyreumatic bodies*), and when gently heated should not emit the odor of *phenol.*" *U. S.*

Uses.—Resorcinol appears in its physiological properties to be allied to phenol. It is distinctly poisonous to the lower organisms, and, according to Martin Cohn (*In. Dis.,* Berlin, 1882) and Andeer (*Ueber das Resorcin,* Würzburg, 1880; also *Cb. M. W.,* 1881), a one per cent. solution of it is sufficient to arrest for a long time putrefactive changes in the urine, organic infusions, and even animal tissues. Platt, however, states (*Am. J. M. S.,* vol. i., 1883) that it is distinctly inferior to phenol as an antiseptic. When given to the lower animals (Dujardin-Beaumetz, *B. G. T.,* ci. 113) it causes tremors, loss of consciousness, and epileptiform convulsions, which, when the dose has been sufficiently large, become more and more violent and associated with marked disturbances of respiration; this function is finally arrested and death ensues. During the spasms the temperature of the animal is distinctly elevated, but when there is quiet narcosis it may fall much below the normal. The urine becomes olive green deepening into blackish. So far as we know, no case of fatal poisoning in man has been recorded. The largest therapeutic doses produce flushing of the face, with giddiness and buzzing in the ears and some quickening of the breathing and pulse, followed after a time by violent perspiration. Sixty grains caused in man giddiness, violent perspiration with marked anxiety, ending in collapse and unconsciousness. Andeer took about one hundred and fifty grains of resorcinol dissolved in a pint of water during fifteen minutes. After disturbance of cerebration and of the special senses, he fell into a condition of collapse, with cold extremities, epileptiform convulsions, opisthotonos, loss of consciousness, and marked irregularity of the respiration. Consciousness did not return for five hours. Murrell records (*M. T. G.,* vol. ii., 1881) a case in which a woman took one hundred

[1] Resorcinol combines with various principles. In this way arise *eucalyptoresorcinol, caffeoresorcinol,* etc. (see *P. J.,* xxi. 977); also a brown powder said to be composed of resorcinol and iodoform which has been commended by Biélaïew (*S. M.,* 1892) as a stimulant application to foul *ulcers,* in *eczema,* etc. It is very irritant, and usually requires dilution (from 6 to 25 per cent.).

and twenty grains of resorcinol and immediately felt giddy, had sensation of pins and needles all over her, and a few minutes later became insensible, with closed eyes, clenched hands, groaning, with blanched lips, dry tongue, normal pupils, insensible conjunctiva, and a temperature of 94° F.; the patellar reflex was entirely gone; the pulse weak and thready.

The chief action of resorcinol is upon the nerve centres, although, like phenol, it probably affects all highly organized tissues. Beyer (*Am. J. M. S.*, April, 1886) stated that it has a direct paralytic action upon the heart.

As an antipyretic, resorcinol has been used by Lichtheim (*Correspondenzbl. f. Schweizer Aerzte,* July, 1880), Murrell, and other clinicians. It is, however, so much more dangerous and less effective than other members of the class that it is used exclusively as a topical remedy in diseases of the skin and of the mucous membrane. Internally it is of value in subacute and chronic *gastric* and *intestinal catarrh,* also in *gastric ulcer* and *enteritis;* externally in a solution of from one to fifteen per cent. it has been employed in *hay fever, nasal catarrh, chronic otitis, gonorrhœa* and *leucorrhœa.* The three to five per cent. solution has been largely used in washing out diseased stomachs but some care is necessary to avoid poisoning. In chronic *cystitis* irrigation with the three per cent. solution is often advantageous. In chronic and subacute *eczema,* where there is much thickening from exudation, resorcinol is a very valuable remedy, and it is also used in *seborrhœa, psoriasis* and *pityriasis,* and in the various parasitic skin diseases but in conditions of acute inflammations of the skin may increase the symptoms through its irritant action. According to Andeer, in powder it is a feeble caustic, which may be suitable for the treatment of *chancres, papilloma, epithelioma,* etc. As a local application to the skin it is preferably used in solution, from ten to thirty grains in one drachm of alcohol, one drachm of glycerin, and eight drachms of water, well sopped on the part and allowed to dry. Murrell affirms that he has given forty grains of resorcinol every four hours without the production of unpleasant symptoms, but this failure to do harm was probably because an impure article was exhibited. In gastric conditions it should be administered in solution, when the stomach is empty.

Dose, two to five grains (0.13 to 0.32 Gm.).

RHAMNUS PURSHIANA. U. S. (Br.)

CASCARA SAGRADA

(rhăm′nŭs pür-shĭ-ā′nạ)

"The dried bark of *Rhamnus Purshiana* De Candolle (Fam. *Rhamnaceæ*), collected at least one year before being used." *U. S.* "The dried bark of Rhamnus purshianus, *DC.*" *Br.*

Cascara Sagrada, *Br., Fr. Cod.;* Sacred Bark; Chittem Wood Bark; Cascara Sagrada, *Sp.*

A number of species of Rhamnus have been described as growing in California, but according to the best authority there are only four species,—*R. alnifolia,* L'Her., *R. crocea,* Nutt., *R. Purshiana,* DC., and *R. californica,* Esch. Of these species, *R. alnifolia* is too rare in the Cascara district to be important; while the spinescent twigs, the very thick oval or roundish leaves, and the small roundish red fruit of *R. crocea* make it so distinct that it cannot be confounded with the Cascara, whose bark, moreover, its bark does not resemble. On the other hand, *R. californica* appears to be very commonly confounded with the official species by collectors, and to have yielded much of the cascara sagrada bark of commerce. *R. californica* is rare in Northern California, but abundant in the countries lying south and southeasterly, while *R. Purshiana* is abundant in Northern California, but scarce in the south, so that any bark collected in Northern California is probably genuine. *R. californica* is chiefly distinguished from the official species by its leaves being thin, and when not smooth having a short close pubescence, and the primary veins of the under surface not nearly so numerous, straight, or fine as those of *R. Purshiana.* Rusby thinks that its leaves are especially distinguished by the channel of the midrib of *R. californica* being altogether absent, or shallow, or inconspicuous. Nevertheless the species so run into one another that competent botanists believe them identical.

The *Rhamnus Purshiana* is a small tree, attaining a height of twenty feet. Its leaves are rather thin, elliptic, for the most part briefly acutely pointed, finely serrated, at the base obtuse, somewhat pubescent beneath, from two to seven inches long and from one to three wide. The rather large flowers are in somewhat umbellate cymes; the sepals five; the minute cucullate petals bifid at the apex. The fruit is black, broadly obovoid, four lines long, three-lobed, and three-seeded. The seeds are convex on the back, with a lateral raphe. It is found in California, extending northward to the British territories.

The *Rhamnus californica,* or *Californian buckthorn* or *California coffee-tree,* yields a bark which is of a dark brown color externally and bright yellow internally, having an intensely bitter taste, with a persistent nauseous aftertaste, and very little odor. It is said to be much more distinctly purgative than that of *R. crocea.*

It does not seem possible to distinguish with certainty between the barks of the two species by their macroscopic appearance. The bark of *R. Purshiana* is usually more red than is that of *R. californica,* but it may be of a distinctly gray color. The microscopic structure of the two barks is, however, different. The medullary rays in *R. Purshiana* are numerous, thin, for a long distance nearly parallel and straight (according to L. E. Sayre, they converge at their outer ends), run nearly three-quarters of the distance through the bark, and

are commonly composed of two rows of cells. In *R. californica* the medullary rays are much broader, much shorter, and are composed usually of three or more rows of cells; further, they are crooked and not parallel throughout their course. Again, the zone of resin spaces is much broader in *R. californica,* and the spaces themselves much larger and more numerous, than in the official species. For further details and elaborations, see paper by H. H. Rusby, *Proc. A. Ph. A.,* 1890. According to L. E. Sayre (*A. J. P.,* March, 1897), the powder of the barks can be distinguished by paying attention to the fact that *R. Frangula* contains no stone cells, while in *R. californica* and *R. Purshiana* such cells are abundant, occurring in large, irregular groups below the cork and usually outside the region of the bast: *R. Purshiana* may also be distinguished from *R. californica* by color tests. After several days' maceration in dilute alcohol the powder of *R. Purshiana* appears of an orange-yellow color, *R. californica* of a purplish color; or if 0.2 Gm. of the powdered bark be placed in a small test tube, and there be added 2 Cc. of potassium hydroxide test-solution, *R. californica* will give a blood-red and *R. Purshiana* an orange-red color.

The bark of the *Rhamnus crocea,* the so-called *California mountain holly,* occurs in slightly curved pieces, externally of a dark brown color, internally of a characteristic red delicately streaked with numerous white veins. The odor is somewhat aromatic, the taste warming and not unpleasantly bitter. It is affirmed to be a tonic and mild laxative.

Properties.—Cascara sagrada occurs in commerce in the form of small broken pieces, often more or less flattened out into a somewhat compressed mass, and also as separated quills of varying length and size. The bark is "in quills or curved pieces, of variable length and 1 to 5 Mm. thick; outer surface reddish-brown, frequently more or less covered with grayish or whitish lichens, several of which are peculiar to this bark, and with small groups of their brownish fruit-heads; inner surface yellowish to light brownish, becoming dark brown with age and reddened by alkalies, longitudinally striate; fracture short, with projections of bast fibres in the inner bark, and the medullary rays forming converging groups; odor distinct; taste bitter and slightly acrid."[1]

[1] The following elaborate microscopic description of cascara sagrada is abbreviated from that of J. Moeller. (*A. J. P.,* Sept. 1882, 462.) The corky layer is about 0.045 Mm. thick, and consists of 8 or 12 rows, somewhat flattened, rather thick-walled, but not sclerotic cells. The parenchyma of the primary bark contains numerous groups of crystals, and scattered groups of roundish stone cells, with very thick walls, and accompanied by single rhombohedric crystals; it is free from secondary cork. The inner bark consists of medullary rays composed of two or three rows of thin-walled, somewhat radially elongated cells, and of broader bast-rays in which the parenchyma cells are coarsely dotted upon the radial and horizontal walls, and loosely united in a tangential direction; the bast-fibres form alternate groups of two or three rows, extending into few bast-rays, and are surrounded by crystal cells. The medullary parenchyma contains a crummy, lemon-yellow substance, which dissolves in water with a yellow color, and in cold potassium hydroxide solution with a dingy red color.

U. S. The freshly fractured surface is colored red by solution of potassium hydroxide. According to the analysis of A. B. Prescott (*N. P.,* Feb. 1879), it contains a very bitter brown resin (which is colored a vivid purple-red by potassium hydroxide); a red resin; a light yellow resin; tannic, malic, and oxalic acids; a neutral crystallizable substance; and a volatile oil.[2] H. F. Meier and J. Le Roy Webber have pointed out in addition the presence of a ferment, glucose, and ammonia. According to these investigators, to the action of the ferment are attributed the unpleasant results attending the administration of "fresh bark;" "seasoned bark"—*i.e.,* such as has been kept a year or two—owes its valuable properties as a laxative, *free from griping,* to the fact that the ferment has exhausted itself; the laxative properties, they state, reside in the resins, and the tonic effects are due to the crystalline principle. (*A. J. P.,* 1888, 91.)[3] Parke, Davis & Co., the introducers of this remedy, inform us that they always keep the bark two years before using it. Schwabe (*A. Pharm.,* 226, 569) identified *emodin,* or trioxymethylanthraquinone, as present, and stated that it was the active principle. Dohme and Engelhardt (*Proc. A. Ph. A.,* 1897, 193) have shown the analogy of cascara sagrada with *Rhamnus Frangula* by obtaining a glucoside to which they give the name of *purshianin.* This decomposes, yielding emodin and a dextro-rotatory non-fermentable sugar, while the frangulin of buckthorn yields emodin and rhamnose as the sugar. Purshianin forms brown-red needles, melting at 237° C. Dohme and Engelhardt failed to obtain in a pure form (*Proc. A. Ph. A.,* 1898, 340) the bitter principle of cascara sagrada. Le Prince (*C. R. A. S.,* 1892, 286) claimed to have obtained the active principle of cascara bark in a crystalline form, which he named *cascarine,* his results are doubted by Jowett who believes that cascarine and purshianin are impure forms of emodin. Jowett (*Proc. A. Ph. A.,* 1904, 288) in an exhaustive paper concludes that the active principle of cascara is contained in that portion of an alcoholic extract which is soluble in water and precipitable by lead subacetate and in that portion of the regenerated lead subacetate precipitate which is soluble in ethyl acetate.

[2] The bark of *R. Wightii,* which is sold in the Indian bazaars, has been chemically investigated by David Hooper and found to contain substances similar to those contained in *R. Purshiana.* (See *P. J.,* Feb. 18, 1888.)

[3] *Tasteless preparations of cascara.*—It has long been known that the action of alkalies, lime, magnesia, ammonia, etc., upon cascara bark preparations diminished the bitterness without interfering with the laxative properties. B. E. Nelson (*Proc. A. Ph. A.,* 1904, 313) carefully examined the various methods which have been proposed and concludes that there is a slight loss of activity due to the action of the alkalies, but in the best preparations this is not sufficient to interfere with their usefulness. (See *Fluidextractum Rhamni Purshianæ Aromaticum,* page 556; also *West. Drug.,* 1902, 496.)

Uses.—Cascara sagrada is an excellent laxative for use in *habitual constipation.* It is not to be employed as a purgative when a powerful impression is desired to be made. Its action closely resembles that of *Rhamnus Frangula,* but is more powerful and certain. In many cases of habitual constipation the continued use of the bark seems to produce a permanent beneficial effect upon the intestinal tract. Ordinarily a single dose may be given at bed time, but in some cases better results are obtained by exhibiting smaller doses after meals. The crude bark itself is never used medicinally, but usually in the form of the extract or fluidextract.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Extractum Rhamni Purshianæ, *U. S.* (*Br.*); Fluidextractum Rhamni Purshianæ, *U. S.* (*Br.*); Fluidextractum Rhamni Purshianæ Aromaticum, *U. S.;* Syrupus Cascaræ Aromaticus, *Br.* (from liquid extract).

RHEUM. U. S. (Br.)

RHUBARB

(rhē′ŭm)

"The dried rhizome of *Rheum officinale* Baillon, *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), or probably other species of *Rheum,* grown in China and Thibet, and deprived of most of the bark and carefully dried." *U. S.* "The erect rhizome or so-called root of Rheum palmatum, *Linn.;* Rheum officinale, *Baill.;* and probably other species; collected in China and Thibet, deprived of more or less of its cortex, and dried." *Br.*

Rhei Radix, *Br.;* Rhubarb Root; Rhubarbe de Chine, *Fr. Cod.;* Rhubarbe, *Fr.;* Rhabarber, *G.;* Rabarbaro, *It.;* Ruibarbo, *Sp.;* Hainoung, *Chin.;* Schara-modo, *Thibet.*

Notwithstanding the length of time that rhubarb has been in use, it has not yet been determined from what precise plant the Asiatic drug is derived, the remoteness of the region where it is collected, and the jealous care with which the monopoly of the trade is guarded, having prevented accurate information.

The terms *rha* and *rheon,* from the former of which were derived the names *rhabarbarum* and *rhubarb,* and from the latter the botanical title *Rheum,* were applied by the ancients to a root which came from beyond the Bosphorus, and which is supposed, though upon somewhat uncertain grounds, to have been the product of *Rheum rhaponticum,* L., growing on the banks of the Caspian Sea and the Volga. This species was also at one time believed to be the source of the medicine now in use; but the true rhubarb has long been known to be wholly distinct from the Rhapontic, and derived from a different source. It was not until the year 1732 that any probable information was obtained as to its real origin. At that time plants were received from Russia by Jussieu in France, and Rand in England, which were said to be of the species affording the genuine rhubarb, and were named by Linnæus, under this impression, *Rheum Rhabarbarum,* a title which has since given way to *Rheum undulatum.* Subsequently, Kaau-Boerhaave obtained from a merchant, who dealt in the rhubarb of Tartary, some seeds which he said were those of the plant producing the root sold by him. These, having been planted, yielded two species of Rheum, *R. undulatum,* and another which Linnæus named *R. palmatum.* Seeds transmitted by Mounsey from St. Petersburg to Hope, and planted in the botanic garden at Edinburgh, produced the latter species, and the same was also raised at Upsal from a root received by Linnæus from De Gorter, and was described in 1767 by the younger Linnæus, two years after the appearance of Hope's paper in the Philosophical Transactions. Thus far the evidence appears equally in favor of *R. palmatum* and *R. undulatum.* Colonel Przewalski has recently reasserted from personal observation that *R. palmatum* produces rhubarb; but the specimens of the root which he brought to St. Petersburg are stated by Dragendorff to be essentially different from true rhubarb. Claims have also been made from time to time for various other species of Rheum as sources of the drug. Pallas, upon exhibiting the leaves of *R. palmatum* to some Bucharian merchants, was told that the leaves of the rhubarb plant were entirely different in shape, and the description he received of them corresponded more closely with those of *R. compactum* than any other known species. Seeds of this plant were, moreover, sent to Miller from St. Petersburg as those of the true Tartarian rhubarb. Wallich, superintendent of the botanical garden at Calcutta, received seeds that were said to be those of the plant which yielded the Chinese rhubarb, growing on the Himalaya Mountains and the highlands of Tartary. These produced a species not previously described, which Wallich named *R. Emodi,* from the native title of the plant. It is the *R. australe* of Don and of Colebrooke, and has been ascertained to afford a root which, though purgative, is very unlike the official rhubarb. In 1867, French missionaries in Southeastern Thibet forwarded to Soubeiran of Paris, live specimens of a plant which they asserted to yield the true rhubarb, and Baillon subsequently described the flowering plant under the name of *R. officinale.* Its root resembles the true rhubarb, but the most careful cultivation has failed to obtain an identical product,[1] and it cannot yet be considered as settled how far the commercial drug is obtained from it.

[1] Senier found that, as raised in England, the root of *R. officinale* yielded less than half the percentage of extract obtained from the East Indian drug. In ten grain doses the extract was decidedly cathartic.

All the plants of this genus are perennial and herbaceous, with large branching roots, which send forth vigorous stems from four to eight feet or more in height, surrounded at their base with numerous very large petiolate leaves, and terminating in lengthened branching panicles, composed of small and very numerous flowers, resembling those of the Rumex or dock. There is some difficulty in arranging the species, in consequence of the tendency of the cultivated plants to form hybrids, and it is frequently impossible to ascertain to which of the wild types the several garden varieties are to be referred. Lindley, *Flora Medica*, states that *R. rhaponticum*, *R. hybridum*, and *R. compactum*, and their hybrids, are the common garden rhubarbs.

R. officinale, Baillon—*B. & T.* 213—is described in the *Pharmacographia* "as a perennial, noble plant, resembling the common garden rhubarb, but of larger size. It differs from the latter in several particulars: the leaves spring from a distinct crown rising some inches above the surface of the ground; they have a subcylindrical petiole, which, as well as the veins of the under side of the lamina, is covered with a pubescence of short erect hairs. The lamina, the outline of which is orbicular, cordate at base, is shortly 5- to 7-lobed, with the lobes coarsely and irregularly dentate; it attains 4 to 4½ feet in length, and rather more in breadth. The first leaves in spring display before expanding the peculiar metallic red hue of copper."

Besides the species already mentioned, *R. leucorrhizum*, growing in the Kirgheez desert in Tartary, *R. capsicum*, from the Altai Mountains, *R. webbianum*, *R. speciforme*, and *R. moorcraftianum*, natives of the Himalaya Mountains, and *R. crassinervium* and *R. hybridum*, cultivated in Europe, but of unknown origin, yield roots which have either been employed as purgatives or possess properties more or less analogous to those of official rhubarb, though they have not entered into general commerce. In Java, the root of an indigenous species is used as a purgative. According to the analysis of J. H. Schmidt, it contains more chrysophan and emodin, and less chrysophanic and rheotannic acids, than does the official drug.[1]

Rhubarb is produced abundantly in the elevated lands of Tartary, about the lake Koko Nor, and is said to be cultivated in the neighboring Chinese province of Shen-see, and in that of Se-chuen. From these sources it is generally supposed that our supplies of Russian and Chinese rhubarb were exclusively derived; but the root is also collected in Bootan and Thibet, on the north of the Himalaya Mountains, and it is probable that the plant pervades the whole of Chinese Tartary. It flourishes best in a light sandy soil. It is stated by Bell, who, on a journey from St. Petersburg to Pekin, had an opportunity of observing it in a growing state, that it is not cultivated by the Tartars, but springs up spontaneously, in tufts, wherever the seeds have fallen upon the heaps of loose earth thrown up by the marmots. In other places the thickness of the grass prevents their access to the soil. The root is not considered sufficiently mature for collection until it has attained the age of six years. It is dug up twice a year in Tartary, in the spring and autumn; in China not till the winter. After removal from the ground, it is cleaned, deprived of its cortical portion and the smaller branches, and then divided into pieces of a convenient size. These are bored with holes, and strung upon cords to dry, according to Bell, about the tents and on the horns of sheep; according to Sievers, under sheds, by which the rays of the sun are excluded, while the air has free access. The Chinese are said first to place the pieces on a stone slab heated by fire beneath, and afterwards to complete the drying process by exposing them to the sun and air. In Bootan the roots are hung up in a kind of drying room, in which a moderate and regular heat is maintained. Much time and attention are devoted to the preparation of the root, and Sievers states that a year sometimes elapses from the period of its collection before it is ready for exportation. A large proportion of its weight is lost in drying, according to some accounts four-fifths, according to others not less than seven-eighths. It is probably in order to favor the drying that the bark is removed. Rhubarb which has been dried by artificial heat is known commercially as high dried and often can be recognized by its more or less blackened surface, and its heavy, scarcely fragrant odor. The trade in rhubarb is said to have formerly centred in the Chinese town of Si-nin, where a Bucharian company or family was established which possessed a monopoly of this trade in consideration of a tribute paid to the government. At present rhubarb is chiefly purchased for the European trade at the town of Hankow, on the upper Yang-tse, the yearly export reaching, it is said, over 5000 peculs (pecul = 133.33 lbs.). There were formerly two varieties of Asiatic rhubarb, the Russian and the Chinese, but at present little or no rhubarb finds its way overland to Europe. As long back as 1687, the Russian government subjected the export of rhubarb from China into Russia to official surveillance, and finally monopolized the trade entirely. At Kiakhta a very rigorous inspection of the drug was enforced, the selected pieces being finally sewed into linen sacks pitched and coated with hide. All the pieces which did not pass examination were committed to the flames, and the remainder was sent to St. Petersburg. This variety was some-

[1] According to Aitchison (*Nature*, July 9, 1885), a rhubarb plant has been found in Northern Afghanistan in which there are usually only three enormous root leaves four feet long and five feet broad, lying flat upon the ground. The fruit is large and of a brilliant scarlet. The root is said to possess purgative properties, but the fruit is preferred, and is given in the form of a decoction.

times called *Turkey rhubarb*, from the circumstance that it was formerly derived from the Turkish ports, whither it is said to have been brought from Tartary by caravans through Persia and Anatolia. Inferior parcels of the root, which could not pass the inspection of the Russian authorities, were said to enter Russia by Tashkend, and to be known to the druggists of that country by the name of *Tashkend rhubarb*. As Russian rhubarb no longer occurs in commerce, the description of it is given in a foot-note.[1]

CHINESE RHUBARB (*India Rhubarb, Rheum Sinense* vel *Indicum*) is in cylindrical or roundish pieces, sometimes flattened on one or both sides, of a dirty brownish-yellow color externally, appearing as if the cortical portion of the root had been removed by scraping, and the surface rendered smooth and somewhat powdery by attrition. The best pieces have a rather close and compact texture, and, when broken, present a ragged uneven surface, variegated with intermingled shades of dull red, yellowish, and white, which are sometimes diversified or interrupted by darker colors, and especially marked with dark lines so arranged as to form an internal ring of star-like spots. The pieces are generally perforated with small holes, intended for convenience of suspension during the drying process, and portions of the suspending cord are not unfrequently found remaining in the holes. According to Elborne (*P. J.*, xv. 497), Chinese rhubarb is really divided into two varieties, which are respectively the product of *R. palmatum* and *R. officinale*,[2] the first variety has a red-grained fracture with white lattice-work veins, while the second variety has a longitudinal ramification of white veins with a black-grained fracture. Chinese rhubarb has a peculiar somewhat aromatic odor, and a bitter, astringent taste, is gritty when chewed, imparts a yellow color to the saliva, and affords a yellowish powder with a reddish-brown tinge. With the pieces of good quality others often come mingled, defective from decay or improper preparation. These are usually lighter, and of a dark or russet color. Like all the other varieties of rhubarb, this is liable to be attacked by worms, and in almost every large parcel pieces may be found which have suffered from this cause.[3]

Chinese rhubarb is the only kind recognized by the U. S. P., and is officially described as "subcylindrical, barrel-shaped, conical, plano-convex or irregularly formed pieces, frequently with a large perforation; hard and moderately heavy; 5 to 15 Cm. long, 4 to 8 Cm. in diameter; externally mottled with alternating striæ of light brown parenchyma cells and dark brown medullary rays, occasionally with reddish-brown cork patches and small radiate scars of fibrovascular tissue, smooth and sometimes covered with a bright brownish-yellow powder; fracture somewhat granular, presenting a peculiar marbled appearance; odor characteristic; taste bitter, astringent; gritty when chewed. Powder bright orange-yellow, becoming red with alkalies, containing rosette-shaped crystals of calcium oxalate, which are from 0.50 to 0.100 Mm. in diameter, and spherical starch grains from 0.005 to 0.020 Mm. in diameter, either single or 2- to 4-compound." *U. S.*

EUROPEAN RHUBARB.—In various parts of Europe, particularly in England, France, Belgium, and Germany, the rhubarb plants have been cultivated for many years, and considerable quantities of the root were at one time brought into the market. At present it appears not to be imported.

English Rhubarb.—This formerly came in two forms. In one the root was cut and perforated in imitation of the Russian. The

[1] The pieces of Russian rhubarb were irregular and somewhat angular, appearing as if the bark had been shaved off longitudinally by successive strokes of a knife, and a portion of the interior substance removed with each shaving. They had a cleaner and fresher appearance than the Chinese, and their color both internally and externally, though of the same general character, was somewhat more lively. They were less compact and heavy, and were cut with less facility, owing to their giving way before the knife. Another distinction is the character of the perforations, which in the Russian rhubarb were large, frequently reaching only to the centre, and evidently made for the purpose of inspection, while in the Chinese they are small, penetrate completely through the pieces, and are intended for the passage of a suspending cord. The taste and odor of the former closely resembled those of the latter, except that the Russian was rather more aromatic. There is the same crackling under the teeth, and the same yellow stain imparted to the saliva; but the color of the powder in this variety was a bright yellow, without the brownish tinge exhibited by the Chinese. When thin slices, previously boiled in water, were examined by the microscope, they exhibited numerous clusters of minute crystals of calcium oxalate. Quekett found between 35 and 40 grains of them in 100 grains of the root. They were observed in both Russian and Chinese rhubarb. For further information as to the varieties of Russian rhubarb, see *A. J. P.*, 1867, p. 212, or abstract in 14th edition U. S. D.

[2] In former editions of this work a variety of rhubarb imported from Canton has been noticed, which was evidently prepared, before leaving China, so as to resemble the Russian, having an angular surface as if pared with a knife. The pieces were obviously selected with great care, as they were remarkably free from defects. But in most of those which came under our notice the small penetrating hole was observable which characterizes the Chinese rhubarb, though it had in some instances been filled with the powdered root, so as in some measure to conceal it. Besides, the colors were not quite so bright as those of Russian rhubarb. This is undoubtedly the variety described by Pereira, under a distinct head, as the *Dutch-trimmed* or *Batavian rhubarb*, and considered by him as probably Bucharian or Russian rhubarb of inferior quality, sent by the way of Canton. A sufficient proof, we think, that this is not the case is the presence in most pieces of the small penetrating hole, occasionally filled with the remains of the cord, and in some pieces almost shaved away in the paring process. We have never seen such a hole in any piece of true Russian rhubarb, which does not appear to be strung up like the Chinese when dried.

Under the title of *Canton stick rhubarb*, Pereira describes a variety of which small quantities have been imported from Canton into London. It closely resembles the English stick rhubarb, and is supposed to be derived from the branches of the root of the plant which yields the true Chinese rhubarb.

[3] Rhubarb is prone to be attacked during storage by the caterpillar of a small grayish-white moth, whose species does not seem to have been determined. According to the experiments of Sawer and Ferguson, rhubarb which has been attacked is best treated on a large scale by a combination of heat and exposure to the vapor of sulphur. Insect-powder had no effect upon the worms. For details of method, see *P. J.*, xx. 1889.

pieces were of various shape and size, sometimes cylindrical, but more commonly flat, or somewhat lenticular, and of considerable dimensions. In the other, the so-called *stick rhubarb,* the pieces were somewhat cylindrical, five or six inches long by an inch or less in thickness, and more or less irregular upon the surface, as if they had shrunk unequally in drying. English rhubarb (from *Rheum rhaponticum*) is lighter than the Asiatic, more spongy, and often somewhat pasty under the pestle. It is redder, and when broken exhibits a more compact and regular marbling, the pinkish lines being arranged like rays from the centre towards the circumference. The "star-like spots" are either wanting or very few and scattered. The powder also has a deeper reddish tint. The odor is feeble and less aromatic than that of the Asiatic varieties; the taste is astringent and mucilaginous, with little bitterness, and the root, when chewed, scarcely feels gritty between the teeth, and but slightly colors the saliva. Few crystals of calcium oxalate are discoverable by means of the microscope. Much English rhubarb is obtained from *R. officinale,* and is put on the market in flat, concave, and convex pieces weighing from three to four ounces each. Externally the convex surface has deep longitudinal furrows and a longitudinal ramification of conspicuous veins, giving rise to an appearance of net-vein markings. In the centre of the concave surface is a small hole similar to that formerly seen in Russian rhubarb. On the inner surface the stellate markings resemble very closely those found in the East Indian rhubarb. The fracture of this form is not red, but shows a whitish parenchymatous tissue with blackish veins. The roots are distinctly gritty when chewed. When rapidly grown in rich soil, English rhubarb is lighter, more spongy, and less active than when slowly grown without high cultivation. It is probable that the powder is used to adulterate that of true Asiatic rhubarb, but of this we have no positive evidence.

French Rhubarb. Rhapontic Rhubarb. Crimea Rhubarb.—The rhubarb produced in France is, according to Guibourt, chiefly from *R. rhaponticum, R. undulatum,* and *R. compactum,* that of *R. palmatum,* which most closely resembles the Asiatic, having been found to degenerate so much as not to be a profitable object of culture. Most of the French rhubarb is produced in the neighborhood of L'Orient, in the department of Morbihan, and the spot where it grows has, from this circumstance, received the name of *Rheumpole.* Two kinds were described by Guibourt, both under the name of *Rhapontic root,*[1]—one proceeding from the *R. rhaponticum,* growing in the gardens in the environs of Paris; the other, from this and the two other species above mentioned, cultivated at Rheumpole; but, according to the *Pharmacographia,* the cultivation in France has been almost entirely abandoned.[2]

Choice of Rhubarb.—In selecting good rhubarb, without reference to the commercial variety, those pieces should be preferred which are moderately heavy and compact, of a lively color, brittle, presenting when broken a fresh appearance, with reddish and yellowish veins intermingled with white, of an odor decidedly aromatic, of a bitter and astringent not mucilaginous taste, feeling gritty and staining the saliva yellow when chewed, and affording a powder either bright yellow, or yellow with but a slight reddish-brown tinge. When very light, rhubarb is usually rotten or worm-eaten; when very heavy and compact, it is of inferior species, culture, or preparation. Rotten, worm-eaten, or otherwise inferior rhubarb is often powdered, and colored yellow with turmeric, and the shavings left when Chinese rhubarb is trimmed for powdering, or to imitate the Russian, are applied to the same purpose.[3] The stellate markings observed in the cut or broken surface of the Chinese rhubarb has been believed by various pharmacologists to be of great practical value in determining the true character of the rhizome and especially in enabling a distinction between the Chinese and European rhubarb to be made. There has been a general concurrence with the statements of Tschirch that the star spots are never present in the root, occurring only in the rhizome. In an elaborate re-examination of this subject by Jakabhasy, however, the star spots were found in the root as well as in the root stock and also in the European as well as in the Asiatic rhubarb. Nevertheless, Jakabhasy states that it is possible to distinguish the two rhubarbs

[1] The *rhapontic root* differs in section from true rhubarb by its distinctly radiated structure, unbroken by the peculiar arrangement (star-like spots) of the vascular tissue which occurs in true rhubarb.

[2] Besides the varieties of rhubarb above described, others are noticed by writers. Pallas speaks of a *white rhubarb,* brought to Kiakhta by the Bucharian merchants who conveyed to that place the drug for Russian commerce. It was white as milk, of a sweet taste, and equal to the best rhubarb in quality. It was supposed to be the product of *R. leucorrhizum.* At present, however, it is unknown in St. Petersburg. The *Himalaya rhubarb* is produced by *R. australe,* and other species mentioned in the text as growing in the Himalaya Mountains. According to Royle, it makes its way to the lower countries in Hindustan, where it sells for one-tenth of the price of the best rhubarb. Twining tried it in the Hospital at Calcutta, and found it superior as a tonic and astringent to Russian rhubarb, and nearly equal to it in purgative power. A variety known in Russia as *Bucharian rhubarb,* differing from the variety which we called Russian, and which is known in Russia as Chinese rhubarb, is imported into that country from Tartary, and reaches St. Petersburg by Nizhni-Novgorod. Parcels of it are said also to reach Vienna, by the way of Brody in Galicia. Still another variety is that called *Siberian rhubarb,* which is known in Russia by the name of *Siberian Rhapontic root.* As these are inferior kinds, and probably never reach our markets, we have not thought it necessary to discuss them in detail. For further information, see *A. J. P.* (xviii. 63 and 123).

[3] It has been stated by Boni that Chinese rhubarb yields from 20 to 25 per cent. of ash, the European rhubarb from 8 to 11 per cent., the difference being due to the excess of calcium oxalate in the Chinese rhubarb. Kremel, however, finds that the amount of ash in different species of rhubarb fluctuates too greatly to be of practical value in the determination of the source, even the Chinese root varying between 10 and 28 per cent.

by the fact that in the European Rhubarb the star spots occur in greater number on the longitudinal section while in the Chinese rhubarb they are present on the transverse section, where they form a circle. He believes also that the superabundance of starch and the lack of crystals in the star spots are diagnostic of the European drug. When the rhubarb is powdered these characteristics are not available, under which circumstances the percentage of ash seems to be valuable. The Chinese rhubarb, unless of very inferior quality yields from 8 to 25 per cent.; the European 1.3 to 6 per cent. of ash. According to Jakabhasy, Shensi is the best, Shanghai the poorest, and Canton the intermediate variety of Chinese rhubarb. Of the European the English is the most, the French next, and the Austrian the least active. Powdered rhubarb should contain numerous roundish starch granules, about .026 Mm. in diameter, large associated calcium oxalate crystals, and small, somewhat stellate, chrysophanic acid crystals, besides parenchymatous cells, pitted vessels, and other ordinary débris of root tissue.[1]

Chemical Properties.—Rhubarb yields all its activity to water and alcohol. The infusion is of a dark reddish-yellow color, with the taste and odor of rhubarb, and the residue, after sufficient maceration, is whitish, inodorous, and insipid. By long boiling the virtues of the medicine are impaired. The first examination of rhubarb yielding results of value was that of Schlossberger and Döpping. Besides extractive, tannic and gallic acids, sugar, starch, pectin, lignin, calcium oxalate, and various inorganic salts, they discovered three coloring principles, holding an intermediate place between resin and extractive matter, being freely soluble in alcohol, and slightly so in water. Two of these were uncrystallizable, and denominated *brown resin* and *red resin*, or *phæoretin* and *erythroretin;* the other, crystallizable in granular crystals, and identical with *chrysophanic acid*, previously discovered by Rochleder and Heldt in the yellow lichen, or *Parmelia parietina* of Sprengel. Chrysophanic acid crystallizes in golden-yellow needles or plates melting at 102° C., and is soluble in ether, alcohol, or benzene. Alkalies also dissolve it, forming fine dark red solutions. Its formula is $C_{15}H_{10}O_4$, and it is now recognized as a derivative of anthracene, $C_{14}H_{10}$, and as closely related to alizarine, $C_{14}H_8O_4$. It bears to methyl-anthracene, $C_{14}H_9(CH_3)$, the same relation that alizarine bears to anthracene. Hence, on distilling it with zinc dust, methyl-anthracene is formed from it by reduction. (See *Chrysarobinum.*)

De La Rue and Müller (*J. Chem. S.*, x. 298) extracted from rhubarb an allied substance, *emodin*, which crystallizes in orange-colored prisms. (See p. 116; also *Emodin*, PART II.) Its formula is $C_{15}H_{10}O_5$, and it is a trioxymethyl-anthraquinone. The relations of both this compound and chrysophanic acid to alizarine and anthracene will be better shown by writing their molecular formulas, as follows:

$C_{14}H_{10}$	$C_{14}H_6(OH)_2O_2$
Anthracene.	Alizarine.
$C_{14}H_5(CH_3)(OH)_2O_2$	$C_{14}H_4(CH_3)(OH)_3O_2$
Chrysophanic acid.	Emodin.

Kubli (*Ph. Z. R.*, 6, p. 603) obtained results both confirmatory and explanatory of those already given. He found a glucoside, *chrysophan*, $C_{27}H_{30}O_{14}$, which, under the influence of dilute acids or ferments, splits up into chrysophanic acid and sugar, according to the reaction

$$C_{27}H_{30}O_{14} + 2H_2O = C_{15}H_{10}O_4 + 2C_6H_{12}O_6$$

also a characteristic tannic acid, *rheo-tannic acid*, $C_{26}H_{26}O_{14}$, which is decomposed by dilute acids into *rheumic acid*, $C_{20}H_{16}O_9$, and sugar. Chrysophan is a yellowish powder, abundantly present in rhubarb, soluble in water or alcohol, not in ether; rheo-tannic acid is a reddish brown powder, sparingly soluble in cold water. Kubli found further a colorless neutral compound, sparingly soluble in hot water, of the formula $C_{10}H_{12}O_4$, which he did not name. He stated that chrysophanic acid is not found in rhubarb, but is produced when the root is digested in water through the breaking up of the glucoside *chrysophan*, probably under the action of a ferment. This ferment he believes to be soluble in water, but insoluble in alcohol, and that on this account an alcoholic extract of the root can be evaporated without the formation of chrysophanic acid. On the other hand, it is to the presence of this ferment that he attributes the progressive deposition of chrysophanic acid from an extract of rhubarb prepared with diluted alcohol. (*Ph. Z. R.*, xxiv. 193.) O. Hesse (*Proc. A. Ph. A.*, 1896, 549) found in addition to chrysophanic acid, $C_{15}H_8O_2(OH)_2$, and emodin, $C_{15}H_7O_2(OH)_3$, a third crystalline principle, which he named *rhein*, and ascribes to it the formula $C_{15}H_6O_2(OH)_4$. Hesse calls attention to the relation these formulas bear to one another. Rhein forms microscopic yellowish-brown scales, is insoluble in water, ether, and benzene, but sparingly soluble in alcohol. It dissolves readily in aqueous solutions of the alkalies and alkaline carbonates, forming deep purple-red solutions. Hesse also finds an amorphous resinous substance, upon which, he states, the entire activity of rhubarb depends. Dragendorff

[1] The powdered rhapontic root seems microscopically indistinguishable from powdered rhubarb; but, according to M. E. Billot, rhapontic root, even when used to adulterate powdered rhubarb, may be detected as follows. On a little of the suspected powder, upon a plate, let fall two or three drops of oil of anise, oil of fennel, or other essential oil; then add magnesia, and rub the mixture well for three or four minutes. If the powder be pure, it will remain yellow; but if it contain the smallest quantity of the French rhapontic root, it will assume a reddish tint, varying from a salmon to a bright rose color, according to the quantity of the impurity present. (See *A. J. P.*, May, 1860, 224.) The *Rumex hymenosepalus*, which is said to be used as an adulterant of powdered rhubarb, according to L. E. Sayre, may be detected by the character of the starch granules, which are long and slender, with a branching hilum extending along their greater diameter.

states that from 11 to 17 per cent. of arabic acid and pectose are present in rhubarb. Hunkel (*P. Archiv.* Nov. 1900, 201) reviewed the investigations of various chemists and isolated *tanoid* by the process of Löwe and a phenolic body (unnamed) which had not been previously described.

The most important researches upon the constituents of rhubarb were made by Tschirch and Heuberger (*A. Pharm.*, Nov. 21, 1902, 596, 630, and *Ph. Ztg.*, Aug. 3, 1904, 651). Their conclusions are that rhubarb contains primarily two classes of substances. 1. *Tannoglucosides;* 2. *Anthraglucosides.* These two classes cannot be sharply separated from each other and are therefore associated together in all extractions. Both of these are characterized by their ready decomposition and conversion into secondary products, such conversion resulting even during the treatment of the drug with ordinary sol vents. Thus, the ether extraction has been found to contain the products of the hydrolysis of the anthraglucosides, namely, chrysophanic acid, emodin and rhein. It is however not proven (indeed not even probable) that the tannoglucosides combine with the anthraglucosides to form so-called double glucosides. On the contrary, the indications are that these two classes of glucosides occur beside each other; furthermore, the relatively large quantity of tannoglucosides and their hydrolytic products is noteworthy and that, therefore, the activity of rhubarb is not attributable solely to the anthraglucosides; but the activity of the latter must be materially modified by that of the tannoglucosides. To what degree the primary tanno- and anthraglucosides have become hydrolyzed in the drug itself, it is difficult to determine; it is certain, however, that the drug contains a considerable quantity of free oxymethylanthraquinones, while it is probable that the formation of the secondary glucosides results during the extraction and manipulation of the extract.

Tschirch sums up the results of the investigation as follows: *Aweng's Double Glucoside* is in its essentials identical with tannoglucoside, but contains some anthraglucoside. *Aweng's Frangulic Acid* is a secondary product of the decomposition of tannoglucoside, containing variable quantities of anthraglucoside as impurity. *Kubli's Rheumtannic Acid* and *Hunkel's Tanoid* are identical with tannoglucoside, but less pure. *Kubli's and Hunkel's Rheum Acid* is identical with *rheum red,* and therefore a product of the hydrolysis of tannoglucoside. *Schlossberger and Dopping's Aporetin* and *Phaeoretin* are impure, difficultly soluble tannoglucoside. *Erythroretin* is a mixture of chrysophanic acid, emodin and rhein. *Garot's Erythrose* is chrysamic acid. *Rhein,* yielding only a diacetyl derivative, cannot be regarded as being tetraoxymethyl-anthraquinone. It has the composition $C_{15}H_8O_6$ (not $C_{15}H_{10}O_6$, Hesse) which formula corresponds to a methylene ether of a tetraoxyanthraquinone. *Dragendorff's, Greenish's and Elborne's Cathartic Acid* is an impure tannoglucoside, containing anthraglucosides and some albuminoid substances. *Gilson's Chrysophan* belongs to the anthraglucosides. *Aweng's Secondary Glucosides* are secondary, mostly difficultly soluble hydrolytic products of the primary tanno- and probably also of the anthraglucosides.

Finally, Tschirch determined that rhubarb contains no resins whatever; that the rheotannoglucosides and their products of decomposition and hydrolysis are devoid of purgative activity, and that such activity is due solely to the anthraglucosides and their derivatives. Rhubarb contains no other body besides the latter that has peristaltic effect on the intestinal tract.

As regards the rheo-tannoglucoside, its medicinal activity is confined to the tonic and mildly astringent effect produced on administering the drug. Tschirch (*Ph. Ztg.*, Aug. 3, 1904, 651) recommended a method for assaying rhubarb based on the volumetric estimation of the free oxymethylanthraquinones, dependent on the ease with which the anthraglucosides can be hydrolized with sulphuric acid. See also *Proc. A. Ph. A.*, 1905, 627.

There are other interesting principles in rhubarb. Some have been disposed to ascribe its odor to a volatile oil, but this has not been isolated. The calcium oxalate is interesting from its quantity, and from the circumstance that, existing in distinct crystals, it occasions the grittiness of the rhubarb between the teeth. The proportion seems to vary exceedingly in different specimens. According to Scheele and Henry, it constitutes nearly one-third, and Queckett found between 35 and 40 per cent., while Brandes obtained only 11, Schrader only 4.5 parts in the hundred, and Dragendorff, in five samples analyzed, from 1.2 to 5.6 per cent. Little or no difference of composition has been found between the Russian and the Chinese rhubarb. The European contains but a small proportion of calcium oxalate, and is therefore less gritty when chewed. It has, however, more tannin and starch than the Asiatic.

When powdered rhubarb is heated, odorous yellow fumes rise, which are probably in part the vapor of chrysophanic acid. Its infusion is reddened by the alkalies, in consequence of their union with this acid, and their reaction on the other coloring principles. It yields precipitates with gelatin, most of the acids, ferric salts, lead acetate, mercurous nitrate, silver nitrate, stannous chloride, lime water, and solutions of quinine. Nitric acid occasions at first a turbidness, and afterwards the deposition of a yellow precipitate. The substances producing precipitates may be considered as incompatible with the infusion.[1]

[1] For a method of detecting the presence of turmeric in powdered rhubarb by the influence of chloroform on the coloring principles of each of these substances, and of distinguishing through the same agency between the true Chinese rhubarb and that of European origin, the reader is referred to a

Uses.—The medicinal properties of rhubarb are peculiar and valuble. Its most remarkable singularity is the union of a cathartic with an astringent power, the latter of which, however, does not interfere with the former, as the purgative effect precedes the astringent. It is also tonic and stomachic, invigorating, in small doses, the process of digestion. It is not probable that these properties reside in a single proximate principle, but in a combination. In its purgative operation rhubarb is moderate, producing fecal rather than watery discharges, and appearing to affect the muscular fibre more than the secretory function. It sometimes occasions griping. Its coloring principle is absorbed, and may be detected in the urine. By its long-continued use the perspiration, especially that of the axilla, is said to become yellow, and the milk of nurses cathartic. It gives a yellow color to the alvine discharges. The conditions of disease to which it is applicable may be inferred from its peculiar properties. When the stomach is enfeebled, or the bowels relaxed, at the same time that a gentle cathartic is required, rhubarb, as a rule, is preferable to all others. Hence its use in *dyspepsia* attended with constipation, in *diarrhœa* when purging is indicated, in the secondary stages of *cholera infantum,* in *chronic dysentery,* and, indeed, whenever mild purgation is needed in an enfeebled subject. Magnesia is often an excellent associate in disorders of the stomach and bowels. By combination with other cathartics, rhubarb frequently acquires additional activity, while it gives increased efficiency to the associated substance. A mixture of calomel and rhubarb is a brisk and powerful cathartic, often used at the commencement of *bilious fevers.* As a rule, rhubarb is not applicable to cases attended with much inflammatory action. Its griping effect may be counteracted by combining it with aromatics.

By the roasting of rhubarb its cathartic property is diminished, probably by the volatilization of the purgative principle, while its astringency remains unaffected. When so treated it is termed *torrefied rhubarb.* This mode of treatment has been sometimes resorted to in cases of diarrhœa. By long boiling the same effect is said to be produced.

Powdered rhubarb has been usefully applied to indolent and sloughing *ulcers.* It is said to have proved purgative when sprinkled over a large ulcerated surface, and the same effect is asserted to have been produced by rubbing it, mingled with saliva, over the abdomen.

European rhubarb must be administered in double or treble the dose of true rhubarb to produce an equal effect. Few medicines are used in a greater variety of forms. It is most effectual in substance. It is frequently given in the shape of pill, combined with an equal proportion of soap when its laxative effect is desired. The infusion is much used in cases of delicate stomach, and is peculiarly adapted to children. The syrup, tincture, and fluidextract are also useful preparations. They are all official.

Dose, as a purgative, from twenty to thirty grains (1.3 to 2.0 Gm.); as a laxative and stomachic from five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Fluidextractum Rhei, *U. S.;* Extractum Rhei, *U. S.* (from fluidextract), *Br.;* Infusum Rhei, *Br.;* Liquor Rhei Concentratus, *Br.;* Pilulæ Rhei Compositæ, *U. S.* (*Br.*); Pulvis Rhei Compositus, *U. S., Br.;* Syrupus Rhei, *U. S.* (from fluidextract), *Br.;* Syrupus Rhei Aromaticus, *U. S.* (from aromatic tincture); Tinctura Rhei, *U. S.* (*Br.*); Tinctura Rhei Aromatica, *U. S.*

RHŒADOS PETALA. Br.

RED POPPY PETALS

(rhœ'ą-dŏs pĕt'ą-lą)

"The fresh petals of Papaver Rhœas, *Linn.*" *Br.*

Corn Poppy, Corn Rose; Coquelicot, *Fr. Cod.;* Pavot rouge, *Fr.;* Wilder Mohn, Klapperrose, Klatschrosen, *G.;* Rosolaccio, *It.;* Amapola (Flor de), *Sp.*

Papaver Rhœas, Willd., *Sp. Plant.* ii. 1146; *B. & T.* 19.—The *red* or *corn poppy* is distinguished by its hairy stem, which is branched, and rises about a foot in height, by its incised pinnatifid leaves, by its urn-shaped capsule, and by the full, bright, scarlet color of its petals. It is a native of Europe, where it grows wild in great abundance, adorning especially the fields of grain with its brilliant flower. It has been naturalized in this country.

Its capsules contain the same kind of milky juice as that found in *P. somniferum,* and an extract has been prepared from them having the properties of opium; but the quantity is too small to repay the trouble of its preparation. Filhol has shown that the extract contains morphine, but in a proportion exceedingly minute compared with that in which it exists in opium. (*J. P. C.,* ii. 513.) The petals are the official portion. They have a narcotic odor, and a mucilaginous, slightly bitter taste. By drying, they lose their odor, and assume a violet-red color. Chevallier believed that he had detected a very minute proportion of morphine in an extract obtained from them; but Attfield seems to have determined satisfactorily the non-existence of morphine in the petals, having sought this alkaloid by three different processes, using a pound of the petals in each experiment, and failed to detect the least evidence of its presence. (*P. J.,* Oct. 1873, p. 291.) Their operation on the system is exceedingly feeble, and they are valued more for their beautiful scarlet color, which they communicate to water, than for their medicinal virtues. According to Leo Meier, the coloring

paper, by W. L. Howie, contained in *A. J. P.* (Jan. 1874, 16), from *P. J.* (Nov. 15, 1873); see also *P. J.,* 1898, 126.

principles of the flowers are two acids, which he denominates *rhœadic* and *papaveric acids.* (See *A. J. P.,* xviii. 211.) A syrup is prepared from them, which was formerly prescribed as an anodyne in catarrhal affections, but is now little esteemed except for its color.

An alkaloid was discovered in this species of poppy by O. Hesse, who proposed to name it *rhœadine.* It seems to pervade all parts of the plant, from which, as the first step in its preparation, an aqueous extract is prepared. This is treated with sodium carbonate, and repeatedly agitated with ether; the ethereal liquid is shaken with a solution of sodium bitartrate, and the mixture is precipitated by ammonia. The precipitate is washed with cold water, dried, and boiled with alcohol, by which coloring matter and another alkaloid in small quantity, probably thebaine, are removed. The residue, consisting mainly of rhœadine, is purified by combining it with acetic acid, treating with animal charcoal, and precipitating with ammonia. The alkaloid is in small white prismatic crystals, tasteless, fusible at 232.2° C. (450° F.), becoming brown at the same temperature and partially subliming. It is almost insoluble in water, alcohol, ether, chloroform, benzene, ammonia, solution of sodium carbonate, and lime water, but is dissolved by dilute acids, which produce colorless solutions. Its composition is represented by the formula $C_{21}H_{21}NO_6$. It does not appear to be poisonous. Hydrochloric and sulphuric acids, moderately concentrated, decompose and dissolve it, with the production of a purple color, which disappears under the action of the alkalies, but is restored by acids. One part of the alkaloid so treated produces a purple color with 10,000 parts of water, rose color with 20,000 parts, and a perceptible redness with 800,000 parts. This change is dependent upon the liberation from the rhœadine of a red coloring matter, while the isomeric *rhœagenine* remains. This forms small white tasteless prisms, which fuse at 223° C. and do not sublime, but are decomposed at higher temperatures. This is a very delicate test, by means of which the alkaloid may be detected in all parts of *Papaver Rhœas,* in the ripe capsules of the opium poppy, and in opium itself. It is said also to exist in Merck's porphyroxine. (*A. J. P.,* 1867, p. 122.) According to Hesse, the milky juice also contains *meconic acid.*

Off. Prep.—Syrupus Rhœados, *Br.*

RHUS GLABRA. U. S.

RHUS GLABRA

(rhŭs glā'brą)

"The dried fruit of *Rhus glabra* Linné (Fam. *Anacardiaceæ*)." *U. S.*

Rhus Glabrum, *U. S.* 1870; Sleek, Scarlet, White, Sumach, Shoe-make, Vinegar Tree; Sumac, *Fr.;* Sumach, *G.*

Rhus glabra, L., *Sp. Pl.* (1753) 265; Willd., *Sp. Plant.* i. 1478.—This species of Rhus, called variously *smooth sumach, Pennsylvania sumach,* and *upland sumach,* is an indigenous shrub from four to twelve feet or more in height, with a stem usually more or less bent, and divided into straggling branches, covered with a smooth, light gray, or somewhat reddish bark. The leaves are upon smooth petioles, and consist of many pairs of opposite leaflets, with an odd one at the extremity, all of which are lanceolate, acuminate, acutely serrate, glabrous, green on their upper surface, and whitish beneath. In the autumn their color changes to a beautiful red. The flowers are greenish red, and disposed in large, erect, terminal compound thyrses. The fruit is in clusters of small crimson berries, which are officially described as "flattened-ovoid, 3 to 4 Mm. in diameter, externally deep crimson, glandular-tomentose; endocarp light yellow, smooth, shiny, enclosing a single seed; inodorous; taste acidulous and astringent." *U. S.*

The shrub is found in Canada and almost all parts of the United States, growing in old neglected fields, along fences, and on the borders of woods. The flowers appear in July, and the fruit ripens in the early part of autumn. The bark and leaves are astringent, and are largely used, especially the leaves, in tanning leather and in dyeing. The sumach for the manufacture of extract for tanners' use is largely cultivated in Virginia, where the annual crop reaches from 7000 to 8000 tons, and is collected at any time between the first of July and the appearance of frost. W. J. Watson found, in the bark of the root, albumen, gum, starch, tannic and gallic acids, caoutchouc, resin, coloring matter, and evidences of volatile oil. (*A. J. P.,* xxv. 194.) Excrescences are produced under the leaves resembling galls in character, and containing large quantities of tannic and gallic acids. These have been used as a substitute for the imported galls by Walters of New York, who thought them in every respect preferable. They may be collected at little expense, as they are produced very abundantly, especially in the Western States. From the experiments of Stenhouse, it appears that the tannic acid of sumach is identical with that of galls, being, like it, resolved, under the influence of sulphuric acid, into glucose and gallic acid, and this change is supposed to take place spontaneously in sumach when long kept. (*Ibid.,* xxxiv. 252.)

The percentage of tannin in Virginia sumach rises at times as high as 27 per cent., but falls a few per cent. below this as the season advances. Samples of leaves gathered along the Mississippi near Dubuque, Iowa, in July and August, yielded 16.36 per cent. and 15.75 per cent. respectively. (*A. J. P.,* 1888, p. 389.) The proportion of tannic acid in the European sumach falls from 6 to 8 per cent. below the percentage of the Virginia sumach, yet the European is much preferred by tanners and

dyers. By using Sicilian sumach it is possible to make the finer white leathers so much used for gloves and fancy shoes, while by the employment of the American product the leather has a disagreeable yellow color, apparently due to a coloring matter, which, according to Loewe, consists of quercitrin and quercitin, and exists in larger quantity in the American than in the Sicilian drug. Enormous quantities of a dark-red, semi-fluid, bitter, astringent extract are prepared in Virginia from sumach, and used both in America and in Europe. It is said to contain from 25 to 30 per cent. of tannin.

Henry Trimble collected some galls from the leaves of *R. glabra* and found that they contained 61.70 per cent. of tannin, reckoned on the weight of the air-dried galls, or 70.90 per cent. of the weight of absolutely dry material. (*A. J. P.*, 1890, p. 564.)

The berries have a sour, astringent, not unpleasant taste, and are often eaten by the country people with impunity. According to Cozzens of New York, the malic acid is contained in the pubescence which covers their surface, as when it is washed away by warm water the berries are wholly free from acidity. W. B. Rogers found the acid to be combined with lime,[1] as acid calcium malate. W. J. Watson ascertained that free malic acid and acid calcium malate coexist in the berries, which contain also, upon the same authority, tannic and gallic acids, fixed oil, extractive, red coloring matter, and a little volatile oil. A medicinal wine has been prepared from the fruit. (*M. S. R.*, Feb. 9, 1867.) For a paper on the relative proportion of the constituents found in the husk and seed portion of the fruit by Frankforter and Martin see *A. J. P.*, 1904, 151.

Uses.—Sumach berries are astringent and refrigerant. A strong decoction, or the fluidextract diluted, affords a very effective and pleasant gargle in *angina*, especially in combination with potassium chlorate. They are rarely used internally.

Dose, fifteen grains (1 Gm.).

Off. Prep.—Fluidextractum Rhois Glabræ, *U. S.*

ROSA GALLICA. U. S. (Br.)

RED ROSE

(rō'ṣą găl'lĭ-cą)

"The dried petals of *Rosa gallica* Linné (Fam. *Rosaceæ*), collected before expanding." *U. S.* "The fresh and dried unexpanded petals of Rosa gallica, *Linn.* From cultivated plants." *Br.*

Rosæ Gallicæ Petala, *Br.*; Red-rose Petals; Flores Rosarum Rubrarum; Rose rouge ou Rose de Provins, *Fr. Cod.*; Roses rouges, *Fr.*; Sammtrose, Zuckerrose, Französische Rose, Essigrosenblätter, *G.*; Rosa rossa, *It.*; Rosa roja (Flore de), Rosa rubra, *Sp.*

Rosa gallica,[1] L., *Sp. Pl.* (1753) 492; Willd., *Sp. Plant.* ii. 1071; *B. & T.* 104.—This species is smaller than *R. centifolia*, L., but resembles it in the character of its foliage. The stem is beset with short bristly prickles. The flowers are very large, with obcordate widely spreading petals, which are of a rich crimson color, and less numerous than in the *R. centifolia*. In the centre is a crowd of yellow anthers on thread-like filaments, and as many villose styles bearing papillary stigmas. The fruit is oval, shining, and of a firm consistence. The red rose is a native of the south of Europe, and is cultivated in gardens throughout the United States.

The drug is officially described as "usually in small cones, consisting of numerous imbricated, roundish, retuse, deep purplish-red, yellowish-clawed petals, having a characteristic odor and a bitterish, slightly acidulous, and distinctly astringent taste." *U. S.* The petals should be gathered before the flower has blown, separated from their claws, dried in a warm sun or by the fire, and kept in a dry place. Their odor, which is less fragrant than that of *R. centifolia*, is improved by drying. They have a velvety appearance, a purplish-red color, and a pleasantly astringent and bitterish taste. Their constituents, according to Cartier, are tannin, gallic acid, coloring matter, a volatile oil, a fixed oil, albumen, soluble salts of potassium, insoluble salts of lime, silica, and ferric oxide. (*J. P. C.*, vii. 531.) According to Filhol, the astringency of red roses is ascribable less to tannic acid, of which they contain but a trace, than to *quercitrin*, which he obtained in notable proportion, and with which their color is probably connected. Rochleder found that in red roses the gallic acid is accompanied by quercitannic acid. They also contain much uncrystallizable sugar. (*Répert. de Pharm.*, Mai, 1863.) The sensible properties and medicinal virtues of the flowers are extracted by boiling water. Their coloring matter, according to Senier (*Y. B. P.*, 1877, p. 63), is an acid, which appears to form crystallizable salts with potassium and sodium, and amorphous ones with the heavy metals. Senier gives as the formula of the insoluble lead compound $Pb_2C_{21}H_{29}O_{30}$. Their infusion is of a pale reddish color, becoming bright red on the addition of sulphuric acid. As their color is impaired by exposure to light and air, they should be kept in opaque well-closed bottles or canisters.

Uses.—Red rose is slightly astringent and tonic, and it was formerly thought to possess

[1] Procter obtained, from the berries, *malic acid* by the following process. Pour boiling water on the ripe berries; macerate for twelve hours; strain, evaporate to one-fourth, and again strain; resume the evaporation, and continue it till the liquid assumes the consistence of thin syrup; then set it aside to crystallize. Wash the crystals of acid calcium malate with a little water, and recrystallize from a boiling solution. Dissolve the salt in hot water, and decompose it with a solution of lead acetate. Wash the precipitated lead malate, suspend it in water, and pass hydrogen sulphide through the liquid until the whole of the lead is separated. Lastly, filter, and evaporate to dryness in a porcelain vessel.

[1] For other species of the genus see *Rosa*, PART II.

peculiar virtues. It is at present chiefly employed as affording an elegant vehicle for tonic and astringent medicines.

Off. Prep.—Confectio Rosæ, *U. S.* (*Br.*); Fluidextractum Rosæ, *U. S.*; Infusum Rosæ Acidum, *Br.*; Pilulæ Aloes et Mastiches, *U. S.*; Syrupus Rosæ, *U. S.* (from fluidextract), *Br.*

RUBUS. U. S.

RUBUS [Blackberry]

(rū'bŭs)

"The dried bark of the rhizome of *Rubus villosus* Aiton, *Rubus nigrobaccus* Bailey, or of *Rubus cuneifolius* Pursh (Fam. *Rosaceæ*)." *U. S.*

Bramble, Finger Berry; Ecorce de Ronce noir, *Fr.*; Brambeeren, Brombeerrinde, *G.*

Of this extensive genus not less than thirty-five species are indigenous in the United States, where they are called by the various names of *raspberry, blackberry, dewberry, cloudberry,* etc. Most of them are shrubby or suffruticose briers, with astringent roots and edible berries; some have annual stems without prickles. They are naturally divided into the *raspberries,* in which the edible fruit is composed of pulpy, one-seeded, coherent little drupes, separate from the dry receptacle, and the *blackberries,* in which the receptacle is juicy and coheres with the drupes to form the fruit. The U. S. Pharmacopœia (8th Rev.) recognizes as the source of rubus only three species, but it is probable that others contribute to the bark of the markets. In fact the U. S. Pharmacopœia of 1890 recognized officially *R. canadensis,* L., and *R. trivialis,* Michaux.

Rubus villosus, Ait., *Hort. Kew.* (1789) 210; Willd., *Sp. Plant.* ii. 1085.—The stem of the *blackberry* is somewhat shrubby, from three to seven feet high, branching, more or less furrowed and angular, and armed with strong prickles. The smaller branches and young shoots are herbaceous. The leaves are ternate or quinate; the leaflets ovate, acuminate, unequally and sharply serrate, and pubescent on both sides; the footstalks and midrib usually armed with short recurved prickles. The flowers are large, white, and in erect racemes, with a hairy, prickly stalk. The calyx is short, with acuminate segments. This plant is very common in thickets, half-cultivated fields, etc., extending from New England to Florida and west to Arkansas, fruiting in August and September. It is the original of the ordinary form of the cultivated blackberry.

Rubus nigrobaccus, Bailey (*R. villosus,* Gray; not Aiton), *High Bush Blackberry,* is a stout bush, reaching the height of 8 or 9 feet, with erect, recurved, glandular-pubescent stems much branched and armed with stout recurved prickles. Its 3 to 5 foliolate leaves have ovate or ovate-oblong leaflets, which are acute, coarsely serrate, and pubescent beneath. The racemosed paniculate flowers are furnished with small bracts and have white obovate petals much longer than the sepals. The fruit is usually black and pulpy though a variety with small white fruit is said to occur. This plant is common in the Eastern United States from New England to Florida.

Rubus cuneifolius, Pursh. *Sand Blackberry* is a shrubby plant, rarely reaching the height of over three feet, much branched, with stout straight or recurved prickles, and dense whitish pubescence on the lower surfaces of the leaves and upon the young shoots. The leaves are furnished with linear stipules, are 3 to 5 foliolate, long petioled with obovate or oval lateral and cuneate terminal leaflets, which are obtuse, and dentate above the middle. The peduncles are furnished with two to five pinkish-white flowers, which yield a large brownish-black fruit. This blackberry inhabits almost the whole of the Eastern United States, affecting sandy soils.

The blackberry root is branching, cylindrical, of various dimensions, from nearly an inch in thickness down to the size of a straw, ligneous, and covered with a thin bark, which is externally of a light brownish or reddish-brown color, and in the dried root is wrinkled longitudinally. The dewberry root is usually smaller, without the longitudinal wrinkles, but with transverse fissures through the epidermis, and of a dark ash color, without any reddish tinge. Both are inodorous. The bark is "in elongated, tough, flexible quills, from 3 to 6 Mm. in diameter, or in similar bands, the bark 1 to 2 Mm. thick; outer surface deep red-brown or dark gray-brown, occasionally blackish-brown, smoothish or somewhat scaly; inner surface yellow or pale brownish, strongly and coarsely long straight-striate; fracture tough-fibrous; readily splitting; inodorous; taste strongly astringent and bitterish." *U. S.* Its virtues are extracted by boiling water and by diluted alcohol, and depend chiefly upon tannin, which is an abundant constituent.[1] The woody part of the roots is inert.

Uses.—Dewberry and blackberry roots have long been a favorite domestic astringent remedy in *diarrhœas.* Given in decoction, they are usually acceptable to the stomach, without being offensive to the taste. The decoction may be prepared by boiling an ounce of the smaller roots, or of the bark of the larger, in a pint and a half of water down to a pint, of which from one to two fluidounces (30 to 60 Cc.) may be given to an adult three or four times, or more frequently, during the twenty-four hours. The fluidextract is an excellent preparation; dose, thirty to sixty minims (1.8 to 3.75 Cc.).

[1] *Aromatic Syrup of Blackberry.*—Take of Blackberry Root 2 oz. troy; Cinnamon, Cloves, each, 90 grains; Mace 60 gr.; Sugar 30 oz. troy. Reduce the root and spices to a powder which will pass through a sieve of 50 meshes to the square inch, moisten this with two fluidounces of alcohol, put into a percolator and displace with water until 17 fluidounces have passed, and dissolve the sugar in the filtrate. A fluidounce is equivalent to 30 grains of the root. (*A. J. P.*, Nov. 1859, p. 552.)

Dose, from twenty to forty grains (1.3 to 2.6 Gm.).

Off. Prep.—Fluidextractum Rubi, *U. S.;* Syrupus Rubi, *U. S.* (from fluidextract).

SABAL. U. S.

SABAL [Saw Palmetto]

(sā'bąl)

"The partially dried ripe fruit of *Serenoa serrulata* (Roemer and Shultes) Hooker filius (Fam. *Palmæ*)." *U. S.*

The *Saw palmetto* flourishes on the Atlantic coast from South Carolina to Florida, where it forms the so-called "palmetto scrub." Its stem, which is from 6 to 10 feet high, has a crown of large leaves, long petioled, with a circular fan-shaped leaf blade split at the edge into from 15 to 30 divisions, which are slightly cleft at their apices. The fruit is a one-sided blackish-brown drupe, from half an inch to one inch long; ovoid-oblong in shape, with a somewhat wrinkled exterior, and a sweetish, not agreeable taste. It occurs in a large panicle which in some cases may weigh as much as nine pounds.

Properties.—Sabal is officially described as follows: "Irregularly spherical to oblong-ovoid; 10 to 25 Mm. long, 10 to 15 Mm. in diameter; externally blackish-brown, shrivelled, somewhat oily; epicarp thin; sarcocarp about 1 Mm. thick, greenish-yellow, soft-spongy; endocarp thin, friable; seed hard, chocolate-brown; odor aromatic; taste sweetish, acrid, and oily." *U. S.* In it Coblentz (*Proc. New Jersey Pharm. Assoc.,* 1895, 45) believes that he found, besides a volatile oil an alkaloid. In the studies of Sherman and Briggs (*Ph. Archiv.,* vol. 2) no alkaloid could be detected. Sieker (*Ph. Rev.,* 1897, 113) examined the fixed oil: the sp. gr. was 0.9138, and it was soluble in alcohol, ether, and petroleum benzin. By pressure the fruit yields about 1½ per cent. of a brownish-yellow to dark red oil, soluble in alcohol, ether, chloroform and benzene, and partly soluble in dilute solution of potassium hydroxide. It contains, according to Sherman and Briggs (*Ph. Archiv.,* 1899, 101; see also *Ph. Rev.,* 1900, 217) about 63 per cent. of free acids, and 37 per cent. of ethyl esters of these acids. The oil obtained exclusively from the nut was thick and of a greenish color, without fruity odor. It was a glyceride of fatty acids.

Uses.—The oil of saw palmetto is probably eliminated through the kidneys unchanged, although we know of no actual experiments to prove this, and appears to exert a stimulant alterative action upon the mucous membrane of the genito-urinary tract, similar to that of other alterative diuretics. Saw palmetto is milder and less stimulant than is cubeb or copaiba, or even the oil of sandal-wood. Like these drugs it also has the power of affecting the respiratory mucous membrane, so that it has been used not only in *chronic* and *sub-acute cystitis,* but also in *chronic bronchitis, laryngitis,* and the catarrhs which accompany *asthma, phthisis,* and other more serious diseases of the lungs. It has been affirmed that saw palmetto is capable of increasing the nutrition of the testicles and of the mammae in functional atony of these organs, but this is very doubtful. It has been especially recommended in cases of *enlarged prostate* of old men; it is not probable that it has a direct influence upon the prostatic gland itself but there is much clinical testimony as to its value and it probably acts by reducing the catarrhal irritation and the relaxed condition of the mucous membrane of the bladder and urethra, which are almost universally present in prostatic hypertrophy. Dose of the fluidextract,[1] ten to twenty-five minims (0.6 to 1.6 Cc.). It is not official but is probably the best form of using the drug, the oil not being on the market.

Dose, fifteen grains (1 Gm.).

SABINA. U. S.

SAVIN

(są-bī'ną)

"The tops of *Juniperus Sabina* Linné (Fam. *Coniferæ*)." *U. S.*

Sabinæ Cacumina; Summitates (Herba) Sabinæ, Savine Tops; Sabine, *Fr. Cod.;* Sevenbaum, Sadebaumspitzen, Sevenkraut, *G.;* Sabina, *It., Sp.*

Juniperus Sabina, L., *Sp. Pl.* (1753) 1039; Willd., *Sp. Plant.* iv. 852; *B. & T.* 254.—This is an evergreen shrub from three to fifteen feet high, with numerous erect, pliant branches, much subdivided. The bark of the young branches is light green, that of the trunk rough and reddish brown. The leaves, which completely invest the younger branches, are numerous, small, erect, firm, smooth, pointed, dark green, glandular in the middle, opposite, and imbricated in four rows. The flowers are male and female on different trees. The fruit is a blackish-purple berry of an ovoid shape, marked with tubercles and the remains of the calyx and petals, and containing three seeds. The savin is a native of the south of Europe and the Levant, and grows wild in the neighborhood of the northwestern lakes of the United States.

The ends of the branches, and the leaves by which they are invested, are collected for

[1] *Fluidextract of Sabal*—Sieker proposed the following formula for this fluidextract: Moisten 1000 Gm. of saw palmetto, in No. 40 powder, with 300 Cc. of alcohol, and proceed to percolate with alcohol in the usual manner, reserving the first 850 Cc. of percolate, distilling the alcohol from the exhaust percolate, dissolving the extract in the reserved portion, and adjusting the volume of the fluidextract to 1000 Cc. with alcohol. The clear fluidextract so obtained has the yellowish brown color, odor and taste of the commercial type, a sp. gr. of 0.8807 at 25° C., and yielded 12.98 per cent. of oil and 13.6 per cent. of extract. (*Ph. Rund.,* Oct. 1895, 236.)

medicinal use in the spring. When dried they are very much faded in color. They are officially described as "short, thin, subquadrangular branchlets bearing leaves which are rather dark green, in four rows, opposite, scale-like, ovate-lanceolate, more or less acute, appressed, imbricated, having on the back a shallow groove containing an oblong or roundish gland; odor peculiar, terebinthinate; taste disagreeable, resinous and bitter." *U. S.* They have a strong, heavy, disagreeable odor, and a bitter, acrid taste. These properties, which are less striking in the dried than in the recent leaves, are owing to a volatile oil. (See *Oleum Sabinæ.*) The leaves impart their virtues to alcohol and to water. C. H. Needles found in them volatile oil, gum, tannic or gallic acid, resin, chlorophyll, fixed oil, bitter extractive, lime, and salts of potassium. (*A. J. P.*, xiii. 15.)

In America the tops of *Juniperus virginiana,* or common red cedar, are sometimes substituted in commerce for savin, which they resemble closely, but from which they can be distinguished by some of their leaves being ternate, by having stone cells in the mesophyll, and by differing in odor and taste. In Europe savin is said to be adulterated with the tops of *J. phœnicea,* which contain volatile oil similar to that of *J. communis.* Such substitution is to be detected by the fact that in *J. phœnicea* the leaves are imbricated in spirals of five, and that in the mesophyll there are large stone cells which do not appear in the official species.

Uses.—Savin is highly irritant, and is supposed to have a special direction to the uterus. It has been much used in *amenorrhœa* and *atonic menorrhagia,* and occasionally as a remedy for *worms.* Chapman strongly recommended it in *chronic rheumatism,* and it is employed in Germany, both internally and externally, in *chronic gout.* In overdoses it may produce dangerous gastro-intestinal inflammation, and it should therefore be used with caution. In no case should it be employed when much general or local excitement exists. In pregnancy it should always be given with great caution. The dose of the fluidextract is from five to ten minims (0.3 to 0.6 Cc.); of the oil, three minims (0.2 Cc.). As an external irritant, savin is useful, in the form of cerate, for maintaining a discharge from blistered surfaces; but as in this country savin ointment is often feeble, either from the age of the drug or from the substitution of red cedar, it has fallen into disrepute. In powder or infusion, savin is used in Europe as an application to *warts, indolent* or *gangrenous ulcers, psora,* and *tinea capitis,* and the expressed juice of the fresh leaves, diluted with water, is sometimes used for similar purposes. Powdered savin should not be used after it has lost the green color, characteristic of the fresh drug.

Dose, five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Fluidextractum Sabinæ, *U. S.*

SACCHARUM. U. S. (Br.)

SUGAR [Cane Sugar]

(săc'ȼha-rŭm)

$C_{12}H_{22}O_{11} = 339.6$

"The refined sugar obtained from *Saccharum officinarum* Linné, and from various species or varieties of *Sorghum* (Fam. *Gramineæ*); also from one or more varieties of *Beta vulgaris* Linné (Fam. *Chenopodiaceæ*)." *U. S.* "A crystallized sugar, $C_{12}H_{22}O_{11}$, obtained from the juice of the sugar-cane." *Br.*

Saccharum Purificatum, *Br.;* Refined Sugar, Cane Sugar, Sucrose; Sucre de Canne, *Fr. Cod.;* Sucre, Sucre pur, Sucre en Pains, *Fr.;* Saccharum, *P. G.;* Weisser Zucker, Zucker, Rohrzucker, *G.;* Zucchero, *It.;* Azucar, Azucar refinado, *Sp.*

Saccharum officinarum, L., *Sp. Pl.* (1753) 54; Willd., *Sp. Plant.* i. 321; *Philos. Trans.* lxix. 207.—The *sugar cane* is an herbaceous plant, possessing a jointed, succulent rhizome, from which arise several shining, jointed, solid stems, from an inch to two inches in diameter, from six to twelve feet high, and containing a white and juicy pith. The color of the stem is yellow, greenish yellow, purple, or striped. The joints are about three inches apart, and give origin to the leaves, which embrace the stem at their base, are three or four feet long and about an inch wide, flat, acuminate, longitudinally striated, furnished with a white midrib, glabrous, finely dentate, and of a green color inclining to yellow. The flowers are pinkish, surrounded by a long silky down, and disposed in a large, terminal, nearly pyramidal panicle, composed of subdivided spikes, and two or three feet in length. The plant has a general resemblance to the Indian corn. Four varieties are mentioned: 1, the *common,* with a yellow stem; 2, the *purple,* with a purple stem and richer juice; 3, the *gigantic,* with a very large light-colored stem; and 4, the *Otaheitan,* which was introduced into the West Indies from the island of Tahiti (Otaheite) by Bougainville and Bligh, and is distinguished by its greater height, the longer intervals between its joints, and the greater length of the hairs which surround the flowers.

The sugar cane is cultivated by cuttings, which are planted in rows, and which, by giving rise to successive shoots, furnish five or six crops before the plants require to be removed. At the end of a year or more the plant flowers, but before this takes place the canes are richest in sugar and are cut down. The quantity of sugar which they yield is variable. According to Avequin of New Orleans, the proportion of cane sugar in the recent stalk is about 10 per cent.; of uncrystallizable sugar from 3½ to 4 per cent. Cane juice is said to contain 17 per cent. of crystallizable sugar, though not more than 13 per cent. is extracted in practice.

Among the saccharine principles distinguished by the chemist are cane sugar, or sugar

properly so called, derived from the sugar cane, the beet, and the sugar maple, and having the formula $C_{12}H_{22}O_{11}$; lactose or milk sugar, and maltose, a product of the action of diastase upon cereals, possessing the same formula; glucose, including dextrose or grape sugar, levulose or fruit sugar, the mixture of the two produced by the hydrolysis of cane sugar and known as invert sugar, and that resulting from the change of starch and starch-containing cereals; arabinose, from gum arabic, agreeing with glucose in the formula $C_6H_{12}O_6$; mannite (mannitol), and dulcite (dulcitol), which are alcohol-like compounds closely related to the true sugars. Quercite, pinite, and inosite were formerly regarded as either pentatomic alcohols or glucoses, but are now considered to be hexahydro derivatives of a pentatomic phenol as yet unprepared. *Glucose,* or *grape sugar,* is conveniently obtained by spreading crystalline honey on porous tiles, dissolving what remains on their surface in alcohol, and crystallizing. The product is about one-fourth of the weight of the honey. It is also prepared from starch by the action of very weak sulphuric acid and this industry has assumed enormous proportions in this country in the last decade. In the report of the 1890 census, the capacity of the factories in the United States was estimated at 43,000 bushels of corn per day. In 1905 the annual production of glucose and grape sugar was from 250,000 to 300,000 tons.

The term glucose is applied to the syrupy product of this process, while the name grape sugar is limited to the solid substance from the same source. The process, in outline, is as follows: The corn is first soaked for two or three days in warm water, and is then ground on specially prepared stones with a stream of water. The meal is next passed into a trough, the bottom of which is made of fine bolting cloth. Here the starch is washed through and led to large tanks, where it is allowed to settle. It is next beaten up with sodium hydroxide, to separate the gluten, and the starch is again allowed to settle in long shallow troughs. The starch, washed from all adhering alkali, is next beaten up with water into a cream, and conducted into the converting tubs. These tubs are supplied with coils of copper steam piping, and are made of wood. Here the starch cream is treated with diluted sulphuric acid, and steam is allowed to bubble up through the mixture from small holes in the copper pipes. This process of conversion, which is called "open conversion," is completed in about two hours. Another method is called "close conversion." The substances are enclosed in stout copper cylinders and subjected to the action of superheated steam. This process occupies about fifteen minutes. After conversion, the acid is neutralized by marble dust and animal charcoal. Since the calcium sulphate which is formed in this operation is slightly soluble, barium carbonate has been used instead of marble dust, but its use has not become general. After neutralization, the liquid is filtered through cloth and animal charcoal, and is then conveyed to the vacuum pan. When glucose syrup alone is desired, the process of conversion is stopped when the starch has disappeared, so that the syrup contains both glucose and dextrin, while when solid grape sugar is desired, the conversion is carried further to the change of dextrin into dextrose. Glucose can be obtained as a hydrate in small and laminated crystals from aqueous solution, and anhydrous in hard crystalline masses either from alcoholic solution or, by the process used by Arno Behr (*A. J. P.,* Aug. 1882, p. 397), from very concentrated aqueous solution. It is less sweet than cane sugar. It is also less soluble in water, and much more soluble in alcohol. It has the sp. gr. 1.54 to 1.57 when anhydrous. Strong mineral acids hardly act on grape sugar, but destroy cane sugar with facility. On the other hand, grape sugar is destroyed by alkalies, with which cane sugar forms definite compounds. Dissolved in water and subjected to prolonged ebullition, grape sugar undergoes very little alteration. Its solution rotates the plane of polarization of polarized light to the right, and is capable of undergoing the vinous fermentation directly, without passing through any intermediate state. It is characterized also, in boiling solution, by reducing alkaline copper tartrate, and by becoming brown by the action of the alkalies.

The name of *glucosides* has been given to certain organic substances which are resolvable, by the presence of acids, or other slight chemical influence, into glucose and some other proximate principle, as in the instance of one variety of tannic acid, which is resolved into glucose and gallic acid. E. Fischer announced (*Ber. d. Chem. Ges.,* 1893, 2400) the discovery of a general method for the formation of glucosides. He finds that, if a glucose be dissolved in an alcohol and gaseous hydrochloric acid be passed into the solution to saturation, the two compounds unite with the elimination of water to form a glucoside or ester of the two. He has found this reaction to extend to methyl, ethyl, propyl, isopropyl, amyl, allyl, and benzyl alcohols, to ethyleneglycol, and glycerin, and even to the oxyacids or alcohol acids like lactic acid. He has tested it for mannose, galactose, dextrose, fructose, gluco-heptose, arabinose, xylose, and rhamnose. *Fruit sugar,* or *levulose,* is an isomeric form of glucose, found in honey and in the juice of fruits; an uncrystallizable mixture of dextrose and levulose (both varieties of glucose) is generated from cane sugar by solution in water or weak acids, and long boiling. Hence it is present in molasses. An aqueous solution of this sugar, like grape sugar, is susceptible of the vinous fermentation without an intermediate change. In consequence of its effect on polarized light, it has been named by the French chemists *invert sugar* (*sucre interverti*), its rotatory power being the reverse

of that of the sugar from which it is produced. A solution of *cane sugar*, like that of grape sugar, has a rotating power to the right. When it ferments, it is first changed into uncrystallizable sugar, according to the reaction:

$$C_{12}H_{22}O_{11} + H_2O = (C_6H_{12}O_6)_2$$

and, as the change proceeds, the rotating power to the right of the cane sugar gradually lessens and disappears, and is replaced by the rotating power to the left of the uncrystallizable sugar formed.

Classification of the Carbohydrates.—The group of the carbohydrates has been studied by Emil Fischer, who has not only made numerous syntheses in this group, but has greatly widened our knowledge of the relations of the several sugars, making necessary a more comprehensive classification. Thus, while no sugars are found in nature containing less than six atoms of carbon, synthetic compounds are formed belonging in the first or monosaccharide class which contain three, four, and five atoms of carbon, as well as others containing seven, eight, and nine atoms of carbon. The classification given below, is based on that of Tollens.

I. Monosaccharides.

Trioses.—Glycerose, $C_3H_6O_3$ (prepared from glycerin by oxidation).

Tetroses.—Erythrose, $C_4H_8O_4$ (prepared from erythrite by oxidation).

Pentoses.—Arabinose, $C_5H_{10}O_5$ (prepared by the action of dilute sulphuric acid upon lævo-rotatory gum arabic; xylose, $C_5H_{10}O_5$ (prepared by boiling beech wood and jute with dilute acids); rhamnose or isodulcite, $C_5H_8(CH_3)O_5$, methyl pentose (obtained in the decomposition of glucosides like quercitrin).

Hexoses.—Glucose or dextrose, $C_6H_{12}O_6$; fructose or levulose, $C_6H_{12}O_6$; mannose, $C_6H_{12}O_6$ (obtained by the careful oxidation of mannite); galactose, $C_6H_{12}O_6$.

Heptoses. $C_7H_{14}O_7$. Manno-heptose (obtained artificially from the corresponding mannose); gluco-heptose (obtained artificially from the corresponding glucose).

Octoses. $C_8H_{16}O_8$. Manno-octose (prepared from the corresponding mannose); gluco-octose (prepared from the corresponding glucose).

Nonoses. $C_9H_{18}O_9$. Manno-nonose (prepared from the corresponding mannose); gluco-nonose (prepared from the corresponding glucose).

II. Disaccharides and Trisaccharides.

Tribioses and *tetrabioses* are as yet unknown.

Pentabioses.—Arabinon, $C_{10}H_{18}O_9$ (has been prepared by the moderated action of dilute sulphuric acid upon arabic acid).

Hexabioses.—Cane sugar, $C_{12}H_{22}O_{11}$; milk sugar, $C_{12}H_{22}O_{11}$; maltose, $C_{12}H_{22}O_{11}$; isomaltose, $C_{12}H_{22}O_{11}$; trehalose, $C_{12}H_{22}O_{11}$.

Hexatrioses.—Meletriose or raffinose, $C_{18}H_{32}O_{16}$; melezitose, $C_{18}H_{32}O_{16}$.

III. Polysaccharides.

(*a*) *Crystallizable polysaccharides.*—Gentianose, lactosin.

(*b*) *Uncrystallizable polysaccharides.* Starches, lichnin, inulin, glycogen, dextrin, natural gums, pectin substances, cellulose, lignin, tunicin.

Cane sugar is manufactured extensively on the continent of Europe from the beet, and this industry is now growing in this country, especially in California. It is also largely produced in Canada and the northern parts of the United States from the sap of the sugar maple (*Acer saccharinum*). Cane sugar may be obtained from cornstalks, and from the *Chinese sugar cane*, or *Sorghum saccharatum*, which latter source for a time assumed some importance in Kansas and the Northwest. In India, sugar is made from the sap of different species of palm. Crude *palm sugar* is called *jaggery*. Next in rank to the sugar beet as a source of cane sugar is the sugar cane, which is extensively cultivated in Africa, the East and West Indies (especially Cuba), Brazil, and some of our Southern States, particularly Louisiana.

Preparation and Purification.—The canes, when ripe, are cut down close to the earth, topped, and stripped of their leaves, and then crushed between a series of horizontally placed iron rollers in a mill, or they are cut in thin transverse slices and the juice extracted by diffusion with warm water. The juice, constituting 90 per cent. of the cane, though much less is actually obtained, is of a pale greenish color, sweet taste, and balsamic odor, and has a sp. gr. varying from 1.033 to 1.106. As it runs out it is received in suitable vessels, and, being quickly removed, is *immediately* mixed with lime, in the form of milk of lime, in the proportion of about 1 part of the earth to 800 parts of the juice, and heated in a boiler to 140° F. The exact proportion of the lime cannot be determined, as the juice varies in quality in different seasons; but the manufacturer should aim at leaving the juice still slightly acid. The gluten and albumen rise to the top, and form a thick scum, from underneath which the liquid is drawn off by a cock into a copper boiler, where it is concentrated by heat, the scum being carefully skimmed off as it forms. When sufficiently concentrated, the juice is transferred to shallow vessels called coolers, from which, when it assumes a granular aspect, it is drawn off into wooden vessels with perforated bottoms, the holes in which are temporarily plugged. At the end of twenty-four hours the liquid is strongly agitated with wooden stirrers, in order to accelerate the granulation of the sugar, which is completed in six hours. The stoppers are now removed, and the syrup is allowed to drain off from the sugar, which in this state is granular, of a yellowish color, and moist. The syrup, by a new evaporation, furnishes an additional portion of sugar, and the liquid which finally re-

mains, incapable of yielding more sugar with advantage, is called *molasses*. Sugar produced in this way is called "open pan" sugar. It is now almost completely displaced by "vacuum pan" sugar.

In the production of raw sugars by the vacuum pan process, the juice, after "defecation" with lime and removal of excess of lime by carbonic acid gas, is run through large filters of bone black, and then into a vacuum pan for concentration. The vacuum pan is a large evaporating pan, closed above by a dome-like top, which connects with an exhausting steam pump, so that the liquid can be concentrated under very reduced pressure. The heat is supplied by coils of steam pipes which run through the interior of the pan. The saccharine juice is evaporated in this until it begins to crystallize, and even after this fresh portions are added, so that the crystals already formed grow by accretion of fresh material. After the crystallization is complete, the warm mixture of crystals and syrup is run into "centrifugals," to which a rapid motion of revolution is given, and the crystals so drained and dried.

There is no doubt that a large proportion of the sugar is lost in the ordinary process of manufacture. Melsens of Brussels, proposed a process, which consists in the use of calcium bisulphite. This salt is alleged to act as an antiseptic, preventing the operation of any ferment; as an absorber of oxygen, opposing the action of that gas on the juice; as a clarifier, rendering insoluble at 100° C. (212° F.) all coagulable matters; as a bleacher of pre-existing coloring matters, and a preventive of the formation of new ones; and, lastly, as a substance furnishing a base to neutralize hurtful acids, which unite with the lime, displacing the weaker sulphurous acid. This process is now largely used, and calcium bisulphite is used in British Guiana and other sugar-producing countries in immense quantities. Emil Pfeiffer proposed another refining process, which consists in the use of acid calcium phosphate, an agent previously recommended by Brande. Reynoso considered alumina the best defecating agent, having succeeded by means of it in throwing down almost all impurities most hurtful. He adds the acid aluminum phosphate to the cane juice, and decomposes this with lime, by which the calcium phosphate is produced and alumina separated, and all these, with some lime in excess, cause the elimination of coloring and nitrogenous matters, so that there remain in the liquid only some of the salts which normally accompany the sugar in the juice. (*J. P. C.*, 4e sér., ii. 232.)

The refining of brown sugar forms a distinct branch of business, and the methods pursued have undergone many improvements. The sugar was first "melted"—that is, dissolved in hot water—and then clarified by heating it with bullock's blood. The clarified syrup was then strained through cloth filters, whereby it was rendered limpid. The clear straw colored syrup from the bag filters was then run into the char filters,—that is, large filters filled with freshly ignited bone black. The syrup after filtration goes to the vacuum pans. This great step in advance was taken by Philip Taylor and Howard. The former introduced the improvement of heating the syrup with great rapidity by means of steam made to pass through a series of tubes traversing the boiler, and the latter devised the plan of causing the syrup to boil under a diminished pressure, created by a suction pump, set in motion by a steam engine, while it was heated by steam circulating round the boiler. In this way the syrup was made to boil at a lower temperature, and with a diminished contact of the air, and the loss of cane sugar by change into that which was uncrystallizable was in great measure avoided. Two, three, or even four vacuum pans may be coupled together, so as to economize fuel, and the vapors arising from one made to heat the next, in which a more perfect vacuum exists, allowing of evaporation at still lower temperatures. Such a combination is called a double, triple, or quadruple effect apparatus.

After the syrup is sufficiently concentrated by any one of these methods, it is transferred to coolers, where it is agitated to cause it to granulate. In this state it is poured into unglazed earthenware moulds of a conical shape, with a hole in the apex, which is stopped with a paper plug. The moulds are placed, with the apex downward, above stoneware pots, intended to receive the uncrystallizable syrup. When the mass has completely concreted, the moulds are unstopped, to allow the colored syrup to drain off. To separate the remains of this syrup, the operation called *claying* is performed. This consists in removing from the base of the loaf a layer of sugar about an inch thick, and replacing it with pure sugar in powder, which is covered with a mixture of pipe clay and water of about the consistence of cream. The water gradually leaves the clay, dissolves the pure sugar, and percolates the mass as a pure syrup, removing in its progress the colored syrup. Sometimes the purification is performed without the use of clay, by allowing a saturated solution of pure sugar to percolate the loaf. When all the colored syrup is removed, the loaf is taken out of the mould and placed in stoves to dry. It now constitutes *white* or *purified sugar*. The syrup which drains from the loaves contains a considerable quantity of cane sugar, and is used in subsequent operations. This process of forming *loaf sugar* by claying and displacing colored syrup by white syrup is now almost entirely replaced by the process already described under raw sugars of crystallizing in the vacuum pan and draining with a centrifugal. The syrups of lowest quality are employed in forming inferior white sugar, from which a syrup finally drains containing so

little cane sugar as not to repay the expense of extracting it. This constitutes *sugar-house molasses.* Good brown sugar, in the process of refining, yields about 70 per cent. of white sugar. The application of animal charcoal to the refining of sugar is now very extensive.

Commercial History.—*Cane sugar* was known to the ancients. It was originally obtained from India, where it was extracted from the sugar cane. About the period of the Crusades, the Venetians brought it to Europe; but at that time it was so scarce and costly as to be used exclusively as a medicine. Upon the discovery of the Cape of Good Hope and the maritime route to the East Indies, the commerce in sugar passed into the hands of the Portuguese. Subsequently the cultivation of the cane extended to Arabia, Egypt, Sicily, Spain, and the Canaries, and finally, upon the discovery of the New World, to America, where it was pursued with the greatest success, and continues to be so. In America it was produced most abundantly in the West Indies, which supplied also a part of the consumption of Europe. The Cuban production, which at one time amounted to over 750,000 tons, has lessened greatly in recent years because of the disturbed condition of the island. The production in Louisiana, once large, diminished under the competition of the foreign beet sugar production, but in recent years, under the stimulus of a bounty, it has increased, and now amounts to about 300,000 tons per year. However, the American production from the sugar beet has developed rapidly in the last decade, advancing from 10,000 tons in 1892 to 247,563 tons in 1903 and 170,135 tons in 1904. This production centres in California, Nebraska, Utah, and Michigan, but individual factories have been erected in New Mexico, Arizona, and as far east as New York State.

The following figures show the production of sugar throughout the world from the two main sources, the sugar cane and the sugar beet.

Beet sugar, 1903–4, 5,953,700 tons; 1904–5, 4,978,300 tons; 1905–6, 7,088,800 tons. Cane sugar, 1903–4, 4,244,200 tons; 1904–5, 4,627,800 tons; 1905–6, 4,947,500 tons. Total amount of sugars, 1903–4, 10,197,900 tons; 1904–5, 9,606,100 tons; 1905–6, 12,036,300 tons.

The importations of raw sugars into the United States for 1904 were 1,652,064 tons, valued at $71,915,750 almost entirely from the sugar cane.

Properties.—Sugar, in a pure state, is a solid of a peculiar grateful taste, permanent in the air, phosphorescent by friction, and of the sp. gr. 1.6. It forms "white, dry, hard, distinctly crystalline granules, odorless, and having a purely sweet taste. Permanent in the air. The aqueous solution, saturated at 25° C. (77° F.), has a specific gravity of about 1.340, is miscible with water in all proportions, should be colorless, and is dextrogyrate. Soluble in 0.46 part of water, and in 137.2 parts of alcohol at 25° C. (77° F.); in 0.2 part of boiling water, and in 28 parts of boiling alcohol; also soluble in 80 parts of boiling absolute alcohol, but insoluble in ether, chloroform, or carbon disulphide. The aqueous or alcoholic solution of Sugar is neutral to litmus paper." *U. S.* "Colorless and inodorous separate crystals. Readily and completely soluble in half its weight of *water,* forming a clear bright syrup. When the syrup is heated to about 180° F. (82.2° C.) with *solution of potassio-cupric tartrate* or with *solution of copper sulphate* and excess of *solution of potassium hydroxide,* there should not result more than a trace of a red or yellowish precipitate (absence of glucose). Refined sugar should yield no reaction with the tests for calcium, chlorides, and sulphates." *Br.* Its solution, when thick and strong, is called *syrup,* and when alcohol is mixed with it, the sugar is gradually deposited in crystals. An aqueous solution of sugar, kept in a warm place, has the property of corroding iron, partially immersed in it, just above the line where the surface of the liquid touches the metal, and the solution itself becomes impregnated with ferrous oxide, and of a deep red-brown color. A similar effect is produced on lead, but zinc and copper are but slightly acted on. (J. H. Gladstone, *Annals of Pharmacy,* iii. 208.) A solution of sugar possesses the property also of dissolving a large quantity of calcium hydroxide, forming a compound called *calcium saccharate.* When a concentrated syrup is gently heated, and spirit added to it, the liquid, on cooling, forms white semi-transparent crystals of hydrated sugar, having the shape of oblique four-sided prisms, and called *rock candy.* When heated to 185° C. (365° F.), it melts into a viscid, colorless liquid, which on being suddenly cooled forms a transparent mass, called *barley sugar.* At a higher temperature (between 204.4° and 215.5° C. (400° and 420° F.) it loses two molecules of water, and is converted into a black porous mass, having a high lustre, called *caramel.*[1] At a still higher temperature it yields combustible gases, carbon dioxide, empyreumatic oil, and acetic acid, and there remains one-fourth of its weight of charcoal, which burns without residue. Sugar renders the fixed and volatile oils to a certain extent miscible with water, and forms with them an imperfect combination; such mixtures are called *oleo-saccharures.* When in solution, it is not precipitated by lead subacetate, a negative property which distinguishes it from most other organic principles.

[1] A coloring substance called *caramel brown* or *sucré couleur* is now largely manufactured from sugar by decomposing it by means of heat carefully applied. It is in the form of a stiff paste, in which it is used for coloring leather, or of a syrup, for coloring liquids. Sucré couleur is now extensively manufactured abroad for coloring rum and spirituous liquors, beer, and wine. It is made exclusively from starch sugar, either by a simple process of heating, or by heating with addition of sodium carbonate or ammonium carbonate. (For details, see *Starch, Glucose, Starch Sugar, etc.,* by Wagner, translated by Frankel, H. C. Baird & Co., Phila.)

Tests.—"Both the aqueous and the alcoholic solution of Sugar should be clear and transparent. When kept in large, well-closed and completely filled bottles, the solutions should not deposit a sediment on prolonged standing (absence of *insoluble salts, ultramarine, Prussian blue,* etc.). If 1 Gm. of Sugar be dissolved in 10 Cc. of boiling water, the solution mixed with 4 or 5 drops of silver nitrate T.S., then about 2 Cc. of ammonia water added, and the liquid quickly brought to the boiling point, not more than a slight coloration, and no black precipitate, should appear in the liquid after standing at rest for five minutes (absence of *glucose,* and of more than a slight amount of *inverted sugar*)." *U. S.* Sugar is sometimes adulterated with crystallized glucose, and it is a common practice among many sugar refiners to "blue" sugar to conceal the yellowish tint due to insufficient refining; ultramarine was formerly largely used but on account of the syrups made from sugar "blued" by ultramarine developing a disagreeable odor, refiners now use Prussian blue and some of the methylene blue dyes. See the official test above. Cane sugar may be distinguished from grape sugar by Trommer's test, which consists in the use of copper sulphate and potassium hydroxide. If a solution of cane sugar be mixed with a solution of copper sulphate, and potassium hydroxide be added in excess, a deep blue liquid is obtained, which on being heated lets fall, after a time, a little red powder. A solution of grape sugar, similarly treated, yields, by heat, a copious greenish precipitate which rapidly changes to scarlet and eventually to dark red. Böttger finds that, when a liquid containing grape sugar is boiled with sodium carbonate and some basic bismuth nitrate, a gray coloration or blackening of reduced bismuth is produced. Cane sugar, similarly treated, has no effect on the test. Donaldson's test for sugar in the *animal fluids* is formed of 5 parts of sodium carbonate, 5 of potassium hydroxide, 6 of potassium bitartrate, 4 of copper sulphate, and 32 of distilled water. A few drops of this solution being added to an animal fluid, and the mixture heated over a spirit-lamp, a yellowish-green color is developed, if sugar be present. J. Horsley's test for sugar in diabetic urine is an alkaline solution of potassium chromate, a few drops of which, boiled with the urine, will make it assume a deep sap-green color. M. J. Nicklés recommends carbon tetrachloride as a test for distinguishing glucose from cane sugar. This liquid mixed with cane sugar in a glass tube, kept for some time near 100° C. (212° F.), causes a darkening of the sugar, gradually increasing until it becomes black. Glucose undergoes no such change. (*J. P. C.,* 4e sér., iii. 119.)

Action of Acids and Alkalies.—The mineral acids act differently on cane sugar according as they are concentrated or dilute. Strong nitric acid, with the assistance of heat, converts it into oxalic acid. (See *Oxalic Acid.*) The same acid, when weak, converts it into *saccharic acid,* confounded by Scheele with malic acid. Concentrated sulphuric acid chars it. Diluted hydrochloric acid, when boiled with cane sugar, converts it into a solid, brown, gelatinous mass. Weak sulphuric acid, by a prolonged action at a high temperature, converts cane sugar, first into uncrystallizable sugar, afterwards into grape sugar, and finally into *ulmin* and *ulmic acid.* Vegetable acids are supposed to act in a similar way. Maumené found that cane sugar undergoes the change into uncrystallizable sugar when kept for a long time in aqueous solution, as well as when heated with acids. When the boiling with acids is prolonged for several days in open vessels, oxygen is absorbed, and, besides ulmin and ulmic acid, formic acid is generated. Soubeiran admits the change of the uncrystallizable into grape sugar, but attributes it to a molecular transformation of the sugar, independently of the action of the acid, as, according to his observation, the conversion takes place only after rest. In confirmation of his views, this chemist states that he found the same changes to be produced by boiling sugar with water alone. Not only does cane sugar change into the uncrystallizable variety when boiled with water, but, as clearly shown by an experiment of E. M. Rault, in aqueous solution, under the influence of light, at ordinary temperatures, it slowly changes into glucose; this alteration does not take place in the dark. (*P. J.,* Jan. 1872, p. 643.)

Cane sugar unites with the alkalies and some of the alkaline earths, forming definite combinations which render the sugar less liable to change. It also unites with lead monoxide. Boiled for a long time with aqueous solutions of potassium hydroxide, the liquid becomes brown, formic acid is produced, and two new acids are generated,—one brown or black and insoluble in water, called *melassic acid,* the other colorless and very soluble, named *glucic acid.* Alkalies and the alkaline earths are said to lessen the rotatory power of sugar in relation to polarized light, but the sugar recovers its power when the alkali is saturated. (*J. P. C.,* 4e sér., iv. 314.) The action of acids and alkalies on cane sugar explains the way in which lime acts in the manufacture and refining of sugar. The acids naturally existing in the saccharine juice have the effect of converting the cane sugar into uncrystallizable sugar, by which a loss of the former is sustained. The lime, by neutralizing these acids, prevents that result. An excess of lime, however, must be carefully avoided, as it injures the product of cane sugar in both quantity and quality. The change in sugar which precedes fermentation, namely, the conversion of cane sugar into the uncrystallizable kind, points to the necessity of operating on the juice before that process sets in, and hence the advantage of grinding canes immediately after they are cut, and boiling the juice at once.

Molasses is of two kinds, the West India and sugar-house. *West India molasses* is a black thick liquid, of a peculiar odor and sweet empyreumatic taste. When mixed with water and with the skimmings of the vessels used in the manufacture of sugar, it forms a liquor which, when fermented and distilled, yields *rum*. *Sugar-house molasses, golden drips,* or *grocer's syrup* is thicker than the West India molasses, and has a different flavor; as found in commerce, it is largely adulterated with glucose. Its sp. gr. is about 1.4, and it contains about 75 per cent. of solid matter. Both kinds of molasses contain uncrystallizable sugar, more or less cane sugar which has escaped separation in the process of manufacture or refining, and gummy and coloring matter.

Diabetic Sugar.—The sugar found in urine is almost exclusively dextrose, $C_6H_{12}O_6$. It may be recognized by its reducing action upon Trommer's solution or by Fehling's test, by its producing a yellow or brown color in contact with alkalies, slowly in the cold, rapidly on heating, by its uniting with phenylhydrazine to form a crystalline glucosazone, by its power of fermenting with yeast, and by its dextro-rotatory character. The tests for sugar in urine should always be preceded by tests for albumin, which latter, if present, should be removed by coagulation and filtration. Traces of sugar are said to be found normally in urine, but this never amounts to more than .01 per cent., while from 3 to 5 per cent. of reducing sugar is often found in the urine of persons suffering from diabetes mellitus.

Uses.—As an aliment and condiment *cane* sugar is enormously used by all civilized and semi-civilized nations. As a carbohydrate it is nearly equivalent to starch in its nutritive value, by its digestion largely adding to the fatty tissues of the body; but, as it contains no nitrogen, it is incapable of sustaining life by itself. It seems to be worked up in the alimentary canal with much more difficulty than other hydrocarbons, and its excessive use is very apt to lead to acid dyspepsia. *Glucose,* or *grape* sugar, on account of its lack of sweetness, is not much used for sweetening, but it exceeds cane sugar in food value on account of its being more readily digested.

As a demulcent, cane sugar has been used to some extent in *catarrhal affections,* especially of the respiratory tract, and S. A. Cartwright of New Orleans (*B. M. S. J.,* vols. xlvii. and li.), affirms that the vapor of boiling cane juice is of very great value in the treatment of *bronchitis* and *consumption.* According to S. Meslach, glucose, when given in doses of from six to six and a half ounces per day in the form of the concentrated syrup, acts as a powerful diuretic, and is very useful in the treatment of *cardiac dropsy.* If the kidneys be healthy, the glucose is said not to appear in the urine. The celebrated grape cure of Europe is said to act by virtue of the glucose in the grape.

The discovery of Minkowski (*T. M.,* 1892), that in dogs, after extirpation of the pancreas, levulose, given in moderate quantities, is consumed in the system, has led to the use of it as a food substitute for true sugar in *diabetes* with some success. As much as two ounces of it a day are sometimes well borne, but levulose frequently appears in the urine when more than one ounce has been given daily and rarely should this amount be exceeded.[1] According to Lepine, levulosuria is likely to occur when there is hepatic disease. Levulose has no direct influence upon the disease but is simply a useful and harmless addition to the dietetics. Under the name of *diabetin* it has been largely advertised as a proprietary preparation. Levulose has been strongly recommended in *phthisis,* in the dose of 4 to 6 tablespoonfuls a day, also as a substitute for sugar of milk for infants when an aperient property is not desired.

Sugar is much used for the purposes of preserving organic substances. It is probable that it acts by producing rapid exosmose of the fluids of the fermentative organisms, its diluted solution being in fact prone itself to undergo fermentative change. All the different kinds of sugar susceptible of the alcoholic fermentation have this power. (Louis Mandl, *A. G. M.,* 5e sér., xvi. 49, Juillet, 1860.) In pharmacy, sugar is employed to render oils miscible with water, to cover the taste of medicines, to give them consistency, to preserve them from change, and to protect certain ferruginous preparations from oxidation. Accordingly, it enters into the composition of several mixtures, pills, and powders, of syrups and confections, and of all the troches. *Molasses* is used as an excipient for pills, and on account of its hygroscopic properties it prevents hardening.

Off. Prep.—Used in the preparation of official confections, pills, powders, masses, effervescent salts, mixtures, and many syrups.

SACCHARUM LACTIS. U. S., Br.

SUGAR OF MILK

(săc'ȼha-rŭm lăc'tĭs)

$C_{12}H_{22}O_{11}.H_2O = 357.48$

"A peculiar crystalline sugar obtained from the whey of cows' milk by evaporation, and purified by recrystallization." *U. S.* "A crystallized sugar, $C_{12}H_{22}O_{11},H_2O$, obtained from the whey of milk." *Br.*

Lactin, Milk Sugar; Lactose; Sucre de Lait, *Fr. Cod.;* Saccharum Lactis, *P. G.;* Milchzucker, *G.;* Lattosio, Zucchero di latte, *It.;* Lactosa, Azucar de leche, *Sp.*

[1] According to J. B. Haycraft, patients with chronic diabetes can destroy 50 Gm. of levulose per diem. In some acute cases a part of the levulose given is burnt up, a part is changed into dextrose, and a third part passes as such into the urine. Rabbits can convert levulose into glycogen, the glycogen so formed accumulating in the liver. (*Zeit. f. Physiol. Chem.,* 1894.)

Preparation.—Sugar of milk is found only in milk, of which it forms about 5 per cent. (Boussingault). It is manufactured largely in Switzerland and the Bavarian Alps, especially from the whey left over in cheese making. In preparing it, milk is first coagulated by the addition of a little diluted sulphuric acid, and the resulting *whey* boiled down to about one-fifteenth of its original bulk into a brown, viscid, sweetly saline mass, which is put into tubs, where, in from twenty-four to forty-eight hours, the sugar crystallizes in a bright yellow granular mass, constituting the so-called "sugar-sand," which is afterwards decolorized by animal charcoal and repeated crystallizations. (*Am. Drug.*, Sept. 1884.) Within recent years the numerous "creameries" in the United States have produced milk sugar in such large quantities as a by-product that its importation from Switzerland has almost ceased. The American method of manufacturing sugar of milk is radically different from that followed abroad, and it thus described by LaWall (*Alumni Report Philadelphia Coll. Pharmacy*, April, 1902): The whey left after the first curdling of the milk (by the separator system) is run into vats, and treated with about 1 per cent. of hydrochloric acid to remove remaining proteid matters, the liquid being heated to the boiling point, and exactly neutralized with calcium hydroxide. The whey is then generally filtered through a filter press and evaporated in vacuo to a thick syrup, run into pans, and allowed to stand for two days, when granular crusts form. These are then centrifuged and washed with cold water to remove calcium chloride and soluble impurities, and the washings are reserved for future operations. The crude milk sugar is of a very light yellow color, and has little taste or odor. It is redissolved in water and the solution filtered through bone black in percolators. The colorless syrupy percolate is concentrated in vacuo to a pasty mass, which is placed in a centrifuge and washed with cold water. The mass is then dried on strainers in a drying chamber at 60° C. (140° F.), powdered in a ball mill, and bolted.

The *casein* obtained by acidulation of the skim milk, and subsidence, is washed and heated with water containing a small amount of sulphuric acid, to remove impurities. The moist pulpy mass left after the removal of the water is then shredded by means of cutting knives run by a high-speed engine, the flakes being removed in wire gauze frames and rapidly dried with a current of air at 140° F. It is then powdered with high-speed disintegrators. See a paper on the American Milk Product Industry by J. W. England. (*Proc. A. Ph. A.*, 1902, 354.)

Properties.—In "white, hard, crystalline masses, or a white powder feeling gritty on the tongue, odorless, and having a faintly sweet taste. Permanent in the air. On incinerating a portion, the percentage of ash remaining should not exceed 0.25 percent. Soluble in 4.79 parts of water at 25° C. (77° F.), and in 1 part of boiling water; insoluble in absolute alcohol, ether, or chloroform. An aqueous solution of Sugar of Milk is neutral to litmus paper, and is dextrogyrate. On adding to 5 Cc. of a hot, saturated aqueous solution of Sugar of Milk an equal volume of sodium hydroxide T.S., and gently warming, the liquid will turn yellow and finally brownish-red. On the further addition of a few drops of cupric sulphate T.S., a brick-red precipitate will appear. If about 1 Gm. of powdered Sugar of Milk be sprinkled upon about 5 Cc. of cold sulphuric acid (sp. gr. 1.84) contained in a flat-bottomed dish, and covered with a watch-glass, the acid may acquire a greenish or reddish, but no brown or brownish-black color within half an hour (absence of *cane-sugar*). An aqueous solution of Sugar of Milk (1 in 10) mixed with a few drops of hydrochloric acid should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of powdered Sugar of Milk be boiled for five minutes with 50 Cc. of distilled water and the solution cooled, no blue coloration should be produced upon the addition of one drop of iodine T.S. (absence of *starch*)." *U. S.* "In crystals or in crystalline masses, grayish-white, hard, odorless, faintly sweet. Soluble in 7 parts of cold *water*, and in about 1 part of boiling *water*. It should not leave more than 0.25 per cent. of ash when incinerated with free access of air. 1 gramme dissolved in 10 cubic centimetres of *water* gives a red color with *solution of phenol-phthalein* after the addition of three drops of the *volumetric solution of sodium hydroxide* (limit of lactic acid)." *Br.*

In commerce sugar of milk frequently occurs in cylindrical masses, the axis of which is a wooden stick, around which the crystals have been deposited. Experiments have shown that much of the milk sugar of commerce contains micro-organisms which have resulted from the decomposition of animal constituents in milk, and the tests of the Pharmacopœias do not exclude such impurities. (*D. C.*, 1893, 250; *Bull. Pharm.*, 1893, v. 5; *P. J.*, 1894, 853.) Its sp. gr. is 1.54. It is not susceptible of the vinous fermentation by the direct influence of yeast; but after the action of dilute acids, which first convert it into a variety of glucose, it is capable of furnishing a spirituous liquor. It is well known that both mares' and cows' milk, after becoming sour, are capable of forming an intoxicating drink, by fermentation. By the action of nitric acid, sugar of milk is converted into mucic acid. When anhydrous it consists of $C_{12}H_{22}O_{11}$; when crystallized, of $C_{12}H_{22}O_{11} + H_2O$. (Staedeler and Krause.) These formulas make anhydrous sugar of milk isomeric with cane sugar. Sugar of milk, when treated with weak sulphuric acid, is inverted or changed into a mixture of *galactose* and *dextrose*, both of the formula $C_6H_{12}O_6$. The galactose crystallizes in fine needles, fusing at 163° C. (325.4° F.).

Sugar of milk is sometimes adulterated with cane sugar or glucose; Hynson and Dunning (*Proc. A. Ph. A.*, 1901, 207) give the following tests for cane sugar and glucose: The test solution is composed of resorcinol 3 parts, hydrochloric acid 1 part, alcohol 100 parts. Dissolve 0.1 Gm. of the suspected milk sugar in a few drops of water contained in a porcelain dish and add to this solution 5 or 6 drops of the test solution. Evaporate slowly over a spirit lamp and allow the outer edge of the solution to boil a little, then tip the dish to one side. On the surface left moist by the receding liquid continue the heat gently. If a trace of cane sugar be present there will appear flashes of vermilion color over the surface treated. If there be an appreciable amount (5 to 10 per cent.) of cane sugar present, a vermilion mirror will be formed which can be more clearly seen upon carefully evaporating the entire solution. The evaporation must take place slowly as the sugars will easily char if exposed to too much heat. A brownish red color quickly charring and not spreading must not be mistaken for cane sugar. This coloration is caused by the milk sugar but need not be confused with the vermilion coloration of cane sugar.

Uses.—Sugar of milk has been recommended as a non-nitrogenous, bland article of diet in *consumption* and other *wasting diseases*, especially when there is extreme irritability of the stomach. According to S. Meslach, Zavadsky, and Germain Sée, it is an active hydragogue diuretic, which may often be used with great advantage in the treatment of *cardiac dropsy*. If the kidneys be sound, the lactose is said not to appear in the urine. It has been given by the authorities quoted in doses varying from three-quarters of an ounce to six ounces a day, administered in concentrated syrup or in milk.

Off. Prep.—Used as a diluent in Extractum Nucis Vomicæ, *U. S.*, *Br.*; Extractum Opii, *U. S.*; Extractum Physostigmatis, *Br.*; Extractum Quassiæ, *U. S.*; Extractum Strophanthi, *Br.*; Pilulæ Podophylli, Belladonnæ et Capsici, *U. S.*; Pulvis Ipecacuanhæ et Opii, *U. S.*; Trituratio Elaterini, *U. S.* (*Br.*).

SAFROLUM. U. S.

SAFROL [Synthetic Oil of Sassafras]

(săf-rō'lŭm)

$C_{10}H_{10}O_2 = 160.86$

"The methylene ether of allyl pyrocatechol [$C_6H_3.C_3H_5.(OOCH_2)$ 1:3:4], found in oil of sassafras, camphor oil, and other volatile oils, purified, if necessary, by repeated chilling and crystallization." *U. S.*

Safrol, *Fr.*, *G.*

Preparation.—Safrol is found in oil of sassafras often in the proportion of 80 per cent., but commercially it is obtained from the red oil of camphor, by fractional distillation, the portion boiling at about 230° C. (446° F.) contains the safrol, this is cooled and the crystals separated. (See *Oleum Sassafras*, p. 875.)

Properties.—It is officially described as "a colorless or faintly yellow liquid with a sassafras-like odor. Specific gravity: 1.105 to 1.106 at 25° C. (77° F.). Boiling point: about 233° C. (451.4° F.). It is optically inactive. On cooling to —20° C. (—4° F.) or below, it solidifies to a mass of crystals, which do not melt below 11° C. (51.8° F.). Soluble in about an equal volume of strong alcohol, and in about 30 parts of 70 percent. alcohol. Miscible in all proportions with ether and chloroform." *U. S.* Physiologically and therapeutically, safrol is equivalent to oil of sassafras.

Dose, five to ten minims (0.3 to 0.6 Cc.).

SALICINUM. U. S., Br.

SALICIN

(săl-ĭ-sī'nŭm)

$C_{13}H_{18}O_7 = 283.99$

"A glucoside obtained from several species of *Salix* and *Populus* (Fam. *Salicaceæ*). Salicin should be kept in well-stoppered bottles." *U. S.* "A crystalline glucoside, $C_6H_{11}O_5.O.C_6H_4.CH_2OH$, obtainable from the bark of various species of Salix, and of Populus." *Br.*

Orthohydroxybenzylglucoside; Salicine, *Fr.*; Salicin, *G.*; Salicina, *It.*

The discovery of salicin is claimed by Buchner of Germany, and Fontana and Rigatelli of Italy; but Leroux of France, deserves the credit of having first accurately investigated its properties. The following is Merck's process for its extraction. A boiling concentrated decoction of the bark is treated with litharge until it becomes nearly colorless. Gum, tannin, and extractive matter, which would impede the crystallization of the salicin, are thus removed from the liquid, while a portion of the oxide is dissolved in combination probably with the salicin. To separate this portion of oxide, sulphuric acid is first added, and then barium sulphide, and the liquor is filtered and evaporated. Salicin is deposited, and may be purified by repeated solution and crystallization. Erdmann has given another process. Sixteen ounces of the bark are macerated for twenty-four hours in four quarts of water mixed with two ounces of lime, and the whole is then boiled for half an hour. The process is repeated with the residue. The decoctions having been mixed, and allowed to become clear by subsidence, the liquor is poured off, concentrated to a quart, then digested with eight ounces of ivory black, filtered, and evaporated to dryness. The extract is exhausted by spirit containing 28 per cent. of alcohol, and the tincture evaporated so that the salicin may crystallize. This is purified by again dissolving, treating with ivory black, and crystallizing.

Merck obtained 251 grains from 16 ounces of the bark and young twigs of *Salix Helix,* and Erdmann 300 grains from the same quantity of the bark of *Salix pentandra.* It may probably be obtained from any of the willow barks having a bitter taste. T. Fawssett states that the best material for preparing salicin is undoubtedly the willow peelings, obtained as refuse from a basket factory, and known in Belgium as "rood schors." David Brown states that the peelings are produced from *Salix fragilis,* while Crispo considers the source to be *Salix purpurea.* These peelings should be used soon after they are stripped from the twigs, and the method of preparing salicin may be conducted as follows: Macerate willow peelings in water for some hours at a temperature as much below the boiling-point as will exhaust them. Strain and remove all moisture from the marc by hydraulic pressure. Evaporate the fluidextract thus formed to a low bulk (*in vacuo*). Precipitate the tannin and extractive by treating the liquid successively with quick lime, lead acetate and lead subacetate, in the order named. Remove an excess of any of these precipitants with oxalic acid. Filter and evaporate the clear solution until crystals appear. This treatment generally sufficed to obtain a satisfactory product, but sometimes a final purification with animal charcoal was necessary. (*P. J.,* June 6, 1903, 784.) For a paper by Jowett on the percentage of salicin obtained from various kinds of willow bark see *Y. B. P.,* 1902, 483, and 1903, 474. Braconnot procured it from various species of Populus, particularly *P. tremula,* or European aspen.

Properties.—When pure, salicin is in white, shining, slender crystals, inodorous, but very bitter, with the peculiar flavor of the bark. It is soluble in cold water, much more so in boiling water, soluble in alcohol, and insoluble in ether and oil of turpentine. It neutralizes neither acids nor salifiable bases, and is not precipitated by any reagent. Concentrated sulphuric acid decomposes it, receiving from it an intense and permanent bright-red color, and producing a new compound called *rutulin.* It is officially described as in "colorless, silky, shining, crystalline needles, rhombic prisms, or a white crystalline powder; odorless, and having a very bitter taste. Soluble in 21 parts of water, and in 71 parts of alcohol at 25° C. (77° F.), in 3.3 parts of water at 80° C. (176° F.), and in 22 parts of alcohol at 60° C. (140° F.); insoluble in ether and chloroform. It melts at 201.4° C. (394.5° F.). Upon ignition, it is consumed, leaving no residue. Its aqueous solution is lævogyrate and neutral to litmus paper. On heating a small portion of Salicin in a test-tube until it turns brown, then adding a few Cc. of water, and afterwards a drop of ferric chloride T.S., a violet color will be produced. Sulphuric acid produces a red color, which disappears upon the addition of water. Upon gently heating 0.1 Gm. of Salicin with 0.2 Gm. of potassium dichromate and 2 Cc. of diluted sulphuric acid, the odor of salicylic aldehyde will be developed. Sulphuric acid containing a trace of molybdic acid produces with Salicin a violet color, changing to a deep brownish-red. Sulphuric acid containing a trace of potassium iodate produces a dark red color, changing to deep purple. Sulphuric acid containing about one-fifth of its volume of solution of formaldehyde produces a deep purplish-red color. If to a small quantity of Salicin a few drops of nitric acid be added, the liquid evaporated to dryness, and the resulting yellowish residue treated with ammonia water and heated upon a water-bath with a fragment of potassium cyanide, a blood-red color will be developed. The aqueous solution of Salicin is not precipitated by tannic or picric acid T.S., nor by mercuric potassium iodide T.S. (absence of, and difference from, *alkaloids*)." *U. S.* "Colorless shining trimetric tabular crystals, with a very bitter taste. Soluble in 28 parts of cold *water* or 60 parts of *alcohol* (90 per cent.); insoluble in *ether.* Colored red by *sulphuric acid.* A small quantity heated with a little *potassium bichromate,* a few drops of *sulphuric acid,* and some *water,* yields salicylic aldehyde, recognizable by its odor of meadow-sweet. The crystals melt when heated, and evolve salicylic aldehyde. On heating to redness in air they leave no residue (absence of mineral impurity)." *Br.* It belongs to the class of glucosides, being resolved by boiling with diluted hydrochloric and sulphuric acids into grape sugar and *saligenin,* according to the reaction:

$$C_{13}H_{18}O_7 + H_2O = C_6H_{12}O_6 + C_7H_8O_2$$

Saligenin, which is ortho-oxybenzyl alcohol, $C_6H_4(OH)CH_2OH$, is converted by further boiling with dilute acids into a resinous body, *saliretin,* $C_{14}H_{14}O_3$. Nitric acid produces with salicin at first two principles called respectively *helicin,* $C_{13}H_{16}O_7$, and *helicoidin,* $C_{28}H_{34}O_{14}$, and afterwards picric and oxalic acids. (*J. P. C.,* xxx. 43.) Distilled with potassium dichromate and sulphuric acid, salicin yields, among other products, a volatile oleaginous liquid, identical with one of the components of oil of spiræa, and recognized as *salicyl aldehyde,* $C_7H_6O_2$ (*salicylous acid*), while saligenin, $C_7H_8O_2$, is the alcohol, and salicylic acid, $C_7H_6O_3$, the acid corresponding. The synthesis of salicin has been effected by Michael (*A. J. P.,* 1879, 492), who obtained first helicin by the reaction of acetochlorhydrose and salicyl aldehyde, and, by the action of nascent hydrogen upon this, salicin.

Uses.—Salicin acts upon the stomach probably as a simple bitter, and after absorption as a feeble and uncertain form of salicylic acid, since it is rapidly, although not completely, decomposed in the system, the products of its change appearing in the urine fifteen to thirty minutes after the ingestion of a single dose. The elimination is partly as salicin, partly as salicylic acid, partly as a salicyluric acid, and

partly as saligenin. It has been highly recommended as a substitute for salicylic acid in *rheumatism* by Maclagan and others, but since it owes its activity to its conversion in the blood into salicylic acid and since this conversion is uncertain, salicin is greatly inferior to the salicylates, and is at present rarely employed. Salicin has been used as an antiperiodic. One or two drachms may be given in the intermission.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

SALVIA. U. S.

SALVIA [Sage]

(săl'vĭ-ą)

"The dried leaves of *Salvia officinalis* Linné (Fam. *Labiatæ*)." *U. S.*

Garden Sage, Meadow Sage, Save, Picked Sage; Sauge officinale, *Fr. Cod.;* Sauge, *Fr.;* Folia Salviæ, *P. G.;* Salbeiblätter, Salbei, *G.;* Salvia, *It., Sp.*

Salvia officinalis, L., *Sp. Pl.* (1753) 23; Willd., *Sp. Plant.* i. 129; *B. & T.* 206.—Common garden sage is a perennial plant, about two feet high, with a quadrangular, pubescent, branching, shrubby stem, furnished with opposite, petiolate, ovate-lanceolate, crenulate, wrinkled leaves, of a grayish-green color, sometimes tinged with red or purple. The flowers are blue, variegated with white and purple, and are disposed on long terminal spikes, in distant whorls, each composed of a few flowers, and provided with ovate, acute, deciduous bracts. The calyx is tubular and striated, with two lips, of which the upper has three acute teeth, the under two. The corolla is tubular, bilabiate, ringent, with the upper lip concave, and the lower divided into three rounded lobes, of which the middle is the largest. The filaments are supported upon short pedicels, to which they are affixed transversely at the middle.

Sage grows spontaneously in Southern Europe, and is cultivated abundantly in our gardens. There are several varieties, differing in the size and color of their flowers, but all possessing the same medicinal properties. The flowering period is in June, at which time the plant should be cut, and dried in a shady place. The leaves are officially described as "long and stoutly petiolate, the blade elliptical or ovate-oblong, 3 to 7 Cm. long, obtuse or subacute at the summit, rounded or subcordate at the base, finely crenulate, thick, grayish-green, very pubescent, especially on the under surface, conspicuously reticulate-veined; odor aromatic; taste aromatic, bitter, and somewhat astringent." *U. S.*

Both these and the flowering summits have a strong, fragrant odor, and a warm, bitterish, aromatic, somewhat astringent taste. They abound in a volatile oil, which may be obtained separate by distillation with water. Muir (*J. Chem. S.,* 37, p. 678) found it to contain a terpene boiling at 156° C. (312.8° F.), another boiling at 171° C. (339.8° F.), *thujone,* $C_{10}H_{16}O$, a liquid boiling at from 197° to 203° C., and ordinary camphor, $C_{10}H_{16}O$. In the fresh oil the first terpene predominates. On standing, the amount of *thujone* increases, and then the camphor. The oil from English leaves contains also a sesquiterpene, $C_{15}H_{24}$, of the boiling point 260° C. (500° F.). Wallach (*Ann. Ch. Ph.,* 1889) states that the first portions contain *pinene* and *cineol,* but the greater portion consists of *thujone,* $C_{10}H_{16}O$ (formerly called *salviol*). Ferrous sulphate strikes a black color with infusion of sage.

Uses.—Sage unites slightly tonic, astringent, and aromatic properties. By the ancients it was highly esteemed; it is at present little used, except as a condiment, but has been given in *dyspepsia,* also for *colliquative sweats.* The dose of the powdered leaves is from twenty to sixty grains (1.3 to 3.9 Gm.). Dose of the infusion (1 oz. in 1 pint of boiling water), two fluidounces (60 Cc.). According to Cadéac and Meunier (*Lyons Méd.,* May, 1891), the volatile oil of sage is a violent epileptiform convulsant, resembling in its action the oil of absinthe, but less powerful.

Dose, from twenty to sixty grains (1.3 to 3.9 Gm.).

SAMBUCI FLORES. Br.

ELDER FLOWERS

(săm-bū'cī flō'rēş)

"The flowers of Sambucus nigra, *Linn.,* separated from the stalks." *Br.*

Sambucus, Elder, U. S. 1890; Sweet Elder, Black Elderberry; Sureau, *Fr. Cod.;* Fleurs de Sureau, Hollunder, Fliederblumen, *G.;* Sambuco, *It.;* Sauco (Flor de), *Sp.*

Sambucus nigra, L., Willd., *Sp. Plant.* i. 1595; *B. & T.* 137.—The common elder of Europe differs from the American most obviously in its size, the former approaching in height that of a small tree. The stem is much branched towards the top, and has a rough whitish bark. The leaves are narrower. The flowers are small, whitish and in five-parted cymes. The ovary consists of but three carpels, there being five cells in *S. canadensis,* L. The berries are larger in the European elder, globular, and blackish purple when ripe.[1] G. De Sanctis (*Gazz. Chim. Ital.,* 1895, xxv. 1, vol. xlix.) obtained coniine from the leaves and stems of *Sambucus nigra.*

Sambucus canadensis, L., *Sp. Pl.* (1753) 269; Willd., *Sp. Plant.* i. 1494; *B. & T.* 138. The flowers of our indigenous *common elder* were dropped from the U. S. P. at the Eighth

[1] A fungus growing on this plant, called *fungus sambuci,* has been used as a local application in *conjunctivitis.* According to Steckel, it is capable of taking up from 9 to 12 times its weight of water. (*N. R. Pharm.,* xiii. 476, 1864.)

Revision. The plant is a shrub from six to ten feet high, with a branching stem, covered with a rough gray bark, and containing a large spongy pith. The small branches and leaf-stalks are very smooth. The leaves are opposite, pinnate, sometimes bipinnate, and composed usually of five to nine oblong-oval, acuminate, smooth, shining, deep-green leaflets; the veins of the under surface are somewhat pubescent. The flowers are small, white, and disposed in loose cymes; the cream-colored corolla is wheel-shaped, with five stamens on the tube. The berries are small, globular, and deep purple when ripe. The shrubs grow in low, moist grounds, along fences, and on the borders of small streams, throughout the United States, from Canada to the Carolinas, and westward as far as Arizona and Texas. It flowers from May to July, and ripens its fruit early in autumn. The flowers, which are official in the Br. Pharm., have an aromatic though rather heavy odor. The berries as well as other parts of the plant are employed, in domestic practice, for the same purposes as the corresponding parts of the European elder, to which this species bears a close affinity.

Properties.—The British Pharmacopœia thus describes elder flowers: "Elder Flowers are small; calyx superior, five-toothed; corolla flat, rotate, deeply five-lobed, creamy-white, with five stamens inserted within the tube; anthers yellow. They have a slightly bitter taste, and a sweet, faint, not altogether agreeable odor." *Br.* The flowers of *S. canadensis* were described in the U. S. Pharmacopœia 1890 as follows:

"The flowers are, when fresh, about 5 Mm. broad, and after drying shrivelled; calyx superior; minutely five-toothed; corolla originally cream-colored, after drying pale brownish-yellow, wheel-shaped and five-lobed, with five stamens on the short tube; odor peculiar; taste sweetish, somewhat aromatic and bitterish. The peduncles and pedicels of the inflorescence should be rejected." *U. S.* 1890. The flowers yield their active properties to water by infusion, and when distilled give over a small proportion of volatile oil, which on cooling assumes a butyraceous consistence and contains an appreciable portion of ammonia. The *berries* are nearly inodorous, but have a sweetish, acidulous taste, dependent on the presence of saccharine matter and malic acid. Their expressed juice is susceptible of fermentation, and forms a vinous liquor used in Northern Europe. It is colored violet by alkalies, and bright red by acids, and the coloring matter is precipitated blue by lead acetate. The *inner bark* is without odor. Its taste is at first sweetish, afterwards slightly bitter, acrid, and nauseous. Both water and alcohol extract its virtues, which are said to reside especially in the green layer between the liber and the epidermis. According to Simon, the active principle of the inner bark of the root is a soft resin, which may be obtained by exhausting the powdered bark with alcohol, filtering the tincture, evaporating to the consistence of syrup, then adding ether, which dissolves the active matter, and finally evaporating to the consistence of a thick extract. Of this, twenty grains produce brisk vomiting and purging. (*Ann. Ph. Ch.*, xxxi. 262.) The bark, analyzed by Kramer, yielded an acid called by him *viburnic acid* (which has proved to be identical with *valeric acid*), traces of volatile oil, albumen, resin, fat, wax, chlorophyll, tannic acid, grape sugar, gum, extractive, starch, pectin, and various alkaline and earthy salts. (*Chem. Gaz.*, May, 1846; from *A. Pharm.*) C. G. Traub found in the bark valeric acid, volatile oil, fat, resin, tannin, sugar, and coloring matter. (*A. J. P.*, 1881, p. 392.) J. B. Metzgar made a partial examination of the fruit and found sugar, gum, tannin, fat, and a resinous body. (*A. J. P.*, 1881, p. 553.) It was also examined by F. F. Lyons (*A. J. P.*, 1892, p. 1), who found 0.5 per cent. of a volatile oil, an amorphous yellow compound of a glucosidal character, and a tannin. The volatile oil of elder flowers was examined by W. J. Bush & Co. (*C. D.*, 1897, 53.) It has the sp. gr. 0.827, and is solid at ordinary temperatures like oil of rose. The liquid portion possesses the fragrance of fresh elder blossoms.

Uses.—The flowers are gently excitant and sudorific, but are seldom used. The berries are diaphoretic and aperient, and their inspissated juice has been used as an alterative in *rheumatism* and *syphilis* in doses of from one to two drachms (3.9 to 7.7 Gm.); also as a laxative in doses of half an ounce (15.5 Gm.) or more. The inner bark is a hydragogue cathartic, and in large doses emetic. It has been employed in *dropsy, epilepsy,* and as an alterative in various *chronic diseases.* An ounce may be boiled with two pints of water to a pint, and four fluidounces (118 Cc.) given for a dose. It is also used in vinous infusion. The leaves are not without activity, and the young leaf-buds are said to be a violent and even unsafe purgative. The juice of the root has been highly recommended in *dropsy* as a hydragogue cathartic, sometimes acting as an emetic, in the dose of a tablespoonful, repeated *pro re nata.* The fruits of the California species *S. glauca* and *S. racemosa* are said to be used as food by the Indians. According to Combemale, confirmed by Lemoine, the aqueous solution of the European elder, *S. nigra,* is a very active diuretic, also causing in the lower animals, when given in sufficient amount, a pronounced fall of temperature, pulse, and respiration. It was found very useful in *cardiac* and *renal dropsies.* The drug itself sometimes caused vomiting and purging, but this effect never followed the use of the decoction.

Dose, from one to two drachms (3.9 to 7.7 Gm.); as a laxative, half an ounce (15.5 Gm.) or more.

Off. Prep.—Aqua Sambuci, *Br.*

SANGUINARIA. U. S.

SANGUINARIA [Bloodroot]

(săn-guĭ-nā′rĭ-ą)

"The dried rhizome of *Sanguinaria canadensis* Linné (Fam. *Papaveraceæ*), collected after the death of the foliage." *U. S.*

Red Puccoon, Tetterwort, Red Indian Paint; Sanguinaire, *Fr.*; Blutwurzel, *G.*

Sanguinaria canadensis, L., *Sp. Pl.* (1753) 505; Willd., *Sp. Plant.* ii. 1140; Bigelow, *Am. Med. Bot.,* i. 75; Barton, *Med Bot.,* i. 31; *B. & T.* 20.—The *bloodroot,* or, as it is sometimes called, *puccoon,* is an herbaceous or perennial plant. The root (rhizome) is horizontal, abrupt, often contorted, about as thick as the finger, two or three inches long, fleshy, of a reddish-brown color on the outside, and brighter red within. It is furnished with numerous slender roots, and makes offsets from the sides, which succeed the old plant. From the end of the rhizome arise the scape and leaf-stalks, surrounded by the large sheaths of the bud. These spring up together, the folded leaf enveloping the flower-bud, and rolling back as the latter expands. The leaf, which stands upon a long channelled petiole, is reniform, somewhat heart-shaped, deeply lobed, smooth, yellowish green on the upper surface, paler or glaucous on the under, and strongly marked by orange-colored veins. The scape is erect, round, and smooth, rising from a few inches to a foot, and terminating in a single flower. The calyx is two-leaved and deciduous. The petals, varying from seven to fourteen, but usually about eight in number, are spreading, ovate, obtuse, concave, mostly white, but sometimes slightly tinged with rose or purple. The stamens are numerous, with yellow filaments shorter than the corolla, and orange oblong anthers. The ovary is oblong and compressed, with a sessile, persistent stigma. The capsule is oblong, acute at both ends, one-celled, two-valved, and contains numerous oval, reddish-brown seeds. The whole plant is pervaded by an orange-colored sap, which flows from every part when broken, but is of the deepest color in the rhizome. The bloodroot is one of the earliest and most beautiful spring flowers of the Northern United States, growing abundantly in loose, rich soils and shady situations. After the fall of the flower the leaves continue to grow, and by the middle of summer have become so large as to give the plant an entirely different aspect. Except the seeds, all parts of the plant are active.

The dried rhizome is in pieces from one to three inches long, from a quarter to half an inch or more in thickness, flattened, faintly annulated, much wrinkled and twisted, often furnished with abrupt offsets and many short fibres, of a reddish-brown color externally, with a spongy uneven fracture, the surface of which is at first bright orange, or whitish, with numerous small red resin-cells, but becomes of a dull brown by long exposure. It is officially described as "of horizontal growth, cylindrical, often somewhat branched, 2 to 7 Cm. long, 5 to 15 Mm. in diameter; externally reddish-brown, slightly annulate; fracture short and somewhat waxy, brownish-red, or yellowish-white with numerous reddish resin cells; odor slight, the powder sternutatory; taste persistently acrid and bitter." *U. S.* For an interesting microscopical description of the rhizome by E. S. Bastin, see *Pharm.,* 1885, p. 201. The color of the powder is a brownish orange-red. Sanguinaria has a faint narcotic odor, and a bitterish very acrid taste, the pungency of which remains long in the mouth and fauces. It yields its virtues to water and alcohol. Dana of New York, obtained from it an alkaloid, denominated by him *sanguinarine,* by infusing the finely powdered root in hot water or diluted hydrochloric or acetic acid, precipitating with ammonia water, collecting the precipitated matter, boiling it in water with pure animal charcoal, filtering off the water, treating the residue left upon the filter with alcohol, and finally evaporating the alcoholic solution. (*Ann. Lyc. of Nat. Hist. New York,* ii. 250.) It may also be conveniently procured by a process similar to that employed by Probst for obtaining chelerythrine from celandine. This consists in forming a strong ethereal tincture of the root, passing through this hydrochloric acid gas, drying the precipitated hydrochloride, which is insoluble in ether, dissolving it in hot water, filtering, precipitating by ammonia, drying the precipitate, dissolving it in ether, decolorizing by animal charcoal, precipitating by means of hydrochloric acid gas, and decomposing the hydrochloride as before. (*Chem. Gaz.,* i. 145.)

G. König (*A. J. P.,* 1891, p. 457) has reinvestigated the constituents of *S. canadensis* and gave us a clear understanding of them. He found *chelerythrine,* which is present in greatest quantity, *sanguinarine, β-* and *γ-homochelidonine,* and *protopine.* Chelerythrine crystallizes with a molecule of alcohol which is not separated at 150° C. Its formula is $C_{21}H_{17}NO_4$, and it is identical with the alkaloid extracted from *Chelidonium majus.* The salts are lemon-yellow. Sanguinarine has the formula $C_{20}H_{15}NO_4$ (Schmidt, $C_{19}H_{15}NO_4$), and is very similar to chelerythrine in its properties. It crystallizes with one-half molecule of H_2O, and melts at 211° C. Its salts are red. The base named γ-homochelidonine is probably identical with that separated by Selle from *Chelidonium majus,* and its formula is $C_{22}H_{21}NO_4$. The fourth alkaloid, protopine, has been prepared from *Chelidonium majus,* from *Sanguinaria canadensis,* and from opium, all three of the specimens being identical. Its formula is $C_{20}H_{17}NO_5$, and it melts at 204° C. The virtues of the root are said to be rapidly deteriorated by time. Thos. M. Newbold extracted from sanguinaria a non-volatile liquid acid (*sanguinarinic acid*) (*A. J. P.,* 1866, p. 496), which

L. C. Hopp has shown to be a solution of impure citric and malic acids. Schlotterbeck (*Ph. Rev.*, 1900, 358) examined sanguinarine nitrate of commerce and found it to consist mainly of chelerythrine, with some sanguinarine and traces of protopine and homochelidonine; he believes that chelerythrine should be called sanguinarine. For methods of assay of sanguinaria see *A. J. P.*, 1896, 305; *M. R.*, 1900, 451; *Proc. A. Ph. A.*, 1903, 284.

Uses.—Sanguinaria is an acrid emetic, with stimulant narcotic powers. In small doses it excites the stomach and accelerates the circulation; more largely given, it produces nausea and consequent depression of the pulse, and in the full dose it occasions active vomiting. It is also expectorant, and is said to be emmenagogue. The effects of an overdose are violent emesis, a burning sensation in the stomach, tormenting thirst, faintness, vertigo, dimness of vision, and alarming prostration. (For fatal cases, see *Am. J. M. S.*, N. S., ii. 506.) Snuffed up the nostrils, bloodroot excites much irritation, attended with sneezing. Upon fungous surfaces it acts as an escharotic. It has been used in various diseases, but is at present never employed, except as a stimulant expectorant in *chronic bronchitis* or in the advanced stages of the acute disorder. Twenty grains (1.3 Gm.) of it are said to usually act as a violent emetic.

Wm. Tully found the alkaloid *sanguinarine* (chelerythrine) to produce vertigo, dilatation of the pupil, a haggard expression of the face, nausea, coldness of the extremities, cold sweats, and diminished frequency with irregularity of the pulse. R. P. Thomas of Philadelphia, who experimented with it on himself and others, gave the following statement of its powers. In doses varying from one-twelfth to one-eighth of a grain (0.005 to 0.008 Gm.) it acted as an expectorant, without disturbing the stomach. One-sixth or one-fourth of a grain (0.01 to 0.016 Gm.), given every two or three hours, generally produced nausea, and sometimes vomiting. Half a grain (0.032 Gm.) in solution, given at intervals of ten minutes, almost invariably vomited after the second or third dose. Under the influence of one-eighth or one-sixth of a grain (0.008 or 0.01 Gm.), given every three hours, for two days or more, the pulse was generally reduced from five to fifteen beats in the minute. He found no alterative effect, and none of any kind directly upon the liver. (*Proc. Am. Med. Ass.*, 1863, p. 219.) Robert Meade Smith found that the alkaloid in large doses produced in mammals vomiting, purging, collapse, convulsions, and death from asphyxia, the convulsions being spinal, but associated with loss of reflex activity and depression of the spinal motor centres. The same authority states that moderate doses cause a rise of arterial pressure by stimulation of the vasomotor centre, while toxic doses depress the pressure, partly by a direct action upon the heart, partly by paralyzing the vasomotor centres. Hans Meyer (*A. E. P. P.*, xxix.) found in the frog that sanguinarine first stimulates and then paralyzes spinal-motor ganglia; on the blood pressure it acted much as described by Smith.[1] Sanguinaria is rarely given in substance.

Dose, U. S. P., two grains (0.13 Gm.).

Off. Prep.—Fluidextractum Sanguinariæ, *U. S.*; Tinctura Sanguinariæ, *U. S.*

SANTALUM RUBRUM. U. S. (Br.)

RED SAUNDERS

(săn'tą-lŭm rû'brŭm)

"The heart-wood of *Pterocarpus santalinus* Linné filius (Fam. *Leguminosæ*)." *U. S.* "The heart-wood of Pterocarpus santalinus, *Linn. f.*" *Br.*

Pterocarpi Lignum, *Br.*; Red Sanders Wood; Lignum Santalinum Rubrum, Rasura Santalum Ligni; Red Sandal Wood; Red Santal Wood; Ruby Wood; Santal rouge, *Fr. Cod.*; Santelholz, Rothes Santelholz, *G.*; Sandalo rajo (Leno de), *Sp.*

Pterocarpus santalinus, L., *Sp. Pl.* (1871) 318; Willd., *Sp. Plant.* iii. 906; Woodv., *Med. Bot.* 430, t. 156; *B. & T.* 82.—This is a large tree, with alternate branches, and petiolate ternate leaves, each leaflet being ovate, blunt, somewhat notched at the apex, entire, veined, smooth on the upper surface, and hoary beneath. The flowers are yellow in axillary spikes, and have a papilionaceous corolla, of which the vexillum is obcordate, erect, somewhat reflexed at the sides, toothed and waved, the alæ spreading with their edges apparently toothed, and the carina oblong, short, and somewhat inflated. The tree is a native of India, attaining the highest perfection in mountainous districts, and inhabiting especially the mountains of Coromandel and Ceylon. It is said that it is everywhere rare, and that plantations of it are being formed. Its wood is the official *red saunders*, though there is reason to believe that the products of other trees are also sold by the same name.

The wood comes in heavy, irregular, roundish or angular billets of various size and thickness,

[1] *Acetum Sanguinariæ*, U. S. 1880. *Vinegar of Sanguinaria.* (*Vinaigre de Sanguinaire*, Fr.; *Blutwurzel-Essig*, G.)—"Sanguinaria, in No. 30 powder, *ten parts* [or one and three-fourths ounces av.]; Diluted Acetic Acid, *a sufficient quantity*, to make *one hundred parts* [or one pint]. Moisten the powder with *five parts* [or one fluidounce] of Diluted Acetic Acid, pack it firmly in a conical glass percolator, and gradually pour Diluted Acetic Acid upon it until *one hundred parts* [or one pint] of filtered liquid are obtained." *U. S.* 1880. Vinegar of Sanguinaria may also be prepared by macerating the powder in one pint of Diluted Acetic Acid for seven days, expressing the liquid, and filtering through paper. It is efficient, and of a deep-red color. On standing, a deposit is always noticed upon the sides of the vessel containing it, and the color pales.

A syrup may be formed from this vinegar by the addition of sugar, as in the syrup of squill. The dose of the vinegar of bloodroot as an emetic is three or four fluidrachms (11.25 or 15 Cc.); as an alterative and expectorant, from fifteen to thirty minims (0.9 to 1.8 Cc.). It has been used as a local remedy in *ringworm* and other *cutaneous diseases*, and has been found by R. G. Jennings efficient as a gargle in the *sore throat of scarlet fever.*

externally brown from exposure, internally of a deep blood-red color, on transverse section variegated with zones of a lighter red. The structure is heavy, compact, and fibrous. In the pharmacies red saunders is usually kept in the shape of small chips, or raspings, or coarse powder, of a deep reddish-brown color, slightly astringent in taste, and when rubbed of a faint peculiar odor. It has little odor or taste. Red saunders is officially described as follows: "Usually in chips, or a coarse, brownish-red powder; in transverse section slightly radiate, with numerous concentric rings, the medullary rays being 1 cell in width; nearly inodorous and almost tasteless. Red Saunders imparts a red color to alcohol, but not to water." *U. S.* It imparts a red color to alcohol, ether, and alkaline solutions, but not to water, and a test is thus afforded by which it may be distinguished from some other coloring woods. The alcoholic tincture produces a deep violet precipitate with ferrous sulphate, a scarlet with mercuric chloride, and a violet with the soluble salts of lead. The coloring principle, which was separated by Pelletier and called by him *santalin,* is of a resinous character, scarcely soluble in cold water, more so in boiling water, very soluble in alcohol, ether, acetic acid, and alkaline solutions, but slightly in the fixed and volatile oils, with the exception of those of lavender and rosemary, which readily dissolve it. It is precipitated when acids are added to the infusion of the wood, prepared with an alkaline solution. Weyermann and Haeffely have found it to possess acid properties, and give it the formula $C_{15}H_{14}O_5$. (*Ann. Ch. Ph.,* 74, p. 226.) Weidel (*Wien. Akad. Ber.,* lx. p. 388), by extracting the red saunders with potassium hydroxide, precipitating with hydrochloric acid, and again extracting from the purified precipitate with ether, obtained a colorless crystalline principle, which he calls *santal,* $C_8H_8O_3 + \frac{1}{2}H_2O$.

Cazeneuve and Hugonneng (*C. R. A. S.,* 104, 1722, 1725) have described two crystalline principles which they have extracted from red saunders, *pterocarpin,* $C_{20}H_{16}O_6$, and *homopterocarpin,* $C_{24}H_{24}O_6$, of which the former fuses at 152° C. and the latter at from 82° to 86° C. The wood has no medicinal virtues, and is employed solely for the purpose of imparting color.

Off. Prep.—Tinctura Lavandulæ Composita, *U. S., Br.*

SANTONICA. U. S.

SANTONICA [Levant Wormseed]

(sạn-tŏn'ĭ-cạ)

"The dried unexpanded flower-heads of *Artemisia pauciflora* (Ledebour) Weber (Fam. *Compositæ*)." *U. S.*

Turkestan, Aleppo, Alexandria or European Wormseed; Santonici Semen, Semen Cinæ, Flores Artemisiæ; Semen Sanctum; Semen-contra, Semencine ou Barbotine, *Fr. Cod.;* Flores Cinæ, *P. G.;* Wurmsamen, Zitwersamen, *G.;* Santonico, *It., Sp.*

Artemisia maritima, L., *Sp. Pl.* (1753) 846,[1] is a small, semi-shrubby perennial, from whose oblique, knotted rootstalks arise numerous leafy shoots and flowering stems. The glabrous and woody stems bear on their many branches numerous small (one inch long) bi- to multi-pinnatifid leaves, while the leaves of the flowering stems are very minute, the upper ones simple. The flower heads are small, numerous, one-tenth of an inch long, with from twelve to eighteen involucral scales, and from three to five flowers. The plant varies very greatly, and several species have been made out of its varieties. The form whose floral buds are said to resemble most closely the commercial drug has been named *A. cina* by Berg and Schmidt (t. 29, c.), and *A. pauciflora* by Weber (*Stechm. de Artem.,* 1775, 26). Following Bentley and Trimen, 157, the revisers of the U. S. Pharm. 1890 recognized the specific distinctness of the variety *pauciflora* and adopted the name given by Weber; but the propriety of this seems doubtful, since the researches of the Russian botanists Besser and Ledebour indicate that the forms are not specifically distinct, but are merely varieties of one plant, which has an extremely wide distribution in the northern hemisphere; from the old marshes of the British Islands it has spread along the coasts of the Baltic and the Mediterranean and eastward over the saline soils in Hungary, through Southern Russia and Central Siberia, to Chinese Mongolia. Nor do Engler and Prantl recognize the species *A. pauciflora,* Weber. They consider with Willkomm that the origin of wormseed is *A. Cina,* Berg. (See also *P. J.,* 1872, 762.)

The British Pharmacopœia under the head of *Santoninum* refers the source to *A. maritima var. Stechmanniana,* Besser. In European commerce there are two kinds of wormseed, one called *Aleppo, Alexandria,* or *Levant wormseed,* the other *Barbary wormseed.* The *Barbary wormseed* is thought by some to be derived from *Artemisia judaica,* by others from *A. Sieberi*[2] of Besser (*A. glomerata* of Sieber), and from *A. ramosa,* C. Smith, all of which grow in Palestine and Arabia. It consists of broken peduncles, having the calyx sometimes attached to their extremity. The calyx is also sometimes separate, consisting of very small linear obtuse leaflets. The flowers are wanting, or are in the shape of minute globular buds. All these parts are covered with a whitish down, which serves to distinguish this variety from the wormseed of the Levant. It is, moreover, lighter and more colored than the latter. Its odor and taste are the same. The Levant wormseed is the santonica of the U. S. Pharmacopœia. It is

[1] Heckel and Schlagdenhauffen (*C. R. A. S.,* 804) find that *Artemisia gallica* contains santonin, essential oil, and probably an alkaloid.

[2] *A. Sieberi* is in all probability, however, but a variety of the very variable *A. herba-alba,* which is used by the Arabs under the name of "*chili*" as a vermifuge, and in which Battandier found two resins and a large quantity of essential oil, but no santonin.

officially described as "heads 2 to 4 Mm. long, oblong-ovoid, slightly flattened, obtuse, consisting of an involucre of about 12 to 18 closely imbricated, glandular scales with broad midribs, enclosing 4 to 5 rudimentary florets. Santonica has the appearance of a granular, yellowish-green or greenish-brown, somewhat glossy powder; odor strong, peculiar, somewhat camphoraceous; taste aromatic and bitter." *U. S.* Astolfi (*Ph. Ztg.*, 1893, 333) gives the following test for recognizing adulteration of santonica. 1 Gm. of the suspected drug is finely pulverized and then agitated with 10 Cc. of absolute alcohol; the whole is heated to boiling, filtered, a piece of potassium hydroxide is added to the filtrate, which is then heated. If the drug is pure, the liquid will acquire a pronounced red color; if falsified, the color will be yellow; and if no santonica be present, the liquid will be colored but faintly, if at all.[1]

Most of the wormseed of commerce comes from the steppes of the northern portion of Turkestan to the great Nizhni-Novgorod fair, whence it finds its way to Moscow and Western Europe. The export from this region is said to have reached 1600 tons annually, but has largely declined, because the conquest of Turkestan by Russia led to the erection in Orenburg and Tschimkent of factories for the manufacture of santonin, which is now sent from there into commerce. The yearly consumption of santonin throughout the world is estimated at about twenty-five tons, and of this at least twelve tons are produced in the factories just spoken of. The santonin in the plants is said to reach its maximum proportion in July and August, and to disappear immediately after the flowering.

Wormseed contains a volatile oil, but it owes its efficiency to *santonin.* (See *Santoninum.*) According to Merck, the mother liquors in the manufacture of santonin from the seeds of *Artemisia maritima* yield a crystalline principle, $C_{15}H_{18}O_4$, which has been named *artemisin.* It is freed from santonin by recrystallization from chloroform. It melts at 200° C., gradually turns yellow in the air, and is more readily soluble in water and in dilute alcohol than is santonin. It gives a fugitive carmine red color when heated with aqueous or alcoholic sodium hydroxide, and is apparently a *hydroxy-santonin.* (*P. J.*, 1896, 484.) *Dose,* of artemisin, 1-640th of a grain (0.0001 Gm.). The oil of santonica, according to Wallach (*Ann. Ch. Ph.*, 225, 314, and 227, 277), is mostly made up of *cineol,* $C_{10}H_{18}O$, which is isomeric with borneol, and seems to be identical with the cajuputol of cajuput oil, together with some *dipentene.* Wormseed is rarely used in this country in substance. It is stated that artemisin is a powerful stimulant to the mucous membrane and muscles of the alimentary canal and that its addition to the simple bitters greatly increases their activity.

Dose, of santonica, ten to thirty grains (0.65 to 2.0 Gm.).

SANTONINUM. U. S., Br.

SANTONIN

(săn-tŏ-nī'nŭm)

$C_{15}H_{18}O_3 = 244.29$

"The inner anhydride or lactone of santonic acid, obtained from Santonica. It should be kept in dark amber-colored vials and in a dark place." *U. S.* "A crystalline principle, $C_{15}H_{18}O_3$, prepared from santonica, the dried unexpanded flower-heads or capitula of Artemisia maritima, var. Stechmanniana, *Besser.*" *Br.*

Santonine, Anhydride Santonique, *Fr. Cod.;* Santoninum, *P. G.;* Santonin, *G.;* Santonina, *It., Sp.*

The present U. S. P. and the Br. Ph. 1898 very properly omit processes for the preparation of santonin. (See U. S. D., 17th ed., 1191.)

By the U. S. process of 1870, which was taken from Wittstein's *Pharmaceutical Chemistry,* the santonica is first exhausted by digestion with diluted alcohol, in connection with slaked lime,—the latter substance being employed to combine with the santonin and remove coloring matter which may subsequently embarrass the proceedings. The tincture thus obtained, having been reduced by the distillation of the alcohol to little more than an aqueous solution, is filtered and treated with acetic acid in slight excess, by which the santonin is separated from the lime which holds it in solution, and, being itself insoluble, is gradually deposited in a crystalline state. The remainder of the process is intended simply to obtain the crystals free from coloring matter, and otherwise pure.

The British (1885) process, which is that of Mialhe somewhat modified (*P. J.*, 1864, 635), spares the expenditure of alcohol in the exhaustion of the santonica, by boiling it originally with water in connection with lime, and differs also from the preceding in precipitating the santonin by hydrochloric instead of acetic acid. The purification is effected in the same manner, except that solution of ammonia is employed in the washing, probably to remove the last trace of acid. Wormseed of Aleppo yields from 1.2 to 1.4 per cent. of santonin. (*J. P. C.*, Mars, 1864, p. 241.) It has been

[1] For a method of valuing santonica, by Dragendorff, see *Proc. A. Ph. A.*, xxvi. 229.

Ehling's Process for valuing Santonica.—Five parts of santonica and one part of milk of lime were boiled for two hours in a considerable quantity of dilute alcohol and the liquid poured off after cooling; this treatment was repeated at least twice more, and the alcohol was then distilled off from the united extracts. The residual liquid was then saturated in the cold with carbonic acid, filtered off from the precipitate after standing some hours, and the filtrate evaporated to dryness. The residue was triturated with animal charcoal and alcohol of specific gravity 0.935, and the paste rinsed into a retort, where it was digested with a measured quantity of alcohol. After boiling, the contents of the retort were thrown on a filter, washed with hot alcohol, and the alcohol driven off from the filtrate, from which, after some hours, crystals of santonin separated. (*P. J.*, 1886, p. 449.)

intimated to us that the large manufacturers of santonin, abroad, first distil off from the santonica its volatile oil, which has some commercial value in Europe, and that the process for preparing santonin is probably facilitated thereby, the affinity of the oil for the santonin making the latter more difficult of purification.

Santonin has been lowered in price since the erection of a factory in Tschimkent, Turkestan, where the Levant wormseed can be furnished cheaply; the process used there is to treat the wormseed with milk of lime; the calcium santonate formed is next treated with sodium hydroxide and carbon dioxide; the sodium santonate is then decomposed by sulphuric acid. The acid liquid, on refrigeration, lets fall the santonin in crystals.

Properties.—Santonin is in "colorless, shining, flattened rhombic prisms; odorless, and nearly tasteless when first put into the mouth, but afterwards developing a bitter taste; permanent in the air, but turning yellow on exposure to light. It sublimes without decomposition, and is soluble in alkalies and in most volatile and fatty oils. Santonin which has become yellow may be converted into white crystals by recrystallization from alcohol. Soluble in 5300 parts of water, 34 parts of alcohol, 78 parts of ether, and in 2.5 parts of chloroform at 25° C. (77° F.); soluble in 800 parts of water at 80° C. (176° F.), and in 5 parts of alcohol at 60° C. (140° F.). It melts at 170.3° C. (338.5° F.). When ignited, it is consumed, leaving no residue. Its solutions are lævogyrate and neutral to litmus paper. If 0.5 Gm. of Santonin be heated with 5 Cc. of alcoholic potassium hydroxide T.S., a red color will be developed. Upon shaking 0.01 Gm. of Santonin with a cold mixture of 1 Cc. each of sulphuric acid and water, heating to 100° C. (212° F.), and adding a minute trace of very dilute solution of ferric chloride, a violet color will result. Sulphuric acid added to Santonin should not produce more than a faintly yellow color (absence of *sugar* and *other readily carbonizable organic impurities*). If 2 Gm. of Santonin be boiled with 80 Cc. of water and 5 Cc. of diluted sulphuric acid, and the liquid, after frequent shaking, be allowed to become cold and then filtered, mercuric potassium iodide T.S., or iodine T.S., should produce no cloudiness in 10 Cc. of the filtrate, mixed with 10 Cc. of distilled water, even after standing for three hours (absence of *alkaloids*)." *U. S.* "Colorless flat rhombic prisms, feebly bitter, fusible and volatile when gently heated. Scarcely soluble in cold and sparingly in boiling *water;* soluble in 4 parts of *chloroform*, in 40 parts of cold and in 3 parts of boiling *alcohol* (90 per cent.). Sunlight renders it yellow. Added to warm *alcoholic solution of potassium hydroxide*, it yields a violet-red color. It is not dissolved by diluted mineral acids. Heated to redness, with free access of air, it burns without leaving any residue (absence of mineral impurity)." *Br.* For a test for santonin, see *Ph. Era*, 1898, 210. The air has no effect upon it, but it becomes yellow on exposure to sunlight. According to Sestini, the santonin is changed, through the influence of light, into formic acid, and an uncrystallizable substance, much more soluble in alcohol and ether than santonin itself, which he calls *photosantonic acid*, $C_{15}H_{22}O_5$, and a red resinous substance. If the santonin be in alcoholic solution, after several months of exposure to sunlight it is changed into the ethyl ether of photosantonic acid. In its relations to polarized light it is very strongly lævogyrate, and retains this property with acids, though losing it entirely when combined with salifiable bases. (Buignet, *J. P. C.*, Janv. 1862, p. 26.)

When warmed with alkalies, santonin is changed into monobasic *santoninic acid*, $C_{15}H_{20}O_4$, while concentrated baryta water changes it on prolonged boiling into the isomeric *santonic acid*. Schmidt (*J. P. C.*, 4e sér., iii. 394) disproved the previously accepted statement that santonin was a glucoside; but Hesse (*Ber. d. Chem. Ges.*, vi. 1280) found santonin to be the anhydride of *santoninic acid*, and prepared this acid by adding an excess of diluted hydrochloric acid to an aqueous solution of the sodium salt, and adding ether, from which the acid may be recovered by evaporation. When santonic acid is heated to 120° C. (248° F.), it is resolved into santonin and water. It has a strongly acid reaction, and decomposes sodium and calcium carbonate.[1] For a history with

[1] *Sodium santoninate* (*Sodii Santoninas*) was official in the *Pharmacopœia Germanica* of 1872, and was recognized in the U. S. P. 1880. It may be prepared by adding santonin to a hot solution of sodium hydroxide as long as it is dissolved; if the liquid is allowed to evaporate slowly, the crystals of sodium santoninate are obtained. It was officially described as in "colorless, transparent, tabular, rhombic crystals, slowly colored yellow by exposure to light, slightly efflorescent in dry air, odorless, having a mildly saline and somewhat bitter taste, and a slightly alkaline reaction. Soluble in 3 parts of water, and in 12 parts of alcohol at 15° C. (59° F.), in 0.5 part of boiling water, and in 3.4 parts of boiling alcohol. When heated to 100° C. (212° F.), until it ceases to lose weight, the salt loses 18 per cent. of its weight (water of crystallization). At a higher heat it chars and finally leaves an alkaline residue, which imparts an intense yellow color to a non-luminous flame. The aqueous solution, on the addition of hydrochloric acid, deposits a crystalline precipitate which is soluble in chloroform, and which yields, with alcoholic solution of potassa, a scarlet-red liquid gradually becoming colorless. A five-per-cent. aqueous solution of the salt should not be precipitated nor be rendered turbid by sodium carbonate test-solution (absence of *alkaline earths*), nor by picric or tannic acids (absence of *alkaloids*)." *U. S.* 1880. This salt was very properly dropped at the U. S. P. 1890 revision, because it is more easily absorbed than santonin in crystals, and therefore much more dangerous to the patient and much less destructive to *intestinal worms*. It must be remembered that serious poisoning from santonin has frequently occurred, notwithstanding its difficulty of absorption.

Santonin and Sodium Albuminate.—Pavesi prepares this as follows: 1 part of santonin, 4 parts of sodium bicarbonate, and 2 parts of dried soluble albumin are warmed with a sufficient quantity of water at 60° to 70° F. until all are dissolved, and then evaporated to dryness at a very gentle heat. The santonin and sodium albuminate forms brilliant white scales, soluble in water. The mineral acids precipitate santonin and albumin, with disengagement of carbon dioxide. The reasons for which Pavesi gives the preference to this combina-

a review of the chemical constituents and decomposition products of santonin see *Y. B. P.*, 1901, 487. Santonin is now considered to be the inner anhydride or lactone of santonic acid.

Cannizzaro and Carnelutti (*Ber. d. Chem. Ges.*, xvi. 2685) have shown that santonic acid breaks up on high heating into *propionic acid*, $C_3H_6O_2$, and *dihydrodimethylnaphthol*, $C_{10}H_7(CH_3)_2.OH$, and distilled over zinc dust it gives a mixture of dimethylnaphthol, $C_{10}H_5(CH_3)_2.OH$, dimethylnaphthalene, $C_{10}H_6(CH_3)_2$, and propylene.[2] *Santonone*, $(C_{15}H_{17}O_2)_2$, a decomposition product of santonin, is made by gradually adding zinc dust to a hot solution of santonin in acetic acid, preferably in the presence of a little platinum tetrachloride. It forms silky white needles, is very soluble in benzene, less so in hot alcohol, ether, or diluted acetic acid, and insoluble in water.

Uses.—Santonin has been used by oculists as a stimulant to the optic nerve in tobacco amaurosis and other forms of *amaurosis;* it is strongly commended in *amenorrhœa* by Bergy, but is chiefly used as a vermicide against the *lumbricoid worm*. In overdose it produces a poisoning whose symptoms are giddiness, mental apathy or stupor, great paleness and coldness of the surface, vomiting, profuse sweating, trembling, mydriasis, and finally loss of consciousness, with convulsions, often violent and accompanied by opisthotonos and emprosthotonos and failure of respiration. Xanthopsia is an early and characteristic symptom. All objects appear discolored, generally yellow, but frequently green, and sometimes blue. At the same time the urine is tinged of a yellow or a green color, and so rapidly does the santonin pass, that the change of color in the urine has been observed at the end of 16 minutes.[1] (*J. P. C.*, Août, 1863, p. 161.) These effects were formerly thought to be due to the staining of the aqueous humor but are more probably to be attributed to a direct action on the retina. In regard to the minimum fatal dose, two grains are said to have killed a feeble child five years old, and one six or seven years old is said to have suffered death from six grains after development of hæmaturia (*B. G. T.*, lxxiv. 362); four grains produced very serious symptoms in a child four years old. (*P. J.*, ix. 696.) The xanthopsia and discolored urine make the diagnosis of santonin poisoning easy. According to Crouzel the addition of alkalies to the urine will demonstrate the presence of santonin, before the coloration is pronounced, by the development of a characteristic carmine-red tint.

The santoninates are inferior to santonin, being more soluble, and for the same reason the principle is preferable in its natural crystalline form to the powder. Santonin is best administered in the form of lozenges made with sugar and tragacanth (for formula, see *A. J. P.*, vi. 124), which, if the unbroken crystals are used, can be rendered very pleasant to the taste, so that children will eat them as candy. The dose of santonin for a child two years old is from one-fourth to one-half grain (0.016 to 0.032 Gm.).

Dose, two to four grains (0.13 to 0.26 Gm.).

Off. Prep.—Trochisci Santonini, *U. S.* (*Br.*).

SAPO. U. S. (Br.)

SOAP [White Castile Soap]

(sā′pō)

"Soap prepared from sodium hydroxide and olive oil." *U. S.* "Soap made with sodium hydroxide and olive oil; containing about 30 per cent. of water." *Br.*

Sapo Durus, *Br.;* Hard Soap, Castile Soap; **Savon** medicinal, *Fr. Cod.;* Savon amygdalin, Savon blanc, Savon d'Espagne. *Fr.;* Sapo medicatus, *P. G.;* Medizinische Seife, Oel-Sodaseife, Seife, Spanische Seife, *G.;* Sapone medicinale, S. amigdalino, Sapone duro, *It.;* Jabon de aceite de olivas, Jabon, *Sp.*

Soaps embrace all those compounds which result from the reaction of salifiable bases with fats and oils. Fats and oils, as has been explained under the titles *Adeps* and *Olea*, consist generally of three glyceryl esters, two solid, differing in fusibility, called *stearin* and *palmitin*, and one liquid, called *olein*. Stearin is found most abundantly in fats which are firm and solid, as suet and tallow, and palmitin and olein in the oils. When the fats and oils undergo *saponification* by reaction with a salifiable

tion over the use of santonin alone are the following. The after-effects of santonin, among others, that of yellowness of vision, are entirely obviated; the preparation is not decomposed in the stomach, because the sodium bicarbonate in the combination retains the santonin in solution, the coagulation of the albumin is prevented, gently purgative sodium salts are introduced into the body, and finally, by the disengagement of a small quantity of carbon dioxide, an active digestion is produced. It is not at all probable that these assertions are correct, but more extended research is justifiable.

[2] The physiological and medicinal properties of various derivatives of santonin have been studied by F. Coppola and by Cannizzaro. Of the more important of these derivatives, *photosantonic acid* and *photosantonin* are said to be narcotics; while *isophotosantonin* and *isophotosantonic acid* are not hypnotics, but convulsants. It is asserted that *santoninoxime* is fully as efficacious as santonin as a germicide, but is much less poisonous to the higher animals than santonin, being absorbed and eliminated very slowly as santonin. It is insoluble in water, easily soluble in oils and fats, but not in organic acids, and is not acted upon by the gastric juice. P. Gucci prepares santoninoxime as follows. Boil a mixture of five parts of santonin, four parts of hydroxylamine hydrochloride, fifty parts of alcohol, and three to four parts of calcium carbonate for six to seven hours on a water-bath, and add an excess of boiling water to the clear solution. The yield is 80 per cent. of the santonin employed. It crystallizes from alcohol in white, lustrous needles which melt at 216° to 219° C., and dissolves readily in alcohol and ether, but very sparingly in boiling water. In hot solutions of alkaline hydroxides and carbonates it dissolves, being precipitated unchanged on the addition of an acid. On being warmed with very dilute hydrochloric acid, the santonin is quantitatively reproduced. It is lævo-rotatory. It can be borne in two or three times larger doses than santonin. (*Gazz. Chim. Ital.*, xix. 367 to 382.)

[1] According to Walter G. Smith, the yellow color imparted to urine by santonin is distinguished from that produced by other substances by becoming purplish red on the addition of ammonia or other alkali. (*P. J.*, Dec. 1870, p. 528.) For researches upon the character of the urinary coloring matter, consult the same paper.

base, these three esters are decomposed into fatty acids peculiar to each, discovered by Chevreul, and called stearic, palmitic, and oleic acids, which unite with the base to form the soap, and into a sweet basic principle called glycerin (glycerol), which is set free. Hence it follows that stearin is a stearate of glyceryl, C_3H_5, the radical of the triatomic alcohol glycerol, $C_3H_5(OH)_3$, palmitin a palmitate, and olein an oleate, and that the fats and oils are mixtures of these three fatty salts. Hence, also, it is obvious that soaps are mixed stearates, palmitates, and oleates of certain bases.

Stearic acid, $C_{18}H_{36}O_2$, is a firm white solid, like wax, fusible at 69.2° C. (157° F.), greasy to the touch, pulverizable, soluble in alcohol, very soluble in ether, but insoluble in water. In the impure state it is used as a substitute for wax in making wax candles. *Palmitic acid,* $C_{16}H_{32}O_2$, forms a white scaly mass, and melts at 62° C. (143.6° F.). *Oleic acid,* $C_{18}H_{34}O_2$, is an oily liquid, insoluble in water, soluble in alcohol and ether, lighter than water, crystallizable in needles, a little below 0° C. (32° F.), and having a slight odor and a pungent taste. (See *Acidum Oleicum.*) *Glycerin* is described under a separate head. (See *Glycerinum.*)

Soaps are divided into the soluble and the insoluble. The soluble soaps are combinations of the fatty acids with sodium, potassium or ammonium hydroxides; the insoluble consist of the same acids united with earths and metallic oxides. It is the soluble soaps only that are detergent, and to which the name *soap* is usually applied. Several of the insoluble soaps are employed in pharmacy, as, for example, the lead monoxide soap, or lead plaster, and the lime soap, or lime liniment. (See *Emplastrum Plumbi* and *Linimentum Calcis.*) The two official soaps are of the soluble kind. One is a soda soap, made with olive oil (Castile soap), the other a potassium soap (soft soap). (See *Sapo Mollis.*) The soap of ammonia is noticed elsewhere. (See *Linimentum Ammoniæ.*)

The consistence of the fixed alkaline soaps depends partly on the nature of the oil or fat, and partly on the alkali present. Soaps are harder the more stearate and palmitate they contain, and softer when the oleate predominates, and, as respects the alkali present, they are harder when formed with sodium hydroxide, and softer when containing potassium hydroxide. Hence it is that of pure soaps, considered as salts, sodium stearate is the hardest and least soluble, and potassium oleate the softest and most soluble.

Preparation.—The following is an outline of the process for making soap. The oil or fat is boiled with a solution of caustic alkali, beginning with a weak solution, and as saponification proceeds using a stronger lye until the whole forms a thick mass, which can be drawn out into long clear threads. After the soap is completely formed, the next step is to separate it from the excess of alkali, the glycerin, and the redundant water. This is effected by adding common salt, or a very strong alkaline lye, in either of which the soap is insoluble. The same end may be attained by boiling down the solution until the excess of the alkali forms a strong alkaline solution, which acts the same part in separating the soap as the addition of a similar solution. As soon as the soap is completely separated, it rises to the surface, and, when it has ceased to froth in boiling, it is ladled out into wooden frames to congeal, after which it is cut into bars by means of a wire. The soap, as first separated, is called *grain soap.* It may be purified by dissolving it in an alkaline lye and separating it by common salt. During this process the impurities subside, and the soap combines with more water, and hence it becomes weaker, although purer and whiter. If the grain soap be not purified, it will form *marbled soap,*—the colored streaks arising principally from an insoluble soap of oxidized iron. Sometimes the marbled appearance is produced by adding to the soap, as soon as it is completely separated, a fresh portion of lye, and immediately afterwards a solution of ferrous sulphate. The greenish-black ferrous hydroxide is precipitated, and gives rise to dark-colored streaks, which, by exposure to the air, become red in consequence of the conversion of the black hydroxide into the ferric hydroxide.

When commercial toilet soap is required, the *grained* soap, or, as it is sometimes called, *boiled* soap, is often remelted, perfumed, and worked over by the process of *milling, plotting,* and *moulding,* whereby the soap is brought into the desired shape for popular use. The *cold process* is also used, and is preferred by many because of its simplicity and economy. The following (from Sadtler's *Industrial Organic Chemistry,* 1906, 64) gives the outlines of the process. The so-called "cold process" requires the use of exact weights of well-refined fats and of caustic soda of a given specific gravity (from 32° to 36° B.), the quantities being such that only just enough soda is present to completely saponify the fat. The materials are allowed to stand together for a short time and then thoroughly mixed in a copper provided with steam agitating paddles, and kept at a temperature of not over 120° F. The reaction proceeds rapidly, and after some fifteen minutes the materials have so far united that they will not separate on standing, although the complete saponification of the charge may require days. They are then run out into the cooling frames. It is obvious that soaps made in this way retain all the glycerin originally combined with the fatty acids disseminated through the particles of soap, and belong to the class of "filled" or "padded" soaps. When cocoanut oil alone is used, the temperature of working in this cold process need not be higher than 75° F. in summer and 90° F. in winter; if one-half tallow, from 104°

to 108° F., and if two-thirds tallow, from 113° to 120° F. is necessary. A well-refined tallow can be saponified in this way, too, and rosin may be added.[1]

The official *soap* (*Sapo*, U. S.; *Sapo Durus*, Br.) is an olive oil soda soap, made on the same general plan as that just explained.

Common soap is also a soda soap; but instead of olive oil it contains solid animal fats. This soap corresponds with the white soap of northern European countries and of the United States, and is formed usually from barilla and tallow. In Scotland it is manufactured from kelp and tallow. It was introduced into the U. S. Pharmacopœia of 1860 as the only proper soap for making opodeldoc; but, as this preparation was discarded, this variety of soap was dismissed along with it.

Besides the official soaps of the U. S. and Br. Pharmacopœias, there are many other varieties, more or less used for medicinal or economical purposes. The official soap of the French Codex (1837), called *amygdaline soap* (*almond oil soap*), is formed of sodium hydroxide and almond oil, and is directed to be kept for two months exposed to the air before being used. *Starkey's soap*, also official in the Codex, is prepared by uniting, by trituration, equal parts of potassium carbonate, oil of turpentine, and Venice turpentine. *Beef's marrow soap* is a fine animal oil soap, also included in the French standard of pharmacy. *Windsor soap* is a scented soda soap, made of one part of olive oil and nine parts of tallow. *Eau de luce* (*aqua luciæ*) is a kind of liquid soap, formed by mixing a tincture of oil of amber and balsam of Gilead with ammonia water. *Transparent soap* is prepared by saponifying kidney fat with soda free from foreign salts, drying the resulting soap, dissolving it in alcohol, filtering and evaporating the solution, and running it into moulds when sufficiently concentrated. The soap is yellow or yellowish brown, and preserves its transparency after desiccation. Harding (*Proc. Minn. Pharm. Assoc.*, 1896, 116) states that sugar is used in soap to give it transparency and sodium carbonate to give firmness. The German transparent soap always contains a large quantity of cocoanut-oil soap. *Palm soap* is prepared from sodium hydroxide and palm oil, to which tallow is added to increase its

[1] The following very practical process is by W. J. Menzies (*C. D.*, Aug. 1880):

On the Manufacture of Soap in small Quantities without Boiling.—Take exactly 10 lbs. of double-refined 98 per cent. powdered sodium hydroxide (Greenbank), put it in any can or jar with 45 lbs. (4½ gallons) of water, stir it once or twice, when it will dissolve immediately and become quite hot; let it stand until the lye thus made is cold. Weigh out, and place in any convenient vessel for mixing, exactly 75 lbs. of clean grease, tallow, or oil (*not* mineral oil). If grease or tallow be used, melt it slowly over the fire until it is liquid and *just warm*,—say temperature not over 37.7° C. (100° F.). If oil is used, no heating is required. Pour the lye slowly into the melted grease or oil in a small stream continuously, at the same time stirring with a flat wooden stirrer about three inches broad; continue gently stirring until the lye and grease are thoroughly combined and in appearance like honey. Do not stir too long, or the mixture will separate itself again. The time required varies somewhat with the weather and the kind of tallow, grease, or oil used; from 15 to 20 minutes will be enough. When the mixing is completed, pour off the liquid soap into any old square box for a mould sufficiently large to hold it, previously dampening the sides with water so as to prevent the soap sticking. Wrap up the box well with old blankets, or, better still, put it in a warm place until the next day, when the box will contain a block of 130 lbs. of soap, which can afterwards be cut up with a wire. Remember the chief points in the above directions, which must be exactly followed. The lye must be allowed to *cool*. If melted tallow or grease be used, it must not be more than *warm*. The *exact* weights of double-refined 98 per cent. powdered sodium hydroxide and tallow or oil must be taken; also the lye must be stirred into the grease, *not* the grease or oil added to the lye. If the grease or tallow used be not clean, or *contain salt*, it must be "rendered," or purified, previous to use, that is to say, boiled with water, and allowed to become hard again to throw out the impurities. Any salt present will spoil the whole operation entirely, but discolored or rancid grease or tallow is just as good as fresh for soap making purposes.

If the soap turn out streaky and uneven, it has not been thoroughly mixed. If very sharp to the taste, too much sodium hydroxide has been taken. If soft, mild, and greasy, too little soda has been used. In either case it must now be thrown into a pan and brought to a boil with a little more water. In the first case boiling is all that is necessary; in the other instances a very little oil or a very little more of the double refined powdered sodium hydroxide must be added to the water. These things will never happen, however, if the directions be exactly followed, and after the soap has been made several times with the experience thus gained the process is extremely easy, and the result will be always a good soap. Beef tallow makes the hardest soap, mutton fat a rather softer soap; of oils, cotton-seed is the cheapest and best, but the soap is much softer, lathering very freely indeed. Ordinary household fat or drippings will make a nice soap, and in many places can be obtained at a very trifling cost and in exchange for goods sold. Such grease, however, must be carefully examined for *salt*, which it often contains. It will be evident that any smaller quantity of soap can be made at a time, according to the above directions, by taking the ingredients in exact proportion. It is not advisable to make more than double the quantity prescribed, as it is difficult to work more by hand. By making successive batches, however, a single person can make two tons of soap in a day simply with apparatus (pans, etc.) obtainable in any household.

By adding a few drops of essential oil just when the mixing is completed, a toilet soap is produced. Oil of mirbane (artificial almond oil) is the cheapest, but the perfume is not nearly so pleasant as real almond oil, citronella, or oil of cloves. If made with clean grease or tallow or light-colored oil, the soap produced is quite white.

Sometimes a little coloring matter will make soap *sell* better, although of no better quality. Half an ounce of potassium dichromate dissolved in the *lye* will give a green color; 1 lb. of palm oil melted with the tallow or oil, a yellow color; or a good brown can be secured by burning ½ lb. of sugar in a saucepan until black, then dissolving it in a pint of water, and adding it to the melted tallow before mixing.

A *very cheap* and good jelly soft soap can be made with soap. Take 5 lbs of the hard soap, crush it down or cut it up into as small pieces as possible; put this into a pan or boiler with 10 gallons of water if a strong hard tallow soap; if an oil soap, only half the quantity of water (5 gallons); just bring it to a boil, and stir well, to thoroughly dissolve all the pieces of hard soap; pour or ladle it into any can, tub, or barrel that is tight, and leave it to cool for two or three days. This will give about 80 lbs. of jelly soft soap at an exceedingly small cost. Of course, if made from colored and scented hard soap it will be a colored and scented jelly soap. This is a good way of working up the scraps and bits of soap after cutting up. It is a *very different* article, however, from a *real* potash soft soap, which should invariably be used for washing woollens. It is possible to produce this real potash soft soap in the cold by a process somewhat similar to the above.

firmness. If it be wanted white, the palm oil may be bleached by heat, potassium dichromate with sulphuric acid, chlorine, or exposure to the sun. This soap has a yellowish color, and the agreeable odor of violets derived from the oil. *Soap balls* are prepared by dissolving soap in a little water and then forming it with starch into a mass of the proper consistence. *Common yellow soap* (*rosin soap*) derives its peculiarities from an admixture of rosin and a little palm oil with the tallow employed, the oil being added to improve its color. Sodium silicate has to some extent been substituted for rosin, as more economical. (*A. J. P.*, 1863, p. 466.) Large quantities of lard oil (nearly pure olein) are manufactured into soap.[1]

All the varieties of soap, except a few of the fancy sort and the olive oil soaps, are manufactured in the United States. The latter are mainly imported from France, Italy, and Spain.

Properties.—Soap, whatever may be its variety, has the same general properties. Its aspect and consistence are familiar to every one. Its odor is peculiar, and its taste slightly alkaline. It is usually somewhat heavier than water, and therefore sinks in that liquid. Exposed to heat it quickly fuses, swells up, and is decomposed. It is soluble in water, and more readily in hot than in cold. Potassa soaps and those containing oleic acid are far more soluble than the soda soaps, especially those in which the stearates and palmitates predominate. Acids added to an aqueous solution of soap combine with the alkali, and set free the oily acids, which, being diffused through the water, give it a milky appearance. Its decomposition is also produced by metallic salts, which invariably give rise to insoluble soaps. Soap is soluble in cold and abundantly in boiling alcohol. This solution constitutes the *tincture of soap*, and forms a very convenient test for discovering lime in natural waters. As the tincture sometimes gelatinizes, it is proposed by Bjorklund to remedy this inconvenience by employing soap in the undried state, that is, containing a large proportion of water. (*J. P. C.*, 4e sér., ii. 179, 1865.) The efficacy of soap as a detergent depends upon its hydrolytic decomposition when in solution, whereby alkali is liberated which saponifies and emulsifies grease and fatty substances rendering them readily removable in the washing processes. The chief adulterations in soap are lime, silica, gypsum, heavy spar, steatite, pipe-clay, and sodium sulphate. When adulterated with these substances, it will not be entirely soluble in alcohol. According to Riegel, glue is an occasional adulteration in Spanish soap, discoverable also by its insolubility in alcohol. The same impurity is sometimes found in other soaps. Soap is officially described as "a white or whitish solid, hard, yet easily cut when fresh, having a faint, peculiar odor free from rancidity, a disagreeable, alkaline taste, and an alkaline reaction. Soluble in water and in alcohol, more readily with the aid of heat. On placing 0.5 Gm. of Soap, together with about 10 Cc. of alcohol, in a tared beaker containing 1 Gm. of dry, clean sand, evaporating the resulting solution of the Soap to dryness, and drying the residue at 110° C. (230° F.), to a constant weight, the loss should not exceed 36 percent. (absence of an undue amount of *water*). An alcoholic solution of Soap (1 in 25) should not gelatinize on cooling (absence of *animal fats*). An aqueous solution of Soap 1 in 20) should remain unchanged in color upon the addition of ammonium sulphide T.S.; and upon acidulating another portion of the solution with hydrochloric acid and filtering, the filtrate should remain unchanged in color when an equal volume of hydrogen sulphide T.S. is added and the mixture is allowed to stand well stoppered in a warm place for half an hour (absence of *metallic impurities*). On dissolving 20 Gm. of Soap in alcohol, with the aid of heat, transferring the undissolved residue, if any, to a tared filter, and washing it thoroughly with boiling alcohol, it should, after drying, weigh not more than 0.8 Gm. (limit of *sodium carbonate*, etc.); of this residue not more than 0.2 Gm. should be insoluble in water (limit of silica and other *accidental impurities*). If a solution of 5 Gm. of Soap in 50 Cc. of hot water be mixed with 3 Cc. of tenth-normal oxalic acid V.S., the subsequent addition of a few drops of phenolphthalein T.S. should produce no pink or red tint (limit of *alkalinity*)." *U. S.* "Grayish-white, dry, inodorous; becomes horny and pulverizable when kept in dry warm air. Easily moulded when heated. Soluble in *alcohol* (90 per cent.), especially on warming. Soluble in 20 parts of cold *water*, and in 1½ parts of hot *water*. It should not contain more alkaline hydroxide or carbonate than is allowed under 'Sapo Animalis.' It does not impart a greasy stain to white unglazed paper (absence of free oil). Incinerated it yields an ash which does not deliquesce (absence of potassium soap). It should lose about 30 per cent. of moisture when dried at 230° F. (110° C.)." *Br.*

Olive oil soda soap (Sapo), otherwise called *Castile* or *Spanish soap*, is a hard soap, and is presented under two principal varieties, the white and the marbled. *White Castile soap*, when good, is of a pale grayish-white color, incapable of giving an oily stain to paper, devoid of rancid odor or strong alkaline qualities, and entirely soluble both in water and in alcohol. It should not feel greasy, nor grow moist, but, on the contrary, should become

[1] Upon the supposition that the detergent properties of soap depend exclusively on the alkali it contains, and are consequently proportionate to the quantity of that ingredient, a mode of estimating the relative value of soaps has been suggested by R. Graeger, based on the molecular weight of the fatty constituent,—those soaps being the strongest of which the acid has the lowest combining number. (See *A. J. P.*, 1861, p. 355.)

dry by exposure to the air, without exhibiting any saline efflorescence. This variety of soap contains about 21 per cent. of water. Sometimes it contains a larger proportion of water, with which the soap is made to combine by the manufacturer, with the fraudulent intention of increasing its weight. Soap thus adulterated is known by its unusual whiteness, and by its suffering a great loss of weight in a dry air. The proportion of water may be ascertained by introducing the soap into a saturated solution of sodium chloride, and boiling, when the soap, nearly free from water, concretes into a solid mass. *Marbled Castile soap* is harder, more alkaline, and more constant in its composition than the other variety. It contains about 14 per cent. of water. Having less water than the white Castile, it is a stronger and more economical soap, but at the same time is less pure. The impurity arises from the veins of marbling, consisting of ferruginous matters, as already explained, and from various substances added as make-weights. Soap made with animal fat, with the probable addition of sodium silicate, has been sold for Castile soap. The Italian brands of Castile soap which have been so largely used in past years are rapidly depreciating in quality; they are now chiefly made from cotton seed oil and other substitutes for olive oil.

Animal oil soda soap (Sapo Vulgaris) is a hard soap, of a white color, inclining to yellow. It is made from tallow and sodium hydroxide. This soap possesses the same general properties as the olive oil soda soap.

Composition.—It has been already explained that soap consists of certain fatty acids united with an alkali. As olive oil is a compound of olein with palmitin and small quantities of the esters of other fatty acids, so the official "soap" is a mixed sodium oleate and palmitate. The former official "common soap" is principally a sodium stearate, and "soft soap," as defined in the Br. Pharmacopœia, is a mixed potassium palmitate and oleate. The table below, from Roscoe & Schorlemmer, gives an excellent view of the composition of commercial soap.[1]

Incompatibles.—Soap is decomposed by all the acids, earths, and earthy and metallic salts. Acids combine with the alkali, and set free the fatty acids of the soap; the earths unite with the fatty acids, and separate the alkali, while the earthy and metallic salts give rise, by double decomposition, to an insoluble soap of their base, and a saline combination between their acid and the alkali of the soap. Hard waters, in consequence of their containing salts of lime, decompose and curdle soap. They may be rendered soft, and fit for washing, by adding sufficient sodium or potassium carbonate to precipitate all the lime.

Uses.—Soap possesses the properties of a laxative, antacid, and antilithic. It acts like an alkaline base and was formerly used to some extent internally, but has been entirely superseded by more elegant alkaline compounds, except in laxative preparations, especially in combination with rhubarb. In *constipation* of the bowels, particularly when arising from hardened fæces in the rectum, a strong solution of soap, especially of soft soap, forms a useful enema. When the latter is used, two tablespoonfuls may be dissolved in a pint of warm water. In pharmacy, soap is frequently employed for the purpose of giving a proper consistence to pills; but care must be taken not to associate it with a substance which may be decomposed by it. It is also an ingredient in some liniments and plasters. In toxicology it is used as a chemical antidote for the mineral acids, and should always be resorted to in poisoning by these agents, without a moment's delay, and its use continued until magnesia, chalk, or sodium or potassium bicarbonate can be obtained. The mode of administration in these cases, is to give a teacupful of a strong solution of soap every three or four minutes, until the patient has taken as much as he can swallow.

Dose, five grains to half a drachm (0.32 to 2.0 Gm.), given in pill.

Off. Prep.—Emplastrum Plumbi, *U. S.;* Emplastrum Resinæ, *Br.;* Emplastrum Saponis, *U. S., Br.;* Extractum Colocynthidis Compositum, *U. S.;* Hydrargyri Oleas, *Br.;* Linimentum Saponis, *U. S.;* Pilulæ Aloes, *U. S.* (*Br.*); Pilula Aloes et Asafetidæ, *Br.;* Pilula Aloes Socotrinæ, *Br.;* Pilulæ Asafœtidæ, *U. S.;* Pilula Cambogiæ Composita, *Br.;* Pilulæ Opii, *U. S.* (*Br.*); Pilula Rhei Composita, *Br.;* Pilula Scillæ Composita, *Br.;* Unguentum Zinci Oleatis, *Br.*

	Fatty Acids.	Potash, K_2O.	Soda, Na_2O.	Water.	Salt and other Admixtures.
Hard Soaps.					
[1] Old Mottled Soap	81.25	1.77	8.55	8.43	. .
New Tallow Soap	61.0	. .	8.4	28.8	2.3
Marseilles Soap	67.0	. .	7.8	21.2	4.0
Palm-oil Soap, yellow	65.2	. .	9.8	19.9	1.1
do. bleached	61.2	. .	9.7	24.8	1.3
Tallow Soap	42.8	. .	8.8	39.1	. .
Cocoanut-oil Soap (Marine Soap)	22.0	. .	4.5	73.5	. .
Palm-oil Soap	49.6	. .	8.0	35.4	1.1
Soft Soaps.					
Common Soft Soap	42.8	9.1	. .	48.0	. .
London Soft Soap	45.0	8.5	. .	46.5	. .
Belgian Green Soap	36.7	7.0	. .	57.0	. .

SAPO ANIMALIS. Br.

CURD SOAP

(sā'pō ăn-ĭ-mā'lĭs)

"Soap made with sodium hydroxide and a purified animal fat consisting principally of stearin; containing about 30 per cent. of water." *Br.*

Sapo Sebacinus; Sapo domesticus; Animal Soap, Tallow Soap, Stearin Soap; Savon animal, *Fr. Cod.*; Hausseife, Talgseife, Stearinseife, *G.*; Sapone animale, *It.*; Jabon animal, *Sp.*

The British Pharmacopœia 1898 has retained curd soap in its list, and thus describes it: "White or with a very light grayish tint; dry; nearly inodorous; becomes horny and pulverizable when kept in dry warm air. Easily moulded when heated. Soluble in *alcohol* (90 per cent.), especially on warming. Sparingly soluble in cold *water;* soluble in hot *water.* 5 grammes of the dried and powdered soap, digested in boiling *alcohol* (90 per cent.), filtered while hot, and the filter washed thoroughly with more of the boiling *alcohol*, yield a filtrate which should not afford a red or pink coloration with *solution of phenol-phthalein* (limit of alkaline hydroxide); and the filter, when washed with hot water, will yield a solution which, on adding *solution of phenolpththalein,* should not require more than 3 cubic centimetres of *decinormal volumetric solution of sulphuric acid* to discharge the resulting red color (limit of alkaline carbonate). It does not impart a greasy stain to white unglazed paper (absence of free oil and fat). Incinerated it yields an ash which does not deliquesce (absence of potassium soap). It should lose about 30 per cent. of moisture when dried at 230° F. (110° C.)." *Br.*

Soap made from animal oils and fats is very largely used for all domestic purposes; it is preferred pharmaceutically for making *solid opodeldoc* because of its partial insolubility in the hydro-alcoholic solvent. (See p. 1088.)

Off. Prep.—Extractum Colocynthidis Compositum, *Br.*; Linimentum Potassii Iodidi cum Sapone, *Br.*; Pilula Scammonii Composita, *Br.*

SAPO MOLLIS. U. S., Br.

SOFT SOAP [Green Soap]

(sā'pō mŏl-lĭs)

"Soap made with potassium hydroxide and olive oil." *Br.*

Sapo Viridis, U. S. P. 1880; Savon mou, Savon vert, Savon à Base de Potasse, *Fr.*; Sapo Kalinus, *P. G.*; Kaliseife, Schmierseife, *G.*; Sapone di potassa, *It.*

* "Linseed Oil, *four hundred grammes* [or 14 ounces av., 48 grains]; Potassium Hydroxide, *ninety-five grammes* [or 3 ounces av., 154 grains]; Alcohol, *forty cubic centimeters* [or 1 fluidounce, 169 minims]; Water, *a sufficient quantity.* Heat the Linseed Oil in a deep, capacious vessel, on a water-bath or steam-bath, to a temperature of about 70° C. (158° F.). Dissolve the Potassium Hydroxide in *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Water, warm the solution to about 70° C. (158° F.), add it to the Linseed Oil, and mix thoroughly; then incorporate the Alcohol and continue the heat (without stirring) until a small portion of the mixture is found to be soluble in boiling Water without the separation of oily drops. Then allow the mixture to cool, and transfer it to suitable vessels. The Potassium Hydroxide used in this process should be of the full strength directed by the Pharmacopœia (85 percent.). Potassium Hydroxide of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 8075 by the percentage of absolute Potassium Hydroxide contained therein." *U. S.* The above process was first introduced into the U. S. P. 1890 with the view of affording a soft soap for medicinal purposes which shall be of uniform strength. Domestic *soft soap* is prepared on the same general principles as hard soap, potassium hydroxide being employed as the alkali, and a fatty matter, rich in olein, as the oil. The French soft soap is made with the seed oils, such as rape seed, hemp seed, etc.; the Scotch and Irish, with fish oil and some tallow, and our own, with refuse fat and grease. A lye of wood ashes is the form of potassium usually employed. In forming this soap it is necessary that it should continue dissolved in the alkaline solution, instead of being separated from it. Hence soft soap is a potassium soap completely dissolved in the solution of its alkali, which is present in excess. As made in this country, it is usually semi-fluid, slippery, capable of being poured from one vessel to another, and of a dirty brownish-yellow color and varying strength.

Properties.—It is officially described as "a soft, unctuous, yellowish-brown mass, having a characteristic odor and an alkaline taste. An aqueous solution shows an alkaline reaction to red litmus paper. If to a solution of 5 Gm. of Soft Soap in 50 Cc. of water, 2 drops of phenolphthalein T.S. be added, not less than 2.3 Cc. nor more than 4.5 Cc. of tenth-normal oxalic acid V.S. should be required to discharge the red tint (limit of *free alkali*). Soluble in hot water to a nearly clear liquid; also in hot alcohol without leaving more than 3 percent. of insoluble residue." *U. S.* "Yellowish-white, sometimes yellowish-green, almost inodorous, of an unctuous consistence. Readily soluble in *alcohol* (90 per cent.), especially on warming, the liquid, on filtration, yielding not more than 3 per cent. of residue (limit of potassium carbonate, insoluble soaps, etc.). It should not contain more alkaline hydroxide or carbonate than is allowed under 'Sapo Animalis.' It does not impart an oily stain to paper (ab-

sence of free oil). Incinerated it yields an ash which is very deliquescent, and which should afford no reaction with the tests for copper." *Br.*

For more than one hundred years, under the name of "*green soap,*" there has been used in Europe a soap made by saponifying linseed, rape seed, or other vegetable oils with various refuse oils, usually including fish oils, an excess of potassium hydroxide, and a little sodium hydroxide. The green color of this soap was probably due to the presence of chlorophyll in the impure vegetable oils used. This green soap, or so-called "German soap," was formerly imported into America, but at present has been almost entirely superseded by soft soap made in this country, from which it does not differ in the nature of its active constituents or in its therapeutic properties.

If a green soap be wanted, it may be made by the process given in the foot-note.[1] The soft soap of France, formerly the *savon vert* of the French Codex, has a greenish color and usually the consistence of a soft ointment. It is made of hemp seed oil, or sometimes of the dregs of olive oil, and potassium hydroxide. G. M. Beringer (*Proc. A. Ph. A.*, 1903, 420) prefers to use Malaga olive oil in making green soap and M. I. Wilbert (*Proc. A. Ph. A.*, 1904, 228) extracts the green coloring matter from hemp seed by macerating 25 parts of ground hemp seed with alcohol and obtains 100 parts of a tincture; by substituting an equal measure of this tincture for the quantity of alcohol used in the official process, a green soap can be made, which will have the color which is regarded by some as a very important characteristic.

Uses.—Soft soap is used in medicine almost exclusively in the treatment of *eczema rubrum*, although sometimes used in other diseases of the skin in which a very powerfully stimulant application is desired. It acts chiefly by virtue of the excess of potassium hydroxide, which enables it to destroy fatty matters rapidly, to remove exudation, and to affect the nutrition of the skin. The tincture, the form in which it is usually employed, may be well rubbed upon the part, either in full strength or diluted, and immediately afterwards the skin must be well washed to remove the alkali, and then zinc oxide or other bland ointment applied.

Off. Prep.—Linimentum Saponis Mollis, *U. S.* (*Br.*); Linimentum Terebinthinæ, *Br.*

[1] "*German Soft Soap.*"—E. B. Shuttleworth has furnished the following process for its preparation. "In a clean pot or dish, preferably of iron or copper, and capable of containing at least three times the quantity, put one part by weight of linseed oil; heat gently, and add, in two portions, three parts in all, by measure, of liquor potassæ, U. S. P. or B. P., providing either come up to the standard requiring 5.8 and 5.84 per cent. of potassium hydrate. Boil quietly and stir frequently until the mass becomes clear, which with four ounces of oil and twelve ounces (fluid) of liquor will require about one hour, and with ten pounds of oil about five hours. If, during the process, the mass becomes too thick to stir easily, add a little water. Allow the soap to become cool, but, before it sets, work in the coloring matter, which must be previously prepared by boiling finely-powdered indigo with water until the color is formed into a thin paste. Twenty grains of indigo, boiled with one and a half ounces of water until the mixture is reduced to about one drachm, will answer for the soap from four ounces of oil. The soap must not be too hot, nor must it be reboiled after adding the coloring matter, or the green will be destroyed." (*Can. Pharm. Journ.*, June, 1878.)

SARSAPARILLA. U. S. (Br.)

SARSAPARILLA

(sär-są-pą-rĭl'lą)

"The dried root of *Smilax medica* Chamisso and Schlechtendal, *Smilax ornata* Hooker, *Smilax papyracea* Duhamel, or a dried root known commercially as Honduras Sarsaparilla, which is probably obtained from *Smilax officinalis* Kunth (Fam. *Liliaceæ*)." *U. S.* "The dried root of Smilax ornata, *Hook. f.* Imported from Costa Rica and commonly known as Jamaica sarsaparilla." *Br.*

Sarsæ Radix, *Br.*; Jamaica Sarsaparilla; Salsepareille, *Fr. Cod.*; Radix Sarsaparillæ, *P. G.*; Sarsaparille, Sarsaparilla, *G.*; Salsapariglia, *It.*; Zarzaparrilla (Raiz de), *Sp.*

In the present state of our knowledge, it is impossible to decide with positiveness from what species the several commercial varieties of the drug are respectively derived. The matter is made more difficult by the observation of H. H. Rusby that the sarsaparilla which was undoubtedly grown in Honduras and which was believed by Rusby to be derived from *S. ornata* or possibly a distinct species, could not be differentiated from true Jamaica sarsaparilla. (*D. C.*, Nov. 1903.) The root (rhizome) of *Smilax China*, a native of China and Japan, has been employed under the name of *China Root* for similar purposes with the official sarsaparilla. As it occurs in commerce, it is in pieces from three to eight inches long and an inch or two thick, usually somewhat flattened, more or less knotty, often branched, of a brownish or grayish-brown color externally, whitish or of a light flesh-color internally, without odor, and of a taste flat at first, but afterwards very slightly bitterish and somewhat acrid, like that of sarsaparilla. The root of *Smilax aspera* is said to be employed in the south of Europe as a substitute for sarsaparilla; but it has little reputation. The East India sarsaparilla, which was at one time referred to this species of smilax, is the product of *Hemidesmus indicus*.[2] (See *Hemidesmus.*) All the species of smilax are climbing or trailing plants, with prickly stems,—a character expressed in the name of the medicine, which is derived from two Spanish words (*zarza parilla*), signifying a small thorny vine.

The official species of smilax are as follows:

S. officinalis, H. B. K., *Nov. Gen. et Sp.* (1815), 271.—In this species the stem is twin-

[2] Under the name of *Raiz de china de México*, the Mexican Pharmacopœia recognizes the root of *S. rotundifolia* as diaphoretic and depurative, but, according to Maisch, this reference is incorrect. (See *A. J. P.*, 1879.)

ing, angular, smooth, and prickly; the young shoots are unarmed; the leaves ovate-oblong, acute, cordiform, five- or seven-nerved, coriaceous, smooth, twelve inches long and four or five broad, with footstalks an inch long, smooth, and furnished with tendrils. The young leaves are lanceolate-oblong, acuminate, and three-nerved. Large quantities of the root are said to be sent down the Magdalena River to Mompox and Carthagena.

S. ornata, Lemaire, *Illust. Hortic.* xii.—This plant was recognized by both Flückiger and Hanbury, and by Bentley and Trimen as *S. officinalis,* and was described by Lemaire with a query to it to express his doubtfulness of its specific distinctness. The species is, however, now generally accepted. The plant has large 7-nerved leaves resembling *S. officinalis.* It is especially distinguished by the young leaves being mottled with white. See *Botanical Magazine,* vol. 115. t. 7054.

S. papyracea, Duham., *Arb.,* ed. Nov. 1, 242, is said to have foliage like *S. officinalis,* with a multiangular stem, with squamiform thorns on the angles, and petioles which are vaginate for one-fourth their length. It is thought to be the source of Para sarsaparilla.

S. medica, Schlecht. et Cham., in *Linnæa* (1831), 47.—This species has an angular stem, armed with straight prickles at the joints, and a few hooked ones in the intervals. The leaves are smooth, bright green on both sides, shortly acuminate, five-nerved, with the veins prominent beneath. They vary much in form, the lower being cordate, auriculate-hastate, the upper cordate-ovate. In the old leaves the petiole and midrib are armed with straight subulate prickles. The inflorescence is an umbel of from eight to twelve flowers, with a smooth axillary peduncle and pedicels about three lines long.

The medicinal species of smilax grow in Mexico, Guatemala, and the warm latitudes of South America. The roots are very long and slender, and originate in great numbers from a common head or rhizome, from which the stems of the plant rise. The whole root with the rhizome is usually dug up, and as brought into market exhibits not unfrequently portions of the stems attached, sometimes several inches in length. The commercial sarsaparillas are conveniently divided into the mealy and non-mealy sarsaparillas. The first class comprises especially the Honduras, Guatemala, and Brazilian varieties; the second the Jamaica, Mexican, and Guayaquil sarsaparillas. A very convenient key for distinguishing the commercial sarsaparillas by certain anatomical characters has been devised by Luerssen in his *Handbuch der Medicin-pharm. Botanik,* ii. 404.

Honduras sarsaparilla is the variety most used in this country. Regarding the botanical origin of this drug little or nothing is definitely known, but it is believed by many botanists to be obtained from *S. officinalis.* It is brought from the Bay of Honduras, and comes in bundles two or three feet long, composed of several roots folded lengthwise, and secured in a compact form by a few circular turns. These are packed in bales imperfectly covered with skins, each bale containing one hundred pounds or more. The roots are usually connected at one extremity in large numbers in a common head, to which portions of the stems are also attached. In some bundles are many small fibres, either lying loose or still adhering to the roots. The roots externally are a dirty grayish or reddish-brown; the cortical portion beneath the epidermis often appears amylaceous when broken.

The *Jamaica* or *red sarsaparilla* of foreign writers is little known by that name in the United States. The island of Jamaica is merely its channel of exportation to Europe.

Jamaica or red sarsaparilla is collected in Central America, especially in Costa Rica, and is the product of *S. ornata,* Hook. (see *Botan. Mag.,* cxv. 1889, t. 7054). It owes its name to the fact that it has been largely exported to Europe through the island of Jamaica. As found in commerce it is in rolls from twelve to eighteen inches long by four or five in thickness, composed exclusively of long slender many-radicled roots very loosely held together by a few turns. Sometimes it is pressed into large bales. It is further to be distinguished from Honduras sarsaparilla by its dark color, the greater abundance of coarse rootlets, the less quantity of starch, its relatively thick cortex, and its less sharp taste. Its epidermis is also redder than is commonly the case with Honduras sarsaparilla.

Cultivated Jamaica Sarsaparilla (*Roja Inglesa*) occurs in thick short rolls and is especially characterized by its yellow-brown or orange color. According to W. B. Hemsley Hooker's I. P. pl. 2589, it is the product of *S. utilis,* Hemsley, a species related to *S. ornata,* from which it differs by its long pedunculated simple umbels.

The *Mexican* or *Vera Cruz sarsaparilla* is derived from *S. medica.* Although sometimes in bundles, it commonly comes in large, rather loose bales, weighing about two hundred pounds, bound with cords or leather thongs, and usually containing the roots folded upon themselves, and separately packed. These, as in the Honduras sarsaparilla, consist of a head or caudex with numerous long radicles, which, however, are somewhat smaller than in that variety, and have a thinner bark. They are often also much soiled with earth. It contains but little starch and has quadrangular endodermal cells, with thickened walls, and more or less oval lumen. It was formerly little esteemed; but, from the acrid taste which it possesses, it is probably of equal value to the other kinds. It is probably derived from *Smilax medica.*

Another variety is the *Carácas sarsaparilla,* brought in large quantities from La Guayra. It is in oblong packages, of about one hundred

pounds, surrounded with broad strips of hide, which are connected laterally with thongs of the same material, leaving much of the root exposed. The roots, as in the last variety, are separately packed, but more closely and carefully. The radicles are often very amylaceous internally, in this respect resembling the following variety.

The *Brazilian,* or, as it is called in Europe, the *Lisbon* or *Pará sarsaparilla,* is not very plentiful in commerce. It comes from the ports of Pará and Maranham, in cylindrical bundles from three to five feet in length by about a foot in thickness, bound about by close circular turns of a very flexible stem, and consisting of unfolded roots, destitute of caudex (rhizome) and stems, and having few radical fibres. It was also shown in the Brazilian exhibit in the Centennial Exhibition, neatly cut and tied into bundles about a foot long and eight inches in diameter. It is the variety of which Hancock speaks as celebrated throughout South America by the name of *Sarsa of the Rio Negro,* and is considered the most valuable variety of the drug. It is distinguished by the thinness of its cortex, the large amount of starch that it contains and its large, radially elongated endodermal cells. It was said by Martius to be derived from *Smilax syphilitica;* but Hancock considers that portion of it which comes from the Rio Negro, and is shipped at Pará, as the product of an undescribed species, certainly not *S. syphilitica.* As determined by Richard, it is the product of the *S. papyracea* of Poiret.

The variety described by Bentley under the name of *Guatemala sarsaparilla* was collected in the province of Sacatapeques, about ninety miles from the sea. It is in cylindrical bundles about two feet eight inches long by four inches in diameter, composed of separate roots, arranged in parallel order, without rootstalk, and bound together by a few turns of the flexible stem of a monocotyledonous plant. The bundles resemble the Brazilian in arrangement, but are much less compact. It is amylaceous, has considerable acrimony, and is probably one of the most efficient varieties. Bentley ascribes it to *S. papyracea.* For a particular description of the root, see *P. J.,* xii. 472.

Guayaquil sarsaparilla, according to Spruce, grows in valleys on the western slopes of the equatorial Andes. It is usually not in bundles, but carelessly packed in bales. "The rhizome and a portion of the stem are often present, the latter being round and prickly. The root is dark, large, and coarse-looking, with a good deal of fibre. The bark is furrowed, rather thick, and not mealy in the slenderer portions of the root, which is near the rootstalk; but, as the root becomes stout, so its bark becomes smoother, thicker, and amylaceous, exhibiting when cut a fawn-colored or pale yellow interior."

Properties.—The dried sarsaparilla roots are several feet in length, about the thickness of a goose-quill, cylindrical, more or less wrinkled longitudinally, flexible, and composed of a thick exterior cortical portion, covered with a thin easily separable epidermis, of an inner layer of ligneous fibre, and of a central pith. The epidermis is of various colors, generally ash-colored, grayish brown, or reddish brown, and sometimes very dark. It is composed of several rows of elongated flattened cells, with their walls thickened by secondary deposits. The cortical portion is in some specimens whitish, in others brown, and not infrequently of a pink or rosy hue. It is occasionally white, brittle, and almost powdery like starch. It is formed of a loose parenchymatous tissue, whose cells are often loaded with starch and raphides. Between it and the woody centre is a circle of small cells, which form the so-called nucleus sheath. The woody part is usually very thin and composed of longitudinal fibres, which allow the root to be split with facility through its whole length. Its vascular bundles contain pitted ducts and prosenchymatous cells. Scattered vascular bundles sometimes occur in the central medulla, which is composed of large medullary cells. The cells of the endoderm are nearly square in transverse section, and uniformly thickened.

Sarsaparilla in its ordinary state is nearly or quite inodorous, but in decoction acquires a decided and peculiar odor. To the taste it is mucilaginous and very slightly bitter, and, when chewed for some time, produces a disagreeable acrid impression, which remains long in the mouth and fauces. It is officially described as "usually more than 1 M. in length, and 4 to 6 Mm. thick, with few or many fine roots adhering; externally varying from light gray-brown and smooth, with few deep and sharp wrinkles, to dark or orange-brown and less smooth, and with more and smaller wrinkles; internally whitish, with a thick, mealy or sometimes horny cortex, a circular wood-zone, and a thick pith; fracture tough; nearly inodorous; taste mucilaginous, somewhat sweetish and bitter, slightly acrid. The thick, woody, knotty rhizome, if present, should be removed." *U. S.* The root is efficient in proportion as it possesses this acrimony, which is said by some authors to be confined to the cortical portion, while the ligneous fibre and medullary matter are insipid and inert. Hancock avers that all parts are equally acrid and efficacious. The truth is probably between the two extremes, and, as in most medicinal roots, it must be admitted that the bark is more powerful than the interior portions, while these are not wholly inactive. The virtues of the root are communicated to water, cold or hot, but are impaired by long boiling. They are extracted also by diluted alcohol. According to Hancock, the whole of the active matter is not extracted by water. In South America it is the custom to prepare sarsaparilla by digestion in wine or spirit, or by infusion in water with additions which may produce the vinous

fermentation and thus add alcohol to the menstruum. The same result, as to the superior efficacy of alcohol as a solvent of the acrid principle of sarsaparilla, has been obtained by the French experimentalists. It has been suggested that sarsaparilla, the virtues of which are admitted to be impaired by long boiling, might also be injured by the degree of heat applied in the water or steam bath. But the contrary appears to have been proved by J. F. Judge of Cincinnati. (*Proc. A. Ph. A.*, 1873, p. 595.)

Parillin. (*Smilacin. Pariglin. Salseparin. Parallinic acid.*)—The crystalline principle in which the virtues of sarsaparilla reside is now called *parillin*. It was first discovered by Palotta, who described it in 1824 under the name of *pariglin*. Subsequently, Folchi supposed that he had found another principle, which he called *smilacin*. Flückiger recommends the preparation of *parillin* by exhausting the crushed root with warm alcohol and distilling the tincture until the residue weighs one-sixth of the root. It is then gradually mixed with one and a half times its weight of water, and after several days the liquid is decanted from the light yellow precipitate, which is then mixed with about half its volume of alcohol, transferred to a filter, and washed with alcohol of 20 or 30 per cent. because parillin is less soluble in weak alcohol than in strong alcohol. The yield was 0.18 and 0.19 per cent. It is white, inodorous, almost tasteless in the solid state, but bitter, acrid, and nauseous when dissolved in alcohol or water. It is very slightly soluble in cold water, but more readily in boiling water, without crystallizing on cooling. It is very soluble in alcohol, especially at the boiling temperature. Ether and the volatile oils also dissolve it. Its aqueous solution has the property of frothing very much on agitation. According to Flückiger, concentrated sulphuric acid yields a yellow solution, which, on absorbing moisture, gradually turns cherry-red; warm diluted sulphuric acid colors parillin greenish, then red, and finally brown; phosphoric acid has a similar reaction, but the color is more greenish-yellow. The aqueous solution is precipitated by alcoholic solution of lead acetate, by lead subacetate, and by tannin, and when warmed reduces alkaline copper tartrate, but does not react with other tests for sugar until after it has been boiled with a dilute acid, when the solution acquires a green fluorescence. This is best observed if a trace of parillin is dissolved in warm concentrated sulphuric acid, and disappears on dilution with water or on neutralizing with ammonia. Parillin is not sternutatory; its acrid taste is best observed in alcoholic solution. (See *A. J. P.*, xii. 245.) The solutions of parillin are without acid or alkaline reaction. By treatment with dilute mineral acids, it is resolved into *parigenin* and sugar. Poggiale found parillin both in the cortical and in the medullary part of the root, but most largely in the former. W. von Schulz (*P. J.*, 1892, 6) has shown that Dragendorff's *smilacin* or *sarsaparill-saponin*, $C_{20}H_{32}O_{10}$, *sarsa-saponin*, $C_{22}H_{36}O_{10}$, discovered by himself, and Flückiger's *parillin*, $C_{26}H_{44}O_{10}$; are three homologous compounds all belonging to the same series, having the general formula $C_nH_{2n-8}O_{10}$. These three all split up into *sarsasapogenin* (parigenin of Flückiger) and one or more molecules of glucose on boiling with dilute acids. Kobert (*A. J. P.*, 1892, 465) comes to practically the same results, stating the constituents to be *parillin* ($C_{26}H_{44}O_{10} + 2\frac{1}{2}H_2O$), insoluble in water; *saponin* (sarsaparill-saponin), $5(C_{20}H_{32}O_{10} + 2\frac{1}{2}H_2O)$, soluble in water; and *sarsa-saponin*, $12(C_{22}H_{36}O_{10} + 2H_2O)$, easily soluble in water, and the most poisonous of the constituents.

The sarsaparilla of commerce is apt to be nearly if not quite inert, either from age, or from having been obtained from inferior species of Smilax. This inequality of the medicine, with the improper modes of preparing it long in vogue, has probably contributed to its variable reputation. The only criterion of good sarsaparilla to be relied on is the taste. If it leave a decidedly acrid impression in the mouth after having been chewed for a short time, it may be considered efficient; if otherwise, it is probably inert. Various false sarsaparillas have been sent into commerce from South America. For description by C. Hartwich see *A. Pharm.*, July, 1902.

Uses.—Few medicines have undergone greater changes of reputation. About the middle of the sixteenth century it was introduced into Europe as a remedy for the venereal disease, in which it had been found very useful in the recent Spanish settlements in the West Indies. After a time it fell into disrepute, and was little employed until about a century ago, when it was again brought into notice by Fordyce and others, as a useful adjuvant and corrigent of mercury in *lues venerea*. Since that period very different opinions have been entertained of it. Some, among whom was Cullen, considered it wholly inert; others, on the contrary, have had the most unbounded confidence in its powers. The probable cause of much of this discrepancy has been already mentioned. Experience, among both regular practitioners and empirics, would seem to have placed its efficacy beyond reasonable doubt. Its most extensive and useful application is in the treatment of *secondary syphilis* and *syphiloid diseases* and that shattered state of the system which sometimes follows the imprudent use of *mercury* in these affections. It is also employed, though with less obvious benefit, in *chronic rheumatism, scrofulous affections*, certain *cutaneous diseases*, and other depraved conditions of health. Its mode of action is less evident than its ultimate effects. It is said to increase the perspiration and urine; but, allowing it to do so, the effect is too slight to explain its remedial influence, and even that which is produced has been ascribed by some

to the medicines with which it is generally associated, or to the liquid in which it is exhibited. In this ignorance of its precise *modus operandi,* we call it an alterative.

Sarsaparilla may be administered in the form of infusion, compound decoction, compound syrup, or fluidextract. A beer made by fermenting an infusion of the drug with molasses is said to be a popular remedy in South America.[1] The smoke of sarsaparilla has been highly recommended in asthma. (*J. P. C.,* xviii. 221.)

Dose, thirty to sixty grains (2 to 3.9 Gm.).

Off. Prep.—Fluidextractum Sarsaparillæ, *U. S.* (*Br.*); Fluidextractum Sarsaparillæ Compositum, *U. S.;* Liquor Sarsæ Compositus Concentratus, *Br.;* Syrupus Sarsaparillæ Compositus, *U. S.* (from fluidextract).

SASSAFRAS. U. S. (Br.)

SASSAFRAS

(săs'sa-frăs)

"The dried bark of the root of *Sassafras variifolium* (Salisbury) O. Kuntze (Syn. *Sassafras Sassafras* (Linné) Karsten) (Fam. *Lauraceæ*), collected in early spring or autumn, and deprived of the periderm." *U. S.* "The dried root of Sassafras officinale, *T. Nees and Eberm.*" *Br.* See next article.

Sassafras Radix, *Br.;* Sassafras Bark, Sassafrax; Sassafras, *Fr. Cod., G.;* Sassafrasso, *It.;* Sasafras (Leño de), *Sp.*

SASSAFRAS MEDULLA. U. S.

SASSAFRAS PITH

(săs'sa-frăs me-dŭl'la)

"The dried pith of *Sassafras variifolium* (Salisbury) O. Kuntze (Syn. *Sassafras Sassafras* (Linné) Karsten) (Fam. *Lauraceæ*)." *U. S.*

Sassafras variifolium, Salisb., O. Kuntze; *Sassafras Sassafras,* Karsten, *Deutsch. Fl.* (1880–83).—*Laurus Sassafras,* Linn., *Sp. Pl.* 1753.—*Laurus variifolia,* Salisb., *Prodromus,* etc., 1796.—*Sassafras officinale,* Nees ab Esenbeck and Ebermaier, 1830.—This is an indigenous tree, of medium size, rising in favorable situations from thirty to fifty feet, with a trunk about a foot in diameter. In the Southern States it is sometimes larger, and in the northern parts of New England is little more than a shrub. The bark of the stem and large branches is rough, deeply furrowed, and grayish; that of the extreme branches or twigs is smooth and beautifully green. The leaves, which are alternate, petiolate, and downy when young, vary much in their form and size even upon the same tree. Some are oval and entire, others have a lobe on one side, but the greater number are three-lobed. Their mean length is four or five inches. The flowers, which appear before the leaves, are small, of a pale greenish-yellow color, and disposed in racemes which arise from the branches below the leaves and have linear bracts at their base. The corolla is divided into six oblong segments. The male flowers have nine stamens; the hermaphrodite, which are on a different plant, have only six, with a simple style. The fruit is an oval drupe, about as large as a pea, of a deep blue color when ripe, and supported on a red pedicel, enlarged at the extremity into a cup for its reception. For the microscopical character of the root and bark, see E. S. Bastin, *A. J. P.,* June, 1895. See also *Ph. Rev.,* 1899, 450.

The sassafras is common throughout the United States, and extends into Mexico. The fresh flowers have a slightly fragrant odor, and almost all parts of the plant are more or less aromatic. The best time for collecting the pith is after the occurrence of frost in autumn, and the same is the case also with the bark of the root. The wood of the root is brownish white, the bark spongy and divisible into layers. Although the Br. Ph. recognizes the whole root as official, the activity resides in the bark, which alone should be employed.

Bark of Sassafras Root.—As found in commerce, this is usually in small irregular fragments, sometimes invested with a brownish epidermis, sometimes partially or wholly freed from it, of a reddish or rusty cinnamon hue, very brittle, and presenting when freshly broken a lighter color than that of the exposed surfaces. The living bark is nearly white, but becomes colored, on exposure, immediately after collection. It is officially described as "in irregular transversely curved, reddish-brown pieces, of variable length and 0.5 to 5 Mm. thick; outer surface nearly smooth; inner surface obscurely short-striate; soft, fragile, with a short, corky fracture; strongly fragrant; taste mucilaginous, aromatic, and astringent." *U. S.* These properties are extracted by water and alcohol. According to Reinsch, the bark contains a heavy and light volatile oil, camphorous matter, fatty matter, resin, wax, a peculiar decomposition product of tannic acid called *sassafrid,* tannic acid, gum, albumen, starch, lignin, and salts. (See *Oleum Sassafras,* page 875.) The sassafrid bears some analogy to cinchonic red, and, like it, appears to be a derivative of the tannin, which exists in much larger proportion in the fresh bark than in that long kept. (Procter, *A. J. P.,* 1866, p. 490.) Owing to its volatile oil and

[1] *Sarsaparilla Beer.*—The following is Hancock's formula. "Take of Rio Negro sarsa, bruised, 2 pounds; bark of guaiac, powdered, 8 ounces; raspings of guaiac wood, anise-seeds, and licorice root, each 4 ounces; mezereon, *bark of the root,* 2 ounces; treacle [molasses], 2 pounds; and a dozen bruised cloves; pour upon these ingredients about four gallons of boiling water, and shake the vessel thrice a day. When fermentation has well begun, it is fit for use, and may be taken in the dose of a small tumblerful twice or thrice a day." This formula is worthy of attention; but the bark of guaiacum, which is not kept in the shops, might be omitted, or replaced by the wood.

tannic acid, the bark of sassafras root is an aromatic stimulant and astringent. It is used almost exclusively as an adjuvant to other more efficient medicines, the flavor of which it improves, while it renders them more acceptable to the stomach. The volatile oil may be used as an aromatic. In overdoses it is capable of producing marked narcotic poisoning, and it is said to act upon the lower animals as a narcotic. John Bartlett has reported several cases in which its use apparently caused abortion.

Sassafras Pith.—This is in slender cylindrical pieces, very light and spongy, about 5 Mm. in diameter, with a mucilaginous taste, and in a slight degree the characteristic flavor of the sassafras. It is officially described as "in more or less cylindrical, often curved or coiled pieces of variable length and about 5 Mm. in diameter, whitish, very light, with a slight odor and a mucilaginous taste. When macerated in water Sassafras Pith yields a mucilage which is not precipitated upon the addition of alcohol." *U. S.* It abounds in a gummy matter, which it readily imparts to water, forming a limpid mucilage, which is not precipitated by alcohol, but has much less tenacity than that of gum arabic and will not answer as a substitute in the suspension of insoluble substances. This mucilage is much employed as a soothing application in inflammation of the eyes, and forms an agreeable and useful drink in *dysenteric, catarrhal,* and *nephritic* diseases. It may be prepared by adding a drachm of the pith to a pint of boiling water.

Dose, of sassafras bark, one to two drachms (3.9 to 7.7 Gm.).

Off. Prep.—*From sassafras bark.*—Fluidextractum Sarsaparillæ Compositum, *U. S.;* Liquor Sarsæ Compositus Concentratus, *Br.*

From sassafras pith.—Mucilago Sassafras Medullæ, *U. S.*

SCAMMONIÆ RADIX. Br.

SCAMMONY ROOT

(scăm-mō'nĭ-æ rā'dĭx)

"The dried Root of Convolvulus Scammonia, *Linn.*" *Br.*

The root of the scammony is recognized by the British Pharmacopœia solely for the preparation of the resin. It is officially described as "brownish-gray or yellowish gray, tapering or nearly cylindrical roots, varying usually from one to three inches (two and a half to seven and a half centimetres) or more in diameter. The Root is frequently contorted and the surface longitudinally furrowed. It is enlarged at the crown, and bears the remains of slender aerial stems. The fracture is very coarsely fibrous; internally the color is light or dark gray. The section exhibits an abnormal wood, consisting of numerous irregularly arranged wood bundles; and, when examined under the microscope, appears beset with starch grains of characteristic shape, and, especially in the cortical region, with resin-cells. Odor characteristic; taste at first somewhat sweet, afterwards slightly acrid. It yields to *alcohol* (90 per cent.) a resin which should have the properties of Scammony Resin." *Br.* The wood consists of compressed pale brown, coarsely porous, usually subdivided fibres in a parenchymatous tissue similar to the bark. For microscopic structure, see *Dragendorff's Jahresbericht,* 1875.[1]

The root of the *male jalap* (*orizaba root, Purgo macho*) has recently largely replaced in commerce the scammony root on account of its containing a much larger percentage of resin chemically indistinguishable from that of scammony. The Levant or true scammony root, it is said, averages a little under 9 per cent. of resin, while the Mexican root[2] usually yields over 15 per cent. Male jalap occurs in transverse pieces one half to an inch in thickness and two to four inches in diameter or in the case of the smaller roots in pieces three or four inches long sometimes obliquely cut, the transverse slices show concentric rings with protruding coarse fibres which at once distinguishes it from the true scammony in which the vascular bundles are scattered.

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[1] Large quantities of a false scammony root of unknown botanical origin have appeared in the London market. The root is 2 to 3 inches in diameter with a thin, brittle, blackish-brown bark, and on transverse section six or seven rings of wood. It is odorless and tasteless. (See *P. J.,* May, 1901, 596.)

[2] *Mexican Scammony Root.*—Mexican scammony root has been identified by E. M. Holmes as being undoubtedly the root of *Ipomœa orizabensis,* and is described as follows: The appearance is quite characteristic and quite different from that of scammony root. It occurs mostly in transverse slices, showing concentric rings, from which coarse fibres protrude on both of the transverse surfaces. The sections are mostly those of the larger portion of the root, and vary from 2 to 3 in. or more in diameter, but are only about ½ in. to ¾ in. in thickness. The smaller roots are about 1 in. or so in diameter, but are frequently 3 or 4 in. long; a few pieces are obliquely cut. The concentric arrangement of the vascular bundles at once distinguishes it from the root of *Convolvulus scammonia,* in which they are scattered and somewhat rounded, forming islands, as it were, in the softer tissue. It appears that during 1903 there was an importation of over 3,000 bags, which sold readily to the German makers of scammony resin. Analyses made showed from 6.4 to 22.2 per cent. of resin, but most of it yielded about 17 per cent. While chemically there appears to be no difference between scammony resin and the resin of *Ipomœa orizabensis,* it remains to be ascertained if they are identical in their physiological action. At the request of Holmes, Harold Dean determined the amount of resin in a specimen and, in a separate paper, gives the method employed and the results, as follows: The drug was powdered, exhausted by percolation with alcohol (90 per cent.), the greater part of the alcohol distilled off, and the resulting strong tincture poured into three times its volume of water. The resin separated as a mass of honey-like consistence. It was well washed with boiling water until the washings were free from sugar and from color, and then dried on a water bath until the weight was constant. The yield of resin amounted to 18.5 Gm. from 100 Gm. of the powdered drug; this is the highest percentage yet recorded from this source. The dried resin was pale brown, and almost entirely soluble in ether, the insoluble portion from 18.5 Gm. weighing less than 0.25 Gm. It had the general characters of scammony resin. The powdered drug, dried at 100° C., yielded 9.89 per cent. of ash. (*P. J.,* March 5, 1904, 226, 327.)

Uses.—Scammony root in substance is not used medicinally, but solely for making resin of scammony.

Off. Prep.—Scammoniæ Resina, *Br.*

SCAMMONIUM. U. S., Br.

SCAMMONY

(scăm-mō′nĭ-ŭm)

"A gum-resin obtained by incising the living root of *Convolvulus Scammonia* Linné (Fam. *Convolvulaceæ*)." *U. S.* "A gum-resin obtained by incision from the living root of Convolvulus Scammonia, *Linn.* Known in commerce as virgin scammony." *Br.*

Scammonium Alepense; Scammonée d'Alep, *Fr. Cod.;* Scammonium, *G.;* Scamonea, *It.;* Escamonea, *Sp.*

Convolvulus Scammonia, L., *Sp. Pl.* (1753) 55; Willd., *Sp. Plant.* i. 845; *B. & T.* 187. This vine has a perennial, tapering root, from three to four feet long, from nine to twelve inches in circumference, branching towards its lower extremity, covered with a light gray bark, and containing a milky juice. The stems are numerous, slender, and twining, extending sometimes fifteen or twenty feet upon the ground or on neighboring plants, and furnished with smooth, bright green, arrow-shaped leaves, which stand alternately upon long footstalks. The flowers are placed in pairs, or three together, upon the peduncles, which are round, axillary, solitary, and of nearly twice the length of the leaf. The plant is a native of Syria, Anatolia, and the Archipelago.

Scammony is collected, according to Russell, in the following manner. In the month of June, the earth is cleared away from about the root, the top of which is cut off obliquely about two inches from the origin of the stems. The milky juice which exudes is collected in shells, or other convenient receptacle, placed at the most depending part of the cut surface. A few drachms only are collected from each root. The juice from several plants is put into any convenient vessel, and concretes by time. In this state it constitutes genuine scammony, but is very seldom exported. It is generally prepared for the market by admixture, while it is yet soft, with the expressed juice of the stalks and leaves, with wheat flour, chalk, ashes, fine sand, etc., and it has been supposed that scammony sometimes consists wholly or in great part of the expressed juice of the root evaporated to dryness by exposure to the sun or by artificial heat. According to Landerer, the roots from which the juice has been collected are in some places boiled with water in copper vessels, and the extract added to the juice, not so much with the purpose of adulteration as under the impression that it favorably modifies the action of the drug. Scammony is exported chiefly from Smyrna, though small quantities are said to be sent out of the country at Alexandretta, the seaport of Aleppo. Pereira was informed by a merchant who resided in Smyrna that it is brought in a soft state into that city upon camels, and afterwards adulterated by individuals called scammony makers. The adulteration appears to be conducted in conformity with a certain understood scale, more or less foreign matter being added according to the price. The materials employed are chiefly chalk and some kind of flour or meal. Very little comparatively is exported perfectly pure. We obtain scammony either directly from Smyrna, or indirectly through some of the Mediterranean ports.[1]

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[1] An interesting account of the collection and preparation of scammony in Anatolia, in the vicinity of Smyrna, has been communicated by S. H. Maltass to the *P. J.*, xiii. 264. The juice is collected in the same manner as described by Russell in reference to Syria. The product, however, of each plant is somewhat less. In some districts, according to Maltass, ten plants produce only a drachm of scammony; in others the average from each root is a drachm, and in a good soil a plant four years old will yield two drachms. The juice received in the shells is mixed with another portion scraped from the cut surface of the root, and this mixture is the pure or *lachryma scammony.* Only a small quantity of this is taken to Smyrna, the greater part being adulterated by the peasants before it reaches the markets. Sometimes the juice is worked up with a decoction of the roots, in which case it is black, heavier than the preceding, and not so easily broken. Sometimes they add a calcareous earth, in a proportion varying from 10 to 150 per cent. The kind thus prepared is usually kept for some time in Smyrna, and is apt to ferment, so as to become porous and lose its gloss. It is in irregular lumps, and is the kind usually sold in London as *lachryma scammony.* Another kind sold in London in rough lumps, and probably under the same name, is prepared in the interior of the country by mixing the juice with wheat starch, ashes, earthy matters, gum arabic or tragacanth, and sometimes wax, yolk of egg, pounded scammony roots and leaves, flour, or resin. A kind much used in Great Britain is prepared by the Jews in Smyrna, and is in the form of cakes as described in the text. It is of two qualities. The *first quality* is prepared by mixing *skilip* (which is an inferior kind of scammony prepared at Angora, and consists of from 30 to 40 per cent. of juice and 60 to 70 of starch) with 60 per cent. of inferior scammony from the neighborhood of Smyrna; the *second quality,* by mixing *skilip* with about 30 per cent. of the latter kind, and adding about 10 per cent. of gum arabic and black-lead. The first quality contains about 50 per cent. of resin, the second about 30 per cent. For an account of specimens of scammony sent by Maltass from Smyrna, see a paper by D. Hanbury in *P. J.* (xiii. 268).

Ch. Boulier of Algiers, gives the following account of the collection of scammony in the northwestern parts of Anatolia. The plant is not cultivated, but grows in rocky places covered with brushwood. At the flowering period, about the end of June and beginning of July, the peasants go forth in search of localities among the mountains where it is most abundant, and, having satisfied themselves on this point, return home, provide themselves with the requisite implements, and set out for the place of collection. Clearing away the brushwood and stems, the peasant digs deeply around the root, then cuts off the top obliquely, and affixes a mussel shell to the root so as to receive the juice as it flows from the dependent part. He then passes on to other plants, upon which he operates in like manner. After a time he retraces his steps, and empties the shells successively into a tinned copper vessel. Next day he goes over the same ground, and scrapes with a knife from the cut surface the juice which has in the mean time flowed out and partly concreted. This he mixes with that previously collected, and, when his vessel is full, takes it to some neighboring market, where it is bought up and sent to the wholesale druggists at Constantinople and Smyrna. The juice reaches the market in a pasty state, and whitish like cheese,

The name of *Aleppo scammony* was formerly given to the better kinds of the drug, and of *Smyrna scammony* to those of inferior quality,—the distinction having probably originated in some difference in the character of the scammony obtained at these two places. But no such difference now exists, as scammony is brought from Smyrna of every degree of purity. It has been customary, in this country, to designate the genuine drug, of whatever quality, as Aleppo scammony, while the name of Smyrna scammony has been given to a spurious article manufactured in the south of France, and to other factitious substitutes. It is quite time that these terms should be altogether abandoned. We shall treat of the drug under the heads of genuine and factitious scammony.

Genuine Scammony.—This is sent into commerce in drums or boxes, and is either in irregular lumps, in large solid masses of the shape of the containing vessel, into which it appears to have been introduced while yet soft, or in circular, flattish or plano-convex cakes. It seldom reaches us in an unmixed state. Formerly small portions of pure scammony were occasionally to be met with in Europe, contained in the shells in which the juice was collected and dried. This variety, denominated *scammony in shells*, is now scarcely to be found. The pure drug is called *virgin scammony*. It is in irregular pieces, often covered with a whitish-gray powder, friable and easily broken into small fragments between the fingers, with a shining grayish-green fracture soon passing into greenish black, and exhibiting under the microscope minute air-cells and numerous gray semi-transparent splinters.[1] It is easily pulverized, affording a pale ash-gray powder. When rubbed with water it readily forms a milky emulsion. It has a rather strong, peculiar odor, comparable to that of old cheese. The taste is feeble at first, and afterwards somewhat acrid, but without bitterness. It gives no evidence, when the requisite tests are applied, of the presence of starch or calcium carbonate, leaves but a slight residue when burned, and yields about 80 per cent. of its weight to ether. Considerable quantities of what is called virgin scammony have been imported into this country since the drug-law went into operation; but, though some specimens are tolerably pure, the drug, on the whole, falls far short of the proper standard. E. R. Squibb examined many specimens, and found the proportion of resin to vary from 25 to 79.7 per cent.; only two or three, out of more than 30 examined, approaching the latter degree of purity within 10 per cent. Squibb gives the following description of the drug imported as *virgin scammony*. "It generally occurs in solid square tin boxes, containing 25 to 28 pounds each. Occasionally, however, it is in round wooden boxes or drums of a similar capacity. The scammony is in irregular, rough and fissured masses of various sizes, sometimes porous, but commonly solid, hard, and semi-resinous, having a tough, dull fracture. It is of a very dark grayish-green color internally, often nearly black, but more of an ash color externally. It is rarely dry enough to be pulverulent, yet still more rarely too moist to be rubbed into coarse powder, and it generally loses 6 per cent. in drying sufficiently to make a fine powder." (*A. J. P.*, Jan. 1863, p. 49.)

Properties.—The official description and tests for scammony are as follows: "In circular cakes or irregular, angular pieces of various sizes, greenish-gray or brownish-black, often covered with a grayish-white powder; very brittle, breaking with an angular fracture, porous and of a resinous lustre; internally of a uniform brownish-black color, more or less translucent in thin fragments; odor peculiar, somewhat cheese-like; taste slightly acrid. Scammony is easily reduced to an ash-gray powder, which when triturated with water yields a greenish emulsion that does not effervesce on the addition of diluted hydrochloric acid; a decoction of Scammony, when cold, does not become blue with iodine T.S.; an alcoholic solution is not colored blue on the addition of tincture of ferric chloride; not less than 75 percent. should be soluble in ether, and when the residue left on the evaporation of the ethereal solution is dissolved in a hot solution of potassium or sodium hydroxide, it is not reprecipitated on the addition of diluted sulphuric acid; ash not more than 3 percent." *U. S.* "It should afford only the slightest reactions with the tests for starch, and should yield at least 70 per cent. of resin soluble in *ether*, and not more than 3 per cent. of ash on incineration. An alcoholic solution should not afford a blue color with *test-solution of ferric chloride* (absence of guaiacum resin)." *Br.*

The form of scammony chiefly found in our markets is that in circular cakes. These are sometimes flattish on both sides, but generally somewhat convex on one side and flat on the other, as if dried in a saucer or other shallow vessel. They are from four to six inches in diameter, and from half an inch to an inch and a half or even two inches thick in the centre, and are often found in fragments. They are hard and heavy, with a faintly shining roughish fracture, and when broken exhibit in general a structure very finely porous, sometimes almost compact, and in a very few instances cavernous. Their color externally is a dark ash or dark olive or slate color approaching to black; internally somewhat lighter and grayish, with an occasional tinge of green

except where exposed to the air. It is in these centres of trade, or on its way from the collectors, that the drug undergoes the various sophistications to which it is subjected,—the peasant himself being usually honest and not disposed to adulterate. (*Ibid.*, April, 1860, p. 521.)

[1] According to Maltass, the purest scammony has a reddish-black fracture, unless it has been mixed with water in its preparation, in which case it is black and very glossy. (*P. J.*, xiii. 266.)

or yellow, but deepening by exposure. The small fragments are sometimes slightly translucent at the edges. The mass, though hard, is pulverizable without great difficulty, and affords a light-gray powder. It imparts to water with which it is triturated a greenish milky appearance. The odor is rather disagreeable, and similar to that of the pure drug. The taste, very slight at first, becomes feebly bitterish and acrid. This kind of scammony is never quite pure, and much of it is considerably adulterated. In some of the cakes calcium carbonate is the chief impurity; in others the adulterating substance is probably meal, as evidences of the presence of starch and lignin are afforded, and in others, again, both these substances are found. Christison discovered in the chalky specimens from 15 to 38 per cent. of calcium carbonate; in the amylaceous, from 13 to 42 per cent. of impurity. It was probably to the flat, dark-colored, compact, difficultly pulverizable, and more impure cakes that the name of *Smyrna scammony* was formerly given. These have been erroneously ascribed by some to *Periploca secamone,* a plant growing in Egypt.

Scammony is ranked among the gum-resins. It is partially dissolved by water, much more largely by alcohol and ether, and almost entirely, when pure, by boiling diluted alcohol. Its active ingredient is resin, which constitutes from 80 to 90 per cent. of pure dry scammony. (See *Resina Scammonii.*) The gum-resin has been analyzed by various chemists, with varying results, as the character of the specimens examined is insufficiently determined by the terms Aleppo and Smyrna scammony employed to designate them. The resin is now known to be identical with that found in the root of the Mexican *Ipomœa orizabensis,* known in commerce as male jalap, and the name *jalapin* is given to it. (See *Jalapa.*) Bouillon-Lagrange and Vogel obtained from 100 parts of Aleppo scammony, 60 of resin, 3 of gum, 2 of extractive, and 35 of insoluble matter; from the same quantity of Smyrna scammony, 29 parts of resin, 8 of gum, 5 of extractive, and 58 of vegetable remains and earthy substances. It is obvious that both the specimens upon which they operated were very impure. Marquart found in pure scammony (*scammony in shells*) 81.25 per cent. of resin, 3.00 of gum with salts, 0.75 of wax, 4.50 of extractive, 1.75 of starchy envelopes, bassorin, and gluten, 1.50 of albumen and lignin, 3.75 of ferruginous alumina, chalk, and magnesium carbonate, and 3.50 of sand.

Christison found different specimens of pure scammony to contain, in 100 parts, from 77 to 83 parts of resin, from 6 to 8 of gum, from 3.2 to 5 of lignin and sand, and from 7.2 to 12.6 of water, with occasionally a little starch, probably derived accidentally from the root, and not in sufficient quantity to cause a cold decoction of the gum-resin to give a blue color with iodine. Hanbury of London, found 91.1 per cent. of resin in the purest scammony in shells. As already stated, scammony is seldom quite pure as found in commerce. Much of it contains not more than 50 per cent. of the resin, some not more than 42 per cent., and the worst varieties as little as 10 per cent., or even less. Sometimes the cakes are of good quality on the outside, and inferior within. In view of this uncertainty as to the strength of scammony, it is undoubtedly best to abandon its internal use altogether, employing only the resin, which is of uniform strength. Indeed, the resin has been officially substituted for the gum-resin in the compound extract of colocynth. Aslanoglon (*Chem. News,* 1901, 682) proposed a quantitative valuation of scammony based on its treatment with ether and oil of turpentine; see also Dowzard's method (*P. J.,* April, 1904, 469).

Factitious Scammony. Montpellier Scammony.—Much spurious scammony was manufactured in the south of France, said by Guibourt to be made from the expressed juice of *Cynanchum monspeliacum* (*C. acutum,* L.), incorporated with various resins and other purgative substances. Thorel, however, a pharmacist of Avallon, denies that this plant is employed in its preparation. (*J. P. C.,* xx. 107.) It has been occasionally imported into the United States and sold as Smyrna scammony. It is usually in flat semicircular cakes, four or five inches in diameter and six or eight lines thick, blackish both externally and within, very hard, compact, rather heavy, of a somewhat shining and resinous fracture, a feeble balsamic odor wholly different from that of genuine scammony, and a very bitter nauseous taste. When rubbed with the moistened finger it becomes dark gray, unctuous, and tenacious. We have seen another substance sold as Smyrna scammony, which was obviously spurious, consisting of blackish, circular, flat cakes, or fragments of such cakes, rather more than half an inch thick, very light, penetrated with small holes, as if worm-eaten, and when broken exhibiting an irregular, cellular, spongy texture. It is affirmed that a resin obtained from the root of *Convolvulus althæoides* of Southern Europe is sometimes substituted for scammony. Pereira described a factitious substance sold as *Smyrna scammony,* which was in circular flat cakes about half an inch thick, blackish, and of a slaty aspect, breaking with difficulty, of a dull, black fracture and of the sp. gr. 1.412. Moistened and rubbed, it had the odor of guaiac; the adulteration was also detected by chemical tests.

Uses.—Scammony is an energetic cathartic, likely to occasion griping, and sometimes operating with harshness. It was known to the ancient Greek physicians, and was much employed by the Arabians, who used it as a purgative and externally in skin diseases. On account of its occasional violence, it is seldom administered, except in combination with other cathartics, the action of which it promotes,

while its own harshness is mitigated.[1] It should be given in emulsion with mucilage, sugar, almonds, licorice, or other demulcent, and its disposition to gripe may be counteracted by the addition of an aromatic.

Dose, from five to ten grains (0.32 to 0.65 Gm.).

Off. Prep.—Resina Scammonii, *U. S.*

SCILLA. U. S., Br.

SQUILL

(sçil'lą)

"The bulb of *Urginea maritima* (Linné) Baker (Fam. *Liliaceæ*), deprived of its dry, membranaceous outer scales, cut into thin slices and carefully dried, the central portions being rejected." *U. S.* "The bulb of Urginea Scilla, *Steinh.*, divested of its dry membranous outer scales, cut into slices, and dried." *Br.*

Squills; Scille, *Fr. Cod.*; Bulbus Scillæ, *P. G.*; Meerzwiebel, *G.*; Scilla, *It.*; Escila (Bulbo de), Cebolla albarrana, *Sp.*

For *Urginea*, Br. Add., see PART II.

Urginea maritima (L.), Baker, *Journ. Linn. Soc.* (1873), 221.—*Urginea Scilla*, Steinheil, *Ann. Sci. Nat.* (1834), 330.—*Scilla maritima*, L., *Sp. Pl.* (1753) 308; Willd., *Sp. Plant.* ii. 125.—This is a perennial plant, with fibrous roots proceeding from the bottom of a large bulb, which sends forth several long, lanceolate, pointed, somewhat undulated, shining, deep-green leaves. From the midst of the leaves a round, smooth, succulent flower-stem rises, from one to three feet high, terminating in a long, close spike of whitish flowers. These are destitute of calyx, and stand on purplish peduncles, at the base of each of which is a linear, twisted, deciduous floral leaf. The squill grows on the sea coast of Spain, France, Italy, Greece, and the other countries bordering on the Mediterranean. The bulb is the official portion. It is generally dried for use, but is sometimes imported in the recent state packed in sand.

Properties.—The fresh bulb is pear-shaped, usually larger than a man's fist, sometimes as large as the head of a child, and consists of fleshy scales attenuated at their edges, closely applied over each other, and invested by exterior scales so thin and dry as to appear to constitute a membranous coat. There are two varieties, distinguished as the *red* and the *white squill*. In the former the exterior coating is of a deep reddish-brown color, and the inner scales have a whitish rosy or very light pink epidermis, with a yellowish-white parenchyma; in the latter the whole bulb is white. They do not differ in medicinal virtue. The bulb abounds in a viscid, very acrid juice, which causes it to inflame and even excoriate the skin when much handled. By drying, this acrimony is very much diminished, with little loss of medicinal power. The bulb loses about four-fifths of its weight in the process. Vogel found 100 parts of fresh squill to be reduced to 18 by desiccation. The process is somewhat difficult, in consequence of the abundance and viscidity of the juice. The bulb is cut into thin transverse slices, and the pieces dried separately by artificial or solar heat. The outer and central scales are rejected, the former being dry and destitute of activity, the latter too fleshy and mucilaginous.

Dried squill, as found in commerce, is in irregular oblong pieces, often more or less contorted, of a dull yellowish-white color with a reddish or rosy tint, sometimes entirely white, slightly diaphanous, brittle and pulverizable when perfectly dry, but often flexible from the presence of moisture, for which it has a great affinity. Occasionally a parcel will be found consisting of vertical slices, some of which adhere together at the base. The odor is very feeble, the taste bitter, nauseous, and acrid. It is officially described as "in irregular, more or less curved, somewhat translucent, yellowish-white or reddish-white segments, 3 to 5 Cm. long, brittle and pulverizable when dry, tough and flexible when damp; odor slight; taste mucilaginous, bitter, and acrid." *U. S.*

The virtues of squill are extracted by water, alcohol, and vinegar. It has been analyzed by Vogel, J. H. Marais, Lebourdais, Tilloy, Merck, and lastly by Schmiedeberg (*Zeit. Physiol. Chem.*, 111, 112) with varying results. The bitter principle, not yet obtained pure, is *scillitin*. Merck, however, obtains three compounds of this class,—*scillipicrin*, *scillitoxin*, and *scillin*. Jarmersted (*A. E. P. P.*, 11, 22) obtained a glucoside which he called *scillain*, but which seems to be identical with scillitoxin. Schmiedeberg (*loc. cit.*) found a peculiar mucilage, analogous to dextrin, which he calls *sinistrin*, $(C_6H_{10}O_5)_n$. It is white, easily soluble in water, insoluble in alcohol, lævo-rotatory; on boiling with dilute sulphuric acid it yields levulose and an inactive sugar of reducing properties. The mucilage is not affected by saliva or diastase. This last statement, however, was contradicted by F. Kurtz (*A. J. P.*, 1894, 246), who says that diastase acts upon it, producing a reducing sugar. Kurtz (*loc. cit.*) also obtained a reducing sugar (probably dextrose) along with the gum direct by extracting the bulb with hot alcohol. S. Wanizewski (*A. J. P.*, 1893, 498) found *scillinine*, soluble in alcohol, but insoluble in water and in chloroform; *scillapicrine*, soluble in both water and alcohol, and *scillamarine*, soluble in both chloroform and alcohol. The bulbs of *Scilla marit-*

[1] *Triplex Pills.*—J. W. Francis of New York City, employed a combination of purgatives which afterwards became very well known as triplex pills. The original formula, obtained through E. R. Squibb, is as follows: Powdered Scammony, Powdered Socotrine Aloes, Blue Mass, of each, 1 *troyounce*; Croton Oil, 20 *minims*; Oil of Caraway, 1½ *fluidrachms*; Tincture of Aloes and Myrrh, 2 *fluidrachms*. Mix well, and make into 500 pills. The usual aperient or laxative dose is one pill at bedtime until the natural condition is restored. (*Proc. A. Ph. A.*, 1872.)

ima also yield a slightly colored liquid oil of unpleasant odor when distilled in a current of steam. (*Husemann's Pflanzenstoffe*, 2d ed., p. 406.)

Examined by the microscope, the bulb is seen to be pervaded by innumerable minute acicular crystals of calcium oxalate. According to Hartwich, the mucilage occurs either in the form of large drops, filling the parenchymatous cells, or as masses enclosing the raphides. For an elaborate microscopic study, with plates, see *A. Pharm.*, July, 1889. Water distilled from it had neither taste nor odor, and was drunk by Vogel to the amount of six ounces without effect. When kept in a dry place, squill retains its virtues for a long time; but if exposed to moisture it soon becomes mouldy.

Uses.—Squill is expectorant, diuretic, and in large doses emetic and purgative. In overdoses it has been known to occasion hypercatharsis, strangury, bloody urine, and fatal inflammation of the stomach and bowels. The Greek physicians employed it as a medicine, and it has retained to the present period a deserved popularity. As an expectorant, it is used in cases both of deficient and of superabundant secretion from the bronchial mucous membrane,—in the former case usually combined with tartar emetic or ipecacuanha, in the latter frequently with the stimulant expectorants. In both instances it operates by stimulating the vessels of the lungs, and it should not be used when there is a high degree of inflammation, with arrested secretion. In *dropsy* it is much employed, especially in connection with digitalis, but, as it is distinctly irritant to the kidneys, it should not be used when there is irritation or active inflammation of these organs. On account of its great uncertainty and occasional harshness, it is very seldom prescribed as an emetic, except in *croup*, in which it is usually given in the form of syrup. When given in substance it is most conveniently administered in the form of pill.

From six to twelve grains (0.4 to 0.78 Gm.) will generally cause vomiting. The vinegar, fluidextract and syrup of squill are official, and are much used. An *acetic extract* has been prepared by F. D. Niblett, by digesting a pound of squill with three fluidounces of acetic acid and a pint of distilled water, with a gentle heat, for forty-eight hours, then expressing, and, without filtration, evaporating to a proper consistence. One grain is equal to about three grains of the powder. (*P. J.*, xii. 133.)

Dose, of squill, from one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Acetum Scillæ, *U. S.*, *Br.*; Fluidextractum Scillæ, *U. S.*; Oxymel Scillæ, *Br.*; Pilula Ipecacuanhæ cum Scilla, *Br.*; Pilula Scillæ Composita, *Br.*; Syrupus Scillæ, *U. S.*, *Br.* (from vinegar); Syrupus Scillæ Compositus, *U. S.* (from fluidextract); Tinctura Scillæ, *U. S.*, *Br.*

SCOPARIUS. U. S. (Br.)

SCOPARIUS [Broom]

(scǫ-pā′rĭ-ŭs)

"The dried tops of *Cytisus Scoparius* (Linné) Link (Fam. *Leguminosæ*)." *U. S.* "The fresh and the dried tops of Cytisus Scoparius, *Link*." *Br.*

Scoparii Cacumina, *Br.*; Broom Tops; Herba Scoparii, Spartium; Irish or Scotch Broom, Besom, Genêt à balais, *Fr.*; Gemeine Besenginster, Besenginster, Besenkraut, Pfriemenkraut, *G.*

Cytisus Scoparius (L.), Link, *Enum. Hort. Berol.* (1822), 241.—*Spartium scoparium*, L., *Sp. Pl.* (1753) 709.—*Sarothamnus scoparius*, Wimm., Koch, *Syn. Fl. Germ. et Helv.* (1837), 152.—This is a common European shrub, cultivated in our gardens, from three to eight feet high, with numerous straight, pentangular, bright green, very flexible branches, and small, oblong, downy leaves, usually ternate, but on the upper part of the plant sometimes simple. The flowers are numerous, papilionaceous, large, showy, of a golden-yellow color, and solitary upon short axillary peduncles. The seeds are contained in a compressed legume, which is hairy at the sutures. It is essential that true broom be carefully distinguished from *Spanish broom* (*Spartium Junceum*), since a number of cases of poisoning have occurred from the substitution of the dried flowers of Spartium for those of broom. (See PART II.)

The whole plant has a bitter, nauseous taste, and, when bruised, a strong, peculiar odor. The tops of the branches are the official portion. They are in "thin, flexible, branched twigs, 2 to 3 Mm. thick; externally dark green, with five wings and numerous reddish-brown cork patches; internally yellowish; younger branches somewhat pubescent; fracture short-fibrous, that of thick pieces tough and splintery; usually free from the simple, obovate leaves; having a peculiar odor when bruised; taste disagreeably bitter." *U. S.* The seeds are reported to be used sometimes, and to be as active as the tops. Water and alcohol extract their active properties. According to Cadet de Gassicourt the flowers contain volatile oil, fatty matter, wax, chlorophyll, yellow coloring matter, tannin, a sweet substance, mucilage, albumen, and lignin. Stenhouse has separated from them two principles, *scoparin*, $C_{21}H_{22}O_{10}$,[1] and an alkaloid, *sparteine*, $C_{15}H_{26}N_2$. The former is in stellate crystals, easily dissolved by boiling water and alcohol, and is obtained by purifying a yellow gelatinous substance deposited upon the evaporation of the decoction. It is only slightly soluble in cold water, more readily in hot water with greenish light yellow color, easily soluble in aqueous ammonia and caustic and carbonated alkalies. It is decomposed by heat. When fused with potassium hydroxide

[1] Goldschmidt and Himmelmayer (*Ap. Ztg.*, 1893, 566) give the following formula of scoparin: $C_{19}H_{16}O_8(OH)(OCH_3)$.

it yields, according to Hlasiwetz, phloroglucin and protocatechuic acid. Sparteine was obtained by distillation from the mother waters of the scoparin. It is a colorless liquid, having a peculiar bitter taste, and all the properties of a volatile alkaloid. It is heavier than water, and boils at 288° C. if distilled in a current of hydrogen gas. It dissolves only slightly in water, but takes up some water itself. In contact with water it becomes opalescent. It turns yellowish on distillation in air, but can be distilled colorless in an atmosphere of carbon dioxide. It is colorless, but becomes brown by exposure to light; it has at first an odor of aniline, but this is altered by rectification. It readily neutralizes acids and forms crystallizable salts, which are extremely bitter. Its sulphate occurs in colorless crystals, and is freely soluble in water. (See *P. J.*, June 28, 1879; also *Sparteinæ Sulphas.*) By the action of potassium dichromate and sulphuric acid, *oxysparteine*,[1] $C_{15}H_{24}N_2O$, is formed, and by the action of hydrogen dioxide upon this, a deliquescent *trioxysparteine*, $C_{15}H_{24}N_2O_3$, is obtained; if the hydrogen dioxide acts upon sparteine itself, *dioxysparteine*, $C_{15}H_{24}N_2O_2$, is formed as a solid, crystallizing in prisms melting at 128.5° C. Zinc and hydrochloric acid reduce sparteine to *hydrosparteine*, $C_{15}H_{28}N_2$, a thick liquid boiling at from 281° to 284° C. (Schmidt, *Pharmaceutische Chemie*, 3te Auf., Bd. ii. 1276.)

Uses.—Scoparius is diuretic and cathartic, and in large doses emetic, and has been employed with great advantage in *dropsy*, for which it was recommended by Meade, Cullen, and others. Cullen prescribed it in the form of decoction, made by boiling half an ounce of the fresh tops in a pint of water down to half a pint, of which he gave a fluidounce (30 Cc.) every hour until it operated by stool or urine. The seeds may be given in powder, in the dose of from ten to fifteen grains (0.65 to 1.0 Gm.). A fluidextract was official in the U. S. P. 1890. (See page 525.)

Scoparin probably represents the diuretic and purgative influences of scoparius, although its physiological and therapeutic properties have not as yet been sufficiently investigated. Poisonous doses of *sparteine* (see *Sparteinæ Sulphas*) cause in the lower animals tremblings, incoördination, increase of reflexes, clonic and tonic convulsions, embarrassment of the respiration, acceleration of the pulse, and enfeeblement of the heart, followed by gradual enfeeblement of all the functions, convulsions, and death from asphyxia. Sparteine paralyzes the respiratory centres and the motor centres of the spinal cord, and has a very feeble influence upon the muscles, lessening, though not destroying, their excitability. Laborde was the first to call attention to its action upon the heart, and his results have been confirmed by Griffe, Garand, and Masius. Under the influence of the alkaloid there is a very great increase in the size and height of the cardiac wave. If the dose has been a small one, the pulse will be at first accelerated. After larger doses there is a slowing of the pulse. Observers agree in stating that the arterial pressure is not materially changed unless the dose is toxic, when it steadily falls; but small doses weaken and larger ones paralyze the peripheral pneumogastric nerve. Upon the vasomotor system sparteine appears to have no influence unless in large toxic doses, when it perhaps acts as a paralyzant. It does not represent the diuretic influence of scoparius. Sée affirms as the result of personal experience that sparteine is of very great value in *cardiac affections*, increasing the force of the cardiac beat, and especially producing regularity in cases of irregular cardiac action. For the latter purpose, he states, it is the most powerful remedy known. Other clinicians have recorded experience favorable to the value of sparteine, but the conclusion of Hiero Stoessel, that sparteine is inferior as a heart tonic to digitalis, and to be employed only as a succedaneum to that drug, probably indicates correctly the scope of its use. It has the great advantage of acting very quickly, the symptoms commencing about twenty minutes after its absorption, and reaching their maximum in four or five hours, but persisting one or two days. It is probably not safe to commence with doses greater than one-sixth of a grain (0.010 Gm.), although observers seem to be in accord in believing that much larger amounts are usually necessary. Voigt, Prior, Sée, and Leo all advise doses of one and a half grains (0.097 Gm.) repeated four or five times in the twenty-four hours. It is affirmed that no cumulative effects need be feared.

As the result of experiments upon the lower animals, Langlois and Maurange (*A. de P.*, vii. 1895) believe that sparteine and oxysparteine are valuable remedies for the maintenance of cardiac action during chloroformization, acting partly by stimulating the heart, partly by depressing the pneumogastric nerve. G. G. Cottam asserts (*T. G.*, Nov. 1896), as the result of a clinical study, that one-tenth grain of the sparteine sulphate, given hypodermically just before the inhalation of chloroform, will prevent any cardiac depression from the anæsthetic.

Dose, of scoparius, ten to fifteen grains (0.65 to 1.0 Gm.).

Off. Prep.—Infusum Scoparii, *Br.*; Succus Scoparii, *Br.*

[1] *Oxysparteine*, $C_{15}H_{24}N_2O$.—This is an alkaloidal oxidation product of sparteine, originally described by F. Ahrens (*Ber. d. Chem. Ges.*, 1891). It occurs in white, somewhat hygroscopic needles, melting at about 84° C., soluble in water, alcohol, ether, and chloroform. It has been found by Hurthle (*A. E. P. P.*, 1892) to be a cardiac stimulant, decreasing the pulse rate, but markedly increasing the arterial pressure and heart work. The hydrochloride, which occurs in large needles (often consolidated together) and is very soluble in water, has been used hypodermically by von Oefele in cases of *heart failure*. The dose is half a grain (0.032 Gm.), rapidly increased to one and a half grains (0.096 Gm.). The system is said soon to become accustomed to it.

SCOPOLA. U. S.

SCOPOLA

(scǫ-pō'lą)

"The dried rhizome of *Scopola Carniolica* Jacquin (Fam. *Solanaceæ*), yielding, when assayed as directed below, not less than 0.5 percent. of its alkaloids." *U. S.*

Belladonna Scopola, Scopola Belladonna, Japanese Belladonna (incorrectly).

In 1771, John Anthony Scopoli, of the University of Pavia, described in the *Flora Carniolica* an *Atropa* from Idria. Three years later, Jacquin made this plant the type of the new genus *Scopola,* and gave it the specific name of *Carniolica.* Of this plant Koch made two species, one with green and the other with purple flowers, but the more recent botanists are in accord in believing that the green-flowered plant, the *S. hladnikiana* of Koch, the *S. viridiflora* of Rabenhorst, is not specifically distinct, there being, indeed, three varieties of *S. Carniolica,* one with purple, one with green, and one with yellow flowers, the latter being the *S. concolor* of De Candolle; indeed, E. M. Holmes has shown that the root examined by Schmidt was probably from a plant with yellow flowers, and therefore the *concolor* of De Candolle. *Scopolia atropoides* has also been described by Nevinny. (*Ph. Post,* 1894, 333, 349, 357.) See also Rusby's papers (*Proc. A. Ph. A.,* 1899, 292 and 1901, 313).

The genus *Scopola* is the connecting link between *Atropa* and *Hyoscyamus,* resembling *Atropa* in leaf and flower and in the microscopical character of its rhizome, but differing in that its fruit is not a berry and in the inflation of its calyx. The Japanese plant, *S. japonica,* is so closely allied to *S. carniolica* that its specific distinction is very doubtful; it has been separated upon the characters of the style being curved, the calyx-teeth unequal and the leaves less obovate and having much longer petioles than *S. Carniolica;* but Holmes has shown that the curved style occurs in *S. Carniolica. S. Carniolica* is a common plant in Bavaria, Austro-Hungary, and Southwestern Russia, usually in the hilly districts, where it grows in damp, stony places. Its general appearance is that of the belladonna, but it is much shorter, rarely growing above a foot in height, has thinner leaves, and is especially distinguished by its fruit being a transversely dehiscent capsule and by the presence of a distinct rhizome.

Properties.—The latter occurs in commerce either entire or longitudinally split in half, in pieces from two to five inches in length and from one-third to three-fourths or even one inch in diameter; of a grayish-brown color, very irregular in shape, often much bent or twisted, the whole surface usually covered thickly with the broad, subcircular, deeply-hollowed-out, projecting scars of the stems of successive seasons, and finely and coarsely wrinkled longitudinally and transversely. The section is whitish and distinctly starchy in appearance. The texture is hard, but somewhat brittle. The taste is slightly bitter, and disagreeable. It is officially described as "of horizontal growth, more or less curved and shortly and sharply flexuous, cylindraceous and somewhat flattened vertically, occurring mostly in pieces from 2.5 to 7.5 Cm. long and 0.8 to 1.6 Cm. broad, often split before drying; upper surface marked with closely set, large, cup-shaped stem scars, margins irregularly contracted; externally varying from yellowish-brown to dark brownish-gray, finely and irregularly wrinkled longitudinally, obscurely annulate and more or less nodular-roughened; fracture short and sharp, exhibiting a yellowish-white bark, its corky layer dark brown, or pale brown, wood indistinctly radiate, and central pith rather horny; nearly inodorous; taste sweetish, afterwards bitterish and strongly acrid." *U. S.*

The Japanese rhizome is from two to six inches long, about one-half inch in diameter, rarely branched, cylindrical or slightly compressed, knotty, bent, with circular disk-like scars, of a pale brown color, not whitish when abraded, with a slightly mousy, narcotic odor, and a taste nearly free from bitterness. According to Thos. Greenish, the microscopical characteristics of the rhizome of *S. Carniolica* are very similar to those of belladonna root, the chief differences being that the bark is less thick, the dark line under the epidermis narrower, the vascular bundles neither so large nor so numerous, and the bundles of raphides less pronounced; the starch grains are also smaller and their shape less distinct. The structure of the rhizome of *S. japonica* was found to be the same as that of the European species.

The alkaloid *scopolamine* (or *scopoleine*), $C_{17}H_{21}NO_4$, has been found to be the characteristic constituent of the root, but is also found in small quantities in belladonna root, stramonium seeds, and *Duboisia myoporoides.* E. Schmidt considers scopolamine to be identical with hyoscine. (*A. Pharm.,* 1892, 206 to 232.) Scopolamine forms permanent transparent crystals of the formula $C_{17}H_{21}NO_4 + H_2O$, melting at 59° C. to a colorless liquid. The double gold chloride melts at from 212° to 214° C. Scopolamine is decomposed by baryta into *scopoline,* $C_8H_{13}NO_2$, a crystalline base, melting at 110° C., and *atropic acid,* $C_9H_8O_2$. Commercial hyoscine hydrobromide is said by E. Schmidt often to consist almost entirely of scopolamine hydrobromide, and Hesse has considered the two bases as identical. (*A. Pharm.,* 1894, 409.) O. Hesse examined commercial scopolamine hydrochloride, and found it to consist of salts of two bases, *hyoscine* and *atroscine.* (*P. J.,* 1896, 296.) Schmidt, continuing his investigations, proves that hyoscine is a mixture of scopolamine and some other body, and believes Hesse's atroscine to be opti-

cally inactive scopolamine. He doubts the existence of hyoscine as a distinct body. (*Ap. Ztg.*, 1896.) Seward W. Williams states, as the result of the assay of many tons of the root of *Atropa belladonna* and of the rhizome of *Scopola*, each of the best qualities occurring in the American market, that while the belladonna root yields on an average 0.50 per cent. of alkaloid, the scopola yields 0.58 per cent. See also *Proc. A. Ph. A.*, 1899, 285.

Assay.—"The method to be employed is identical with that given for Belladonna Leaves, on page 228, using *ten grammes* of Scopola, in No. 60 powder." *U. S.*

Uses.—The physiological and medicinal properties of scopola are very similar to those of belladonna, but the crude drug has been scarcely used at all in medicine. It has been largely employed in America in the manufacture of belladonna plaster and much of the hyoscine of commerce in the last decade has been obtained from it. Its alkaloid *Scopolamine hydrobromide* is recognized in the United States Pharmacopœia as identical with hyoscine hydrobromide.

Dose, one to two grains (0.065 to 0.13 Gm.).

Off. Prep.—Fluidextractum Scopolæ, *U. S.*; Extractum Scopolæ, *U. S.* (from fluidextract).

SCOPOLAMINÆ HYDROBROMIDUM. U. S.

SCOPOLAMINE HYDROBROMIDE

(scŏ-pō-lą-mĭ'næ hȳ-drŏ-brō'mĭ-dŭm)

$C_{17}H_{21}NO_4.HBr + 3H_2O = 434.92$

"The hydrobromide [$HBr.C_{17}H_{21}NO_4 + 3H_2O$] of an alkaloid obtained from plants of the *Solanaceæ;* chemically identical with Hyoscine Hydrobromide (see *Hyoscinæ Hydrobromidum*)." *U. S.* "The hydrobromide, $C_{17}H_{21}NO_4$,HBr,$3H_2O$, of an alkaloid contained in Hyoscyamus Leaves, different species of Scopola, and possibly other solanaceous plants." *Br.*

Hyoscinæ Hydrobromidum, *Br.*; Hyoscine Hydrobromide; Bromhydrate d'Hyoscine, *Fr.*; Scopolaminum hydrobromicum, *P. G.*; Skopolaminhydrobromid, *G.*

For a description of the properties and uses of this salt see *Hyoscinæ Hydrobromidum*, page 645.

SCUTELLARIA. U. S.

SCUTELLARIA [Skullcap]

(scū-tęl-lā'rĭ-ą)

"The dried plant of *Scutellaria lateriflora* Linné (Fam. *Labiatæ*)." *U. S.*

Scullcap, Hoodwort, Madweed, Mad-dog or Side-flowering Scullcap, Blue Pimpernel, Hooded Willow-herb; Scutellaire, *Fr.*; Helmkraut, Schildkraut, *G.*

Several species of Scutellaria have attracted attention. *Scutellaria galericulata*, L., or common *European scullcap*, which also grows wild in this country, has a feeble, somewhat alliaceous odor, and a bitterish taste. It has been employed in intermittents, and externally in old ulcers. The indigenous species, *S. integrifolia*, L. (syn. *S. hyssopifolia*, L.), is intensely bitter, and might probably be found useful as a tonic.

Scutellaria lateriflora, L., *Sp. Pl.* (1753) 598.—This is an indigenous perennial herb, with a stem erect, much branched, quadrangular, smooth, and one or two feet high. The leaves are ovate, acute, dentate, subcordate upon the stem, opposite, and supported upon long petioles. The flowers are small, of a pale blue color, and disposed in long, lateral, leafy racemes. The tube of the corolla is elongated, the upper lip concave and entire, the lower three-lobed. The plant grows in moist places by the sides of ditches and ponds in the United States and Canada.

Properties.—The dried tops are officially described as "about 50 Cm. long, smooth; stem quadrangular, branched; leaves opposite, petiolate, about 5 Cm. long, ovate-lanceolate or ovate-oblong, serrate; flowers about 6 Mm. long, in axillary one-sided racemes, with a pale blue corolla and bilabiate calyx, closed in fruit, the upper lip helmet-shaped; odor slight; taste bitterish." *U. S.* H. Molisch and G. Goldschmidt (*Ph. Ztg.*, Dec. 4, 1901, 965) obtained from *Scutellaria* and a number of other labiates an identical body, to which they gave the name *scutellarin*. It is present in all of the different *Scutellarias*, being most abundant in the upper epidermis of the leaf, but found also in the roots, stems and flowers of the plant. It was further obtained from the leaves of *Galeopsis Tetrahit*, L., and of *Teucrium Chamaedrys*, L. In *Scutellaria altissima*, L., the presence of cinnamic and fumaric acid could also be established. Scutellarin is obtained by boiling freshly gathered leaves for 15 minutes in ten times their weight of water, filtering the decoction and adding from 1 to 2 per cent. of hydrochloric acid, which causes an abundant precipitate of scutellarin. If precipitation is effected from the hot solution, the scutellarin separates in the form of light yellow crystals. The formula $C_{21}H_{10}O_{12}$ has been assigned to the crude scutellarin so obtained. Its alcoholic solution gives a red precipitate with lead acetate and an intense green color with ferric chloride, changing on heating to a red color if the reagent is not present in great excess; alcoholic potassium or sodium hydroxides, as also alkali acetates, produce reddish-yellow precipitates, which change on exposure to the air to a green. Baryta water has the same effect. The green color is produced immediately if an oxidizing agent, such as chlorine or bromine water, is added.

Uses.—Scullcap is as destitute of medicinal properties as a plant may well be, not even being aromatic. When taken internally, it produces no very obvious effects, and probably is of no remedial value, although at one time it

was esteemed as a remedy in *hydrophobia.* It has also been used in *neuralgia* and *convulsive affections, chorea, delirium tremens,* and *nervous exhaustion* from fatigue or over-excitement. (*A. J. P.,* xxiii. 370; *N. J. M. R.,* v; *M. S. Rep.,* 1870.)

Dose, thirty to ninety grains (2.0 to 5.8 Gm.).

Off. Prep.—Fluidextractum Scutellariæ, *U. S.*

SENEGA. U. S. (Br.)

SENEGA [Senega Snakeroot]

(sĕn'ę-gą)

"The dried root of *Polygala Senega* Linné (Fam. *Polygalaceæ*)." *U. S.* "The dried root of Polygala Senega, *Linn.*" *Br.*

Senegæ Radix, *Br.;* Rattlesnake Root, Mountain Flax, Senega or Seneca Root or Snakeroot, Radix Polygalæ Virginianæ; Polygala de Virginie, *Fr. Cod.;* Radix Senegæ, *P. G.;* Senegawurzel, Klapper-Schlangenwurzel, *G.;* Poligala Virginiana, *It.;* Poligala de virginia (Raiz de), *Sp.*

Besides *P. Senega,* two other species have attracted some attention in Europe—*P. amara* and *P. vulgaris*—as remedies in chronic pectoral affections; but, as they are not natives of this country, and are never used by practitioners here, they do not merit particular notice.[1]

Polygala Senega, L., *Sp. Pl.* (1753) 704; Willd., *Sp. Plant.* iii. 894; Bigelow, *Am. Med. Bot.,* ii. 97; Barton, *Med. Bot.,* ii. 111; *B. & T.* 29.—This unostentatious plant has a perennial branching root, from which several erect, simple, smooth, round, leafy stems annually rise, from nine inches to a foot in height. The stems are occasionally tinged with red or purple below, but are green near the top. The leaves are alternate or scattered, lanceolate, pointed, smooth, bright green on the upper surface, paler beneath, and sessile or supported on very short footstalks. The flowers are small and white, and form a close spike at the summit of the stem. The calyx is their most conspicuous part. It consists of five sepals, two of which are wing-shaped, white, and larger than the others. The corolla is small and closed. The capsules are small, much compressed, obcordate, two-valved and two-celled, with two oblong-ovate, blackish, hairy seeds, slightly longer than the lobes of the caruncle. In *P. alba,* Nutt., the seeds are silky and about twice the length of the caruncle lobes.

Polygala Senega extends over most of the United States and Southern Canada, east of the Rocky Mountains. At one time it was largely collected in Canada and the Northeastern Atlantic states; when this supply was exhausted, Kentucky and the States West and Southwest of it were invaded; then Wisconsin and the Northwestern States, from which with Western Canada the commerce at present derives its chief supply. There are two varieties of the plant, the typical *P. Senega,* the form found in the Northeastern United States, and the variety *latifolia,* which extends from Maryland and Pennsylvania to Michigan and Tennessee. This variety is distinguished by its height (from ten to twenty inches) and its very large, ovate or ovate-lanceolate leaves, which taper towards each end and attain a length of four inches. The root of commerce seems to be obtained from both varieties. It is brought into market in bales weighing from fifty to four hundred pounds.

Properties.—As the root occurs in commerce, it is of various sizes, from that of a straw to that of the little finger, presenting a thick knotty head, which exhibits traces of the numerous stems. It is tapering, branched, variously twisted, often marked with crowded annular protuberances, and with a projecting keel-like line, extending along its whole length. It is officially described as "somewhat cylindrical, tapering, more or less flexuous, 3 to 15 Cm. long and 2 to 8 Mm. thick, bearing several similar, horizontal branches and a few rootlets; crown knotty with numerous buds and short stem-remnants; externally yellowish-gray or brownish-yellow, longitudinally wrinkled, usually marked by a keel which is more prominent in perfectly dry roots near the crown; fracture short, wood light yellow, usually excentrically developed; odor slight, nauseating; taste sweetish, afterwards acrid." *U. S.* The epidermis is corrugated, transversely cracked, of a yellowish-brown color in the young roots, and brownish gray in the old. In the smaller branches the color is a lighter yellow. The bark is thick, hard, and resinous, and whitish in its interior; it contains the active principles of the root. The central portion is ligneous, white, and quite inert, and should be rejected in the preparation of the powder. The color of this is gray. On microscopic examination the bark is seen to be composed of —1st, an outer layer, composed of a series of tubular cells; 2d, a middle layer of thin-walled, parenchymatous cells; 3d, an inner layer containing bast-cells. The keel is produced by the excessive development of this last layer of bark upon one side. There is no medulla. The odor of senega is peculiar, strong in the fresh root, but faint in the dried. The taste is at first sweetish and mucilaginous, but after chewing becomes somewhat pungent and acrid, leaving a peculiar irritating sensation in the fauces. Senega root varies somewhat in appearance according to the locality from which it is derived, and local varieties are recognized in commerce. In *Southern senega* the roots are very small, while in Manitoba senega they are large and thick, dark in color, and often have purple markings about the crown. The official senega is often known

[1] A senega which was first used in Japan, and which has been referred by some writers to *P. japonica,* by others to *P. tenuifolia,* has been examined by Reuter, who finds in it 0.8 per cent. of resin, traces of methyl salicylate, and 8.8 per cent. of an oil which has somewhat the odor of patchouli.

in commerce as *Southern senega,* or *small senega,* the roots seldom attaining the size of an ordinary lead-pencil, and four to five hundred of the dried roots being required to make a pound.

Between the years 1870 and 1880 the so-called *Northern,* the *White,* the *False,* or the *Large senega* was sent into the American market from Wisconsin, Minnesota, and further west. It is much larger than true senega, probably eighty to one hundred to the pound. The knot at the top of the root is from one to three inches in diameter; below it the root abruptly contracts to from half an inch to an inch in diameter; it is usually from eight to ten inches long, more fleshy and much less contorted than true senega, nearly free from small rootlets, but breaking up below into from four to eight descending branches; very light-colored, with the ligneous portion thick and regular, and in the circular outlines of the section, with the keel rudimental or not rarely altogether absent. The taste is similar to that of true senega, but somewhat more mucilaginous and less rapidly acrid. In structure, false senega root is very similar to the true root; it has, indeed, been asserted that there are anatomical differences between the two senegas, but O. Linde (*P. J.*, xvi. 724) has been unable to make out any such differences. According to L. E. Sayre (*A. J. P.,* Sept. 1897), it is not possible to distinguish the two drugs when powdered. For description of the roots of a number of species of Polygala, see *Flora,* Jan. 1886, and *D. C.,* 1901, 26. False Senega was thought to be the product of *Polygala Boykinii,* Nuttall, but it appears to be well established that it is obtained from *P. alba,* Nuttall, whose habitat extends from the mountains of Texas to western British America. The properties of senega as well as the medicinal virtues of the root, are extracted by boiling water and by alcohol. Diluted alcohol is an excellent solvent.

Senega root was analyzed by Gehlen, Peschier of Geneva, Feneulle of Cambray, Dulon d'Astafort, Folchi, and Trommsdorff, and subsequently by Quevenne. The virtues of senega appear to reside chiefly, if not exclusively, in the acrid principles called *senegin* and *polygalic acid.* These principles resemble saponin very closely and are recognized as distinct. Quevenne obtained polygalic acid by the following process. Powdered senega is exhausted by alcohol of 33°, and so much of the alcohol is distilled off as to bring the resulting tincture to the consistence of syrup. The residue is treated with ether in order to remove the fatty matter. The liquid upon standing deposits a precipitate, which is separated by filtration and is then mixed with water. To the turbid solution thus formed alcohol is added, which facilitates the production of a white precipitate, consisting chiefly of polygalic acid. The liquid is allowed to stand for several days, that the precipitate may be fully formed. The supernatant liquid being decanted, the precipitate is drained upon a filter, and, being removed while yet moist, is dissolved by the aid of heat in alcohol of 36°. The solution is boiled with purified animal charcoal, and filtered while hot. Upon cooling, it deposits the principle in question in a state of purity. Thus obtained, polygalic acid is a white powder, inodorous, and of a taste at first slight, but soon becoming pungent and acrid, and producing a very painful sensation in the throat. It is fixed, unalterable in the air, inflammable, soluble in water slowly when cold and rapidly with the aid of heat, soluble in all proportions in boiling absolute alcohol, which deposits most of it on cooling, quite insoluble in ether and in the fixed and volatile oils, and possessed of the properties of reddening litmus and neutralizing the alkalies. Quevenne found it, when given to dogs, to occasion vomiting, and much embarrassment in respiration, and in large quantities to destroy life. Dissection exhibited evidences of inflammation of the lungs, and frothy mucus was found in the stomach, œsophagus, and superior portion of the trachea, showing the tendency of this substance to increase the mucous secretion, and explaining in part the beneficial influence of senega in croup. (*J. P. C.,* xxii. 449, and xxiii. 227.) Bolley showed that the active principle was resolvable by hydrochloric acid into glucose and a peculiar substance called *sapogenin.* Rochleder (*Chem. Cb.,* 1867, p. 925) confirmed this view of the identity of polygalic acid and saponin. Later investigators assert the existence of two homologous principles in the senega root,—*senegin,* $C_{17}H_{26}O_{10}$, and *polygalic acid,* $C_{19}H_{30}O_{10}$. That this latter is a variety of saponin is no doubt true. Christophson (*J. P. C.,* 1874) and Schneider (*A. Pharm.* [3], 7, 394) have also thoroughly established the existence of saponin in senega root. According to the researches of Trommsdorff and Schneider, saponin is contained solely in the bark, the woody tissues being inert. (See *Quillaja,* p. 1035.) L. Reuter (*A. Pharm.,* 1889, 309 and 452) finds that the constituents of senega root are fixed oil and resin, traces of volatile oil (a mixture of valeric ether and methyl salicylate), sugar (7 per cent.), senegin or saponin (from 2 to 5 per cent.), yellow coloring matter, and malates. The quantity of methyl salicylate[1] varied in different samples from 0.25 to 0.33 per cent. See also Schroeder's analysis (*A. J. P.,* 1896, 178). Kain (*Ph. Ztg.,* 1898, 562) states that he has discovered a lævo-rotatory glucoside distinguished from saponin by its mild taste, solubility in absolute alcohol, and in its not giving a precipitate with barium hydroxide.

Senega yields its virtues to water, cold or hot, and to boiling alcohol, and the extracts obtained by means of these liquids have the sensible properties of the root. But under the

[1] Methyl salicylate occurs in very many, if not all, of the species of the genus Polygala. (See paper by Kremers and James, *Ph. Rev.,* xvi.)

influence of heat a portion of the acrid principle unites with the coloring matter and coagulated albumen, and thus becomes insoluble in water. In forming an aqueous extract, the infusion should be prepared by percolation, as it is thus most concentrated, and consequently requires less heat in its evaporation. In preparing the infusion, the temperature of the water should not exceed 104° F. Experience has thoroughly proved the value of the use of an alkali in small proportion in making galenical preparations of senega, it prevents gelatinization and combines with the active principles (see *Fluidextractum Senegæ*, page 561).

The roots of *Panax quinquefolius*, L., or ginseng, were at one period frequently mixed with those of senega, but are easily distinguishable by their shape and taste. The roots of *Gillenia trifoliata* (L.), Moench., and *Asclepias Vincetoxicum*, L. (*P. J.*, ix. 411), and of *Triosteum perfoliatum*, L. (see PART II), are noted as occurring in commercial senega; they are readily detected by the absence of the keel-like line.

Uses.—When given in overdose, senega is capable of acting as an irritant poison, producing violent vomiting and purging. Although other medicinal properties have been attributed to it, for many years it has been employed in medicine solely as a *stimulant expectorant*, useful in the advanced stages of an *acute bronchitis* attended with free expectoration; in *chronic bronchitis*, and in *asthma* and other diseases with catarrhal inflammation of the pulmonic mucous membrane. Polygalic acid may be employed in the dose of from the fourth of a grain to a grain (0.016 to 0.065 Gm.), and may be administered either in pill, capsule, or mixture. For a formula for its preparation, see also *A. J. P.*, 1860, 150.

Dose, from fifteen to twenty grains (1.0 to 1.3 Gm.).

Off. Prep.—Infusum Senegæ, *Br.;* Fluidextractum Senegæ, *U. S.;* Liquor Senegæ Concentratus, *Br.;* Syrupus Senegæ, *U. S.* (from fluidextract); Tinctura Senegæ, *Br.*

SENNA. U. S. (Br.)

SENNA

(sĕn'nạ)

"The dried leaflets of *Cassia acutifolia* Delile (Alexandria Senna), or of *Cassia angustifolia* Vahl (India Senna) (Fam. *Leguminosæ*)." *U. S.* SENNA ALEXANDRINA. *Alexandrian Senna, Br.* "The dried leaflets of Cassia acutifolia, *Delile*." *Br.* SENNA INDICA. *East Indian Senna* (syn. *Tinnevelly Senna*). "The dried leaflets of Cassia angustifolia, *Vahl.* From plants cultivated in Southern India." *Br.*

Senna Alexandrina, Senna Indica, *Br.;* Senna Leaves; Séné, *Fr. Cod.;* Feuilles de Séné, *Fr.;* Folia Sennæ, *P. G.;* Sennesblätter, *G.;* Sena, *It.;* Sen, *Sp.*

The plants which yield senna belong to the genus Cassia, of which several species contribute to furnish the drug. These were confounded by Linnæus and comprised in a single species, which he named *Cassia Senna.* Since his time the subject has been more thoroughly investigated, especially by Delile, who accompanied the French expedition to Egypt and had an opportunity of examining the plant in its native country. Besides the official species, it is probable that *C. lanceolata* of Forskhal and *C. æthiopica* of Guibourt contribute towards commercial senna. The leaves of a number of species of Cassia are utilized like senna leaves in the respective countries in which they grow, among which may be mentioned *C. marylandica*, L.; *C. cathartica*, Mart.; *C. rugosa*, Don; *C. splendida*, Vog.; *C. lævigata*, Willd.; *C. multijuja*, Rich.; *C. Chamæcrista*, L.; and *C. montana*, Hayne.

Cassia acutifolia, Delile, *Flore d'Egypte* (1812), 219.—*C. Senna*, Linn., *Sp. Pl.* 377.—*C. lanceolata*, Collad., *Hist. Cass.* 93, t. 15.—*C. lenitiva*, Bisch., *Bot. Zeit.* (1850) 885.—*Senna acutifolia*, Batka, *Proc. Linn. Soc.* (1854), 282. This is described as a small undershrub, two or three feet high, with a straight, woody, branching, whitish stem; but, according to Landerer, the senna plant attains the height of eight or ten feet in the African deserts. The leaves are alternate and pinnate, with glandless footstalks, and two small narrow pointed stipules at the base. The leaflets, of which from four to six pairs belong to each leaf, are almost sessile, oval-lanceolate, acute, oblique at their base, nerved, from half an inch to an inch long, and of a yellowish-green color. The flowers are yellow, and in axillary spikes. The fruit is a flat, elliptical, obtuse, membranous, smooth, grayish-brown, bivalvular legume, about an inch long and half an inch broad, scarcely if at all curved, and divided into six or seven cells, each containing a hard, heart-shaped, ash-colored seed. *C. acutifolia* grows wild in great abundance in Upper Egypt, Nubia, Sennaar, and other parts of Africa. This species furnishes the greater part of the variety known in commerce by the name of Alexandria senna.

Cassia angustifolia, Vahl, *Symb. Bot.* i. 29. *C. elongata*, Lemaire, *J. P. C.* (1821), 345; Fée, *Journ. de Chim. Méd.*, vi. 232; Carson, *Illust. of Med. Bot.*, i. 36, pl. 29.—The name *C. elongata* was conferred by Lemaire upon the plant from which the India senna of commerce is derived, but the U. S. and Br. Pharmacopœias unite in ascribing the source to *C. angustifolia*, Vahl. The botanical description was completed by Fée from dried specimens of the leaves and fruit found by him in unassorted parcels of this variety of senna. Wallich afterwards succeeded in raising the plant from seeds found in a parcel of senna taken to Calcutta from Arabia, and it has been described by Royle, Wight and Arnott, and Lindley. As usually grown, it is annual, but with care it may be made to live through the year, and then assumes the character of an undershrub. It has

an erect, smooth stem, and pinnate leaves, with from four to eight pairs of leaflets. These are nearly sessile, lanceolate, obscurely mucronate, oblique at the base, smooth above and somewhat downy beneath, with the veins turned inward so as to form a wavy line immediately within the edge of the leaflet. The most striking character of the leaflet is its length, which varies from an inch to twenty lines. The petioles are without glands; the stipules minute, spreading and semi-hastate. The flowers are bright yellow, and arranged in axillary and terminal racemes rather longer than the leaves. The legume is oblong, membranous, tapering abruptly at the base, rounded at the apex, and an inch and a half long by somewhat more than half an inch broad. This plant is found in Southern Arabia and on the coast of East Africa from Mozambique to the Somali land. It has been said to grow in the interior of India, and is cultivated at Tinnevelly for medicinal use.

Cassia obovata, Colladon, *Hist. Cass.* 92, t. 15.—The stem of this species is rather shorter than that of *C. acutifolia,* rising to the height of only a foot and a half. The leaves have from five to seven pairs of leaflets, which are obovate, very obtuse, sometimes mucronate. The flowers are in axillary spikes, of which the peduncles are longer than the leaves of the plant. The legumes are very much compressed, curved almost into the kidney form, of a greenish-brown color, and covered with a very short down, which is perceptible only by the aid of a magnifying glass. They contain from eight to ten seeds. This species grows wild in Syria, Egypt, Senegambia, and Jamaica. (*P. J.,* Sept. 1867.) It has been cultivated successfully in Italy, Spain, and the West Indies. It is said to be no longer gathered for senna, although its leaflets and pods occur in Alexandria senna.

C. lanceolata of Forskhal (*Fl. Ægypt. Arab.,* 85; syn. *C. Sophera,* L., *Sp. Pl.* 379), found by that author growing in the deserts of Arabia, is admitted by Lindley and others as a distinct species. Some difference of opinion, however, exists upon this point. De Candolle considered it a variety of the *C. acutifolia* of Delile, from which it differs chiefly in having leaflets with glandular petioles, and, as Forskhal's description preceded that of Delile, he designated the species by the name of *C. lanceolata.* Forskhal's plant has been supposed by some to be the source of the India or Mocha senna, but the leaflets in this variety are much longer than those of *C. lanceolata,* from which the plant differs also in having no gland on the petiole. Niebuhr informs us that he found the Alexandria senna growing in the Arabian territory of Abu-Arisch, whence it is taken by the Arabs to Mecca and Jedda. This is probably the *C. lanceolata* of Forskhal. It is highly probable that this species is the source of a variety of senna which has been brought to this market under the name of *Mecca senna.*

Cassia æthiopica of Guibourt, *Hist. Drogues,* 3e éd., iii. 219 (*C. ovata* of Mérat), formerly confounded with *C. acutifolia,* is considered by Lindley to be a distinct species. It grows in Nubia, Fezzan, to the south of Tripoli, and probably, according to Guibourt, throughout Ethiopia. It is from this plant that the *Tripoli senna* of commerce is derived.

Several varieties of this valuable drug are known in commerce. Of these, four have been received in America,—the Alexandria, the Tripoli, the India, and the Mecca senna,—but only two are recognized by the Pharmacopœia.

1. Alexandria Senna.—This variety of senna is gathered in extreme Upper Egypt and the Soudan, and thence sent to Assouan at the First Cataract of the Nile, whence it finds its way into commerce through Cairo, Suakim, Suez and Alexandria. As the Egyptian customs keep no especial statistics the quantity exported can only be judged by the fact that in 1902 one Cairo firm sent into commerce 400 tons of senna. Two crops are produced annually, one in the spring and one in the autumn. The plants are first cut, then dried, and then the stripped-off leaves and pods are packed in crude bales, in which several species of senna are represented in varying proportion, the predominating species being *C. acutifolia.* Formerly there was a purposive mixture of the product of Cassia acutifolia with the leaflets of *C. obovata,* brought from other parts of Egypt, and even from Syria, with the leaves of *Cynanchum oleæfolium* (*C. Argel* of Delile, *Solenostemma Argel,* Hayne), known commonly by the name of *argel* or *arguel,* and sometimes with those of *Tephrosia apollinea* of De Candolle, a leguminous plant growing in Egypt and Nubia. According to M. Royer, the proportions in which the three chief constituents of this mixture were added together were five parts of *C. acutifolia,* three of *C. obovata,* and two of *Cynanchum.* Thus prepared, the senna was again packed in bales, and transmitted to Alexandria. But at present there is no such uniformity in the constitution of Alexandria senna, and, though the three chief ingredients may still sometimes be found in it, they are not in the same fixed proportions, and not unfrequently the Cynanchum leaves are wholly wanting. This variety of senna is often called in French pharmaceutical works *séné de la palthe,* a name derived from an impost formerly laid upon it by the Ottoman Porte. A parcel of Alexandria senna, as it was formerly brought to market, consisted of the following ingredients: 1, the leaflets of *C. acutifolia,* characterized by their acute form, and their length, almost always less than an inch; 2, the leaflets of *C. obovata,* known by their rounded very obtuse summit, which is sometimes furnished with a small projecting point, and by their gradual diminution in breadth towards their base; 3, the pods, broken leafstalks, flowers, and fine fragments of other parts of one or both of these species; 4, the leaves of

Cynanchum oleæfolium, which are distinguishable by their length, almost always more than an inch, their greater thickness and firmness, the absence of any visible lateral nerves on their under surface, their somewhat lighter color, and the regularity of their base. In this last character they strikingly differ from the genuine senna leaflets, which, from whatever species derived, are always marked by obliquity at their base, one side being inserted in the petiole at a point somewhat lower than the other, and at a different angle. Discrimination between this and the other ingredients is of some importance, as the Cynanchum must be considered an adulteration. It is said by the French writers to produce hypercatharsis and much irritation of the bowels, but was found by Christison and Mayer to occasion griping and protracted nausea, with little purgation. The flowers and fruit of the Cynanchum were also often present, the former white and in small corymbs, the latter an ovoid follicle rather larger than an orange-seed. Besides the above constituents of Alexandria senna, it occasionally contained leaflets of genuine senna, much longer than those of the *acutifolia* or *obovata,* equalling in this respect the Cynanchum, which they also somewhat resembled in form. They were distinguishable, however, by their greater thinness, the distinctness of their lateral nerves, and the irregularity of their base. The leaflets and fruit of *Tephrosia apollinea,* which have been an occasional impurity in this variety of senna, may be distinguished, the former by their downy surface, their obovate-oblong, emarginate shape, their parallel unbranched lateral nerves, and by being usually folded longitudinally; the latter, by its dimensions, being from an inch to an inch and a half long, and only two lines broad. As *now* imported, Alexandria senna is often quite free from the leaves of Cynanchum, and may have few or none of the leaflets of obovate senna. It is probably brought directly to Alexandria from Upper Egypt, without having undergone intermixture at Boulak or other intervening place. In Europe, this senna was formerly adulterated with the leaflets of *Colutea arborescens,* L., or bladder senna, and the leaves of *Coriaria myrtifolia,* L., a poisonous plant of Southern Europe. An account of these plants is given in PART II.

The leaflets of the Coriaria are ovate-lanceolate, grayish green with a bluish tint, and are readily known, when not too much broken up, by their strongly-marked midrib and two lateral nerves running from the base nearly to the summit. Another addition to Alexandria senna has been detected by Lacroix of Mâcon, France, in the leaves of the *Globularia Turbith* (*Globularia Alypum,* Linn.), which seem to have taken the place of the *Colutea arborescens,* because more closely resembling the senna leaflet. The leaves of the Globularia are spatulate, much enlarged towards the upper end, rounded at the extremity, but always terminating in a short sharp point. Besides, they are brown, thick, firm, and hard to the touch, while those of the Colutea are green, very thin, and soft. They have an acrid, very bitter taste, but are without nauseous odor. They are asserted to be cathartic, but milder than senna, and capable of being substituted for it in twice the dose. (*J. P. C.,* 4e sér., i. 413.) The so-called *Aden senna* which Holmes states to be active, is composed of small, broad, not very acute, hairy leaves, and is believed to be obtained from *C. holosericea,* Fres. A false senna from Madras has been identified by E. M. Holmes as the product of *Cassia montana,* Hayne. The leaflets are about the size of the Tinnevelly senna, but are distinguishable by obtuse or rounded ends furnished with distinct mucro, which is, however, often broken off and wanting from individual leaves; by the obtuse angles of the lateral veins and by the presence of a well marked network of veins of the under surface; further, the color of the upper surface is distinctly browner than of the Tinnevelly leaflet, and the whole leaves of *Cassia montana* have from 10 to 15 pairs of leaflets, while the Tinnevelly senna has only from 6 to 8 pairs. In the drug this character can usually be made out by noticing the number of scars on the rachis. For a microscopic description of powder, see H. G. Greenish, *P. J.,* 66, 694. In detecting the adulteration of senna, the apothecary may avail himself not only of the general physical characteristics of the leaves, but also of the fact that while the senna leaf, containing no tannic acid, does not precipitate ferric chloride, most leaves used in adulteration do alter the ferric solution. The microscopic characteristics of the false leaves, though varying greatly, are almost always very different from those of senna. In the senna leaflets the epidermis from the upper and under surface is very similar. The stomata are numerous; the epidermal hairs are unicellular and deciduous, leaving, when detached, a base which has the appearance of an annular pad, around which the neighboring cells seem to radiate. The parenchyma of the cell has a thick epidermis, and is divided into three layers, the uppermost and lowest of which consist of palisade tissue, and are separated by a zone of very small, rounded, parenchymatous cells. Stellate crystals of calcium oxalate are scattered throughout the parenchyma, and prismatic crystals, one in each cell, occur clustered around the bast tissue of the principal veins.

Alexandria Senna is officially described as "leaflets about 25 Mm. long and 10 Mm. broad, having extremely short, stout petioles; inequilaterally lanceolate or lance-ovate, acutely cuspidate, entire, subcoriaceous, brittle, pale green or grayish-green, sparsely and obscurely hairy, especially beneath, the hairs appressed, 1-celled, and thick-walled; odor characteristic; taste somewhat mucilaginous and bitterish." *U. S.* For a microscopical description of Alexandria senna, see *Proc. A. Ph. A.,* 1882, p. 238.

2. Tripoli Senna.—Genuine Tripoli senna consists in general exclusively of the leaflets of one species of Cassia, formerly considered to be a variety of *C. acutifolia,* but now admitted to be distinct, and named *C. æthiopica.* The leaflets, however, are much broken up, and it is probably on this account that the variety is usually less esteemed than the Alexandrian. The aspect given to it by this state of comminution, and by the uniformity of its constitution, enables the eye at once to distinguish it from the other varieties of senna. The leaflets, moreover, are shorter, less acute, thinner, and more fragile than those of *C. acutifolia* in Alexandria senna, and their nerves are much less distinct. The general opinion at one time was that it was brought from Sennaar and Nubia to Tripoli in caravans; but, it is reasonably asked by Fée, how could it be afforded at a cheaper price than the Alexandrian, if thus brought on the backs of camels a distance of eight hundred leagues through the desert? It is probably collected at Fezzan, immediately south of Tripoli.

3. India Senna.—This variety is in Europe sometimes called *Mocha senna,* probably because obtained originally from that port. It derives its name of India senna from the route by which it reaches us. Though produced in Arabia, it is brought to this country and Europe from Calcutta, Bombay, and possibly other ports of Hindostan. It consists of the leaflets of *Cassia elongata,* with some of the leafstalks and pods intermixed. The eye is at once struck by the great length (about two inches) and comparative narrowness of the leaflets, so that the variety may be readily distinguished. The pike-like shape of the leaflet has given rise to the French name of *séné de la pique.* Many of the leaflets have a yellowish, dark-brown, or blackish color, probably from exposure after collection, and the variety has commonly in mass a characteristic dull tawny hue. It is generally considered inferior in purgative power. Leaflets of a senna resembling the Indian were brought by Livingstone from Southern Africa, where the plant grows abundantly. (*P. J.,* xvii. 499.) "Leaflets 25 to 50 Mm. long, 10 to 15 Mm. broad, inequilaterally lanceolate, entire, thin, more abruptly pointed than those of Alexandria Senna, yellowish-green, and smooth above, paler beneath; in odor and taste closely resembling Alexandria Senna. Senna should be free from stalks, and from Argel leaves, which are sometimes present in Alexandria Senna, and which are equilateral, 1-veined, thick, wrinkled, glaucous, and possess 3-celled hairs." *U. S.*

A variety of India senna has reached this country which is a product of Hindostan, being cultivated at Tinnevelly, and probably other places in the south of the Peninsula. The plant was originally raised from seeds obtained from the Red Sea, and is the same as that from which the common Indian senna is derived. The drug is exported from Madras to England, where it is known by the name of *Tinnevelly senna.* It is a fine unmixed variety, consisting of unbroken leaflets, from one to two or more inches long, and sometimes half an inch in their greatest breadth, thin, flexible, and of a fine green color. T. B. Groves, however, states as the result of his experiments that Tinnevelly senna contains only two-thirds as much of the active principle as does the Alexandrian. (*P. J.,* Oct. 1868, p. 292.)

4. Mecca Senna.—After the publication of the fifth edition of this Dispensatory, a variety of senna was imported under the name of *Mecca senna,* consisting of the leaflets, pods, broken stems, and petioles of a single species of Cassia. The leaflets were oblong-lanceolate, on the average longer and narrower than those of *Cassia acutifolia,* and shorter than those of *Cassia elongata.* The variety in mass had a yellowish or tawny hue, more like that of India than like that of Alexandria senna. May it not have been the product of the *Cassia lanceolata* of Forskhal? We might infer so from the name, and from the character of the leaflet. Landerer, however, speaks of a valuable variety of senna, characterized by the large size of the leaflets, and sold under the name of Mecca senna, which he says comes from the interior of Africa.

Much study has been given to the question of distinguishing the powder of Alexandria and India senna by means of the microscope. (See papers by Sayre, *A. J. P.,* 1896, 1897; Schneider, *Am. Drug.,* 1897; Denniston, *Ph. Rev.,* vol. xvi.) As a result of these studies it is asserted that it is possible to take advantage of the greater hairiness of the Alexandria senna as a practical distinction, it being alleged that a piece of the epidermis of Alexandria leaf contains twice as many hairs as does a similar sized shred of epidermis from the India senna. It is especially proposed to count the number of epidermal cells between two hairs or their scars, the average distance of the hairs from one another being in the Alexandria senna three epidermal cells, and in the India six cells. Advantage may also be taken of the difference in the neighboring cells of the stomata; in the majority of stomata, in each case, there are two of the neighbor-cells, but in India senna the proportion is one having three neighbor-cells to seven having two, and in the Alexandria the proportion is one having three to two having two.

Commercial senna is prepared for use by *garbling,* or picking out the leaflets, and rejecting the leafstalks, the impurities, and the leaves of other plants. The pods are also rejected by some apothecaries. They were preferred by the Arabian and mediæval physicians of Europe to the leaves, while Pereira states that they are much milder in their operation than the leaflets. This has been explained by the researches of E. F. Salmon, who has found that they contain about 25 per cent. more cathartin than the leaves, but no resinous principle or

volatile oil. (*P. J.*, Oct. 1889.) The griping of senna being largely due to the resin, it is *a priori* to be expected that the pods would act more kindly than the leaves. A. W. Macfarlane has found this to be actually the case. From six to twelve pods for the adult, or from three to six for the young or very aged, infused in a claret-glass of cold water, in his experience, act very kindly but very thoroughly upon the whole intestine.

Properties.—The odor of senna is faint and sickly; the taste slightly bitter, sweetish, and nauseous. Water and diluted alcohol extract its active principles. Pure alcohol extracts them but imperfectly. (Bley and Diesel, *Ph. Cb.*, Feb. 1849, p. 126.) The leaves are said to yield about one-third of their weight to boiling water. The infusion is of a deep reddish-brown color, and has the odor and taste of the leaves. When exposed to the air for a short time, it deposits a yellowish insoluble precipitate, supposed to result from the union of extractive matter with oxygen. The nature of this precipitate, however, is not well understood. Decoction also produces some change in the principles of senna, by which its medicinal virtues have been supposed to be impaired, but some experiments of B. Heerlein would seem to show that this opinion is incorrect. An extract prepared by boiling down an infusion, redissolving the residue, and again boiling down to a solid consistence, was found to operate actively in a dose equivalent to a drachm of the leaves. (*Ph. Cb.*, 1851, p. 909.) To diluted alcohol it imparts the same reddish-brown color as to water, but rectified alcohol and ether, digested upon the powdered leaves, become of a deep olive-green.

Lassaigne and Feneulle first isolated a substance to which they gave the name of *cathartin*, but it proved to be a mixture; Bley and Diesel (*Ph. Cb.*, 1849, p. 126) isolated a yellow coloring matter, which they called *chrysoretin*, but which Martius identified as *chrysophan;* Ludwig (*A. Pharm.* (2), 119, p. 42, and 190, p. 69) obtained two bitter principles, *sennapicrin* and *sennacrol*, the first insoluble, the second soluble in ether; but the active purgative principle was first discovered in 1866 by Dragendorff and Kubly (*Viertelj. f. Prakt. Pharm.*, 16, pp. 96 and 337), who found it to be a glucoside of weak acid character, and named it *cathartic acid.* Thos B. Groves, in 1868 (*P. J.*, 1869, p. 196), unaware of Dragendorff and Kubly's discovery, isolated the same principle, and found for it the same reactions. For a method of preparing cathartic acid, by Ralph Stockman, see *P. J.*, 1885, p. 740. Its formula is given as $C_{180}H_{96}N_2SO_{82}$, and by boiling its alcoholic solution with acids it yields *cathartogenic acid* and sugar. Gensz (*A. J. P.*, 1893, 334), who prepared it later by the method of Kubly and Stockmann, gave the formula $C_{30}H_{36}NO_{15}$. It is amorphous, difficultly soluble in cold water, readily soluble in boiling water. The best solvent is a 30 to 40 per cent. alcohol; ether, benzene, chloroform, and petroleum ether are without solvent action. Alkalies with heat decompose it. It is prepared by partially precipitating with alcohol infusion of senna, concentrating to a syrupy consistence *in vacuo,* filtering, treating the filtrate with a large proportion of absolute alcohol, and repeatedly dissolving in water, and precipitating by alcohol the precipitate thus obtained. It is purified by submitting it (dissolved in moderately strong hydrochloric acid) to dialysis on a diaphragm of parchment paper, cathartic acid having strong colloidal properties. Groves found that ammonium cathartate purged moderately in the dose of three and three-quarters grains, with considerable griping, and that of certain mixed cathartates seven and a half grains purged violently, with much griping and sickness, and continued to act through most of a day. He considers four grains a fair dose. It should be given in connection with an aromatic and a saline cathartic. *Magnesium cathartate* is soluble. The salts of this acid in aqueous solution are decomposed and rendered inert by long exposure to heat in contact with the air. (Groves, *P. J.*, Oct. 1868, 200-1.) Dragendorff and Kubly also found chrysophanic acid in small proportions, the two substances, *sennacrol* and *sennapicrin,* previously mentioned, and a peculiar non-fermentable saccharine principle, with the formula $C_{21}H_{44}O_{19}$, which they named *catharto-mannite.* (*J. P. C.*, 4e sér., v.) A. Seidel proposes the name of *sennit* for catharto-mannite, and gives a process for its preparation in *A. J. P.*, 1885. In 1900 Tschirch and Hiepe made a comprehensive investigation of the chemical constituents of senna. From the aqueous percolate they extracted, besides *cathartic acid,* a crystalline body, giving the same reactions as *sennanigrin* and having the composition $C_{14}H_{10}O_5$. From the weak ammoniacal percolate they obtained *anthraglucosennin,* which, however, is composed of several distinct substances, for on treating it with ether, a portion enters solution and another remains undissolved; then the ether-soluble portion, if boiled with toluene and the solution poured on petroleum benzin, precipitates *sennaemodin,* while *sennachrysophanic acid* remains in solution and may be obtained on evaporation; the portion insoluble in toluene is a body which the authors have named *glucosennin.* Its composition agrees with the formula $C_{22}H_{18}O_8$, and it is possibly an emodin glucoside. From the portion of anthraglucosennin insoluble in ether, *sennaisoemodin* is obtained by treatment with acetone and shaking the resultant solution with petroleum benzin. The acetone solution retains a substance which the authors have named *sennarhamnetin.* Finally, the portion of anthraglucosennin remaining undissolved after treatment with ether and acetone is a black body which resembles in this and other respects aloenigrin. *Sennanigrin,* however, yields on treatment with alco-

holic potassium hydroxide, sennaemodin and sennachrysophanic acid. (*A. Pharm.*, Aug 31, 1900, 427, 448.)

Some results of experiments on the properties of senna which more particularly concern the pharmacist are noted in a paper contained in the *J. P. C.* (Janv. 1874, p. 80), and require to be mentioned here, because they tend to fix certain points which are left undetermined in the above statement. An extract made by evaporating in the air an aqueous infusion of senna possesses but partially the purgative properties of the leaves. If the extract be redissolved in a large quantity of water, and the solution be again evaporated, the extract now obtained will be quite inert. It follows that a prolonged decoction of senna destroys its cathartic powers. The presence of an alkali in the decoction increases the rapidity of the destruction. An infusion of senna in lime water, heated to the boiling point, and then deprived of lime by a stream of carbon dioxide, becomes inert. An infusion of senna, made to boil after the addition of potassium hydroxide, and then neutralized by an acid, is also inert. The mineral acids destroy the purgative powers of senna, but less energetically than the alkalies; the vegetable acids exercise the same power but feebly. Concentrated alcohol does not dissolve the active principle, which is soluble in cold water. It was Heerlein who first determined the complete want of purgative power in the pure alcoholic extract of senna. Nevertheless, this extract possesses in a high degree the odor and taste of senna, and, taken internally, without purging, imparts a deep-yellow color to the urine, which the alkalies change to red. The leaves exhausted by alcohol have all their purgative effect, but lose the power of affecting the urine so that an alkaline solution shall color it red. These facts prove that chrysophanic acid is not the purgative principle of senna. The fact that alcohol removes the odor and taste of senna without affecting its purgative action may sometimes be advantageously applied in cases in which the taste of senna is extremely offensive. L. Siebold, after experimenting with senna leaves washed with alcohol, arrived at the following conclusions. 1. Strong spirit does not remove any of the active principle from senna leaves. 2. The therapeutic action of cathartic acid is assisted by one or more of the constituents yielded by senna to strong alcohol, though these constituents produce no purgative effect when taken alone. 3. Senna exhausted by alcohol is a reliable and pleasant purgative, but somewhat weaker in its action than the unexhausted leaves.[1]

Incompatibles.—Many substances produce precipitates with the infusion of senna, but it does not follow that they are all medicinally incompatible, as they may remove only inert ingredients. Cathartic acid is precipitated by infusion of galls and solution of lead subacetate. Lead acetate and tartar emetic which disturb the infusion, have no effect upon the solution of this substance.

Uses.—Senna was first used as a medicine by the Arabians. It was noticed in their writings as early as the ninth century, and the name itself is Arabic. It is a prompt, efficient, and very safe purgative, well calculated for *fevers* and *febrile complaints*, and other cases in which a decided but not violent impression is desired. A disadvantage is that it is likely to produce griping. This effect, however, may be obviated by combining with the senna some aromatic, and some one of the alkaline salts, especially potassium bitartrate, potassium tartrate, or magnesium sulphate. The explanation which attributes the griping property to the oxidized extractive, and its prevention by the saline substances to their influence in promoting the solubility of that principle, is not satisfactory. The purgative effect of senna is considerably increased by combination with bitters,—a fact noticed by Cullen, and abundantly confirmed by subsequent experience. The decoction of guaiac is said to exert a similar influence. Senna yields one or more of its principles to the urine, as, from twenty to thirty minutes after it has been taken, this secretion acquires the property of being reddened by ammonia. (*J. P. C.*, Aôut, 1863.) Senna taken by nurses is said to purge sucking infants, and an infusion injected into the veins operates as a cathartic. The drug is never prescribed in powder. In official preparations "Tinnevelly senna may be used in place of Alexandria senna." *Br.* 1885. Dose of cathartic acid as a laxative, from three to six grains (0.2 to 0.4 Gm.).

Dose, of senna, one-half to two drachms (2.0 to 7.7 Gm.).

Off. Prep.—Confectio Sennæ, *U. S., Br.;* Fluidextractum Sennæ, *U. S.;* Infusum Sennæ, *Br.;* Infusum Sennæ Compositum, *U. S.;* Liquor Sennæ Concentratus, *Br.;* Pulvis Glycyrrhizæ Compositus, *U. S., Br.;* Syrupus Sennæ, *U. S.* (from fluidextract), *Br.;* Tinctura Sennæ Composita, *Br.*

SERPENTARIA. U. S. (Br.)

SERPENTARIA [Virginia Snakeroot]

(sĕr-pĕn-tā′rĭ-ą)

"The dried rhizome and roots of *Aristolochia Serpentaria* Linné (Virginia Serpentaria),

[1] *Vinum Sennæ. Senna Wine.*—Alexandria Senna Leaves, *one and a half ounces;* Sherry Wine, *twenty-seven ounces.* Macerate for eight days, press, and strain; then add five grains of Gelatin, dissolved in two and a half drachms of distilled water, and then the following: Tincture of Orange Peel, *one ounce;* Tincture of Ginger, *a half-ounce;* Aromatic Tincture, *eighty minims;* Honey, *two ounces.* Again allow to stand for ten days, and filter. This wine is reputed to be an excellent aperient for persons suffering from hemorrhoids. It should be taken in tablespoonfuls, according to the effect desired. (*Dieterich's Pharm. Manual.*)

or of *Aristolochia reticulata* Nuttall (Texas Serpentaria) (Fam. *Aristolochiaceæ*)." *U. S.* "The dried rhizome and roots of Aristolochia Serpentaria, *Linn.*, or of Aristolochia reticulata, *Nutt.*" *Br.* For *Aristolochia*, Br. Add., see PART II.

Serpentariæ Rhizoma, *Br.;* Serpentary Rhizome; Radix Colubrina, Radix Viperina; Serpentary, Sangree; Serpentaire de Virginie, *Fr. Cod.;* Couleuvrée de Virginie, *Fr.;* Virginische Schlangenwurzel, *G.*

Many species of Aristolochia have been employed in medicine. The roots of all of them are tonic and stimulant, and their supposed possession of emmenagogue properties has given origin to the name of the genus. *A. Clematitis, A. longa, A. rotunda,* are still retained in official catalogues of the continent of Europe, where they are indigenous. *A. Pistolochia,* L., of Southern Europe appears to have been the Aristolochia of Pliny and is still used under the name of *Pistolochia.* The root of *A. Clematitis* is very long, cylindrical, as thick as a goose-quill or thicker, variously contorted, beset with the remains of the stems and radicles, of a grayish-brown color, a strong, peculiar odor, and an acrid, bitter taste; that of *A. longa,* L., is spindle-shaped, from a few inches to a foot in length, of the thickness of the thumb or thicker, fleshy, very brittle, grayish externally, brownish yellow within, bitter, and of a strong, disagreeable odor when fresh; that of *A. rotunda,* L., is tuberous, roundish, heavy, fleshy, brownish on the exterior, grayish-yellow internally, and similar to the preceding in odor and taste; that of *A. Pistolochia,* L., consists of numerous slender yellowish or brownish fibres, attached to a common head, and possessed of an agreeable aromatic odor, with a taste bitter and somewhat acrid. Many species of Aristolochia, growing in the West Indies and Southern America, have been used medicinally. *A. cymbifera,* Martius, known in Brazil as *milhommen, jarra, jarrinha,* and in Mexico as *guaco,* is said to have medicinal properties similar to those of the official species, but Butte affirms that it is depressant to the sensory nerve centres and useful in *neuralgia* and *pruritus.* In the Argentine Republic[1] the root of *A. argentina* is used as a diuretic and diaphoretic, especially in *rheumatism.* In the East Indies *A. indica,* L., is employed for similar purposes with the European and American species, and the Arabians are said by Forskhal to use the leaves of *A. sempervirens* as a counter-poison. *A. fœtida,* Kunth., of Mexico, or *Yerba del Indio,* is used as a local stimulant to foul ulcers. A number of species of Aristolochia are employed as a remedy for snake-bites in various parts of the world, as *A. Serpentaria,* L., in North America; *A. maxima,* L. (the rhizome of which is called *Guaco* or *Contra Capitano*), in South America; *A. anguicida,* L., in the Antilles; *A. brasiliensis,* Mart. et Zucc.; *A. cymbifera,* Mart. et Zucc.; *A. macroura,* Gom.; *A. trilobata,* L., etc. There is no sufficient reason for supposing that any one of them is effective.

Aristolochia Serpentaria, L., *Sp. Pl.* (1753) 961; Willd., *Sp. Plant.* iv. 159; Bigelow, *Am. Med. Bot.,* iii. 82; Barton, *Med. Bot.,* ii. 41; *B. & T.* 246.—This species of Aristolochia is an herbaceous plant, with a short rhizome and numerous slender roots. Several stems often rise from the same rhizome. They are about eight or ten inches in height, slender, round, flexuose, jointed at irregular distances, and frequently reddish or purple at the base. The leaves are oblong-cordate, acuminate, entire, of a pale yellowish-green color, and supported on short petioles. The flowers proceed from the joints near the root, and stand singly on long, slender, round, jointed peduncles, which are sometimes furnished with one or two small scales, and bend downward so as nearly to bury the flower in the earth or decayed leaves. The tube of the calyx is curved like the letter S, enlarged at the base (ovary) and at its throat, the short limb being obtusely three-lobed. The anthers—six or twelve in number—are sessile, attached to the under part of the stigma, which is fleshy and from three to six-lobed. The fruit is an hexangular, six-celled capsule, containing several small flat seeds. The plant grows in rich shady woods throughout the Middle, Southern, and Western States, abounding in the valley of the Ohio and in the mountainous regions of our interior. It flowers in May and June. The root is collected in Western Pennsylvania, West Virginia, Ohio, Indiana, and Kentucky. As it reaches Philadelphia, it is usually in bales containing about one hundred pounds, and is often mixed with the leaves and stems of the plant, and with adhering dirt.[1]

A. hastata, Nuttall, *Gen. of N. Am. Plants,* 200.—*A. sagittata,* Muhlenberg, *Catal.*—This is now considered to be nothing more than a variety of *A. Serpentaria,* from which it differs in having hastate, acute, somewhat cordate leaves, and the lip of the corolla ovate. It flourishes on the banks of the Mississippi, in the Carolinas, and elsewhere. Its root scarcely differs from that of the official plant, and is frequently mixed with it, as is proved by the presence of the characteristic hastate leaves in the parcels brought into market.

A. reticulata, Nuttall, *Trans. Am. Phil. Soc.* (1837), 162; Bridges, *A. J. P.,* xvi. 118; Carson, *Illust. of Med. Bot.,* ii. 32, pl. 77.—This plant was probably first observed by Nuttall, as a specimen labelled "*A. reticulata,* Red River," in the handwriting of that botanist, is

[1] *Brazilian Aristolochia* as it comes into the European markets consists of pieces about 10 Cm. (4 inches) long, gray-brown, longitudinally wrinkled, the thickest roots being split; the transverse section shows a rather thick bark, and a ligneous cylinder, which is distinctly radiating, and contains wide dotted ducts and wood-fibres; the bark and medullary rays contain much starch, and, in numerous but slightly enlarged cells, a mixture of yellow resin and volatile oil. The taste and odor are warm and camphoraceous.

[1] For an account of *A. hirsuta* see 18th ed., U. S. D., p. 1222.

contained in the Herbarium of the Academy of Natural Sciences of Philadelphia. From a root similar to that of *A. Serpentaria* numerous short, slender, round, flexuose, jointed stems arise, usually simple, but sometimes branched near the root. The older stems are slightly villous, the young densely pubescent. The leaves, which stand on very short villous petioles, are round or oblong-cordate, obtuse, reticulate, very prominently veined, and villous on both sides, especially upon the veins. From the lower joints of the stem four or five hairy, jointed peduncles proceed, which bear small leafy villous bracts at the joints, and several flowers on short pedicels. The flowers are small, purplish, and densely pubescent, especially at the base and on the ovary. The hexangular capsule is deeply sulcate. This species grows from Virginia to Louisiana, Texas, Arkansas, and Oklahoma.

Properties.—Virginia snakeroot is officially described as follows: "*Virginia Serpentaria.*—Rhizome of oblique growth, about 2 Cm. long and about 2 Mm. in diameter; externally yellowish-brown, slightly annulate, the upper surface with numerous stem-scars or stem-bases, the lower surface bearing a dense tress of thin, branching roots from 4 to 7 Cm. long; fracture short, yellowish-brown; xylem in the roots 5-rayed; odor camphoraceous; taste bitter and aromatic." *U. S. Texas Serpentaria* is officially characterized as follows: "The rhizome is about twice as large as that of Virginia Serpentaria, of a grayish-brown color, and the roots are fewer, less interlacing, and thicker." *U. S.* It contains a larger percentage of volatile oil than does the other variety of the drug. The color of serpentaria, which in the recent root is yellowish, becomes brown by time; that of the powder is grayish. Examined microscopically, the rhizome is seen to have only a moderately thick bark, composed chiefly of small-celled liber tissue; the woody tissue is formed of reticulated or pitted vessels and long prosenchymatous cells; the medulla is situated to the upper side of the centre, and has its cells large and thin-walled. The root yields all its virtues to water and alcohol, producing with the former a yellowish-brown infusion, with the latter a bright greenish tincture, rendered turbid by the addition of water. Chevallier found in the root volatile oil, a yellow bitter principle, soluble in water and alcohol, resin, gum, starch, albumen, lignin, and various salts. Bucholz obtained from 1000 parts, 5 of a green fragrant volatile oil, 28.5 of a yellowish-green resin, 17 of extractive matter, 181 of gummy extract, 624 of lignin, and 144.5 of water. The active ingredients are probably the volatile oil and the yellow bitter principle of Chevallier, which that chemist considers analogous to the bitter principle of quassia; alkaline solution of cupric tartrate shows, moreover, the presence of a glucose sugar. The volatile oil passes over with water in distillation, rendering the liquid milky, and impregnating it with the odor of the root. The volatile oil has been carefully investigated by J. C. Peacock (*A. J. P.*, 1891, 257). He found it to contain a terpene, $C_{10}H_{16}$, boiling at 157° C., of sp. gr. 0.865 (probably pinene); a compound ester boiling at 211° C., sp. gr. 0.9849, which on saponification yielded borneol, $C_{10}H_{18}O$, and a crystalline acid; a fraction boiling at from 239° to 240° C., sp. gr. 0.9888, and of the composition $C_{18}H_{20}O$; and some green or bluish-green fluorescent oil in small quantity, which decomposes even when distilled under reduced pressure. The borneol ester constitutes about 60 per cent. of the oil. A principle called *aristolochine,* obtained from *A. Clematitis* and the roots of *A. rotunda* and *A. longa,* was investigated by Jul. Pohl. (*A. E. P. P.*, xxix.) He obtained it as a yellow crystalline mass, soluble in chloroform, ether, acetone, acetic anhydride, and alcohol, insoluble in petroleum benzin, benzene, and carbon disulphide, almost insoluble in cold water, slightly soluble in hot water. An ultimate analysis gave for its composition $C_{32}H_{22}NO_{13}$. O. Hesse obtained from the root of *Aristolochia argentina* an alkaloid to which he gives the name *aristolochine,* but has furnished no formula; a principle, *aristolin,* $C_{15}H_{28}O_3$; *physosterin palmitate,* in white scales, fusing at 82° C.; and a mixture of acids to which he gives the names *aristic acid,* $C_{18}H_{13}NO_7$, *aristidic acid,* $C_{17}H_{10}(CH_3)NO_7$, and *aristolic acid,* $C_{16}H_{13}NO_7$.[1]

The roots of *Spigelia marilandica* are sometimes found associated with serpentaria. They may be distinguished by the absence of the bitter taste, and, when the stem and foliage are attached, by the peculiar character of these parts. (See *Spigelia.*) We have seen the young roots of *Polygala Senega* mixed with serpentaria. Independently of their difference in odor and taste, they may be distinguished by being simple, and by a projecting line running from one end to the other of the root. Another adulteration was detected by P. S. Milleman of Chicago, who found in a parcel a large quantity of "golden seal" (*Hydrastis canadensis*). The rhizomes, with rootlets attached, were from a quarter of an inch to an inch in length, and about one-eighth of an inch in diameter (*A. J. P.*, 1874, p. 516), but at the present time (1906) on account of the high price of senega and hydrastis neither admixture is likely to occur again.

Uses.—Serpentaria is a feeble stimulant tonic. Too largely taken, it occasions nausea, griping pains in the bowels, sometimes vomit-

[1] The resinous *aristinic acid* has been obtained from a number of species of the genus *Aristolochia,* notably by Walz from *A. Clematitis,* by Chevallier from *A. Serpentaria,* by Dymock and Warden from *A. indica,* by Hesse from *A. argentina,* by Hooper from *A. bracteata.* Hooper has also obtained a closely allied, if not identical, resinous acid from the aristolochiaceous plant *Bragantia Wallichii,* besides an alkaloid, which, under the name of *Alpam,* has long been used in Western India as an antidote to snake venom. The allied species, *Bragantia tomentosa* of Blume, is said to be employed in Java as an emmenagogue.

ing and dysenteric tenesmus. It has been recommended in *intermittent fevers*, and may be serviceable as an adjunct to quinine. It is sometimes given in *dyspepsia*. The dose of fluidextract is from twenty minims to half a fluidrachm (1.3 to 1.8 Cc.). According to Pohl, aristolochine in sufficient dose produces in the higher animals violent irritation of the gastro-intestinal tract and of the kidneys, with death in coma from respiratory paralysis.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Fluidextractum Serpentariæ, *U. S.;* Infusum Serpentariæ, *Br.;* Liquor Serpentariæ Concentratus, *Br.;* Tinctura Cinchonæ Composita, *U. S., Br.;* Tinctura Serpentariæ, *U. S., Br.*

SERUM ANTIDIPHTHERICUM. U. S.

ANTIDIPHTHERIC SERUM, DIPHTHERIA ANTITOXIN

(sē′rŭm ăn′-tĭ-dĭph-thĕr′ĭ-cŭm)

"A fluid separated from the coagulated blood of a horse *Equus caballus* Linné, immunized through the inoculation of diphtheric toxin. It should be kept in sealed glass containers, in a dark place, at temperatures between 4.5° and 15° C. (40° and 59° F.)." *U. S.* "The blood serum of horses which have been immunized against the diphtheria poison." *P. G.*

Serum Antidiphthericum, *P. G.;* Diphtherie-heilserum, *G.;* Serum antidiphthérique, *Fr.;* Siero antidifterico, *It.;* Suero antidifterico, *Sp.*

The antitoxic properties of the blood serum of animals immunized by the inoculation of bacterial toxins was discovered in 1890 by Behring and Kitasato (*D. M. W.*, Nos. 49, 50, 1890). The great practical therapeutic value of diphtheria antitoxin was demonstrated independently by Behring and Roux and announced in papers read before the International Congress of Hygiene and Demography which met in Budapest in 1894.

Only the serum of the blood is used in medicine for prophylactic or curative purposes, although other body juices contain the active principle. The antitoxin has never been isolated in pure form. It is precipitated with the globulins and is believed to be allied to the enzymes. The antitoxic-globulin retains its properties more persistently than the allied globulins with which it is associated. That is, it is more resistant to deleterious influences, more stable and more soluble than the other globulins found in blood serum. As we lack definite knowledge of the true chemical nature of the active principle contained in antitoxic serums, the antitoxin is variously spoken of as antikörper (G.) or anti-bodies, free receptors (Ehrlich), cytases (Metchnikoff), etc. Of the several antitoxins known, diphtheria antitoxin is the only one recognized by the U. S. Pharmacopœia. Each antitoxin is specific; that is, neutralizes the poison of the particular infection which was inoculated into a susceptible animal to produce it. While diphtheria antitoxin is used for other diseases, it is specific only in neutralizing the poisons produced by the diphtheria bacillus. Diphtheria antitoxin is sometimes normally present in small amounts in the blood serum of guinea pigs, horses, man, and other animals.

Preparation.—Diphtheria antitoxin is made by injecting the diphtheria poison (toxine) into horses. The horses are injected either subcutaneously or intravenously; usually the former method is preferred. Horses are selected because, on account of their size, a large amount of blood may readily be obtained, and because the horse is exceedingly sensitive to the diphtheria poisons. Behring originally employed dogs and sheep with success; Aronson preferred the goat; Roux was the first to use the horse.

The antitoxin is produced by a vital reaction of the cells of the body caused by the stimulation of the toxine. Just which cells of the body take most active part in the production of the antitoxin is not exactly clear. Metchnikoff believes this power lies almost solely with the phagocytes, while Ehrlich believes that any of the body cells, but especially the connective tissue cells, play the most important rôle. The followers of Ehrlich and Metchnikoff have built up two divergent schools of thought to account for antitoxic immunity. It is interesting to note that both schools place the nutrition and metabolism of the cell at the groundwork of antitoxin production.

The *toxine* is made by growing a virulent culture of the diphtheria bacillus in an alkaline nutrient bouillon at 37° C. This culture, when five to seven days old, is filtered through unglazed porcelain or diatomaceous earth in order to remove the bacterial cells. The clear filtrate, containing the soluble poisons elaborated by the growth and multiplication of the bacilli, is the diphtheria toxine. On account of the time and expense required to prepare the poison by filtering out the bacterial cells a simpler and quicker method is often used in establishments where large quantities are used daily. This method consists in simply killing the bacteria in the culture with tricresol (0.4 per cent.) or chloroform, allowing the bacterial mass to settle to the bottom and using the clear supernatant fluid,—which may be filtered through sterilized paper. This method does not remove all the bacterial cells, and is therefore more apt to cause reactive inflammation or abscess at the site of inoculation.

The horse is inoculated with increasing amounts of the toxine. At first 0.1 Cc. is used. This amount usually causes a local and constitutional reaction, swelling and œdema at the site of inoculation, fever and derangement of appetite. These symptoms pass away in a few days, when a larger quantity of toxine is then inoculated, and this process continued, until, within a few months the horse is able to withstand the subcutaneous inoculation of 500 to 1000 Cc. of a strong toxine with perhaps less local and general disturbance than is caused by the first treatment with a fractional part of

a cubic centimeter. As the doses of toxine given to the horse increase, the amount of antitoxin in the blood gradually increases until, after three to six months of treatment, the horse's blood usually contains from 200 to 400 units of antitoxin to the cubic centimeter. The production of stronger antitoxic serums depends upon the horse and not upon the treatment. Some horses react actively and produce very high potency serums for long times; others cannot be induced to give a serum containing more than 150 to 200 units per cubic centimeter. After a variable period (from several months to years) the horse loses the power of reaction so that despite active treatment the immunizing power of the blood serum steadily diminishes. The horse is bled from the external jugular vein by means of a trocar and canula. The blood is drawn into long sterile cylindrical flasks or tubes and allowed to clot. The clear serum collects and in a few days is drawn off by a pipette. This clear albuminous fluid is the Serum Antidiphthericum of the Pharmacopœia.

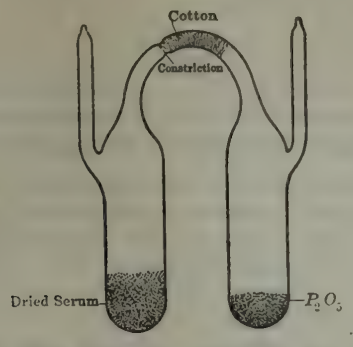
Preservatives.—The antitoxin in the blood serum immediately neutralizes the toxine when the two are brought into contact, but the antitoxic serum does not prevent the growth of the bacteria themselves. Diphtheria bacilli grow and multiply well in diphtheria antitoxic serum. In other words, diphtheria antitoxin is a good culture medium for bacteria of all kinds. The greatest care must therefore be taken to prevent contamination. The serum may be kept sterile indefinitely only by means of the most exacting bacteriological precautions. It is sometimes marketed without the addition of an antiseptic substance, but this practice has been largely discontinued for the following reasons: (1) The difficult technique required to prevent accidental contamination during the process of preparation and bottling; (2) the danger of the introduction of serious contamination by unskilled persons who use the serum; (3) the addition of a small amount of certain preservatives is harmless. Roux used camphor for this purpose, Behring phenol (0.5 per cent.), Aronson tricresol (0.4 per cent.), McFarland formaldehyde (1 to 1000); Theobald Smith prefers chloroform, as it does not cause a precipitate. Almost all the serums made by the American manufacturers contain tricresol.

Properties.—Antidiphtheric Serum is officially described as "a yellowish or yellowish-brown, transparent or slightly turbid liquid, odorless or having a slight odor due to the presence of the antiseptic used as a preservative. Specific gravity: 1.025 to 1.040 at 25° C. (77° F.). Antidiphtheric Serum gradually loses its power, the loss in one year varying between 10 percent. and 30 percent. Each container should be furnished with a label or statement, giving the strength of the Antidiphtheric Serum, expressed in antitoxic units, the name and percentage of the antiseptic used for the preservation of the liquid (if such be used), the date when the Antidiphtheric Serum was last tested, and the date beyond which it will not have the strength indicated on the label or statement. The standard of strength, expressed in units of antitoxic power, should be that approved or established by the United States Public Health and Marine Hospital Service." *U. S.*

Tests.—*The Immunity Unit.*—The strength of antidiphtheric serum is expressed in Immunity Units. The unit is a measure of strength, not of quantity. The official unit for this country is the standard serum prepared and dispensed by the Hygienic Laboratory of the U. S. Public Health and Marine-Hospital Service in accordance with the law of July 1, 1902. The American standard is based on Ehrlich's normal serum made at the K. Institut für Experimentelle Therapie, Frankfurt a. Main, Germany. It is difficult to define the immunity unit in a brief sentence. A proper understanding of it may only be had from a study of the theoretical considerations involved (see *"The immunity unit for standardizing diphtheria antitoxin." Bulletin No. 21,* Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service, Washington, 1905). The unit may be defined as the neutralizing power possessed by an arbitrary quantity of a diphtheria antitoxic serum kept under special conditions to prevent deterioration in an authorized laboratory. From a theoretical viewpoint the unit may be defined as that quantity of diphtheria antitoxic serum which will just neutralize 200 minimal lethal doses of a pure poison. By a "pure" poison is understood one containing only *toxin,* and no *toxoid, toxone,* or other substances capable of uniting with the antibodies. The test by which the strength of antitoxin contained in a unit is measured is a physiological one and depends upon the neutralization of the toxine by the antitoxin. This neutralization can only be determined by injecting the toxine and antitoxin mixtures into guinea pigs, which animals are highly susceptible to the diphtheria bacillus and its poisons.

The preparation and preservation of the standard serum is encompassed by many technical difficulties. A high grade serum is selected. This is given a preliminary test to determine its potency. The serum is now reduced to dryness by evaporation at 37° C. in vacuo. Special apparatus is used to accomplish this evaporation quickly and at the same time to prevent contamination. The dried serum must be kept guarded under special conditions to prevent deterioration. The oxygen of the air must be excluded in order to retard the process of oxidation, which rapidly alters the antibodies, especially under the influence of light. The standard serum is, therefore, always kept in absolute darkness in the Hygienic Laboratory of the U. S. Public Health and Marine-Hospital Service. The serum must be

perfectly dry. It is therefore kept under the influence of phosphoric anhydride, P_2O_5, as shown in the accompanying illustration. Fur-



U-shaped tubes used for preserving the standard serum. Half size.

ther, the serum is kept in a specially built ice box maintained at the constant temperature of 5° C. by means of circulating brine. The dried official serum is preserved in a small glass apparatus consisting of two parts connected by means of a glass tube. The serum is placed in one portion of the apparatus and phosphoric anhydride, which is a very powerful dehydrating substance, in the other. The air is exhausted as much as possible by means of a high vacuum and the apparatus hermetically sealed. After a few days the acid will have taken up all the moisture from the serum, and the tube connecting the two parts may then be melted and sealed off, separating the acid from the serum. Several hundred such tubes are prepared, each one containing a weighed quantity of the powdered serum. From this arrangement it will be seen that the powdered serum is kept dry, free from contact with the oxygen of the air, guarded against the action of the light, and preserved at a constant low temperature. Once every two or three months, or whenever it is desired to test the serum, one of these bulbs is broken and 1 gramme of the serum carefully weighed and dissolved in a solution made by mixing physiological saline solution (0.85 per cent.) one part, and pure glycerin two parts.

Testing the Standard Serum.—This glycerinated solution of blood serum is now accurately standardized in order to determine its precise antitoxic value in terms of Ehrlich's immunity unit. The number of immunity units contained in a given quantity of the serum is determined by the test (L+) dose of toxine (vide infra). That quantity of serum necessary to be added to the L+ dose of the toxine so that the mixture will kill the guinea pig on about the fourth day contains just one immunity unit. In the commercial testing of serums in order to have a coefficient of safety it would be safer to require the pig to live.

Testing the Toxine.—The toxine is a complex substance composed, according to Ehrlich, of several poisons, viz., *toxin, toxoid, toxone* and *epitoxonoid.* The diphtheria toxine is first investigated biologically by adding varying quantities of the poison to the immunity unit and inoculating the mixtures into a series of guinea pigs. In this way it is very evident, as Ehrlich has shown, that two limits, boundaries or zones are always shown, which are of the greatest importance in determining the nature and composition of the poison. Each of these limits is designated by the letter L, from *limes,* a boundary or zone. These limits are known respectively as L^0 (0 = nil) and L+ (+ = death).

By L^0 is meant that quantity of poison which just neutralizes or saturates one immunity unit as shown at the necropsy done forty-eight hours after the subcutaneous injection of the mixture into the guinea pig. The reaction at the site of inoculation at this examination must be hardly noticeable. Theoretically the L^0 dose of toxine must unite with and neutralize just 200 "combining units" of antitoxin. The L^0 dose, therefore, contains just 200 minimal lethal doses of a theoretically pure poison.

By L+ is meant the smallest quantity of toxine which will neutralize one immunity unit, plus a quantity necessary to kill the animal on the fourth day. As defined by Ehrlich, the L+ dose is that quantity of poison which, despite the antibodies contained in one immunity unit of serum, contains a sufficient excess of poison to cause the death of the guinea pig within the course of four days.

In studying the constitution of the diphtheria poison it is also necessary to determine its absolute toxicity with the greatest possible precision. The absolute toxicity of the diphtheria poison is spoken of as the minimal lethal dose (MLD), sometimes as the minimal fatal dose (MFD), and occasionally as the simple lethal dose. The determination of the minimal lethal dose is often an exceedingly tedious problem. This is due in part to the fact that the determination of the exact limits is largely influenced by the individuality of the guinea pigs, so that it is necessary to repeat the work on a series of animals in order to reach an average.

The minimal lethal dose may be readily defined as that quantity of toxine which will surely kill every guinea pig weighing 250 grammes in the course of four days, or at the very latest, five days. As Ehrlich has pointed out, such a quantity may kill some of the animals sooner, that is, within thirty-six to forty-eight hours. A quantity of diphtheria poison that will kill every guinea pig, without exception, acutely within thirty-six to forty-eight hours contains more than the minimal lethal dose. The L+ dose is a much more definite and constant factor than the MLD. It does not show the irregularities or present the difficulties met with in determining the absolute toxicity of the poison. On account of the importance of the L+ and the L^0 doses

the following simplified tables taken from actual experiments are given to show just how these two factors are obtained:

Test to determine the L+ dose of a toxine.

	Result.
1 immunity unit + 0.19 Cc. toxine	Invariably causes late paralysis, never acute death.
1 immunity unit + 0.20 Cc. toxine	Sometimes causes late paralysis and sometimes acute death.
1 immunity unit + 0.21 Cc. toxine	Always causes acute death about the fourth day.
1 immunity unit + 0.22 Cc. toxine	Always causes acute death, usually on the second or third day.

The L+ dose of this toxine is, therefore, just 0.21 Cc.

Tests to determine the L⁰ dose of a toxine.

	Result at autopsy 48 hours after inoculation.
1 immunity unit + 0.14 Cc. toxine	No visible reaction.
1 immunity unit + 0.15 Cc. toxine	No visible reaction.
1 immunity unit + 0.16 Cc. toxine	Slightest possible congestion about carbon particles or no reaction.
1 immunity unit + 0.17 Cc. toxine	Apparent reaction at site of inoculation.
1 immunity unit + 0.18 Cc. toxine	Injection and œdema at site.
1 immunity unit + 0.19 Cc. toxine	Injection and œdema at site.

The L⁰ dose of this toxine, therefore, is 0.16 Cc.

Concentrated Serums.—At one time it was the practice of some manufacturers to concentrate the unit strength of weak serums by evaporation in vacuo at a temperature of 40° C. or less. This produces a liquid of higher specific gravity, containing the original antitoxic strength, but in less liquid. This form of concentration has not met with favor and serves no useful purpose. As the concentrated blood serum is more difficult of absorption and possibly more irritating, the practice has been entirely abandoned. Another method of concentration now employed by the New York Board of Health (Gibson, R. B.: *Jour. of Biol. Chem.*, vol. i., Nos. 2, 3, Jan. 1906) is as follows: The serum is precipitated with an equal volume of saturated ammonium sulphate solution and the precipitate extracted with a solution of saturated commercial sodium chloride. The antitoxin globulin dissolves in the latter and the insoluble globulin is separated by filtration. The antitoxin is separated from the filtrate by the addition of a half volume of saturated ammonium sulphate solution; or, better still, by the addition of acetic acid in the usual way. The precipitate separated by filtration is pressed as dry as possible between absorbent paper and dialyzed a few hours in parchment paper. The resultant dialyzed solution is then neutralized and redialyzed for several days. A quarter of one per cent. of sodium chloride and some toluol are added and sterilization effected by double filtration through a Berkefeld filter. The concentrated antitoxin solution thus prepared contains probably from two to three times the proportion of protein present in normal serum. Large quantities of serum can be worked over at comparatively small expense by the method indicated. The product thus prepared is claimed to be as good as ordinary antitoxin serum. Tests made by the New York Board of Health show that the artificially concentrated antitoxin kept in small vials in an ice box, preserves its potency as well or even better than the ordinary antitoxin serum. Therapeutically the comparative results obtained are identical. Local irritation, rashes, etc, seem to be less frequent and severe when this concentrated or "refined" antitoxin is administered.

Dried Antitoxic Serum.—The dried antidiphtheric serum is official in the German pharmacopœia and is also prepared by the Pasteur Institute of Paris, France, for general sale. This dried product is little used in the United States on account of the difficulty found in bringing it into solution and the inconvenience of preparing a sterile solution. The dried serum retains its potency a much longer time than the liquid serum. The serum is dried in vacuo, either in shallow pans or by allowing warmed, dried and sterile air to bubble through the liquid. Precautions must be taken during the process to prevent bacterial contamination. The serum is simply reduced to dryness and the golden yellow flakes ground into a fine powder, in which state it is found upon the market in hermetically sealed vials. The dried serum contains no antiseptic or other added

substance. It appears as a yellowish-white powder, soluble in ten parts of water, giving a solution which in color and appearance resembles the corresponding antidiphtheric serum. The solution should be made with sterile water and in the original bottle, and should be freshly prepared each time. The solution should be clear, except for little albuminous particles. It is used for subcutaneous injection in exactly the same way as the liquid serum.

LEGAL REQUIREMENTS.—All diphtheria antitoxin sold in interstate commerce in this country must comply with the regulations made in accordance with the law approved July 1, 1902, entitled "An Act to regulate the sale of viruses, serums, toxins, and analogous products in the District of Columbia, to regulate interstate traffic in said articles, and for other purposes." It is illegal to sell, barter or exchange diphtheria antitoxin made in one State or Territory or the District of Columbia in another State or Territory or the District of Columbia unless the following salient points of the law have been complied with: 1. The product must be plainly marked with the proper name of the article contained therein; 2, the label on the package must plainly state the name of the manufacturer; 3, the package must be plainly labeled with the license number issued by the Secretary of the Treasury; 4, the date beyond which the contents cannot be expected, beyond reasonable doubt, to yield specific results must be given on the label or package. The execution of the law rests with the Surgeon-General of the U. S. Public Health and Marine-Hospital Service. Annual inspections of all licensed manufacturers are made by officers of the above named Service. From time to time products of each licensed manufacturer are bought on the open market and examined in the Hygienic Laboratory of the Public Health and Marine-Hospital Service at Washington for purity and potency.

Uses.—Diphtheria antitoxin is a true specific for *diphtheria* if it is given in sufficient quantity and sufficiently early in the disease. The very unfavorable results obtained in England in 1895 in the treatment of diphtheria with serum were due, according to the report of the Lancet Commission (*L. L.*, July 19, 1896), in a great majority of cases, to the use of serums too weak to produce therapeutic results. Experimental researches, for example, the very careful work of Madsen in Copenhagen in 1896, showed that for therapeutic purposes weak serum is of very little value. Equally disappointing results will be obtained if the antitoxin is administered after the toxine has damaged the cells. The early use of the remedy is of the greatest importance. No time should be lost, not even the delay in waiting for bacteriological confirmation. As soon as diphtheria is suspected, from 2000 to 5000 units of antitoxin should at once be injected into the subcutaneous tissue. The reliable figures given in the table below, collected by Dieudonné (*Schutzimfung und Serum Therapie*) shows conclusively the great practical value of diphtheria antitoxin and emphasizes the importance of administering the remedy early.

It will be seen from this table that every hour's delay lessens the chance of successful treatment. In cases treated within the first 24 hours of the onset of the disease the mortality is very small. "The bacteriological investigations of diphtheria in the United States" by William Welch (*Am. J. M. S.*, vol. 108, p. 427) show that 1115 cases of diphtheria treated in the first three days of the disease yielded a mortality of 8.5 per cent., whereas 546 cases in which the antitoxin was first injected after the third day of the disease a mortality of 27.8 per cent. resulted. Welch's statistics gathered from the hospitals of the world show conclusively that the antitoxin treatment produces "an apparent reduction of case mortality of 55.8 per cent." Numerous statistics from all parts of the world upon the effect of the antitoxin treatment of diphtheria are practically unanimous in showing the good results of this remedy. The great value of diphtheria antitoxin is perhaps most strikingly seen in the laryngeal cases.

The curative dose is usually 2000 to 5000 units, which should be repeated every four to eight hours until favorable results are manifest. As much as 67,000 units have been given to a patient with favorable results (St. Clair Street, *Med. Rec.*, Nov. 18, 1905). Fortunately the serum is usually harmless even when injected in large quantities. The remedy should always be given by the hypodermic method. Strict asepsis must be observed. The liquid may be injected under the skin of any part of the body where the subcutaneous tissue

Author.	Total number of cases.	Mortality percentage.	First day.	Second day.	Third day.	Fourth day.	Fifth day.	Sixth day.	After the sixth day.	Unknown.
Welch	1489	14.2	2.3	8.1	13.5	19.0	29.3	34.1	33.7	17.6
Hilbert	2428	18.3	2,2	7.6	17.1	23.8	33.9	34.1	38.2	....
Collective investigations of the American Pædiatric Society	5794	12.3	4.9	7.4	8.8	20.7	35.3	....	....	....
Collective investigations in the Austrian Health Department	1103	12.6	8.0	6.6	9.8	25.5	28.8	30.7	21.0	31.8
Collective investigations of the German Imperial Board of Health	9581	15.5	6.6	8.3	12.9	17.0	23.2	....	26.9	....

is loose. The back, near the angle of the scapula, is a favorite site for inoculation; sometimes the flank, or abdominal walls are chosen. The exhibition of the remedy by the mouth or per rectum is uncertain, slow and unsatisfactory. The use of antitoxin should not exclude the ordinary local treatment, such as gargles, sprays, and applications to the throat.

Diphtheria antitoxin is just as valuable for prophylaxis as for curative purposes. The passive immunity produced by the inoculation of the antitoxin serum does not last very long. The transitory nature of the immunity afforded by prophylactic injections is probably dependant upon the fact that the antitoxin is slowly excreted by the kidneys. The usual prophylactic dose for a child is 500 units. If the exposure to the infection continues the dose should be repeated in three or four weeks. The antitoxin in the blood neutralizes the toxine elaborated by the bacilli growing on the mucous membrane of the throat, but has no deleterious effect upon the bacilli themselves. The micro-organisms in this situation may continue to grow and remain virulent for months. This is the explanation of occasional failures of the antitoxin to prevent a subsequent attack of the disease.

Though the serum is usually harmless, sometimes urticaria, localized erythema and joint pains follow its administration. These symptoms commonly pass away without untoward consequences. The serum appears not to irritate the kidneys, even when injected into the tissues in very large amounts. Occasionally sudden death immediately follows the injection of diphtheria antitoxin. The cause of this unfortunate result is explained as occurring in persons with the so-called *status lymphaticus*. Such persons stand shock badly and would succumb to other trivial surgical operations. See "A study of the cause of sudden death following the injection of horse serum," Rosenau and Anderson. (*Bull.* 29, Hyg. Lab., P. H. and M. H. S.)

Diphtheric antitoxin gradually loses its strength, especially when kept under unfavorable conditions of light, temperature, etc. The loss in one year is usually from 10 to 30 per cent.; however, a serum will retain considerable antitoxic potency after years. Except for its diminished potency an old serum is quite as good as one freshly prepared; so that in an emergency or in order to save time an old serum may be administered, provided it remains uncontaminated.[1]

[1] OTHER FORMS OF ANTITOXINS.—*Tetanus Antitoxin. Antitetanic Serum.*—Tetanus heilserum, *G.;* Serum Antitétanique, *Fr.;* Siero Antitetanico, *It.*

Tetanus antitoxin was the first of the curative serums to be discovered by Behring and Kitasato, in 1890 (*D. M. W.*, No. 49, 1890), which work contained all the essentials of modern serum therapy.

The tetanus bacillus and the diphtheria bacillus are types of the pathogenic micro-organisms which produce strong and specific soluble poisons when grown in pure cultures *in vitro*. It is owing to this property that potent and useful antitoxins are readily obtainable against these two infections, by injecting the toxines into susceptible animals. The toxine found in the filtered bouillon of a pure culture of the tetanus bacillus is the most virulent poison known. The purified and dried tetanus toxin prepared by Brieger and Cohn was fatal to a 15 gramme mouse, in a dose of 0.000,000,05 gramme.

There are two toxines produced by the tetanus bacillus in pure culture,—tetano-spasmin and tetanolysin. The former exerts its poisonous influence upon the ganglionic motor nerve cells and causes the well known muscular contractions which characterize the disease (lockjaw). The latter (tetanolysin) acts as a dissolving agent upon the red corpuscles of the blood and is of minor importance.

Few organisms are distributed more widely and generally about all inhabited localities than tetanus. It is found in the dejecta of a large number of mammalian animals in whose intestinal tracts it finds favorable conditions for growth and multiplication. The spores are exceedingly resistant and are blown about in the dust so that they contaminate many objects and surfaces. The tetanus bacillus is a strict anaërobe; that is, it cannot grow or multiply in the presence of oxygen. It is therefore easy to understand why punctured wounds, such as are made by dirty nails, splinters, toy pistols, etc., are especially prone to this infection.

Tetanus antitoxin is made in all respects similar to Serum Antidiphthericum (*q.v.*) by injecting increasing amounts of the specific poison subcutaneously into horses. The antitetanic serum has the same physical and chemical properties as diphtheria antitoxin. It is also tested in the same way, both as to purity and potency. At present there is no American unit for standardizing the potency of tetanus antitoxin, but one is now in process of preparation in the Hygienic Laboratory of the Public Health and Marine-Hospital Service.

It has been shown experimentally by Marie and Morax, and Ransom and Meyer that the poisons produced by the tetanus bacilli growing in a wound travel up the axis cylinder of the motor nerves until they reach the central motor ganglia.

After the symptoms have once appeared, indicating that the toxine has reached and injured the motor nerve cells, the antitoxin is of little avail. The principle use of tetanus antitoxin therefore is as a prophylactic. Ten Cc. of the antitoxic serum should be administered in all cases of wounds threatened with the complication of tetanus. This applies especially to punctured wounds with old dirty nails and other objects liable to contamination with street dirt, garden earth or manure. In addition to this the wound should be freely opened and cleaned surgically with appropriate antiseptics. The prophylactic use of tetanus antitoxin is equally valuable in wounds of horses and other susceptible animals as in man. The dried and powdered antitetanic serum is sometimes used to dust upon the wound in order to neutralize the poison *in situ*.

If the case is not seen sufficiently early to use the antitoxin as a prophylactic, 1 to 3 Cc. of the serum may be injected into the nerve trunk leading from the wound. In this way the serum will reach the affected nerve cells sooner and more surely than when injected subcutaneously or into a vein. When the symptoms are well advanced very large quantities of the remedy should be used subcutaneously or intravenously. Ten Cc. or more may be injected every four to six hours for several days or until a favorable effect is noted. In severe cases, in addition to applying the antitoxin locally to the wound and injecting some into the nerve trunk, it should also be administered intravenously, as well as subcutaneously.

Tetanus antitoxic serum has also been injected into the cerebrospinal space or directly into the brain matter by trephining. It has also been injected into the spinal cord; but experience seems to indicate that these methods have no advantages over those already stated.

Tubercle Antitoxin. Antitubercle Serum.—This serum is prepared by injecting tuberculin and other toxic products of the tubercle bacillus into horses, asses, goats, and other animals. Maragliano and Marmorek have prepared antitubercle serums by special methods. The serums thus obtained have

SEVUM PRÆPARATUM. U. S., Br.

PREPARED SUET [Sevum, Pharm. 1890]

(sē'vŭm præ-pa-rā'tŭm)

"The internal fat of the abdomen of the sheep *Ovis aries* Linné, purified by melting and straining. Prepared Suet should be kept

in well-closed vessels inpervious to fat. It should not be used after it has become rancid." *U. S.* "The internal Fat of the abdomen of the sheep, Ovis Aries, *Linn.*, purified by melting and straining." *Br.*

Sevum, *U. S.* 1890; Sebum Ovillum; Mutton-Suet, Prepared Mutton Tallow; Suif de Mouton, *Fr. Cod.;* Graisse de Mouton, *Fr.;* Sebum ovile, *P. G.;* Hammeltalg, Talg, Schöpsentalg, Unschlitt, *G.;* Grasso di Moutone, Grasso duro, *It.;* Sebo de carnero, *Sp.*

Suet is the fat of the sheep, taken chiefly from about the kidneys. It is prepared by cutting the fat into pieces, melting it with a moderate heat, and straining it through linen or flannel. In order to avoid too great a heat, the crude suet is sometimes purified by boiling it in a little water. Mutton suet is of a finer consistence, and requires a higher temperature for its infusion, than any other animal fat. It is very white, sometimes brittle, inodorous, of a bland taste, insoluble in water, and nearly so in alcohol. Boiling alcohol, however, dissolves it, and deposits it upon cooling. It consists, according to Chevreul, of stearin, palmitin, and olein, containing approximately 70 per cent. of stearin and palmitin and 30 per cent. of olein. These principles are described under the *Fixed Oils* (page 806). It is officially described as "a white, solid fat, nearly inodorous, and having a bland taste when fresh, but becoming rancid on prolonged exposure to the air. Insoluble in water or cold alcohol; soluble in 44 parts of boiling alcohol, in about 60 parts of ether, and slowly in 2 parts of petroleum benzin. From its solution in the latter, when kept in a stoppered flask, it slowly separates in a crystalline form on standing. An alcoholic solution of Prepared Suet is neutral or has only a slightly acid reaction to litmus paper moistened with alcohol. Prepared Suet melts between 45° and 50° C. (113° and 122° F.), and congeals between 37° and 40° C. (98.6° and 104° F.)." *U. S.* "White, smooth, almost odorless; melting point between 112° and 120° F. (44.4° and 48.9° C.); commences to re-solidify at about 100° F. (37.8° C.). Freely soluble in *petroleum spirit,* slowly soluble in *benzol,* insoluble in cold *alcohol* (90 per cent.), slightly soluble in *ether* or boiling *alcohol* (90 per cent.)." *Br.* E. Dieterich examined a large number of samples of mutton and beef suet, and found that they were without exception acid and that neutral suet does not exist. The melting point of mutton suet is between 48.5° and 50.5° C.; that of beef suet, between 47.5° and 48° C. The specific gravity of mutton suet lies between 0.937 and 0.952; that of beef suet, between 0.943 and 0.952. (*A. Pharm.*, 1887, 496.)

Off. Prep.—Ceratum Resinæ Compositum, *U. S.;* Unguentum Hydrargyri, *U. S., Br.*

little antitoxic power and have not given sufficiently encouraging results either in the laboratory or in medical practice to justify placing dependence upon their therapeutic virtues. Antitubercle serum has the same chemical and physical properties as the other antitoxins.

Streptococcus Antitoxin. Antistreptococcus Serum. Streptococcus Heilserum, *G.;* Serum Antistreptococcique, *Fr.;* Siero Antistreptococco, *It.*

Antistreptococcus Serum is prepared by inoculating pure cultures of streptococci into horses. At first, killed cultures are used and afterwards the live and virulent organisms are injected either subcutaneously or intravenously. There are many different strains of streptococci, some of them exceedingly virulent; others appear to be nonpathogenic. Streptococci are the cause of erysipelas, puerperal fever, and are frequently found associated with or complicating scarlet fever, smallpox, phlegmonous inflammations, tuberculosis, sore throat, etc., etc.

The antistreptococcus serums found upon the market are sometimes prepared with particular cultures. More often the serum is polyvalent; that is, several virulent cultures from different sources are used in inoculating the animals. There is no satisfactory test for the potency of antistreptococcus serum. These serums really contain little if any antitoxic power. The tests for purity are similar to those used for other serums. The physical and chemical properties of antistreptococcus serum are similar to other serums.

Antistreptococcus serum is used in *erysipelas, puerperal fever, scarlet fever* and other diseases caused or complicated with the streptococcic infections. The results obtained are contradictory and not altogether satisfactory. The usual dose is 10 Cc. every six hours.

Yersin Serum. Plague Antitoxin. Antipest Serum, *G.;* Serum Antipesteuse, *Fr.*

The Yersin serum is prepared by the inoculation of horses with increasing doses of pure cultures of the plague bacillus. First, dead cultures, afterwards living organisms, are used. The injections are made either subcutaneously or intravenously. The blood serum of horses treated for a long period of time by this method contains antitoxic properties useful in plague as a prophylactic or curative agent.

Yersin has also prepared a serum against cholera by similar methods; but this has proven less valuable in actual practice. These serums must not be confused with the *Haffkine prophylactics* for plague and cholera, which consists of dead cultures and are used to produce an active immunity as contrasted with the passive immunity caused by antitoxic serums. The Haffkine prophylactics must not be used as curative remedies, as they contain the toxine. To administer them during the course of the disease would be adding fuel to the flames.

SINAPIS. Br.

MUSTARD

(si-nā′pĭs)

"The dried ripe seeds of Brassica nigra, *Koch,* and Brassica alba, *Boiss.,* powdered and mixed." *Br.*

The British Pharmacopœia describes powdered mustard seed as "a greenish-yellow powder with a bitter pungent taste, inodorous when dry, but exhaling when moist a characteristic pungent odor. A cooled decoction is not rendered brown by a solution of *boric acid* (absence of turmeric), and should yield no characteristic reaction with the tests for starch."

SINAPIS ALBA. U. S. (Br.)

WHITE MUSTARD

(si-nā′pĭs ăl′bą)

"The seed of *Sinapis alba* Linné (Fam. *Cruciferæ*)." *U. S.* "The dried ripe seeds of Brassica alba, *Boiss.*" *Br.*

Sinapis Albæ Semina, *Br.;* White Mustard Seeds; Yellow Mustard Seed; Moutarde blanche, *Fr. Cod.;* Semen Erucæ, *P. G.;* Weisser Senfsamen, Weisser Senf, *G.;* Senape bianca, *It.;* Mostaza blanca, *Sp.*

Off. Prep.—Charta Sinapis, *Br.*

SINAPIS NIGRA. U. S. (Br.)

BLACK MUSTARD

(si-nā'pis nī'grą)

"The seed of *Brassica nigra* (Linné) Koch (Fam. *Cruciferæ*)." *U. S.* "The dried ripe seeds of Brassica nigra, *Koch*." *Br.*

Sinapis Nigræ Semina, *Br.;* Black Mustard Seeds; Semina Brassicæ; Moutarde noire, *Fr. Cod.;* Moutarde, *Fr.;* Semen Sinapis, *P. G.;* Senfsamen, Schwarzer Senf, *G.;* Senape nera, *It.;* Mostaza (Semilla de), *Sp.*

Linnæus described two genera, Brassica and Sinapis, and subsequent botanists have greatly disagreed as to whether they should be considered identical or not. The British Pharmacopœia still follows Bentham and Hooker, but the revisers of the U. S. P. have adopted the opinion of Engler and Prantl and Britton and Brown, that the two genera are distinct. The genus Sinapis differs from Brassica in that the pods of the former are terminated by a long, flat, sword-like beak, whereas in Brassica the beak is cylindrical or conical.

Brassica nigra, Koch, in *Roehl. Deutschl. Fl.* (1833), 713.—*Sinapis nigra,* Linné, *Sp. Pl.* (1753) 668.—Common or black mustard is an annual plant, with a stem three or four feet in height, divided and subdivided into numerous spreading branches. The leaves are petiolate and variously shaped. Those near the root are large, rough, lyrate-pinnate, and unequally toothed, those higher on the stem are smooth, and less lobed, and the uppermost are entire, narrow, smooth, and dependent. The flowers are small, yellow, and stand closely together upon peduncles at the upper part of the branches. The pods are smooth, erect, nearly parallel with the branches, quadrangular, and furnished with a slender beak; seeds numerous, dark brown.

Sinapis alba, Linné, *Sp. Pl.* (1753) 668; *Brassica alba,* Boiss., *Voy. Espag.* (1839-45) 39.—The white mustard is also annual. It is rather smaller than the preceding species. The lower leaves are deeply pinnatifid, the upper sublyrate, and all irregularly toothed, rugged, with stiff hairs on both sides, and pale green. The flowers are in racemes, with yellow petals, and linear, green calycine leaflets. The pods are spreading, bristly, rugged, roundish, swelling in the position of the seeds, ribbed, and provided with a very long ensiform beak.

Both plants are natives of Europe and cultivated in our gardens, and *B. nigra* has become naturalized in some parts of this country. Their flowers appear in June. The seeds are kept in the pharmacies, both whole and in the state of very fine powder as prepared by the manufacturers for the table.[1] The latter is sometimes mixed with spice and ground into a smooth paste with water in a mill resembling a paint mill, and then is known as *French mustard.*

The *Brassica juncea,* Coss. (*Sinapis juncea,* L.), is extensively grown in India, and its seeds are largely exported to Europe. The same plant is also cultivated in Southern Russia. The seeds afford a very fine yellow mustard flour, and, according to Paul Birkenwald, yield 1.67 parts per hundred of volatile oil, against 1.89 parts per hundred by the true black mustard seed. (*S. W. P.,* 1888.)

Black mustard seeds are officially described as "subglobular, about 1.2 Mm. in diameter; testa deep red-brown, sometimes with a grayish tinge, minutely pitted; embryo greenish-yellow, oily, with a curved hypocotyl and two conduplicate cotyledons; odor while dry, slight, on moistening, powerfully irritating; taste strongly pungent and acrid. The powder contains few or no starch grains." *U. S. White mustard seeds* are "subglobular, 1 to 2 Mm. in diameter; testa yellowish, minutely pitted; embryo yellowish, oily, with a curved hypocotyl and two conduplicate cotyledons; inodorous; taste mildly pungent and acrid. The powder contains few or no starch grains." *U. S.* Both afford a yellow powder, which has a somewhat unctuous appearance, and cakes when compressed. This is commonly called *flour of mustard,* or simply *mustard,* and is prepared by crushing and pounding the seeds and then sifting them, the purest flour being obtained by a second sifting. Both the black and the white seeds are used in its preparation. It is often adulterated with wheat flour colored by turmeric, to which red pepper is added to render the mixture sufficiently hot. Pure mustard powder contains very few starch granules, but is frequently adulterated with farinaceous powders; the U. S. P. requires that White or Black Mustard should conform to the following test. "If 1 Gm. of powdered White (or Black) Mustard be exhausted by slow percolation with alcohol, and the marc mixed with 200 Cc. of water and heated to boiling, and if, after cooling, sufficient cold water be added to make the mixture measure 1000 Cc., the addition of 4 Cc. of tenth-normal iodine V.S. should not produce a dark blue color (limit of *starch*)." *U. S.* The epidermis of white mustard seeds contains a mucilaginous substance which is extracted by boiling water. When bruised or powdered, both kinds impart their active properties wholly to water, but in a very slight degree to alcohol. They yield upon pressure a fixed oil, called *oil of mustard,* of a greenish-yellow color, little odor, and a mild not unpleasant taste; and the portion which remains is even more pungent than the unpressed seeds. The

[1] The seeds of *Brassica iberifolia,* according to O. Harz, are sometimes sold as true white mustard seed. He examined some obtained from Bavaria, which had been returned by customers to the dealers on account of their bitter and disagreeable taste. He furnishes characteristic microscopical tests for distinguishing the false from the true mustard seed. His statement, however, that powdered white mustard seed when mixed with water is odorless, and that the false gives off a strong odor of essential oil of mustard, would seem to be a good reason, if correct, for preferring the false seed. (*P. J.,* 1887, 478.)

fixed oil of mustard consists of the glycerin compounds of stearic, oleic, and *erucic* or *brassic* acid, $C_{22}H_{42}O_2$, a homologue of oleic acid. Small quantities of *behenic* acid, $C_{22}H_{44}O_2$, also occur in oil of black mustard. This fixed oil is a yellow non-drying oil of from 0.915 to 0.920 sp. gr. at 15° C., solidifying at from —12° to —16°.[1] It has been long known that black mustard seeds yield by distillation with water a very pungent volatile oil, containing sulphur. Guibourt conjectured, and Robiquet and Boutron proved, that this oil does not pre-exist in the seeds, but is produced by the action of water. Hence the absence or very slight degree of odor in the seeds when bruised in a dry state, and their pungency when water is added. It seemed reasonable to suppose that the reaction in this case was similar to that exercised by water upon bitter almonds (see *Amygdala Amara*), and this has been proved to be the fact by the experiments of Simon, Bussy, Boutron, and Frémy. The composition and peculiar decompositions of the volatile oil of black mustard have already been described. (See *Oleum Sinapis Volatile.*)

A principle was extracted by Will from white mustard seed, with the aid of alcohol. It has been named *sinalbin*, and has the formula $C_{30}H_{44}N_2S_2O_{16}$. It is decomposed, after the analogy of sinigrin (potassium myronate), into acrinyl sulphocyanate, C_8H_7NSO, sinapine bisulphate, $C_{16}H_{25}NSO_9$, and sugar, $C_6H_{12}O_6$, an albuminoid substance being formed at the same time. "The acrinyl sulphocyanate (C_8H_7NSO) is a very active principle, oily, insoluble in water, not volatile. It may be obtained by causing ether to act on the product of the decomposition of sinalbin. Treated by an alkali and then neutralized by an acid, it colors ferric chloride red." (*J. P. C.*, Avril, 1872, 327.)

The analyses of mustard seeds and mustard flour given in table, page 1126, are by Piesse and Stansell (*Analyst*, 1880, p. 161).

[1] *Mustard Seed Oil.*—F. W. Widmayer communicates some practical information concerning the character, yield, etc., of the fixed oil of mustard seed, which is largely obtained as a by-product in the manufacture of powdered mustard from both black and white mustard seed. The oil from yellow seed is of a greenish yellow color, that of the brown seed a much darker shade. Both have but little odor and a mild, not unpleasant taste. It is a semi-drying oil. The analytical data showing maximum and minimum results by M. L. Tolman and L. S. Munson on five samples are as follows: Specific gravity at 15.5° C. 0.9147 to 0.9193; Butyro-refractometer reading (15.5°) 74.5 to 76.5; Index of refraction at 15.5° 1.4750 to 1.4762; Maumené number 61.4 to 79.4; Specific temperature reaction 130.9 to 190.3; Hübl number 98.4 to 113.0; Saponification value 173 to 182.8; Melting point of fatty acids 20.8° to 21.5° C.; Free fatty acids as oleic .13 to 1.13 per cent.; Solidification from —8° to —18°. One remarkable feature of this oil is its penetrating or diffusing power. Barrels that will hold olive, cotton seed, or petroleum oils or even new oil or alcohol barrels invariably leak on being filled with it, and it is said by one who has had extensive experience in the mustard business that it has been known to come through a tank which had stood a pressure of 80 pounds of steam. (*D. C.*, 1904, 8.)

J. U. Lloyd has proposed standards for black and white mustard seed, mainly directed towards limiting the proportion of starch; the latter is not a constituent of ripe mustard seed, but commercial mustard nearly always contains starch, due to starch-bearing seeds accidentally present in the mustard seed, or to fraudulent admixture. (*A. J. P.*, 1898, 433.) Dieterich (*Ph. Ztg.*, Oct. 3, 1900, 767) proposed an assay for mustard seed, mustard oil and mustard paper.

Uses.—Mustard seeds swallowed whole operate as a laxative, and have acquired some reputation as a remedy in *dyspepsia*, and in other affections attended with torpid bowels and deficient excitement. The white seeds are preferred, and are taken in the dose of a tablespoonful (15.5 Gm.) once or twice a day, mixed with molasses, or previously softened and rendered mucilaginous by immersion in hot water. They probably act in some measure by mechanically stimulating the bowels. The powder, commonly called simply mustard, in the quantity of from one to two teaspoonfuls (3.9 to 7.7 Gm.), is an efficient and prompt stimulant emetic, especially valuable in *narcotic poisoning*. As a condiment mustard acts as a stimulant to the gastric mucous membrane, and by virtue of this stimulant action it will sometimes relieve obstinate *hiccough*. But mustard is most valuable as a rubefacient. Mixed with water in the form of a cataplasm, and applied to the skin, it very soon produces redness with burning pain, which in less than an hour usually becomes insupportable. When a speedy impression is not desired, especially when the sinapism is applied to the extremities, the powder should be diluted with an equal portion of rye meal or wheat flour. Care should be taken not to allow the application to continue too long, as vesication with obstinate ulceration, and even sphacelus, may result. This caution is particularly necessary when the patient is insensible and the degree of pain can afford no criterion of the sufficiency of the action. The volatile oil is powerfully rubefacient, and capable of producing speedy vesication, but certainly is less controllable than is the mustard poultice. For external application as a rubefacient, 30 drops of the oil may be dissolved in a fluidounce of alcohol, or 6 or 8 drops in a fluidrachm of almond or olive oil. (See *Linimentum Sinapis Compositum*, U. S. 1890.) To form a *sinapism* it has been recommended to mix 20 drops of the volatile oil with a gelatinous mass made by heating together 3.5 drachms of glycerin and 5 drachms of starch. It has been given internally in *colic*, two drops being incorporated with a six-ounce mixture, and half a fluidounce (15 Cc.) given for a dose. In overdoses it is highly poisonous, producing gastro-enteric inflammation, and probably perverting the vital processes by pervading the whole system. Its odor is perceptible in the blood, and is said to impart the smell of horseradish to the urine. A *spirit of mustard* may

be prepared by macerating, for two hours, 250 parts of powdered black mustard with 500 parts of cold water, then adding 120 parts of alcohol of 86 per cent., and distilling over 120 parts of spirit.[1]

Dose, one to two drachms (3.9 to 7.7 Gm.).

Off. Prep.—Charta Sinapis, *U. S.*, *Br.*

SODII ACETAS. U. S.

SODIUM ACETATE

(sō′dī-ī ą-cē′tās)

$NaC_2H_3O_2 + 3H_2O = 135.10$

"It should contain in an uneffloresced condition not less than 99.5 percent. of pure Sodium Acetate [$CH_3.COONa + 3H_2O$], and should be kept in well-stoppered bottles." *U. S.*

Acetate of Soda; Acetas Sodicus (Natricus), Terra Foliata Tartari Crystallisata, Terra Foliata Tartari; Acétate de Soude Cristallisé, *Fr. Cod.*; Natrium Aceticum, *P. G.*; Natriumacetat, Essigsaures Natron, *G.*; Acetato di Sodio, *It.*

Sodium acetate may be easily prepared by adding crystals of sodium carbonate to acetic acid until it is neutralized, filtering, concentrating the solution, and crystallizing. It is prepared in the large way in the manufacture of crude pyroligneous acid, for the purpose of being decomposed, so as to yield the official acetic acid, by the action of sulphuric acid. The steps of the process by which it is made from the crude acid have been given under *Acidum Aceticum*.

Properties.—It is officially described as in "colorless, transparent, monoclinic prisms, or a granular, crystalline powder; odorless, and having a cooling, saline taste. Efflorescent in warm, dry air. Soluble in about 1 part of water, and in 23 parts of alcohol at 25° C. (77° F.); and in all proportions of boiling water and of boiling alcohol. When heated to 60° C. (140° F.), the salt begins to liquefy. At 123° C. (253.4° F.) it becomes dry and anhydrous; at 315° C. (599° F.) it is decomposed, with evolution of inflammable, empyreumatic vapors, leaving a black residue of sodium carbonate and carbon, which imparts to a non-luminous flame an intense yellow color, gives an alkaline reaction with litmus paper, and effervesces with acids. An aqueous solution of the salt (1 in 20) should be alkaline to red litmus paper, but should not affect phenolphthalein. If a few particles of the salt be added to a mixture of 1 Cc. of sulphuric acid and 1 Cc. of alcohol, and heated to boiling, acetic ether will be formed, recognizable by its odor. On the addition of a few drops of ferric chloride T.S., the aqueous solution (1 in 20) assumes a deep red color, and, when boiled, yields a brown, flocculent precipitate of basic ferric acetate. A saturated aqueous solution should not be rendered turbid by the addition of sodium bitartrate T.S. (limit of *potassium*). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of Sodium Acetate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 14.7 (14.74) Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator." *U. S.* Sodium acetate, when crystallized, consists of one acetic acid molecule, one atom of sodium and 3 molecules of water.

Uses.—Sodium acetate is diuretic, but is very rarely used as a medicine. It is employed principally to yield acetic acid by the action of sulphuric acid. In prescribing this salt, the fact, first noticed by Violette, should not be forgotten, that the mixture of equal parts of it and potassium nitrate, if heated, explodes with great violence. (*N. R.*, April, 1873.)

Dose, twenty grains to two drachms (1.3 to 7.7 Gm.).

SODII ARSENAS. U. S., Br.

SODIUM ARSENATE

(sō′dī-ī ăr′sę-năs)

$Na_2HAsO_4.7H_2O = 309.84$

"It should contain in an uneffloresced condition not less than 98 percent. of pure

[1] Analyses of Mustard.

	White Mustard, whole seeds.		White Mustard, ground.		Brown Mustard, whole seeds.	Brown Mustard, ground.	
	Yorkshire.	Cambridge.	Superfine.	Fine.	Cambridge.	Superfine.	Fine.
Moisture	9.32	8.00	6.30	5.78	8.52	4.35	4.52
Fatty oil	25.56	27.51	37.18	35.74	25.54	36.96	38.02
Cellulose	10.52	8.87	3.90	4.15	9.01	3.09	2.06
Sulphur	0.99	0.93	1.33	1.22	1.28	1.50	1.48
Nitrogen	4.54	4.49	5.05	4.89	4.38	4.94	5.01
Albuminoids	28.37	28.06	31.56	30.56	26.50	29.81	30.25
Myrosin and albumen	5.24	4.58	7.32	6.67	5.214	6.46	6.78
Soluble matter	27.38	26.29	36.31	36.60	24.22	31.14	32.78
Volatile oil	0.06	0.08	0.03	0.04	0.047	1.437	1.50
Potassium myronate	. . .	. . .	. . .	. . .	1.692	5.141	5.366
Ash	4.57	4.70	4.22	4.31	4.98	5.04	4.84

Di-sodium-ortho-arsenate [$AsO(OH)(ONa)_2 + 7H_2O$], and should be kep. in well-stoppered bottles." *U. S.* "The anhydrous salt, di-sodium hydrogen arsenate, Na_2HAsO_4, obtained by exposing to a temperature of 300° F. (148.9° C.) crystallized sodium arsenate, which may be prepared by treating with water the product of the fusion of arsenious anhydride with sodium nitrate and sodium carbonate." *Br.* (See page 1128.)

Natrum Arsenicum, Arsenias Natricus (Sodicus); Sodium Arseniate; Arseniate of Soda; Arséniate de Soude, *Fr. Cod.;* Natriumarsenat, Arsensaures Natron, *G.;* Arseniato bisodico, *It.;* Arseniato sodico, *Sp.*

In the U. S. P. the crystallized and anhydrous salts are official, while the anhydrous salt is the only one recognized in the Br. authority.

The process for this salt was first made official by the Br. Pharmacopœia of 1864, and by the U. S. Pharmacopœia of 1870.[1] In the process, the arsenious acid (arsenic trioxide) is converted into arsenic acid at the expense of the nitric acid of the sodium nitrate, and then combines with the sodium of both salts, carbon dioxide and nitrous fumes being given off. The reaction seems to be as follows:

$$As_2O_3 + 2NaNO_3 + Na_2CO_3 + H_2O = 2Na_2HAsO_4 + N_2O_3 + CO_2$$

According to Higgins, the gases emitted in this process contain more or less arsenic,—an inconvenience which may be avoided by first dissolving the arsenious acid in a solution of sodium hydroxide, and then adding the nitrate. The calcination should be performed in a reverberatory furnace. The gases which escape up the chimney are now free from arsenic, and consist only of ammonia and nitrous vapors. (*J. P. C.*, 4e sér., ii. 177.)

Properties.—Sodium arsenate is in "colorless, transparent, monoclinic prisms, odorless, and having a mild, alkaline taste; *caution should be used in tasting this salt, as it is very poisonous.* Efflorescent in dry air, and somewhat deliquescent in moist air. Soluble in 1.2 parts of water at 25° C. (77° F.), and very soluble in boiling water; very sparingly soluble in cold, but nearly insoluble in boiling alcohol. When gently heated, the salt loses 5 molecules of water (28.8 percent.), and is converted into a white powder. At 148° C. (298.4° F.) it loses all of its water of crystallization, at a higher temperature the salt fuses, and at a red heat it is converted into pyroarsenate. Sodium Arsenate should respond to the tests of identity and purity prescribed under *Sodii Arsenas Exsiccatus.*" *U. S.* "A white powder, soluble in 6 parts of *water,* and yielding an alkaline solution. It is only slightly soluble in cold or boiling *alcohol* (90 per cent.). It affords the reactions characteristic of sodium and of arsenates. A solution of 1 gramme of Sodium Arsenate with 1 of *glacial acetic acid,* in 50 cubic centimetres of *water,* should require 2.03 grammes of *lead acetate* for complete precipitation. It should yield no characteristic reaction with the tests for lead, copper, iron, aluminium, calcium, magnesium, potassium, ammonium, carbonates, chlorides, nitrates, or sulphates. It should not lose weight on being heated to 300° F. (148.9° C.) (absence of hydrous sodium arsenate)." *Br.*

Anhydrous sodium arsenate has the composition Na_2HAsO_4; in crystals it sometimes contains 12 molecules of water, equal to 53.73 per cent. of its weight. According to the official formula, this salt crystallizes with 7 molecules of water, or 40.39 per cent. "The latter salt loses 40.38 per cent. of its weight when dried at 300° F. (148.9° C.), becoming anhydrous. An aqueous solution of 12.4 grains of anhydrous arseniate of sodium, acidulated with acetic acid, requires not less than 34 grains of acetate of lead for complete precipitation." *Br.* 1885. If the temperature of a solution of the salt be kept at 30° C. (86° F.), crystals will be deposited which contain 4 molecules of water. J. Lefort examined 10 different samples of the salt, obtained from as many different sources, and found their water of crystallization to vary from 44.05 to 57.45 per cent. (*J. P. C.*, 1880, 487.)

Uses.—In medicinal properties sodium arsenate corresponds with the other compounds of arsenic (see *Arseni Trioxidum*), and may be similarly employed. The dose of the crystallized salt is stated at from one-twelfth to one-third of a grain (0.005 to 0.021 Gm.), that of the anhydrous salt from one-fortieth to one-tenth of a grain (0.0016 to 0.006 Gm.); but it is generally prescribed in the form of solution. (See *Liquor Sodii Arsenatis.*) Arsenic has been used to a considerable extent hypodermically in the treatment of *chorea* and other nervous diseases. According to the clinical studies of H. N. Moyer, sodium arsenate is preferable to Fowler's solution for this purpose, as being more uniform in composition and less irritating. Sodium arsenate is used in the form of hypodermic tablets. Moyer gives from one-twentieth to one-tenth of a grain in from ten to fifteen minims of distilled water.

Pearson's arsenical solution is an aqueous solution of sodium arsenate, and much weaker than the official solution. It is made by dissolving 1 Gm. (15 grains) of sodium arsenate (crystallized) in 600 Cc. (20 fl. oz., 138 minims) of distilled water. This preparation is considerably used on the continent of Europe in the form of bath, for which it is preferred to arsenic trioxide or the arsenites. The arsenical

[1] "Take of Arsenious Acid, in fine powder, *two troyounces;* Nitrate of Sodium, in fine powder, *eight hundred and sixteen grains;* Dried Carbonate of Sodium, in fine powder, *five hundred and twenty-eight grains;* Distilled Water, boiling hot, *half a pint.* Having mixed the powders thoroughly, put the mixture into a large clay crucible, and cover with the lid. Expose it to a full red heat until effervescence has ceased, and complete fusion has taken place. Pour the fused salt on a porcelain slab, and as soon as it has solidified, and while it is still warm, put it into the hot water, and stir until it is dissolved. Filter the solution, and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering paper, keep them in a well-stoppered bottle." *U. S.* 1870.

bath has been especially commended by Guéneau de Mussy in *nodose rheumatism*, or *rheumatic gout;* dose for a bath, from half a drachm to three drachms (2.0 to 11.6 Gm.).

Dose, of crystallized sodium arsenate, one-tenth of a grain (0.006 Gm.); of the British dried salt, one-fortieth to one-tenth of a grain (0.0016 to 0.006 Gm.).

Off. Prep.—Ferri Arsenas, *Br.;* Liquor Sodii Arsenatis, *U. S., Br.* (from dried salt); Sodii Arsenas Exsiccatus, *U. S.*

SODII ARSENAS EXSICCATUS. U. S., Br.

EXSICCATED SODIUM ARSENATE

(sō'dĭ-ī är'sę-năs ęx-sĭc-cā'tŭs)

$Na_2HAsO_4 = 184.68$

"It should contain not less than 98 percent. of pure anhydrous Di-sodium-ortho-arsenate [$AsO(OH)(ONa)_2$]." *U. S.* (See page 1127.)

Sodii Arsenas, *Br.;* Natrium Arsenicum Exsiccatum; Dried (anhydrous) Arsenate of Soda; Arséniate de Soude desséché, *Fr.;* Getrocknetes Natriumarsenate, *G.*

"Sodium Arsenate Crystals, *a sufficient quantity.* Break the crystals into small fragments, and allow them to effloresce at a temperature between 40° and 50° C. (104° and 122° F.) until they are completely disintegrated; then gradually increase the temperature to 150° C. (302° F.), and continue the drying until the product ceases to lose weight. Reduce it to a fine powder, and transfer it to dry, well-stoppered bottles." *U. S.* This salt corresponds with the sodium arsenate of the British Pharmacopœia. As sodium arsenate and exsiccated sodium arsenate differ greatly in dose, they should each have a distinctive title as in the U. S. P. (8th Rev.). For properties see also *Sodii Arsenas,* page 1127.

Properties.—It is officially described as "an amorphous, white powder; odorless, and having a mildly alkaline taste; *it should be tasted with great caution, as the salt is very poisonous.* Permanent in dry air. Soluble in 3 parts of water at 25° C. (77° F.), and very soluble in boiling water; very sparingly soluble in cold, but nearly insoluble in boiling alcohol. When heated to 150° C. (302° F.), the salt should not lose weight; at red heat it is converted into pyroarsenate. It imparts an intense yellow color to a non-luminous flame. The aqueous solution of the salt (1 in 20) yields a white precipitate with barium chloride T.S., or with calcium chloride T.S., and a dark red precipitate with silver nitrate T.S., all of which precipitates are soluble in nitric acid. If 0.5 Cc. of an aqueous solution (1 in 20) be mixed with 2 Cc. of hydrochloric acid, and a drop of this mixture be placed upon a bright piece of copper-foil, then, upon applying a gentle heat, a dark steel-gray film will be deposited upon the copper. If to 2 Cc. of an aqueous solution (1 in 20), 5 Cc. of tenth-normal silver nitrate V.S. be added, and the precipitate redissolved by a slight excess of ammonia water, no black precipitate of reduced silver should appear on boiling (absence of *arsenite*). If to 5 Cc. of an aqueous solution (1 in 20), 1 Cc. of ammonium sulphide T.S. be added, no dark coloration should appear (absence of *lead, copper, iron,* etc.)." *U. S.*

Uses.—Dried or exsiccated sodium arsenate is useful when it is desired to exhibit the salt in pill form, but differs in no way in its physiological action from sodium arsenate.

Dose, one-twentieth of a grain (0.003 Gm.).

SODII BENZOAS. U. S., Br.

SODIUM BENZOATE

(sō'dĭ-ī bĕn'zo-ăs)

$NaC_7H_5O_2 = 143.01$

"It should contain not less than 99 percent. of pure Sodium Benzoate [$C_6H_5.COONa$], and should be kept in well-stoppered bottles." *U. S.* "Sodium benzoate, C_6H_5COONa, may be obtained by neutralizing benzoic acid with sodium carbonate." *Br.*

Sodæ Benzoas; Benzoate of Soda; Benzoate de Soude, *Fr. Cod.;* Natrium Benzoicum, Natriumbenzoat, Benzosaures Natron, *G.;* Benzoato di sodio, *It.;* Benzoato sodico, *Sp.*

Sodium benzoate is easily made by adding benzoic acid to a concentrated hot solution of sodium carbonate or bicarbonate until effervescence ceases, and allowing the solution to cool and crystallize. R. Rother, in order to avoid annoyances in the effervescence, mixes four ounces of benzoic acid and two and three-fourths ounces of sodium bicarbonate in an evaporating dish with from two to four fluidounces of alcohol; when a uniform mixture is produced, from three to six fluidounces of water are added, heat applied gently, and the powder granulated.

Properties.—It is officially described as "a white, amorphous, granular or crystalline powder; odorless, and having a sweetish astringent taste. Permanent in the air. Soluble in 1.6 parts of water, and in 43 parts of alcohol at 25° C. (77° F.); in 1.3 parts of boiling water, and in 12 parts of boiling alcohol. When heated, the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a residue of sodium carbonate and carbon. To a non-luminous flame it imparts an intense yellow color. Its aqueous solution is neutral or slightly alkaline to litmus paper. If a few drops of ferric chloride T.S. be added to an aqueous solution of the salt, a salmon-colored precipitate will be deposited. If 5 Cc. of diluted sulphuric acid be added to a solution of 1 Gm. of the salt in 10 Cc. of water, a white precipitate of benzoic acid will be produced, which, after being thoroughly washed, should conform to the tests of purity given

under *Acidum Benzoicum.* If an aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of dry Sodium Benzoate be thoroughly ignited at red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 13.85 Cc. of half-normal hydrochloric acid V.S., methyl-orange T.S. being used as indicator." *U. S.* "Soluble in less than 2 parts of cold *water,* in 24 parts of cold *alcohol* (90 per cent.), and in 12 of boiling *alcohol* (90 per cent.). An aqueous solution has a faintly alkaline reaction, and gives a yellowish or flesh-colored precipitate when mixed with *test-solution of ferric chloride.* A strong aqueous solution, to which a little *diluted hydrochloric acid* is added, affords a crystalline precipitate of benzoic acid. Each gramme of the salt, when heated, melts, emitting an odor of benzoin, then chars, and finally leaves a residue which affords the reactions characteristic of sodium, and, when dissolved in *water,* requires for neutralization from 6.8 to 6.9 cubic centimetres of the *volumetric solution of sulphuric acid.* It should yield no characteristic reaction with the tests for lead, copper, iron, calcium, magnesium, potassium, ammonium, or carbonates, and only the slightest reactions with the tests for chlorides or sulphates." *Br.*

Uses.—This salt was suggested as long ago as 1857 by Socquet and Bonjean, as a remedy in *gout* and *rheumatism,* and is certainly valuable in *lithæmia* and *lithæmic gravel* for the purpose of aiding in the elimination of uric acid. It has also been highly commended in *puerperal fever,* and in *tuberculosis.*[1] (*B. M. J.,* ii. 1879, 498, 982.)

Dose, from twenty to thirty grains (1.3 to 2.0 Gm.).

SODII BICARBONAS. U. S., Br.

'SODIUM BICARBONATE

(sō'dī-ī bī-cär'bo-nās)

$NaHCO_3 = 83.43$

"It should contain not less than 99 percent. of pure Sodium Bicarbonate [CO(OH)(O Na)], and should be kept in well-closed vessels, in a cool place." *U. S.* "Sodium Bicarbonate, $NaHCO_3$, may be obtained by exposing crystals of sodium carbonate to carbonic anhydride, or by the interaction of sodium chloride and ammonium bicarbonate." *Br.*

Natrium Carbonicum Acidulum; Bicarbonas Sodicus; Bicarbonate of Soda, Soda Saleratus, Acid Sodium Carbonate; Carbonate (Bi) de Soude, *Fr. Cod.;* Sel de Vichy, *Fr.;* Natrium Bicarbonicum, *P. G.;* Natriumbicarbonat, Doppeltkohlensaures Natron, *G.;* Bicarbonato di sodio, *It.;* Bicarbonato sodico, *Sp.*

Two kinds of sodium bicarbonate were formerly official,—one, which is known by the title of this article, and which, to comply with the tests, must not have more than one per cent. of impurity, and the other, "commercial bicarbonate," which must contain at least 95 per cent. of pure bicarbonate. Formerly to obtain a salt which would comply with the official test it was necessary to purify the commercial salt, and the process of the U. S. Pharm. 1870 will be found as serviceable as any to accomplish this purpose.[2] The U. S. Pharm. 1890 recognized only the purer salt, having dismissed *Sodii Bicarbonas Venalis.* Sodium bicarbonate must now contain 99 per cent. of the pure salt, and the quality of the commercial salt has greatly improved in late years.

Immense quantities of sodium bicarbonate were formerly imported from Great Britain, but the importation has fallen off, and is only trifling at the present time (1906). It is now made of excellent quality by the Pennsylvania Salt Manufacturing Co., at Natrona, Pa., using cryolite as raw material, and by the Solvay Process Co., of Geddes, near Syracuse, N. Y., using the ammonia-soda process. (See *Sodii Carbonas.*) The American production, in 1905, was 68,867 tons, valued at $1,135,610.

In the United States Pharmacopœia of 1860 a process for making sodium bicarbonate was given, but it has since been abandoned, as the salt can be made much more economically on the large scale. The process consists in treating crystallized sodium carbonate, contained in suitable chambers, with carbon dioxide gas until the carbonate has taken up another molecule of carbon dioxide. It is formed by the union of neutral carbonate, Na_2CO_3, with carbon dioxide gas, CO_2, in the presence of water, H_2O, according to the following reaction:

$$Na_2CO_3 + CO_2 + H_2O = 2HNaCO_3$$

two molecules of the bicarbonate being generated. The necessary water is obtained through the liberation of the water of crystallization of the carbonate; in fact, provision has to be made for the escape of the excess by placing the crystals upon perforated bottoms.

[1] *Sodium Boro-benzoate.*—According to Thos. S. Wiegand, this salt may be made by adding benzoic acid to a hot solution of borax to saturation and evaporating to dryness; or by making an aqueous solution of three ounces of borax and another with four ounces of sodium benzoate, mixing, and evaporating to dryness, the yield is about six ounces. The dose is from twelve to fifteen grains. (*A. J. P.,* 1884, p. 615.)

[2] "Take of Commercial Bicarbonate of Sodium, in powder, *sixty-four troyounces;* Distilled Water, *six pints.* Introduce the powder into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour the Water gradually upon it. When the liquid has ceased to drop, or when the washings cease to precipitate a solution of sulphate of magnesium, remove the Bicarbonate of Sodium from the percolator, and dry it on bibulous paper, in a warm place." *U. S.* 1870.

We are informed that crude sodium bicarbonate is also prepared in breweries, in the same manner as potassium bicarbonate or saleratus, by placing the carbonate in suitable vessels over the fermenting beer in the vats, so as to be constantly immersed in an atmosphere of carbon dioxide. It is sold under the same name as the analogous salt of potassium, but is usually distinguished as *soda sal aëratus.*

Properties.—The bicarbonate is officially described as "a white, opaque powder, odorless, and having a cooling, mildly alkaline taste. Permanent in dry, but slowly decomposed in moist air. Soluble in 12 parts of water at 15° C. (59° F.); above this temperature the solution gradually loses carbon dioxide, and at boiling heat the salt is entirely converted into normal carbonate; insoluble in alcohol. When heated, the salt is decomposed into normal carbonate, water, and carbon dioxide, and finally, at 100° C. (212° F.), loses about 36.9 percent. of its weight. At a bright red heat it melts. To a non-luminous flame it imparts an intense yellow color. The solution, when freshly prepared with cold distilled water, without shaking, gives a slightly alkaline reaction with litmus paper. The alkalinity increases by standing, agitation, or increase of temperature. With acids the solution effervesces strongly. If Sodium Bicarbonate be heated in a test-tube, no odor of ammonia should be evolved. If 1 Gm. of the salt be dissolved in 19 Cc. of water, it should yield a perfectly clear and colorless solution, leaving no residue. If 1 Gm. of the salt be dissolved without agitation in 20 Cc. of water, at a temperature not exceeding 15° C. (59° F.), and 0.2 Cc. of normal hydrochloric acid and 2 drops of phenolphthalein T.S. be added, a red tint should not appear immediately (limit of *carbonate*). If 5 Cc. of an aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride T.S. (absence of *sulphocyanate*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Two Gm. of Sodium Bicarbonate should require for complete neutralization not less than 23.7 (23.74) Cc. of normal sulphuric acid V.S., methyl-orange T.S. being used as indicator." *U. S.* "In powder or small opaque monoclinic crystals, white, of a saline taste, soluble in 11 parts of cold *water.* It affords the reactions characteristic of sodium and of bicarbonates. Each gramme should require for neutralization from 11.8 to 11.9 cubic centimetres of the *volumetric solution of sulphuric acid.* It should yield no characteristic reaction with the tests for lead, copper, iron, aluminium, calcium, magnesium, potassium, sulphites, or thiosulphates, and only the slightest characteristic reactions with the tests for chlorides, sulphates, or ammonium. A solution of the salt in cold *water* gives a whitish precipitate, becoming brownish-red on standing, with *test-solution of mercuric chloride* (distinction from sodium carbonate). The addition of *test-solution of ferric chloride* to the aqueous solution acidulated with *hydrochloric acid* should cause no red coloration (absence of thiocyanates). 20 parts of Sodium Bicarbonate are neutralized by 16.7 parts of Citric Acid, and by 17.8 parts of Tartaric Acid." *Br.* The salt furnished by the manufacturers almost always comes up to the requirements of the Pharmacopœias. The presence of carbonate may be known by a decided alkaline taste and reaction, by a cold solution of the salt yielding a precipitate with magnesium sulphate, and by a solution in 40 parts of water affording, without agitation, an orange-colored or reddish-brown precipitate with corrosive sublimate. The pure bicarbonate is not precipitated by platinic chloride, nor, when treated with nitric acid in excess, by barium chloride or silver nitrate. The non-action of these tests shows the absence of salts of potassium, and of sulphates and chlorides. For Wenzell's method of testing sodium bicarbonate, see *Proc. A. Ph. A.*, 1894, 277.

When the solution is exposed to heat, the salt gradually parts with carbon dioxide, and, at the temperature of 100° C. (212° F.), is converted into sesquicarbonate. At a red heat the second equivalent of carbon dioxide is expelled, and the anhydrous carbonate is left.

Sodium thiosulphate has been detected in small amount in European sodium bicarbonate by E. Mylius, who supersaturated the suspected bicarbonate in solution with sulphuric acid, and added a little pure zinc, when the odor of hydrogen sulphide was produced. A slight trace of arsenic was also discovered in the sodium bicarbonate. (*A. Pharm.*, 1886, p. 598.) F. B. Power subsequently examined samples of American bicarbonate, and found them all free from thiosulphate and arsenic; he detected, however, traces of chlorides, ammonia, and monocarbonate in the commercial salt. (*Ph. Rund.*, 1887, p. 35.) E. Kuhlmann recommends rosolic acid as the best test for detecting monocarbonate; if a small fragment be placed in a solution of sodium bicarbonate, the liquid remains perfectly colorless even after a quarter of an hour if the salt be pure; but if it contain from one to four per cent. of monocarbonate a rose-red color will be produced after a few moments, and *immediately* in the presence of larger quantities, rapidly changing them to purple-red. (*A. Pharm.*, 1887, p. 72.)

Uses.—This salt has the general medicinal properties of the carbonate, but, from its mild taste and its less irritating qualities, proves more acceptable to the palate and stomach. It is often resorted to in *calculous cases* characterized by excess of uric acid. The continued use of the carbonate in these cases is liable to induce phosphatic deposit after the removal of the uric acid. According to D'Arcet, who made the observation at the

springs of Vichy, this objection does not apply to the bicarbonate, especially when taken in carbonic acid water, for this salt, by its superabundant acid, has the power of maintaining the phosphates in solution even after the alkali has caused the uric acid to disappear. The same remark is applicable to potassium bicarbonate. Sodium bicarbonate has been given in *infantile croup,* with apparent advantage in promoting the expulsion of the false membrane, in the dose of a grain every five minutes, dissolved in milk and water. Lemaire has proposed it as an antiphlogistic remedy in the treatment of *pneumonia, membranous angina,* and *croup,* supposing it to act on the principle of removing from the blood the excess of fibrin which exists in that liquid in inflammation. Its utility in membranous angina has been confirmed by Marchal (de Calvi). According to Jeannel, the use of sodium bicarbonate lessens the sugar in the urine of diabetic patients.

Dose, for an adult, from ten grains to a drachm (0.65 to 3.9 Gm.), taken most conveniently in a glass of carbonic acid water. When given in angina, fifteen grains (1 Gm.) may be administered every half-hour in a tablespoonful of water.

Off. Prep.—Caffeina Citrata Effervescens, *U. S.* (*Br.*); Ferri Arsenas, *Br.;* Ferri Carbonas Saccharatus, *U. S.;* Ferri Phosphas, *Br.;* Lithii Citras Effervescens, *U. S., Br.;* Magnesii Sulphas Effervescens, *U. S., Br.;* Mistura Rhei et Sodæ, *U. S.;* Potassii Citras Effervescens, *U. S.;* Pulvis Acetanilidi Compositus, *U. S.;* Pulvis Effervescens Compositus, *U. S.* (*Br.*); Sodii Citro-Tartras Effervescens, *Br.;* Sodii Phosphas Effervescens, *U. S., Br.;* Sodii Sulphas Effervescens, *Br.;* Spiritus Ætheris Compositus, *Br.;* Trochisci Sodii Bicarbonatis, *U. S.* (*Br.*).

SODII BISULPHIS. U. S.

SODIUM BISULPHITE

(sō′dī-ī bī-sŭl′phĭs)

$NaHSO_3 = 103.35$

"It should contain not less than 90 percent. of pure Sodium Bisulphite, and should be kept in a cool place, in small, completely filled, well-stoppered bottles." *U. S.*

Sulfite (Bi) de Soude, *Fr. Cod.;* Natrium Bisulfurosum; Doppeltschwefligsaures Natron, *G.*

Sodium bisulphite is prepared by thoroughly saturating a concentrated solution of sodium carbonate or bicarbonate with sulphurous acid gas, and collecting the crystals which form upon the cooling of the liquid. As found in commerce, it usually contains sodium thiosulphate and sulphate, is not reliable, and will not respond to the official tests; even when kept in well-stoppered bottles it will readily lose its crystalline character and the quantity of sulphurous acid gradually diminishes. The bisulphite, under the technical name of *leucogen,* is largely used in many industries. It serves as bleaching agent in washing wool, and in the steeping of grain, and in preserving meats and vegetable juices, because of its reducing and anti-fermentative character.

Properties.—It is officially described as in "opaque, prismatic crystals, or a granular powder, exhaling an odor of sulphur dioxide, and having a disagreeable, sulphurous taste. Exposed to the air, the salt loses sulphur dioxide, and is gradually oxidized to sulphate. Soluble in 3.5 parts of water, and in 70 parts of alcohol at 25° C. (77° F.); in about 2 parts of boiling water, and in 49 parts of boiling alcohol. When strongly heated, the salt decrepitates, emits vapors of sulphur and of sulphur dioxide, and leaves a residue of sodium sulphate. To a non-luminous flame it imparts an intense yellow color. Its aqueous solution gives an acid reaction with blue litmus paper. On the addition of hydrochloric or sulphuric acid, an aqueous solution of the salt evolves sulphur dioxide, which is recognized by its odor, and by its blackening a strip of paper dipped into mercurous nitrate T.S. and held over the escaping gas. If 1 Gm. of Sodium Bisulphite be dissolved in 10 Cc. of diluted nitric acid, and the solution heated sufficiently to expel the gases, the liquid should not become turbid (absence of *thiosulphate*). If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid, and heated sufficiently to expel the sulphur dioxide, the remaining solution, after being restored to its original volume, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 50 Cc. of tenth-normal iodine V.S., measured from a burette into a glass-stoppered vial (of about 100 Cc. capacity), 0.25 Gm. of finely powdered crystals of Sodium Bisulphite be added, the solution allowed to stand for about an hour, and shaken at frequent intervals, then the addition of not more than 6.45 Cc. of tenth-normal sodium thiosulphate V.S. should be required to decolorize the solution." *U. S.*

Uses.—The medicinal properties are those of the sulphites generally. (See *Sodii Sulphis.*)

Dose, five to ten grains (0.32 to 0.65 Gm.).

SODII BORAS. U. S. (Br.)

SODIUM BORATE [Borax]

(sō′dī-ī bō′rās)

$Na_2B_4O_7 + 10H_2O = 379.32$

"It should contain in the uneffloresced condition not less than 99 percent. of pure sodium tetraborate, and should be kept in well-stoppered bottles." *U. S.* "This salt, sodium pyroborate, $Na_2B_4O_7,10H_2O$, occurs native. It is also made artificially by neutralizing

native boric acid with sodium carbonate, or by boiling native calcium borate with solution of sodium carbonate." *Br.*

Borax, *Br., P. G.;* Sodæ Biboras, Biborate of Soda, Sodium Biborate. Sodium Pyroborate. Sodium Tetraborate; Natrium Biboricum (Biboracicum), Boras Sodicus; Borate de Soude, *Fr. Cod.;* Borax, Bauracon. Sel de Perse. *Fr.;* Borax, Borsaures Natron, *G.;* Borato di sodio, Borace, *It.;* Borato sodico, Borax, *Sp.*

Borax was known to the ancients; but its chemical character was first ascertained by Geoffroy in 1732. It exists in nature, and may be obtained by artificial means. It occurs in several localities in Europe, in Peru, and in beds, associated with calcium borate, in the district of Iquique, in the republic of Ecuador. This mineral (*boronatrocalcite*), which has become an article of commerce, and is considerably used as a substitute for borax, contains, according to T. L. Phipson, 34 per cent. of water, 11.95 of soda, 14.45 of lime, 34.71 of boric acid, 1.34 of chlorine, 1.10 of sulphuric acid, 0.60 of silica, and 2 of sand, and may be considered as a compound essentially of one molecule of crystallized sodium borate and two molecules of calcium borate, with two molecules of water. It is said also to contain usually some iodine and bromine. (G. Sims.) Borax has long been known to occur in certain lakes of Thibet and Persia, from which it was obtained by spontaneous evaporation. It constituted the impure borax called in commerce *tincal.*

An abundant source of borax has been developed within the limits of the United States. The existence of a borax lake in California was first made known by J. A. Veatch, who visited it in September, 1856, and, upon examining its waters, found borax among its constituents. The borax lake is a small offset of a large sheet of water, called Clear Lake, which is situated in the midst of a volcanic region, about 36 miles from the Pacific, and about 100 miles north of San Francisco. The smaller lake is separated from the larger by a low ridge of volcanic materials loosely massed together. It is of variable dimensions according to the season, being sometimes dry, at other times filled with water to the extent of about a mile in length and half a mile in breadth. In September, 1863, the water, being analyzed by G. E. Moore, was found to contain in a gallon 2401.56 grains of solid matter, of which about one-half was common salt, one-quarter sodium carbonate, and the remainder chiefly sodium borate, equivalent to 535.08 grains of the crystallized biborate to the gallon. The borax, being the least soluble of the saline constituents, from time to time, as the water becomes saturated, crystallizes out, and is deposited at the bottom of the lake, where it has accumulated in large quantities. The crystals of borax, from the minutest speck up to a diameter of two or three inches, intermixed with blue mud, form a layer at the bottom of the lake of variable thickness,—18 inches in one place that was examined. This deposit forms an apparently inexhaustible supply of borax, for as fast as removed in one place it is deposited in another by crystallization from the water, which, supplied from the volcanic regions around, promises to continue furnishing the borax for an indefinite period. Already the lake has supplied large quantities of borax to commerce. Iron coffer-dams are sunk to the bottom of the lake, the water pumped out, and the mixed mud and crystals removed. The crystals are picked out, and the earth, which is strongly impregnated with borax, is lixiviated, and the solution thus obtained evaporated in boilers until crystals form. In 1868 operations practically ceased at Borax Lake, but were continued at the neighboring Hachinhama Lake until 1873. At present the supply of American borax comes from the more easily worked deposits in the sandy deserts about Death Valley, southeast of Pyramid Lake, in Nevada, in the Slate Range district, San Bernardino Co., and the Saline Valley, Inyo Co., California. In order to reduce as much as possible the cost of transportation, the boraxes of the Pacific coast are made usually of high quality, and the so-called "boracic acid glass," one pound of which is equal to three pounds of ordinary borax, is prepared. For an interesting description of the Slate Range district, see *Chem. News,* 1886, 245. The most important deposits which are worked at present, 1906, in California are the *colemanite* (*calcium borate*) deposits twelve miles northeast of Daggett in the Mojave Desert. The formation (one hundred feet or more in width) has been traced for fully ten miles. The colemanite is readily dissolved by sodium carbonate solution, when the borax crystallizes out. The total production of borax in the United States for 1905, was 20,882 tons, valued at $2,122,801.

The world's production of boric acid minerals for 1903 in metric tons, was as follows: *Calcium borate.*—United States, 31,235; Bolivia, 1,206; Chili, 15,734; Peru, 2,584; Turkey, 9000. *Crude boric acid.*—Italy, 2,583.

Preparation of Artificial Borax.—Large quantities of borax are now made for the European market by the direct combination of *native boric acid* with soda. The acid is found abundantly in the crater of Vulcano, one of the Lipari Islands, but principally in a volcanic region of Tuscany occupying a space of ten or twelve miles. Within this region are found numerous hillocks and fissures, the latter of which emit hot aqueous vapor containing boric acid and certain gases. Around one or several of these fissures a circular basin of masonry is built, which is filled with water and called a lagoon. By the jets of vapor constantly breaking through it, the water becomes gradually impregnated with boric acid and heated. A series of such lagoons are made to communicate with each other on the declivity of a hill, and the lowest to discharge itself into a reservoir, where the solution is

allowed to rest and deposit mechanical impurities. From this reservoir the solution is made to pass into leaden evaporating pans, heated by the natural vapor, where it receives sufficient concentration to fit it for being conducted into wooden tubs, where it is allowed to cool and crystallize. The crude acid, thus obtained, contains, on an average, 84 per cent. of boric acid, the impurities consisting chiefly of alum, the double ammonium and magnesium sulphate, and calcium sulphate. The seven works in the neighborhood of Castelnuovo in Tuscany, belonging to Count Larderel, were producing, in 1878, over three millions of kilogrammes. Vulcano yielded 4000 kilogrammes of boric acid yearly. The crude acid is converted into borax by dissolving it to saturation in a solution of sodium carbonate, heated by steam, and the liquor, after boiling, is allowed to stand for ten or twelve hours. It is then drawn off into wooden vessels lined with lead, where it crystallizes. The impure crystals thus obtained are refined by dissolving in water heated by steam, adding sodium carbonate to the solution, and crystallizing. The merit of introducing the process for obtaining artificial borax belongs to Cartier and Payen, who succeeded in establishing its manufacture in France. According to Veatch, boric acid exists in the sea water on the coast of California.

Another method of neutralizing the Italian boric acid is practised in England. Instead of combining the acid and alkali in solution, the manufacturer mixes the acid in a solid state with a proper proportion of soda ash, and exposes the mixture to the heat of a reverberatory furnace, provision being made for the collection of a large quantity of ammonia, which is always present in the crude acid and escapes during the process. The remaining operations are similar to those performed in the preparation of sodium carbonate from the cake. (*A. J. P.*, 1867, p. 339.)

Properties.—Borax is a white salt, occurring in "colorless, transparent, monoclinic prisms, or a white powder, inodorous, and having a sweetish, alkaline taste. Slightly effloresecent in warm, dry air. Soluble in 20.4 parts of water at 25° C. (77° F.), and in 0.5 part of boiling water; insoluble in alcohol; it is soluble in 1 part of glycerin at 80° C. (176° F.). When heated, the salt at first loses part of its water of crystallization, then melts, and, when further heated, swells up and forms a white, porous mass. At a red heat it loses all of its water of crystallization (47 percent.), and fuses to a colorless glass. To a non-luminous flame it imparts an intense yellow color. An aqueous solution (1 in 20) colors red litmus paper blue, and yellow turmeric paper reddish-brown. After being acidulated with hydrochloric acid, the solution colors blue litmus paper red; yellow turmeric paper remains unchanged at first, but on drying, becomes brownish-red, and this color is temporarily changed to bluish-black by moistening with ammonia water. If a drop of the solution of Sodium Borate in glycerin be held in a non-luminous flame, a transient bright green color will appear. If a slight excess of diluted sulphuric acid be added to a hot, saturated, aqueous solution of the salt, shining, scaly crystals of boric acid will separate on cooling, which, when dissolved in alcohol and the liquid ignited, impart a green color to the flame. With 21 Cc. of water, 1 Gm. of Sodium Borate should yield a perfectly clear and colorless solution, leaving no residue. The aqueous solution (1 in 20) should not effervesce with acids (absence of *carbonate* or *bicarbonate*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). The aqueous solution (1 in 20) should not be rendered turbid by magnesia mixture (absence of *phosphate*). If 1 Gm. of the salt be dissolved in 20 Cc. of diluted sulphuric acid by the aid of heat, and 3 drops of indigo T.S. be added, the blue color should not be discharged after heating for ten minutes on a water-bath (absence of *nitrate*)." *U. S.* "Transparent colorless crystals, sometimes slightly effloresced, with a weak alkaline reaction; insoluble in *alcohol* (90 per cent.), soluble in 25 times its weight of cold, and in half its weight of boiling *water*. It dissolves in its own weight of *glycerin*. It turns *turmeric paper* brown. It colors flame intensely yellow. A hot saturated solution, when acidulated with any of the mineral acids, lets fall, as it cools, a scaly crystalline deposit of boric acid, the solution of which in *alcohol* (90 per cent.) burns with a green flame. Each gramme dissolved in 200 cubic centimetres of *water* should require for neutralization 5.2 cubic centimetres of the *volumetric solution of sulphuric acid,* using *methyl orange* as the indicator." *Br.* Above a red heat it melts into a limpid liquid, which, after cooling, concretes into a transparent solid, called *glass of borax,* much used as a flux in assays with the blowpipe. Borax has been found in the English market adulterated to the extent of 20 per cent. with sodium phosphate. This may be detected by exposing the suspected borax to the heat of a drying-room for a few hours, when the phosphate, if present, will effloresce, and may be picked out. Commercial borax is used as a flux in metallurgical operations; as the basis of the enamel so much applied to iron utensils, glazed brick, and much china, earthenware, and tiling; in the laundry with starch to impart a gloss to linen; by the meat packers of the United States (1000 tons yearly) as an antiseptic, and very largely in soaps and toilet preparations and in detergent powders.

Borax has the property of rendering cream of tartar very soluble in water, and forms a combination with it called *soluble cream of tartar*, which is sometimes used in medicine. This preparation attracts moisture from the air, and

is soluble in its own weight of cold and half its weight of boiling water. (See *Potassii Bitartras.*) R. F. Fairthorne states that borax is more soluble in water if sugar has been added to it. (*A. J. P.*, March, 1881.) Soluble cream of tartar may be made by substituting boric acid for the borax. *Boric acid soluble cream of tartar* was directed by the French Codex of 1837, and was made by the following formula. Four hundred parts of cream of tartar and 100 of the acid are dissolved in a silver basin, at the boiling temperature, in 2400 parts of water. The solution is kept boiling until the greater part of the water is consumed. The fire is then moderated, and the solution continually stirred while the evaporation proceeds. When the matter has become very thick, it is removed by portions, which are flattened in the hand, completely dried by the heat of a stove, powdered, and kept in well-stoppered bottles. This form of soluble cream of tartar is more soluble than that made with borax. According to E. Robiquet, in order to obtain soluble cream of tartar, made with boric acid, of good quality, it is necessary to use a large quantity of water, and to boil for a long time. By proceeding thus, the boric acid undergoes a molecular modification, equivalent to a change from the crystallized to the vitreous condition, and a preparation readily and totally soluble in cold water is insured. The product should not be powdered, but kept in large grains. (*J. P. C.*, xxi. 197.) Borax is incompatible with the salts of the alkaloids; in warm solution it decomposes hydrated chloral.

Composition.—Borax has the formula $Na_2B_4O_7 + 10H_2O$. It ordinarily crystallizes in monoclinic prisms, and contains ten molecules of water (*prismatic borax*); but a variety of the salt exists which crystallizes in octahedrons, and contains only five molecules of water (*octahedral borax*). The latter is obtained in the artificial production of borax by crystallizing from a concentrated solution at a temperature between 60° and 80° C. (140° and 176° F.). When a solution of borax is evaporated at 100° C. (212° F.), the salt is left as a transparent, amorphous, brittle mass, containing four molecules of water. (Schweitzer.)[1]

Boric acid may be obtained artificially by decomposing a hot saturated solution of borax with sulphuric acid, which unites with the soda to form sodium sulphate and sets free the acid. As thus obtained it is in white, shining, scaly crystals, characterized by the property of imparting a light-green color to the flame of burning alcohol. Boric acid has the formula H_3BO_3, and is now official. (See *Acidum Boricum.*)

Boron is a non-metallic element, which, like carbon, is found to exist in two allotropic states, designated amorphous, and crystallized boron, corresponding severally to amorphous carbon and to the diamond. Crystallized boron is very brilliant, and of different colors, from garnet-red to a nearly colorless honey-yellow. Its density is 2.68, and its hardness very great. Wöhler and Deville distinguished three varieties of crystals, containing from 2 to 4 per cent. of carbon, and one specimen, in addition to carbon, about 7 per cent. of aluminum. The hardest variety was as hard as diamond. (See *Chem. Gaz.*, 1857.)

Uses.—The actions of borax and of boric acid upon the animal system are identical. The effects of borax are, however, very feeble, Cyon having found that in daily doses of three drachms borax exerts no perceptible influence upon the dog. Nevertheless, in sufficient amount it is a depressing poison, having an influence upon the heart as well as upon the spinal centres, and a number of instances of poisoning from it have been reported. The symptoms have varied somewhat, but in most if not all of the cases there have been great depression of spirits, fall of bodily temperature, a very feeble pulse,—rapid or slow,—and an erythematous eruption accompanied with much swelling of the parts, and especially affecting the lower extremities, and followed by exfoliation; nausea, violent vomiting, and hiccough have been present in some cases; ecchymoses have been noted; the mind usually remains clear until late in the poisoning, but death has been preceded by coma, with disturbances of the respiration, and involuntary discharges. The continued use of borax has produced "*borism*," which is characterized by gastric irritation, a peculiar absence of fatty matter and of moisture from the skin, and various skin eruptions, especially eczema, reddish papules with squamous desquamating borders, seborrhœic acne, and scarlatiniform plaques.

Borax has been used internally in *dysmenorrhœa*, and as an oxytocic for a supposed specific influence upon the uterus, and has also been employed in the *uric acid diathesis*. Again, it has been highly commended in *epilepsy*, but in a careful test made on a large scale in the epileptic wards of the Philadelphia Hospital by H. C. Wood it was found to have little or no influence on that disorder.

Borax is an antiseptic of moderate power. According to the experiments of Sternberg, it is more efficient in preventing putrefaction than in destroying the organisms of disease. Walb found that a five per cent. solution of it would keep fibrin perfectly fresh for nineteen days. It has been used to a considerable extent in antiseptic surgery, and, being free, or nearly so, from irritating properties, may be applied in powder or in strong solution to *wounds, ulcers, abscesses*, etc. Wounds dressed in a dry manner with a lint which has been prepared by previously wetting with a hot saturated solu-

[1] *Sodium borate* (neutral).—This soluble borate may be made by adding boric acid to a hot concentrated aqueous solution of sodium diborate or borax until it has a neutral reaction; the crystals which separate (sodium borate) have been erroneously described under the name sodium tetraborate. They are transparent, fragile, and glassy; it is found in commerce in glass-like masses. It is soluble in cold water, but more soluble (70 per cent.) in hot water.

tion of borax and drying, are said to do extremely well. Its chief value in practical medicine grows out of its peculiar detergent, mildly stimulant, or alterative action upon the mucous membrane. In *aphthous ulceration, diphtheria,* and other *inflammations of the mouth,* crystals of it may be allowed to dissolve slowly in the mouth. Bouchut has highly recommended, in *infantile diarrhœa,* enemas made by dissolving from two to five drachms of borax in two fluidounces of water. Washing out the bladder with a saturated solution of boric acid or borax is most efficacious in *subacute* and *chronic cystitis.* The same solution has also been found very useful in *inflammations of the urethra and vagina,* especially when there is pruritic irritation, and even in *scaly diseases of the skin.* A solution in distilled water, from five to ten grains to an ounce, is often of great service in *conjunctivitis.* Borax should not be prescribed in dilute solution mixed with glycerin, as a reaction occurs, the liquid becoming acid to test-paper.

Dose, ten to twenty grains (0.6 to 1.3 Gm.).

Off. Prep.—Glycerinum Boracis, *Br.;* Mel Boracis, *Br.;* Unguentum Aquæ Rosæ, *U. S.*

SODII BROMIDUM. U. S., Br.

SODIUM BROMIDE

(sō′dī-ī brō′mi-dŭm)

NaBr = 102.24

"It should contain, when dried, not less than 97 percent. of pure Sodium Bromide, and should be kept in well-stoppered bottles." *U. S.* "Sodium Bromide, NaBr, may be prepared in the same manner as Potassium Bromide, sodium hydroxide being used in place of potassium hydroxide." *Br.*

Bromure de Sodium, *Fr. Cod.;* Natrium bromatum, *P. G.;* Natriumbromid, Bromnatrium, *G.;* Bromuro di sodio, *It.;* Bromuro sodico, *Sp.*

This salt contains a larger proportion of bromine than does potassium bromide, on account of the lower atomic weight of sodium, sodium bromide containing 77.62 per cent. of bromine, while potassium bromide contains 67.13 per cent. It is a trifle more soluble in water and alcohol. It may be made by the same process that is employed for potassium bromide, substituting sodium carbonate for potassium carbonate. According to Castelhaz, it is best made by transforming bromine into ammonium bromide, separating any iodine present as iodide by crystallization from the mother waters, and decomposing the ammonium bromide with sodium carbonate. The solution should be evaporated by heating carefully. (*A. J. P.,* xlii. 509.)

Properties.—It occurs in "colorless or white, cubical crystals, or a white, granular powder, odorless, and having a saline, slightly bitter taste. The salt absorbs moisture from the air without deliquescing. Soluble in about 1.7 parts of water, and in 12.5 parts of alcohol at 25° C. (77° F.); in 0.8 part of boiling water, and in 11 parts of boiling alcohol. When heated to a bright red heat, the salt melts, and, at a somewhat higher temperature, slowly volatilizes without decomposition. To a nonluminous flame it imparts an intense yellow color. An aqueous solution (1 in 20) is neutral or shows a faintly alkaline reaction with red litmus paper. Silver Nitrate T.S. added to a concentrated aqueous solution produces a yellowish-white precipitate, insoluble in nitric acid and in a moderate excess of ammonia water. If 1 Gm. of the salt be dissolved in 10 Cc. of water and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no color should be produced by the subsequent addition of a drop of phenolphthalein T.S., even after boiling (limit of *alkali*). If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and then chlorine water which has been diluted with an equal volume of water be cautiously introduced, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of *iodide*). The aqueous solution of Sodium Bromide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If diluted sulphuric acid be dropped upon some of the powdered salt, no yellow color should appear at once (absence of *bromate*). Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). If 0.3 Gm. of the well-dried salt be dissolved in about 50 Cc. of water, and 2 or 3 drops of potassium chromate T.S. be added, it should require not less than 28.5 nor more than 30 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color." *U. S.* "Soluble in less than 2 parts of *water,* and in 16 parts of *alcohol* (90 per cent.). It affords the reactions characteristic of sodium and of bromides. Each gramme of the dry salt dissolved in *water* should require for complete precipitation not less than 95.8 nor more than 97.8 cubic centimetres of the *volumetric solution of silver nitrate.* It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, zinc, calcium, magnesium, potassium, ammonium, carbonates, cyanides, bromates, or iodates, and only the slightest reactions with the tests for chlorides, iodides, or sulphates. *Test-solution of ferric chloride* should not cause a red coloration in the aqueous solution (absence of thiocyanates)." *Br.*

Uses.—The medicinal properties of sodium bromide are similar to those of potassium bromide, except that the sodium salt is much less depressant to the circulation.

Dose, fifteen grains to one drachm (1.0 to 3.9 Gm.).

SODII CARBONAS. Br.

SODIUM CARBONATE

(sō'dĭ-ī cär'bo-năs)

$Na_2CO_3 + 10H_2O = 284.11$

"Sodium Carbonate, $Na_2CO_3,10H_2O$, may be obtained from sodium chloride, either by interaction with ammonium bicarbonate and subsequent ignition, or by its conversion into sodium sulphate and the action of heat on a mixture of the sulphate with carbon and calcium carbonate." *Br.*

Carbonate of Soda, Sal Soda, Washing Soda; Natrium Carbonicum, *P. G.;* Carbonas Sodicus, Sal Sodæ; Carbonate de Soude pur cristallisé, *Fr. Cod.;* Einfach Kohlensaures Natron, Kohlensaures Natron, Soda, *G.;* Carbonato di sodio, *It.;* Carbonato sodico cristalizado, *Sp.*

Sodium carbonate is official in the U. S. P. (8th Rev.) only as *Sodii Carbonas Monohydras.* (See page 1141.)

Before entering upon the consideration of sodium carbonate, we shall speak generally of the sources of the alkali soda. These may be divided into the natural and the artificial. The natural sources are the minerals of native soda, and certain marine plants which yield the alkali in their ashes; the artificial are certain salts which furnish it by chemical decomposition.

Native soda, sometimes called *natron,* is found chiefly in Hungary, Egypt, and South America, and exists in these countries either in the surface earth, which often exhibits a saline efflorescence, or in solution in small lakes, from which it is extracted by taking advantage of the drying up of the water during the heats of summer. The native soda from Egypt, called *trona,* is a *sesquicarbonate;* that from South America is less carbonated. Of these sources, the only one which retains any importance at the present day is Egyptian trona, of which some 5000 tons are annually shipped from Alexandria. Native soda, in the form of sesquicarbonate, has been found in a soda lake in the territory of the Nizam, in Hindostan. Barth, in his *Travels in Africa,* states that natron is largely collected on the shores of Lake Tchad, and in some other localities in Central Africa. A similar product exists abundantly in low places along the sea coast of Arabia, near Aden. (R. Haines, *P. J.,* July, 1863.) Probably the most numerous and extensive natural soda deposits in the world exist in Southeastern Wyoming, in the counties of Albany, Carbon, and Natrona. The salts are the carbonate and sulphate, at times pure, and again as mixtures both hydrated and partly dehydrated. For a full account of these localities with analyses of different deposits, see *The Mineral Industry* for 1897, 612–616. New York, 1898.

Impure soda, derived from the ashes of plants growing on the surface or borders of the sea, is called barilla or kelp, according to the character of the plants incinerated. Barilla is obtained from several vegetables, principally belonging to the genera *Salsola, Salicornia,* and *Chenopodium.* In Spain, Sicily, and some other countries these plants are cultivated for the purpose of yielding soda by their combustion. When ripe, they are cut down, dried, and burnt in heaps. The ashes form a semi-fused, hard, and compact saline mass, which is broken up into fragments by means of pickaxes, and introduced into commerce. Kelp, called *varec* in France, is procured by the incineration of various kinds of sea weeds, principally the algæ and fuci, which grow on the rocky coasts of many countries. The Orkneys and Hebrides, and the rocky coasts of Wales, Scotland, and Ireland, furnish large quantities of these weeds. The plants are fermented in heaps, then dried, and afterwards burnt to ashes in ovens roughly made of brick or stone and built in the ground. The alkali in the ashes melts, and forms the whole into a solid mass. When cold, it is broken up with iron instruments into large heavy masses, in which state it is found in commerce. About twenty-four tons of sea weeds produce one ton of kelp. *Barilla,* when of good quality, is in hard, dry, porous, sonorous, grayish-blue masses, which become covered with a saline efflorescence on exposure. It possesses a peculiar odor and an alkaline taste. *Spanish barilla* contains from 25 to 40 per cent. of carbonated alkali, the residue being made up of sodium sulphate, sodium sulphide and chloride, calcium carbonate, alumina, silica, oxidized iron, and a small portion of charcoal which has escaped combustion. Before the introduction of artificial soda, barilla formed the source of the crystallized carbonate employed in medicine. At present it is principally used in the manufacture of soap. *Kelp* is in hard, vesicular masses, of a dark-gray, bluish, or greenish color, a sulphurous odor, and an acrid, caustic taste. It is still less pure than barilla, containing only from 5 to 8 per cent. of carbonated soda, the rest being made up of a large proportion of sodium and potassium sulphates, and potassium and sodium chlorides, a small quantity of sodium iodide, and insoluble and coloring matters. Large quantities of kelp were formerly manufactured in Great Britain and the neighboring islands, particularly the Orkneys; but the demand and production have generally fallen off since the introduction of artificial soda. At present kelp is used principally in the manufacture of iodine. (See *Iodum.*)

Artificial Soda.—This is made from common salt by the older or Leblanc process in two steps; first, by converting the salt by sulphuric acid into sodium sulphate, and, secondly, by decomposing the sulphate by calcium carbonate and charcoal at a high temperature, so as to yield sodium carbonate. The chemical reactions may be summarized as follows:

$$2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl$$

$$Na_2SO_4 + CaCO_3 + C_4 = Na_2CO_3 + CaS + 4CO$$

The sulphate, first dried, is mixed with its own

weight of ground limestone, and half its weight of small coal, ground and sifted, and the whole is heated in a reverberatory furnace, which may be either stationary or, as is more general now, revolving on a horizontal axis. In this "black-ash furnace" the mixture fuses, and forms a black mass called *black ash, soda ball,* or *British barilla.* The coal, at the temperature employed, converts the sodium sulphate into sodium sulphide. This reacts with the limestone, so as to form calcium sulphide and sodium carbonate, Na_2S and $CaCO_3 = CaS$ and Na_2CO_3. Black ash contains from 36 to 45 per cent. of alkali, imperfectly carbonated on account of the high temperature used, the remainder being principally calcium sulphide, caustic lime, sodium chloride, calcium sulphite, and coaly matter. It is next digested in warm water, which takes up the alkali and other soluble matters, and leaves the insoluble impurities, called *soda waste,* which is now largely utilized in the manufacture of sodium thiosulphate. The solution is evaporated to dryness, and the mass obtained is calcined with one-fourth of its weight of sawdust, in order to convert the alkali fully into carbonate, by means of the carbon dioxide resulting from the combustion of the sawdust. The product is redissolved in water, and the solution evaporated to dryness. The alkali, in this stage of its purification, contains about 50 per cent. of sodium carbonate, and is called *soda-ash.* It is brought to the state of crystallized sodium carbonate by dissolving it in water, straining the solution, evaporating it to a pellicle, and setting it aside to crystallize. This process was invented in 1784 by Leblanc, and the first manufactory for producing it on a large scale was established in 1790, near Paris, by Leblanc and Dizé. The process is pursued on an immense scale in Great Britain, especially in Liverpool and Glasgow. Various modifications have been proposed, and in part carried into practice, which affect the Leblanc process more or less fundamentally. One of the most important of these is the Hargreaves-Robinson method of preparing "salt-cake" or sodium sulphate without the previous preparation of sulphuric acid. Sulphur dioxide (from the roasting of pyrites), atmospheric oxygen, and steam are made to act upon salt previously prepared in broken cakes or fragments. Sodium sulphate and hydrochloric acid are obtained. The use of sodium nitrate is dispensed with, the sulphate is purer than that of the old method, and the hydrochloric acid is more easily condensed. It requires, however, a more expensive plant. A troublesome side-product of the Leblanc process is the calcium sulphide or "alkali waste," and much ingenuity has been used in endeavoring to utilize this and to recover the sulphur. The most successful sulphur recovery process thus far has been that of Chance, who decomposes the calcium sulphide by carbon dioxide, liberating H_2S. This is mixed with air and passed over a layer of ferric oxide, which at a low red heat causes the hydrogen to burn, liberating the sulphur, which may either be collected or burned to SO_2 for the lead-chamber process. It is asserted that 95 per cent. of the sulphur can be thus recovered.

The Gossage process, still more recently proposed, aims to avoid the formation of the "alkali waste" altogether, and to do away with the black-ash furnace. By heating the salt cake with the necessary proportion of coal-slack the sodium sulphate is reduced to sodium sulphide. This is dissolved, allowed to settle, and the supernatant liquid, freed from silica and alumina, is conducted to towers, where it is treated with excess of carbon dioxide, whereby sodium bicarbonate and hydrogen sulphide are formed. The bicarbonate may be heated to change it into normal salt, while the carbon dioxide is utilized in decomposing fresh quantities of sulphide.

Within the last few decades a process has been put in practice which has given so much satisfaction in its results as to be likely to rival, if not to supersede, the hitherto unequalled process of Leblanc. It is designated the *ammonia-soda* process, and is based on the fact that when carbon dioxide is passed into a solution of common salt in aqueous ammonia a double decomposition occurs, and the slightly soluble sodium bicarbonate is precipitated:

$$NH_3 + CO_2 + NaCl + H_2O = HNaCO_3 + NH_4Cl$$

From the mother liquor containing the sal-ammoniac, if deemed advisable, the ammonia may be withdrawn by the action of lime, and serve in the renewal of the operation. The sodium bicarbonate is reduced by heat to the carbonate, and the carbon dioxide thus obtained serves to convert the ammonia into the ammonium bicarbonate necessary in the proceeding. The waste product here is calcium chloride, which takes with it all the chlorine of the salt originally used. Therefore if the ammonia-soda process were to replace the Leblanc process, hydrochloric acid and chlorine would have to be made independently, and would become much dearer than at present. To obviate this objection to the ammonia-soda process and to produce hydrochloric acid as one product of the same process, the late Walter Weldon proposed to use magnesia instead of lime in the decomposing of the sal-ammoniac. This would leave magnesium chloride instead of calcium chloride. From the magnesium chloride the chlorine can be obtained as follows:

$$MgCl_2 + H_2O = 2HCl + MgO$$

Steam will liberate hydrochloric acid from the magnesium chloride. This process is carried out practically at Salindres in France, although its economy is not definitely established.

A still more promising suggestion is that of the distinguished chemist Ludwig Mond of Brunner, Mond & Co., who are the chief English manufacturers of ammonia-soda. He proposes to freeze out the ammonium chloride from the mother liquors by artificial refrigeration, sublime it, and pass the vapor over magnesia, whereby

the hydrochloric acid is retained in combination with the magnesia as magnesium chloride, while the ammonia passes on. The magnesium chloride is then heated in a current of air, when it is split up into chlorine and magnesia.

The reaction between ammonium bicarbonate and sodium chloride, upon which the ammonia process was founded, was first discovered by Dyar and Hemming about 1838, but it was only in 1863 that Ernest Solvay, a Belgian chemist, made it a practical success. The advantages of this method are that the sodium chloride is directly transformed into sodium carbonate, that in the precipitation sodium is the only metal thrown down, and that the preparation is therefore remarkably pure, that it is entirely exempt from the compounds of sulphur, that the amount of product is very large, that the apparatus used is very simple, that there is a great saving of fuel and of labor, and, finally, that no unwholesome gases are diffused in the atmosphere, interfering with the health of the workmen and the community. Schloesing and Rolland have observed that in the double decomposition between ammonium bicarbonate and sodium chloride a certain portion only—about two-thirds—undergoes the change. This is explained by Bauer, who finds that the reaction is limited by another in an inverse direction. Thus, if ammonium bicarbonate and sodium chloride yield sodium bicarbonate and ammonium chloride (hydrochlorate of ammonia), these, put together, inversely yield ammonium bicarbonate and sodium chloride. An equilibrium is thus established, and the mixture preserves a constant composition, at the point where the two reactions take place at the same time. (*J. P. C.*, Sept. 1874.) At present the ammonia-soda process is gaining rapidly upon the Leblanc process. In England, the Leblanc process is most strongly entrenched and backed by the resources of the "United Alkali Company," a combination of manufacturers with a paid-up capital of $42,000,000; this steady gain is shown by the following figures:

	1894. Tons.	1895. Tons.	1896. Tons.
Leblanc process	434,298	408,173	360,929
Ammonia-soda process	361,603	428,614	431,577
Total production	795,901	836,787	792,506

In 1900 the world's production of soda ash and caustic soda by the two processes was as follows: ammonia-soda product, 1,400,000 tons; Leblanc product 400,000 tons.

The production of alkali—reckoned at 58° soda ash—in the United States amounted to 386,361 tons in 1900, valued at $4,768,383, and in 1905 to 518,954 tons, valued at $8,204,545, all by the ammonia-soda process. The main producers were the Solvay Process Co. of Geddes, near Syracuse, N. Y., and the Michigan Alkali Co.

Another source of this carbonate has been discovered in *cryolite*, a mineral existing in great abundance on the coast of Greenland, and largely imported into this country by a manufacturing company which enjoys to a certain extent a monopoly of the mineral under the Danish authorities. Cryolite consists mainly of a double aluminum and sodium fluoride, containing in 100 parts 13 of aluminum, 34 of sodium, and 53 of fluorine. Sodium carbonate is obtained by heating cryolite with lime, whereby calcium fluoride is formed, while the sodium and aluminum combine to form a sodium aluminate, a weak salt, which is dissolved out by lixiviation. The soda is converted into carbonate by passing carbon dioxide under pressure through the solution, and the alumina, separated from the soda, becomes insoluble, and is deposited. (*A. J. P.*, Jan. 1868, p. 71.) Cryolite is also largely used in Denmark and Germany in the preparation of sodium carbonate and of alumina, the latter of which is employed in the manufacture of alum and aluminum.

Besides the preparation of sodium carbonate, cryolite is employed for other imporant purposes. Within recent years it has become quite important as a flux for the electrolytic production of aluminum by the Hall and similar processes. (See *Alumen.*) Its only known locality, at least in large amount, is Greenland, where it is found on the southwest coast, near Cape Farewell, existing in beds, of which one is said to be eighty feet thick and three hundred long. It is imported by the "Pennsylvania Salt Manufacturing Company" into Philadelphia in immense quantities. It is a handsome mineral, hard, brittle, and translucent, sometimes almost transparent, but generally of a frosty whiteness, which probably suggested its name of *cryolite* or *kryolite*, from the Greek κρύος, *frost*. Though homogeneous in great degree, it exhibits here and there in its substance dark spots, sometimes mere specks, sometimes of considerable size, which appear to be crystalline centres of substances mixed with it at the time of solidification, such as galena, ferrous carbonate, copper and iron pyrites, etc.

The different kinds of impure sodium carbonate, whether barilla, kelp, or soda-ash, being exceedingly variable in composition, it is important to have a ready method of determining the quantity of real carbonated alkali which they contain. The mode in which this is done, is by means of an instrument called an alkalimeter, which is frequently used by analytical chemists. These various forms of carbonated soda are largely consumed in dyeing and bleaching, and in the manufacture of soap and glass. In reference to "the English commercial test," see *A. J. P.*, Sept. 1870, p. 447. The following are descriptions of the different grades of artificial soda, known under the names of British barilla, and soda-ash.

British barilla, so called to distinguish it from Spanish barilla, which has its source in the ashes of maritime plants, is a blackish-brown substance, becoming darker by exposure to the air. When broken it exhibits an imperfect metallic lustre, and a close striated texture. Its taste is alkaline and caustic. On exposure to a moist atmosphere it becomes covered with a yellow efflorescence, and quickly falls to powder, with disengagement of heat and hydrogen sulphide, the powder at the same time increasing in weight by the absorption of carbon dioxide and water.

Soda-ash is in white or gray masses, and contains about half its weight of foreign salts, consisting of sodium chloride and sodium sulphate.

Properties.—The carbonate according to the U. S. P. 1890 occurs in "colorless, monoclinic crystals, odorless, and having a strongly alkaline taste. In dry air the salt effloresces, and, if left exposed, soon loses about half of its water of crystallization (31.467 per cent. of its weight), and becomes a white powder. Soluble in 1.6 parts of water at 15° C. (59° F.), in 0.09 part at 38° C. (100.4° F.), and in 0.2 part of boiling water; insoluble in alcohol and in ether; soluble in 1.02 parts of glycerin. When heated at 32.5° C. (90.5° F.), the crystals fuse in their water of crystallization, and lose some water. At a higher temperature, the salt continues to lose water, until, at last, an anhydrous residue is left, corresponding to 37 per cent. of the weight of the crystals. At a bright red heat the anhydrous salt fuses. To a non-luminous flame it imparts an intense, yellow color. The aqueous solution gives an alkaline reaction with litmus paper, and effervesces strongly with acids. A 5 per cent. aqueous solution of the salt should be perfectly clear and colorless, leaving no insoluble residue. If 5 Cc. of the aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride test-solution (absence of *sulphocyanate*). If to 5 Cc. of the aqueous solution, slightly supersaturated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution be added, no turbidity should be produced, either before or after the addition of ammonia water in slight excess (absence of *arsenic, lead, iron, aluminum,* etc.). If 5 Cc. of the aqueous solution be slightly supersaturated with acetic acid, the addition of 0.5 Cc. of ammonium oxalate test-solution should produce no turbidity (absence of *calcium*). If 5 Cc. of the aqueous solution be slightly supersaturated with acetic acid, the addition of 0.5 Cc. of sodium cobaltic nitrite test-solution should not render it turbid within one hour (limit of *potassium*). If 1.2 Gm. of the salt be dissolved in 10 Cc. of diluted nitric acid, then 0.5 Cc. of silver nitrate decinormal volumetric solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of silver nitrate volumetric solution (limit of *chloride*). If 2.5 Gm. of the salt be dissolved in 10 Cc. of diluted hydrochloric acid, then 0.1 Cc. of nitric acid and 0.1 Cc. of barium chloride test-solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of *sulphate, sulphite,* and *hyposulphite*). If the crystallized salt be heated in a test-tube, the vapor of *ammonia* should not be evolved. To neutralize 1 Gm. of anhydrous Sodium Carbonate (deprived of its water of crystallization by heat immediately before being weighed) should require not less than 18.7 Cc. of normal sulphuric acid (corresponding to not less than 98.9 per cent. of the pure salt), methyl-orange being used as indicator." *U. S.* 1890. "In transparent colorless rhombic crystals, efflorescent, with a harsh taste and strong alkaline reaction, soluble in 2 parts of cold *water.* It should respond to the qualitative tests enumerated under 'Sodii Bicarbonas,' except that its aqueous solution gives an immediate brownish-red precipitate with *test-solution of mercuric chloride.* When heated it liquefies and then dries up, losing 62.93 per cent. of its weight. Each gramme of the crystallized salt should require for neutralization at least 6.9 cubic centimetres of the *volumetric solution of sulphuric acid.* 20 parts of Sodium Carbonate are neutralized by 9.8 parts of Citric Acid, and by 10.5 parts of Tartaric Acid." *Br.*

This salt presents an anomaly in its solubility, as ascertained by Henri Loewel; it is more soluble in water at 36.1° C. (97° F.) than at its boiling point. Sodium carbonate is insoluble in alcohol. The most usual impurities in it are sodium sulphate and common salt, which may be detected by converting it into a nitrate and testing separate portions of this severally with barium chloride and silver nitrate.[1] Common salt is seldom entirely absent, but good specimens are free from sodium sulphate. When badly prepared it is liable to contain sodium sulphide, which may be detected by the production of the odor of hydrogen sulphide upon dissolving the salt in water. Sodium carbonate is incompatible with acids, which decompose it with effervescence, acidulous salts, lime water, ammonium chloride, and earthy and metallic salts. When crystallized it contains ten molecules of water. It is thus perceived that this salt, when crystallized, contains two-thirds of its weight of water; but the quantity actually present in it, as found in commerce, is variable, being dependent on the extent to which it may have undergone efflorescence. To obtain pure sodium carbonate for the purpose of a test, J. Lawrence Smith of Louisville, Ky., recommends that

[1] For a method of determining the precise quantity of the sulphate in a special case, see *J. P. C.*, Août, 1873, p. 124.

sodium oxalate should be prepared from the common carbonate, and then decomposed by heat.[1]

Uses.—Soda being the natural alkali of the blood and other liquids of the human organism, its influence upon that organism in disease is very slight. In the experiments of Gradeau the injection of 107 grains of sodium carbonate directly into the blood of a dog produced practically no symptoms, and in the studies of Münch upon the effect on the human system of the continuous exhibition for a few days of large amounts of soda the results were almost entirely negative. The chief influence of the salt is upon certain of the liquid excretions. Thus, the urine becomes distinctly alkaline, without, however, so far as we know, there being any distinct change in its general constituents. The experiments of Lewaschen prove that soda salts given to dogs with biliary fistula increase very markedly the liquidity of the bile and diminish the percentage of solids in it. These experiments are in accord with clinical experience, which shows that the alkaline sodium salts, given one to two hours after meals in full dose, are of decided value in the treatment of *gall-stones* and various affections associated with excessive acidity of the biliary secretion. On account of its having no general effect upon the system, soda and its carbonates are superior to potassium as simple alkaline remedies. When, therefore, it is desired to overcome *acidity of the stomach or intestines,* or to render acid urine alkaline, these preparations are very available; but they are not applicable in *gout, uric acid diathesis, rheumatism,* and occasionally in other diseases attended with *gastric acidity,* when it is desirable to bring about increased destruction of tissue and increased elimination of solids. Under these circumstances sodium salts are inferior to the potassium salts. Alkaline sodium salts are also employed with advantage, internally and externally, in *skin diseases,* especially those of a papulous and scaly character. A lotion suitable for these cases may be formed by dissolving from two to three drachms of the carbonate in a pint of water. For a bath, from eight to sixteen ounces of the salt may be dissolved in the necessary quantity of water. In recent *burns* without much destruction of the skin, the free application of a saturated solution will usually give immediate relief. When swallowed in an overdose, it acts as a corrosive poison. The best antidotes are the fixed oils, acetic acid, and lemon juice.

Dose, from ten to thirty grains (0.65 to 2.0 Gm.).

Off. Prep.—Extractum Ergotæ, *Br.;* Liquor Magnesii Carbonatis, *Br.;* Liquor Sodæ Chlorinatæ, *Br.;* Magnesii Carbonas Levis, *Br.;* Magnesii Carbonas Ponderosus, *Br.*

SODII CARBONAS EXSICCATUS. Br.

EXSICCATED SODIUM CARBONATE

(sō'dĭ-ī căr'bo-năs ĕx-sĭc-cā'tŭs)

"Nearly anhydrous sodium carbonate, Na_2CO_3, which is obtained by heating Sodium Carbonate until it loses nearly 63 per cent. of its weight." *Br.*

Dried Carbonate of Soda; Exsiccated Sodium Carbonate; Carbonate de Soude sec du commerce, *Fr. Cod.;* Natrium carbonicum siccum, *P. G.;* Getrocknetes Natriumcarbonat, Entwässerte Soda, *G.;* Carbonato sodico seco, *Sp.*

"Sodium Carbonate, *two hundred grammes* [or 7 ounces av., 24 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Break the crystals into small fragments, and allow them to effloresce for several days in warm air, at a temperature not exceeding 25° C. (77° F.), until they are completely disintegrated; then dry the white powder at a temperature of about 45° C. (113° F.), until its weight is reduced to *one hundred grammes* [or 3 ounces av., 231 grains]. Pass the powder through a sieve, and preserve it in well-stoppered bottles." *U. S.* 1890.

Sodium carbonate contains ten molecules of water of crystallization, and, when heated, readily undergoes aqueous fusion. Upon continuing the heat, the water is driven off, and a white porous mass remains, which is easily reduced to powder. Dried sodium carbonate is in the form of a white powder, and differs in nothing from the crystallized, except in being devoid of water of crystallization. (See *Sodii Carbonas.*) It is officially described as "a loose, white powder, conforming to the reactions and tests given under *Sodii Carbonas.* To neutralize 1 Gm. of the salt should require not less than 13.8 Cc. of normal sulphuric acid (corresponding to about 73 per cent. of anhydrous Sodium Carbonate), methyl-orange being used as indicator." *U. S.* 1890. (See *Sodii Carbonas Monohydras.*)

Uses.—This preparation was introduced into practice by Beddoes, who extolled its virtues

[1] Smith gives the following particular description of the method employed by him. 63 grammes of oxalic acid and 143 grammes of ordinary sodium carbonate are each dissolved, with heat, in 200 cubic centimeters of distilled water; the alkaline solution is filtered if necessary, and, when cool, the solution of oxalic acid, just hot enough to prevent crystallization, is added by degrees, with stirring. It is expected that the solution, when completed, shall have a slight alkaline reaction. Shortly after the operation is finished, the sodium oxalate will be in a great measure precipitated. The whole is then allowed to stand until completely cool; the supernatant liquid is decanted, a little distilled water added, and the lumps of crystals that may have formed are broken up by a stirrer, thrown on a six-inch filter over a Bunsen aspirator, washed with about half a liter of distilled water, and allowed to dry. The quantity of dry oxalate produced is 30 grammes. In this state it may be kept in a dry bottle until wanted for use in forming sodium carbonate. It is then projected, little by little, into a platinum capsule, over a good-sized Bunsen burner. After being strongly heated, the oxalate is changed by the decomposition of the oxalic acid into the carbonate, and, if the heat be high enough to fuse the salt, about 23 grammes of the fused carbonate will be obtained. Fused or not, this is dissolved in water, filtered, evaporated to dryness, dehydrated over a naked flame, and granulated by stirring while hot. (*A. J. P.,* 1875, 31.)

in *calculous* diseases. It is applicable to the cure of such affections only when dependent on a morbid secretion of uric acid. Its advantage over the common carbonate is that it admits of being made into pills, in consequence of being in the dried state. As the water of crystallization forms more than half of the carbonate, the dose of the dried salt must be reduced in proportion. For the medicinal properties of this salt, see *Sodii Carbonas.*

Dose, two to ten grains (0.13 to 0.65 Gm.) may be given three times a day, in the form of pill prepared with soap and aromatics.

Off. Prep.—Pilula Ferri, *Br.*

SODII CARBONAS MONOHYDRAS. U. S.

MONOHYDRATED SODIUM CARBONATE

(sō'dī-ī cär'bo-nās mō-no-hȳ'drās)

$Na_2CO_3 + H_2O = 123.19$

"It should contain not less than 85 percent. of pure anhydrous Sodium Carbonate [$CO.(ONa)_2$], corresponding to not less than 99.5 percent. of the crystallized monohydrated salt." *U. S.*

Preparation.—This salt was introduced into the U. S. P. (8th Rev.), upon the recommendation of Coblentz and Frerichs, on account of its much greater stability when compared with sodium carbonate; it contains but one molecule of water of crystallization, while the ordinary carbonate contains ten; as it is almost impossible to keep the carbonate without effloresceng, it became difficult to use it for chemical or pharmaceutical purposes without previously determining the quantity of water present. Coblentz ascertained by experiment that by exposure in an open vessel, monohydrated sodium carbonate gained the first week 0.14 per cent. of moisture, this increased to 0.16 per cent. by the second week. It is prepared by heating and crystallizing sodium carbonate at a temperature above 35° C. As it can be prepared commercially at a low price of excellent quality and is in the form of granular crystals its introduction into the Pharmacopœia will prove a great convenience. It may be used in the place of sodium carbonate.

Properties.—It is officially described as "a white, crystalline, granular powder, odorless, and having a strong alkaline taste. When exposed to the air, under ordinary conditions, it absorbs only a slight percentage of moisture; exposed to warm, dry air at or above 50° C. (122° F.) the salt effloresces, and at 100° C. (212° F.) it loses its water of crystallization (14.52 percent.). Soluble in 2.9 parts of water at 25° C. (77° F.), and in 1.8 parts of boiling water; insoluble in alcohol and in ether; soluble in 8 parts of glycerin. The aqueous solution shows an alkaline reaction with red litmus paper, and effervesces strongly with acids. To a non-luminous flame the solution imparts an intense yellow color. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of Monohydrated Sodium Carbonate, or 0.855 Gm. of the anhydrous salt, be dissolved in 10 Cc. of distilled water, it should require not less than 32.3 Cc. of half-normal sulphuric acid V.S. for neutralization, 3 drops of methyl-orange T.S. being used as indicator." *U. S.*

Uses.—Monohydrated sodium carbonate can be used for the same purposes that sodium carbonate can, in the proportion of 1 of the former to 2.3 of the latter. (See *Sodii Carbonas,* page 1140.) For internal use it may replace the exsiccated sodium carbonate, being nearly identical with it in composition. (See *Sodii Carbonas Exsiccatus,* page 1140.)

Dose, two to ten grains (0.13 to 0.65 Gm.).

Off. Prep.—Alumini Hydroxidum, *U. S.;* Extractum Ergotæ, *U. S.;* Liquor Sodæ Chlorinatæ, *U. S.;* Massa Ferri Carbonatis, *U. S.;* Spiritus Ætheris Nitrosi, *U. S.;* Suppositoria Glycerini, *U. S.*

SODII CHLORAS. U. S.

SODIUM CHLORATE

(sō'dī-ī klō'rās)

$NaClO_3 = 105.70$

"It should contain not less than 99 percent. of pure Sodium Chlorate [$ClO_2.ONa$]. This salt should be kept in well-stoppered bottles, and *great caution should be observed* in handling it, as dangerous explosions are liable to occur when it is heated, or subjected to concussion or trituration with organic substances (cork, tannic acid, sugar, etc.), or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances." *U. S.*

Natrium Chloricum; Chlorate de Soude, *Fr. Cod.;* Natriumchlorat, Chlorsaures Natron, *G.;* Clorato sodico, *Sp.*

This official salt, while manufactured on a large scale for use in the textile industries by the method described under *Potassii Chloras,* is usually prepared on a small scale by Wittstein's process, which consists in first preparing sodium bitartrate by adding a strong solution containing 9.5 parts of tartaric acid to a hot aqueous solution of 9 parts of sodium carbonate. The hot solution is mixed with one in which 8 parts of potassium chlorate have been dissolved. Potassium bitartrate separates, while sodium chlorate remains in solution. The filtered solution is evaporated and crystallized. If desired of absolute purity, it may be recrystallized from an alcoholic solution. Owing to the facility with which this salt parts with its oxygen, the official cautionary direction should be borne in mind.

Properties.—It is officially described as in "colorless, transparent crystals (principally

cubes with tetrahedral facets), or a crystalline powder; odorless, and having a cooling, saline taste. Permanent in dry air. Soluble in about 1 part of water, and in about 100 parts of alcohol at 25° C. (77° F.); in 0.5 part of boiling water, and in about 40 parts of boiling alcohol; also soluble in about 5 parts of glycerin. When heated, the salt melts, then gives off oxygen (about 45 percent. of its weight), and finally leaves a residue of sodium chloride, readily soluble in water, and yielding, with silver nitrate T.S., a white, curdy precipitate, insoluble in nitric acid. To a nonluminous flame it imparts an intense yellow color. An aqueous solution of Sodium Chlorate (1 in 20) is neutral to litmus paper. When a crystal of the salt is dropped into hydrochloric acid, the liquid assumes a deep greenish-yellow color, and emits the odor of chlorine. A saturated, aqueous solution should not be rendered turbid by sodium bitartrate T.S. (limit of *potassium*). The aqueous solution of the salt (1 in 20), upon the addition of 1 Cc. of ammonium sulphide T.S., should not develop a dark coloration (absence of *lead, copper,* etc.)." *U. S.*

Uses.—Sodium chlorate has medicinal properties similar to those of potassium chlorate, while its greater solubility permits the use of stronger solutions. According to Brissaud, when given in daily doses of more than two drachms it is apt to produce albuminuria. In overdose it would probably cause symptoms not distinguishable from those caused by potassium chlorate poisoning.

Dose, five to fifteen grains (0.32 to 1.0 Gm.).

SODII CHLORIDUM. U. S., Br.

SODIUM CHLORIDE

(sō′dĭ-ī ċhlō′rĭ-dŭm)

NaCl = 58.06

"It should contain when dried not less than 99 percent. of pure Sodium Chloride." *U. S.* "Sodium Chloride, NaCl, is common salt, purified." *Br.*

Chloruretum Sodicum, Sal Commune, s. Cullĭnare; Table Salt; Muriate of Soda, Sea Salt, Salt; Chlorure de Sodium purifié, *Fr. Cod.*; Hydrochlorate de Soude, Sel commun, Sel de Cuisine, Sel marin, *Fr.*; Natrium Chloratum, *P. G.*; Natriumchlorid, Chlornatrium, Kochsalz, *G.*; Cloruro di sodio, Sal commune, *It.*; Cloruro sodico, Sal comun, *Sp.*

This mineral production, so necessary to mankind, is universally distributed over the globe, and is the most abundant of the native soluble salts. Most animals have an instinctive relish for it, and, from its frequent presence in the solids and fluids of the animal economy, it may be supposed to perform an important part in assimilation and nutrition.

Natural state.—Common salt exists in nature either in the solid state or in solution. In the solid state, called *rock salt, fossil salt,* and *sal gemmæ,* it is often found forming extensive beds, and even entire mountains, from which it is extracted in blocks or masses by mining operations. Its geological position is very constant, it occurring almost invariably in secondary formations, associated with clay and gypsum. In solution it exists in certain springs and lakes, and in the waters of the ocean. The principal salt mines are found in Poland, Hungary, and Russia; in various parts of Germany and Austria, particularly the Tyrol; in Cheshire, England; in Spain; in various parts of Asia and Africa; in Turk's island near St. Domingo; and in Peru and other countries of South America. There are but few mines in the United States where rock salt is produced,—at present, one in Louisiana, two in Kansas, and a group operated by one company in the western part of the State of New York; but there are numerous salt springs, which either flow naturally or are produced artificially by sinking wells to various depths in places where salt is known to exist. These are found principally in Missouri, Kentucky, Illinois, Ohio, Michigan, Pennsylvania, Virginia, West Virginia, and New York. In the last-mentioned State the springs are the most productive, the chief ones being situated at Salina, Montezuma, and Galen. In West Virginia an important salt region exists, extending fifteen miles on both sides of the Great Kanawha River, and in Michigan in the counties of Huron, Bay, Wayne, and Saginaw extensive salt wells are worked. The production of salt in the United States in 1904 was 22,030,002 barrels of 280 lbs. each, valued at $6,021,222. Nearly 90 per cent. of this was evaporated from brine, the remainder being the rock salt product.

Rock salt is always transparent or translucent; but it often exhibits various colors, such as red, yellow, brown, violet, blue, etc., which are supposed to be derived from iron and manganese.

Extraction.—Mines of salt are worked in two ways. When the salt is pure, it is merely dug out in blocks and thrown into commerce. When impure, it is dissolved in water, and extracted afterwards from the solution by evaporation. When the salt is naturally in solution, the mode of extraction depends upon the strength of the brine and the temperature of the place where it is found. When the water contains from 14 to 15 per cent. of the salt, it is extracted by evaporation in large iron boilers. If, however, it contains only 2, 3, 4, or 5 per cent., the salt is obtained in a different manner. If the climate be warm, it may be procured by spontaneous evaporation, effected by the heat of the sun; if temperate, by a peculiar mode of evaporation, to be mentioned presently, and the subsequent application of artificial heat.

Sea water is a weak saline solution, containing 2.7 per cent. of common salt, which is extracted by the agency of solar heat in warm countries. Salt thus obtained is called *bay salt.* The extraction is conducted in Europe

principally on the shores of the Mediterranean, the waters of which are salter than those of the open ocean. The mode in which it is performed is by letting the sea water into shallow dikes, lined with clay, and capable, after having been filled, of being shut off from the sea. In this situation the heat of the sun gradually concentrates the water, and the salt is deposited. About 30,000 tons a year are thus made at Alameda, California, the only place in the United States where solar evaporation is carried out. In temperate climates, weak brines are first concentrated in buildings called *graduation houses.* These are rough wooden structures open on the sides, ten or eleven yards high, five or six wide, and three or four hundred long, and containing an oblong pile of brushwood somewhat smaller than the building itself. The brine is pumped up into troughs full of holes, placed above the brushwood, upon which it is allowed to fall, and in its descent it becomes minutely divided. This operation, by greatly increasing the surface of the brine, promotes its evaporation; and, being repeated several times, the solution is at last brought to the requisite degree of strength to permit of its final concentration in iron boilers by artificial heat.

Properties.—Sodium chloride is white, without odor, and of a peculiar taste called saline. It is usually crystallized in cubes; but by quiet evaporation it often assumes the form of hollow quadrangular pyramids, or hopper-shaped crystals, consisting of an aggregation of cubes. It is officially described as in "colorless, transparent, cubical crystals, or a white, crystalline powder, odorless, and having a purely saline taste. Permanent in dry air. Soluble in 2.8 parts of water at 25° C. (77° F.), and in 2.5 parts of boiling water; almost insoluble in alcohol. When heated, the salt decrepitates. At a red heat it fuses, and at a white heat it is slowly volatilized and partly decomposed. To a non-luminous flame it imparts an intense yellow color. An aqueous solution of the salt is neutral to litmus paper. With silver nitrate T.S. the solution yields a white, curdy precipitate, insoluble in nitric acid, and readily soluble in ammonia water. The aqueous solution of Sodium Chloride (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 2 Gm. of the finely powdered salt be digested for some hours with 25 Cc. of warm alcohol, and, after cooling, the undissolved salt be removed by filtration, the filtrate evaporated to dryness, and the residue dissolved in 5 Cc. of water, and if 1 Cc. of chloroform be added, and chlorine water which has been diluted with twice its volume of water, cautiously introduced, drop by drop, with constant agitation, the chloroform should not acquire a violet, yellow, or orange color (absence of *bromide* and *iodide*). If 1 Gm. of well-dried Sodium Chloride be dissolved in sufficient distilled water to measure 100 Cc., and 10 Cc. of the solution be mixed with a few drops of potassium chromate T.S., it should require not less than 17 (17.05) Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color." *U. S.* "In small white crystalline grains or transparent cubic crystals, free from moisture, with a purely saline taste, soluble in less than 3 parts of *water.* It affords the reactions characteristic of sodium and of chlorides. It should yield no characteristic reaction with the tests for potassium, bromides, or iodides, and only slight reactions with the tests for calcium, magnesium, or sulphates." *Br.* When pure, it undergoes no change in the air; but when contaminated with magnesium chloride, as not unfrequently happens, it is deliquescent. Exposed to a gradually increasing heat, it first decrepitates from the presence of interstitial moisture, next melts, and finally volatilizes in white fumes with but partial decomposition. (Mulder, *J. P. C.,* 4e sér., iii.) It is decomposed by several of the acids, particularly sulphuric and nitric, which disengage vapors of hydrochloric acid; by potassium carbonate with the assistance of heat; and by silver nitrate and mercurous nitrate. In contact with iron, in the presence of air and moisture, it undergoes decomposition. (*Chem. News,* June, 1869.) It is decomposed by steam excessively heated, with the escape of hydrochloric acid and an alkaline residue. (*Chem. News,* June 4, 1875.) Several varieties of common salt are distinguished in commerce, as *stored salt, fishery salt, bay salt,* etc.; but they are characterized by the size and compactness of the grains, and not by any difference in composition.

Composition.—Common salt, in its pure state, consists of one atom of chlorine and one of sodium. It contains no water of crystallization. The common salt of commerce, besides pure sodium chloride, contains, generally speaking, insoluble matter, and usually more or less of calcium and magnesium sulphates and calcium and magnesium chlorides. When pure, it is not precipitated by sodium carbonate, barium chloride, or potassium ferrocyanide. Calcium chloride is generally present in very small amount; but the magnesium chloride sometimes amounts to 28 parts in 1000. Calcium sulphate is usually present, constituting variously from 1 to 23½ parts in 1000, and magnesium sulphate is sometimes present and sometimes absent. To separate the earths, a boiling solution of sodium carbonate must be added as long as any precipitate is formed. The earths will form as carbonates, and must be separated by filtration, and the sodium sulphate and sodium chloride resulting from the double decomposition will remain in solution. The sodium sulphate may then be decomposed by the cautious addition of barium chloride, avoiding excess, which will generate sodium chloride and insoluble barium sulphate.

Uses.—Sodium chloride, in small doses, acts as a stomachic tonic and anthelmintic, in larger

ones as a purgative and emetic. From the experiments of Buchheim, it appears that common salt quickly passes into the blood, and is thrown off in greater part, in six hours, by the kidneys. The portion not found in the urine and fæces is probably appropriated to the uses of the economy. Plouviez, as the result of experiments made upon himself, came to the conclusion that the use of a saline regimen has the effect of increasing the number of the red blood corpuscles as well as the weight and strength of the body. This is, however, contradicted by the more recent experiments of Münch, and the common experience of mankind seems to show that, while the habitual use of a certain amount of the salt is necessary for health, over-use of it has no effect in producing plethora.

Common salt has been used with good effect by a number of practitioners as a remedy in *intermittent fever*. It is not alleged to be equal to quinine. The dose is from eight to twelve drachms (31 to 46.5 Gm.), given in divided doses during the apyrexia. It is best administered in mucilage of slippery elm, or in coffee. In *hæmoptysis*, common salt, in the dose of a teaspoonful (3.9 Gm.), taken dry, often proves successful in stopping the flow of blood. Externally applied in solution it is stimulant, and may be used either locally or generally. Locally, it is sometimes employed as a fomentation in *sprains* and *bruises*, and as a general external application it forms the salt water bath, a valuable remedy as a tonic and excitant in depraved conditions of the system, especially when occurring in children. A pound of salt dissolved in four gallons of water forms a solution of about the strength of sea water, and suitable for a bath. A 0.9 per cent. solution is largely used under the name of *physiological* or *normal salt solution* in *shock* and *hemorrhage*.

The uses of common salt in domestic economy as a condiment and an antiseptic are well known. In pharmacy it is employed to prepare chlorine, hydrochloric acid, ammonium chloride, calomel, and corrosive sublimate. It is also used to form sodium sulphate, with a view to its conversion into sodium carbonate.

Dose, as a cathartic, from two drachms to half an ounce (7.7 to 15.5 Gm.); as an emetic, from half an ounce to an ounce (15.5 to 31 Gm.), dissolved in four or five times its weight of water. It is frequently used as a clyster, two tablespoonfuls in a pint of water.

SODII CITRAS. U. S.

SODIUM CITRATE

(sō′dĭ-ī cī′trăs)

$2Na_3C_6H_5O_7 + 11H_2O = 709.20$

"It should contain not less than 97 percent. of pure Sodium Citrate [$2C_3H_4(OH)(CO ONa)_3 + 11H_2O$], and should be kept in well-stoppered bottles." *U. S.*

Citrate of Soda; Citras Sodicus; Citrate de Soude, *Fr.*; Natrium Citricum; Natriumcitrat, Citronsaures Natron, *G.*

Preparation.—This salt may be made by adding to a hot aqueous solution of 59 parts of citric acid an aqueous solution of 53 parts of monohydrated sodium carbonate, neutralizing, evaporating, and crystallizing.

Properties.—It is officially described as "a white, granular powder, odorless, and having a cooling, saline taste. It slowly effloresces on exposure to dry air. Soluble in 1.1 parts of water at 25° C. (77° F.), and in 0.4 part of boiling water; slightly soluble in alcohol. When heated to about 150° C. (302° F.) the salt loses all of its water of crystallization; on ignition at a red heat it decomposes and a mixture of sodium carbonate and carbon is left, which has an alkaline reaction and strongly effervesces with acids. To a non-luminous flame the salt imparts an intense yellow color. An aqueous solution of Sodium Citrate (1 in 20) is slightly alkaline to red litmus paper. The addition of 2 Cc. of calcium chloride T.S. to 10 Cc. of the aqueous solution of the salt (1 in 20) yields a clear solution, which, upon boiling, deposits a white, granular precipitate. The aqueous solution (1 in 20) should not be colored red by a drop of phenolphthalein T.S., nor effervesce on the addition of an acid (absence of *carbonate*). The aqueous solution of the salt (1 in 20), slightly acidulated with acetic acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of Sodium Citrate be thoroughly carbonized at a temperature not exceeding red heat, and the residue extracted with boiling distilled water, until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 16.4 (16.41) Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator." *U. S.*

Sodium citrate may be used for the same purposes as potassium citrate (see *Potassii Citras*).

Dose, from fifteen to sixty grains (1.0 to 3.9 Gm.).

Off. Prep.—Syrupus Hypophosphitum Compositus, *U. S.*

SODII CITRO-TARTRAS EFFERVESCENS. Br.

EFFERVESCENT SODIUM CITRO-TARTRATE

(sō′dĭ-ī cī′trō-tär′trăs ĕf-fẹr-vĕs′cẹns)

"Sodium Bicarbonate, in powder, 51 *ounces* (Imperial) or 510 grammes; Tartaric Acid, in powder, 27 *ounces* (Imp.) or 270 grammes; Citric Acid, in powder, 18 *ounces* (Imp.) or 180 grammes; Refined Sugar, in powder, 15 *ounces* (Imp.) or 150 grammes. Mix the powders thoroughly; place the mixture in a dish or pan of suitable form heated to between 200° and 220° F. (93.3° and 104.4° C.). When the mixture, by aid of careful manipulation, has assumed a granular character, separate it into granules of uniform and convenient size by

means of suitable sieves. Dry the granules at a temperature not exceeding 130° F. (54.4° C.). The product should weigh about 100 *ounces* (Imp.) or 1000 grammes." *Br.*

The object of this combination is to furnish sodium citrate and tartrate in a convenient and portable form. As the water has been driven off by heat, no reaction takes place until dissolved in water, when the two acids combine with the soda of the bicarbonate to produce sodium tartrate and citrate, and the carbon dioxide escapes with brisk effervescence. It is in this form that the preparation is intended to be used. The salts combine laxative with refrigerant properties, which adapt them to the *febrile state*, while the carbonic acid renders them acceptable to the stomach, and will often check *nausea* and *vomiting*.

Dose, one to two drachms (3.9 to 7.7 Gm.), which may be taken in a small wineglassful or more of water, and repeated occasionally as required.

SODII HYDROXIDUM. U. S., Br.

SODIUM HYDROXIDE [Sodium Hydrate, Caustic Soda, Soda, Pharm. 1890]

(sō'dĭ-ī hȳ-drŏx'ĭ-dŭm)

$NaOH = 39.76$

"It should contain not less than 90 percent. of pure anhydrous Sodium Hydroxide, and not more than 2 percent. of other inorganic substances, with the exception of water. It should be kept in well-stoppered bottles made of hard glass." *U. S.*

Soda Caustica; Hydrate of Soda; Natrium Causticum, s. Hydricum; Soude caustique, *Fr. Cod.*; Natron, Aetznatron, *G.*; Soda caustica, *It.*; Hidrato sodico, *Sp.*

"Take of Solution of Soda *two pints*. Boil down the solution rapidly, in a silver or clean iron vessel, until there remains a fluid of oily consistence, a drop of which when removed on a warmed glass rod solidifies on cooling. Pour the fluid on a clean silver or iron plate, or into moulds, and, as soon as it has solidified, break it in pieces, and preserve it in stoppered green glass bottles." *Br.* 1885.

The Solution of Sodium Hydroxide, being a solution of the caustic alkali, yields it on evaporation in the solid state. Metallic vessels are used in consequence of the chemical action of soda on earthenware or porcelain, and the product is directed to be kept in green glass bottles because these resist its action better than those of white glass. Sodium hydroxide is usually poured into cylindrical moulds to harden, or allowed to solidify in mass, and broken into irregular fragments.

"The sodium hydroxide, sodium hydrate, or 'caustic soda,' of commerce, occurs in hard grayish-white rods or cakes, deliquescent, very alkaline and corrosive. It affords the reactions characteristic of sodium. It usually contains as impurities alumina, carbonates, chlorides, phosphates, silicates, and sulphates. A clear solution of caustic soda may be used, instead of a solution of *Purified Sodium Hydroxide*, in all analytical operations in which the foregoing impurities would not vitiate the result.

Purified Sodium Hydroxide may be obtained by dissolving caustic soda in ethylic alcohol, filtering the solution, evaporating it to dryness in a silver dish, occasionally adding distilled water during the evaporation. The residue is *Purified Sodium Hydroxide*. It should yield no characteristic reaction with the tests for phosphates or sulphates, and not more than the slightest reactions with the tests for carbonates. It is not quite free from alumina.

Pure Sodium Hydroxide may be prepared by the interaction of pure barium hydroxide and sodium sulphate, or by the interaction of pure sodium and water. A solution of Pure Sodium Hydroxide is required only in testing for small quantities of aluminium." *Br.* 1898, *Appendix.*

Sodium hydroxide has been made on a large scale by simply modifying the Leblanc process (see *Sodii Carbonas*), so that more coal is added in the black-ash fusion, when carbonate is reduced to hydroxide with the liberation of carbon monoxide by the action of the quick-lime, the reactions being:

$$CaCO_3 + C = CaO + 2CO$$
$$Na_2CO_3 + CaO + H_2O = 2NaOH + CaCO_3$$

It is also made like the corresponding compound, caustic potash, by the decomposition of sodium carbonate in solution by quick-lime. (See *Liquor Sodii Hydroxidi.*) It may also be purified from carbonate, and from lime salts and other impurities, as the potassium hydroxide is purified by treatment with alcohol, which dissolves the alkali, but leaves the salts insoluble. (See *Sodii Carbonas*, page 1136.) Chemically pure sodium hydroxide can be made with commercial success from metallic sodium. The sodium is oxidized in water, using small pieces in succession, and keeping the temperature from rising too high. So obtained it is free from sodium chloride and sulphate, and from alumina, silica, and ferric oxide. (*A. J. P.*, xlii. 50.) Klas Lindroth obtained a product containing a mere trace of carbonate and chloride by evaporating the solution of impure sodium hydroxide until it has a sp. gr. of 1.375, and allowing it to crystallize at a temperature of 17° F. (*A. J. P.*, xliv. 106.) The manufacture of caustic soda in the United States has developed very greatly within the last few years, it being manufactured in connection with soda ash at the works of the Solvay Process Co., of Syracuse, New York, and Detroit, Michigan, and the Michigan Alkali Co., at Wyandotte, Michigan, and electrolytically at Niagara Falls by the Matthiessen Alkali Co. The importations of caustic soda are therefore decreasing, and will probably soon cease entirely; they amounted to 33,000 tons in 1897, but had di-

minished to 1500 tons in 1904. The American production for 1904 amounted to 80,173 tons, valued at $2,924,850.

Properties.—It is officially described as "dry, white flakes, fused masses, or translucent or opaque white pencils, showing a crystalline fracture, odorless, and having a caustic taste. *Great caution is necessary in tasting and handling it,* as it rapidly destroys organic tissues. Exposed to the air, it rapidly deliquesces, absorbs carbon dioxide, and becomes covered with a dry coating of carbonate. Soluble in about 1 part of water at 25° C. (77° F.), and in 0.8 part of boiling water; very soluble in alcohol. When heated to about 525° C. (977° F.), Sodium Hydroxide melts to a clear, oily liquid, and at a bright red heat it is slowly volatilized unchanged. When introduced into a non-luminous flame, it imparts to it an intense yellow color. A solution of Sodium Hydroxide, even when greatly diluted, gives an alkaline reaction with red litmus paper. The aqueous solution (1 in 20) should be perfectly clear and colorless (absence of *organic matter* and *insoluble impurities*), and after being acidulated with acetic acid, it should yield no precipitate on the addition of an excess of tartaric acid T.S. (limit of *potassium*). The aqueous solution of Sodium Hydroxide (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). On adding a slight excess of diluted sulphuric acid to 10 Cc. of an aqueous solution of Sodium Hydroxide (1 in 10), no distinct effervescence should occur (limit of *carbonate*). If 0.7 Gm. of Sodium Hydroxide be dissolved in 1.5 Cc. of water, and the solution added to 10 Cc. of alcohol, not more than a slight, white precipitate should occur within ten minutes (limit of *silicate,* etc.). Introduce about 1 Gm. of Sodium Hydroxide into a stoppered weighing-bottle, and weigh accurately. Dissolve this in about 50 Cc. of water, and titrate the solution with normal sulphuric acid V.S., using methyl-orange T.S. as indicator. Multiply the number of Cc. of the normal sulphuric acid V.S. consumed, by 3.976, and divide this product by the weight of the Sodium Hydroxide taken; the quotient represents the percentage of Sodium Hydroxide present." *U. S.*

As prepared by the Br. 1885 process, sodium hydroxide is in grayish-white fragments, opaque, brittle, and extremely corrosive. It is deliquescent, very soluble in water, soluble in alcohol, and possessed of all the alkaline properties of potassium hydroxide, from which it differs in imparting a yellow color to flame, and in not giving in solution a yellow precipitate with platinic chloride or a crystalline precipitate with tartaric acid in excess. When heated it melts, and at an intense heat evaporates. Though deliquescent, like potassium hydroxide, it does not, like that alkali, become permanently liquid, but forms a paste, which after a time effloresces. The difference in this respect between the two alkalies is owing to the circumstance that, while both are converted into carbonates by uniting with the carbon dioxide of the air, potassium hydroxide forms a deliquescent and sodium hydroxide an efflorescent salt. It is apt to contain 20 or 25 per cent. of water and impurities originating from the sodium carbonate used in preparing the solution from which it is made. The official volumetric assay permits the presence of 10 per cent. of water and impurities, but limits the fixed impurities to 2 per cent.

If the solution be colored brown by hydrogen or ammonium sulphide, the presence of lead may be suspected, derived probably from the glass vessels in which it has been kept. It is used externally as a caustic in the same manner as potassium hydroxide, when cast into sticks. It has the advantage of being less deliquescent, and is probably milder.[1] It may be used also for making the solution of sodium hydroxide extemporaneously. (See *Liquor Sodii Hydroxidi.*) For the general effects of sodium hydroxide upon the system, see *Sodii Carbonas,* page 1140.

Off. Prep.—Antimonium Sulphuratum, *Br.;* Benzinum Purificatum, *U. S.;* Hydrargyri Oxidum Flavum, *U. S.;* Liquor Sodii Hydroxidi, *U. S.*

SODII HYPOPHOSPHIS, U. S., Br.

SODIUM HYPOPHOSPHITE

(sō'dĭ-ī hȳ-pŏ-phŏs'phīs)

$NaPH_2O_2 + H_2O = 105.29$

"It should contain not less than 98 percent. of pure Sodium Hypophosphite [$PO.H_2ONa + H_2O$], and should be kept in well-stoppered bottles; caution should be observed in dispensing Sodium Hypophosphite, as explosion is liable to occur when it is triturated or heated with nitrates, chlorates, or other oxidizing agents." *U. S.* "Sodium Hypophosphite, $NaPH_2O_2$, is obtained by the interaction of sodium carbonate and calcium hypophosphite." *Br.*

Natrium Hypophosphorosum, Hypophosphis Sodicus; Hypophosphite of Soda; Hypophosphite de Soude, *Fr. Cod;* Unterphosphorigsaures Natron, *G.;* Hipofosfito sodico, *Sp.*

Preparation.—Sodium hypophosphite is prepared by mixing solutions of calcium hypophosphite and monohydrated sodium carbonate, in the proportion of eight ounces of the former dissolved in five pints of water to six of the latter in two pints of water. Double decomposi-

[1] *London Paste.*—The formula used at the London Throat Hospital for preparing this caustic is as follows: Take of caustic soda and unslaked lime equal parts. Reduce to a fine powder in a warm mortar, and mix intimately. Keep in well-closed bottles, and when required for use take as much as is sufficient. It is recommended for destroying enlarged tonsils or the elongated uvula, where treatment with the "guillotine" or scissors is objected to. This preparation resembles the Vienna Paste, but is preferable in consequence of its being less liable to spread beyond the limits of application. Soda being used instead of potash, and water in place of alcohol, the operation is much less painful. (*N. R.,* Aug. 1878.)

tion takes place, with the formation of calcium carbonate and sodium hypophosphite, of which the latter is held in solution and the former is precipitated. After filtration to separate the calcium carbonate, the solution is evaporated to a pellicle, and then stirred constantly until the salt granulates, the heat being continued. If required quite pure, the granulated salt is dissolved in official alcohol, and the liquid, having been evaporated to a syrupy consistence, is set aside to crystallize.

Sometimes sodium hypophosphite explodes with violence during the evaporation of its solution. This was ascribed to the use of too high a temperature; but the same accident has occurred when the heat was applied by means of a water bath. (See *A. J. P.*, 1860, p. 87.) In a communication of Tuson to the *Chemical News* (No. 31, p. 46), it is stated that, though he had superintended the manufacture of large quantities of calcium and sodium hypophosphites, he had never witnessed anything like an explosion; but the heat employed in evaporation had never approached 100° C. (212° F.), and this is probably the true explanation. Caution, therefore, should be observed to evaporate at a low temperature.

Properties.—As described in the U. S. Pharm. (8th Rev.), sodium hypophosphite occurs in "small, colorless, transparent, rectangular plates of a pearly lustre, or a white, granular powder, odorless, and having a bitterish-sweet, saline taste. Very deliquescent on exposure to moist air. Soluble in about 1 part of water, and in about 25 parts of alcohol at 25° C. (77° F.); in 0.12 part of boiling water, and in 1 part of boiling alcohol; slightly soluble in absolute alcohol; insoluble in ether. When heated in a test-tube, the salt at first loses its water of crystallization, and at about 200° C. (392° F.) it is decomposed, evolving hydrogen and hydrogen phosphide which burns spontaneously with a bright yellow flame. Finally, there is left a residue of sodium pyrophosphate and metaphosphate, sometimes mingled with a little red phosphorus. To a non-luminous flame the salt imparts an intense yellow color. An aqueous solution of Sodium Hypophosphite is neutral or slightly alkaline to litmus paper. The diluted aqueous solution, slightly acidulated with diluted sulphuric acid, yields, with silver nitrate T.S., a white precipitate, which rapidly turns brown or black, owing to the separation of metallic silver. With copper sulphate T.S., on gentle heating, a reddish-brown precipitate is formed.

When the aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, is added, drop by drop, to an excess of mercuric chloride T.S., a white precipitate of mercurous chloride is formed. On further addition of the hypophosphite solution in excess, the precipitate becomes gray from reduction to metallic mercury. The aqueous solution (1 in 20) should not be colored red by the addition of a drop of phenolphthalein T.S., nor effervesce on the addition of an acid (absence of *caustic alkali* and *carbonate*). The aqueous solution of the salt (1 in 20), acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 5 Cc. of the aqueous solution of the salt (1 in 10) be measured into a beaker containing 3 Cc. of nitric acid, diluted with about 10 Cc. of water and evaporated to dryness on a water-bath, the residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.*

Sodium hypophosphite is described in the British Pharmacopœia as "a white granular salt, having a bitter nauseous taste. It is deliquescent, soluble in its own weight of *water* and in 30 parts of *alcohol* (90 per cent.), but insoluble in *ether*. When heated in air it yields spontaneously inflammable hydrogen phosphide and hydrogen. It colors flame strongly yellow. It is rapidly attacked by oxidizing agents. Its solution yields with a warm solution of *copper sulphate* a red precipitate of cuprous hydride, which, on boiling, evolves hydrogen. 0.5 gramme boiled for ten minutes with 25 cubic centimetres of *water* and 1.15 grammes of *potassium permanganate*, and filtered, should afford a nearly colorless solution. It should yield no characteristic reaction with the tests for lead, copper, iron, aluminium, zinc, calcium, magnesium, potassium, ammonium, chlorides, or sulphates, only the slightest reactions with the tests for carbonates, and its solution should give little or no precipitate with *solution of lead acetate* (limit of phosphates and phosphites)." *Br.*

Hypophosphorous acid consists of one atom of phosphorus, two of oxygen, and three of hydrogen, of which, however, only one is replaceable by metal. It has a strong affinity for oxygen, and acts therefore as a powerful deoxidizing agent, as is shown by its reducing silver and mercury from their salts. The solubility of sodium hypophosphite is increased by the addition of hypophosphorous acid. As the soluble salts of mercury and silver are reduced by the hypophosphites, they are of course incompatible with sodium hypophosphite in prescriptions. With calcium hypophosphite, all the soluble sulphates and carbonates produce precipitates.

Uses.—The hypophosphites were first recommended by Churchill in the treatment of *phthisis* and subsequently by J. D. Brown in diseases attended with *loss of nerve power*, and in many of the complaints of infancy connected with the *scrofulous diathesis* and *defect in the osseous system*. (*B. M. S. J.*, lxxiii. 412, Dec. 21, 1865.) Their value is, however, problematical.

Dose, ten to twenty grains (0.65 to 1.3 Gm.), three times a day.

Off. Prep.—Emulsum Olei Morrhuæ cum Hypophosphitibus, *U. S.*; Syrupus Hypophosphitum, *U. S.*; Syrupus Hypophosphitum Compositus, *U. S.*

SODII IODIDUM. U. S., Br.

SODIUM IODIDE

(sō′dĭ-ī ī-ŏd′ĭ-dŭm)

NaI = 148.78

"It should contain not less than 98 percent. of pure Sodium Iodide, and should be kept in well-stoppered bottles." *U. S.* "Sodium Iodide, NaI, may be prepared from iodine and sodium hydroxide by a process similar to that employed in making Potassium Bromide; the salt being crystallized at a temperature of not less than 68° F. (20° C.)." *Br.*

Iodure de Sodium, *Fr. Cod.;* Natrium Jodatum, *P. G.;* Natriumjodid, Jodnatrium, *G.;* Yoduro sodico, *Sp.*

Preparation.—This iodide may be prepared either by treating a solution of sodium hydroxide with iodine, or by double decomposition between ferrous iodide and sodium carbonate, precisely as potassium iodide is obtained by the corresponding processes for that salt. As only small quantities are likely to be wanted as a medicine, the latter process is preferable, being more easily conducted on a small scale. (See Procter's paper on the preparation of this iodide, in *A. J. P.*, July, 1854, p. 305.)

Properties.—It is a very soluble white salt, crystallizing in anhydrous cubes from a hot solution, and in oblique rhombic prisms, with two molecules of water, by spontaneous evaporation. It is officially described as in "colorless, cubical crystals, or a white, crystalline powder; odorless, and having a saline and slightly bitter taste. In moist air Sodium Iodide deliquesces and frequently undergoes decomposition, the salt assuming a brown tint. Soluble in about 0.5 part of water, and in about 3 parts of alcohol at 25° C. (77° F.); in 0.33 part of boiling water, and in 1.4 parts of boiling alcohol. When strongly heated the salt melts, and at a bright red heat it is slowly volatilized and partly decomposed. To a non-luminous flame it imparts an intense yellow color. An aqueous solution of Sodium Iodide is slightly alkaline to red litmus paper. If 1 Gm. of the salt be dissolved in water, and 0.1 Cc. of tenth-normal sulphuric acid V.S. be added, no red color should be produced by the addition of a drop of phenolphthalein T.S. even after heating (limit of *alkali*). If to 5 Cc. of the aqueous solution (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated and impart to the solution a light reddish-brown color. On agitating this mixture with a few drops of chloroform, the latter will acquire a violet color. A solution of 1 Gm. of the salt in 1 Cc. of water should yield no precipitate with 1 Cc. of sodium bitartrate T.S. (limit of *potassium*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 0.5 Gm. of the salt be dissolved in 10 Cc. of distilled water, which has been previously boiled and cooled in a small flask, the solution should not have a distinct yellow tint (absence of *free iodine*), nor should the solution acquire a yellow color within half a minute after the addition of 2 drops of diluted sulphuric acid (which should be free from sulphurous acid or nitrous acid) (limit of *iodate*). Ten Cc. of the aqueous solution of the salt (1 in 20), when acidulated with hydrochloric acid, should not be rendered turbid by the addition of 1 Cc. of potassium sulphate T.S. (absence of *barium*). If 5 Cc. of the aqueous solution be gently heated with 1 drop of ferrous sulphate T.S., 1 drop of ferric chloride T.S., and 0.5 Cc. of potassium hydroxide T.S., no blue color should appear after acidulating the mixture with hydrochloric acid (absence of *cyanide*). If to 1 Gm. of Sodium Iodide, contained in a test-tube of about 40 Cc. capacity, 5 Cc. of water, 5 Cc. of potassium hydroxide T.S., and about 0.2 Gm. of aluminum wire be added, and if in the upper portion of the test-tube a pledget of purified cotton be inserted, and over the mouth there be placed a piece of moistened red litmus paper, then if the tube be heated upon a water-bath for fifteen minutes, no blue coloration of the paper should be discernible (limit of *nitrates* and *nitrites*). If 0.2 Gm. of Sodium Iodide be dissolved in 2 Cc. of ammonia water, and 15 Cc. of tenth-normal silver nitrate V.S. be added, then after thoroughly agitating and filtering, the filtrate, upon supersaturating with nitric acid, should not become more than slightly turbid, nor should any darkening appear within ten minutes (limit of *chlorides* and *bromides*, and absence of *thiosulphate*). If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of distilled water, and about 5 drops of potassium chromate T.S. be added, it should require not more than 34.6 Cc. nor less than 33 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color (corresponding to at least 98 percent. of pure Sodium Iodide)." *U. S.* "A dry white crystalline deliquescent powder, having a saline and somewhat bitter taste, readily soluble in less than its weight of *water* and in 3 parts of *alcohol* (90 per cent.). It affords the reactions characteristic of sodium and of iodides. Each gramme should not lose more than 0.05 gramme of water when dried at 248° F. (120° C.); and each gramme of this dried salt, when dissolved in *water*, should require for complete precipitation not less than 66.5 cubic centimetres of the *volumetric solution of silver nitrate*. It should yield no characteristic reaction with the tests for lead, copper, arsenium, iron, aluminium, calcium, magnesium, potassium, ammonium, bromates, cyanides, carbonates, or iodates, and only the slightest reactions with the tests for bromides, chlorides, or sulphates." *Br.*

Uses.—Sodium iodide has the same therapeutic effects and is used in the same diseases as potassium iodide. It is said to be better

borne than the latter iodide, although it contains about 8 per cent. more iodine than the potassium salt. In Italy it has been used with remarkable success in *constitutional syphilis.* At the suggestion of Gross, it was employed by John J. Black, at the Philadelphia Hospital, as a substitute for potassium iodide in the treatment of syphilitic affections, and seemed to be not less efficacious than that medicine, while producing none of its unpleasant effects. (*Am. J. M. S.,* July, 1865, p. 87.)

Dose, ten grains (0.65 Gm.), gradually increased to forty grains (2.6 Gm.), three times a day, dissolved in three fluidounces (90 Cc.) of water.

SODII NITRAS. U. S.

SODIUM NITRATE

(sō′dī-ī nī′trās)

$NaNO_3 = 84.45$

"It should contain not less than 99 percent. of pure Sodium Nitrate [$NO_2.ONa$], and should be kept in well-stoppered bottles." *U. S.*

Nitrate of Soda, Cubic Nitre, Chile Saltpeter; Nitras (Azotas) Sodicus, Nitrum Cubicum; Azotate (Nitrate) de Soude, *Fr. Cod.;* Nitre cubique, Nitrate de Chili, *Fr.;* Natrium Nitricum, *P. G.;* Natriumnitrat, Chilesalpeter, *G.;* Nitrato di sodio, *It.*

This salt, called also *cubic nitre,* was first recognized as official in 1870. Sodium nitrate is imported from South America, where it is found naturally, especially in the desert of Atacama, forming beds of vast extent. The nitrate deposits have been found uniformly through a zone 250 geographical miles in length north to south, and two geographical miles in width east to west. It was estimated that the nitrate beds contained the enormous quantity of 99,031,525 tons, and it was stated that with the (1887) export duty the deposits would yield a revenue of £230,809,474. (*J. Soc. Chem. Ind.,* 1887, 229.) Attempts were made between 1820 and 1830 to export it to England and the United States; but the cargoes were unsalable. Soon afterwards, however, its value became known. The salt has been found also largely in Brazil, in the province of Bahia, near the river San Francisco. (*A. J. P.,* Nov. 1861, 502.) For an account of the sodium nitrate deposits of Chili, see *Potassii Nitras.* The shipments of sodium nitrate from South American ports to all parts amounted in 1904 to 1,463,000 tons and in 1905 to 1,583,000 tons. The importations into the United States were, 1904, 297,864 tons valued at $9,260,808; and in 1905, 282,692 tons valued at $9,557,522. The crude salt is in saline lumps, rather soft and friable, and damp on the surface. Its varieties are classified, according to their color and state of aggregation, as *white compact, yellow, gray compact, gray crystalline, white crystalline.*

"*Caliche,*" as the crude mineral is called, contains from 48 to 75 per cent. of sodium nitrate, from 20 to 40 per cent. of sodium chloride, and smaller amounts of sodium sulphate, calcium sulphate, potassium nitrate, and potassium and sodium iodate (from 0.059 to 0.175 per cent. of iodine). Occasionally calcium borate, associated with sodium borate, is found under the beds of the nitrate.

Properties.—Sodium nitrate, when pure, is in "colorless, transparent, rhombohedral crystals, odorless, and having a cooling saline, and slightly bitter taste. Hygroscopic in moist air. Soluble in about 1.1 parts of water, and in about 100 parts of alcohol at 25° C. (77° F.); in 0.6 part of boiling water, and in 40 parts of boiling alcohol. When heated to 312° C. (593.6° F.), the salt melts without decomposition. At a higher temperature it evolves oxygen, and is reduced to nitrite. When Sodium Nitrate is heated with charcoal, the mixture deflagrates. To a non-luminous flame it imparts an intense yellow color. Its aqueous solution is neutral to litmus paper. If the aqueous solution be mixed in a test-tube with a drop of diphenylamine T.S., and sulphuric acid be carefully poured in, so as to form a separate layer, a deep blue color will appear at the line of contact. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and then chlorine water which has been diluted with an equal volume of water be introduced, drop by drop, with agitation, the chloroform should remain free from any violet tint (absence of *iodide*)." *U. S.* Like potassium nitrate, it deflagrates when thrown on the fire, but it is distinguished by giving rise to an orange-yellow flame, and by the rhomboidal shape of its crystals, those of nitre being long six-sided prisms. It evolves ruddy fumes when warmed in a test-tube with sulphuric acid and copper wire.

Uses.—This salt has been praised as a remedy in *dysentery* (see 15th ed. U. S. D.), in the *dose* of from half an ounce to an ounce (15.5 to 31 Gm.) in the course of the day in dilute solution, but is at present very rarely, if ever, used in practical medicine.

Off. Prep.—Liquor Sodii Phosphatis Compositus, *U. S.*

SODII NITRIS. U. S., Br.

SODIUM NITRITE

(sō′dī-ī nī′trīs)

$NaNO_2 = 68.57$

"It should contain not less than 90 percent. of pure Sodium Nitrite [NO.ONa], and should be kept in well-stoppered bottles." *U. S.* "A salt, $NaNO_2$, obtained by fusing sodium nitrate with metallic lead." *Br.*

Nitrite of Sodium, Nitrite of Soda; Nitrite de Soude, *Fr.;* Salpetrigsaures Natron, *G.*

This salt was official in the U. S. Pharmacopœia of 1890 for the first time: it was introduced for the purpose of furnishing the nitrous radical to form ethyl nitrite in the preparation of spirit of nitrous ether. (See *Spiritus Ætheris Nitrosi.*)

Preparation.—According to M. A. Darbon it is made on a large scale as follows: Sodium nitrate is melted in large cast iron vessels, whereby hygroscopic water is removed and a part of the iodides and iodates, still present, are decomposed. At 310° C. the nitrate begins to fuse. It is heated to 400° to 420° C., and pure metallic lead in thin sheets is gradually added, the mass being constantly stirred, about 280 parts of lead being necessary for 100 parts of sodium nitrate used. The lead must be as free as possible from other metals and antimony particularly must be absent. When all the lead has been added, care having been exercised to prevent overheating, the stirring must be kept up for some time, and the melted mass is then, by means of a cast iron ladle, run in the form of thin threads into water with constant stirring.

In this process, besides the nitrite, about 1 per cent. of sodium hydroxide is produced, which in its turn dissolves a portion of lead, and has to be removed during the subsequent purification, either by nitric acid or by lead nitrate or sulphuric acid. The crude products are a solution containing the nitrite, undecomposed saltpetre, sodium hydroxide holding lead in solution, the soluble impurities of the sodium nitrate, such as sodium chloride, etc., and a residue consisting of lead oxide, a little metallic lead, and a certain proportion of lead peroxide. The solution strained from the residue, with the washings, is diluted to about 6° to 8° B., neutralized with nitric acid as long as a precipitate is formed, separated from this precipitate, concentrated to 42° to 45° B. while warm, and then left to crystallize—the crystals requiring possibly recrystallization. The pure crystals are separated by a centrifugal machine, washed, dried and packed in cylinders of double thickness of parchment paper. (*Chem. News,* Sept. 22, 1899, 146.)

Properties.—It is officially described as in "white, opaque, fused masses, or pencils, or colorless, transparent, hexagonal crystals; odorless, and having a mild, saline taste. When exposed to the air, the salt deliquesces and is gradually oxidized to sodium nitrate, and becomes unfit for use. Soluble in about 1.4 parts of water at 25° C. (77° F.), and very soluble in boiling water; slightly soluble in alcohol. When heated, the salt melts, and at a red heat it is decomposed, yielding oxygen, nitrogen dioxide, and sodium oxide. To a non-luminous flame it imparts an intense yellow color. An aqueous solution of Sodium Nitrite should be colorless and give a slightly alkaline reaction with red litmus paper. If the aqueous solution of the salt be mixed with some potassium iodide T.S., and a few drops of an acid added, iodine will be liberated, and nitrogen dioxide gas will escape with effervescence. If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid, and heated sufficiently to expel the gases, the resulting solution after restoring it to its original volume should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 30 Cc. of tenth-normal potassium permanganate V.S., diluted with about 150 Cc. of distilled water, 5 Cc. of sulphuric acid and 10 Cc. of a solution of 1 Gm. of Sodium Nitrite in sufficient distilled water to make 100 Cc. be successively added, the liquid brought to a temperature of 40° C. (104° F.) and allowed to stand for five minutes, not more than 3.75 Cc. of tenth-normal oxalic acid V.S. should be required to decolorize the solution (each Cc. of tenth-normal potassium permanganate consumed corresponding to 0.0034285 Gm. of pure Sodium Nitrite)." *U. S.* The British Pharmacopœia defines it as "a white deliquescent crystalline powder, very soluble in *water.* The solution is neutral or slightly alkaline, and affords reactions characteristic of sodium salts and of nitrites. 0.1 gramme dissolved in *water,* introduced into a brine-charged nitrometer, and tested with *potassium iodide* and *diluted sulphuric acid,* should liberate at the ordinary temperature (60° F. or 15.5° C.) and pressure (30 inches or 760 millimetres of mercury) not less than 32.5 cubic centimetres of nitric oxide, corresponding to not less than 95 per cent. of sodium nitrite, the gas being almost completely absorbed by strong solution of *ferrous sulphate.* The aqueous solution of the salt should not give more than the slightest traces of a precipitate on the addition of *diluted sulphuric acid* (absence of lead)." *Br.*

Uses.—Sodium nitrite acts upon the animal organism precisely as do the other nitrites, being more slowly absorbed, however, and much less rapidly eliminated. Its influence is, therefore, more slowly manifested and much more permanent than is that of amyl nitrite or nitroglycerin. Ten grains are sufficient to cause flushing of the face and markedly increased heart action; indeed, five grains are said to have produced serious symptoms. (*L. L.,* ii. 1883.) It is evident that, although twenty grains of the commercial sodium nitrite have been given without serious effect, the commencing *dose* of the pure article should not exceed three grains (2.0 Gm.).

Off. Prep.—Spiritus Ætheris Nitrosi, *U. S.*

SODII PHENOLSULPHONAS. U. S. (Br.)

SODIUM PHENOLSULPHONATE [Sodii Sulphocarbolas, Pharm. 1890, Sodium Sulphocarbolate]

(sō'dī-ī phē-nōl-sŭl'phǫ-năs)

$NaC_6H_5O_4S + 2H_2O = 230.45$

"It should contain not less than 99 percent. of pure Sodium Paraphenolsulphonate [C_6H_4

(OH)SO_3Na 1:.4 + $2H_2O$], and should be kept in well-stoppered bottles." *U. S.* "Sodium Sulphocarbolate, or sodium phenol-para-sulphonate, $C_6H_4OH.SO_2ONa,2H_2O$, may be obtained by dissolving phenol in excess of sulphuric acid, and converting the phenolsulphonic acid so obtained into a sodium salt." *Br.*

Sodii Sulphocarbolas, *Br., U. S.* 1890; Sodium paraphenolsulphonate; Sodium Sulphophenate; Sulfophénate de Soude, *Fr.;* Phenolsulfosaures Natrium, Phenylschwefelsaures Natron, *G.*

Sodium phenolsulphonate may be made by mixing equal parts of pure phenol and strong sulphuric acid, whereby *paraphenol sulphonic acid* (sulphocarbolic acid), $C_6H_4(HSO_3)OH$, is produced. The mixed liquids must be subjected to a temperature of 55° C. (131° F.) for several days, and then twenty parts of water should be added. Two parts of barium carbonate are added to the liquid, a little at a time, carefully graduating the quantity until effervescence ceases. The liquid is now allowed to stand to permit the precipitation of barium sulphate, and of any carbonate which might be present, and the liquor filtered. The solution of *barium phenolsulphonate* is decomposed by adding sodium carbonate until precipitation ceases, when the liquid is filtered from the barium carbonate, and the sodium phenolsulphonate may be obtained by evaporating the filtrate and crystallizing.

Properties.—The U. S. Pharmacopœia describes this salt as in "colorless, transparent, rhombic prisms; odorless, and having a cooling, saline, bitter taste. Somewhat efflorescent in dry air. Soluble in 4.8 parts of water, and in about 130 parts of alcohol at 25° C. (77° F.); in 0.7 part of boiling water, and in 10 parts of boiling alcohol. When heated a little above 100° C. (212° F.), the salt loses all of its water of crystallization (15.5 percent.), and becomes white. At a higher temperature it chars, emits inflammable vapors having the odor of phenol, and finally leaves a residue of sodium sulphate amounting to 30.6 percent. of the original weight. To a non-luminous flame it imparts an intense yellow color. An aqueous solution of Sodium Phenolsulphonate is neutral to litmus paper. A diluted solution of the salt (1 in 100) is rendered pale violet by ferric chloride T.S., but remains clear; barium chloride T.S. leaves the solution clear, but if a portion of the salt be ignited, and the residue dissolved in water, the same reagent will produce in the solution a copious, white precipitate. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121)." *U. S.* "Soluble in 6 parts of *water*, and in 150 parts of *alcohol* (90 per cent.), the solutions being without action on *litmus*. On ignition it gives off phenol, and leaves a residue of sodium sulphate. It imparts an intense yellow color to flame. The dilute aqueous solution is rendered violet by *test-solution of ferric chloride*, does not give a yellowish-brown precipitate with *solution of uranium nitrate* (distinction from salicylate), and should not at once be rendered turbid by *solution of barium chloride* (absence of sulphates)." *Br.*

Uses.—The sulphocarbolates, or as now called, the phenolsulphonates, have been introduced into medicine with the idea that they would unite the properties of sulphuric acid and phenol. It is, however, probable that they are inert; future investigations can alone give us positive information.

Dose, five to ten grains (0.32 to 0.65 Gm.).

SODII PHOSPHAS. U. S., Br.

SODIUM PHOSPHATE [Sodium Orthophosphate]

(sō'dĭ-ī phŏs'phās)

$Na_2HPO_4 + 12H_2O = 355.61$

"It should contain, in an uneffloresced condition, not less than 99 percent. of pure Disodium-ortho-phosphate [$PO.(OH)(ONa)_2 + 12H_2O$], and should be kept in well-stoppered bottles, in a cool place." *U. S.* "This salt, disodium hydrogen phosphate, $Na_2HPO_4,12H_2O$, may be obtained by the interaction of sodium carbonate and the solution of acid calcium phosphate produced on mixing bone-ash and sulphuric acid." *Br.*

Medicinal Tribasic Sodium Phosphate, Phosphate of Soda; Disodium Hydrogen Phosphate; Phosphas Sodicus (Natricus), Sal Mirabile Perlatum; Phosphate de Soude, *Fr. Cod.;* Natrium Phosphoricum, *P. G.;* Natriumphosphat, Phosphorsaures Natron, *G.;* Fosfato bisodico, *It.;* Fosfato sodico, *Sp.*

A process for this salt is no longer official; for that of the U. S. P. 1870, see foot-note.[1]

The incombustible part of bones is obtained by burning them to whiteness, and consists of neutral calcium phosphate, called bone phosphate, associated with some calcium carbonate, etc. (See *Os Ustum.*) When this is mixed with sulphuric acid, the calcium carbonate is entirely decomposed, giving rise to effervescence. The calcium phosphate undergoes partial decom-

[1] *Sodii Phosphas.*—"Take of Bone, calcined to whiteness and in fine powder, *one hundred and twenty troyounces;* Sulphuric Acid *seventy-two troyounces;* Carbonate of Sodium, Water, each, *a sufficient quantity.* Mix the powder with the Sulphuric Acid in an earthen vessel; then add eight pints of Water, and, having stirred the mixture thoroughly, digest for three days, occasionally adding a little Water to replace that which is lost by evaporation, and frequently stirring the mixture. At the expiration of that time, pour in eight pints of boiling Water, and strain through muslin, gradually adding more boiling Water until the liquid passes nearly tasteless. Set by the strained liquor that the dregs may subside, and, having poured off the clear solution, boil it down to eight pints. To the concentrated liquid, poured off from the newly-formed dregs and heated in an iron vessel, add by degrees Carbonate of Sodium, previously dissolved in hot Water, until effervescence ceases, and the phosphoric acid is completely saturated; then filter the liquid, and set it aside to crystallize. Having removed the crystals, add, if necessary, a small quantity of Carbonate of Sodium to the liquid, so as to render it slightly alkaline; then alternately evaporate and crystallize, so long as crystals are produced. Lastly, keep the crystals in a well-stopped bottle." *U. S.* 1870.

position; the greater part of the lime, being detached, precipitates as calcium sulphate, while the phosphoric acid, set free, combines with the undecomposed portion of the phosphate, and remains in solution as an acid calcium phosphate, holding dissolved a small portion of the calcium sulphate. In order to separate the acid phosphate from the precipitated mass of calcium sulphate, boiling water is added to the mixture, the whole is strained, and the sulphate washed as long as acid phosphate is removed, which is known by the water passing through in an acid state. The different liquids which have passed the strainer, consisting of the solution of acid calcium phosphate, are mixed and allowed to stand, and by cooling a portion of calcium sulphate is deposited, which is removed by decantation. The bulk of the liquid is now reduced by evaporation, and, in consequence of the diminution of the water, a fresh portion of calcium sulphate is deposited, which is separated by subsidence and decantation as before. The acid calcium phosphate solution, being heated, is now saturated by means of a hot solution of sodium carbonate. The carbon dioxide is liberated with effervescence, and the alkali, combining with the *excess* of acid of the acid phosphate, produces a sodium phosphate, while the acid calcium phosphate, by the loss of its excess of acid, becomes the neutral phosphate and precipitates. The calcium phosphate is separated by a new filtration, and the filtered liquor, which is a solution of sodium phosphate, is evaporated so as to crystallize.

In the U. S. process of 1870 the calcined bone is to the acid as 10 to 6; in the Br. process of 1867 as 10 to 6½ nearly. The proportion recommended by Berzelius is as 10 to 6.66. The acid, in the former official process, was added to the calcined bone in the concentrated state, and afterwards diluted with more or less water. In the process given by Berzelius it is first diluted with twelve times its weight of water. All the writers state that sodium phosphate crystallizes more readily by allowing its solution to be slightly alkaline, and a remarkable fact is, that a neutral solution, when it crystallizes, leaves a supernatant liquid which is slightly acid and uncrystallizable. Hence it is necessary, after getting each successive crop of crystals, to render the mother water slightly alkaline, before it will furnish an additional quantity.

Funcke, a German chemist, has given the following cheap and expeditious method for obtaining sodium phosphate. To the powdered calcined bone, diffused in water, sufficient diluted sulphuric acid is added to decompose all the calcium carbonate which it contains. When the effervescence ceases, the matter is treated with nitric acid, which dissolves the calcium phosphate and leaves the sulphate. The nitric solution of the phosphate is then treated with sodium sulphate, equal in quantity to the bone employed, and after the reaction is completed, the nitric acid is recovered by distillation. In consequence of a double decomposition, calcium sulphate and sodium phosphate are formed, the latter of which is separated by water, and crystallized in the usual manner.

Properties.—The medicinal sodium phosphate, according to the U. S. Pharmacopœia (8th Rev.), is in "large, colorless, monoclinic prisms, or a granular, crystalline salt; odorless, and having a cooling, saline taste. The crystals effloresce in the air, and gradually lose 5 molecules of their water of crystallization (25.1 percent.). Soluble in about 5.5 parts of water at 25° C. (77° F.); insoluble in alcohol. When heated to about 40° C. (104° F.), the salt fuses, yielding a colorless liquid. At 100° C. (212° F.) it loses all its water of crystallization (60.3 percent.), and at a red heat is converted into sodium pyrophosphate. It imparts to a non-luminous flame an intense yellow color. An aqueous solution of Sodium Phosphate is slightly alkaline to red litmus and phenolphthalein paper. An aqueous solution of the salt (1 in 20) yields a white, crystalline precipitate with magnesia mixture T.S. With silver nitrate T.S. an aqueous solution yields a yellow precipitate, soluble in ammonia water and in nitric acid. If 0.5 Cc. of the aqueous solution (1 in 20) be mixed with 1 Cc. of ammonium molybdate T.S., the mixture will at once assume a yellow color, and after being gently heated a few minutes will yield a yellow precipitate. No residue should be left on dissolving the salt in water (absence of *calcium*, etc.). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). No effervescence should occur on the addition of hydrochloric or nitric acid to a solution of the salt (absence of *carbonate*). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "In transparent colorless rhombic prisms, terminated by four converging planes, efflorescent, having an alkaline reaction and a saline taste. It is soluble in 6 parts of cold *water*. It affords the reactions characteristic of sodium and of phosphates. Heated to dull redness, it loses 62.84 per cent. of its weight." *Br.*

Before the blowpipe, sodium phosphate at first undergoes the aqueous fusion, and afterwards, at a red heat, melts into a globule of limpid glass, which becomes opaque on cooling. It is liable to adulteration, sometimes containing sodium carbonate, from this salt having been added in excess in its preparation, in which case it will effervesce with acids. If it contain sodium sulphate, or any other soluble sulphate, the precipitate caused by barium chloride will be a mixture of barium sulphate and phosphate, and will not be totally soluble in nitric acid. A. B. Lyons found a specimen which consisted almost entirely of sodium sulphate. (*A. J. P.*, 1875, 371; see also *N. R.*, April, 1877.) Barium chloride will detect sodium carbonate also, by producing a precipitate

of barium carbonate, soluble with effervescence in nitric acid. If a chloride be present, the *yellow* precipitate caused by silver nitrate will be a mixed one of silver chloride and phosphate, not entirely soluble in the same acid. The salt is incompatible with soluble salts of lime, with which it gives a precipitate of calcium phosphate, and with neutral metallic solutions. It is found in several of the animal secretions, particularly the urine. For an elaborate article upon the methods of determining the percentage of phosphates present in a substance, see *Chem. News,* Oct. 1874, 200. Samples of sodium phosphate have been found in commerce contaminated with arsenic in dangerous quantities. The official test to detect arsenic should always be applied to sodium phosphate. (*C. D.,* June 30, 1900, 1073; *Am. Drug.,* Aug. 27, 1900, 103.)

The medicinal sodium phosphate is one of the three sodium salts of tribasic phosphoric acid, H_3PO_4. In this salt two of the three replaceable hydrogen atoms have been replaced by sodium, so that its formula is HNa_2PO_4, which then crystallizes out with 12 molecules of water. Its complete formula is then $HNa_2PO_4 + 12H_2O$. When gently heated, it loses its water of crystallization (see *Sodii Phosphas Exsiccatus*) and at a red heat the salt is converted into *sodium pyrophosphate,* $Na_4P_2O_7$. (See *Sodii Pyrophosphas.*)

Uses.—Sodium phosphate was introduced into practice about the year 1800 by Pearson of London. In doses of from one to two ounces (31 to 62 Gm.) it is a mild purgative, and, from its pure saline taste, is well adapted to the cases of children, and of persons of delicate stomach. In smaller doses it has been considerably used, generally in connection with other phosphates, to meet any real or supposed deficiency of phosphates in the system, and for this purpose it is well adapted by its ready solubility. As was first observed by Wm. Stephenson of Edinburgh, it has, especially in children, an extraordinary influence upon the hepatic secretion. In infantile cases, with *white or green stools,* with *diarrhœa,* and sometimes with *jaundice,* these evidences of deficient or disordered bile often quickly yield to small doses of sodium phosphate, the passages assuming their healthy yellow color, and the attendant disease generally disappearing. These statements of Stephenson are confirmed by the experience of H. C. Wood, at least in regard to children.

Dose, of sodium phosphate, from three or four to ten grains (0.20 or 0.26 to 0.65 Gm.) for children, according to their age, best administered with their food, especially milk; it may be repeated whenever there is occasion to give food. To adults from twenty to forty grains (1.3 to 2.6 Gm.) may be given, dissolved in water, after meals.

Off. Prep.—Ferri Phosphas, *Br.;* Liquor Sodii Phosphatis Compositus, *U. S.;* Sodii Phosphas Effervescens, *U. S.* (from dried salt), *Br.;* Sodii Phosphas Exsiccatus, *U. S.*

SODII PHOSPHAS EFFERVESCENS. U. S., Br.

EFFERVESCENT SODIUM PHOSPHATE

(sō′dĭ-ī phŏs′phăs ĕf-fẹr-vĕs′cẹns)

Sodæ Phosphas Effervescens; Effervescent Phosphate of Soda; Natrium Phosphoricum Effervescens; Phosphate de Soude effervescent, *Fr.;* Brausendes Natriumphosphat, *G.*

* "Exsiccated Sodium Phosphate, in fine powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Sodium Bicarbonate, dried and powdered, *four hundred and seventy-seven grammes* [or 16 ounces av., 361 grains]; Tartaric Acid, dried and powdered, *two hundred and fifty-two grammes* [or 8 ounces av., 389 grains]; Citric Acid, uneffloresced crystals, *one hundred and sixty-two grammes* [or 5 ounces av., 313 grains], to make about *one thousand grammes* [or 35 ounces av., 120 grains]. Powder the Citric Acid and mix it intimately with the Exsiccated Sodium Phosphate and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104° C. (199.4° and 219.2° F.). When the mixture has acquired a moist consistence, by the aid of careful manipulation with a wooden spatula, rub it through a No. 6 tinned-iron sieve, and dry the granules at a temperature not exceeding 54° C. (129.2° F.). Keep the product in well-stoppered bottles." *U. S.*

"Sodium Phosphate, in crystals, 50 *ounces* (Imperial) or 500 grammes; Sodium Bicarbonate, in powder, 50 *ounces* (Imp.) or 500 grammes; Tartaric Acid, in powder, 27 *ounces* (Imp.) or 270 grammes; Citric Acid, in powder, 18 *ounces* (Imp.) or 180 grammes. Dry the Sodium Phosphate until it has lost 60 per cent. of its weight; powder the product and mix it with the other ingredients. Place the whole in a dish or pan of suitable form heated to between 200° and 220° F. (93.3° and 104.4° C.). When the mixture, by aid of careful manipulation, has assumed a granular character, separate it into granules of uniform and convenient size by means of suitable sieves. Dry the granules at a temperature not exceeding 130° F. (54.4° C.). The product should weigh about 100 *ounces* (Imp.) or 1000 grammes." *Br.*

This salt, introduced in the Br. Add. 1885, and into the U. S. P. (8th Rev.), affords a pleasant means of giving sodium phosphate.

Dose, one-fourth to one-half ounce (7.7 to 15.5 Gm.).

SODII PHOSPHAS EXSICCATUS. U. S.

EXSICCATED SODIUM PHOSPHATE

(sō′dĭ-ī phŏs′phăs ĕx-sic-cā′tŭs)

"It should contain not less than 99 percent. of pure anhydrous Sodium Phosphate [PO. (OH) $(ONa)_2$], and should be kept in well-stoppered bottles." *U. S.*

"Sodium Phosphate, *a convenient quantity.* Allow the crystals to effloresce for several days in warm air, at a temperature of from 25° to 30° C. (77° to 86° F.), then continue the drying in an oven; raise the temperature very gradually until 100° C. (212° F.) has been reached, and maintain this temperature until the salt ceases to lose weight. Powder and sift the residue, and preserve it in well-stoppered bottles." *U. S.* This salt was introduced in this form for use in making effervescent sodium phosphate. Forty parts of exsiccated sodium phosphate represent about 100 parts of crystallized sodium phosphate (see *Sodii Phosphas*).

Properties.—It is officially described as "a white powder which absorbs moisture readily, and conforms to the reactions and tests given under *Sodii Phosphas.*" *U. S.*

Uses.—Exsiccated Sodium Phosphate is not used medicinally, but it is suited for administering sodium phosphate in capsules, or in pilular form, because the pills would be smaller than those made from the crystallized salt.

Dose, three to fifteen grains (0.2 to 1.0 Gm.).

Off. Prep.—Sodii Phosphas Effervescens, *U. S.*

SODII PYROPHOSPHAS. U. S.

SODIUM PYROPHOSPHATE

(sō′dĭ-ī pȳ-rŏ-phŏs′phăs)

$Na_4P_2O_7 + 10H_2O = 443.02$

"It should contain, in an uneffloresced condition, not less than 99 percent. of pure Sodium Pyrophosphate $[(PO)_2O.(ONa)_4 + 10H_2O]$, and should be kept in well-stoppered bottles." *U. S.*

Natrium Pyrophosphoricum; Pyrophosphate de Soude, *Fr. Cod.;* Natriumpyrophosphat, *G.;* Pirofosfato sodico, *Sp.*

This official salt is prepared by heating sodium phosphate in a suitable vessel to redness. When sodium phosphate is subjected to a temperature of 44° C. (111.2° F.), it melts in its water of crystallization; if the heat be increased to 100° C. (212° F.), all the water will be dispelled, and but 40 per cent. of the original weight remain; at 300° C. (572° F.) it is converted into the tetrabasic phosphate or pyrophosphate. By dissolving this residue in water, filtering and crystallizing, the salt may be obtained.[1]

Properties.—It is officially described as in "colorless, transparent, monoclinic prisms, or a crystalline powder; odorless, and having a cooling, saline, and feebly alkaline taste; slightly efflorescent in warm air. Soluble in about 11.5 parts of water at 25° C. (77° F.), and in 1.1 parts of boiling water; insoluble in alcohol. When heated to 100° C. (212° F.), the salt loses its water of crystallization (40.35 per-cent.) without previous fusion. At a higher temperature it fuses, forming a transparent liquid, which, on cooling, solidifies to a crystalline mass. To a non-luminous flame it imparts an intense yellow color. An aqueous solution is feebly alkaline to red litmus and to phenolphthalein paper. An aqueous solution of the salt (1 in 20) yields with magnesia mixture a white precipitate; with silver nitrate T.S. it yields a white precipitate (distinction from *orthophosphate*); this precipitate is soluble in ammonia water and also in nitric acid without effervescence (absence of *carbonate*). With an excess of ammonium molybdate T.S. no precipitate is formed within fifteen or twenty minutes, even when a gentle heat is applied (distinction from *orthophosphate*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Five cubic centimeters of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.*

Uses.—The action of this salt upon the human economy is probably that of the phosphate.

SODII SALICYLAS. U. S., Br.

SODIUM SALICYLATE

(sō′dĭ-ī săl-ĭ-cȳ′lăs)

$NaC_7H_5O_3 = 158.89$

"It should contain not less than 99.5 percent. of pure Sodium Salicylate $[C_6H_4(OH)COONa]$, and should be kept in well-stoppered bottles, protected from heat and light." *U. S.* "Sodium Salicylate, $(C_6H_4.OH.COONa)_2,H_2O$, may be obtained by the interaction of salicylic acid and sodium carbonate or sodium hydroxide." *Br.*

Salicylate of Soda; Salicylate de Soude, *Fr. Cod.;* Natrium salicylicum, *P. G.;* Natriumsalicylat, *G.;* Salicilato di sodio, *It.;* Salicilato sodico, *Sp.*

This salt was introduced into the U. S. Pharmacopœia at the revision of 1880. It is prepared by mixing 100 parts of pure salicylic acid with sufficient water to form a paste, and then with 104 parts of pure crystallized sodium carbonate (U. S. P. 1890) (uneffloresced) in a glass or porcelain vessel; carbon dioxide will be evolved, and sodium salicylate will remain in solution. The liquid may be strained through thoroughly washed muslin, if necessary, and heated in an evaporating dish until the carbon dioxide is expelled. If alkaline to litmus paper, enough salicylic acid must be added to be slightly in excess, and the solution is then evaporated at a low heat to dryness. If the acid be not in excess, the salt will not be white, but gray or lead-colored. Hager (*N. R.*, Nov. 1879) furnished the table on page 1155, whereby, in the absence of the crystallized sodium salicylate, the salt may be prepared in *solution,* by using the given proportions, in parts by weight, of

[1] This salt has been highly recommended for removing ink stains from colored cotton fabrics. It is said to remove the stains slowly without affecting the other colors.

salicylic acid and sodium bicarbonate. These figures differ somewhat from those given in the official saturation table, as given in the U. S. P. (8th Rev.).

Properties.—Pure sodium salicylate is a "white, microcrystalline powder or scales, or an amorphous, colorless powder, or having not more than a faint pink tinge; odorless, and having a sweetish, saline taste. Soluble in 0.8 part of water, and in 5.5 parts of alcohol at 25° C. (77° F.); very soluble in boiling water or alcohol; also soluble in glycerin. When heated, the salt is decomposed, giving off inflammable vapors and an odor of phenol, and finally leaves a residue of sodium carbonate. To a non-luminous flame it imparts an intense yellow color. An aqueous solution of Sodium Salicylate, when freshly made, should be colorless, and should slightly redden blue litmus paper. Ferric chloride T.S., added to an excess of a concentrated solution of the salt, produces a violet precipitate; but when added to a dilute solution (1 in 100), it produces a deep violet-blue color. If copper sulphate T.S. be added to the aqueous solution (1 in 20), a green color is produced. On adding to about 0.2 Gm. of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then, cautiously, drop by drop, about 1 Cc. of methyl alcohol, and heating the mixture to boiling, methyl salicylate will be evolved, recognizable by its odor. Diluted hydrochloric or sulphuric acid produces in a concentrated aqueous solution of the salt a voluminous, white precipitate, which, after being separated by filtration, and washed, should conform to the reactions and tests given under *Acidum Salicylicum*. If to an aqueous solution of the salt (1 in 20), 3 drops of iodine T.S. and a slight excess of hydrochloric acid be added, the filtrate from this mixture should not yield a precipitate upon the addition of barium chloride T.S. (absence of *sulphites*). If the aqueous solution of the salt (1 in 20) be acidulated with hydrochloric acid and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. of dry Sodium Salicylate be thoroughly ignited at a red heat, and the residue extracted with boiling distilled water until the washings cease to react with methyl-orange T.S., the mixed filtrate and washings should require for complete neutralization not less than 12.5 (12.52) Cc. of half-normal sulphuric acid V.S., methyl-orange T.S. being used as indicator." *U. S.* "When heated to redness, the salt evolves inflammable vapors, and a white residue remains which effervesces with acids, and imparts an intense yellow color to flame. *Test-solution of ferric chloride* colors a concentrated solution reddish-brown, and a dilute solution violet. A solution containing not less than 1 per cent. affords a yellowish-brown precipitate with *solution of uranium nitrate* (distinction from carbolates and sulphocarbolates). 50 to 100 grammes kept in a closed vessel for several days should not evolve the faintest odor of phenol. If the aqueous solution be acidulated with *nitric acid* and the precipitate be dissolved by a little *alcohol* (90 per cent.), the mixture affords not more than the slightest reactions with the tests for sulphates or for chlorides. It dissolves without coloration or effervescence in cold *sulphuric acid* (absence of organic impurities and of carbonates)." *Br.* Sodium salicylate is incompatible with antipyrine, forming, when mixed in powder, a liquid mixture.

Uses.—The action of sodium salicylate upon the economy, and its therapeutic use, are precisely those of salicylic acid, except that the salt is not locally irritating, and, being soluble, is more rapidly absorbed. When salicylic acid is administered, it is probably converted into sodium salicylate as fast as it is taken into the blood. One drachm of the salt contains about fifty grains of the acid.

Dose, from ten to thirty grains (0.6 to 2.0 Gm.).

SODII SULPHAS. U. S., Br.

SODIUM SULPHATE [Glauber's Salt]

(sō'dĭ-ī sŭl'phăs)

$Na_2SO_4 + 10H_2O = 319.91$

"It should contain, in an uneffloresced condition, not less than 99 percent. of pure Sodium Sulphate $[SO_2(ONa)_2 + 10H_2O]$, and should be kept in well-closed vessels, in a cool place." *U. S.* "Sodium Sulphate, $Na_2SO_4,10H_2O$,

To make of Sodium Salicylate.	Take of		To make of Sodium Salicylate.	Take of		To make of Sodium Salicylate.	Take of		To make of Sodium Salicylate.	Take of	
	Salicylic Acid.	Sodium Bicarbonate.		Salicylic Acid.	Sodium Bicarbonate.		Salicylic Acid.	Sodium Bicarbonate.		Salicylic Acid.	Sodium Bicarbonate.
4	3.3	2.0	11	9.0	5.5	18	14.7	9.0	25	20.4	12.5
5	4.1	2.5	12	9.8	6.0	19	15.5	9.5	26	21.2	13.0
6	4.9	3.0	13	10.6	6.5	20	16.3	10.0	27	21.11	13.5
7	5.7	3.5	14	11.4	7.0	21	17.2	10.5	28	22.9	14.0
8	6.5	4.0	15	12.2	7.5	22	18.0	11.0	29	23.7	14.5
9	7.4	4.5	16	13.1	8.0	23	18.8	11.5	30	24.5	15.0
10	8.2	5.0	17	13.9	8.5	24	19.6	12.0			

may be obtained by the interaction of sodium chloride and other sodium salts with sulphuric acid." *Br.*

Sulphate of Soda; Sulfas Sodicus (Natricus), Sal mirabile Glauberi; Vitriolated Soda, Glauber's Salt; Sulfate de Soude purifié, *Fr. Cod.;* Sel de Glauber, *Fr.;* Natrium Sulfuricum, *P. G.;* Natriumsulfat, Schwefelsaures Natron, Glaubersalz, *G.;* Solfato di Sodio, *It.;* Sulfato Sodico, Sal admirabile de Glaubero, *Sp.*

Sodium sulphate, in small quantities, is extensively diffused in nature, and is obtained artificially in several chemical operations. It exists in solution in many mineral springs, among which may be mentioned those of Cheltenham and Carlsbad, and it is found combined with calcium sulphate constituting a distinct mineral. Many ponds containing this salt are found in the country between Santa Fé and the head waters of the Arkansas, and on the route to the Rocky Mountains. See reference to natural sodium carbonate and sulphate as found in Wyoming. (*Sodii Carbonas,* p. 1139.) A large deposit of Glauber's salt has been found in the Caucasus, not far from Tiflis. It is about ten feet below the surface, and was penetrated five feet, and probably extended much deeper. There are, besides, in the same region, various lakelets, containing the same salt in solution. (*N. R.,* Oct. 1872, 151.) As an artificial product, sodium sulphate is formed in the processes for obtaining hydrochloric acid and chlorine, and in the preparation of ammonium chloride from ammonium sulphate and common salt. It may also be procured from sea water, in which its ingredients are present.

Immense quantities of sodium sulphate are made by decomposing common salt by sulphuric acid, in the manufacture of soda-ash and sodium carbonate (see *Sodii Carbonas*), and, so far from the generated hydrochloric acid being a product of much value, its absorption in a convenient way, so as to avoid the nuisance of its escape into the atmosphere in a gaseous state, is an object of importance to the manufacturer. (See *Acidum Hydrochloricum.*) Thomas, Dellisse, and Boucard have proposed a process for preparing sodium sulphate, by double decomposition between sodium chloride and ferrous sulphate. This process avoids the production of hydrochloric acid vapors, and is said to furnish a cheap salt.

The residue of the process for obtaining chlorine by the action of sulphuric acid and manganese dioxide on common salt is a mixture of sodium sulphate and manganous sulphate. Large quantities of this residue are formed in manufacturing chlorinated lime (bleaching powder), and the sodium sulphate in it, roughly purified, supplies a part of the salt consumed in making soda-ash and sodium carbonate.

The process for obtaining ammonium chloride from ammonium sulphate and common salt forms another source of sodium sulphate. By double decomposition, sodium sulphate and ammonium chloride are formed, and by exposing the mixed salts to heat, the ammonium chloride sublimes, and the sodium sulphate remains behind. (See *Ammonii Chloridum.*)

Properties.—Sodium sulphate is in "large, colorless, transparent, monoclinic prisms, or granular crystals; odorless, and having a bitter, saline taste. The salt effloresces rapidly in the air, and finally loses all of its water of crystallization. Soluble in 2.8 parts of water at 15° C. (59° F.), in 0.25 part at 34° C. (93.2° F.), and in 0.47 part at 100° C. (212° F.); insoluble in alcohol; soluble in glycerin. When heated to 33° C. (91.4° F.), the salt fuses, and, on continuing the heat to 100° C. (212° F.), it loses all of its water of crystallization (55.9 percent.). At a red heat the anhydrous salt fuses without decomposition. To a non-luminous flame it imparts an intense yellow color. Its aqueous solution is neutral to litmus paper. An aqueous solution of Sodium Sulphate (1 in 20) yields, with barium chloride T.S., a white precipitate insoluble in hydrochloric acid. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "Soluble in less than half its weight of *water* at temperatures from 77° to 86° F. (25° to 30° C.). Heated to boiling this solution deposits crystals of the anhydrous salt. Insoluble in *alcohol* (90 per cent.). Exposed to heat in a porcelain crucible it loses 55.9 per cent. of water. It affords the reactions characteristic of sodium and of sulphates. Each gramme dissolved in *water* and acidulated with *hydrochloric acid* gives, by the addition of *solution of barium chloride,* a white precipitate, which, when it has been washed and dried, should weigh 0.725 gramme. It should yield no characteristic reaction with the tests for lead, iron, aluminium, calcium, magnesium, potassium, ammonium, or carbonates, and only the slightest reactions with the tests for chlorides." *Br.* When recently prepared it is beautifully transparent; but on exposure to the air it effloresces, and the crystals become covered with an opaque white powder. After long exposure it undergoes complete efflorescence, and falls into powder with loss of more than half its weight. A supersaturated solution of sodium sulphate will remain without crystallizing at ordinary temperatures, even though containing several times the weight of the salt that will be dissolved at the same degree of heat. But the solution instantly forms into a crystalline mass upon adding to it a fragment of the same salt crystallized, or other substances that have been exposed to the air, or upon abruptly placing it in contact with the air.

When crystallized sodium sulphate is subjected to heat it dissolves in its water of crystallization, then dries, and afterwards by

the application of a red heat melts with the loss of 55½ per cent. of its weight. Coppet has ascertained that there are two varieties of the anhydrous sulphate,—one in which the salt is deprived of its water at ordinary temperature, the other in which the desiccation is effected at a heat above that of 33° C. (91.4° F.). The two differ in their relation to the crystallization of the salt, the former causing immediate crystallization when thrown into a supersaturated solution, the second not. (*J. P. C.*, 1874, 36.) Occasionally it contains an excess of acid or alkali, which may be discovered by litmus or turmeric paper. Common salt may be detected by silver nitrate; a salt of iron by potassium ferrocyanide. This salt is not subject to adulteration. It is incompatible with potassium carbonate, calcium chloride, the salts of barium, lead acetate and subacetate, and with silver nitrate if the solutions are strong. It consists of two atoms of sodium combined with the group SO_4 characteristic of sulphates, and crystallizes with ten molecules of water, $Na_2SO_4 + 10H_2O$.

Uses.—Sodium sulphate in doses of from half an ounce to an ounce (15.5 to 31 Gm.) is an efficient hydragogue cathartic; in smaller doses, an aperient and diuretic. When in an effloresced state, the dose must be reduced one-half, on account of its having lost about one-half of its weight of water. Sodium sulphate is much less used than formerly, having been almost entirely superseded by magnesium sulphate, which is less disagreeable to take and milder in its action. Its nauseous taste, however, may be disguised by the admixture of a little lemon juice or cream of tartar, or by the addition of a few drops of sulphuric acid. It is an ingredient in the artificial Cheltenham salt. (See PART II.) D. de Luca has found sodium sulphate remarkably efficient in removing *stains* or *opacity* of the *cornea,* if applied in the form of powdered crystals directly to the eyeball twice daily. (*J. P. C.*, Sept. 1867.) The only uses of sodium sulphate in the arts are to make sodium carbonate and some kinds of glass. It has no U. S. official preparations.

Dose, two drachms to an ounce (7.7 to 31 Gm.).

Off. Prep.—Sodii Sulphas Effervescens, *Br.*

SODII SULPHAS EFFERVESCENS. Br.

EFFERVESCENT SODIUM SULPHATE

(sō′dī-ī sŭl′phăs ĕf-fẹr-vĕs′cẹnṣ)

Sodæ Sulphas Effervescens; Effervescent Sulphate of Soda; Natrium Sulfuricum Effervescens; Brausendes Natriumsulfat, *G.*

"Sodium Sulphate, in crystals, 50 *ounces* (Imperial) or 500 grammes; Sodium Bicarbonate, in powder, 50 *ounces* (Imp.) or 500 grammes; Tartaric Acid, in powder, 27 *ounces* (Imp.) or 270 grammes; Citric Acid, in powder, 18 *ounces* (Imp.) or 180 grammes. Dry the Sodium Sulphate until it has lost 56 per cent. of its weight; powder the product and mix it with the other ingredients. Place the whole in a dish or pan of suitable form, heated to between 200° and 220° F. (93.3° and 104.4° C.). When the mixture, by aid of careful manipulation of the powder, begins to aggregate, stir it assiduously until it has assumed a granular character; then separate it into granules of uniform and convenient size, by means of suitable sieves. Dry the granules at a temperature not exceeding 130° F. (54.4° C.). The product should weigh about 100 *ounces* (Imp.) or 1000 grammes." *Br.*

This was a new official preparation of the British Pharm. 1885, having been introduced in the "Additions." It is used as an effervescent laxative, in the *dose* of from one-fourth to one-half ounce (7.7 to 15.5 Gm.) dissolved in cold water and taken while effervescing.

SODII SULPHIS. U. S., Br.

SODIUM SULPHITE

(sō′dī-ī sŭl′phīs)

$Na_2SO_3 + 7H_2O = 250.39$

"It should contain, in the uneffloresced and air-dried condition, not less than 96 percent. of pure Sodium Sulphite, and should be kept in well-stoppered bottles, in a cool place." *U. S.*
"Sodium Sulphite, $Na_2SO_3,7H_2O$, may be obtained by interaction of sulphurous acid and sodium carbonate." *Br.*

Natrium Sulfurosum, Sulfis Sodicus (Natricus); Sulfite de Soude, *Fr.*; Natriumsulfit, Schwefligsaures Natron, *G.*

This salt may be prepared by passing sulphurous acid gas into a solution of sodium carbonate, and evaporating out of contact of the air. The sulphurous acid unites with the soda of the carbonate to form sodium sulphite, and the carbon dioxide escapes. After sufficient concentration, the solution is allowed to cool, and the salt crystallizes. A better way, however, is to dissolve a convenient weight of sodium carbonate in a small quantity of water, then pass the sulphurous acid gas through the solution until it is completely saturated, and acid sodium sulphite is formed. The addition of an equal weight of sodium carbonate forms a solution of the neutral sulphite, which is to be evaporated and crystallized. On exposure the salt gradually changes into a sulphate.

Properties.—Sodium sulphite is in "colorless, transparent, monoclinic prisms; odorless, and having a cooling, saline, sulphurous taste. Exposed to the air, the salt effloresces, and is slowly oxidized to sulphate. Soluble in 2 parts of water at 25° C. (77° F.), and in 1.4 parts of boiling water; sparingly soluble in alcohol. When gently heated, the salt softens somewhat, but it does not fuse. Above 100° C. (212° F.) the crystals lose all their water (50 percent.), without fusing or changing their shape. At a red heat the salt fuses to a reddish-yellow

mass of sodium sulphate and sodium sulphide. To a non-luminous flame the salt imparts an intense yellow color. Its aqueous solution is neutral or feebly alkaline to litmus paper. Upon the addition of hydrochloric acid to the salt, sulphur dioxide gas is liberated, which is recognized by its odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. and held in the escaping gas. If 1 Gm. of the salt be dissolved in 10 Cc. of diluted nitric acid, and the solution heated sufficiently to expel the gases, the liquid should not become turbid (absence of *thiosulphate*). If 1 Gm. of the salt be dissolved in 20 Cc. of diluted hydrochloric acid and heated sufficiently to expel the sulphur dioxide, the remaining solution, after being restored to its original volume, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If to 50 Cc. of tenth-normal iodine V.S., measured from a burette into a glass-stoppered vial (of about 100 Cc. capacity), 0.5 Gm. of the finely powdered crystals of Sodium Sulphite be added, the solution allowed to stand for about an hour, and shaken at frequent intervals, not more than 11.65 Cc. of tenth-normal sodium thiosulphate V.S. should be required to discharge the color of the solution." *U. S.* "In colorless transparent monoclinic prisms, efflorescent in dry air, inodorous, with a saline and sulphurous taste. It is readily soluble in *water*, very sparingly in *alcohol* (90 per cent.). It affords the reactions characteristic of sodium and of sulphites. The aqueous solution has a neutral or faintly alkaline reaction, and if treated with *hydrochloric acid* evolves sulphurous anhydride, but does not become cloudy (absence of thiosulphate). Each gramme dissolved in 50 cubic centimetres of *water* should decolorize not less than 77.7 nor more than 81.7 cubic centimetres of the *volumetric solution of iodine*." *Br.* Sulphuric acid added to the solution gives rise to an odor of burning sulphur, owing to the escape of sulphurous acid, and the liquid remains transparent, indicating the absence of lime. Sodium sulphite consists of two atoms of sodium combined with the group SO_3, characteristic of sulphites, and crystallized with seven molecules of water, $Na_2SO_3 + 7H_2O$. For methods of determining sodium carbonate in sodium sulphite by C. E. Caspari and M. R. Moffatt see *Proc. A. Ph. A.*, 1902, 429; also *West. Drug.*, 1904, 59.

Uses.—Sodium sulphite has been used in cases of *yeasty vomiting* with remarkable success. The matter vomited in these cases contains two microscopic fungi, called Sarcina ventriculi and Torula cerevisiæ. The remedy was first used at the suggestion of Graham of London, who supposed that the sulphurous acid, necessarily extricated from the salt in the stomach by the acid of the yeasty matter, would destroy the parasites. Sodium sulphite is sometimes used locally, especially in that species of *aphthous sore mouth* which is attributed to a parasitic vegetable. The wash may be made of a drachm of the salt to a fluidounce of water. It is said that the solution acts with surprising rapidity, a single application of it sometimes removing the disease in 24 hours. Astrié, an Italian physician, has proposed this salt as a remedy for the constitutional effects of mercury, when used in excess, on the ground that it has the power of rendering the metal soluble. It also has been largely given internally as an antizymotic (see *Sodii Thiosulphas*), but without general success. According to Carey Lea (*Am. J. M. S.*, Jan. 1865), it is partially converted in the system into a sulphate and partially escapes with the urine unchanged.

Dose, of sodium sulphite, fifteen to sixty grains (1.0 to 3.9 Gm.).

SODII THIOSULPHAS. U. S., Br.

SODIUM THIOSULPHATE [Sodii Hyposulphis, Pharm. 1890, Sodium Hyposulphite]

(sō'dī-ī thī-o-sŭl'phăs)

$Na_2S_2O_3 + 5H_2O = 246.46$

"It should contain not less than 98 percent. of pure Sodium Thiosulphate, and should be kept in well-stoppered bottles." *U. S.*

Hyposulphite of Soda; Natrum Subsulfurosum (Hyposulfurosum); Hyposulphis Sodicus; Hyposulphite de Soude, *Fr. Cod.*; Sulfite sulfuré de Soude, *Fr.*; Natrium thiosulfuricum, *P. G.*; Natriumthiosulfat, Unterschwefligsaures Natron, *G.*; Hiposulfito sodico, *Sp.*

This salt is used in the United States and British Pharmacopœias as a test, and for the formation of the *Volumetric Solution of Sodium Thiosulphate.* It is readily prepared, according to Walchner, by mixing a pound of dry sodium carbonate, in fine powder, with five ounces of sulphur, heating the mixture gradually in a porcelain vessel until the sulphur melts, and stirring the agglutinated mass, still kept hot, in order that every portion of it may come in contact with the air. The sodium sulphide first formed is thus converted into sodium sulphite. This is dissolved in water, and the filtered solution being boiled with sulphur becomes one of sodium thiosulphate, from which, after filtration and concentration, the salt is deposited in crystals. It may be obtained also by digesting the solution of sodium sulphite at a high temperature, but short of ebullition, with finely divided sulphur. Thiosulphuric acid exists only in combination, and its salts were formerly considered simply as sulphuretted sulphites. The true hyposulphurous acid, according to theory, would be H_2SO_2, while $H_2S_2O_3$ is more properly *thiosulphuric* acid, as it differs from sulphuric acid by the replacement of one oxygen atom by one sulphur atom.

Inasmuch as Schützenberger discovered the true hyposulphurous acid, H_2SO_2, exact chemical usage would demand that we give the distinguishing name thiosulphuric to what was formerly called hyposulphurous. Schützenberger

himself called the newly-discovered acid *hydrosulphurous,* but this is not characteristic, and the correct name for "sodium hyposulphite" is *sodium thiosulphate.*

Properties.—It is officially described as in "colorless, transparent, monoclinic prisms; odorless, and having a cooling, afterwards bitter taste. Permanent in the air below 33° C. (91.4° F.), but efflorescent in dry air above that temperature; slightly deliquescent in moist air. Soluble in about 0.35 part of water at 25° C. (77° F.); at a boiling heat the solution is rapidly decomposed; insoluble in alcohol; slightly soluble in oil of turpentine. When rapidly heated to 50° C. (122° F.), the salt melts. When slowly heated until it is effloresced, and afterwards to 100° C. (212° F.), it loses all of its water of crystallization (36.3 percent.), and at a red heat is decomposed, sulphur being liberated, while a residue of sodium sulphide and sodium sulphate remains. To a non-luminous flame it imparts an intense yellow color. Its aqueous solution is neutral or faintly alkaline to litmus paper. An aqueous solution of Sodium Thiosulphate readily dissolves many salts of silver (chloride, bromide, iodide, oxide, etc.), and discharges the color of a solution of iodine or of starch iodide. If ferric chloride T.S. be dropped into the aqueous solution (1 in 20), a dark violet color will be produced, which disappears rapidly on agitation. Addition of sulphuric or hydrochloric acid to the aqueous solution liberates from it sulphur dioxide (recognized by its odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. held in the escaping gas); a white precipitate of sulphur is also formed (distinction from *sulphite* or *bisulphite*). If to 5 Cc. of an aqueous solution of the salt (1 in 10), 3 Cc. of nitric acid be added, the solution cautiously evaporated to dryness on a water-bath, and the residue treated with distilled water, the liquid filtered, and the filtrate and washings evaporated to dryness, this residue should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). The residue from 20 Cc. of an aqueous solution (1 in 20), treated as directed above, when dissolved in 20 Cc. of water and slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). The aqueous solution (1 in 20) should not be rendered turbid by the addition of ammonium oxalate T.S. (absence of *calcium*). An aqueous solution of the salt (1 in 20) should not be colored red by a drop of phenolphthalein T.S. (absence of *caustic alkali* or *carbonate*); nor should a drop of silver nitrate T.S. produce a brown or a black precipitate in 5 Cc. of this solution (absence of *sulphide*). If 1 Gm. of Sodium Thiosulphate be dissolved in 20 Cc. of water, it should require the addition of not less than 39.75 Cc. of tenth-normal iodine V.S. to produce a slight yellow tint." *U. S.* Its solution dissolves silver chloride and all water-insoluble compounds of that metal, except the sulphide, and that resulting from the decomposition of a silver salt by light. Though without action on potassium iodide, it dissolves iodine, decomposes iodic acid with liberation of iodine, and destroys the blue color of starch iodide. (Brande and Taylor.) In dissolving iodine it forms with it sodium iodide and sodium tetrathionate, as represented by the formula

$$2(Na_2S_2O_3) + I_2 = (NaI)_2 + Na_2S_4O_6$$

It dissolves also lead sulphate and iodide, and calcium sulphate, much more freely than does water. (*J. P. C.,* 1864, 363.) Its relations to iodine render it valuable as a means of estimating the quantity of free iodine, for which purpose it is used in the Pharmacopœias in the form of a *volumetric solution.* In consequence of its peculiar solvent properties, it is much used in photography. The photographers employ it for the purpose of dissolving the unchanged silver iodide or bromide from the plate after the action of the light, and thus fixing the image already formed. It is also largely used as an *"antichlor"* in the paper manufacture, to free the paper pulp from the excess of chlorine used in the bleaching. One of the most delicate tests is that of iodine with starch. The blue color produced by the mixture of very small quantities of these two substances in solution is instantly discharged by a solution containing a trace of the thiosulphate. If zinc or iron is dipped into an acidified solution of the thiosulphate, the liberated hydrogen at once reduces the sulphurous oxide which is in the solution to hydrogen sulphide, recognizable by lead acetate paper. This test will serve to show even traces of thiosulphate.

Uses.—Sodium thiosulphate is a very powerful poison to fungi and other low organic forms. Consequently, when added to fermenting mixtures it arrests the process of change. This led G. Polli to suggest its use in certain diseases supposed to be dependent on a fermentation or zymosis in the blood. The theory has seemed plausible to many practitioners, and the remedy has been extensively administered in *pyæmia* and in the so-called *zymotic disorders* and allied affections. Although individual experiences corroborating the early successes of Polli have been reported, the general professional verdict is unmistakably adverse. The thiosulphate seems not to be without influence upon the human system. When taken internally it appears to have deoxidizing powers, probably through the passage of the thiosulphuric into sulphuric acid. It has been found, in its action on the urine, to diminish urea and increase uric acid, to increase the sulphates, and to cause the presence of sugar and oxalic acid in the urine. (Kletzinsky, *Ann. Thér.,* 1860, p. 109.) With a view to its poisonous influence on the sarcina ventriculi which attends *yeasty vomiting,* it has been employed in that complaint and, as a local application, it may be used in all the *parasitic affec-*

tions of the skin and mouth. As the effects of this salt proceed from its acid constituent, other thiosulphates may be substituted, and *calcium thiosulphate* has been recommended. For the mode of preparing this salt, see *A. J. P.*, 1863.

Dose, ten to twenty grains (0.65 to 1.3 Gm.), three times a day simply dissolved in water, or in the form of syrup. For external use a drachm may be dissolved in a fluidounce of water.

SODIUM. Br.

SODIUM

(sō'dĭ-ŭm)

"The metal sodium as met with in commerce. It should be preserved in well-stoppered bottles under mineral naphtha." *Br.*

Sodium, *Fr.;* Natrium, Natronmetall, *G.;* Sodio, *It., Sp.*

Sodium is a peculiar metal, the hydroxide of which is known as the alkali "soda." It was discovered by H. Davy in 1807, who obtained it in small quantity by decomposing the alkali by the agency of galvanic electricity. Sodium was formerly prepared on a large scale by igniting an intimate mixture of dry sodium carbonate, coal, and chalk. The amount of metal obtained by this method is, however, not over 40 per cent. of the theoretical result. A much improved process was next brought out by Castner (*J. Soc. Chem. Ind.*, 1887, 174), in which an iron carbide, or a mixture of fine iron and coke, is used to reduce the caustic soda, according to the reaction:

$$6NaOH + FeC_2 = 2Na_2CO_3 + 6H + Fe + 2Na$$

The reduction of the sodium hydroxide takes place at a temperature of about 800° C., and is carried out in steel crucibles, each of which holds 5.6 kilos of sodium hydroxide and 1.97 kilos of carbide. The product of the reaction consists of about 4.85 kilos of sodium carbonate and 0.933 kilo of metallic sodium. This latter collects in a receiver connected with the top of the crucible, while the sodium carbonate is dissolved out from the residue and is causticized preparatory to being used again. This process in turn has been replaced by the electrolytic processes. The most successful of these is that of Castner, who uses an electrolyte of fused sodium hydroxide in an iron pot or crucible with an anode of iron and a cathode of copper. The sodium is reduced at a comparatively low temperature, and is ladled from the vessel into moulds. The process is carried out at present on a large scale by the Niagara Electro-Chemical Co., and at Oldbury, England, and several places in Germany. The production of sodium (all by the electrolytic process) in the United States in 1904 amounted to 1,320,000 pounds valued at $170,000.

Sodium is a soft, malleable, ductile solid, of a silver-white color. It possesses the metallic lustre in a high degree, when protected from the action of the air, by which it is quickly tarnished and oxidized. Its sp. gr. is 0.97, and its fusing point 95.6° (204° F.). Its chemical affinities resemble those of potassium, but are less energetic. Like potassium, it has a strong attraction for oxygen. When thrown upon cold water it instantly fuses into a globule without inflaming, and traverses the surface in different directions with rapidity; on warm water it inflames. In both cases the water is decomposed, hydrogen is liberated, and sodium hydroxide generated. Like potassium, if exposed with a bright surface to the air, it undergoes a slow combustion, which renders it luminous in the dark. It combines with oxygen to form the monoxide, Na_2O, and a peroxide, Na_2O_2. This latter oxide is always formed when the metal is burned in the open air. "A soft metal, rapidly oxidizing in the air, but showing a bright metallic surface when freshly cut. It violently attacks water or alcohol (90 per cent.), with evolution of hydrogen, little or no insoluble matter remaining. It imparts an intense yellow color to flame. Each gramme very cautiously added to water affords a solution which should require for neutralization at least 42.6 cubic centimetres of the volumetric solution of sulphuric acid." *Br.*

Sodium is a constituent of many important medicinal preparations. Sodium salts are characterized by communicating to the blowpipe flame a rich yellow color, and by not being precipitable by any reagent except potassium metantimoniate. Sodium monoxide consists of two atoms of sodium and one atom of oxygen. This reacts with water to form sodium hydroxide (caustic soda),

$$Na_2O + H_2O = 2NaOH$$

The dioxide (or peroxide), Na_2O_2, is now manufactured on a large scale from the metal, and used as a substitute for hydrogen peroxide in bleaching processes. It forms a canary-yellow powder, which decomposes rapidly in the presence of moisture.

The official combinations containing sodium are the solutions of sodium hydroxide and chlorinated soda, sodium acetate, arsenate, benzoate, bicarbonate, bisulphite, borate, bromide, carbonate, chlorate, chloride, citrate, hydroxide, hypophosphite, iodide, nitrate, nitrite, phenolsulphonate, phosphate, pyrophosphate, salicylate, sulphate, sulphite, thiosulphate, and potassium and sodium tartrate.

Off. Prep.—Liquor Sodii Ethylatis, *Br.*

SPARTEINÆ SULPHAS. U. S.

SPARTEINE SULPHATE

(spär-tę-ī'næ sŭl'phăs)

$C_{15}H_{26}N_2.H_2SO_4 + 5H_2O = 419.26$

"The sulphate $[SO_2(OH)_2.C_{15}H_{26}N_2 + 5H_2O]$ of an alkaloid obtained from Scoparius. Sparteine Sulphate should be kept in well-stoppered, amber-colored vials." *U. S.*

Sulfate de Spartéine, *Fr. Cod.;* Sparteinum Sulphuricum; Sparteinsulfat, Schwefelsaures Spartein, *G.;* Sulfato de esparteina, *Sp.*

This alkaloidal salt, prepared from Scoparius (see page 1103) is officially described as in "colorless, rhombohedral crystals, or a crystalline powder; odorless, and having a slightly saline and somewhat bitter taste. It crystallizes with varying amounts of water of crystallization, but when recrystallized from a solution in diluted alcohol it contains 5 molecules of water. Soluble in 1.1 parts of water, and in 2.4 parts of alcohol at 25° C. (77° F.); insoluble in ether and chloroform. When heated to 110° C. (230° F.), the salt loses all of its water of crystallization (21.3 percent.), and when anhydrous, melts at 136° C. (276.8° F.). It is hygroscopic, and its aqueous solution has an acid reaction upon blue litmus paper.

If 25 Cc. of ether be added to about 0.1 Gm. of Sparteine Sulphate in a test-tube, followed by a few drops of diluted ammonia water, avoiding an excess, and if an ethereal solution of iodine (1 in 50) be afterwards added until the liquid, when shaken, turns from an orange to a dark reddish-brown color, the bottom and sides of the test-tube will, after a short time, be coated with minute, dark greenish-brown crystals. Barium chloride T.S., in an aqueous solution of Sparteine Sulphate, produces a white precipitate insoluble in hydrochloric acid. If a solution of potassium ferrocyanide (1 in 20) be added to a solution of the salt, a yellow precipitate is produced. Sulphuric acid, when added to Sparteine Sulphate, should not become colored (absence of *sugar* and *other readily carbonizable organic impurities*). On shaking 0.05 Gm. of Sparteine Sulphate, in a test-tube, with 5 Cc. of potassium hydroxide T.S., the liquid will at first be turbid, and small drops of Sparteine will gradually collect on the surface. If a strip of moistened red litmus paper be suspended in the mouth of the test-tube, and a gentle heat then applied, the test paper will gradually acquire a blue color, but no odor of ammonia should be perceptible (absence of *ammonium salts*)." *U. S.* G. Marque (*J. P. C.*, xxx. 555) states that if a small quantity of sparteine sulphate be mixed with about one-third of its weight of chromium trioxide, and gently heated in a porcelain dish, the mass will soon turn green and emit a strong odor resembling coniine. Moureu and Villier (*Bull. Soc. Chim.*, 1903 (6), 12, 545) confirm Stenhouse's formula for sparteine sulphate, $C_{15}H_{26}N_2.H_2SO_4 + 5H_2O$.

According to S. Solis-Cohen the reason that sparteine has proved so unsatisfactory practically, is because it is not used in a sufficient dose. He affirms that in serious cases from one-half to two grains (0.032 to 0.13 Gm.) should be given hypodermically every second hour for three or four doses, after which the drug should be given by the mouth in lessening dose until after two or three days one grain to one and one-half grains (0.065 to 0.096 Gm.) is taken daily by the mouth. The effect upon the pulse tension must be carefully watched and the dose modified according to circumstances.

For an account of the physiological and therapeutic action of this alkaloid, see *Scoparius*.

Dose, from one-sixth to one-half grain (0.01 to 0.032 Gm.).

SPIGELIA. U. S.

SPIGELIA [Pinkroot]

(spĭ-gē'lĭ-ȧ)

"The dried rhizome and roots of *Spigelia marilandica* Linné (Fam. *Loganiaceæ*)." *U. S.*

Maryland, Carolina or Indian Pink, Worm-grass or Worm-weed, Star-bloom; Spigélie du Maryland, *Fr.*; Marylandische Spigelie, Spigelie, *G.*; Spigelia, *It.*

Two species of Spigelia have attracted attention as anthelmintics,—*S. anthelmia* of South America and the West Indies, and *S. marilandica* of this country. *Spigelia Anthelmia*, L., of South America is an annual plant, from one to two feet in height, with thin, shortly petioled leaves, those of the lower stem being lanceolate, those above varying from very broadly lanceolate to ovate, with a distinct tendency to a rhomboidal outline and attaining a length of over four inches. It is much used as a powerful and certain anthelmintic in its native country, and its rhizome is said to have appeared in the European markets. The only specimens which we have seen, however, have been the whole dried plant, of which the attached rhizomes are much smaller and the rootlets much finer than in the North American species. It is affirmed that in overdoses this rhizome is a powerful poison, which has caused death not only in the domestic animal but also in man.

Spigelia marilandica, L., *Syst. Ed.* (1767) 734; Willd., *Sp. Plant.* i. 825; Bigelow, *Am. Med. Bot.*, i. 142; Barton, *Med. Bot.*, ii. 75; *B. & T.* 180.—The *Carolina pink* is an herbaceous perennial plant. The stems, several of which rise from the same rhizome, are simple, erect, four-sided, nearly smooth, and from twelve to twenty inches high. The leaves are opposite, sessile, ovate-lanceolate, acuminate, entire, and smooth, with the veins and margins slightly pubescent. Each stem terminates in a one-sided spike, and supports from four to twelve flowers with very short peduncles. The calyx is persistent, with five long, subulate, slightly serrate leaves, reflexed in the ripe fruit. The corolla is funnel-shaped, and much longer than the calyx, with the tube inflated in the middle, and the border divided into five acute, spreading segments. It is of a rich carmine color externally, paler at the base, and orange-yellow within. The edges of the segments are slightly tinged with green. The stamens, though apparently very short, and inserted into the upper part of the tube between the segments, may be traced down its internal sur-

face to the base. The anthers are oblong, heart-shaped; the ovary superior, ovate; the style about the length of the corolla, and terminating in a linear fringed stigma projecting considerably beyond it. The capsule is double, consisting of two cohering, globular, one-celled portions, with many seeds.

The plant is a native of our Southern and Southwestern States, being seldom found north of the Potomac. It grows in rich soils on the borders of woods, and flowers from May to July. The root is the only part recognized in the Pharmacopœias. The drug was formerly collected in Georgia and the neighboring States by the Creek and Cherokee Indians, who disposed of it to the white traders. The whole plant was gathered and dried, and came to us in bales or casks. After the emigration of the Indians, the supply of spigelia from this source very much diminished, and at one time it nearly if not quite ceased. The consequence was for a time a great scarcity, and an increase in the price of the drug; but a new source of supply was opened from the Western and Southwestern States, and it is now again plentiful. As we receive spigelia at present, it consists chiefly if not exclusively of the root, without the stems and leaves. We have been informed that most of it comes in casks or bales from St. Louis by the way of New Orleans. That contained in casks is to be preferred, as less liable to be damp and mouldy.

Properties.—Pinkroot consists of numerous slender, branching, crooked, wrinkled fibres, from three to six inches long, attached to a knotty head or caudex, which exhibits traces of the stems of former years. It is brownish or yellowish-brown externally, of a faint, peculiar odor, and a sweetish, slightly bitter, not very disagreeable taste. On microscopic examination the middle layer is seen to be very well developed and the nucleus sheath wanting. It is officially described as a "rhizome of oblique and sharply flexuous growth, somewhat branched, 1.5 to 5 Cm. long, 2 to 4 Mm. in diameter; externally dark purplish-brown or blackish, the upper surface knotty from approximate stem-bases bearing cup-shaped scars; the lower surface with numerous long, rather coarse, finely branched roots; fracture short, showing a yellowish wood and a dark pith; odor somewhat aromatic; taste bitter and pungent." *U. S.*

The virtues of spigelia are extracted by boiling water. The root, analyzed by Feneulle, yielded a fixed and volatile oil, a small quantity of resin, a bitter substance supposed to be the active principle, a mucilaginous saccharine matter, albumen, gallic acid, the malates of potassium and calcium, etc., and woody fibre. The principle upon which the virtues of the root are thought to depend is brown, of a bitter nauseous taste, like that of the purgative matter of the leguminous plants, and when taken internally produces vertigo and a kind of intoxication. An analysis of the root by R. H. Stabler yielded as results a bitter uncrystallizable principle upon which the virtues of the medicine are supposed to depend, a little volatile oil, tannic acid, inert extractive, wax, resin, lignin, and salts of sodium, potassium, and calcium.

Stabler found that the active principle is acrid and bitter, soluble in water and alcohol, insoluble in ether, not volatilizable without change, uncrystallizable, neutral, and deliquescent. W. L. Dudley (*Am. Chem.*, vol. i. p. 150), on the contrary, found that the active principle of spigelia is a volatile alkaloid. He made it by distilling the ground root with milk of lime over a paraffin bath, and collecting the distillate in hydrochloric acid. After evaporation to dryness, the residue is taken up with alcohol and crystallized out of solution. He compared the reactions of this alkaloid, which he called *spigeline*, with those of nicotine, coniine, and lobeline. Spigeline yields a brownish-red precipitate with a solution of iodine in potassium iodide, a white crystalline precipitate with potassio-mercuric iodide, and a white flocculent precipitate with meta-tungstic acid. Boorsma (*P. J.*, 1898, 89) found 0.0005 Gm. of *spigeline* to be lethal to guinea pigs.

The stalks of the dried plant are oval below the first pair of leaves, and then become obscurely four-sided. The leaves, when good, have a fresh greenish color, and an odor somewhat like that of tea. In taste they resemble the root, and they afforded to Feneulle nearly the same principles. The quantity, however, of the bitter substance was less, corresponding with their inferior efficacy. This circumstance should cause their rejection from commerce, as the inequality in power of the two portions of the plant would lead to uncertainty in the result, when they were both employed. It is frequently necessary to separate the spigelia from various adulterant roots. Among the most important of these may be mentioned the roots of certain small vines which frequently twine around the spigelia stem; these roots can be distinguished by their being long, slender, crooked, yellowish, thickly set with short capillary fibres, and much smaller and lighter-colored than is pinkroot; the large light-colored rhizomes of various species of Ruellia, distinguished by their readily separable bark and few coarse roots; the rhizomes of *Phlox ovata*, L., which are smooth, lacking the cup-shaped scars of spigelia, and have straighter, thicker, and less wiry rootlets. According to Henry G. Greenish, *Phlox root* can at once be separated microscopically from spigelia root by the presence in it of numerous stone-cells, and also of cells more or less completely filled by granular cystoliths. (*P. J.*, xxi.) The activity of spigelia is somewhat diminished by time.

Uses.—Spigelia is generally considered among the most powerful anthelmintics. In the ordinary dose it usually produces little sensible effect on the system; more largely given it acts as a cathartic, though unequal and uncertain in its operation; in overdoses it is said to cause vertigo, dimness of vision, dilated pupils,

spasms of the facial muscles and of the eyelids, and even general convulsions. The death of two children who expired in convulsions was attributed to it by Chalmers. H. A. Hare (*Med. News,* March, 1887) has found that in the lower animals it produces symptoms similar to those just described, namely, dilatation of the pupil, exophthalmia, strabismus, progressive muscular weakness of spinal origin, cardiac depression, and death from failure of respiration. The narcotic effects are said to be less likely to occur when the medicine purges, and to be altogether obviated by combining it with cathartics. The danger from its employment cannot be great, as it is in very general use in the United States, in both regular and domestic practice, and we never hear at present of serious consequences. Its effects upon the nervous system have been erroneously conjectured to depend on other roots sometimes mixed with the genuine. The vermifuge properties of spigelia, first learned from the Cherokee Indians, were made known to the medical profession by Lining, Garden, and Chalmers of South Carolina.

It may be given in substance or infusion. The practice of preceding its use by an emetic has been generally abandoned. It is frequently given in combination with calomel. The infusion, however, is a more common form of administration. It may be made by infusing half a troyounce of the root in a pint of boiling water. It is usually combined with senna or some other cathartic, to insure its action on the bowels. A preparation much sold under the name of *worm tea* consists of spigelia, senna, manna, and savin, mixed together, in various proportions, to suit the views of different individuals. Spigelia is also very often given in the form of fluidextract.

Dose, of the powdered root, for a child three or four years old, ten to twenty grains (0.65 to 1.3 Gm.), for an adult, one to two drachms (3.9 to 7.7 Gm.), to be repeated morning and evening for several days successively, and then followed by a brisk cathartic.

Off. Prep.—Fluidextractum Spigeliæ, *U. S.*

SPIRITUS.

SPIRITS

(spĭr'ĭ-tŭs)

Alcoolats, *Fr.;* Geiste, *G.;* Spirito, *It.*

Spirits, as the term is here used, are alcoholic solutions of volatile principles formerly in general procured by distillation, but now frequently prepared by simply dissolving the volatile principle in alcohol or diluted alcohol. The distilled spirits are prepared chiefly from aromatic vegetable substances, the essential oils of which rise with the vapor of alcohol and condense with it in the receiver. Some of the oils, however, will not rise at the temperature of boiling alcohol, but may be distilled with water. In this case it is necessary to employ diluted alcohol or proof spirit, with the water of which the oil comes over in the latter part of the process. As the proof spirit of commerce is often impregnated with foreign matters, which give it an unpleasant flavor, it is better to use alcohol which has been carefully rectified, and to dilute it with the due proportion of water, as directed by the U. S. Pharmacopœia. In preparing the spirits, care should be taken to avoid the color and empyreumatic flavor arising from the decomposition of the vegetable matter by heat. Sufficient water must, therefore, be added to cover the vegetable matter after the alcohol shall have been distilled, and, as a rule, the heat should be applied by means of a water bath, or of steam. The aromatic should be macerated for some days with the alcohol before being submitted to distillation, as the oil, being thus dissolved, rises more readily with the spirituous vapor than when confined in the tissue.

The aromatic spirits are used chiefly to impart a pleasant odor and taste to mixtures, and to correct the nauseating and griping effects of other medicines. They serve also as carminatives in *flatulent colic,* and as agreeable stimulants in *debility of the stomach.*

The U. S. P. (8th Rev.) did not retain the following spirits of the U. S. P. 1890: Spiritus Aurantii, Spiritus Limonis, Spiritus Myrciæ, Spiritus Myristicæ, and Spiritus Phosphori.

SPIRITUS ÆTHERIS. U. S., Br.

SPIRIT OF ETHER

(spĭr'ĭ-tŭs æ'thẹ-rĭs)

Liquor Anodynus Mineralis Hoffmanni; Ether officinal alcoolisé, *Fr. Cod.;* Ether sulfurique alcoolisé, Liqueur d'Hoffmann, *Fr.;* Spiritus Ætherеus, *P. G.;* Aetherweingeist, Hoffmannsche Tropfen, *G.;* Etere con alcool, Liquore anodino di Hoffmann, *It.;* Eter sulfurico alcoholizado, Licor anodino mineral de Hoffmann, *Sp.*

* "Ether, *three hundred and twenty-five cubic centimeters* [or 10 fluidounces, 475 minims]; Alcohol, *six hundred and seventy-five cubic centimeters* [or 22 fluidounces, 396 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

"Ether, 10 *fl. ounces* (Imperial measure) or 500 cubic centimetres; Alcohol (90 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Mix." *Br.*

This preparation is merely ether diluted with about twice its volume of alcohol. Although introduced into the U. S. P. 1880, it does not seem to have been employed to any extent, and it might have been dropped with advantage at a later revision. The corresponding preparation of the German Pharmacopœia contains less ether, being made of one part of ether to three parts of alcohol, both by weight. Prepared with materials of proper strength, its sp. gr. is 0.806 to 0.811. *Br.* Its medicinal properties are similar to those of ether.

Dose, one to three fluidrachms (3.75 to 11.25 Cc.), properly diluted with sweetened water.

Off. Prep.—Tinctura Lobeliæ Ætherea, *Br.*

SPIRITUS ÆTHERIS COMPOSITUS. U. S., Br.

COMPOUND SPIRIT OF ETHER

(spīr'ĭ-tŭs æ'thẹ-rīs cọm-pŏs'ĭ-tŭs)

Hoffmann's Anodyne; Liqueur Nervine de Bang, *Fr.*; Zusammengesetzter Aetherweingeist, *G.*

* "Ether, *three hundred and twenty-five cubic centimeters* [or 10 fluidounces, 475 minims]; Alcohol, *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims]; Ethereal Oil, *twenty-five cubic centimeters* [or 406 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

"Ether, 5½ *fl. ounces* (Imperial measure) or 137.5 cubic centimetres; Alcohol (90 per cent.), 78 *fl. ounces* (Imp. meas.) or 1950 cubic centimetres; Sulphuric Acid, 36 *fl. ounces* (Imp. meas.) or 900 cubic centimetres; Distilled Water, 1½ *fl. ounces* (Imp. meas.) or 37.5 cubic centimetres; Sodium Bicarbonate, *a sufficient quantity*. Gradually mix the Sulphuric Acid with *forty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Alcohol; let the mixture stand for twenty-four hours. Then distil slowly until a thermometer, the bulb of which is within the liquid, indicates a temperature of 341° F. (171.6° C.). Pour the distillate into a separator, and, after separation is complete, remove the lower layer. Add the Distilled Water to the upper layer, and also, gradually, Sodium Bicarbonate, until, after agitation, the liquid is nearly neutral to *litmus paper*. Separate the ethereal liquid, and add to it the Ether and *thirty-eight fluid ounces* (Imp. meas.) or nine hundred and fifty cubic centimetres of the Alcohol. Filter." *Br.*

This preparation is an alcoholic solution of ether, containing a little heavy oil of wine. In the U. S. formula, determinate quantities of ether, alcohol, and oil are taken, the ether having half the volume of the alcohol. The formula of the U. S. P. (8th Rev.) is practically the same as that of the U. S. P. 1880. In the last revision of the British Pharmacopœia this preparation was improved according to the suggestions of W. Inglis Clark (*P. J.*, 1896, 183); but the process still yields an uncertain product, containing ether, alcohol, and a trace of oil of wine.

Properties.—This spirit is a colorless, volatile liquid, having a burning, slightly sweetish taste, and the peculiar odor of ethereal oil. If it have an empyreumatic odor, it has been badly prepared. Its sp. gr. is 0.815, according to the U. S. Pharmacopœia of 1870; the present official preparation contains a little less oil of wine. When pure, it is wholly volatilized by heat, and devoid of acid reaction. It becomes milky on being mixed with water, owing to the precipitation of the ethereal oil; but this change does not prove its goodness, as the same property may be given to the spirit of ether by the addition of various fixed oils. This sophistication may be detected by mixing the suspected preparation with water, drawing a piece of paper over the surface of the liquid to absorb the oily globules, and exposing the paper to heat. If the globules are fixed oil, the greasy stain will remain; if ethereal oil, the stain will disappear. When fixed oils are used to adulterate this preparation, the milkiness is generally too great, and not like the translucent leaden milkiness of the genuine article. (Squibb.) "A colorless mobile liquid with characteristic ethereal odor and taste. Specific gravity 0.808 to 0.812. It gives an opalescent solution when mixed with twice its volume of *water*. 2 or 3 cubic centimetres evaporated spontaneously on a watch-glass should not yield a residue having an unpleasant odor (absence of empyreumatic impurities)." *Br.*

It is much to be regretted that our manufacturing chemists do not follow the Pharmacopœia in making compound spirit of ether. In rectifying crude ether, the distillation is continued as long as the ether comes over of the proper specific gravity, after which the manufacturer has been in the habit of changing the receiver and obtaining an additional distillate, consisting of ether and alcohol, mixed with a small quantity of ethereal oil. Now, it is this second distillate, variously modified by the addition of alcohol, ether, or water, so as to make it conform in taste, odor, opalescence, etc., to a standard preparation, kept by the manufacturer, that is sold as Hoffmann's anodyne. Nothing could be more uncertain in its results than a proceeding like this, and we cannot be surprised that the medicine as obtained from different apothecaries varies very much in properties, and often disappoints the expectations of the physician. The chief excuse for the departure from the official directions is the costliness of the ethereal oil; but, even were this much greater than it really is, the excuse would not be valid, and it cannot be justified, on any principle of morality, to sell under the official title a preparation which has no claim to it whatever.

Uses.—This preparation is intended as a substitute for the anodyne liquor of Hoffmann, which it closely resembles when properly prepared. In addition to the stimulating and antispasmodic qualities of ether which it contains, it possesses anodyne properties, highly useful in *nervous irritation* and in want of sleep from this cause. These additional virtues are probably derived from the official oil of wine, which Physick and Dewees found, dissolved in alcohol, very efficacious in certain disturbed states of the system, as a tranquillizing and anodyne remedy. Such indeed, are the generally admitted effects of compound spirit of ether, when made with a due admixture of the ethereal oil. This preparation is on many occasions a useful adjunct to laudanum, to prevent *nausea*.

Dose, from thirty minims to two fluidrachms (1.8 to 7.5 Cc.), to be given in sweetened water.

SPIRITUS ÆTHERIS NITROSI. U. S., Br.

SPIRIT OF NITROUS ETHER [Sweet Spirit of Nitre]

(spīr'ị-tŭs æ'thẹ-rĭs nī-trō'sī)

"An alcoholic solution of Ethyl Nitrite [NO. $OC_2H_5 = 74.51$], yielding, when freshly prepared and tested by the process given below, not less than 4 percent. of ethyl nitrite." *U. S.* "An alcoholic solution containing ethyl nitrite, aldehyde, and other substances." *Br.*

Spiritus Nitri Dulcis; Spiritus Ætheris Nitrici; Spiritus Nitrico-æthereus; Ether Azoteux Alcoolisé, Liqueur anodine nitreuse, *Fr.;* Spiritus Ætheris nitrosi, *P. G.;* Versüsster Salpetergeist, *G.;* Etere nitroso officinale, Spirito d'etere nitroso, *It.;* Espiritu de nitro dulce, *Sp.*

* "Sodium Nitrite, *one hundred grammes* [or 3 ounces av., 231 grains]; Sulphuric Acid, *forty cubic centimeters* [or 1 fluidounce, 169 minims]; Monohydrated Sodium Carbonate, *six-tenths of a gramme* [or 9 grains]; Potassium Carbonate, completely deprived of water by drying, *three grammes* [or 46 grains]; Alcohol, Water, each, *a sufficient quantity.* Mix the Sulphuric Acid with *one hundred and twenty cubic centimeters* [or 4 fluidounces, 28 minims] of Water, cool the liquid, add *eighty-five cubic centimeters* [or 2 fluidounces, 420 minims] of Alcohol previously diluted with an equal volume of Water, and introduce the solution into a 1000 Cc. [or 2 pint] flask, surrounded by a mixture of ice and water. Dissolve the Sodium Nitrite in *two hundred and eighty cubic centimeters* [or 9 fluidounces, 225 minims] of Water, filter, and, having poured the filtrate into a separatory funnel, allow the liquid to slowly drop into the flask containing the acid mixture. When all has been added and the reaction is complete, allow any crystals which may have formed to settle at the bottom of the flask, and decant the cold mixture of ethyl nitrite and aqueous solution quickly to the previously cleaned separatory funnel, and draw off and discard the aqueous liquid. Wash the separated ethyl nitrite, first, with *twenty cubic centimeters* [or 325 minims] of ice-cold Water, and then remove any traces of acid by washing it with *fifteen cubic centimeters* [or 243 minims] of ice-cold Water, in which the Monohydrated Sodium Carbonate has previously been dissolved. Carefully separate the ethyl nitrite from the aqueous liquid, and agitate it in a well-stoppered vial with the Potassium Carbonate to remove traces of water. Then cool the liquid, decant, and pour the ethyl nitrite immediately into a tared bottle containing *five hundred grammes* [or 17 ounces av., 279 grains] of Alcohol. Ascertain the weight of the ethyl nitrite poured into the Alcohol by noting the increase in weight of the tared bottle and contents, and then add enough Alcohol to make the mixture weigh *twenty-two times* the weight of the ethyl nitrite added. Lastly, transfer the product to small, well-stoppered, dark amber-colored vials, and keep these in a cool place, remote from lights or fire." *U. S.*

"Nitric Acid, 3 *fl. ounces* (Imperial measure) or 150 cubic centimetres; Sulphuric Acid, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Copper, 2 *ounces* (Imp.) or 100 grammes; Alcohol (90 per cent.), *a sufficient quantity.* To *one pint* (Imp. meas.) or one thousand cubic centimetres of the Alcohol add gradually the Sulphuric Acid, stirring them together; then stir in *two and a half fluid ounces* (Imp. meas.) or one hundred and twenty-five cubic centimetres of the Nitric Acid; the mixture being made in a retort or flask, in which the copper has been placed, and to which a thermometer is fitted; attach to the retort or flask an efficient condenser and receiver, the latter containing *twenty fluid ounces* (Imp. meas.) or one thousand cubic centimetres of the Alcohol, and, applying heat gently, distil at a temperature commencing at 170° F. (76.7° C.), and rising to 175° F. (79.4° C.), but not exceeding 180° F. (82.2° C.), until the volume of liquid in the receiver has been increased to *thirty-two fluid ounces* (Imp. meas.) or to sixteen hundred cubic centimetres, the receiver and the condenser being kept cool with ice-cold water. Then withdraw the source of heat, and having allowed the contents of the retort to cool, introduce the remaining *half-ounce* (Imp. meas.) or twenty-five cubic centimetres of Nitric Acid, and resume the distillation as before, until the liquid in the receiver has been increased to *thirty-four fluid ounces* (Imp. meas.) or seventeen hundred cubic centimetres. Mix this liquid with *one pint* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, or with as much as will make the product contain 2½ per cent. of ethyl nitrite when tested as described in the following paragraph. Preserve the Spirit of Nitrous Ether in well-closed vessels; preferably in a cool dark place, and in small bottles." *Br.*

Test.—"1 volume agitated briskly at intervals during 5 minutes in a brine-charged nitrometer, with 1 volume of *solution of potassium iodide* and 1 volume of *diluted sulphuric acid,* should yield, at the normal temperature (60° F. or 15.5° C.) and pressure (30 inches or 760 millimetres of mercury), and when freshly prepared, at least 6¼, but not more than 7, volumes of nitric oxide gas, corresponding to at least 2½ parts by weight of ethyl nitrite in 100 parts by weight of the Spirit; and even after it has been kept for some time, and the vessel containing it has occasionally been opened, it should yield not much less than 5 times its volume of the gas, corresponding to nearly 2 per cent. by weight of ethyl nitrite or a minimum of 1¾ per cent." *Br.* The U. S. P. (8th Rev.) and the Br. Ph. 1898 quantitative test is based on Allen's method, differing only in the relative quantities of the reagents. (See p. 1166; also paper by Curtman, *Proc. Missouri Pharm. Assoc.,* July, 1892; *A. J. P.,* 1898, 273.)

Assay. U. S. (8th Rev.)—"Transfer about 30 Gm. of the Spirit of Nitrous Ether, which has been previously shaken with 0.5 Gm. of potassium bicarbonate, to a tared 100 Cc. measuring flask, and weigh it accurately. Add sufficient alcohol to bring the volume to exactly 100 Cc., and mix thoroughly. Introduce into a nitrometer (see Part III, Gasometric Estimations) exactly 10 Cc. of the alcoholic solution, followed by 10 Cc. of potassium iodide T.S., and afterwards by 10 Cc. of normal sulphuric acid V.S. When the volume of gas has become constant (within 30 to 60 minutes), note the volume of gas collected. Multiply this volume in Cc. by 0.307, and divide the product by the original weight of the Spirit of Nitrous Ether. At standard temperature and pressure, the quotient will represent the percentage of ethyl nitrite in the liquid. The temperature correction is one-third of one percent. of the total percentage just found for each degree, additive if temperature is below, subtractive if above, 25° C. (77° F.). The barometric correction is four-thirtieths of one percent. for each millimeter, additive if above, subtractive if below, 760. When assayed according to the above method, Spirit of Nitrous Ether should yield not less than 4 percent. of ethyl nitrite." *U. S.*

Allen's Test for Ethyl Nitrite.—A nitrometer[1] should be filled with strong brine, and 5 Cc. of the sample to be tested should be placed in the cup of the nitrometer, and allowed to enter through the tap, taking care that no air gets in at the same time. Five Cc. of a strong solution of potassium iodide is next allowed to enter, and this is followed by about 5 Cc. of dilute sulphuric acid. Effervescence immediately ensues, and, if the tube be vigorously agitated at intervals, the reaction will be complete in five minutes, when the level of the liquid in the two limbs of the nitrometer is adjusted, and the volume of nitrogen dioxide gas read off. If the volume of gas evolved be small, another 5 Cc. of the sample should be let into the nitrometer, and the agitation repeated. The calculation is the same as in Eykman's process, the reaction being:

$$(C_2H_5)NO_2 + KI + H_2SO_4 = (C_2H_5)OH + KHSO_4 + I + NO$$

When strictly accurate results are not required, the volume of gas need not be corrected for variations of pressure, temperature, and tension of aqueous vapor, and if these considerations be omitted the calculation will be much simplified. Thus, if 0.030 gramme of nitrogen dioxide (representing 0.075 gramme of $C_2H_5NO_2$) under the *ordinary* conditions of pressure and temperature be taken to measure 23.55 Cc., then

$$\frac{\text{volume of gas in Cc.} \times 0.3185}{\text{measure of sample in Cc.} \times \text{density of sample}} = \text{percentage by weight of } C_2H_5NO_2.$$

If the density of the sample be omitted from the equation, the result will be the number of grammes of ethyl nitrite per 100 Cc. of the sample.

The nitrometer method has been proved to give very good results with pure sodium nitrite (prepared from silver nitrite) employed in known amount. The results with spirit of nitrous ether are somewhat higher than those given by Eykman's method, the difference being least when sodium chloride is employed in the latter process and time is given for the ferrous solution to react thoroughly on the solution of ethyl nitrite. The results by the iodide method are almost certainly more accurate than those by Eykman's process. With most specimens of sweet spirit of nitre a considerable amount of nitric oxide is produced (and iodine liberated) before adding the acid, the reaction probably depending on the presence of free acid in the sample. The results obtained in the nitrometer are remarkably constant, and the method furnishes a very easy means of assaying sweet spirit of nitre with considerable accuracy, which is further increased if a correction of 1.5 Cc. (= 0.0048 gramme of $C_2H_5NO_2$) be made for solubility of the gas. The process has the advantage of great ease and rapidity, and actually measures the nitrous compounds present in the sample, instead of leaving their proportions to be inferred from a more or less complex reaction, such as the reduction of permanganate, and others.

The official spirit of nitrous ether is a mixture of nitrous ether or ethyl nitrite, $C_2H_5NO_2$, and alcohol (rectified spirit). For many years, spirit of nitrous ether has been made by acting on alcohol with nitric acid, and the present British process and that of the U. S. P. 1880 are constructed on this plan. The U. S. P. 1890 and 8th Rev. processes differed essentially; in these, the use of nitric acid is abandoned, sodium nitrite being substituted as the source of the nitrous compound. Nitrous ether is always generated by the reaction of nitric acid with alcohol; and it matters not whether the alcohol be mixed with nitric acid directly, or with the materials for generating it, namely, nitre and sulphuric acid. In the U. S. Pharmacopœia of 1850 the requisite nitric acid was obtained by using the materials for generating it, namely, potassium nitrate and sulphuric acid; for details of the process, see U. S. D., 14th ed., p. 1445.

In the U. S. 1860 process, which was modelled after the plan of Squibb, the nitric acid and alcohol were directly mixed in a retort. The liquid condensed in the receiver was mixed with potassium carbonate, and again distilled, in order to free it from the acid which had come over with the nitrous ether, and, being too strong with ether to meet the purposes required, was diluted with alcohol, and thus brought to the state of *spirit* of nitrous ether. It was a great improvement over the formula of earlier Pharmacopœias,

[1] For a simple form of nitrometer, see *P. J.*, 1887, p. 763, or *Proc. A. Ph. A.*, 1887, p. 19; also *Ephem.*, 1889, p. 1202; *C. & D.*, 1901, 1045.

and had the merit of insuring a preparation of definite strength. But in the Pharmacopœia of 1870 the British process was substituted, as even better than it.

The U. S. 1880 process differed in several particulars from those formerly official. Copper was no longer used. The use of this metal originated with Redwood, under the impression that the nitrous radical was liberated by it and enabled to unite more readily with the ethyl of the alcohol, to form ethyl nitrite. Our experience is that upon the small scale the copper served a useful purpose in controlling and moderating the reaction, but excellent results have been obtained by substituting broken glass, and we have obtained quite as large a yield of the peculiar ether when the copper was omitted. The nitric acid was not added in two portions, but the whole quantity was mixed with the sulphuric acid and alcohol at first. This was an improvement, in our opinion. The direction to "heat rapidly, by means of a water-bath, until strong reaction occurs and the temperature reaches 80° C. (176° F.)," was likely to cause loss in the hands of the inexperienced through excessive action, and inability to condense all the vapor of ethyl nitrite which would be suddenly generated. A temperature of 72° C. (161.6° F.), in our experience, was simply sufficient to start the reaction, and as soon as effervescence took place the heat should have been *at once removed,* and not reapplied until the reaction slackened, so that a uniform and not an excessive reaction might be maintained. The greatest change was, however, in purifying the distillate by agitating it with ice cold distilled water, separating the ethereal layer and mixing it with alcohol, so that the finished product should contain 5 per cent. by weight of the crude ethyl nitrite. It is very doubtful, in our opinion, whether anything was removed by the agitation with cold water except some of the alcohol. As aldehyde and hydrocyanic acid are both soluble in ethyl nitrite, and as alcohol must be added subsequently, the advantage of the separation of the nitrous ether in this way was not very apparent, and when it is considered that ethyl nitrite is soluble in water and more soluble in alcohol, some of the most valuable portion of the distillate must have been wasted by being dissolved in cold water. A thoroughly effective method of separating ethyl nitrite from its solution in alcohol and water is yet to be discovered. Some manufacturers agitate the distillate with a saturated solution of calcium chloride to separate the ethyl nitrite, and the British Pharmacopœia once used this method as a test.[1]

The U. S. P. 1890 process overcame these objections by generating the nitrous compound necessary to effect the combination with ethyl by acting on sodium nitrite with sulphuric acid in the presence of alcohol, the violence of the reaction being controlled by diluting both the sulphuric acid and the alcohol with water, and by using an aqueous solution of the nitrite. A very thorough means of refrigeration had to be used, on account of the extreme volatility of the distillate, and because evolution of ethyl nitrite commenced before all the sulphuric acid was added and without the use of any other heat than that generated by the chemical reaction. Heat was not applied until the reaction became slower, and then only very moderately and capable of being instantly withdrawn if necessary. The advantages of this process are that the production of aldehyde and acetic ether is avoided, through the absence of nitric acid, and pure ethyl nitrite is easily obtained. Sodium nitrite can be procured of standard purity, although the impurities in the commercial salt do not affect the character of the ethyl nitrite. The use of alkaline nitrites in making ethyl nitrite is not new, as both potassium and sodium nitrites have been employed, Feldhaus, Dunstan, Dymond,[2] and others having published processes; Frerichs of St. Louis, used the method on a large scale, and C. O. Curtman and E. L. Patch of Boston, also recommended its employment. See *Am. Drug.,* 1893, p. 171. An improvement was made in the U. S. P. (8th Rev.) process and in the cold processes pre-

[1] R. F. Fairthorne prepared Spirit of Nitrous Ether without the use of a retort or still. (*A. J. P.,* 1880, p. 7; see also method by Emlen Painter, *Proc. A. Ph. A.,* 1884–1886.)

[2] *Ethyl Nitrite. Expeditious Method of Preparing the Pure Ether.*—Dunstan and T. S. Dymond find the following method to be admirably adapted to the production of pure nitrous ether in the nearly theoretical quantity without the use of heat, the ether, in the absence of excess of acid, being easily separated without distillation. A solution is made by dissolving 34.5 grammes of sodium nitrite in water. The liquid is diluted to 120 Cc. and cooled below 0° C. by surrounding the vessel which contains it with a mixture of ice and salt. The sodium nitrite of commerce contains from 95 to 98 per cent. of nitrite, and therefore a quantity corresponding to the pure salt must be taken. A slight excess of the salt does not interfere with the reaction. 13.5 Cc. of sulphuric acid is added to a cooled mixture of 32 Cc. of alcohol, with an equal volume of water; the liquid is then diluted to 120 Cc. and cooled below 0° C. This acid liquid is allowed to pass gradually through a thistle funnel with constant stirring to the bottom of the solution of sodium nitrite, contained in a long narrow glass vessel surrounded by ice and salt. The addition of the whole of the acid liquid occupies only a few minutes, and at its conclusion a pale-yellow layer of ethyl nitrite is found to be completely separated from the lower layer of solution of sodium sulphate, which is semi-solid from the separation of crystals of the salt. The ethyl nitrite so formed contains only traces of alcohol and water, the first being removed by agitation with cold water, the second by digestion with recently ignited anhydrous potassium carbonate. The yield is from 30 to 35 grammes; the calculated yield is 37.5. It cannot be preserved under ordinary conditions without decomposition, but if kept in contact with fragments of anhydrous potassium carbonate in a closely stoppered bottle it may be kept for a long time without change. It boils at 17.5° C., and possesses at 0° C. the sp. gr. 0.917–0.920 (water at 0° C. = 1). Analysis proves it to be nearly absolutely pure ethyl nitrite. The authors recommend for medicinal use a 2-per-cent. *solution of ethyl nitrite* in absolute alcohol. Its stability might be increased by the addition of 5 per cent. of glycerin; but even this is prone to change, though not so much as the solution in absolute alcohol simply, while the solution in rectified spirit changes to a still greater extent. The solution intended to be administered should not be diluted with water until just before it is to be taken. (*P. J.,* 1888, 861–863.)

viously proposed by reversing the order of mixing the liquids in the flask; in the former pharmacopœial process the acid solution was dropped slowly into the sodium nitrite solution and alcohol; this caused some loss of ethyl nitrite with evolution of nitrogen tetroxide, on the other hand in the present official cold process if carefully conducted with sufficient refrigeration, the production of ethyl nitrite takes place uniformly and slowly with very little loss. The great advantage, however, in this process consists in the avoidance of distillation and use of heat in preparing a very volatile product.

The present British formula rejects the sodium nitrite process, but introduces under *Liquor Ethyl Nitritis* (see p. 711) a solution made by decomposing sodium nitrite in the presence of alcohol, and diluting the ethyl nitrite produced, with alcohol containing a little glycerin. It is unfortunate that both preparations were not made of the same strength, the solution containing 3 per cent., the spirit only 2 per cent., of ethyl nitrite; the solution contains no aldehyde, but the spirit is permitted to contain aldehyde and other substances.

Theory of the Production of Nitrous Ether, etc.—The reaction in the U. S. P. (8th Rev.) process may be expressed as follows:

$$2C_2H_5OH + 2NaNO_2 + H_2SO_4 = 2C_2H_5NO_2 + Na_2SO_4 + 2H_2O$$

Alcohol, sodium nitrite, and sulphuric acid when brought in contact yield ethyl nitrite, sodium sulphate, and water. The nitric acid process may be explained as follows. One molecule of nitric acid, by reacting with one molecule of alcohol, forms one molecule of nitrous acid, one molecule of *aldehyde*, and one molecule of water: thus,

$$HNO_3 + C_2H_6O = HNO_2 + C_2H_4O + H_2O$$

The nitrous acid, as soon as formed, reacts with a second molecule of alcohol, so as to form one molecule of nitrous ether or ethyl nitrite, with separation of one molecule of water, according to the reaction:

$$C_2H_5.OH + HNO_2 = C_2H_5NO_2 + H_2O$$

In the process of the British Pharmacopœia the nitric acid is converted into nitrous acid by the reducing action of metallic copper and sulphuric acid, the reaction being:

$$HNO_3 + Cu + H_2SO_4 = HNO_2 + CuSO_4 + H_2O$$

The nitrous acid now reacts with the alcohol as in the previous reaction, so as to produce the nitrous ether. The object of using the sulphuric acid is to economize the nitric acid.

Properties of Ethyl Nitrite.—*Pure* ethyl nitrite is pale yellow, has the odor of apples and Hungary wine, boils at 18° C. (64.4° F.), and has the sp. gr. 0.900 at 15.5° C. The density of its vapor is 2.627. Litmus is not affected by it. When it is mixed with an alcoholic solution of potassium hydroxide, potassium hyponitrite and alcohol are formed, without producing a brown color, showing the absence of aldehyde. It is soluble in 48 parts of water, and in all proportions in alcohol or rectified spirit. It is highly inflammable, and burns with a white flame without residue. The impure ether, as formerly obtained by the Edinburgh and Dublin processes for subsequent dilution to form sweet spirit of nitre, boiled at 21.1° C. (70° F.), and had the density of 0.886 at 4.4° C. (40° F.). The specific gravity assigned to it by the Edinburgh College was 0.899. Mixed with an alcoholic solution of potassium hydroxide, it became dark brown, with production of *aldehyde resin*. This discoloration showed the presence of aldehyde. When kept, it became acid in a short time, as shown by litmus, and nitric oxide was given off, which often caused the bursting of the bottle. Its tendency to become acid was rendered greater by the action of the air, and depended on the absorption of oxygen by the aldehyde, which thereby became acetic acid. Harvey of Leeds, has suggested the use of pure crystals of potassium bicarbonate in a bottle in order to prevent the development of an acid reaction. J. C. Rademacher has found that the crystals after a time are partially converted into a nitrate. (*A. J. P.*, xlii. 106.) These facts evince the propriety of preserving this ether in small, strong bottles, kept full and in a cool place. Nitrous ether is formed by the combination of nitrous acid with the radical ethyl, and its formula is $C_2H_5.NO_2$. It was, therefore, improperly called *nitric ether*. Considered as a salt, its proper name is *ethyl nitrite*. In its pure and concentrated state it is never used in medicine. (See *Liquor Ethyl Nitritis*, p. 711.)

Properties of Spirit of Nitrous Ether.—This is "a clear, mobile, volatile, and inflammable liquid of a pale yellowish or faintly greenish-yellow tint, having a fragrant, ethereal, and pungent odor free from acridity, and a sharp, burning taste. Specific gravity: about 0.823 at 25° C. (77° F.). When freshly prepared, or even after being kept for some time with but little exposure to light and air, it is neutral to litmus paper. When long kept, or after having been freely exposed to air and light, it acquires an acid reaction, but it should not effervesce when a crystal of potassium bicarbonate is dropped into it." *U. S.* "A limpid liquid, having a very faint yellowish tinge, inflammable, of a peculiar penetrating apple-like odor, and a characteristic taste. When Spirit of Nitrous Ether is carefully poured on an acidulated strong solution of *ferrous sulphate* contained in a test-tube, a deep olive-brown coloration is produced at the surface of contact of the two liquids, widening as the tube is gently shaken. 10 cubic centimetres, mixed with 5 cubic centimetres of the *volumetric solution of sodium hydroxide* and 5 cubic centimetres of *water*, should assume a yellow color, which should not become brown on standing 12 hours (limit of aldehyde). It should not effervesce, or only very feebly, when shaken with *sodium bicarbonate* (limit of acid)." *Br.* It keeps well in

half-pint bottles, securely stopped with waxed glass stoppers, and covered with dark paper, as Squibb proved by examining some bottles thus put up, after the lapse of two years. When exposed it is apt to become acid with age. Sweet spirit of nitre mixes with water and alcohol in all proportions. It is very inflammable, and burns with a whitish flame. The sp. gr. of the British official spirit of nitrous ether is 0.838 to 0.842 at 15° C. (59° F.).

Impurities and Tests.—Spirit of nitrous ether, when made by the nitric acid process, is never quite free from aldehyde, and, if the distillation be too long continued, it is prone to contain a good deal of this substance, which afterwards becomes acetic acid by absorbing oxygen. The change goes on rapidly if the preparation be insecurely kept. Aldehyde, if in considerable proportion, may be detected by its imparting a pungent odor and an acrid flavor, and by the spirit assuming a brown tint on adding a weak solution of potassium hydroxide, owing to the formation of aldehyde resin (see official test, page 1169). Another test for aldehyde, though less reliable, is the addition of an equal volume of sulphuric acid to the sweet spirit of nitre. If the sample be good, the change of color will be slight, and the mixture will be considerably viscid; if it contain much aldehyde, it will become dark-colored. If water or spirit be present in undue proportion, the viscidity will be less. (Phillips.) Acetic acid, as well as other acids (usually nitrogen acids) that may happen to be present, may be discovered by the taste, by their acting on litmus strongly, and by their decomposing the alkaline carbonates or bicarbonates with effervescence. Nitrogen acids are known by their coloring blue a piece of paper previously dipped into tincture of guaiac. These acids operate injuriously by their chemical reactions with other substances, when spirit of nitre is prescribed in mixtures. Thus, they liberate iodine from potassium iodide, gradually decolorize compound infusion of rose, and in the compound mixture of iron hasten the conversion of ferrous oxide into ferric oxide. To obviate these effects, Harvey of Leeds, keeps sweet spirit of nitre standing on crystals of potassium bicarbonate, and states that, if the preparation be of full strength, no appreciable portion of the alkali will be dissolved. (*P. J.*, Jan. 1842.) When acid sweet spirit of nitre is rectified from calcined magnesia, it becomes acid again in a short time, but, according to Klauer, when rectified from neutral potassium tartrate it continues unchanged for months. A deep olive color with ferrous sulphate shows the presence of a nitrogen oxide or acid.

According to Bastick, sweet spirit of nitre contains about one-fifth of one per cent. of anhydrous hydrocyanic acid, when made from nitrous ether formed by acting upon alcohol with nitrous acid evolved by the action of starch on nitric acid, according to the process of Liebig. In making sweet spirit of nitre on a large scale, Squibb found that hydrocyanic acid vapors were produced if the heat happened to rise too high, and the ether ceased to be formed. Schoor and G. B. Schmidt found that, after a careful distillation, hydrocyanic acid could be detected in the residue left in the retort to the amount of 0.977 per cent., while the distillate contained but an insignificant trace. (*Ph. Ztg.*, No. 37; *N. R.*, Sept. 1880.)

Alcohol and water are often fraudulently added to sweet spirit of nitre. These additions are difficult to detect. The official tests are as follows: "If a test-tube be half filled with the Spirit, and put into a water-bath heated to 65° C. (149° F.) until it has acquired this temperature, the Spirit should boil distinctly upon the addition of a few small pieces of broken glass. If 10 Cc. of the Spirit be mixed with 5 Cc. of potassium hydroxide T.S., previously diluted with 5 Cc. of water, the mixture will assume a yellow color which should not turn decidedly brown within twelve hours (limit of *aldehyde*)." *U. S.* When in undue proportion, alcohol and water may be detected in the British preparation, in a rough way, by agitating it with twice its volume of a saturated solution of calcium chloride. Specific gravity is no criterion of the quality of the preparation as obtained by any formula. The addition of water will raise its density, and the same effect will be produced by adding ethyl nitrite. A high density, in connection with deficient ethereal qualities, would of course indicate free acids, or an excess of water, or both. A specific gravity lower than the U. S. and Br. standard would show the presence of alcohol either stronger than it should be or in too large a proportion. The fraudulent dilution of sweet spirit of nitre with alcohol and water is a great evil, considering its extensive use and its valuable remedial properties. Water is injurious not merely as a diluent but also as the most efficient promoter of chemical changes. In commerce this valuable medicine is usually found variously diluted with twice, thrice, and even *four* times its weight of alcohol and water. In this way its ether strength is greatly reduced. Squibb examined six samples of sweet spirit of nitre, five of which were obtained from reliable wholesale druggists; of these one sample contained 3.16 per cent. of nitrous ether, four between one and two per cent., and one under one per cent., while a standard preparation, made according to the U. S. Pharmacopœia, contained at least 4.3 per cent. The addition of glycerin to spirit of nitrous ether has been highly recommended as a preservative.

Uses.—Spirit of nitrous ether is diaphoretic, diuretic, and antispasmodic. It is deservedly much esteemed as a medicine, and is extensively employed in febrile affections, either alone or in conjunction with tartar emetic, for the purpose of promoting the secretions, especially those of sweat and urine. It is especially selected in cases in which the tendency is asthenic.

On account of its action upon the kidneys, it is often conjoined with other diuretics, such as squill, digitalis, potassium acetate, nitre, etc., for the purpose of promoting their action in dropsical complaints.

The inhalation of sweet spirit of nitre produces acceleration of the pulse, with a peculiar leaden purple color of the lips, mouth, and finger-tips, followed by flushing of the face, extreme giddiness, nausea, muscular debility, and violent headache, excessively rapid irregular pulse, and dyspnœa. These symptoms undoubtedly depend in great part upon the presence of the ethyl nitrite, which action is without doubt like that of the other nitrites, being simply somewhat less prompt and fugacious than that of amyl nitrite, because the ethyl compound is less volatile, and therefore less rapidly absorbed and eliminated.

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Mistura Glycyrrhizæ Composita, *U. S.*

SPIRITUS AMMONIÆ. U. S.

SPIRIT OF AMMONIA

(spīr'ĭ-tŭs ăm-mō'nī-æ)

"An alcoholic solution of Ammonia [NH_3 = 16.93] containing ten percent., by weight, of the gas. This solution deteriorates on keeping, and should be tested frequently. It must not be dispensed for medicinal purposes if it contains less than 10 percent. of gaseous Ammonia." *U. S.*

Liquor Ammonii Caustici Spirituosus; Spiritus Ammoniaci Caustici Dzondii; Ammoniated Alcohol; Alcoolé d'Ammoniaque, Liqueur d'Ammoniaque vineuse, *Fr.*; Weingeistige Ammoniakflüssigkeit, Weingeistiges Ammoniak, *G.*

* "Stronger Ammonia Water, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Alcohol, recently distilled, and, after distillation, kept in glass vessels, *a sufficient quantity.* Pour the Stronger Ammonia Water into a flask provided with a safety funnel and connected, by means of a glass condenser, with a well-cooled receiver containing *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, the delivery tube of the condenser reaching nearly to the bottom of the receiver. Heat the flask carefully, and very gradually, to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature until Ammonia ceases to be evolved. Then disconnect the receiver, and, having ascertained the strength of a portion of the contents by the method of assay given below, add enough Alcohol to make the product contain *ten percent.*, by weight, of Ammonia gas. Keep the Spirit in glass-stoppered bottles, in a cool place." *U. S.*

Spirit of ammonia is now official in the U. S. Pharmacopœia only, the British Pharmacopœia not having adopted it. It is a solution of caustic ammonia in alcohol. As prepared by the U. S. process of 1850, the ammoniacal gas was received in the alcohol and condensed by it; and the proportions of the ingredients were so adjusted as to give a preparation containing between 10 and 11 per cent. of ammonia, and capable of saturating about 30 per cent. of official sulphuric acid. Accordingly it agreed in ammoniacal strength, as it was intended it should do, with the U. S. Liquor Ammoniæ. Its sp. gr. was 0.831, or thereabouts. But in the official process of 1870 the materials for the generation of ammonia were mixed with a large proportion of water, the vapor of which came over to some extent with the gas and was condensed along with it. The resulting spirit was, therefore, somewhat diluted with water, and to an indefinite extent, so that the preparation had no precise sp. gr.; and, though the whole amount obtained contained all the ammonia generated, no accurate criterion of its relative strength could be made. This fault has been remedied in the present official process by substituting stronger water of ammonia for the ammonium chloride, water, and lime, and not permitting the temperature to rise above 60° C. (140° F.). In addition to this, the amount of ammonia present is determined by volumetric assay, and it contains the same quantity of ammonia that is present in ammonia water,—*i.e.,* 10 per cent. Alcohol which has been kept in the cask for a long time will be discolored when the gaseous ammonia is passed into it.

Properties.—The spirit of ammonia, formerly called *ammoniated alcohol,* is "a colorless liquid, having a strong odor of ammonia, and a specific gravity of about 0.808 at 25° C. (77° F.). When diluted with water, it should respond to the tests for identity and purity given under *Aqua Ammoniæ.*" *U. S.*

Assay.—"Introduce into a weighing bottle about 2 Cc. of the Spirit, weigh accurately, dilute with 50 Cc. of distilled water, and titrate with half-normal sulphuric acid V.S., using litmus T.S. as indicator. Multiply the number of Cc. of half-normal sulphuric acid V.S. consumed, by 0.008465, and this product by 100, and divide by the weight in grammes of the Spirit taken to obtain the percentage of ammonia gas." *U. S.* When good, it does not effervesce with diluted hydrochloric acid; but if old, or carelessly kept, it is apt to be partially carbonated, as shown by this test. It, however, absorbs carbon dioxide more slowly than does ammonia water.

Uses.—Spirit of ammonia is stimulant and antispasmodic, and is given in *hysteria, flatulent colic,* and *nervous debility.* It is, however, little used internally, the aromatic spirit, which is pleasanter and has similar properties, being preferred. Spirit of ammonia dissolves resins, gum-resins, camphor, and the volatile oils, and is a very convenient addition to spirituous liniments intended to produce a rubefacient effect. Not more than one part of the spirit should, as a rule, be added to six or eight parts, by measure, of the liniment. It enters into no official preparation.

Dose, ten to thirty minims (0.6 to 1.8 Cc.) in a wineglassful (60 Cc.) of water.

SPIRITUS AMMONIÆ AROMATICUS. U. S., Br.

AROMATIC SPIRIT OF AMMONIA

(spĭr'ĭ-tŭs ăm-mō'nĭ-æ ăr-ǫ-măt'ĭ-cŭs)

Spiritus Ammoniæ Compositus; Spirit of Sal Volatile; Alcoolat ammoniacal aromatique, *Fr. Cod.;* Aromatischer Ammoniakgeist, *G.*

* "Ammonium Carbonate, in translucent pieces, *thirty-four grammes* [or 1 ounce av., 87 grains]; Ammonia Water, *ninety cubic centimeters* [or 3 fluidounces, 21 minims]; Oil of Lemon, *ten cubic centimeters* [or 162 minims]; Oil of Lavender Flowers, *one cubic centimeter* [or 16 minims]; Oil of Myristica, *one cubic centimeter* [or 16 minims]; Alcohol, *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims]; Distilled Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. To the Ammonia Water, contained in a flask, add *one hundred and forty cubic centimeters* [or 4 fluidounces, 352 minims] of Distilled Water, and afterwards the Ammonium Carbonate reduced to a moderately fine powder. Close the flask and agitate the contents until the Ammonium Carbonate is dissolved and allow it to stand for twelve hours. Introduce the Alcohol into a graduated bottle of suitable capacity, add first the Oils, then gradually the solution of Ammonium Carbonate, and afterwards enough Distilled Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Set the liquid aside during twenty-four hours in a cool place, occasionally agitating, then filter it through paper, in a well-covered funnel. Keep the product in glass-stoppered bottles, in a cool place." *U. S.*

"Ammonium Carbonate, 4 *ounces* (Imperial) or 100 grammes; Strong Solution of Ammonia, 8 *fl. ounces* (Imp. meas.) or 200 cubic centimetres; Oil of Nutmeg, 4½ *fl. drachms* (Imp. meas.) or 14.1 cubic centimetres; Oil of Lemon, 6½ *fl. drachms* (Imp. meas.) or 20.3 cubic centimetres; Alcohol (90 per cent.), 6 *pints* (Imp. meas.) or 3000 cubic centimetres; Distilled Water, 3 *pints* (Imp. meas.) or 1500 cubic centimetres. Place the Oil of Lemon, Oil of Nutmeg, and Alcohol with the Distilled Water in a retort; distil *seven pints* (Imp. meas.) or three thousand five hundred cubic centimetres; then distil and separately collect an additional *nine fluid ounces* (Imp. meas.) or two hundred and twenty-five cubic centimetres. Place the latter, together with the Ammonium Carbonate and the Strong Solution of Ammonia, in a bottle holding rather more than *a pint* (Imp. meas.) or rather more than half a litre; securely cork the bottle and gently warm it in a water-bath to 140° F. (60° C.), shaking from time to time until all the salt has dissolved. Filter the resulting solution when cold through cotton wool, and gradually mix the filtrate with the portion first distilled." *Br.*

In both of these formulas ammonium carbonate and uncombined ammonia are used; but they differ in the relative proportion of the materials and the mode of conducting the process. The U. S. spirit is a mere solution of the ingredients in alcohol diluted with a small proportion of water, while the British contains so much of the ingredients as may rise in distillation and be condensed with the seven pints of spirit that result. The strength of the former is definite, that of the latter more or less indefinite, as a portion of the materials must be left behind. The advantage arising from distillation, however, the avoidance of discoloration, is one which is well worth considering, although the spirit will always grow darker with age. The present preparation differs from that formerly official in the substitution of oil of myristica for oil of pimenta, it having been shown that oil of pimenta increased the tendency of the spirit to darken. Commercial oil of myristica frequently has a terebinthinate odor. Much care is needed to select for this preparation volatile oils that are fresh and of good quality. The translucent official ammonium carbonate, which is a mixture of bicarbonate and carbamate, does not dissolve in alcohol; the bicarbonate precipitates, and the carbamate dissolves. The object of the addition of free ammonia in the official process is to convert the insoluble bicarbonate into the carbamate, and it is directed that these shall be allowed to stand during *twelve hours* while this change is taking place. The effloresced ammonium carbonate of commerce having parted with some of its ammonia is a bicarbonate; hence when it is used, unless more than the official proportion of the ammonia water be added, some of the ammonium salt will remain in the precipitate as ammonium bicarbonate.

The difficulty of precipitation which so many pharmacists complain of is thus explained. It is a useful precaution to permit the ammonium carbonate and ammonia water to remain in contact for twelve hours before diluting with the other ingredients; this will secure the entire conversion of the bicarbonate, and obviate the precipitation above noted. In addition to this, it is officially directed to set the mixed liquid aside, for twenty-four hours, before final filtration. It is officially described as "a nearly colorless liquid when freshly prepared, but gradually acquiring a somewhat darker tint. It has the pungent odor and taste of ammonia. Specific gravity; about 0.900 at 25° C. (77° F.)." *U. S.* "A transparent liquid having a pungent ammoniacal odor and flavor; nearly colorless when first prepared, but liable to darken slightly. Specific gravity 0.888 to 0.893. 20 cubic centimetres require for neutralization 25.5 cubic centimetres of the *volumetric solution of sulphuric acid,* corresponding to about 2.4 per cent. of ammonia (NH_3), or 2.16 grammes in 100

cubic centimetres. 20 cubic centimetres, after the addition of 16 cubic centimetres of *solution of barium chloride,* should yield a precipitate which becomes more copious on heating to 160° F. (71° C.), and after filtering, the filtrate should yield a further precipitate when more of the reagent is added and the liquid is again heated." *Br.*

Uses.—Aromatic spirit of ammonia is much more largely used than the simple spirit of ammonia on account of its grateful taste and odor. It is advantageously employed as a stimulant antacid in *sick headache.*

Dose, thirty minims to a fluidrachm (1.8 to 3.75 Cc.), sufficiently diluted.

Off. Prep.—Mistura Sennæ Composita, *Br.;* Tinctura Guaiaci Ammoniata, *U. S.;* Tinctura Valerianæ Ammoniata, *U. S.*

SPIRITUS AMMONIÆ FŒTIDUS. Br.

FETID SPIRIT OF AMMONIA

(spĭr'ĭ-tŭs ăm-mō'nĭ-æ fœt'ĭ-dŭs)

Alcoolat ammoniacal fétide, Essence antihystérique, *Fr.;* Ammoniakalischer Stinkasantgeist, *G.*

"Asafetida, 1½ *ounces* (Imperial) or 75 grammes; Strong Solution of Ammonia, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Break the Asafetida into small pieces, and macerate it in a closed vessel in *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the Alcohol for twenty-four hours; distil until alcoholic vapors cease to be condensed; mix the distillate with the Strong Solution of Ammonia, and add sufficient Alcohol to make *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This is an alcoholic solution of the volatile oil of asafetida mixed with strong water of ammonia, and is an energetic nervous stimulant and antacid, adapted to certain *hysterical conditions* associated with gastric weakness and acidity. It is one of the preparations formerly recognized by the British Colleges, and reinstated after having been dropped from the first British Pharmacopœia. "25 cubic centimetres should require for neutralization at least 42.5 cubic centimetres of the *volumetric solution of sulphuric acid,* corresponding to at least 2.88 grammes of ammonia (NH_3) in 100 cubic centimetres." *Br.*

Dose, thirty minims to a fluidrachm (1.8 to 3.75 Cc.), to be largely diluted when administered.

SPIRITUS AMYGDALÆ AMARÆ. U. S.

SPIRIT OF BITTER ALMOND [Essence of Bitter Almond]

(spĭr'ĭ-tŭs ă-mĭg'dă-læ ă-mā'ræ)

Alcoolé d'essence amande amére, *Fr.;* Bittermandelgeist, *G.*

* "Oil of Bitter Almond, *ten cubic centimeters* [or 162 minims]; Alcohol, *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims]; Distilled Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Oil in the Alcohol, and add enough Distilled Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This was a new official spirit in the U. S. P. 1890; it is employed solely for flavoring purposes, and should always be used with care. The official oil of bitter almond now requires the presence of a trace of hydrocyanic acid, and hence the official spirit, containing 1 per cent. of oil, would show a slight trace. It would be safer to use for the spirit an oil free from hydrocyanic acid. A few drops only should be added to those substances which require a flavor.

Dose, from two to eight minims (0.12 to 0.5 Cc.).

Off. Prep.—Syrupus Amygdalæ, *U. S.*

SPIRITUS ANISI. U. S., Br,

SPIRIT OF ANISE

(spĭr'ĭ-tŭs ă-nī'sī)

Essence of Anise; Teinture d'essence d'anis vert, *Fr. Cod.;* Anisgeist, *G.*

* "Oil of Anise, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.* "Oil of Anise, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* To the Oil of Anise add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Anise. This Spirit of Anise contains half the proportion of Oil of Anise present in the Essence of Anise of the British Pharmacopœia of 1885," *Br.,* and is now of the same strength as the U. S. spirit.

Dose, as a stomachic and carminative, from one to two fluidrachms (3.75 to 7.5 Cc.), properly diluted.

SPIRITUS ARMORACIÆ COMPOSITUS. Br.

COMPOUND SPIRIT OF HORSERADISH

(spĭr'ĭ-tŭs ăr-mŏ-rā'cĭ-æ cŏm-pŏs'ĭ-tŭs)

Esprit (alcoolat) de Raifort composée, Alcoolat antiscorbutique, *Fr.;* Zusammengesetzter Meerrettiggeist, *G.*

"Horseradish Root, scraped, 5 *ounces* (Imperial) or 125 grammes; Dried Bitter-Orange Peel, well bruised, 5 *ounces* (Imp.) or 125 grammes; Nutmeg, bruised, 55 *grains* or 3.15 grammes; Alcohol (90 per cent.), 1¼ *pints*

(Imp. meas.) or 625 cubic centimetres; Distilled Water, 1½ *pints* (Imp. meas.) or 750 cubic centimetres. Mix, and distil *two pints* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This may be used advantageously as an addition to diuretic remedies, in *dropsy* attended with debility, especially in the case of drunkards.

Dose, from one to four fluidrachms (3.75 to 15 Cc.).

SPIRITUS AURANTII COMPOSITUS. U. S.

COMPOUND SPIRIT OF ORANGE

(spĭr'ĭ-tŭs âu-răn'tĭ-ī cŏm-pōs'ĭ-tŭs)

Teinture d'essence d'orange, *Fr. Cod.;* Esprit d' orange composée, *Fr.;* Zusammengesetzter Orangegeist, *G.*

* "Oil of Orange Peel, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Oil of Lemon, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Oil of Coriander, *twenty cubic centimeters* [or 325 minims]; Oil of Anise, *five cubic centimeters* [or 81 minims]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them. Keep the product in completely filled, well-stoppered bottles, in a cool and dark place." *U. S.*

This compound spirit has been introduced for the purpose of producing the orange flavor in making the official Elixir Aromaticum (page 433). It will be found by physicians to be a useful and fragrant addition to prescriptions.

Off. Prep.—Elixir Aromaticum, *U. S.;* Fluidextractum Rhamni Purshianæ Aromaticum, *U. S.*

SPIRITUS CAJUPUTI. Br.

SPIRIT OF CAJUPUT

(spĭr'ĭ-tŭs căj-ŭ-pū'tī)

Teinture (alcoolé) d'essence de Cajeput, Alcoolé d'essence de Cajeput, *Fr.;* Cajeputgeist, *G.*

"Oil of Cajuput, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* To the Oil of Cajuput add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Cajuput." *Br.*

For an account of the medicinal properties and uses of oil of cajuput, of which this is simply an alcoholic solution, see *Oleum Cajuputi.* "This Spirit of Cajuput contains five times the proportion of Oil of Cajuput present in the Spirit of Cajuput of the British Pharmacopœia of 1885." *Br.*

Dose, from five to twenty minims (0.3 to 1.3 Cc.), properly diluted.

SPIRITUS CAMPHORÆ. U. S., Br.

SPIRIT OF CAMPHOR

(spĭr'ĭ-tŭs căm'phŏ-ræ)

Tinctura Camphoræ, *U. S.* 1850; Tincture of Camphor; Alcohol Camphoratus; Teinture de camphre concentrée, *Fr. Cod.;* Esprit de Camphre, Alcool camphré, *Fr.;* Spiritus Camphoratus, *P. G.;* Kampherspiritus, *G.*

* "Camphor, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Camphor in *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol, filter through paper, and pass enough Alcohol through the filter to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Camphor, 1 *ounce* (Imperial) or 50 grammes; Alcohol (90 per cent.), *a sufficient quantity.* To the Camphor add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Camphor." *Br.*

The present official spirit differs from that of 1880 in being made from alcohol *without dilution with water;* this change was recommended in the preceding edition of this commentary. The addition of water to the solution was by no means a practical improvement, in view of the extensive employment of the preparation in liniments containing chloroform, oils, etc., in which, of course, it was frequently immiscible without producing turbidity. For a method of assay of spirit of camphor see *Ph. Centralh.,* 1901, 472. Spirit of camphor is an excellent preparation, much used locally in liniments and internally in affections of the alimentary canal and as an antispasmodic. Dilution with water precipitates the camphor, but when as in many cases it is desired to combine it with aqueous preparations, by dropping it into brandy or whisky and then adding water an eligible preparation is obtained; or the spirit of camphor may be dropped upon sugar and then mixed with water.

Dose, from ten to thirty minims (0.6 to 1.8 Cc.).

SPIRITUS CHLOROFORMI. U. S., Br.

SPIRIT OF CHLOROFORM

(spĭr'ĭ-tŭs ϕhlō-rŏ-fŏr'mī)

Chloric Ether, Spirit of Chloric Ether, *Br.;* Alcoolé de Chloroforme, *Fr.;* Chloroformspiritus, *G.*

* "Chloroform, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Alcohol, *nine hundred and forty cubic centimeters* [or 31 fluidounces, 377 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

"Chloroform, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity*. To the Chloroform add enough of the Alcohol to form *one pint* (Imp. meas.) or one thousand cubic centimetres of the Spirit of Chloroform." *Br.*

The chloroform strength of this preparation does not differ very greatly from that of the spirit of chloroform which was official in the United States Pharmacopœia of 1880; the latter contained 10 per cent. of chloroform by weight, while the spirit now official contains 6 per cent. by volume, the seeming difference being due to the specific gravity of the chloroform. *Chloric ether* of the older works was a solution of variable strength of chloroform in alcohol, and was used as a general anæsthetic. The practice has, however, very properly been abandoned, and the spirit of chloroform is now used as an internal remedy, especially in cases of gastro intestinal spasm or pain, in which it acts as a local agent. The official elixir of orange is an agreeable vehicle for its administration.

Dose, from ten to sixty minims (0.6 to 3.75 Cc.).[1]

SPIRITUS CINNAMOMI. U. S., Br.

SPIRIT OF CINNAMON

(spīr'ĭ-tŭs cĭn-nā-mō'mī)

Teinture (alcoolé) d'essence de Cannelle, Esprit de Cannelle, *Fr.;* Zimmtspiritus, *G.;* Spirito di cannella, *It.*

* "Oil of Cinnamon, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

"Oil of Cinnamon, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity*. To the Oil of Cinnamon add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Cinnamon." *Br.*

The spirit of cinnamon is an agreeable aromatic cordial. It contains five times the proportion of oil of cinnamon present in the spirit of cinnamon of the British Pharmacopœia of 1885.

Dose, from five to twenty minims (0.3 to 1.3 Cc.) in water.

Off. Prep.—Acidum Sulphuricum Aromaticum, *Br.;* Syrupus Rhei, *U. S.*

SPIRITUS FRUMENTI. U. S.

WHISKY

(spīr'ĭ-tŭs frū-mĕn'tī)

"An alcoholic liquid obtained by the distillation of the fermented mash of grain—such as Indian corn, rye, wheat, and barley, or their mixtures." *U. S.*

Eau de Vie de grain, *Fr.;* Kornbranntwein, *G.*

The term *whisky* is said to have been first applied to the spirit obtained from barley in the Highlands of Scotland, and to signify water in the language of the people of that region. (*Rees's Cyclopædia.*) In the strict sense of the word, as at present understood, and as officially defined, it belongs to the distilled spirit from different grains, including Indian corn, wheat, rye, and barley. The whisky of this country is generally made from corn or rye. The term, however, is sometimes extended to other forms of ardent spirit, and that resulting from the distillation of cider is frequently, although incorrectly, designated as *apple whisky*.

In the preparation of whisky, the infusion of rye or other grains is first made to undergo fermentation, by which the saccharine matter and indirectly the starch are converted into alcohol. In this state the liquid is called the *mash*. This is submitted to distillation, and the product is denominated *low wines*. By a second distillation it becomes purer and stronger, and now takes the name of raw corn spirit or whisky. Sometimes, we are informed, it is submitted to a third distillation, in order still further to purify it. By time certain chemical changes take place by which the natural impurities contained in the liquor are destroyed, and the whisky becomes mellow, losing the disagreeable odor and taste which it is apt to have when first distilled. It is generally believed that these changes involve the conversion of the aldehydic constituents of the raw spirit into acids which unite with the higher alcohols of the fusel oil to form esters which give the improved taste and mellowness to an aged whisky.

There are volatile principles naturally existing in the grains, which accompany the liquor in all its changes and give their characteristic flavor to the resulting spirit. These can scarcely be considered as impurities. But there are others, produced during the process of fermentation, which serve seriously to contaminate the product. Among these is *fusel*

[1] *Alcoholic Solution of Chloroform.*—A preparation for inhalation, composed of one-third pure chloroform and two-thirds nearly absolute alcohol, was recommended by Warren, under the name of *strong chloric ether*. Snow has since employed a similar mixture, using equal parts of chloroform and alcohol. The mixture, made in the proportion adopted by Snow, is commended by Robert as the best anæsthetic agent yet proposed. As the name chloric ether was originally applied by T. Thomson of Glasgow, to Dutch liquid (see page 329), it would be well to abandon the same appellation to designate chloroform, or its mixture with alcohol. Warren used his preparation in fifty cases with success, and considered it safer than chloroform, and more agreeable than ether, but there is no reason for supposing that it has especial value. The preparation sold in London and elsewhere under the name of "*chloric ether*" is a weak solution of chloroform of variable quality, containing at most but 16 or 18 per cent. of chloroform, and sometimes not more than 5 or 6 per cent.

oil or *grain oil* (amyl alcohol), which is offensive both to the smell and to the taste, and from which it is very desirable that the spirit should be freed as far as possible. This is determined in an approximately quantitative way by shaking out with carbon tetrachloride, oxidizing the solution so obtained with chromic acid mixture, and then titrating the valeric and other acids obtained with decinormal barium hydroxide. Minute proportions of acetic and butyric acids are often present in whisky, and valeric acid has been detected. (*A. J. P.*, 1859, 573.)

Properties.—Whisky, when recently prepared, is colorless; one method of giving it color was to store it in sherry casks whereby flavor as well as a brownish-yellow color was acquired. At present it is almost always stored in oaken barrels, the inside of the staves of which have been charred. By remaining in such barrels for several years undisturbed it ages rapidly and acquires color from the caramelized "wood gum" of the barrels. Its taste and odor, when mellow by age, though peculiar, are not disagreeable. According to the U. S. P. (8th Rev.), whisky is "an amber-colored liquid, having a distinctive odor and taste, and a slightly acid reaction. Whisky should be at least four years old. Its specific gravity should not be more than 0.945, nor less than 0.924 at 15.6° C. (60° F.), corresponding, approximately, to an alcoholic strength of 37 to 47.5 percent. by weight, or 44 to 55 percent. by volume, of absolute alcohol (see PART III, Alcohol Tables). If 100 Cc. of Whisky be very slowly evaporated in a tared dish on a water-bath, the last portions volatilized should not have a harsh or disagreeable odor (absence of more than a trace of *fusel oil* from grain); and the residue, when dried at 100° C. (212° F.), should not weigh more than 0.5 Gm. This residue should have no sweet or distinctly spicy taste (absence of *added sugar, glycerin,* and *aromatic substances*), and it should almost completely dissolve in 10 Cc. of cold water, forming a solution which is colored not deeper than light green by a few drops of ferric chloride T.S. diluted with 10 volumes of water (absence of more than traces of *oak tannin* from casks). If 50 Cc. of Whisky be shaken vigorously in a stoppered flask with 25 Gm. of kaolin, and, after standing half an hour, be filtered, the color of the filtrate should not be much lighter than that of the Whisky before treatment. To render 100 Cc. of Whisky distinctly alkaline to litmus, not more than 1.2 Cc. of normal potassium hydroxide V.S. should be required (limit of *free acid*)." *U. S.*

Whisky is an excellent alcoholic stimulant, which differs therapeutically from brandy in its having less tendency to cause constipation. Owing to its cheapness and its customary purity, it is usually preferable to brandy as a medicinal agent. It is also used as an antiseptic for wounds and ulcers.

SPIRITUS GAULTHERIÆ. U. S.

SPIRIT OF GAULTHERIA [Spirit of Wintergreen]

(spīr′ĭ-tŭs gâul-thē′rĭ-æ)

Teinture (alcoolé) d'essence de Gaulthérie, *Fr.*; Bergtheegeist, *G.*

* "Oil of Gaultheria, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Alcohol, *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

This spirit, which was made official for the first time in the U. S. P. 1880, is simply a solution of the oil of gaultheria in alcohol in the proportion of 5 per cent.; it has long been in use in many parts of our country, and authoritative recognition was needed. It is probably most largely used for imparting flavor to prescriptions.

Dose, from ten to twenty minims (0.6 to 1.3 Cc.).

SPIRITUS GLYCERYLIS NITRATIS. U. S. (Br.)

SPIRIT OF GLYCERYL TRINITRATE, SPIRIT OF NITROGLYCERIN [Spiritus Glonoini, Pharm. 1890, Spirit of Glonoin]

(spīr-ĭ-tŭs glĭç-ẹ-rȳ′lĭs nī-trā′tĭs)

"An alcoholic solution containing 1 percent., by weight, of Glyceryl Trinitrate [$C_3H_5(O.NO_2)_3 = 225.44$]. Spirit of Nitroglycerin should be kept and transported in well-stoppered tin cans, and should be stored in a cool place, remote from lights or fire. Great care should be exercised in dispensing, handling, packing, transporting, and storing the Spirit, since a dangerous explosion may result if any considerable quantity of it be spilled, and the alcohol be partly or wholly lost by evaporation. If, through accident, it be spilled, a solution of potassium hydroxide should be at once poured over it, to effect decomposition." *U. S.*

Liquor Trinitrini, *Br.*; Solution of Trinitrin; Liquor Nitroglycerini; Solution of Nitroglycerin; Liquor Glonoini; Solution of Glonoin; Nitroglyceringeist, Glycerintrinitratlösung, *G.*

"Trinitroglycerin of commerce, 17½ *grains* or 1 gramme; Alcohol (90 per cent.), *a sufficient quantity.* Dissolve the trinitroglycerin in sufficient of the Alcohol to produce *four fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Solution of Trinitrin." *Br.*

This official spirit was introduced into the U. S. P. 1890 with the view of furnishing an eligible mode of administering nitroglycerin.

The British Liquor Trinitrini is practically identical. Abundant precautions are included, which should on no account be neglected. The official description is as follows: "A clear, colorless liquid, having the odor and taste of alcohol. *Caution should be exercised in tasting*

it, since even a small quantity of it is liable to produce a violent headache. The same effect is produced when it is freely applied to the skin. It is neutral to litmus paper. Specific gravity: 0.814 to 0.820 at 25° C. (77° F.). On diluting 10 Cc. of the Spirit with 15 Cc. of water—both liquids, as well as the mixture, being brought to 15° C. (59° F.)—the liquid will exhibit at most a faint cloudiness, but the addition of a further portion of 5 Cc. of water should produce a white turbidity. If the specific gravity of the Spirit be higher than 0.830 at 25° C. (77° F.), or if 10 Cc. of it be rendered turbid by less than 10 Cc. of water, the Spirit should be rejected." *U. S.* "A clear and colorless liquid, neutral to *test-papers*. Specific gravity 0.840. A mixture of 10 cubic centimetres with an equal volume of *water*, cooled to 60° F. (15.5° C.), remains clear, but the further admixture of 1 cubic centimetre of *water* causes opacity (presence of a due amount of trinitroglycerin). On further diluting with *water* and setting the mixture aside, there is deposited a liquid of oily consistence, one drop of which, absorbed by paper and struck with a hammer on a hard surface, explodes. 110 minims contain 1 grain of trinitroglycerin; 100 cubic centimetres contain 1 gramme." *Br.* For a method of assaying this spirit, by Chas. Rice, see *Am. Drug.*, 1895, 6; also Nagelvoort's method, *A. J. P.*, 1894, 527. On account of the importance of nitroglycerin as a therapeutic agent, we append the following.

Nitroglycerin. Trinitrine. Glonoin. Glyceryl Trinitrate. ($C_3H_5(NO_3)_3$).—When glycerin is gradually added in small portions at a time to a mixture of one part of strong nitric acid and three to four parts of concentrated sulphuric acid, and at a temperature kept low by artificial refrigeration, it is converted into a bright yellow liquid, which has remarkable explosive properties and has received the name at the head of this article. Nitroglycerin was discovered in the year 1847 by Sobrero of Turin. It was afterwards made a subject of study by de Vrij of the Netherlands, Gladstone, and Kopp, but did not attract general attention until 1867, when Alfred Nobel, a Swedish engineer, suggested its use for explosive purposes. It is a yellow liquid (said to be colorless or slightly yellowish when pure); of a sp. gr. from 1.525 to 1.6; inodorous; of a sweet, pungent, aromatic taste; very slightly soluble in water, but readily soluble in ether, alcohol, and methylated spirit; not freezing above —15.5° C. (4° F.) when quite pure, according to J. R. Wagner, but, as it occurs in commerce, solidifying by continued exposure to a temperature of 8° C. (46.4° F.), and assuming the form of long needles, which it is dangerous to handle, as they explode violently when gently broken. In the liquid state the mere contact of flame does not inflame or explode it; but concussion, or touching it with a red-hot iron, explodes it with great vehemence. Detonating mixtures, or exploding gunpowder, in its near vicinity, produce the same effect. By keeping, it undergoes partial decomposition, and in confined vessels the pressure of the accumulated gases which result is sometimes so great as to cause its explosion upon the slightest concussion. Its explosive force greatly exceeds that of gunpowder. According to Nobel, one measure of the fluid yields on explosion 10,384 measures of gas, while one measure of gunpowder yields only 800 measures. It has, therefore, been much employed in blasting rocks, in mining, quarrying, road making, etc., and its economical advantages have kept it in extensive use, notwithstanding the danger. From these facts the inference is evident that it should not be kept in large quantities, nor conveyed to any considerable distance; the most fearful consequences have followed a neglect of these precautions. Practical operators recommend that it should be made extemporaneously where wanted as an explosive agent.

Nitroglycerin is formed by the introduction of the nitro-group (NO_2) in place of the three replaceable hydrogen atoms of the glycerin formula, according to the reaction:

$$C_3H_5(OH)_3 + 3(NO_2,OH) = C_3H_5,(NO_3)_3 + 3(HOH)$$

E. Kopp gives the following as his method of preparing nitroglycerin on the spot where it is needed. First, fuming nitric acid of the sp. gr. 1.51 to 1.53 is mixed with twice its weight of the strongest sulphuric acid. At the same time commercial glycerin, free from lead and lime, is evaporated in a pot to 30° or 31° Baumé, so that on cooling it shall have a syrupy consistence. Into 3300 grammes of the acid mixture, contained in a glass or porcelain capsule placed in a trough of cold water, 500 grammes of the prepared glycerin are slowly poured with constant stirring, great care being taken to prevent any sensible heating of the mixture. The whole is then to be left for five or ten minutes, after which the mixture is to be poured into five or six times its volume of cold water to which a rotatory motion has been given. The nitroglycerin precipitates rapidly in the form of a heavy liquid, which is separated by decantation, then washed with a little alkaline water which is decanted, and then put into bottles. In this state it still contains a little acid and water, but these do not interfere with its use as an explosive agent. Latterly it has also been prepared by mixing 3½ parts of sulphuric acid of 1.83 sp. gr. with 1 part of potassium nitrate, and cooling this, when potassium sulphate will crystallize out. The acid drained off from this is peculiarly adapted for the formation of nitroglycerin, which then takes place rapidly and without so much dangerous development of heat.

Uses.—The action of nitroglycerin upon the human system is that of the nitrites. It differs in its influence from amyl nitrite solely in that its effects are not quite so prompt and are

perceptible for a much longer time. The amount required to produce a sensible action is exceedingly small. Thus J. M. Merrick experienced distinct effects from one-fortieth of a drop, and Field has recorded a temporary loss of consciousness and other alarming symptoms as produced by about one-forty-fifth of a drop. In the case of B. Schuchardt (*A. J. P.*, 1867), as much as ten drops are affirmed to have been swallowed, with the production of giddiness, violent, throbbing headache, weariness, and a semi-unconsciousness lasting several hours. According to Louis Kolipinski (*Med. News*, 1890), two drachms of the ordinary solution of nitroglycerin have been recovered from without very serious symptoms (amount taken doubtful). For a case in which death was legally decided to have been criminally produced by the poison, see *J. P. C.*, xxvi. 356. The inhalation of the vapors of nitroglycerin produces the same symptoms, so that care is recommended in its manufacture. As nitroglycerin may be considered a glyceryl nitrate, its action as a nitrite appears at first remarkable. It has been shown, however, by Hay that during its alkaline decomposition it yields nascent nitrous acid, and it can scarcely be questioned that this acid is developed and acts upon the system.

Spirit of glonoin, or an equivalent solution of *nitroglycerin*, is very much used in *angina pectoris, asthma, convulsions*, and other diseases in which amyl nitrite is employed. (See *Amyl Nitris.*) As a *cardiac stimulant*, in collapse, poisoning by illuminating gas, and other conditions, it may be used either by the mouth or by subcutaneous injections.

Dose, of the spirit, from one to two minims (0.06 to 0.12 Cc.).

SPIRITUS JUNIPERI. U. S., Br.

SPIRIT OF JUNIPER

(spĭr′ĭ-tŭs jū-nĭp′ē-rī)

Teinture d'essence de Genièvre, *Fr. Cod.;* Spiritus Juniperi, *P. G.;* Wachholderspiritus, *G.*

* "Oil of Juniper, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Alcohol, *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

"Oil of Juniper, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity*. To the Oil of Juniper add enough of the Alcohol to form *one pint* (Imp. meas.) or one thousand cubic centimetres of the Spirit of Juniper. If the solution be not clear, agitate with a little *powdered talc*, and filter. This Spirit of Juniper contains two and a half times the proportion of Oil of Juniper present in the Spirit of Juniper of the British Pharmacopœia of 1885." *Br.* It is now uniform in strength with the U. S. preparation.

This spirit is used chiefly as an addition to diuretic infusions. It is about 33 per cent. stronger than the spirit official before 1890.

Dose, from thirty to sixty minims (1.8 to 3.75 Cc.).

Off. Prep.—Mistura Creosoti, *Br.*

SPIRITUS JUNIPERI COMPOSITUS. U. S.

COMPOUND SPIRIT OF JUNIPER

(spĭr′ĭ-tŭs jū-nĭp′ē-rī cŏm-pŏs′ĭ-tŭs)

Teinture (alcoolé) d'essence de Genièvre composée, *Fr.;* Zusammengesetzter Wachholderspiritus, *G.*

* "Oil of Juniper, *eight cubic centimeters* [or 130 minims]; Oil of Caraway, *one cubic centimeter* [or 16 minims]; Oil of Fennel, *one cubic centimeter* [or 16 minims]; Alcohol, *fourteen hundred cubic centimeters* [or 47 fluidounces, 162 minims]; Water, *a sufficient quantity*, to make *two thousand cubic centimeters* [or 67 fluidounces, 301 minims]. Dissolve the Oils in the Alcohol, and gradually add enough Water to make the product measure *two thousand cubic centimeters* [or 67 fluidounces, 301 minims]." *U. S.*

This spirit is a useful addition to diuretic infusions and mixtures in debilitated cases of *dropsy*. It corresponds very closely to Holland gin.

Dose, from two to four fluidrachms (7.5 to 15 Cc.).

SPIRITUS LAVANDULÆ. U. S., Br.

SPIRIT OF LAVENDER

(spĭr′ĭ-tŭs lą-văn′dŭ-læ)

Teinture (alcoolé) d'essence de Lavande, *Fr.;* Spiritus Lavandulæ, *P. G.;* Lavandelspiritus, *G.*

* "Oil of Lavender Flowers, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Alcohol, *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

"Oil of Lavender, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity*. To the Oil of Lavender add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Lavender. This Spirit of Lavender contains five times the proportion of Oil of Lavender present in the Spirit of Lavender of the British Pharmacopœia of 1885." *Br.*

Spirit of lavender is used chiefly as a perfume, and as an ingredient in other preparations. The official spirit is about 33 per cent. stronger than the spirit of the U. S. P. 1870. The perfume usually sold under the name of *lavender water* is not a distilled spirit, but an alcoholic solution of the oil, with the addition of

other odorous substances. The following is given by Brande as one of the most approved recipes for preparing it. "Take of rectified spirit five gallons, essential oil of lavender twenty ounces, essential oil of bergamot five ounces, *essence of ambergris* [made by digesting one drachm of ambergris and eight grains of musk in half a pint of alcohol] half an ounce. Mix." The Br. spirit is double the strength of the U. S. preparation. It is a grateful stimulant and carminative when administered in sweetened water.

Dose, from five to twenty minims (0.3 to 1.3 Cc.).

Off. Prep.—Mistura Ferri Composita, *U. S.*

SPIRITUS MENTHÆ PIPERITÆ. U. S., Br.

SPIRIT OF PEPPERMINT

(spĭr'ĭ-tŭs mĕn'thæ pĭp-ĕ-rĭ'tæ)

Essence of Peppermint: Teinture d'essence de Menthe, *Fr. Cod.;* Spiritus Menthæ Piperitæ, *P. G.;* Pfefferminzspiritus, Englische Pfefferminzessenz, *G.;* Alcohol de menta piperita, *Sp.*

* "Oil of Peppermint, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Peppermint, bruised, *ten grammes* [or 154 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Oil of Peppermint in *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Alcohol, add the Peppermint,[1] and allow it to macerate for twenty-four hours. Then filter through paper, and add, through the filter, enough Alcohol to make the Spirit measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Oil of Peppermint, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* To the Oil of Peppermint add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Peppermint. This Spirit of Peppermint contains five times the proportion of Oil of Peppermint present in the Spirit of Peppermint, and half the proportion of the *Essence of Peppermint* of the British Pharmacopœia of 1885." *Br.* It is now uniform in strength with the U. S. spirit.

The distilled spirit has no advantage over a simple solution of the oil in alcohol; and this mode of preparing it has been adopted both in the U. S. and British Pharmacopœias. It has long been popularly used under the name of *essence of peppermint.* The spirit of peppermint affords a convenient method of administering a dose of the volatile oil, being of such a strength that when dropped on loaf-sugar it may be taken without inconvenience.

Dose, ten to thirty minims (0.6 to 1.8 Cc.), given as just mentioned, or mixed with sweetened water.

Off. Prep.—Mistura Rhei et Sodæ, *U. S.*

[1] P. H. Utech suggests the maceration of the peppermint in water for two hours, washing and draining, before adding to the solution of the oil; water soluble matter is removed and a more permanent green color produced. He recommends the same treatment for the spearmint in making spirit of spearmint.

SPIRITUS MENTHÆ VIRIDIS. U. S.

SPIRIT OF SPEARMINT

(spĭr'ĭ-tŭs mĕn'thæ vĭr'ĭ-dĭs)

Tinctura Olei Menthæ Viridis, *U. S.* 1850; Essence of Spearmint; Grüne Minzessenz, *G.*

* "Oil of Spearmint, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Spearmint, bruised, *ten grammes* [or 154 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Oil of Spearmint in *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Alcohol, add the Spearmint, and allow it to macerate for twenty-four hours. Then filter through paper, and add, through the filter, enough Alcohol to make the Spirit measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

The remarks made on the Spirit of Peppermint are equally applicable to this. Both are usually employed as carminatives.

Dose, ten to thirty minims (0.6 to 1.8 Cc.).

SPIRITUS MYRISTICÆ. Br.

SPIRIT OF NUTMEG [Essence of Nutmeg]

(spĭr'ĭ-tŭs mŷ-rĭs'tĭ-cæ)

Teinture (alcoolé) d'essence de Muscade, *Fr.;* Muskatspiritus, *G.*

"Oil of Nutmeg, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* To the Oil of Nutmeg add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Nutmeg. If the solution be not clear, agitate with a little *powdered talc,* and filter. This Spirit of Nutmeg contains five times the proportion of Oil of Nutmeg present in the Spirit of Nutmeg of the British Pharmacopœia of 1885." *Br.* It is double the strength of the U. S. 1890 spirit.

It is used chiefly for its flavor. Spirit of nutmeg was not retained in the U. S. P. (8th Rev.). It was made in the U. S. P. 1890 by dissolving 50 Cc. of oil of nutmeg in 950 Cc. of alcohol. (See *Oleum Myristicæ.*)

Dose, from five to twenty minims (0.3 to 1.3 Cc.).

Off. Prep.—Mistura Ferri Composita, *Br.*

SPIRITUS RECTIFICATUS. Br.

ALCOHOL (90 PER CENT.) [Rectified Spirit]

(spĭr'ĭ-tŭs rĕc-tĭ-fĭ-cā'tŭs)

"A liquid containing 90 parts by volume of ethyl hydroxide, C_2H_5OH, and 10 parts by volume of water; obtained by the distillation of fermented saccharine liquids." *Br.*

See *Alcohol* (page 104).

SPIRITUS ROSMARINI. Br.

SPIRIT OF ROSEMARY

(spĭr'ĭ-tŭs rŏs-mă-rī'nī)

Spiritus Anthos; Teinture d'essence de Romarin, *Fr. Cod.;* Rosmarinspiritus, *G.;* Alcohol de romero, *Sp.*

"Oil of Rosemary, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* To the Oil of Rosemary add enough of the Alcohol to form *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Spirit of Rosemary. This Spirit of Rosemary contains five times the proportion of Oil of Rosemary present in the Spirit of Rosemary of the British Pharmacopœia of 1885." *Br.*

The plant is no longer official. (See PART II.) This spirit is a grateful perfume, and is used chiefly as an ingredient in lotions and liniments.

SPIRITUS VINI GALLICI. U. S., Br.

BRANDY

(spĭr'ĭ-tŭs vī'nī găl'lĭ-cī)

"An alcoholic liquid obtained by the distillation of the fermented, unmodified juice of fresh grapes." *U. S.* "A spirituous liquid distilled from wine and matured by age, and containing not less than 36½ per cent. by weight or 43½ per cent. by volume of ethyl hydroxide." *Br.*

Spirit of French Wine; Eau de Vie, Cognac, *Fr.;* Branntwein, Franzbranntwein, *G.*

All liquids which have undergone the alcoholic fermentation yield an ardent spirit by distillation. (See *Alcohol,* p. 104.) When the alcoholic liquid is wine, the product of the distillation is brandy. This ardent spirit is subject to variation, according to the character of the wine from which it is distilled. The best brandy is obtained from French wines, and the kinds called Cognac and Armagnac are most esteemed. Cognac is probably the most profitable wine producing region in the world, and has given its name to the most widely known brandy. Very large quantities of brandy are now made in California, but the taste is peculiar and easily distinguished from that of Cognac. Our Pharmacopœia formerly recognized French brandy exclusively; but since the revision of 1860 all spirits have been admitted under that name, when obtained from the juice of grapes and sufficiently strong and pure to meet the requirements below specified.

Properties.—"A pale amber-colored liquid, having a distinctive odor and taste, and a slightly acid reaction. Brandy should be at least four years old. Its specific gravity should be not more than 0.941, nor less than 0.925 at 15.6° C. (60° F.), corresponding, approximately, to an alcoholic strength of 39 to 47 percent. by weight, or 46 to 55 percent. by volume, of absolute alcohol (see PART III, Alcohol Tables). If 100 Cc. of Brandy be slowly evaporated in a tared dish on a water-bath, the last portions volatilized should have an agreeable odor free from harshness (absence of *fusel oil* from grain or potato spirit); and the residue, when dried at 100° C. (212° F.), should not weigh more than 0.5 Gm. This residue should have no sweet or distinctly spicy taste (absence of *added sugar, glycerin,* and *aromatic substances*), and it should almost completely dissolve in 10 Cc. of cold water, forming a solution which is colored not deeper than light green by a few drops of ferric chloride T.S. diluted with 10 volumes of water (absence of more than traces of *oak tannin* from casks). If 50 Cc. of Brandy be shaken vigorously in a stoppered flask with 25 Gm. of kaolin, and, after standing half an hour, be filtered, the color of the filtrate should not be much lighter than that of the Brandy before treatment (absence of *caramel coloring*). To render 100 Cc. of Brandy distinctly alkaline to litmus, not more than 1 Cc. of normal potassium hydroxide V.S. should be required (limit of *free acid*)." *U. S.* Besides alcohol, water, and volatile oil, it contains coloring matter, tannin, œnanthic ether described under *wine,* a little acetic ether, and a little aldehyde. Brandy is classed according to its color, as pale and high-colored. *Pale brandy* has a yellow color, derived from the cask in which it is kept. *High-colored* brandy has a deep-red color given to it, before importation, by burnt sugar (caramel), which is said to impart a more agreeable flavor. *Factitious brandy* is sometimes made from alcohol, deprived of fusel oil, and reduced to the proper proof by water, by adding to it acetic ether in the proportion of from half an ounce to an ounce to the gallon. *Oil of cognac,* which it is stated contains the aroma from wines, is made from compressed wine lees by placing it in a still with five times its bulk of water, 2 per cent. of newly slaked lime, 1 per cent. of potash, and 1 per cent. of common salt. The stirring apparatus is set in motion, steam applied, the heat allowed to rise gradually to 240° C. (464° F.), and the green oil separated; the average yield is very small (.003 per cent.); the oil is then rectified, and 2 grammes of it are added to 100 litres of 50 per cent. alcohol to impart the odor and taste which so-called "best brandy"

should have. The proper color is then given by burnt sugar. The spurious liquid may be known by its leaving on evaporation a residue, containing sugar and no tannin, the absence of the latter being shown by the evaporated portion not striking a black color with ferric salts. The nature of the liquid may also be detected by the absence of aldehyde. For modes of detecting impurities in brandy and other ardent spirits, see Allen, *Com. Org. Anal.*, 3d ed., i. 143 *et seq.*

Uses.—Brandy is esteemed as a cordial and stomachic, and is frequently given, in the form of toddy or milk punch, in the sinking stages of *low fevers*. In the late London Pharmacopœia there was an official preparation of it, called *Mistura Spiritus Vini Gallici*, consisting of brandy, cinnamon water, the yolks of eggs, sugar, and oil of cinnamon. This, though a convenient form for the administration of brandy, was subsequently omitted. It is now again official in the British Pharmacopœia, but the oil has been left out. If prepared with the U. S. cinnamon water, it would certainly be sufficiently flavored without the addition of the oil.

Off. Prep.—Mistura Spiritus Vini Gallici, *Br.*

STAPHISAGRIA. U. S. (Br.)

STAPHISAGRIA [Stavesacre]

(stăph-ĭ-să'grĭ-ą)

"The ripe seed of *Delphinium Staphisagria* Linné (Fam. *Ranunculaceæ*)." *U. S.* "The dried ripe seeds of Delphinium Staphisagria, *Linn.*" *Br.*

Staphisagriæ Semina, *Br.*; **Semen Staphisagriæ**, Staphidiagriæ or Pedicularis; Stavesacre Seeds; Staphisaigre, *Fr. Cod.*; Stephanskörner, Läusekörner, *G.*; Stafisagria, *It.*

Delphinium Staphisagria, L., or stavesacre, is a handsome, annual or biennial plant, one or two feet high, with a simple, erect, downy stem, and palmate, five- or seven-lobed leaves, supported on hairy footstalks. The flowers are bluish or purple, in terminal racemes, with pedicels twice as long as the flower, and bracteoles inserted at the base of the pedicel. The nectary is four-leaved and shorter than the petals, which are five in number, the uppermost projected backward so as to form a spur, which encloses two spurs of the upper leaflets of the nectary. The seeds are in straight oblong capsules. The plant is a native of the south of Europe. E. M. Holmes calls attention to the remarkable fact that the plant in the English botanic gardens hitherto considered to be *Delphinium Staphisagria* is in reality another species, *i.e.*, *Delphinium pictum*, Willd. The author accounts for the absence of the true plant in botanic gardens partly by the fact that it is only half-hardy in Great Britain, while *D. pictum* is hardy, and partly by the reason that the illustrations in several works on medicinal plants—even in Bentley and Trimen's "Medicinal Plants" are incorrect or unreliable. The two species are distinguished as follows: *D. Staphisagria* has very hairy stems, glandular hairs being mixed with the long spreading soft hairs; flowers that when well-developed have an ultramarine blue tint; a calyx with very short or almost obsolete spur; carpels containing only four or five seeds. *D. pictum*, Willd., has shorter soft hairs, but no glandular hairs on the stems; the flowers are of a pale lilac color; the spur is as long as the calyx segments; each carpel contains ten or twelve seeds, and these are only half the size of those of *D. Staphisagria*. The true *D. Staphisagria* extends from Teneriffe around both the northern and southern coasts of the Mediterranean to Asia Minor. It is quite possible, therefore, that varieties having blossoms of different tints may occur. The evidence obtainable, however, goes to show that the form of the plant from which the seed of commerce is obtained—which, by the way, will not germinate, or only very rarely—has clear blue flowers. (*Y. B. P.*, 1899, 390.)

Properties.—The seeds of stavesacre are officially described as "irregularly tetrahedral, one side convex, 5 to 6 Mm. long and 3 to 6 Mm. broad; externally blackish-brown, becoming lighter with age, strongly reticulate; endosperm oily, enclosing a small, straight embryo; odor slight; taste intensely bitter and acrid." *U. S.* Their virtues are extracted by water and alcohol. Analyzed by Lassaigne and Feneulle they yielded a brown and a yellow bitter principle, a volatile oil, a fixed oil, albumen, a nitrogenous substance, a mucilaginous saccharine matter, mineral salts, and a peculiar alkaloid called *delphinine*[1] or *delphinia*, which exists in the seeds combined with an excess of malic acid. Marquis, in Dragendorff's laboratory in 1877, isolated the following four alkaloids: *delphinine*, $C_{22}H_{35}NO_6$, a crystallizable alkaloid, of bitter taste, weak alkaline reaction, soluble in alcohol, ether, and chloroform; *delphinoidine*, $C_{42}H_{68}N_2O_7$, amorphous, soluble in ether, alcohol, chloroform, reaction strongly alkaline, fusing point from 110° to 120° C.; *delphisine*, $C_{27}H_{46}N_2O_4$, crystallizing in warty aggregations, soluble in ether, alcohol, and chloroform; *staphisagrine*, $C_{22}H_{33}NO_5$, only obtained amorphous, difficultly soluble in water and ether, easily soluble in alcohol and chloroform, of bitter taste, fusing point 90° C., of alkaline reaction in alcoholic solution. (*Pflanzenstoffe*, 2d ed., 1884, 617.) The total amount of alkaloids is about 1 per cent. According to Charalampi Kara-Stojanow (*In. Dis.*, Dorpat, 1890), delphinine and delphisine have the same com-

[1] If delphinine be rubbed up with an equal quantity of malic acid, and some drops of concentrated sulphuric acid added, there will be produced an orange-red color passing into rose, growing deeper after some hours, and finally changing from the edges to violet, and at last becoming cobalt blue. (Tattersall, *Chem. News*, 41.) It is stated that no other alkaloid and no other organic acid, except malic, affords this reaction.

position, $C_{31}H_{49}NO_7$, crystallize from their solutions in ether and petroleum benzin in identical forms, and have their melting points at 191° C. and 189° C., while delphinoidine has the formula $C_{25}H_{42}NO_4$. Ahrens (*Ap. Ztg.*, 1899, 361) obtained from the residue of the seeds of *D. staphisagria*, from which delphinine, delphinoidine, delphisine and staphisagrine had been extracted, the alkaloid *staphisagroine* (*Ber. d. Chem. Ges.*, 1899, 1581). For Katz's process for extracting delphinine, see *Ph. Ztg.*, 1900, 735.

Uses.—The seeds were formerly used as an emetic and cathartic, but have been abandoned in consequence of their violence. A strong tincture has been employed as an embrocation in *rheumatism*. The ointment is used to destroy *lice* and the *itch-mite*. Bazin has used the extract internally in *eczema* in doses of a grain and a half (0.096 Gm.). (*Ann. Thér.*, 1851.) Staphisagria should, however, never be used internally, and when it is applied externally, care should be exercised not to put it on an abraded scalp, but only upon the unbroken epidermis. In some countries the seeds are used like Cocculus Indicus to intoxicate fish.[1]

Dose, one grain (0.065 Gm.).

Off. Prep.—Fluidextractum Staphisagriæ, *U. S.*; Unguentum Staphisagriæ, *Br.*

STILLINGIA. U. S.

STILLINGIA [Queen's Root]

(stĭl-lĭn'jĭ-ą)

"The dried root of *Stillingia sylvatica* Linné (Fam. *Euphorbiaceæ*)." *U. S.*

Silver Leaf, Queen's Delight, Yaw Root; Stillingie, *Fr.*, *G.*

Stillingia sylvatica, L., *Mant.* (1767) 126; Willd., *Sp. Plant.* iv. 588; *B. & T.* 241.—This is an indigenous perennial plant, commonly called *Queen's delight*, with herbaceous stems, two or three feet high, and alternate, sessile, oblong or lanceolate-oblong, obtuse, serrulate leaves, tapering at the base, and accompanied with stipules. The male and female flowers are distinct upon the same plant. They are yellow, and arranged in the form of a spike, of which the upper part is occupied by the male, the lower by the female flowers. The male florets are scarcely longer than the bracteal scales. The plant grows in pine barrens from Virginia to Florida, flowering in May and June. When wounded it emits a milky juice. For structural characteristics of stillingia, see *D. C.*, 1898, 5.

The root, which is the part used, is large, thick, and woody. It is officially described as "slenderly fusiform, usually in cut pieces, of variable length and 0.5 to 3 Cm. in diameter; externally reddish-brown, longitudinally wrinkled; fracture fibrous, bark light reddish-brown, 0.5 to 4 Mm. thick, spongy, finely fibrous, with numerous resin cells, easily separable from the porous, radiate wood; odor distinct; taste bitter, acrid, and pungent." *U. S.* The odor is slight, peculiar, and somewhat oleaginous, but in the recent root is said to be strong and acrimonious. The taste is bitterish and pungent, leaving an impression of disagreeable acrimony in the mouth and fauces. It imparts its virtues to water and alcohol. H. R. Frost thinks that the active principle is somewhat volatile, and states that the root loses much of its activity when long kept. W. Saunders has obtained from the root a volatile oil, which he found to possess the odor, taste, and peculiar acrimony of the root in a high degree. He procured six and a quarter ounces from five pounds of the dried root. It had a thick consistence, and required the addition of alcohol to render it fit for manipulation. Wm. Bichy (*A. J. P.*, 1885, p. 529) found an alkaloid which he named *stillingine*. It was obtained as an amorphous powder, volatilizable on heating, forming a sulphate in fine scale-like crystals.

Uses.—In large doses stillingia is emetic and cathartic, in smaller doses alterative, with some influence over the secretions. It has been long popularly used in South Carolina, but was first introduced to the notice of the profession by Thomas Young Simons (*Amer. Med. Recorder*, 1828, vol. xiii. p. 312) as a valuable alterative remedy in *syphilitic affections* and other affections ordinarily requiring the use of mercury. From the reports in its favor there seems no reason to doubt the efficacy of this medicine in *secondary syphilis, scrofula, cutaneous diseases, chronic hepatic affections*, and other complaints

[1] When given in poisonous doses to the lower animals, *delphinine* produces excessive salivation, followed by violent and repeated vomiting, great disturbance of respiration, failure of heart action, gradual enfeeblement of voluntary motion and of sensation, and a peculiar fibrillary spasm of the muscles of the abdomen, which is said to be characteristic of the poisoning. Elevation of temperature and glycosuria have both been noticed; death is said to occur always from failure of respiration, though the heart is greatly enfeebled and finally ceases in diastole. According to Gauthier, the period of depression of the heart and of sensibility is preceded by one of excitement. The pupils are dilated and the motor nerve finally paralyzed. (*L. M. R.*, Oct. 1887.) Turnbull, in his work *On the Medical Properties of the Ranunculaceæ*, states that pure delphinine may be given to the extent of three or four grains a day, in doses of half a grain each, without exciting vomiting, and without producing much intestinal irritation, though it sometimes purges. In most instances it proves diuretic, and gives rise to sensations of heat and tingling in various parts of the body. Externally, it acts like veratrine, but, according to Turnbull, produces more redness and burning and less tingling than that substance. He has employed it in neuralgia, rheumatism, and paralysis. It may be applied by friction, in the form of ointment or alcoholic solution, in proportions varying from ten to thirty grains of the alkaloid to an ounce of the vehicle, and the friction should be continued till a pungent sensation is produced. Turnbull probably had an impure alkaloid; the doses just mentioned would not be safe with a pure delphinine.

Staphisagrine is said to act like delphinine, except that it does not depress the heart so much or produce fibrillary contractions. Although cases of human poisonings have occurred with staphisagria, we know of none in which the result has been fatal. The symptoms are similar to those produced in the lower animals. Kobert states that the alkaloids of staphisagria all resemble aconitine in their action, but that delphinoidine has some narcotic action.

ordinarily benefited by alterative medicines. It is best given in the form of the official fluid-extract.

Dose, half a fluidrachm increased to a fluidrachm (1.8 to 3.75 Cc.). Stillingia is sometimes advantageously combined with sarsaparilla and other alteratives.[1]

Off. Prep.—Fluidextractum Stillingiæ, *U. S.*

STRAMONII SEMINA. Br.

STRAMONIUM SEED

(strą-mō′nī-ī sĕm′į-ną)

"The dried ripe seeds of Datura Stramonium, *Linn.*" *Br.*

Semen Stramonii, *P. G.;* Thornapple; Stramoine, Pomme épineuse, Semences (Graines) de Stramoine, *Fr.;* Stechapfelsamen, *G.;* Stramonio, *It.;* Estramonio, *Sp.*

Datura Stramonium, L., *Sp. Pl.* (1753) 179; Willd., *Sp. Plant.* i. 1008; Bigelow, *Am. Med. Bot.,* i. 17; *B. & T.* 192.—The *thornapple* is an annual plant, of rank and vigorous growth, usually about three feet high, but in a rich soil sometimes six feet or more. The root is large, whitish, and furnished with numerous rootlets. The stem is erect, round, smooth, somewhat shining, simple below, dichotomous above, with numerous spreading branches. The leaves, which stand on short round footstalks in the forks of the stem, are five or six inches long, of an ovate-triangular form, irregularly sinuated and toothed at the edges, unequal at the base, dark green on the upper surface, and pale beneath. The flowers are large, axillary, solitary, and peduncled, having a tubular, pentangular, five-toothed calyx, and a funnel-shaped corolla with a long tube, and a waved plaited border, terminating in five acuminate teeth. The upper portion of the calyx falls with the deciduous parts of the flower, leaving its base, which becomes reflexed and remains attached to the fruit. This is a large, fleshy, roundish-ovate, four-valved, four-celled capsule, thickly covered with sharp spines, and containing numerous seeds, attached to a longitudinal placenta in the centre of each cell. It opens at the summit. There are two varieties of this species of Datura, one with a green stem and white flowers, the other with a dark reddish stem minutely dotted with green, and purplish flowers striped with deep purple on the inside. The latter, however, is considered by some botanists as a distinct species, being the *D. Tatula* of Linnæus. The properties of both are the same.

It is doubtful to what country this plant originally belonged. Many European botanists refer it to North America, while we in return trace it to the old continent. Nuttall considers it as having originated in South America or Asia, and it is probable that its native country is to be found in some part of the East. It is said to grow wild, abundantly in Southern Russia, from the borders of the Black Sea eastward to Siberia. Its seeds, being retentive of life, are taken in the earth put on shipboard for ballast from one country to another, not infrequently springing up upon the passage, and thus propagating the plant in all regions which have any commercial connection. In the United States it is found everywhere in the vicinity of cultivation, frequenting dung heaps, the road sides and commons, and other places where a rank soil is created by the deposited refuse of towns and villages. Its flowers appear from May to July or August, according to the latitude. Where the plant grows abundantly, its vicinity may be detected by the rank odor which it diffuses to some distance around. All parts of it are medicinal. The leaves, seeds, and root were formerly recognized by the U. S. P., the leaves and seed in the U. S. P. 1890, but in the U. S. P. (8th Rev.) the seeds were not included and the leaves alone are official under the title *Stramonium.*[2] The leaves may be gathered at any time from the appearance of the flowers till the autumnal frost. In this country the plant is generally known by the name of *Jamestown (vulgo, Jimson) weed,* derived probably from its having been first observed in the neighborhood of that old settlement in Virginia.

[1] *Syrupus Stillingiæ Compositus. Compound Syrup of Stillingia.*—This syrup, notwithstanding its reputation as a model of polypharmaceutical skill, is largely used in the West and South. John King makes it as follows: Take of Queen's Root (Stillingia) 2 lbs. [avoirdupois]; Turkey-corn Root (Corydalis) 2 lbs. [av.]; Blue-flag Root (Iris versicolor) 1 lb. [av.]; Elder Flowers 1 lb. [av.]; Pipsissewa Leaves (Chimaphila) 1 lb. [av.]; Coriander ½ lb. [av.]; Prickly Ash Berries (Xanthoxylum) ½ lb. [av.]; Sugar, Refined, 24 lbs. [av.]; Water, q. s., Alcohol, 76 per cent., q. s. Grind and mix the vegetable drugs together, place them in a convenient vessel, cover them with alcohol of 76 per cent., and macerate for three days. Then transfer the whole to a percolator and gradually pour alcohol on top until 4 pints of tincture have been obtained, which retain and set aside. Then continue the percolation with water, and of this second percolate reserve so much as contains a sensible amount of alcohol, and distil or evaporate the latter from it. Continue the percolation by water until the solution obtained is almost tasteless, and boil down this weaker infusion until, when added to the second solution, after the evaporation of its alcohol, it will make 24 pints. To these two solutions combined add the sugar, and dissolve it by heat, carefully removing any scum which arises as it begins to boil, and if it exceeds 28 pints, evaporate to that quantity with constant stirring. Then remove from the fire, and, when nearly cold, add the 4 pints of reserved alcoholic tincture and make 4 gallons of syrup, each pint of which will be equal to 4 fluid-ounces of the ingredients. The 24 pounds of sugar, when added to the 24 pints of solution, will always make more than 28 pints. (*N. R.,* May, 1880.)

[2] Under the name of DATURÆ FOLIA or *Datura Leaves,* the Indian and Colonial Addendum recognizes the dried leaves of *Datura fastuosa,* Linn., var. *alba,* Nees (Natural Order, *Solanaceæ*), and of *Datura Metel,* Linn.; and under the name of DATURÆ SEMINA, *Datura seeds,* the dried seeds of the first-named of these species. The leaves are described as "ovate, acuminate, with long petioles and sinuate-dentate margins; often unequal at the base. The larger are seven or eight inches (seventeen or twenty centimetres) long, and four or five inches (ten or twelve and a half centimetres) broad." *Br. Add.*

The seeds are somewhat wedge-shaped, with rounded, thickened, furrowed, wavy margins, strongly compressed laterally; from one-sixth of an inch to one-fifth of an inch (four to five millimetres) broad, and about one-twenty-fifth of an inch (one millimetre) thick. The hilum is situated on one edge and extends from about the middle to the acute end of the seed. The testa is finely pitted and reticulated, and is of a dull yellowish-brown color; it is comparatively thick, and encloses a narrow translucent endosperm which surrounds a curved embryo. *Br. Add.*

In India *Datura alba, D. ferox,* and *D. fastuosa* are employed as poisons. Under the names of *Man t'o lo fa, Wan t'o lo hua,* and *Nau yeung fa,* the Chinese use as a medicine the flowers of the *Datura alba;* according to Frank Browne, they contain 0.485 per cent. of hyoscine, free from other alkaloids. *El Bethene,* a Datura of the Sahara Desert, is capable of causing delirium, coma, and death, and it is probable that all the species of the genus are poisonous. A. R. L. Dohme (*Proc. A. Ph. A.,* 1894, 231) examined stramonium to determine the value in alkaloid of the various parts of the plant; he found that, in general, the fresh parts yielded more than the dried parts; the stems contained the most alkaloid, the seeds next, then the leaves, and the roots the least of all.

1.—The *fresh leaves* when bruised emit a fetid narcotic odor, which they lose upon drying. Their taste is bitter and nauseous. These properties, together with their medicinal virtues, are imparted to water and alcohol. Water distilled from them, though possessed of their odor in a slight degree, is destitute of their active properties. They contain, according to Promnitz, 0.58 per cent. of gum, 0.6 of extractive, 0.64 of green starch, 0.15 of albumen, 0.12 of resin, 0.23 of saline matters, 5.15 of lignin, and 91.25 of water. The leaves, if carefully dried, retain their bitter taste. They are officially described as "usually of a dark green or grayish-green color, much wrinkled and matted together; petiolate, 6 to 20 Cm. long, inequilaterally ovate, acuminate, very oblique at the base, the large teeth few, acute, with rounded sinuses; thin, brittle; odor distinct, heavy, and narcotic; taste nauseous. The powder contains few hairs and has numerous rosette-shaped calcium oxalate crystals from 0.010 to 0.020 Mm. in diameter." *U. S.*

The mesophyll of stramonium contains cluster crystals of calcium oxalate. J. S. Ward has found commercial stramonium leaves freely adulterated with those of *Carthamus helenioides* and *Xanthium Strumarium.* (*P. J.,* lxvi. 326.) For a paper on the structure of the leaves of *D. Stramonium, A. Belladonna,* and *H. niger* by Schlotterbeck and van Zwaluwenburg, the reader is referred to *Proc. A. Ph. A.,* 1897, 202.

2.—The *seeds* are small, kidney-shaped, pitted and wrinkled, flattened on the sides, of a dark-brown almost black color, inodorous unless bruised, and of the bitter, nauseous taste of the leaves, with some degree of acrimony. The testa is dull brownish black, hard, and encloses a cylindrical curved embryo, which is embedded in a whitish oily albumen. They are much more energetic in their action on the system than are the leaves. Hirtz and Hopp inferred from their experiments that one part of an extract prepared from them was equal in strength to five parts of an extract prepared in precisely the same manner from the leaves. (*Ann. Thér.,* 1862, p. 22.) Geiger and Hesse succeeded in isolating an alkaloid, to which the name *daturine* was given, and which Trommsdorff has repeatedly procured by their process. Von Planta (*A. J. P.,* 23, p. 38) found that daturine was identical with atropine, and this result has since been confirmed; but Ladenburg (*Ber. d. Chem. Ges.,* 13, p. 909) found that *Datura Stramonium* contains two alkaloids, which he designated as *heavy daturine* and *light daturine.*

The more difficultly soluble heavy daturine fuses at 113.5° to 114° C. (237° to 237.2° F.), and must be considered as a mixture of *atropine* and *hyoscyamine.* It yields a gold salt fusing between 135° and 150° C. (275° and 302° F.), out of which, by crystallization repeated six times and by rejection each time of the mother liquor, is obtained hyoscyamine gold-chloride fusing at 158° to 160° C. (316.4° to 320° F.). From the mother liquors by evaporation is obtained nearly pure atropine gold chloride fusing at 135° to 140° C. (275° to 284° F.). If the heavy daturine be repeatedly crystallized out of dilute alcohol, pure atropine can be isolated from it, fusing at 113.5° to 114.5° C. (237° to 238° F.), and yielding a lustreless gold salt fusing at 135° to 139° C. (275° to 282.2° F.). The light daturine is the alkaloid which Ladenburg and Meyer in a previous study had shown to be identical with hyoscyamine. Hence *Datura Stramonium* contains the two alkaloids *atropine,* $C_{17}H_{23}NO_3$, and *hyoscyamine,* isomeric with the other, which *Atropa Belladonna* also contains. (*A. J. P.,* 1884, 440.) The mother liquors from which hyoscyamine is obtained yield a difficultly crystallizable base, first called hyoscine, but now known as *scopolamine.* Its gold salt is more difficultly soluble than the gold salts of atropine and hyoscyamine, and affords a means of separation. The base, when purified, can be crystallized out of ether in colorless crystals, melting at 59° C. Its formula is $C_{17}H_{21}NO_4$, and it is decomposed by boiling with baryta water into *scopolin,* $C_8H_{13}NO_2$, and *atropic acid,* $C_9H_8O_2$. (Schmidt, *Pharm. Chemie,* 3te Auf., ii. 1339.)

Gérard (see *J. P. C.,* 1892, 8) studied *daturic acid* obtained from stramonium seed. D. Holde has, by means of benzene, extracted from stramonium seed 16.7 per cent. of a fixed oil (*P. J.,* lxx. p. 90). This has been examined by J. M. Baird and F. E. Sleeper, see *Proc. A. Ph. A.,* 1903, 324.

Assay of Stramonium.—"The method to be employed is identical with that given on page 228 for Belladonna Leaves, using *ten grammes* of Stramonium, in No. 60 powder." *U. S.*

Uses.—Stramonium is so similar to belladonna in the symptoms produced by it in small or large doses, in its toxicity and its general physiological and therapeutic action, that the two drugs are practically identical. Furthermore, they are about the same strength in activity, so the preparations may be used in similar doses. Stramonium has been employed in all the conditions for which belladonna is more

commonly used, but has acquired special repute in the treatment of *asthma*, this probably being due to the fact that the practice of smoking *Datura ferox* in that disease was introduced into Great Britain from the East Indies by General Gent, and that afterwards the English species was substituted for that employed in Hindostan. Formerly the roots were chiefly used, but at present the dried leaves are exclusively employed. They may be smoked in a common tobacco pipe, or may be made into cigars, but are commonly employed in the form of a powder, to be burnt upon a saucer; mixed with potassium nitrate they constitute the basis of most of the proprietary asthmatic powders. Death is said to have been produced by the free use of the India *Datura ferox*, but it seems hardly possible that the species which is found in North America would produce such a result.

Of the parts of the plant employed, the leaves and the seeds are the most powerful. They may be given in the dose of a grain (0.065 Gm.) twice a day; an extract made by evaporating the decoction, in one-quarter or one-half the quantity. The inspissated juice of the fresh leaves was formerly very commonly prescribed; but the alcoholic extract is now almost exclusively used, the dose being half a grain (0.032 Gm.). (See *Extractum Stramonii.*) A tincture and a fluidextract of the leaves are also official, to which the reader is referred; the fluidextract and extract of the seeds are no longer official. The dose should be gradually increased till the narcotic operation becomes evident, or relief from the symptoms of the disease is obtained.

Dose, one to five grains (0.065 to 0.32 Gm.) of the leaves (Stramonium, *U. S.*).

Off. Prep.—*From Leaves.* Extractum Stramonii, *U. S.* (from fluidextract); Fluidextractum Stramonii, *U. S.*; Tinctura Stramonii, *U. S.*, *Br.*

From Seed.—Extractum Stramonii, *Br.*

STRAMONIUM. U. S. (Br.)

STRAMONIUM [Stramonii Folia, Pharm. 1890, Stramonium Leaves]

(strą-mō′nī-ŭm)

"The dried leaves of *Datura Stramonium* Linné (Fam. *Solanaceæ*), yielding, when assayed as directed below, not less than 0.35 percent. of mydriatic alkaloids." *U. S.* "The dried leaves of Datura Stramonium, *Linn.*" *Br.*

Stramonii Folia, *Br., U. S.* 1890—Stramonium Leaves; Herba Stramonii; Thornapple Leaves; Thorn, Devil's or Mad Apple, Apple of Peru, Stink-weed, Jamestown (Jimson) Weed or Lily, Devil's Trumpet, Derotry; Stramoine ou Pomme-épineuse, *Fr. Cod.*; Feuilles de Stramoine, *Fr.*; Folia Stramonii, *P. G.*; Stechapfelblätter, *G.*; Stramonio, *It.*; Estramonio (Hoja de), *Sp.*

For description, official assay, uses, dose, etc., of stramonium, the reader is referred to the preceding article, *Stramonii Folia.*

STRONTII BROMIDUM. U. S.

STRONTIUM BROMIDE

(strŏn′tī-ī brō′mi-dŭm)

$SrBr_2 + 6H_2O = 352.94$

"It should contain not less than 97 percent. of pure Strontium Bromide, and should be kept in glass-stoppered bottles." *U. S.*

Bromure de Strontium, *Fr. Cod.*; Strontiumbromid, *G.*; Bromuro Estroncico, *Sp.*

This salt, made official in the U. S. P. 1890, may be made by burning strontium in bromine vapor, by dissolving strontium carbonate in hydrobromic acid, or by substituting hydrobromic acid for hydrochloric acid in the latter part of the process given for preparing strontium salts. (See page 1186.)

Properties.—It is officially described as in "colorless, transparent, hexagonal crystals; odorless and having a bitter, saline taste. Very deliquescent. Soluble in about 1 part of water at 25° C. (77° F.), and in 0.4 part of boiling water. It is readily soluble in alcohol, and is precipitated from this solution upon the addition of an equal volume of ether, in which it is insoluble. When heated, the crystals at first melt, and then lose all their water (30.4 percent.). The anhydrous salt fuses at 630° C. (1166° F.). To a non-luminous flame the salt communicates an intense red color. Its aqueous solution is neutral to litmus paper. With calcium sulphate T.S., the aqueous solution (1 in 20) slowly forms a white precipitate of strontium sulphate, insoluble in dilute acids; the same reaction occurs more quickly with diluted sulphuric acid and the readily soluble sulphates. With potassium chromate T.S. it forms a yellow precipitate of strontium chromate, soluble in acetic acid. With ammonium carbonate T.S., or sodium carbonate T.S., it forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid. If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, and then chlorine water, which has been diluted with an equal volume of water, introduced cautiously, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of *iodide*). The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. each of Strontium Bromide and sodium acetate be dissolved in 5 Cc. of distilled water, and the solution made slightly acid by the addition of from 3 to 5 drops, or a sufficient quantity, of diluted acetic acid, the solution should not, upon the addition of 5 drops of potassium dichromate T.S. and agitating, become cloudy within three minutes (limit of *barium*). If 0.5 Gm. of Strontium Bromide be dissolved in about 50 Cc.

of distilled water, and a few drops of potassium chromate T.S. be added, it should require the addition of not less than 27.4 (27.48) Cc. nor more than 29.4 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color (corresponding to at least 97 percent. of pure Strontium Bromide)." *U. S.* For further tests, see *Proc. A. Ph. A.*, 1897, 608.

Uses.—Strontium bromide has been strongly commended as a substitute for potassium bromide in the treatment of *epilepsy* and allied conditions. It depends for its action on the nervous system upon the presence of bromine in it, and appears to act upon the nervous centres in much the same manner as does the corresponding salt of potassium. Its influence upon the general nutrition is much more favorable than is that of the potassium salt, and it is much less apt to produce the disagreeable effects of bromism. Moreover, it is less irritating to the gastro-intestinal mucous membranes, on which, indeed, it often seems to exert a beneficial influence, and it probably acts as a powerful intestinal antiseptic. For these reasons many cases of epilepsy tolerate it much better than they do other bromides. In the clinical experience of H. C. Wood, however, it has seemed to be in its anticonvulsive influence among the least powerful and certain of its class. Possibly this result has been due to Wood not having employed it in sufficient dose, he never having administered more than two drachms a day, while the French observers affirm that it may be given with great advantage in the daily dose of three drachms. Strontium bromide is further stated by Sée to have an extraordinary influence in the reduction of the excretion of sugar in *diabetes*, and to be a valuable remedy in the treatment of *gastric dilatation* and *catarrh*.

Dose, fifteen to thirty grains (1 to 2 Gm.).

STRONTII IODIDUM. U. S.

STRONTIUM IODIDE

(strŏn'tĭ-ī ī-ŏd'ĭ-dŭm)

$SrI_2 + 6H_2O = 446.02$

"It should contain not less than 98 percent. of pure Strontium Iodide, and should be kept in small, glass-stoppered vials, carefully protected from light." *U. S.*

Iodure de Strontium, *Fr.*; Strontiumjodid, *G.*

This official salt may be made by evaporating a solution of hydriodic acid saturated with strontium hydroxide or carbonate.

Properties.—It is officially described as in "colorless, transparent, hexagonal plates; odorless, and having a bitter, saline taste. Deliquescent, and colored yellow by exposure to air and light. Soluble in about 0.5 part of water at 25° C. (77° F.), and in 0.27 part of boiling water. Also soluble in alcohol, and slightly soluble in ether. When cautiously heated, the crystals melt and gradually lose their water (24.05 percent.), becoming anhydrous. At a red heat, the salt is decomposed, losing iodine, and leaving a residue of strontium oxide. To a non-luminous flame it imparts an intense red color. Its aqueous solution is neutral, or very slightly alkaline to litmus paper. With calcium sulphate T.S. it slowly forms a white precipitate of strontium sulphate, insoluble in diluted acids; the same reaction occurs more quickly with diluted sulphuric acid and the readily soluble sulphates. With potassium chromate T.S. it forms a yellow precipitate of strontium chromate, soluble in acetic acid. With ammonium carbonate T.S., or sodium carbonate T.S., it forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid. If to 5 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chlorine water be added, iodine will be liberated, and impart to the solution a light reddish-brown color; on agitating the mixture with a few drops of chloroform, the latter will acquire a violet color. The aqueous solution of the salt (1 in 20), slightly acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 1 Gm. each of Strontium Iodide and sodium acetate be dissolved in 5 Cc. of distilled water, and the solution be made slightly acid by the addition of from 3 to 5 drops, or a sufficient quantity, of diluted acetic acid, the solution should not, upon the addition of 5 drops of potassium dichromate T.S., and agitating, become cloudy within three minutes (limit of *barium*). If 0.5 Gm. of Strontium Iodide be dissolved in about 100 Cc. of distilled water contained in a flask, and 25 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of nitric acid, and 5 Cc. of ferric ammonium sulphate T.S. be successively added, the flask stoppered and thoroughly shaken, then the addition of not less than 1.7 Cc. nor more than 3.1 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to produce a permanent red tint (corresponding to 98 percent. of pure Strontium Iodide)." *U. S.*

Uses.—This salt has been brought forward as a means of obtaining the alterative influence of an iodide without irritating the intestinal tract or depressing the general nutrition. It contains about 56.5 per cent. of iodine, and, although its actual value has scarcely as yet been made out, may be substituted for potassium iodide in various diseases.

Dose, five to fifteen grains (0.32 to 1 Gm.).

STRONTII SALICYLAS. U. S.

STRONTIUM SALICYLATE

(strŏn'tĭ-ī săl-ĭ-cȳ'lăs)

$Sr(C_7H_5O_3)_2 + 2H_2O = 394.72$

"It should contain not less than 98.5 percent. of pure Strontium Salicylate [$(C_6H_4.OH.$

$COO)_2Sr + 2H_2O$], and should be kept in well-stoppered bottles, protected from heat and light." *U. S.*

Strontium Salicylicum; Salicylate de Strontium, *Fr.;* Salicylsaures Strontium, Strontiumsalicylat, *G.*

Preparation.—This salt is made by adding 10 parts of salicylic acid to 100 parts of hot water and then adding 5.3 parts of pure strontium carbonate, filtering, evaporating and crystallizing.

Properties.—It is officially described as "a white, crystalline powder; odorless, and having a sweetish, saline taste. Soluble in 18 parts of water and in 66 parts of alcohol at 25° C. (77° F.), in 3.5 parts of boiling water, and in 10.5 parts of boiling alcohol. When heated, the salt is decomposed, giving off inflammable vapors and an odor of phenol, and finally leaving a gray residue of strontium carbonate. To a non-luminous flame its solution imparts an intense red color. Its aqueous solution should be colorless, and slightly alkaline to litmus paper. Ferric chloride T.S., when added to an excess of a concentrated aqueous solution of the salt, produces a violet precipitate; but when added to a very dilute solution (1 in 100), it produces a deep violet-blue color. If copper sulphate T.S. be added to the aqueous solution (1 in 20), a green color will be produced. On adding about 1 Cc. of concentrated sulphuric acid to about 0.2 Gm. of the salt, in a test-tube, then about 1 Cc. of methyl alcohol, in drops, and heating the mixture to boiling, the odor of methyl salicylate will be evolved. With calcium sulphate T.S., the aqueous solution of the salt (1 in 20) slowly forms a white precipitate of strontium sulphate, insoluble in dilute acids; the same reaction occurs more quickly with diluted sulphuric acid or a readily soluble sulphate. With potassium chromate T.S., Strontium Salicylate forms a yellow precipitate of strontium chromate, soluble in acetic acid. With ammonium carbonate T.S., or sodium carbonate T.S., the salt forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid. If to the aqueous solution of Strontium Salicylate (1 in 20) 5 drops of hydrochloric acid be added, and the mixture agitated and filtered, the filtrate should not respond to the Time-Limit Test for *heavy metals* (see PART III, Test No. 121). If 2 Gm. of Strontium Salicylate be agitated with 10 Cc. of diluted acetic acid, heated, cooled, and filtered, the filtrate, upon the addition of 5 drops of potassium dichromate T.S., should not become cloudy within three minutes (limit of *barium*). If to 0.5 Gm. of Strontium Salicylate, contained in a porcelain crucible, 1 Cc. of sulphuric acid be added, the mixture cautiously heated until no more vapors are given off, the residue again moistened with a few drops of the acid, again heated, and finally ignited until white and of constant weight, the residue of strontium sulphate should weigh not less than 0.227 Gm." *U. S.*

Uses.—Strontium salicylate when taken internally is slowly decomposed in the alimentary canal with the liberation of salicylic acid, which acid or its educts can be detected in the urine shortly after administration. As a salicylate, the strontium salt is of especial value in subacute *rheumatic* affections, acting more slowly and persistently than most of the other allied salts, and having much less tendency to disturb the digestion. It may be administered in capsule, but should never be given in the form of compressed pills.

Dose, five to thirty grains (0.32 to 2.0 Gm.).

STRONTIUM.

STRONTIUM

(strŏn'tĭ-ŭm)

Sr = 86.94

Strontium belongs to the alkaline earth-group of metals along with barium and calcium. It is a yellow metal, of the sp. gr. 2.5, somewhat harder than lead, and is sufficiently malleable to be hammered out into thin plates. It oxidizes quickly on exposure to air, and hence must be kept under naphtha, like the alkali metals. It has so far been prepared only in a small way by electrolysis from the chloride or the hydroxide, the best procedure being that of Bunsen and Matthiessen.

For the preparation of pure salts, Barthe and Falières found that the following method permits the preparation of pure strontium salts with comparative ease, and has the advantages that no heat is necessary, and that the chemicals employed need not be pure.

Dissolve natural strontium carbonate (or the sulphide obtained by reduction of the sulphate) in just sufficient diluted hydrochloric acid (1 to 5); it will be an advantage if some of the carbonate or sulphide remains undissolved. The clear liquid, which contains calcium, barium, and strontium salts, besides small quantities of iron, aluminum, and magnesium, is decanted from the deposit, and a small excess of ammonia added, which precipitates iron and alumina. To the filtrate is added an excess of sulphuric acid; the precipitate, consisting of strontium, barium, and calcium sulphates, is washed repeatedly by decantation with water containing from 1 to 2 per cent. of sulphuric acid, and finally with distilled water. This will remove all traces of magnesium and calcium sulphate. The precipitate is next treated in the cold with an excess of a solution of ammonium or potassium carbonate (1 to 10), stirring frequently for two days, and finally washing with distilled water by decantation. The mixture of carbonate and sulphate is treated with diluted hydrochloric acid, which dissolves strontium carbonate and traces of baryta. After allowing it to stand for twenty-four hours the clear liquid is decanted and filtered through a filter previously washed with diluted hydrochloric acid. To the perfectly clear filtrate are added 200 Gm. of hydro-

chloric acid per liter, and then from 2 to 3 Gm. of precipitated strontium sulphate, which may contain barium sulphate; stirring frequently for several hours. The strongly acid liquid dissolves a little strontium sulphate (about 0.25 per cent.), but in proportion as the strontium is dissolved the barium takes hold of the sulphuric acid, while an equivalent quantity of strontium chloride is formed. The strontium sulphate being in excess will insure the final elimination of all the barium. The filtrate is evaporated to dryness, the salt dissolved in three times its weight of distilled water, allowed to stand for twenty-four hours, filtered, evaporated to crystallization, and dried. The crystals showed in the spectroscope only the lines of strontium. (*Bull. Soc. Chim.*, 1892, 104.)

Strontium nitrate is largely used for making *red fire* in pyrotechnics; the salt is made by dissolving strontium carbonate in diluted nitric acid, evaporating the solution and crystallizing.

In 1890, J. V. Laborde demonstrated that the traditional belief in the toxicity of the salts of strontium was incorrect. He found that fifteen grains intravenously given to a medium-sized dog produced no effect whatever, and that large quantities of the strontium salts might be mixed with the food of the animal without disturbing the general nutrition, the strontium salts being less harmful than the corresponding salts of potassium. Indeed, he asserts that during the administration of the strontium the animals gained in health and weight, and, further, that the eliminated strontium in the fecal and urinary discharges had a distinct beneficial antiseptic influence. It is stated that Vulpian in 1885 announced the value of strontium salts, but certainly to Laborde belongs the honor of first establishing their usefulness.

STROPHANTHINUM. U. S.

STROPHANTHIN

(strō-phăn-thĭ'nŭm)

"A glucoside, or mixture of glucosides, obtained from Strophanthus. It should be kept in well-stoppered, amber-colored vials." *U. S.*

Strophantine, *Fr. Cod.*; Strophanthin, *G.*

Preparation.—Strophanthin [1] was made official in the U. S. P. (8th Rev.). It may be made by Fraser's process by depriving the ground seeds of fatty oil by percolation with petroleum benzin, making a tincture from the marc with 70 per cent. alcohol, distilling, evaporating and treating the extract with water, this solution is then filtered and the filtrate precipitated with tannic acid; the precipitate is washed, mixed with litharge, dried and exhausted with alcohol; by adding ether to the alcoholic liquid, strophanthin is precipitated. (See *Strophanthus*, below.)

Properties.—It is officially described as a "white or faintly yellowish crystalline powder, containing varying amounts of water of crystallization, which it does not lose entirely without decomposition. Taste intensely bitter; *great caution should be used in tasting it.* Permanent in the air. It is very soluble in water and in diluted alcohol, less soluble in absolute alcohol, but nearly insoluble in ether, chloroform, and benzene. When heated, it begins to fuse at 170° C. (338° F.), and is not completely melted until the temperature of 190° C. (347° F.) is reached. Its solutions are dextrogyrate, and neutral to litmus paper. Sulphuric acid produces with Strophanthin an emerald-green color, changing to brown. If to an aqueous solution of Strophanthin a trace of ferric chloride T.S. and a few Cc. of sulphuric acid be added, a red-brown precipitate will be produced, turning dark green after one or two hours. Strophanthin should not reduce alkaline cupric tartrate V.S.; if its solution be heated to 70° C. (158° F.) with a small amount of diluted hydrochloric acid (1 in 20), it will be decomposed into strophanthidin, which precipitates, and a sugar, which will remain in solution, and which will reduce alkaline cupric tartrate V.S." *U. S.*

Uses.—On account of the great variability of strophanthus seeds, strophanthin, which fully represents their therapeutic activities, should always be preferred to the crude preparations of the drug. It is best administered in the form of granules. Stahr affirms (*Th. M.*, 1898, xii.) that three-tenths of a grain (0.020 Gm.) may be safely administered in twenty-four hours.

Dose, one two-hundredth of a grain (0.0003 Gm.).

STROPHANTHUS. U. S. (Br.)

STROPHANTHUS

(strō-phăn-thŭs)

"The ripe seed of *Strophanthus Kombé* Oliver (Fam. *Apocynaceæ*), deprived of its long awn." *U. S.* "The dried ripe seed of Strophanthus Kombé, *Oliver*, freed from the awns." *Br.*

Strophanthi Semina, *Br.*; Strophanthus Seeds; Strophantus, *Fr. Cod.*; Semen Strophanthi, *P. G.*; Strophanthussamen, *G.*; Strofanto, *It.*; Estrofanto (Semilla de), *Sp.*

According to Engler and Prantl, there are twenty-eight recognized species of the genus found in Africa and Asia, extending to China,

[1] E. Merck & Co. have sent into commerce, under the name of *G. Strophanthin crystallizatum*, a crystalline glucoside obtained from the seeds of *S. gratus*. This occurs in colorless satiny, quadratic, tabular crystals, easily soluble in hot water, soluble in 100 parts of water at 15° C., in 30 parts of absolute alcohol, difficultly soluble in acetic ether, ether and chloroform. The solution of 0.01 Gm. in 1 Gm. of water poured on concentrated sulphuric acid gives it a rose-red color while the aqueous solution assumes a dirty green color. It loses 20 per cent. of moisture at 105° C. and the dried glucoside melts at 187° to 188° C.

the East Indies, and the Philippines. The commercial drug is often largely composed of the seeds of other than the recognized official species, and may contain the seeds from related genera, especially those of *Kickxia africana*, Benth.[1] The seeds of all the species of strophanthus apparently possess, however, hairs that have a characteristic thickened base somewhat resembling those of nux vomica seeds. The seeds of various species of the genus Strophanthus are used for the preparation of arrow poison in Africa, at Kombé in the Manganja country, in the Gaboon district, and in Guinea and Senegambia. In Gaboon this poison is called *inée, onaye,* or *onage*. The plant which yields the arrow poison of Kombé was first brought to Europe by Sir John Kirke and described as a new species by Oliver of Kew, under the name of *S. Kombé*. There can be no doubt that much of the Strophanthus of commerce is yielded by other species. *S. Kombé* grows solely in East Africa, as far as is known, so that all of the drug coming from West Africa must be yielded by other species. The tracing of the origin of the seeds is made more difficult by the fact that in Africa seeds from different regions are mixed before shipment. The seeds of *S. hispidus* enter commerce, as do also those of *S. glaber, S. emini,* and *S. courmontii*. (*P. J.,* lxiii. p. 321.) A white woolly Strophanthus is said to be yielded by *S. Nicholsoni*, a species first characterized by Holmes (*P. J.,* lix. 208). *S. gratus* of Sierra Leone also contributes its seeds; also *S. glaber* contains *ouabaïn,* which, according to Karsten, is identical with strophanthin. (*C. R. A. S.,* cxxvi. 346.)

S. hispidus when by itself takes the form of a bush, but usually occurs as a woody climber inhabiting the forests between the coasts and the centre of the African continent. It reaches to the tops of the highest trees, coiling on the ground, and hanging in festoons from tree to tree. The stem is several inches in diameter. The flowers are cream-colored, yellow at the base, purplish-spotted above. They are grouped in terminal cymes. The lobes of their gamopetalous corollas are prolonged into very narrow tail-like ends, nine or more inches in length. They last but a short time during the months of October and November. The fruit, a pair of follicles from 10 to 17 inches long, is ripe in June, and is gathered by the natives, who scrape off the husks (epicarp and mesocarp) before drying, and preserve the more leathery internal inner covering (endocarp) with the enclosed seeds; hence the pods as they appear in commerce are smooth and of a tawny color. The seeds themselves are covered with long comose hairs, which, being deciduous, are apt to be lost before the escape of the seed from the pod. In preparing the arrow poison, the natives are said to pound the seeds deprived of their hairs to a pulp, add the adhesive sap of another plant, and simply smear the mixture for six inches along the point of the arrow. Game wounded by such an arrow is said to be rarely able to move a hundred yards, and the flesh is eaten without bad effect. Karsten has examined the *root* of Strophanthus hispidus and found that it contained *trigonelline, choline* and *strophanthin* in such small proportions that it will probably never be commercially valuable. (*B. P. G.,* 1902; 12, 241.)

Strophanthus occurs in commerce either in pods or as clean seeds. Helbing states (*P. J.,* March, 1887) that he has found the seeds to constitute about 37 per cent., the pod (endocarp) 37 per cent., and the hairs about 25 per cent., and says that the quality of the pods may be determined by examining the color of the pappus. If this is white and bright, the seeds and pods are in good condition.

At present (1905) strophanthus seeds are much less mixed than formerly.[1] There are two chief varieties. The official commands a much higher price than does the inferior variety, composed of the seeds of *S. hispidus*.

Official strophanthus seeds are from one and one-half to two and one-half Cm. long, and from four to five Mm. broad. They are more or less rounded off at the base, without, however, losing the distinctly pointed shape; towards the upper end they become suddenly very much narrower, and end in the stalk of the pappus, which stalk is usually not apparent. They are flattened at the sides, and have a much more prominent keel-shaped ridge on one side than on the other; the seed is twisted slightly in the form of a spiral from the base to the apex. This twist is, however, often not very apparent. The color of the seeds varies from a grayish green to a brown, when the fine

[1] The seeds of *Kickxia africana* are without hairs, spindle-shaped, not flattened, twisted into an S-like shape, and with the base and the point of the seed alike in their forms. On cross-section the cotyledons are seen much folded, while those of the strophanthus lie parallel one upon the other. The transverse section of the kickxia seed, when treated with concentrated sulphuric acid, first turns brown, then red, while the seeds of both kinds of strophanthus take on a green color. According to Stapf the plant represents a new genus and should be known as the *Funtumia africana;* the only other species of the genus, *F. elastica,* yields India rubber.

[1] In 1892 Hartwich classified commercial strophanthus seeds (*A. Pharm.,* 1892, 401), in the following groups: (1) The official products yielded by *S. hispidus* or *S. Kombé*, which contain strophanthin and no crystals of calcium oxalate. (2) Those resembling the official seeds, but of different habitat,—viz., Mozambique and Sierre Leone. (3) Those which contain calcium oxalate crystals, but no strophanthin,—viz., Senegal, Lagos, Niger, German East Africa, Togoland, and Baol of Senegal. (4) A very hairy seed from the Upper Niger. The hairs vary in color from a silky white to brown; the embryo contains calcium oxalate crystals, but the seeds do not contain strophanthin. (5) Seeds which are said to be glabrous, but possess hairs in the region of the raphe. These include those from Lagos and Zambesi, and contain neither calcium oxalate crystals nor strophanthin. In 1896 S. E. Jelliffe stated that there are in the American market two hairy seeds, the product respectively of *S. hispidus* (Kombé) and *S. asper,* and one smooth seed, *S. gratus* of the Gaboon. (See *D. C.,* 1896, 101.) The seeds of *S. Gratus* are recommended by E. Gilg as more easily recognized than the others and because it yields strophanthin more readily in crystalline form. (*B. P. G.,* 1904, 90.)

hairs have been rubbed off. The hairs are silky, not more than 1 Mm. long. The seeds[1] are officially described as "of a light fawn-brown color, with a distinct greenish tinge; about 15 Mm. long and 4 to 5 Mm. wide, 2 to 2.5 Mm. thick, lance-ovoid, obtuse at the base, gradually acuminate and somewhat acute at the summit, usually twisted, bearing on one side a ridge running from about the centre to the apex; silky-lustrous from a dense coating of closely appressed hairs, which mostly lie in longitudinal grooves on the surface; fracture short and somewhat soft, the fractured surface whitish and oily; kernel consisting of a thin endosperm enclosing straight cotyledons; odor slight, or heavy when the seeds are crushed and moistened; taste very bitter. The endosperm, and often parts of the cotyledons, quickly assume a green color when crushed or cut and treated with concentrated sulphuric acid. Under the microscope the hairs are seen to be of a light greenish-brown color, 1 Mm. or less in length and to consist of but one thin-walled cell. A decoction prepared with 1 part of the seed and 10 parts of water has a brownish color, and is not changed in appearance on the addition of iodine T.S., ferric chloride T.S., or mercuric potassium iodide T.S." *U. S.*

The seeds of *S. hispidus* are of a pure brown color, with the hairs very inconspicuous and the keel consequently very prominent. They are distinctly smaller than those of *S. Kombé,* being about one Cm. long and one and a half to two Mm. broad. The stalk of the pappus is usually very evident. They are not longitudinally grooved but are often wrinkled on the surface more or less lengthwise.

The more important of the rarer varieties of strophanthus are composed of seeds which at one time were much mixed in Africa before exportation with those of *S. Kombé* and *S. hispidus* and are the products of two species, *S. glabra* and *S. Thalloni.* The seeds of *S. glabra* are about thirteen to sixteen Mm. long from three to four and a half Mm. wide, and from one to one and a half Mm. thick. They are lanceolate with a rounded or truncated base and a long attenuate apex. The ventral face is flat or concave, the dorsal being convex, and possesses sometimes a small keel near the shaft. The surface is glabrous, of a dull waxy appearance; the color varies from an ochre-yellow to a fawn or cinnamon; the odor is characteristic; the fracture is horny and the taste extremely bitter. The hairs of the awn are about seven Cm. in length, numerous, silky, white, and when viewed in a mass yellowish or grayish. The seed coat is relatively thin; the albumen is thick and cartilaginous; the embryo is not thick, the radicle is as long as in *S. hispidus* or *S. Kombé.* With concentrated sulphuric acid the color changes from yellow to rose and finally to violet.

The seeds of *S. Thalloni* are very long and narrowly spindle shaped tapering above and below, and covered with numerous brownish hairs. A smooth blackish-brown Strophanthus seed is said to be sent into commerce from Indo-Malaya.

The seeds of *S. Courmontii* are 8 to 14 Mm. in length, 2.5 to 3.5 Mm. in breadth and 1 to 2 Mm. in thickness; of a distinctly lanceolate form and decidedly brown color, often with the hairs rubbed off, but having a golden sheeny appearance when these remain, while the tint is dull and reddish when they are absent. The ridge on the ventricular surface is indistinct and the arrangement of the hairs in longitudinal rows is not as apparent as in the official seed. They also contain crystals of calcium oxalate in abundance, which have been stated by some observers to be entirely absent from *S. Kombé* and *S. hispidus* but are in fact there in very small amount. The seeds of *S. elemi* are grayish green in hue and contain crystals of calcium sparingly in the embryo. The statement of E. M. Holmes (*P. J.,* lxiv.) that the seeds of *S. Kombé* and *S. hispidus* give with sulphuric acid a greenish reaction, while those of *S. Courmontii* give a reddish, and *S. elemi* a yellowish brown changing into reddish, seems not be absolutely accurate, for while the seed albumen of *S. Kombé* always gives the greenish reaction the cotyledons frequently are mottled with red and rarely give an entirely red reaction. (Perredes.)

The Qualitative Examination of Strophanthus Seeds.—C. Hartwich (*A. Pharm.,* 1892) declares the usual course for the qualitative examination of strophanthus seeds—as the external appearance, the bitter taste, and the few chemical tests—insufficient, and recommends a microscopical test for stropthanthin to supplement the usual tests. In the examination of a great variety of strophanthus seeds some were found to contain starch, which is contrary to the general opinion.

For the valuation of the seeds the presence of strophanthin should be ascertained in the following manner. A fine cross-section of the seed is placed on a glass slide and covered with a drop of concentrated sulphuric acid. The endosperm at least should assume an intense green color, which is easily seen with a hand-glass. Often the green is preceded momentarily by a blue color. The cotyledons are also colored green, but generally less intensely than the endosperm. Gradually the color changes through blue into red, and after one-quarter to one hour it disappears. In seeds which contain but little strophanthin the endosperm alone is colored green, while the embryo is colored yellow and then red, or only the epidermis and the adjacent cells are colored in addition.

Tests for Tincture and Extract of Strophanthus.—For testing the tincture three drops are taken, and for the extract a piece a little larger than a pin head. In either case mix the drug

[1] For an elaborately illustrated article on the histology of *S. Kombé,* by P. E. F. Perredes, see *W. C. R. L.,* No. 15; see also *B. P. G.,* 1904, 104, 120.

with a half-drop of ferric chloride solution and three drops of sulphuric acid. A brown precipitate is formed which is distinctly green after one hour, and should retain the color for fully three hours.

Hardy and Gallois have obtained from strophanthus two crystalline principles. One, which is a glucoside, they call *strophanthin;* the second, an alkaloid, they name *inæine.* The first-named appears to be the active principle of the poison. (*J. P. C.,* 3e sér., xxv. p. 176.) T. R. Fraser describes more fully the glucoside strophanthin. (*P. J.,* 1886, July 23.) When heated with dilute sulphuric acid it yields glucose and *strophanthidin,* which is insoluble in water, is very soluble in alcohol, and has a strongly bitter taste. *Strophanthin* is a white crystalline powder, neutral in reaction, intensely bitter, freely soluble in water, less so in rectified spirit, and nearly insoluble in ether and chloroform. According to E. Merck it fuses at 185° C. Fraser has since (*A. J. P.,* 1889, p. 532) further investigated strophanthin. He found it difficult to separate, but obtained it pure by a somewhat tedious process, depending upon the formation of a tannate and subsequent decomposition by lead oxide. It yielded upon analysis results corresponding to the formula $C_{30}H_{34}O_{10}$. Thoms (*Ber. d. Chem. Ges.,* 1898, 534) obtained pure strophanthin. Arnaud gives its formula as $C_{31}H_{46}O_{12}$; this was confirmed by Kohn and Kulisch. Feist gives its composition as $C_{40}H_{66}O_9$. Thoms found that the strophanthins as obtained from different species differ somewhat in chemical composition and properties and he proposes to designate them as follows: *k-strophanthin* when obtained from *S. Kombé; g-strophanthin* (*S. gratus*), *e-strophanthin* (*S. Emini*), *h-strophanthin* (*S. hispidus*). To g-strophanthin he gives the formula $C_{30}H_{46}O_{12} + 9H_2O$. *Strophanthidin* has the formula $C_{23}H_{38}O_7 + 1\frac{1}{2}H_2O$. Strophanthidin, the product of decomposition of the glucoside, is described as having an intensely bitter taste and a neutral reaction, and as being very slightly soluble in water, moderately soluble in cold and freely in warm alcohol. It crystallizes with great readiness. No alkaloid was detected, but in the lead precipitate from an aqueous solution of the alcoholic extract a compound was found of strongly acid reaction and freely soluble in water, to which the name of *kombic acid* has been given. The experiments of Fraser have shown that the active principle of strophanthus is most abundant in the seeds, but that it is contained also in the follicles and the hairs. Pharmaceutical preparations of the drug should, therefore, be made from the separated seeds, while the pericarp and the hairs may be employed for the manufacture of strophanthin. For methods of assaying strophanthus see *D. C.,* 1900, 132.

Uses.—The first experiments with the Kombé arrow-poison were those of Thomas R. Fraser. (*J. A. P.,* vii. 141.) One-twentieth of a grain of the extract of the seeds produced in the frog stiffness of the limbs, gradual loss of reflex sensibility, arrest of the heart in systole, and, after a time, complete loss of voluntary movement,—the respiration continuing for a length of time after the cessation of the heart's beat. The loss of voluntary movement and the cessation of respiration appear to be due to a direct action of the poison upon the muscles themselves. The first influence of the poison upon the muscular fibre is to increase its tonicity, and when the muscle dies it does not go into relaxation, but passes directly from life into post-mortem rigidity. The drug seemed to exert little or no influence upon the spinal cord or the nerve trunks.

These experiments have been abundantly confirmed by subsequent observers, so that it is fairly established that the Kombé arrow-poison is essentially a muscle poison, and that it acts upon the muscles of the heart as it acts upon other muscles, only more vigorously. In some cases, especially in mammals, death occurs through respiratory paralysis, and not through cardiac arrest,—the respiratory muscles in these cases feeling the influence of the poison more powerfully than the heart. The value of the drug in practical medicine depends chiefly upon its heart action, moderate doses of it producing in both man and the lower animals pronounced rise of the blood pressure. It is probable that the muscles in the arterioles feel the effect of the drug, and by their contraction help in the elevation of the arterial pressure, although this is not proved, and Fraser believes to the contrary.

In man, the effect of full therapeutic doses of the drug is to lower the pulse from ten to thirty beats, increasing at the same time its force and volume, usually without producing other symptoms, unless it be increased diuresis. The effect upon the pulse comes on much more quickly and is much less permanent than that of digitalis, lasting usually from four to eight hours. The diuretic action of the drug seems to depend not only on its effect upon the circulation, but also largely on a direct influence upon the secreting structure. Only one case of doubtful cumulative action has as yet been reported (see H. C. Wood's *Therapeutics*), and it is probable that the active principle is both rapidly absorbed and rapidly and completely eliminated. Strophanthus is of great value in practical medicine in the same class of cases in which digitalis is employed. (See *Tinctura Strophanthi.*) It seems to be superior to digitalis as a diuretic, and therefore is especially indicated in *cardiac dropsy.* Strophanthus is locally irritating, and in some cases even therapeutic doses produce violent gastric pain and vomiting. Local anæsthetic properties have been claimed for strophanthin by Panas, by Gley, by Hare and De Schweinitz, and by other observers. The irritating effects of strophanthin are, however, too great for its practical use, and it has been especially shown by Hare and De Schweinitz that the drug when

placed in the eye is exceedingly prone to produce violent inflammation and even ulceration of the cornea.

Strophanthin is now used in medicine, but great caution is necessary in its employment, on account of its extreme activity (Fraser found that a solution of 1 part of strophanthin in 6,000,000 would stop the frog's heart) and the present absolute uncertainty as to the proper dose, growing out of its varying impurity. Rothziegel and Koralzewski maintain, however, that the active principle is more prompt and certain in its influence, and less apt to disturb the stomach, than are the ordinary preparations of the drug. They give the dose as from 1-300th to 1-200th of a grain (0.0002 to 0.0003 Gm.), and have in some cases administered as much as one-sixteenth of a grain (0.004 Gm.) during twenty-four hours. When the alkaloid is given hypodermically the effect on the pulse is said to be manifest in five minutes. *Strophanthin tannate* contains 58.14 per cent. of strophanthin, and is given in the dose of from one-hundredth of a grain to one-sixtieth of a grain (0.0006 to 0.001 Gm.).

As the amount of strophanthin varies in true strophanthus seeds from 0.45 to 1 per cent. (Rice), it is plain that such preparations as tincture and extract must very greatly vary in their activity, even when carefully made from the drug. If it were possible to practically assay these preparations, the Pharmacopœia should direct only assayed preparations; but at present there seems to be no practical method known. In experiments made by H. C. Wood and W. S. Carter the extract of strophanthus prepared by evaporating the official tincture was found to be as uniform and effective in its action as the tincture itself. Strophanthin is now official and is preferable to the older preparations. (See *Strophanthinum.*)

Dose, of strophanthus, one-half to two grains (0.032 to 0.13 Gm.).

Off. Prep.—Extractum Strophanthi, *Br.;* Tinctura Strophanthi, *U. S., Br.*

STRYCHNINA. U. S., Br.

STRYCHNINE

(strȳ́ch-nī′na)

$C_{21}H_{22}N_2O_2 = 331.73$

"An alkaloid obtained from Nux Vomica, and also obtainable from other plants of the *Loganiaceæ.*" *U. S.* "An alkaloid, $C_{21}H_{22}N_2O_2$, obtained from the dried ripe seeds of Strychnos Nux-vomica, *Linn.,* and other species of Strychnos." *Br.*

Strychnia, *U. S.* 1870; Strychninum; Strychnine, *Fr. Cod.;* Strychnin, *G.;* Stricnina, *It.;* Estricnina, *Sp.*

The U. S. and Br. Pharmacopœias very properly omit processes for preparing this alkaloid, as it can be made profitably only by the manufacturing chemist on a large scale. (See U. S. D., 17th ed., p. 1295.)

The bean of St. Ignatius yields strychnine more easily and more largely than nux vomica.[1] If thought desirable, brucine may be in great measure separated from the strychnine of commerce, by dissolving the latter in very dilute nitric acid, filtering, and concentrating. Brucine nitrate crystallizes in short, thick, dense prisms grouped together; strychnine nitrate in radiated tufts of long, light, capillary needles. By gentle agitation with the liquid, the latter salt is suspended and may be poured off, leaving the former. The alkaloids may be obtained by dissolving the salts in water, and precipitating with ammonia.

Properties.—As usually found in commerce, strychnine is a white or grayish-white powder. When rapidly crystallized from its alcoholic solution, it has the form of a white, granular powder; when slowly crystallized, that of elongated octohedra, or rhombic prisms with pyramidal summits. It is officially described as in "colorless, transparent, prismatic crystals, or a white crystalline powder; odorless, and having an intensely bitter taste, perceptible even in solutions of 1 in 700,000. *Strychnine should be tasted with extreme caution.* Permanent in the air. Soluble in 6400 parts of water, 110 parts of alcohol, 5500 parts of ether, 6 parts of chloroform, 150 parts of benzene, and in 180 parts of amyl alcohol at 25° C. (77° F.); soluble in 3000 parts of water at 80° C. (176° F.), and in 28 parts of alcohol at 60° C. (140°F.). Its melting point is 268° C. (514.4° F.). Upon ignition it is consumed, leaving no residue. Its solutions are lævogyrate and alkaline to litmus paper. Sulphuric acid containing 1 percent. of ammonium vanadate produces with Strychnine a deep violet-blue color, changing to a deep purple, and finally to a cherry-red. Sulphuric acid containing a trace of potassium iodate produces a violet color, changing momentarily to reddish-purple. If 0.1 Gm. of Strychnine dissolved in a few drops of nitric acid be evaporated to dryness, and a few drops of ammonia water added to the yellow residue, an orange color will be produced, which will turn reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide T.S. Sulphuric acid should produce no color (absence of *sugar* and *other readily carbonizable organic impurities*), but on adding a fragment of potassium dichromate, a deep blue color is momentarily produced, changing to deep violet, then to purplish-red, cherry-red, and finally to orange or yellow. Nitric acid, when added to a crystal of Strychnine on a white porcelain surface, should not produce more than a faintly pink color (limit of *brucine*)." *U. S.* "Trimetric

[1] J. F. Molyn proposed, previously to the extraction of strychnine, to subject nux vomica to fermentation, by which the saccharine and gummy matters of the seeds are decomposed, and lactic acid is formed, which decomposes the strychnine and brucine igasurates, producing with these bases very soluble lactates. For the particulars of this process see *A. J. P.* (xix. 99), and for other processes see U. S. D., 14th ed., p. 1456.

prisms; colorless and inodorous; very sparingly soluble in *water,* but communicating to it an intensely bitter taste; soluble in 150 parts of cold but in less of boiling *alcohol* (90 per cent.), and in 6 parts of *chloroform;* slightly soluble in cold *absolute alcohol,* but readily in 40 parts of boiling *absolute alcohol,* and nearly insoluble in *ether. Sulphuric acid* forms with it a colorless solution, which on the addition of *potassium bichromate* acquires an intensely violet hue, speedily passing through red to yellow. When *sulphuric acid* containing one-two-thousandth part of *potassium permanganate* is brought into contact with a minute particle of Strychnine, a violet coloration results. Not colored by *nitric acid* (absence of brucine); leaves no ash when burned with free access of air (absence of mineral impurities)." *Br.* It melts like a resin, is decomposed at a comparatively low temperature, and entirely dissipated at a red heat. Guy obtained a crystalline sublimate, at a heat but a few degrees below that at which it begins to change color and undergo decomposition. Its melting point has been given as 284° C. (543° F.), but, according to Flückiger, in small portions it melts as low as 225° C. and can with care be sublimed without decomposition. According to Waddington, when heated to decomposition it emits a most suffocating odor, resembling the odor of asphaltum. (*P. J.,* March, 1868, p. 413.) Fused with an excess of potassium hydroxide, it yields, according to Goldschmied (*Ber. d. Chem. Ges.,* 15, p. 1977), *indol,* C_8H_7N, and when distilled with zinc dust it yields a *dimethyl pyridine,* C_7H_9N, and *carbazol,* $C_{12}H_9N$. The volatile oils dissolve it freely. Petroleum benzin dissolves 0.607 per cent. of it, and amyl alcohol 0.55 per cent. (Dragendorff, *J. P. C.,* 4e sér., iv. 473.) It has an alkaline reaction on test-paper, and forms salts with the acids. Nitric acid does not redden it if perfectly pure, but almost always reddens it as found in commerce, in consequence of the presence of brucine. Eugène Marchand proposed the following test by which a very minute proportion of strychnine may be detected. If a little of the alkaloid be rubbed with a few drops of concentrated sulphuric acid containing one-hundredth of nitric acid, it will be dissolved without change of color; but if the least quantity of lead peroxide be added to the mixture, a magnificent blue color will be instantly developed, which will pass rapidly into violet, then gradually to red, and ultimately become yellow. (*J. P. C.,* 3e sér., iv. 200.) Otto recommended as a test a minute quantity of solution of potassium dichromate, which, added to the solution of strychnine in concentrated sulphuric acid, produces a splendid violet color. (*A. J. P.,* xix. 77.) A similar change of color is produced, according to E. W. Davy, by substituting a strong solution of potassium ferricyanide (red potassium prussiate) for that of potassium dichromate. (*A. J. P.,* xxv. 414.) It appears that any substance capable of yielding nascent oxygen readily will serve to develop the characteristic violet color, when applied after the addition of sulphuric acid. Landerer has found that solid iodic acid or potassium iodate heated gently with strychnine gives rise to a beautiful violet color, gradually passing to red, which remains unchanged for many days. (*A. J. P.,* March, 1861, p. 110.) According to Wm. Copney, the least efficacious agent is potassium chlorate, a much better is lead dioxide, a still better is manganese dioxide, and the best of all is potassium dichromate, and the general result of numerous experiments, recently made, is that the last-mentioned agent is the most effective. The sulphuric acid must be of not less sp. gr. than 1.84. The play of colors, according to Copney, is first blue, then purple, then crimson, which is followed by red and green, the latter sometimes giving place to yellow. It is stated that the 1-500,000th part of a grain may be detected. (See *A. J. P.,* xxviii. 459.) On the other hand, some chemists have found difficulties with the potassium dichromate test. Thus, Brieger (*Jahresb.,* 1850, p. 617) found that, unless the substance was first moistened with sulphuric acid and the dichromate added to it subsequently, the reaction of strychnine was interfered with by quinine, morphine, and especially by sugar. Sonnenschein (*Fresenius's Zeitschrift,* 9, p. 495) found that ceroso-ceric oxide was much more sensitive as a reagent to use with sulphuric acid for strychnine than potassium dichromate. This fact we can confirm from experience. It gives a blue color lasting longer, which then becomes violet, and then a permanent cherry-red.[1] Vanadio-sul-

[1] To succeed in detecting the alkaloid when mixed in small proportion with organic matters, it is necessary first to disintegrate the organic matter, that the action of a solvent of the strychnine should not be impeded, and that the alkaloid should be completely separated from the foreign matter. The process of Rogers and Girdwood, by which these objects are effected, is the following: Digest the substance supposed to contain the strychnine with a mixture of 1 part of hydrochloric acid and 10 of water, until it becomes apparently fluid. Filter, and evaporate the liquid to dryness on a water bath. Treat the residue with alcohol as long as anything is dissolved, filter, and evaporate. Dissolve the residue in water, and filter. Add solution of ammonia in excess to the aqueous solution, and agitate in a bottle or long tube with half an ounce of chloroform. Upon repose the chloroform subsides, holding the alkaloid in solution. Draw it off by a pipette, and evaporate the chloroform over a water bath. Moisten the dry residue with concentrated sulphuric acid, and expose the mixture for some hours to the temperature of a water bath, by which means all the organic matter except the strychnine is decomposed. Treat the charred mass with water, filter, add excess of ammonia, and shake the mixture with a drachm of chloroform. Separate the chloroform as before, and, if the matter left after the evaporation of a small portion of it is charred by concentrated sulphuric acid, the whole of it must be treated in the same manner as the previous chloroform solution. The last chloroform solution obtained is then to be tested for strychnine. Take up a little of it in a capillary tube, and drop it on the smallest space of a warm porcelain dish, so that each successive drop may be evaporated. When the dish is quite cold, moisten the spot with concentrated sulphuric acid, and add a minute fragment of potassium dichromate. Should the characteristic color not be developed, it is said that, if there be the minutest quantity of strychnine present, the color will become visible on adding sulphuric acid rendered slightly yellow by chromium trioxide. In conducting the process, care must be taken not to stir the spot moistened by sulphuric

phuric acid (1 part of ammonium vanadate dissolved in 200 parts of pure sulphuric acid of 1.84 sp. gr.) is colored by strychnine at first violet-blue, passing into violet, and finally cinnabar-red. On dilution with water this color remains rose-red. According to Dragendorff, the color persists when as little as 0.001 milligramme of strychnine is used.

Wm. T. Wenzell states that, when very minute quantities of the alkaloid are being dealt with, much the best plan is to prepare a reagent by dissolving in 2000 grains of sulphuric acid one grain of potassium permanganate. The alkaloid, during the evaporation of its acidulated solution on the porcelain, collects in the margins of the film, and the smallest possible dot of the reagent is to be placed so that its margin comes in contact with that of the film. In this way, Wenzell affirms, he was able to detect 1-900,000th part of strychnine. (*A. J. P.*, xlii. 385.) Some doubt was thrown upon the value of this test by experiments which seemed to prove that the presence of morphine in excess, especially in connection with organic matter, so far modified or disguised the action of the test upon strychnine as to prevent the appearance of the characteristic color, but subsequent and carefully conducted experiments by Robert P. Thomas satisfactorily determined that the conclusions in relation to the effects of morphine were erroneous, and that whether alone or associated with organic matters, in small or in large quantity, it does not prevent the operation of this color-test if carefully applied. (*Am. J. M. S.*, Oct. 1861, and 1862, 1340; also *J. Am. C. S.*, 1894, No. 12.) J. U. Lloyd in his novel "Stringtown on the Pike" used in an interesting manner a color reaction which he had discovered that produced a color which might deceive some who were working on a toxicological investigation in strychnine poisoning. *Lloyd's reaction* consists in adding sulphuric acid to a mixture of 1 part of hydrastine and 4 parts of morphine and adding a little potassium dichromate in the manner in which the color test for strychnine is made; colors are produced which somewhat resemble those given by strychnine, but a careful toxicologist could not be deceived. A controversy ensued upon the announcement of the reaction, participated in by Williams, Mayer, Wangerin, Wharton, and others, the result of which proved that the value of the official color test of strychnine had not been seriously assailed. *D. C.*, 1901, 28, 48; *Proc. N. Y. State Pharm. Assoc.*, 1901, 252; *Amer. Drug.*, 1903, 66. Strychnine consists of carbon, hydrogen, nitrogen, and oxygen and has the formula $C_{21}H_{22}N_2O_2$. The salts of strychnine are for the most part soluble and crystallizable. Their solution is decomposed by the alkalies and their carbonates, and by tannic but not by gallic acid, and is not affected by ferric salts. They are precipitated by the solution of iodine in potassium iodide, and the precipitate, though soluble in alcohol, is insoluble in the diluted acetic and hydrochloric acid of the U. S. Pharmacopœia. (Fairthorne, *A. J. P.*, xxvii. 212.)[1]

acid with a rod before the addition of the dichromate, and not to expose the spot to a very strong light, which interferes with the chemical reactions. (*M. T. G.*, June, 1857, p. 620.) The process of dialysis may be advantageously applied to the separation of strychnine from the organic matters containing it, when brought to the liquid state. (See *Dialysis*, PART II.) Diluted acetic acid may be used for extracting the alkaloid with other soluble substances from the contents of the stomach.

It is stated by C. W. Bingley that, if much tartar emetic be contained in a solution with a little strychnine, a pale greenish color is produced instead of the violet, and, in like manner, if antimony chloride be present, the sulphuric acid and potassium dichromate test fails altogether. (*Chem. Gaz.*, June 16, 1856, p. 229.) Richard Hagen, having been induced, by the assertion of von Sicherer that this test fails when the strychnine is mixed with tartar emetic or other tartrates, or even tartaric acid, to investigate the subject, ascertained that this statement, as a rule, is erroneous; for the reaction takes place with strychnine or its hydrochloride though mixed with 20 or 30 parts of antimony tartrate; yet when *strychnine nitrate* is used with 20 parts of the antimonial tartrate, the mass almost instantly acquires a green color with the reagents mentioned. But even with strychnine nitrate the test succeeds if lead peroxide is used instead of chromium trioxide as the oxidizing agent. (*Ibid.*, Oct. 15, 1857, p. 398.)

For a particular account of the results produced by the reaction of a large number of substances with strychnine, the reader is referred to a paper by T. G. Wormley, in the *Chem. News* for April 14 and 28, 1860 (pp. 218 and 242). Among other trials made by him was that of the action of this alkaloid on frogs, proposed as a test by Marshall Hall. The poison was injected into the stomachs of the animals through a pipette. A solution containing 1 per cent. of strychnine produced rigidity and violent tetanic spasms immediately, and death in 8 minutes. With 1 part of strychnine to 1000 of the solvent, the spasmodic symptoms were induced in 3 or 4 minutes; with 1 in 10,000, in from 10 to 24 minutes; with 1 in 20,000, and 1 in 30,000, the symptoms were less unequivocal though tetanic spasms were noticed in some of the animals.

Experiments by W. A. Guy on the effects of sulphuric and nitric acids on strychnine and many other alkaloids, published with tabulated results, show that in no one out of 66 proximate principles, chiefly alkaloids, was the same change of color produced as in strychnine by concentrated sulphuric acid, followed by a crystal of potassium dichromate. (See *A. J. P.*, Nov. 1861, p. 517.) In the same number of the same journal (p. 527) is a paper by T. E. Jenkins, giving the result of experiments with sulphuric acid and potassium dichromate on numerous alkaloids, all tending to prove the delicacy and certainty of this color-test of strychnine. A. Wynter Blyth distils the suspected alkaloid with a solution of potassium permanganate to dryness, condensing the vapor in a cold flask, and applying Nessler's test for ammonia to the liquid thus obtained. He finds that all the poisonous alkaloids differ, but are individually constant in the amount of ammonia yielded, and that the test can always decide to which class the alkaloid belongs, and often what alkaloid it is. Strychnine yields half its nitrogen, or 5.09 per cent. of ammonia. See also *M. T. G.*, 1875, i. 387.

[1] When an aqueous solution of strychnine sulphate and potassium nitrite is boiled, an effervescence takes place, owing to the escape of nitrogen, and the solution becomes yellow. If ammonia is now added, a precipitate takes place, which has been found to consist of two alkaloids, resulting from the oxidation of the strychnine in different degrees. One of these the discoverer, P. Schutzenberger, proposes to name *oxystrychnine*, and the other *dioxystrychnine*. (See *A. J. P.*, March, 1859, p. 133.)

Methyl-strychnine. Methyl-brucine.—These alkaloids are formed by replacing one of the atoms of hydrogen in strychnine by methyl (CH_3), which is effected by acting on the alkaloids by methyl iodide. A singular and, if verified, very important statement in relation to these modifications of strychnine and brucine, made by Stahlschmidt (*Ann. Ch. Phys.*), is that they are not poisonous. He gave to a rabbit five grains of methyl-strychnine without any bad symptoms, though the same animal was afterwards killed in five minutes by one-twentieth of a grain of strychnine placed upon its tongue. The important practical inference is that methyl iodide might be an antidote to strychnine. (See *A. J. P.*, 1860, p. 220.)

Strychnine is likely to contain impurities, of which the chief, besides brucine, are coloring matter and lime or magnesia. The two latter impurities are left behind when the adulterated alkaloid is incinerated in the open air. Pure strychnine leaves no ashes under these circumstances. Brucine is detected by the red color which it yields with nitric acid. Neither this nor sulphuric acid colors strychnine,—a test which distinguishes it from several other alkaloids.

Uses.—The effects of strychnine upon the system are identical in character with those of nux vomica, and it is employed for the same purposes as a medicine. In whatever way strychnine is introduced into the system, it acts, if in sufficient quantity, as a violent poison. The evidences of its slightest action are muscular twitchings and stiffness. After poisonous doses the symptoms usually come on not only speedily but very suddenly. They are convulsions, both tonic and clonic, affecting all the voluntary muscles, plainly reflex in character, and interrupted by periods of usually complete relaxation. Consciousness is undisturbed. The body is during the convulsion rigid, with the face drawn into the *risus sardonicus,* the limbs stiffly extended, and the whole person bowed backward in marked opisthotonos. The convulsions are accompanied with pain, and may be so severe as to cause death by locking the chest in a general respiratory spasm. This death during a convulsion may occur very early, and is accompanied by evident signs of asphyxia; if in any convulsion consciousness be affected, it is by approaching asphyxia, and is an evidence of imminent peril. In many instances the patient survives some hours and finally dies of exhaustion.

The best chemical antidote to strychnine is potassium permanganate, which should be freely administered from time to time until a result is reached. Washing out the stomach with a solution of the permanganate is excellent, provided it is done early and the patient anæsthetized before any attempt is made. We have seen fatal spasm brought on before the stomach tube reached the œsophagus. The general treatment of strychnine poisoning consists in the maintenance of absolute quiet, and the use of such spinal sedatives as chloroform, amyl nitrite, opium, chloral, and potassium bromide; tobacco, aconite, and various similar sedative substances have been used, but no drug which acts powerfully as a cardiac depressant should be employed. Chloroform and amyl nitrite act very promptly, but their impression is fugacious, and their use should be restricted to the arresting of convulsions so severe as to threaten life. Opium may be given in moderate doses, and very large doses of cannabis Indica have been employed in some cases with excellent results, but, as it exists in our markets, this drug is too uncertain for any reliance to be placed upon it. Potassium bromide and hydrated chloral are exceedingly valuable remedies. In any case of severe strychnine poisoning it would be advisable to begin the general medicinal treatment with the administration of half an ounce (15.5 Gm.) of potassium bromide. After this hydrated chloral may be given in from twenty- to thirty-grain (1.3 to 2.0 Gm.) doses, at intervals of greater or less length, according to the severity of the symptoms, inhalations of chloroform, ether, and amyl nitrite being practised *pro re nata,* and the bromide also being repeated in much smaller dose if it seems advisable.

Ether acts too slowly to be comparable in its effects to chloroform in this toxæmia, but it must not be forgotten that chloroform is alleged to have produced sudden cardiac death in strychnine poisoning, and in the latter stages, when exhaustion has set in, ether certainly is the safer remedy; under these circumstances alcohol should be freely administered, as tending not only to quiet spasm, but also to sustain the heart's action.

In an investigation of the members of the pyridine series of bases by C. Greville Williams and W. H. Waters (*Proc. Roy. Soc.,* xxxii. p. 162, 1881), they found that β lutidine (dimethyl-pyridine, C_7H_9N) was antagonistic to strychnine and an apparent antidote. When injected into frogs already under the influence of strychnine, it arrested the convulsions; or if given first and then followed by a fatal dose of strychnine, it prevented the appearance of the tetanus. (Blyth, *Poisons, their Effects and Detection,* 1884, p. 319.)

The chief physiological action of strychnine is stimulation of the motor and vasomotor centres of the cord; the peripheral nerves are affected only by very large toxic doses, which exert both a direct and an indirect sedative influence upon them. The diagnosis of strychnine poisoning from tetanus, hysteria, and other convulsive diseases is to be determined by the jaw being affected after the limbs and trunk, the relaxation between the convulsions, the universality of the latter, the retention of consciousness, the rapidity of the attack, and the history of the case.

On account of its stimulant effect upon the gastric mucous membrane, and of its tendency to excite the vasomotor and motor centres of the spinal cord and thereby increase the activity of the circulation and the general systemic tone, strychnine is a very valuable tonic, which may be given along with iron and simple bitters in *anæmia,* and especially in cases of general relaxation. Its striking convulsive influence early led to its use in *palsies,* and it is habitually so employed today. As, however, the loss of muscular power in these cases is very rarely due in chief part, if at all, to depression of the spinal centres, it is not common to see any very marked result from the use of the drug. In *infantile palsies* and other affections in which the nutrition of the muscles is largely at fault, the injection of strychnine into the affected muscles is sometimes productive of great good.

As a respiratory stimulant strychnine is very valuable in *subacute* and *chronic bronchitis,* especially in old and feeble subjects, in advanced *adynamic pneumonia,* in *chloral, opium,* and other *narcotic poisoning,* and in the accidents of *anæsthesia,* when death is threatened from respiratory failure. In these cases it must be given in large doses, and, when the symptoms are urgent, hypodermically. In certain forms of circulatory failure and *shock* it is very commonly employed. In *heart diseases* it is usually inferior to digitalis, but may be used with benefit in fatty *myocarditis.*

Strychnine, owing to its tendency to increase the activity of non-striated as well as of striated muscular fibres, is a valuable addition to laxative medicines where there is reason to suspect relaxation of the muscular coat of the bowel. By the oculists strychnine is much used in *atrophy of the optic nerve.* The *dose* of strychnine varies very greatly according to the effect desired. As a simple tonic from 1-40th and 1-30th of a grain (0.0016 to 0.002 Gm.) may be given three times a day. As a stimulant in low diseases, in certain affections of the spinal cord, in chronic heart disease, and in the adynamic nervous conditions of chronic alcoholism, etc., much larger amounts may be given with great advantage. Very large doses should be given hypodermically from four to six hours apart, and be ascended to rather than commenced with. In this way an amount of even three-fourths of a grain (0.048 Gm.) of strychnine a day may be reached.[1]

Dose, one-sixtieth to one-thirtieth of a grain (0.0011 to 0.002 Gm.).

Off. Prep.—Elixir Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Glyceritum Ferri, Quininæ et Strychninæ Phosphatum, *U. S.;* Pilulæ Laxativæ Compositæ, *U. S.;* Syrupus Ferri, Quininæ et Strychninæ Phosphatum, *U. S.* (from glycerite) (*Br.*); Syrupus Hypophosphitum Compositus, *U. S.*

STRYCHNINÆ HYDROCHLORIDUM. Br.

STRYCHNINE HYDROCHLORIDE [Hydrochlorate of Strychnine, Brit. Pharm. 1885]

(strȳc̣h-nī′næ hȳ-drọ-c̣hlō′rị-dŭm)

$C_{21}H_{22}N_2O_2HCl + 2H_2O = 403.67$

"The hydrochloride of an alkaloid obtained from Nux Vomica and from other species of Strychnos." *Br.*

Strychninum Hydrochloricum; Chlorhydrate de Strychnine, *Fr.;* Strychninhydrochlorid, Salzsaures Strychnin, *G.*

This salt of strychnine was made official for the first time in the Br. Ph. 1898; it is used in making *Liquor Strychninæ Hydrochloridi.* (See p. 739.) It is described as in "small colorless trimetric prisms which readily effloresce in the air; soluble in 35 parts of *water* or in 60 parts of *alcohol* (90 per cent.), forming a solution which is neutral to *litmus* and intensely bitter to the taste. The salt should afford the reactions characteristic of hydrochlorides, and should respond to the qualitative tests mentioned under 'Strychnina,' but should not yield any characteristic reaction for sulphates. Dried at a temperature of 212° F. (100°C.) it should lose from 7.3 to 8.8 per cent. of moisture." *Br.*

In its physiological and therapeutic action, strychnine hydrochloride is equivalent to strychnine though slightly weaker.

Off. Prep.—Liquor Strychninæ Hydrochloridi, *Br.*

STRYCHNINÆ NITRAS. U. S.

STRYCHNINE NITRATE

(strȳc̣h-nī′næ nī′trăs)

$C_{21}H_{22}N_2O_2.HNO_3 = 394.30$

"The nitrate [$NO_2OH.C_{21}H_{22}N_2O_2$] of the alkaloid Strychnine. It should be kept in well-stoppered vials." *U. S.*

Azotate de Strychnine, *Fr. Cod.;* Nitrate de Strychnine, *Fr.;* Strychninum nitricum, *P. G.;* Strychninnitrat, Salpetersaures Strychnin, *G.;* Nitrato di stricnina, *It.*

Preparation.—This salt may be made by dissolving a sufficient quantity of the alkaloid strychnine in diluted nitric acid until it is neutralized, evaporating the solution and crystallizing the strychnine nitrate.

Properties.—It is officially described as in "colorless, glistening needles; odorless, and having an intensely bitter taste. *Strychnine Nitrate should be tasted with extreme caution.* Permanent in the air. Soluble in 42 parts of water, 120 parts of alcohol, 156 parts of chloroform, and in 60 parts of glycerin at 25° C. (77° F.); soluble in 8 parts of water at 80° C. (176° F.), and in 60 parts of alcohol at 60° C. (140° F.); insoluble in ether. When heated, the salt decomposes, but it does not melt, and when ignited it is consumed without leaving a residue. Its aqueous solutions are neutral to litmus paper, and lævogyrate. A solution of the salt, when poured carefully into a test-tube upon a layer of sulphuric acid containing in solution a little diphenylamine, will develop a blue zone at the juncture of the two liquids. On being heated with hydrochloric acid a bright red color is formed. Sulphuric acid containing 1 percent. of ammonium vanadate produces with Strychnine Nitrate a dark violet-blue color, changing to purple, and then to red. Sulphuric acid containing a trace of potassium dichromate produces momentarily a blue color,

[1] Strychnine should never be prescribed in liquid form in combination with bromides, iodides, or chlorides, for fear of forming the insoluble strychnine hydrobromide, hydriodide, or hydrochloride. Several cases of poisoning have occurred through neglect of this precaution. A. B. Lyons (*A. J. P.,* Oct. 1877) records a case of poisoning through the patient's receiving in the last dose the greater portion of the strychnine hydrobromide, which had crystallized out.

changing to violet, then to purplish-red, cherry-red, and finally to orange or yellow. If 0.1 Gm. of the salt, dissolved in a few drops of nitric acid, be evaporated to dryness, and a few drops of ammonia water added to the residue, an orange color will be produced, which will turn reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide T.S. The addition of sulphuric acid to a crystal of Strychnine Nitrate on a white porcelain surface should not produce more than a faintly yellow color (limit of *brucine*)." *U. S.*

Uses.—Strychnine nitrate is employed for the same purposes as strychnine sulphate. (See *Strychninæ Sulphas.*)

Dose, one-sixtieth to one-thirtieth of a grain (0.0011 to 0.002 Gm.).

STRYCHNINÆ SULPHAS. U. S.

STRYCHNINE SULPHATE

(strȳch-nī'næ sŭl'phăs)

$(C_{21}H_{22}N_2O_2)_2.H_2SO_4 + 5H_2O = 850.21$

"The sulphate $[SO_2(OH)_2.(C_{21}H_{22}N_2O_2)_2 + 5H_2O]$ of the alkaloid strychnine. It should be kept in well-stoppered vials." *U. S.*

Strychniæ Sulphas, *Pharm.* 1870; Strychninum Sulphuricum; Sulfate de Strychnine, *Fr. Cod.*; Schwefelsaures Strychnin, Strychninsulfat, *G.*; Sulfato de estricnina, *Sp.*

Preparation.—A process for this salt is no longer official. That of the U. S. P. 1870 will be found in the foot-note.[1] Two forms of strychnine sulphate are known, the acid sulphate, or commercial sulphate, and the official or neutral sulphate. Commercial strychnine sulphate, $C_{21}H_{22}N_2O_2.H_2SO_4 + 2H_2O$, crystallizes in needles. The water is expelled at 150° C. (302° F.). To prepare the neutral sulphate $(C_{21}H_{22}N_2O_2)_2.H_2SO_4$, a solution of the acid sulphate is divided into two equal portions: one of these portions is precipitated by ammonia, and the precipitate is added to the other part of the solution and the mixture boiled. On cooling, the liquid deposits the neutral salt in transparent prisms containing 5 molecules of H_2O. The crystals melt and become anhydrous at 200° C. (392° F.). By the spontaneous evaporation of an aqueous solution of the salt, transparent pyramids belonging to the quadratic system are obtained. According to Rammelsburg, these crystals contain 6 molecules of H_2O. (*Ber. d. Chem. Ges.*, 1881, p.1231; *N. R.*, Jan. 1882.)

Properties.—This salt is in "colorless, or white prismatic crystals, or a white, crystalline powder; odorless, and having an intensely bitter taste, perceptible even in solutions of 1 in 700, 000. *Strychnine Sulphate should be tasted with extreme caution.* Efflorescent in dry air. Soluble in 31 parts of water, 65 parts of alcohol, and in 325 parts of chloroform at 25° C. (77° F.); soluble in 6 parts of water at 80° C. (176° F.), and in 20 parts of alcohol at 60° C. (140° F.); insoluble in ether. When heated at 100° C. (212° F.), the salt loses its water of crystallization (10.59 percent.), and when anhydrous melts at 200° C. (392° F.). Upon ignition, it is consumed, leaving no residue. Barium chloride T.S. produces in a solution of the salt a white precipitate, which is insoluble in hydrochloric acid. Sulphuric acid should produce no color with strychnine sulphate, but on adding a fragment of potassium dichromate, a blue color should be formed, changing to deep violet, then to purplish-red, cherry-red, and finally to orange or yellow. Sulphuric acid containing 1 percent. of ammonium vanadate produces a deep violet-blue color, changing to deep purple, and finally to cherry-red. Sulphuric acid containing a trace of potassium iodate produces a violet color, changing to reddish-purple. If 0.1 Gm. of the salt be dissolved in a few drops of nitric acid, evaporated to dryness, and a few drops of ammonia water added to the yellow residue, an orange color will be produced, which will turn momentarily reddish-purple, and finally brown, on the addition of a small amount of alcoholic potassium hydroxide T.S. Nitric acid, when added to a crystal of Strychnine Sulphate on a white porcelain surface, should not produce more than a faintly yellow color (limit of *brucine*)." *U. S.* The chief advantage of this preparation over strychnine is its much greater solubility in water, by which it is better adapted to external use, as for application to blistered surfaces, or for hypodermic injection, or as an ingredient in collyria. Owing to the presence of sulphuric acid and water of crystallization in this salt, it contains but about 75 per cent. of strychnine, and the proportionate dose would be therefore somewhat greater than that of the alkaloid.[1] (See *Strychnina.*)

[1] *Strychniæ Sulphas.*—"Take of Strychnia *a troy-ounce;* Diluted Sulphuric Acid *nine fluidrachms*, or *a sufficient quantity;* Distilled Water *a pint.* Mix the Strychnia with the Distilled Water, heat the mixture gently, and gradually add Diluted Sulphuric Acid until the alkaloid is neutralized and dissolved. Filter the solution, and evaporate with a moderate heat, so that crystals may form on cooling. Lastly, having drained the crystals, dry them rapidly on bibulous paper, and keep them in a well-stopped bottle." *U. S.* 1870.

[1] *Strychnine Arsenite* having been proposed as a remedy by Grimelli of Modena, Chiappero of Turin, undertook to prepare the salt. For this purpose he dissolved arsenic trioxide in water acidulated with hydrochloric acid, and neutralized the arsenic trioxide with strychnine. But, according to M. T. Ceresoli of Paris, the result was a mixture of strychnine arsenite and hydrochloride. The latter chemist prepares a pure strychnine arsenite in the following manner: He takes 3.12 grammes of potassium hydroxide, 3.30 of arsenic trioxide, and 40.00 of distilled water. Having dissolved the potassium hydroxide in the water, boiling hot, he adds the arsenic trioxide, which is completely dissolved. He then dilutes 2.65 grammes of monohydrated sulphuric acid with 20 grammes of distilled water, and, having heated the mixture to ebullition, adds 12 grammes of pure crystallized strychnine, which is entirely dissolved. The two solutions being kept at about the temperature of 100° F., he pours the arsenical solution into that of strychnine. A grumous mass is produced, much of which, however, is dissolved by heat. The liquid being filtered boiling hot from the undissolved mass,

Dose, one-fortieth to one-twentieth of a grain (0.0016 to 0.003 Gm.).

STYRAX. U. S. (Br.)

STORAX

(stȳ′răx)

"A balsam obtained from the wood and inner bark of *Liquidambar orientalis* Miller (Fam. *Hamamelidaceæ*)." *U. S.* "A balsam obtained from the trunk of Liquidambar orientalis, *Miller,* and purified by solution in ethylic alcohol, filtration, and evaporation of the solvent." *Br.*

Styrax Præparatus, *Br.;* Prepared Storax; Styrax Liquidus, Balsamum Storacis, Balsamum Styracis, Balsamum Styrax Liquidus; Liquid Storax; Styrax liquide, *Fr. Cod.;* Styrax, *P. G.;* Storax, Flüssiger Storax, *G.;* Storace liquido, *It.;* Estoraque liquido, *Sp.*

All species of the genus Liquidambar as well as those of a related genus, Altingia, yield storax. The product most valued, however, is that obtained from *L. orientalis,* Miller.

Liquidambar orientalis, Miller, *Gard. Dict.* (1768) · 8th ed. No. 2; *B. & T.* 107.—The *oriental sweet-gum* is a tree from twenty to forty feet high. The palmate leaves have each of their divisions obscurely three-lobed, and are serrate, perfectly smooth, bright green and shining on the upper and pale on the under surface. The tree is a native of Asia Minor, in the southwestern parts of which it forms large forests. It yields the so-called *liquid storax.*

According to the researches of Moeller, storax is a pathological rather than a physiological product; when the young wood is injured secretion reservoirs are formed in which the storax is produced. (*O. Z.,* 1.) The more recent accounts of the method of collecting the drug indicate that the outer bark is first heavily bruised, so as to injure the inner bark, and after a time the outer bark having been removed the inner bark is scraped off. According to Maltass, this inner bark is first pressed cold in horse-hair bags, after which hot water is thrown over the bags and they are again pressed. Lieutenant Campbell states that the inner bark is first boiled with water, and, a portion of the balsam which rises having been skimmed off, is then pressed so as to extract the remainder. The residuary bark, after expression, is dried in the sun, and employed in various parts of Turkey for fumigation. It is the drug known in commerce as *Storax bark* or *Cortex Thymiamatis.* (Hanbury, *P. J.,* xvi. 463.) The balsam is sent in casks to Constantinople, Smyrna, and other ports of the Levant.

Several kinds of storax have been described. The purest was the *storax in grains,* which was in whitish, yellowish-white, or reddish-yellow tears, about the size of a pea, opaque, soft, adhesive, and capable of uniting so as to form a mass. Another variety, formerly called *styrax calamita,* from the circumstance, it is supposed, that it was brought wrapped in the leaves of a kind of reed, consisted of dry and brittle masses, formed of yellowish agglutinated tears, in the interstices of which was a brown or reddish matter. The French call it *storax amygdaloïde.* This and the preceding variety had a pleasant odor like that of vanilla. Neither of them, however, is now found in the markets. It is probable that one or both of these varieties may have been the product of *Styrax officinale.* A third variety, which is sometimes sold as the *styrax calamita,* is in brown or reddish-brown masses of various shapes, light, friable, yet possessing a certain degree of tenacity, and softening under the teeth. Upon exposure, it becomes covered upon the surface with a white efflorescence of styracin. It evidently consists of sawdust, united with a portion of the balsam. As found in commerce, it is usually in the state of a coarse, soft, dark-colored powder, mingled with occasional light friable lumps of various sizes, and containing very little of the balsam. When good, it should yield, upon pressure between hot plates, a brown resinous fluid having the odor of storax. Hanbury states that some of this variety is prepared at Trieste, Venice, and Marseilles, by mixing the residue of the liquidambar bark remaining after expression, and reduced to coarse powder, with genuine liquid storax. (*P. J.,* April, 1863.)[1] A fourth

which consists almost exclusively of potassium sulphate, the filtered liquid is evaporated nearly to dryness, and the residue dissolved in absolute alcohol, by which the potassium sulphate is all left behind. The undissolved mass, after the first filtration, is repeatedly washed with alcohol; and the alcoholic solutions are mixed, concentrated, and set aside to crystallize. At the end of two days the arsenite separates in the form of cubic crystals.

Strychnine arsenite is in white cubic crystals, containing water, which they lose in contact with the air, becoming almost efflorescent. They are completely decomposed by heat, with an empyreumatic odor, and leave nothing but a black and porous charcoal. Towards the end of the vaporization, dense white vapors rise with the alliaceous odor of arsenic. The taste is bitter and metallic. Strychnine arsenite is soluble in 35 parts of cold and 10 of boiling water; is soluble also in alcohol, and less so in ether. Its formula is $(C_{21}H_{22}N_2O_2)HAsO_3$. Though scarcely yet employed, at least to any considerable extent, as a medicine, it would seem, from its constituents, to be likely to fulfil important indications, and has the advantage of a uniform composition. Consisting of two ingredients, each of which is perhaps scarcely inferior, as a remedy in intermittent fever, to any other except cinchona and its derivatives, it probably possesses strong antiperiodic powers, and might very properly be the subject of trial in any intermittent disease which proves rebellious to quinine,—the prescriber, however, being always on his guard against its poisonous action. Its commencing dose should not be larger than the smallest dose of strychnine. (*J. P. C.,* 4e sér., i. 343).

[1] *False Storax, Liquidambar styraciflua,* or *Sweet Gum* of our Southern States.—Its geographical range reaches into Mexico, and it yields a storax-like product in an abundance proportionate to the heat of the climate. A specimen from Guatemala is described by Flückiger and Hanbury as a yellow, opaque resin, of honey-like consistence, becoming transparent, amber-colored, and brittle by exposure to the air, and having a rather terebinthinous balsamic odor and but little taste. Sometimes it occurs as a thick golden-brown fluid. It contains cinnamic acid and styracin. (*A. J. P.,* 1874, p. 161.) It is soluble in alcohol, and has been gathered to a considerable extent in the United States for the preparation of chewing gum. The resins of *Liquidambar formosana* and *L. altigiana* are known in Eastern commerce. *Malay storax* is an aromatic resinous product obtained from the *Altingia excelsa,* Noronha, *L. altigiana,* Bl. It is sometimes called *rasamala resin* and contains tannic acid besides a very minute amount of cinnamic and benzoic acids.

variety, which, under the name of *liquid storax*, is the one commonly used, is a semi-fluid, adhesive substance, brown or almost black upon the surface exposed to the air, but of a slightly greenish-gray color within, and of an odor somewhat like that of balsam of Peru, though less agreeable. It is kept in jars.

Properties.—The storax used by pharmacists should correspond to the following official directions and tests. "A semi-liquid, grayish, sticky, opaque mass, depositing, on standing, a heavy, dark brown stratum; transparent in thin layers, and having an agreeable odor and a balsamic taste. Insoluble in water, but completely soluble (with the exception of accidental impurities) in an equal weight of warm alcohol. If the alcoholic solution, which has an acid reaction, be cooled, filtered, and evaporated, it should leave not less than 70 percent. of the original weight of the balsam, in the form of a brown, semi-liquid residue almost completely soluble in ether and in carbon disulphide, but insoluble in petroleum benzin. When heated on a water-bath, Storax becomes more fluid, and if it be then agitated with warm petroleum benzin, the supernatant liquid, on being decanted and allowed to cool, will be colorless, and will deposit white crystals of cinnamic acid and cinnamic esters." *U. S.* "Heated in a test-tube placed in boiling water, it becomes more liquid, but gives off no moisture; boiled with *solution of potassium bichromate* and *sulphuric acid*, it evolves an odor resembling that of essential oil of bitter almonds." *Br.*

As found in commerce, storax is usually so much adulterated as to require purification before it can be used, and in both Pharmacopœias processes were formerly given. Whenever not originally pure enough for use, it should be dissolved in alcohol, the solution strained, and the alcohol distilled off to a certain extent, and then completely evaporated at a gentle heat. Among the substances used in the adulteration of storax is turpentine. To detect it Hager employed the following method. He liquefied the resin, in a tube, by means of a water bath, added half its volume of absolute alcohol, and hastened the solution by agitation; he then treated it with several volumes of benzin. This operation was repeated twice. The liquors obtained were then evaporated, in a tared vessel, and there was secured, for pure storax, a colorless residue (45 to 55 per cent.), with a light-blue opalescence; for that mixed with turpentine, a residue more considerable, yellowish, and having the terebinthinate odor. (*J. P. C.*, Fév. 1876, p. 161.)

Storax melts with a moderate heat, and, when the temperature is raised, takes fire and burns with a white flame, leaving a light, spongy, carbonaceous residue. It imparts its odor to water, which it renders yellow and milky. Its active constituents are dissolved by alcohol and ether. Neumann obtained from 480 grains of storax 120 of aqueous extract, and from an equal quantity 360 grains of alcoholic extract. Containing volatile oil and resin, and yielding benzoic or cinnamic acid by distillation, it is entitled to rank as a balsam.

The most abundant constituent of storax is probably *storesin*, $C_{36}H_{55}(OH)_3$, discovered in 1877 by W. von Miller. This is present both free and in the form of a cinnamic ester. Storesin is an amorphous substance, melting at 168° C. (334.4° F.), readily soluble in petroleum benzin. *Cinnamic esters of phenylpropyl, cinnamic ester of ethyl, cinnamic ester of benzyl*, and especially *cinnamate of cinnamyl*, $C_9H_7O_2.C_9H_9$, the so-called *styracin* of Bonastre, have also been observed. This last compound can be removed by ether, benzene, or alcohol after the separation from the resin of the cinnamic acid; it is insoluble in water, and volatile only in superheated steam. It crystallizes in tufts of long rectangular prisms, which melt at 38° C. (100.4° F.), but frequently do not solidify readily. By concentrated solution of potassium hydroxide, it is resolved into a cinnamate and cinnamic alcohol (*styrone*), $C_9H_{10}O$, which latter is not present in liquid storax. The yield of *cinnamic acid* varies from 6 to 12 per cent., or even, according to Löwe, as much as 23 per cent. of crystallized cinnamic acid can be obtained. The acid dissolves abundantly in ether, alcohol, or hot water, slightly in cold water; it is inodorous, but has an acrid taste. It fuses at 133° C. (276.4° F.), and boils at 290° C. (554° F.). Another minor constituent of storax is a fragrant substance melting at 65° C., and possessing the odor of vanillin, which Rump (*Ber. d. Chem. Ges.*, 1878, 1034) identified. Miller also shows that water removes from the drug a little free benzoic acid. There is further found in liquid storax a hydrocarbon, C_8H_8, first prepared by Simon in 1839, which exists in the resin as a liquid, and also in a polymeric form as a solid. The former, called *styrol* or *cinnamene*, has a sp. gr. of 0.924, and a boiling point of 146° C. (294.8° F.). It is a colorless, mobile liquid, possessing the odor and burning taste of liquid storax. It has since been formed synthetically, and has been recognized as *phenylethylene*, $C_6H_5.CH = CH_2$. When heated for a considerable time to 100° C. (212° F.), or for a shorter period to 200° C. (392° F.), it is converted without change of composition into the colorless, transparent solid *metastyrol*, which, unlike styrol, is not soluble in alcohol or in ether. Lastly, there has been found in liquid storax, by J. H. van t'Hoff (1876), about 0.4 per cent. of a pleasant-smelling lævo-rotatory oil of the formula $C_{10}H_{16}O$. (*Pharmacographia*, 2d ed., 274 and 275.) Tschirch and L. v. Itallie (*A. Pharm.*, Sept. 1901, 506) state that styrax contains free cinnamic acid, vanillin, styrol, styracin, cinnamic acid-ethyl ester, cinnamic acid-phenylpropyl ester and storesinol partly free and partly as cinnamic acid ester.

Uses.—Styrax is a stimulating expectorant and very feeble germicide, which was at one

time used in various *pulmonic catarrhs,* also in *gonorrhœa* and *leucorrhœa,* but at present is very seldom used except as a constituent of the compound tincture of benzoin. Externally, mixed with two or three parts of olive oil, liquid storax was found by H. Schultze of Magdeburg, to be very effective as a local remedy in scabies.

Dose, ten to twenty grains (0.65 to 1.3 Gm.).

Off. Prep.—Tinctura Benzoini Composita, *U. S.*, *Br.*

SUCCI.

JUICES

(sŭc′cī)

Sucs végétaux, *Fr.;* Pflanzensäfte, *G.*

Though introduced to professional notice by Squire in the year 1835, and subsequently used by many practitioners, the Juices were recognized but once by the U. S. Pharmacopœia (1870). They consist of the expressed juices of fresh plants, preserved by the addition of one-third of their bulk of alcohol. Considering the great inequality in strength, and of course the uncertainty in operation, of fresh juices themselves, varying according to the soil, climate, mode of cultivation, season, and the age of the plant, it may be questioned whether they merit the prominence which has been given them in the British Pharmacopœia.

SUCCUS BELLADONNÆ. Br.

JUICE OF BELLADONNA

(sŭc′cŭs bĕl-lą-dŏn′næ)

Suc de Belladone, *Fr.;* Belladonnasaft, *G.*

"Bruise the fresh leaves and young branches of Atropa Belladonna, *Linn.;* press out the juice; to every three volumes of juice add one of Alcohol (90 per cent.); set aside for seven days; filter." *Br.*

Dose, five to fifteen minims (0.3 to 0.9 Cc.).

SUCCUS CONII. Br.

JUICE OF CONIUM

(sŭc′cŭs cŏ-nī′ī)

Juice of Hemlock; Suc de grande Ciguë, *Fr.;* Schierlingsaft, *G.*

"Bruise the fresh leaves and young branches of Conium maculatum, *Linn.;* press out the juice; to every three volumes of juice add one of Alcohol (90 per cent.); set aside for seven days; filter." *Br.*

The albumen is probably coagulated under the influence of the alcohol; and hence the propriety of directing filtration.

The experiments of John Harley (*A. J. P.,* 1867, 363) seemed to indicate that the juice is the best preparation of conium. He found that one fluidounce of it contained 0.42 grain of the alkaloid, and that five and a half fluidrachms of it produced very severe and characteristic symptoms. Subsequent experience has shown, however, that Succus Conii, at least as it reaches Philadelphia, is even in the best brands a very uncertain preparation, distinctly inferior in every way to the U. S. fluidextract made from the green fruit. (See *Y. B. P.,* 1896, 292.)

Dose, one fluidrachm (3.75 Cc.), which may be increased until some effects are produced.

Off. Prep.—Unguentum Conii, *Br.*

SUCCUS HYOSCYAMI. Br.

JUICE OF HYOSCYAMUS

(sŭc′cŭs hȳ-ŏs-cȳ′ą-mī)

Suc de Jusquiame, *Fr.;* Bilsenkrautsaft, *G.*

"Bruise the fresh leaves, flowering tops, and young branches of Hyoscyamus niger, *Linn.;* press out the juice; to every three volumes of juice add one of Alcohol (90 per cent.); set aside for seven days; filter." *Br.*

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

SUCCUS SCOPARII. Br.

JUICE OF BROOM

(sŭc′cŭs scŏ-pā′rī-ī)

Suc de Genet à Balais, *Fr.;* Besenginstersaft, *G.*

"Bruise fresh Broom Tops; press out the juice; to every three volumes of juice add one of Alcohol (90 per cent.); set aside for seven days; filter." *Br.*

In large doses this juice is prone to disturb the stomach and bowels. It is more appropriately used as an adjuvant to other diuretics than alone.

Dose, as a diuretic, one to two fluidrachms (3.75 to 7.5 Cc.).

SUCCUS TARAXACI. Br.

JUICE OF TARAXACUM

(sŭc′cŭs tą-răx′ą-cī)

Suc de Pissenlit, *Fr.;* Löwenzahnwurzelsaft, Löwenzahnsaft, *G.*

"Bruise fresh Taraxacum Root; press out the juice; to every three volumes of juice add one of Alcohol (90 per cent.); set aside for seven days; filter." *Br.*

Dose, two fluidrachms to half a fluidounce (7.5 to 15 Cc.).[1]

[1] *Procter's Preserved Juice of Taraxacum.*—Of the fresh roots collected in September or October, twenty pounds avoirdupois are to be sliced transversely, reduced to a pulpy mass by grinding or contusion, then thoroughly incorporated with four pints of alcohol sp. gr. 0.835, and set aside in stoneware jars. After a week, or a longer time, the pulpy mass is to be subjected to strong pressure, and the liquor filtered and bottled for use. Even after six months the pulp thus treated preserves the sensible properties of the dandelion in a marked degree. Should the alcohol in the expressed liquor be objected to, it may be partially removed by evaporation by means of a water bath until the bulk of the juice has been diminished one-sixth; eight ounces of sugar are then added for every pint. (*A. J. P.,* xxv.)

SULPHONETHYLMETHANUM. U. S.

SULPHONETHYLMETHANE

(sŭl-phōn-ē-thĭl-mĕth-ā′nŭm)

$C_8H_{18}S_2O_4 = 240.46$

"Diethylsulphonemethylethylmethane [$(CH_3)(C_2H_5)C(SO_2C_2H_5)_2$], a product of the oxidation of the mercaptol obtained by the condensation of methylethylketone with ethylmercaptan. It should be preserved in well-stoppered vials." *U. S.*

Trional, Trionalum: Diethylsulphone-methylethyl-methane; Trional, *Fr. Cod.;* Diéthylsulfone-méthyl-éthyl-méthane, *Fr.;* Methylsulfonalum, *P. G.;* Methyl-sulfonal, Trional, *G.;* Trional, *Sp.*

Preparation.—Sulphonethylmethane is made by passing hydrochloric acid gas to saturation through a mixture of ethyl mercaptan and methyl ethylketone, then oxidizing the condensation product (methyl-ethyl-ketone mercaptol) by treating it with a weak solution of potassium permanganate; the compound is purified by repeated crystallization from its solutions in boiling water.

Sulphonethylmethane (or trional) and tetronal [1] are substances which are members of the group of disulphones to which sulphonal belongs and are respectively *diethylsulphon-methylethyl-methane* and *diethylsulphon-diethyl-methane.* Their relationship to sulphonal (diethylsulphon-dimethyl-methane) will be readily seen by a comparison of formulas.

$C\begin{cases}SO_2C_2H_5\\SO_2C_2H_5\\CH_3\\CH_3\end{cases}$	$C\begin{cases}SO_2C_2H_5\\SO_2C_2H_5\\CH_3\\C_2H_5\end{cases}$	$C\begin{cases}SO_2C_2H_5\\SO_2C_2H_5\\C_2H_5\\C_2H_5\end{cases}$
Sulphonal.	Trional.	Tetronal.

Properties.—It is officially described as in "colorless, lustrous, odorless, crystalline scales, which have a bitter taste in aqueous solution. Soluble in 195 parts of water at 25° C. (77° F.), more readily in boiling water, and readily soluble in alcohol and ether. When heated to 76° C. (168.8° F.), it melts, and at a red heat is consumed, evolving sulphur dioxide and leaving no weighable residue. Its aqueous solution is neutral to litmus paper. If 0.1 Gm. of Sulphonethylmethane be heated with 0.1 Gm. of powdered charcoal in a dry test-tube, the characteristic unpleasant odor of mercaptan will be developed. If 0.1 Gm. be gradually heated with dried sodium acetate, hydrogen sulphide will be evolved. One Gm. dissolved in 50 Cc. of boiling water should develop no odor. This solution, when cooled and filtered, should show no turbidity on the addition of barium nitrate T.S. or silver nitrate T.S. (absence of *sulphates* and *chlorides*). One drop of potassium permanganate T.S. added to the aqueous solution of Sulphonethylmethane should not be immediately decolorized (absence of *readily oxidizable organic impurities*)." *U. S.*

Uses.—Sulphonethylmethane or trional is devoid of local properties, is absorbed rapidly and acts much more promptly than does sulphonal. Given to man in doses of from fifteen to twenty grains (1.0 to 1.3 Gm.), it usually causes in from fifteen minutes to an hour a quiet, apparently normal, sleep, without unpleasant after-effects.

There appears to be no recorded case of fatal acute poisoning by trional. Sixty grains (3.9 Gm.) are said to have produced hæmatoporphyrinuria, but one hundred and twenty grains (7.7 Gm.) have been recovered from without very serious symptoms. Although trional is less prone than is sulphonal to cause chronic poisoning, a number of cases have occurred. The symptoms have been great lassitude, giddiness, headache, tinnitus aurium, gastro-intestinal pain, vomiting, obstinate constipation, pronounced tremors, ataxia, especially shown by an uncertain gait, general paresis, with loss of control over the sphincter; also lessened secretion of the urine, and hæmatoporphyrinuria. Strangury has been noted, while even the therapeutic dose may cause excessive acidity of the urine. These symptoms differ from those produced by sulphonal chiefly in that the hæmatoporphyrinuria is less pronounced, the premonitory symptoms are more marked, and the result much less frequently death.

In acute trional poisoning the stomach should be evacuated; very dilute solution of sodium carbonate should be given freely by the mouth and by hypodermoclysis; strychnine and cardiac stimulants used hypodermically *pro re nata.* In chronic poisoning the most important part of the treatment is the free administration in every possible way of a one per cent. solution of sodium carbonate.

Dose, ten to twenty grains (0.65 to 1.3 Gm.).

SULPHONMETHANUM. U. S., Br.

SULPHONMETHANE

(sŭl-phōn-mĕth-ā′nŭm)

$C_7H_{16}S_2O_4 = 226.55$

"Diethylsulphonedimethylmethane [$(CH_3)_2C(SO_2C_2H_5)_2$], the product of the oxidation of the mercaptol obtained by the condensation of acetone with ethylmercaptan. It should be preserved in well-stoppered vials." *U. S.* "Sulphonal, or dimethyl-methane-diethylsulphone, $(CH_3)_2C(SO_2C_2H_5)_2$, is a product of the oxidation of mercaptol, $(CH_3)_2C(SC_2H_5)_2$, obtained from acetone and mercaptan." *Br.*

Sulphonal, *Br.;* Diethylsulphon-dimethyl-methane; Acétone-diéthylsulfone, *Fr. Cod.;* Sulfonalum, *P. G.;* Sulfonal, *G.;* Sulfonale, *It.;* Sulfonal, *Sp.*

[1] *Tetronal,* $(C_2H_5)_2C(SO_2C_2H_5)_2$. *Diethyl sulphone diethyl methane* is made by the same process as that used for sulphonal or sulphonmethane (see page 1201) with the exception that diethylketone is used in place of acetone; the product (diethyl ketone mercaptol) is oxidized by treatment with potassium permanganate and the crystals purified. It occurs in colorless, crystalline scales, melting at 85° C. (185° F.); soluble in 450 parts of cold water and readily soluble in alcohol and ether.

Tetronal acts physiologically like trional but has failed to come into use as a hypnotic. Practically in pure insomnia not due to pain, trional is the most effective, least disturbing and most used of the hypnotics.

Preparation.—This compound belongs to the class of disulphones, to which belong also trional and tetronal. (See page 1200.) It may be made by the following processes. When anhydrous mercaptan (ethyl sulphydrate) and anhydrous acetone are mixed and a stream of dry hydrochloric acid gas passed through, the liquid gradually becomes turbid and separates into two layers, the upper being mercaptol (dithioethyldimethylmethane), the lower, diluted hydrochloric acid. The mercaptol is separated, washed, and then oxidized with potassium permanganate, the liberated oxygen converting the mercaptol into sulphonal. It may also be prepared by the action of ethyl chloride on sodium thiosulphate, the resulting sodium ethyl thiosulphate being converted into ethyl mercaptan and acid sodium sulphate by the action of water. This conversion is made to take place in the presence of alcohol, hydrochloric acid, and acetone, the ethyl mercaptan being condensed to mercaptol, which is oxidized by potassium permanganate, sulphonal being the result. It forms heavy colorless prismatic crystals, melting at 125.5° C., which are not very soluble in cold water, but more readily in boiling water, and in alcohol and alcoholic ether. A characteristic test is to fuse the sulphonal in a small dry test-tube, heat to about 280° C., and to the clear liquid add pyrogallic (or gallic) acid. The liquid becomes brown and gives off the characteristic odor of mercaptan or sulphur alcohol. Heating with potassium cyanide or even with powdered charcoal will effect the same decomposition.

Properties.—It is officially described as in "colorless, inodorous, and nearly tasteless prismatic crystals. Soluble in 360 parts of water, 47 parts of alcohol, 45 parts of ether, and in 16 parts of chloroform at 25° C. (77° F.); soluble in 15 parts of boiling water, and in 2 parts of boiling alcohol; soluble in benzene. When heated to 125.5° C. (258° F.) it melts, and at a red heat it is consumed, evolving vapors of sulphur dioxide and leaving no weighable residue. Its aqueous solution is neutral to litmus paper. If 0.1 Gm. of Sulphonmethane be heated with 0.1 Gm. of powdered charcoal in a dry test-tube, the characteristic unpleasant odor of mercaptan will be developed. If 0.1 Gm. be gradually heated with dry sodium acetate, hydrogen sulphide will be evolved. Its solution in boiling water should develop no odor. This solution, after cooling and filtering, should show no turbidity upon the addition of either barium nitrate T.S. or silver nitrate T.S. (absence of *sulphates* and *chlorides*). If 1 drop of potassium permanganate T.S. be added to an aqueous solution of Sulphonmethane, the liquid should not be immediately decolorized (absence of *readily oxidizable organic impurities*)." *U. S.* The British Pharmacopœia gives the following description: "Colorless, inodorous, nearly tasteless prismatic crystals; without action on *litmus;* melting at 258° F. (125.5° C.). Soluble in 15 parts of boiling *water,* in 450 parts of cold *water,* in 50 parts of cold *alcohol* (90 per cent.), very soluble in boiling *alcohol* (90 per cent.), soluble in *ether.* Heated to redness with free access of air, it burns, evolving sulphurous anhydride, and leaving no residue (absence of mineral impurity). If a mixture of Sulphonal with an equal weight of *potassium cyanide* be heated, the odor of mercaptan is evolved, and when to the solution of the product in *water* excess of *hydrochloric acid* and a few drops of *test-solution of ferric chloride* are added, a reddish color is developed. It evolves hydrogen sulphide when gradually warmed with dried *sodium acetate.* It should yield no characteristic reaction with the tests for chlorides or sulphates." *Br.*

Uses.—In the lower animals sulphonmethane produces sleep, which, if the dose has been sufficient, deepens into coma accompanied by paresis, tremors, and convulsions. Occasionally loss of power notably in the hind legs precedes the cerebral symptoms. The action of the drug upon the circulation seems to be very feeble although it has not been thoroughly made out. According to Schick, the nerves and muscles are not altered, so that the symptoms must be centric in origin. Kast found that the blood is not changed, and, according to W. J. Smith, tissue-change is not influenced.

Kast believed that sulphonal is eliminated in the form of a highly soluble organic compound, probably a sulphonic acid. Jaffe and Jolles have, however, each obtained unaltered sulphonal from the urine; but it would appear probable that the greater part of the sulphonal splits up in the system so as to yield ethylsulphonic acid, which escapes in the urine (W. J. Smith).

When sulphonal is given to human beings in doses of from fifteen to thirty grains, sleep usually develops in from half an hour to an hour. It is usually quiet, and not followed by disagreeable after-effects, although sometimes mental confusion and lassitude remain. Over pain sulphonal exerts no influence. It was originally asserted by Kast that the drug would prove especially useful in *insomnia* from cardiac diseases, but further experience does not sustain this. Occasionally sulphonal produces nausea, headache, depression or other disagreeable after-effects, and in old people or those suffering from mental enfeeblement, mental confusion is likely to occur. Chronic poisoning has frequently been caused by the continuous use of sulphonal. The symptoms develop suddenly without distinct prodromes, and usually continue to the fatal issue (75 per cent. of cases). The most characteristic and often first manifestation is pink to dark red urine, which stains linen, etc., followed by constipation, vomiting, gastric tenderness, ataxia, anuria, paresis, loss of reflexes, albuminous, bloody or suppressed urine, collapse; after death a widespread fatty degeneration has been found. No effective treatment is known, but large amounts of alkalized water (soda) should be given by

the mouth and by hypodermoclysis. Even after therapeutic doses of sulphonal a measles-like rash often appears.

Whenever sulphonal is given largely or for a length of time, the urine should be carefully watched, and any smoky or dark appearance of the excretion should be the signal for the immediate withdrawal of the drug. That enormous doses of sulphonal may be recovered from is shown by the case reported by Neisser, in which over three ounces are said to have been taken, six hours elapsing before any medical treatment was instituted. In the case reported by Knaggs, four hundred and fifty grains produced death after unconsciousness lasting for three days, with complete anuria.

Dose, from ten to forty grains (0.65 to 2.6 Gm.), which should always be given in fine powder, compressed pills frequently passing through the bowels unchanged.

SULPHUR LOTUM. U. S.

WASHED SULPHUR

(sŭl'fŭr lō'tŭm)

S = 31.83

"Washed sulphur, when dried, should contain not less than 99.5 percent. of pure Sulphur." *U. S.*

Flores Sulphuris Loti; Soufre Sublimé Lavé, *Fr. Cod.*; Sulphur Depuratum, *P. G.*; Gereinigter Schwefel, Gereinigte Schwefelblumen, *G.*; Solfo sublimato e levato, *It.*; Azufre lavado, *Sp.*

* "Sublimed Sulphur, *one hundred grammes* [or 3 ounces av., 231 grains]; Ammonia Water, *ten cubic centimeters* [or 162 minims]; Water, *a sufficient quantity*. Pass the Sublimed Sulphur through a No. 30 sieve, mix it thoroughly with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, add the Ammonia Water, and digest for three days, agitating occasionally. Then add *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, transfer the mixture to a muslin strainer, and wash the Sulphur with Water until the washings cease to impart a blue color to red litmus paper. Then allow it to drain, press the residue strongly, dry it rapidly at a moderate heat, pass it through a No. 30 sieve, and keep it in well-stoppered bottles." *U. S.*

Sublimed sulphur is frequently contaminated with small quantities of sulphuric acid and other impurities, and the object of the ammonia in the above process is to neutralize the acid, the salt being subsequently washed out and to remove any arsenical contamination. (See *Sulphur Sublimatum.*)

Properties.—It is officially described as "a fine yellow powder, without odor or taste. Insoluble in water; readily soluble in carbon disulphide; slightly soluble in absolute alcohol; more readily soluble in petroleum benzin, benzene, oil of turpentine, and many other oils; also in ether, chloroform, and in boiling aqueous solutions of alkali hydroxides. At about 115° C. (239° F.) it fuses to a yellow, mobile fluid, which upon further heating becomes dark and viscid, until a temperature above 300° C. (572° F.) is reached, when it becomes a thin liquid boiling at 448° C. (838.4° F.). If air be admitted, it burns to sulphur dioxide, which is identified by its characteristic odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. held in the gas. The amount of residue left after volatilizing or igniting a weighed portion of dried Washed Sulphur should not exceed 0.2 percent. If 0.5 Gm. of Washed Sulphur be boiled with 10 Cc. of sodium hydroxide T.S., it should be dissolved, leaving no appreciable residue (absence of *earthy* and *metallic impurities*). If 0.5 Gm. of Washed Sulphur be digested for several hours with 10 Cc. of ammonia water, the liquid filtered, and the clear filtrate evaporated to dryness on a water-bath, then, after adding 1 Cc. of nitric acid and again evaporating, the solution obtained by dissolving the residue in 10 Cc. of hydrochloric acid (8 percent.) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 5 Cc. of water be agitated with 2 Gm. of Washed Sulphur, the liquid should not change the color of blue or red litmus paper (absence of *acid* and of *ammonia*)." *U. S.*

Dose, one to three drachms (3.9 to 11.6 Gm.).

Off. Prep.—Pulvis Glycyrrhizæ Compositus, *U. S.*; Sulphuris Iodidum, *U. S.*; Unguentum Sulphuris, *U. S.*

SULPHUR PRÆCIPITATUM. U. S., Br.

PRECIPITATED SULPHUR [Milk of Sulphur, Br.]

(sŭl'fŭr præ-cĭp-ĭ-tā'tŭm)

S = 31.83

"Precipitated Sulphur, when dried, should contain not less than 99.5 percent. of pure Sulphur." *U. S.* "Sulphur precipitated by hydrochloric acid from a solution of calcium sulphides and thiosulphate, which has been made by boiling together sulphur and lime in water." *Br.*

Lac Sulphuris; Milk of Sulphur; Magisterium Sulphuris; Soufre précipité, *Fr. Cod.*; Lait de Soufre, *Fr.*; Sulfur præcipitatum, *P. G.*; Schwefelmilch, *G.*; Solfo precipitato, *It.*

* "Sublimed Sulphur, *one hundred grammes* [or 3 ounces av., 231 grains]; Lime, *fifty grammes* [or 1 ounce av., 334 grains]; Hydrochloric Acid, Water, each, *a sufficient quantity*. Slake the Lime, and mix it uniformly with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water. Add the Sublimed Sulphur, previously sifted, and, after thorough mixing, add *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water, and boil the mixture in a porcelain or glass vessel during one hour, stirring or agitating very frequently, and replacing the Water lost by evaporation. Then cover the vessel, and permit the contents to cool and become clear by subsidence.

Carefully draw off the clear solution, and filter the remainder. To the united liquids add gradually, and with constant stirring, Hydrochloric Acid previously diluted with an equal volume of Water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction and a yellow color. Collect the precipitate on a strainer, and wash it, until the washings are tasteless and cease to give a precipitate upon the addition of ammonium oxalate test solution. Then dry the product rapidly, at a moderate heat, and keep it in well-stoppered bottles." *U. S.*

The process for precipitated sulphur was not changed in the last revision. The Br. Pharm. in its official definition outlines the method used in the U. S. preparation.

In the U. S. process three molecules of calcium oxide react with six atoms of sulphur to form two molecules of calcium disulphide and one of calcium thiosulphate (hyposulphite);

$$3CaO + (S_2)_3 = 2CaS_2 + CaS_2O_3$$

On the addition of the hydrochloric acid, six atoms of sulphur are precipitated (four from the two molecules of calcium disulphide and two from the one molecule of calcium thiosulphate), and the calcium and oxygen unite with the hydrochloric acid, so as to form calcium chloride and water, according to the reaction:

$$2CaS_2 + CaS_2O_3 + 6HCl = 3CaCl_2 + 3H_2O + (S_2)_3$$

This rationale is not exactly applicable to the British process of 1885, in which the proportion of the sulphur to the lime employed was greater than in that of the U. S. Pharm., and on account of this greater excess of sulphur the reaction takes place as follows:

$$3CaO + (S_2)_6 = 2CaS_5 + CaS_2O_3$$

a calcium pentasulphide being formed. Hydrochloric acid is the most eligible precipitant for the sulphur, as it gives rise to calcium chloride, which is a very soluble salt and is easily washed away. Sulphuric acid is wholly inadmissible, as it generates calcium sulphate, which, from its sparing solubility, becomes necessarily intermingled with the precipitated sulphur. According to Schweitzer, the best material from which to precipitate the sulphur is potassium sulphide, formed by boiling sulphur with potassium hydroxide. Otto of Brunswick, finds that potassium sulphide is likely to contain copper sulphide, and therefore he prefers calcium sulphide.

Properties.—Precipitated sulphur is in friable lumps, of a white color, with a pale yellowish-green tint, and consisting of finely divided particles slightly cohering, or, as officially described, is "a fine, amorphous powder, of a pale yellow color, without odor or taste. Insoluble in water; very slightly soluble in absolute alcohol; readily soluble in carbon disulphide, petroleum benzin, benzene, oil of turpentine, and many other oils; also in ether, chloroform, and in boiling aqueous solutions of alkali hydroxides. At 115° C. (239° F.) Precipitated Sulphur melts, and at a higher temperature it volatilizes, or, if air be admitted, burns to sulphur dioxide. If 1 Gm. of Precipitated Sulphur be ignited, it should not leave a weighable residue. If 1 Gm. of Precipitated Sulphur be digested for several hours with 10 Cc. of ammonia water and the liquid filtered, one-half of the clear filtrate should not leave a residue on evaporation; if the remainder be evaporated to dryness on a water-bath, then, after adding 1 Cc. of nitric acid and again evaporating, the solution obtained by dissolving the residue in 10 Cc. of hydrochloric acid (8 percent.) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 5 Cc. of water be agitated with 2 Gm. of Precipitated Sulphur, the liquid should not change the color of blue or red litmus paper (absence of *acid* and *alkali*)." *U. S.* For a paper on Selenium in Sulphur by T. D. Reed, see *Proc. A. Ph. A.*, 1897, 251. "A grayish-yellow soft powder, free from grittiness and from the smell of hydrogen sulphide. Under the microscope it is seen to consist of opaque globules, without any admixture of crystalline matter. It responds to the chemical tests mentioned under 'Sulphur Sublimatum.'" *Br.* The German test, that 1 Gm. of precipitated sulphur should dissolve in 5 Gm. of carbon disulphide, is trustworthy, according to Fittinger. Precipitated sulphur is entirely dissipated by heat; water boiled with it should not redden litmus. When recently prepared, it is devoid of taste, but possesses a peculiar odor. When long exposed, in a moist state, to the air, it becomes strongly contaminated with sulphuric acid. From its color it was formerly called *lac sulphuris*, or *milk of sulphur*. It is insoluble in water, but dissolves in a boiling solution of potassium hydroxide, and in oil of turpentine by the aid of heat. When of a brilliant white color, the presence of calcium sulphate may be suspected, in which case the preparation will not be wholly volatilized by heat. If pure, it communicates a harsh feel when rubbed between the fingers, owing to the friction of the particles. Precipitated sulphur differs from sublimed sulphur in being in a state of more minute division, and in presenting, after fusion, a softer and less brittle mass. Its peculiarities are supposed to depend upon the presence of water, which, however, is found in too small a quantity to constitute a regular *hydrate*. According to Rose, its white color is occasioned by the presence of a small proportion of hydrogen sulphide. Soubeiran states that it always contains some hydrogen sulphide, causing it to differ as a therapeutic agent from sublimed sulphur.

Uses.—Precipitated sulphur possesses medicinal properties similar to those of sublimed sulphur. Its state of extreme division renders it more readily suspended in liquids. It is sometimes selected for forming sulphur ointments; these are lighter in color and smoother than those made with sublimed sulphur.

Dose, one to three drachms (3.9 to 11.6 Gm.).

Off. Prep.—Trochiscus Sulphuris, *Br.*

SULPHUR SUBLIMATUM. U. S., Br.

SUBLIMED SULPHUR

(sŭl′phŭr sŭb-lĭ-mā′tŭm)

S = 31.83

"It should contain not less than 99 percent. of pure Sulphur." *U. S.* "May be prepared, more or less directly, from native sulphur or sulphides." *Br.*

Flores Sulphuris; Brimstone; Soufre Sublimé, *Fr. Cod.;* Fleur (Crême) de Soufre, *Fr.;* Sulfur sublimatum, *P. G.;* Schwefel, Schwefelblumen, Schwefelblüthe, *G.;* Solfo sublimato, *It.;* Azufre sublimado, Azufre, *Sp.*

Natural States.—Sulphur is very generally disseminated throughout the mineral kingdom, and is almost always present, in minute quantity, in animal and vegetable matter. Among vegetables, it is particularly abundant in mustard and other cruciform plants. It occurs in the earth either native or in combination. When native it is found in masses, translucent or opaque, or in the powdery form mixed with various earthy impurities. In combination it is usually united with certain metals, as iron, lead, mercury, antimony, copper, and zinc, forming compounds called sulphides. *Native sulphur* is most abundant in volcanic countries, and is hence called *volcanic sulphur.* The most productive mines of sulphur are found in Sicily (400 distinct sulphur workings existing there, with a present annual production of 538,354 tons) and in the former Pontifical States. In 1869 or 1870 sulphur in large masses was discovered in the volcanic island of Saba, one of the Dutch West Indies, about 110 miles south of St. Thomas. Sulphur exists as a mineral in widely separated localities and in enormous quantities in the Western United States. A large mine of native sulphur has been opened in California, about twenty miles from Santa Barbara, and seven from the sea coast. In 1872 a great hill of almost pure sulphur was found about 900 miles west of Omaha and 30 miles south of the Union Pacific Railroad. Two hundred miles south of Salt Lake City there is a deposit of sulphur two thousand feet square and of an unknown thickness, shafts having been sunk sixty feet without reaching the bottom. This sulphur is said to be free from arsenic and antimony and is a surface deposit. Much sulphur has been found in Mount Humboldt, Nevada, and Sulphur Mountain, as it is called, in the Yellowstone National Park, is largely composed of the mineral. The only localities in the United States in which sulphur is actively mined, however, are the Cove Creek Mine, Utah, and in Calcasieu Parish, La., where the Union Sulphur Company is now operating on an extensive scale, and a sulphur deposit underlying a quicksand is being mined by the Frasch process. A double-walled iron pipe is driven through the quicksand into the sulphur bed, and steam having been sent down between the walls of the pipe, the melted sulphur is raised in the inner pipe. An annual production of 300,000 tons can readily be obtained from this locality. Sulphur exists in large quantities in various localities in Japan. It is estimated that at Atosanobori there are five million tons of superior ore. The importations of sulphur from Sicily amounted in 1903 to 191,033 tons, but in 1905 dropped to 84,579 tons; the domestic production in 1903 was 35,098 tons, but in 1905 it increased to 232,000 tons. It is probable that in a year or two the Louisiana production will bring about the cessation of all importation from Sicily.

An estimate of the amount of sulphur consumed in the United States during 1902 to 1904 is presented in the table below.

Extraction.—Sulphur is obtained either from sulphur earths or from the native iron and copper sulphides, called iron and copper pyrites. The sulphur earths are placed in earthen pots set in oblong furnaces of brick work. From the upper and lateral part of each pot a tube proceeds obliquely downwards, which communicates with the upper part of a similar pot, situated outside the furnace, and perforated near its bottom, to allow the melted sulphur to flow into a vessel containing water, conveniently placed to receive it. Fire being applied, the sulphur rises in vapor, leaving the impurities behind, and, being condensed again, flows from the perforated pot into a vessel containing the water. Sulphur as thus obtained is called *crude sulphur,* and contains about one-twelfth of its weight of earthy matter. For purification it is generally melted in a cast iron vessel. When the fusion is complete, the impurities subside, and the purer sulphur is dipped out and poured into cylindrical wooden moulds, which give it the form of solid cylinders about an inch in diameter, called in commerce *roll sulphur* or *cane brimstone.* The dregs of this process, ground to powder, constitute a very impure kind of sulphur, of a gray color, called in commerce *sulphur vivum* or *horse brimstone.* The above process purifies the sulphur but imperfectly. At the same time it causes a considerable loss, as the dregs just mentioned contain a large proportion of sulphur. A more eligible

Source.	1902.	1903.	1904.
	Long tons	Long tons	Long tons
Domestic sulphur and sulphur content of pyrite	97,636	108,967	220,104
Imported sulphur	174,939	191,033	129,532
Sulphur content of imported pyrite	196,786	189,184	190,219
	469,361	489,184	539,855

mode of purification consists in distilling the crude sulphur from a large cast iron still set in brickwork over a furnace, and furnished with an iron head. The head has two lateral communications, one with a chamber of brick work, the other with an iron receiver immersed in water, which is constantly renewed to cool it sufficiently to cause the sulphur to condense in the liquid form. When the tube between the still and the receiver is shut, and that communicating with the chamber is open, the sulphur condenses on its walls in the form of an impalpable powder, and constitutes *sublimed sulphur*, or *flowers of sulphur*. If, on the other hand, the communication with the chamber be closed, and that with the receiver open, the sulphur will condense in the latter in the fused state, and, when cast in cylindrical moulds, forms the *roll sulphur* of commerce.

In the island of Anglesea, and at Swansea, Wales, large quantities of sulphur are obtained from imported Spanish copper pyrites in the process for extracting the metal. The furnaces in which the ore is roasted are connected with chambers in which the volatilized sulphur is condensed.

A process for separating pure sulphur from the residue of the manufacture of soda (calcium sulphide), proposed by Max Schaffner, has been used in most of the soda factories of Germany, and has been introduced, to a greater or less extent, in England, France, and Belgium. (See details, *A. J. P.*, 1869, p. 545.) We shall confine ourselves to an outline. The process is divided into three parts: *first*, the preparation of the *soda solution* by heaping up the soda residue in the air, whereby oxidation takes place, and polysulphides and thiosulphates are formed, which are extracted by lixiviation; *secondly*, the solution thus obtained is decomposed in close stone or iron vessels, by hydrochloric acid, which decomposes the polysulphides and thiosulphates, with precipitation of sulphur; and, *thirdly*, the sulphur is obtained pure by fusing it under water, with steam and a pressure of $1\frac{3}{4}$ atmospheres. Calcium chloride remains in solution, gypsum is suspended, and the addition of a little milk of lime neutralizes any free acid present, and with the sulphur forms calcium sulphide, which dissolves whatever arsenic sulphide may be present, leaving the sulphur free from impurities. This collects in the bottom of the kettle, and is drawn off into moulds. From 60 to 65 per cent. of pure sulphur is thus obtained from the soda residue. A. M. Chance (*J. Soc. Chem. Ind.*, 1888, p. 162) has described a process which after several years of experiment has been perfected, and seems likely to solve definitely the problem of sulphur recovery, if, as stated, 95 per cent. of the sulphur can be either recovered as brimstone or burned in sulphur furnaces for the manufacture of sulphuric acid. Chance passes limekiln gases (carbon dioxide and nitrogen) into the vats of alkali waste, liberating thereby the sulphur as hydrogen sulphide. This mixed with nitrogen goes into another vessel of alkali waste, when H_2S and CaS unite to form $Ca(HS)_2$, a calcium sulphydrate, while the nitrogen is allowed to escape. The $Ca(HS)_2$ is now decomposed by a fresh quantity of CO_2, and thus liberates a double quantity of hydrogen sulphide. This is so pure that when mixed with the requisite quantity of air and passed over anhydrous ferric oxide at a dull red heat the hydrogen is burned, liberating the sulphur, according to the reaction:

$$H_2S + O = H_2O + S$$

The sulphur can be obtained either in the sublimed or in the fused form, according to the temperature of the chamber. The present annual production by the Chance process in England amounts to 20,000 tons.

Crude sulphur comes to this country principally from Messina, in Sicily, and the ports of Italy. Roll sulphur and the flowers are usually brought from Marseilles. Good Sicilian sulphur does not contain more than 3 per cent. of impurity, consisting chiefly of earths. The Louisiana sulphur the extraction of which is described on page 1204 enters commerce, having the purity of 99.9 per cent. Crude sulphur is employed by the manufacturers of sulphuric acid, and, as it is very variable in quality, it becomes important to ascertain its value. This may be done by drying a given weight of it and submitting it to combustion. The weight of the incombustible residue, added to that lost in drying, gives the amount of impurity.

Properties.—Sulphur is a non-metallic element, existing in several allotropic states. In its ordinary state it is a brittle solid, of a pale yellow color, permanent in the air, and exhibiting a crystalline texture and shining fracture. It has a slight taste, and a perceptible odor when rubbed. When pure its sp. gr. is about 2, but it varies a little in density in its different allotropic states. Occasionally, from impurity, its sp. gr. is as high as 2.35. Its atomic weight is 31.83, and its symbol S. It is a poor conductor of heat, and becomes negatively electric by friction. The melting point of sulphur varies with its allotropic state, which is readily altered by heat. Pure sulphur melts and sublimes at 114.5° C. (238° F.). If heated above its melting point, it undergoes, in proportion to the heat applied, a progressive change, which will cause it, upon slow cooling, to solidify at a temperature lower than that at which it was melted; and if it be remelted it will be found to have a higher melting point than before. Melted sulphur is perfectly limpid, and of a bright yellow color. When sulphur is melted, and, after partial cooling, the crust formed on its surface is pierced, and the fluid portion poured out, it may be obtained in slender monoclinic crystals, constituting an allotropic condition of the element. This variety, however, gradually passes back into the more permanent variety found in nature. When sulphur is heated above its melting point, it becomes

deeper in color and less fluid. At 200° C. (392° F.) it has a deep brown color, and is so viscid that it cannot be poured from the containing vessel. If the temperature be still further increased, the sulphur resumes its fluidity, but retains its brown color. Finally, when the temperature reaches 448.4° C. (839° F.), it boils, forming a yellow vapor, and may be distilled. If melted sulphur, heated above 200° C. (392° F.), is suddenly cooled by being poured out into water, it becomes a reddish-brown plastic mass, with alteration of properties, called *soft sulphur* (*viscid sulphur*), which constitutes another allotropic variety, and is employed in taking impressions of medals, etc. This form of sulphur resumes the hard state, but not its original color, after the lapse of a few days, or suddenly if heated to 100° C. (212° F.). Sulphur is insoluble in water, but soluble in alkaline solutions, petroleum, rectified coal naphtha, the fixed oils, oil of turpentine and other volatile oils, alcohol and ether, chloroform, and carbon disulphide. One of its best solvents is carbon disulphide, from solution in which it crystallizes generally in rhombic octahedra, forms belonging to a different system from the monoclinic prisms obtained by crystallizing melted sulphur by cooling. Hence sulphur is said to be dimorphous. Eugène Pelouze has observed that the oils obtained by distilling the tar from gas works dissolve most sulphur at a temperature near their boiling point, and, if a saturated solution at this heat were to be allowed to cool, it would deposit sulphur in a crystalline form, and M. C. Wiedmann has suggested the application of this property to extraction of sulphur from native sulphur earths and ores, and from the residue of coal-gas works. (*A. J. P.*, June, 1871, p. 267.)

The allotropic states of sulphur have been studied chiefly by Brodie, Magnus and Weber, and Berthelot. These states are induced, for the most part, by heat, and are distinguished by the crystalline form of the sulphur, and by its solubility or non-solubility in carbon disulphide. *Insoluble sulphur* is the name given to that part of the soft sulphur which is left undissolved by the disulphide, amounting to between one-third and nearly one-half of the former. Brodie was unable to determine the melting point of this sulphur, but found it considerably above 120° C. (248° F.), or the melting point of prismatic sulphur. Flowers of sulphur contain about one-third of their weight of insoluble sulphur.

According to Marès, sulphur mixed with calcium carbonate, in the presence of the organic matters of the soil, is converted at first into hydrogen sulphide, then, under the influence of air and porous bodies, into sulphuric acid, finally into calcium sulphate, but Egidio Pollacer, on the contrary, thinks that sulphur in contact with calcium carbonate passes very readily into sulphuric acid, and then to calcium sulphate, independently of organic matters, and without being preliminarily changed into hydrogen sulphide, and this opinion he supports by several experiments. (*J. P. C.*, Oct. 1874, p. 330.)

Sulphur takes fire at about the temperature of 148.8° C. (300° F.), and burns with a blue flame, combining with the oxygen of the air, and giving rise to sulphurous oxide, SO_2. The combinations of sulphur are numerous, and are among the most powerful chemical agents. It forms with oxygen four oxides, *sulphurous* oxide (sulphur dioxide), SO_2, *sulphuric* oxide (sulphur trioxide), SO_3, *sulphur* sesquioxide, S_2O_3, and *sulphur heptoxide*, S_2O_7. The first two of these oxides, by their union with water, form *sulphurous acid*, H_2SO_3, and *sulphuric acid*, H_2SO_4. There are also known *hyposulphurous acid*, H_2SO_2, the corresponding oxide of which is not known, and in combination *thiosulphuric acid* (frequently spoken of as hyposulphurous acid), $H_2S_2O_3$, *persulphuric acid*, $H_2S_2O_8$, and a series of acids, $H_2S_2O_6$, $H_2S_3O_6$, $H_2S_4O_6$, and $H_2S_5O_6$, called the *thionic series*. It forms with hydrogen, hydrogen sulphide (*hydrosulphuric acid* or *sulphuretted hydrogen*), and with the metals, various *sulphides*.[1] Some of the sul-

[1] *Ferri Sulphidum*, FeS; 87.33. *Ferrous Sulphide.* "Protosulphide of Iron, prepared by melting together Iron, in small pieces, and Sublimed Sulphur." *U. S.* 1870.

This was introduced into the U. S. Pharmacopœia of 1870 as the material from which hydrogen sulphide may be obtained, which, though not official, is in constant use as a reagent, and is often employed with great advantage in processes for isolating the active principles of medicinal substances. Ferrous sulphide is best prepared by bringing iron and sulphur into contact at a red or white heat. The following are the processes of the late Dublin and Edinburgh Pharmacopœias.

"Take of rods of Iron, of the size employed in the manufacture of nails, *any convenient number*. Having raised them to a strong red or white heat, apply them in succession by their heated extremities to sticks of Sulphur, operating so that the melted Sulphide, as it is formed, may drop into a stone cistern filled with water, and be thus protected from oxidation. The water being poured off, let the product be separated from the Sulphur with which it is mixed, and, when dried, let it be enclosed in a well-stopped bottle." *Dub.*

"An inferior sort, good enough, however, for many purposes, is obtained by heating one part of Sublimed Sulphur and three of Iron Filings, in a crucible, in a common fire till the mixture begins to glow, and then removing the crucible, and covering it until the action, which at first increases considerably, shall come to an end." *Ed.*

Iron and sulphur form a number of sulphides, such as ferrous sulphide, FeS, ferric disulphide, FeS_2 (this occurs in nature as *common* or *cubic pyrites*), and ferric sesquisulphide, Fe_2S_3, which, while not found free in nature, occurs in magnetic pyrites, the formula of which is Fe_7S_8 or $5FeS + Fe_2S_3$. When the sulphide is obtained by the application of solid sulphur to white-hot iron, the product corresponds with magnetic pyrites; but when procured by heating flowers of sulphur with an excess of iron filings, as directed in the above Edinburgh process, a protosulphide is formed mixed with metallic iron. When sulphur is applied to white-hot iron over water, the metal appears to become hotter, burns with scintillations in the vapor of the sulphur, and changes instantly to sulphide, which, being comparatively fusible, melts into globules; these drop into the water, which serves to extinguish them.

Properties.—Ferrous sulphide has a yellowish color and the metallic lustre. When obtained over water it is in the form of brownish-yellow globules having a somewhat crystalline texture. When pure it furnishes a yellow powder, and dissolves in dilute sulphuric or hydrochloric acid without leaving a residue of sulphur, and with the production of hydrogen sulphide free from admixture of hydrogen. As pre-

phides are analogous to oxy-acids, others to basic hydroxides; and these different sulphides, by combining with one another, form compounds which, from their analogy to salts, are called by Berzelius *sulphosalts.*

Sulphur, when obtained by roasting the native sulphide, sometimes contains arsenic, and is thereby rendered poisonous. Sicilian sulphur, being volcanic, is not subject to this impurity. The common English roll sulphur is sometimes made from iron pyrites, and is then prone to contain orpiment (*arsenic trisulphide*). This impurity may be detected by heating the suspected sulphur with nitric acid. The arsenic, if present, will be converted into arsenic trioxide, and the nitric solution, diluted with water, neutralized with sodium carbonate, and acidulated with hydrochloric acid, will give a yellow precipitate of arsenic pentasulphide with a stream of hydrogen sulphide. A precipitate may be more readily obtained from the nitric solution if, after neutralization, sulphurous acid be added, which will convert the arsenic acid into arsenous acid. This is more easily decomposed by the hydrogen sulphide, but the precipitate obtained will now be the trisulphide. Sulphur, when perfectly pure, is wholly volatilized by heat, and soluble without residue in oil of turpentine. According to Playfair, a solution of sodium nitro-prusside is a delicate test for the alkaline sulphides, producing with them a violet tint. Bailey of West Point, employed the same test for detecting sulphur in any compound. The substance suspected to contain it is fused with sodium carbonate, with the addition of carbonaceous matter if necessary. If sulphur be present it will be converted into sodium sulphide, and upon the addition of a small portion of the fused mass to a drop of the nitro-prusside the characteristic violet tint will be produced.

Sublimed sulphur, usually called *flowers of sulphur* (*flores sulphuris*),[1] is "a fine, yellow powder, having a slight characteristic odor, and a faintly acid taste. Insoluble in water; readily soluble in carbon disulphide; slightly soluble in absolute alcohol; more readily soluble in petroleum benzin, benzene, oil of turpentine, and many other oils; also in ether, chloroform, and in boiling aqueous solutions of alkali hydroxides. At about 115° C. (239° F.) it fuses to a yellow, mobile fluid, which upon further heating, becomes dark and viscid, until a temperature above 300° C. (572° F.) is reached, when it becomes a thin liquid boiling at 448° C. (838.4° F.). In the air it burns to sulphur dioxide, characterized by its odor, and by its blackening a strip of paper moistened with mercurous nitrate T.S. held in the gas. When agitated with water, the latter gives an acid reaction with litmus paper. The amount of residue left after volatilizing or burning a weighed portion of well-dried Sublimed Sulphur should not exceed 0.5 percent." *U. S.* "A slightly gritty powder of a bright greenish-yellow color, without taste and without odor. Under the microscope it is seen to consist of almost opaque irregular particles without any admixture of crystalline matter. It burns with a blue flame, forming sulphurous anhydride; and is entirely volatilized by heat. It should not have any action upon *litmus. Solution of ammonia,* agitated with it, and filtered, does not on evaporation leave any residue (absence of arsenium sulphide)." *Br.* It is always contaminated with a little sulphuric acid, which is formed at the expense of the oxygen of the air contained in the subliming chambers. Accordingly, it always reddens litmus, and, if the acid is present in considerable quantity, sometimes cakes. It may be freed from acidity by careful washing with diluted ammonia water. (See *Sulphur Lotum.*)

Uses.—Sulphur is laxative, diaphoretic, and resolvent. It is supposed to be rendered soluble by the alkali of the bile. Mialhe taught that it is carried into the circulation by the fatty matters in the alimentary canal which dissolve it. (*M. T. G.,* June, 1868, p. 642.) It evidently passes off by the pores of the skin, as is shown by the fact that silver carried in the pockets of patients under a course of it becomes blackened with a coating of sulphide. The stools which it occasions are usually semi-solid, and it is gentle in its operation, unless it contain a good deal of acid, when it may cause griping; the liability of the sublimed sulphur to contain acid renders it less eligible for exhibition than the washed sulphur, from which all acidity is removed. The diseases in which sulphur is principally used are *hemorrhoids, atonic gout, chronic rheumatism, chronic catarrh,* and *asthma.* It has also been given as an antiperiodic, being considered particularly applicable to cases in which the apyrexia is incomplete.

Applied locally, sulphur is a specific in *scabies.* It is sometimes applied as an air bath, in the form of sulphurous acid gas, the

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pared, however, by the usual processes, it is not entirely soluble in dilute sulphuric acid, a portion of uncombined sulphur being left. The fused globules have the composition $5FeS + FeS_2$, or, according to some, $5FeS + Fe_2S_3$. This sulphide is employed solely as a pharmaceutical agent for the production of hydrogen sulphide. It yields this gas by reaction with diluted sulphuric acid.

$$FeS + H_2SO_4 = H_2S + Fe.SO_4$$

Sulphuretted hydrogen is a colorless gas, with an odor like that of putrid eggs. Its sp. gr. is 1.1782. It saturates bases, with which it forms salts called sulphides.

[1] *Ventilated (Dusted) Sulphur.*—Wacker gives the name "ventilated sulphur" to finely divided (dusty) sulphur, which is obtained by subjecting finely powdered sulphur to the action of a blower whereby the fine particles are carried into large compartments provided for the purpose. The operation must, however, be conducted in an atmosphere devoid as much as possible of oxygen (such as illuminating or fuel gas), since the finely divided sulphur is liable to cause explosion in the presence of oxygen. The product is pale yellow, resembles precipitated sulphur, and will pass through sieves of 200 meshes to the inch. Its extreme fineness renders it superior to the ordinary powdered or flowers of sulphur for many purposes for which these are commonly used, and particularly for spraying grape vines infected with the disease of the leaves called "oidium," for which ordinary flowers of sulphur is popularly employed in Italy. (*Ph. Centralh.,* July 4, 1901, 417.)

head being protected from its effects.[1] It has been used to a considerable extent in *diphtheria*, the flowers being blown by means of a tube, or a little cone of paper like a lamp lighter, upon the fauces from four to six times a day. The external use of sulphur is strongly recommended by O'Connor of London, in *sciatica* and *chronic articular rheumatism*. The limb affected is covered with sulphur, and bandaged with new flannel, over which sheets of wadding are wrapped. The dressing should not be taken off for several days, as its earlier removal would interfere with the absorption of the sulphur, on which its curative effect depends. (*L. L.*, Am. ed., June, 1857, p. 507.) The dose of sulphur is from one to three drachms (3.9 to 11.6 Gm.), mixed with syrup or molasses, or taken in milk. It is often combined with potassium bitartrate, or with magnesia.

According to Hannon of Brussels, *soft sulphur*, recently prepared, possesses valuable therapeutic properties, not as a laxative, but as a stimulant to the circulation, lungs, and skin, far more active than ordinary sulphur. The *dose* of soft sulphur is from twenty to fifty grains (1.3 to 3.2 Gm.), given in the form of pill. It has also been successfully employed for filling the hollows of *carious teeth*. (*P. J.*, xvii. 330.) Sublimed sulphur has been used with extraordinary success in South Africa and the Philippines in the treatment of *amœboid dysentery*. It acts probably by killing the amœba. It may be given in divided doses up to two hundred grains (13 Gm.) a day.

Much sulphur is consumed in the arts, principally in the manufacture of gunpowder and of sulphuric acid.

Dose, one to three drachms (3.9 to 11.6 Gm.).

Off. Prep.—Antimonium Sulphuratum, *Br.;* Confectio Sulphuris, *Br.;* Emplastrum Ammoniaci cum Hydrargyro, *Br.;* Emplastrum Hydrargyri, *Br.;* Potassa Sulphurata, *Br.;* Pulvis Glycyrrhizæ Compositus, *Br.;* Sulphur Lotum, *U. S.;* Sulphur Præcipitatum, *U. S.;* Sulphuris Iodidum, *Br.*

SULPHURIS IODIDUM. U. S., Br.

SULPHUR IODIDE

(sŭl'phŭ-rĭs ī-ŏd'ĭ-dŭm)

Sulfur Iodatum; Ioduretum Sulfuris; Iodure de Soufre, *Fr.;* Jodschwefel, *G.*

• "Washed Sulphur, *twenty grammes* [or 308 grains]; Iodine, *eighty grammes* [or 2 ounces av., 360 grains]. Mix the Sulphur and Iodine thoroughly by trituration; introduce the mixture into a flask, close the orifice loosely, and, by means of a water-bath, gradually and with occasional agitation apply a heat not exceeding 60° C. (140° F.), until the ingredients combine and become of a uniformly dark color throughout. Then increase the heat to the boiling point of the water, so as to fuse the mass. Should any Iodine have sublimed and condensed on the glass, incline the flask so as to combine the Iodine with the fused mass, and then pour the latter upon a porcelain plate or other suitable cold surface. When it is cold break the product into pieces of suitable size, and keep them in a glass-stoppered bottle, in a cool place." *U. S.*

"Iodine, 4 *ounces* (Imperial) or 100 grammes; Sublimed Sulphur, 1 *ounce* (Imp.) or 25 grammes. Intimately mix the Sublimed Sulphur with the Iodine; heat the mixture gently in a loosely corked flask; when the mass becomes uniformly dark, increase the temperature so as to produce liquefaction; allow the product to cool in the flask. The flask should then be broken, and the solidified mass of Sulphur Iodide reduced to fragments, which should be kept in a well-closed vessel." *Br.*

Both of the official processes were derived from the French Codex. Though formerly official with the London and Dublin Colleges, it was omitted in the first British Pharmacopœia, to be resumed in that of 1898. The process simply effects a combination of the two elements by melting them together.

Properties.—Sulphur iodide is in "brittle masses of a crystalline fracture and a grayish-black, metallic lustre, having the odor of iodine and a somewhat acrid taste. Almost insoluble in water; soluble in about 60 parts of glycerin; very soluble in carbon disulphide. Alcohol, ether, and a solution of potassium iodide dissolve the iodine, leaving the sulphur. Continued boiling with water vaporizes all of the iodine, leaving about 20 percent. of sulphur as residue. On exposing Sulphur Iodide to the air, it gradually loses iodine. On heating it, some iodine sublimes at first; at a somewhat higher temperature a sublimate is formed, containing both iodine and sulphur. At a still higher temperature, the whole is volatilized, leaving only a trace of residue. If 0.5 Gm. of finely pulverized Sulphur Iodide, together with 1 Gm. of potassium iodide, be dissolved in 20 Cc. of water (the sulphur separating), not less than 28 Cc. of tenth-normal sodium thiosulphate V.S. should be required for complete decolorization of the mixture, using starch T.S. as indicator." *U. S.* "A grayish-black solid substance, with a radiate crystalline appearance. It resembles iodine in smell, and in the property of staining the skin. Soluble in 60 parts of *glycerin;* insoluble in cold *water*. When boiled with *water* the iodine passes off in vapor, and the sulphur remains as an insoluble residue having about one-fifth of the weight of the Sulphur Iodide taken." *Br.* This compound is chemically regarded as *iodine disulphide*, I_2S_2, or, as sometimes stated, *sulphur subiodide*. Its solution in glycerin would probably prove useful, in some cases, as a

[1] *Sulphur candles* are now furnished by manufacturers, and are made by inserting wicks into melted sulphur contained in a can; as the sulphur cools, the wicks retain an upright position, and to obtain the effects of sulphurous acid gas it suffices to light the wicks and permit the fumes to come in contact with moist air. They are used for disinfecting apartments, etc.

substitute for the ointment of this iodide. It is rapidly decomposed, when in a state of powder, upon the addition of several of the volatile oils, violet vapors of iodine being evolved, and the odor of sulphur perceived. (G. W. Patterson.) Sulphur iodide has been very usefully employed as an external remedy in various skin diseases, such as *tinea capitis, lupus, lepra,* etc., applied in the form of ointment. (See *Unguentum Sulphuris Iodidi.*) Internally, it has been used with alleged great advantage in human *glanders.* (Bourdon of Paris, *Ann. Thér.,* 1858, 239.)

Off. Prep.—Unguentum Sulphuris Iodidi, *Br.*

SUMBUL. U. S. (Br.)

SUMBUL [Musk-root]

(sŭm'bŭl)

"The dried rhizome and root of an undetermined plant, probably of the family *Umbelliferæ.*" *U. S.* "The dried transverse slices of the root of Ferula Sumbul, *Hook.*" *Br.*

Sumbul Radix, *Br.;* Racine de Sumbul *Fr.;* Sumbulwurzel, Moschuswurzel, *G.*

Under the name of *sumbul* or *jatamansi,* a root has long been used in India, Persia, and other parts of the East, as a perfume, an incense in religious ceremonies, and medicinally. It was the root of a then unknown plant, supposed to be umbelliferous, and, from the character of the root, to grow in low wet places. The plant is said to inhabit no part of British India, but the regions to the north and east of it, as Nepaul, Bootan, Bucharia, etc. The root is taken northward to Russia, and reaches the rest of Europe through St. Petersburg. The physicians of Moscow and St. Petersburg were the first to employ it on the continent of Europe. Granville first introduced it to the notice of the profession in Great Britain and in this country. It has also been imported into England from India, whither it was brought from a great distance. The plant which was recognized by the U. S. P. 1890 as the source of the sumbul of the day was the *Ferula Sumbul,* Hooker fil., *Bot. Mag.* (1875) t. 6196.

Euryangium Sumbul, Kauffmann, *Nouv. Mém. Soc. Imp. Nat. de Moscow* (1871), xiii. t. 24, 25.—This plant was first discovered by the Russian Fedschenko in 1869, growing at an elevation of 3000 feet in the mountains which separate Russian Turkestan from Bucharia. In 1871 it was described by Kauffmann, who erected a new genus on characters dependent upon the enormous size of the vittæ in the immature fruit. The plant has been cultivated in the Moscow botanical gardens, and, less successfully, at Kew, and it has been found that the vittæ almost disappear in ripening, and do not afford a good generic character. The plant is described as an enormous umbellifer, reaching a height of eight feet, and having a solid, cylindrical, slender stem, which in the upper part gives origin to about twelve slender divaricate branches. The root-leaves are two and a half feet long, with short, channelled, broadly dilated, completely clasping petioles. They are triangular in outline, tripinnate, with the alternate divisions fine. The stem-leaves rapidly decrease in size until they become mere sheathing bracts. The flowers are polygamous, the fruit from three-eighths to one-half inch long by one-fourth inch wide; the mericarps oblong-oval, dorsally much compressed, thin, with three faint, thread-like, dorsal ridges; no dorsal vittæ, and commissural ones collapsed. The sumbul of the present world-markets differs so materially from that formerly seen that the U. S. P. revisers have adopted the suggestion of Holmes that it is a distinct drug of unknown botanical origin. J. E. Aitchison states (*Tr. Linn. Soc.,* ser. 2, *Bot.,* 69) that the root of *Ferula suaveolens,* which has only a faint musky odor, is one of the kinds exported from Persia to Bombay by the Persian Gulf.

Properties.—Sumbul formerly occurred in the markets in transverse slices 1 to 5 inches in diameter and an inch or more in thickness, with a dark, thin bark, a light, spongy parenchyma and dirty-brown surfaces, showing under the lens an abundant resinous exudation. Further, the taste, at first feebly sweetish, became after a time bitterish and balsamic, but not disagreeable, and a strong aroma was developed under mastication, diffusing itself with a sensation of warmth through the mouth and throat and rendering the breath fragrant. The musky odor was very strong. The sumbul of the present day differs from that just described, in being smaller, often in cylindrical pieces, and having a firmer structure and less decided odor, and also, according to Holmes, often a branched rootstock. It is officially described as "in transverse segments, of variable length and rarely exceeding 10 Cm. in diameter; externally dusky brown, annulate, longitudinally wrinkled, or with a smooth, silver-gray periderm; fracture short-fibrous, light yellow or brownish-yellow, spongy, porous, with numerous brownish-yellow resin reservoirs, and irregular, easily separable fibres; bark about 0.5 Mm. thick; odor strong, musk-like; taste bitter." *U. S.*

The root has been analyzed by Reinsch and other German chemists, and found to contain volatile oil, two balsamic resins, one soluble in alcohol, the other in ether; wax, gum, starch, a bitter substance soluble in water and alcohol, and an acid which was named *sumbulic acid,* but which Riecker and Reinsch showed to be *angelic acid,* $C_5H_8O_2$, accompanied by a little valeric acid, $C_5H_{10}O_2$. Solution of potassium hydroxide is said to convert the resin into the potassium salt of an acid called *sumbulamic,* but which has not been sufficiently investigated. The musk-like odor seems to be connected with the balsamic resins, and probably depends on some principle associated

with them not yet isolated. The volatile oil, of which 0.33 per cent. is yielded by distillation, has a taste like that of peppermint. On dry distillation it yields a bluish oil which contains *umbelliferone*. Philip H. Utech (*A. J. P.*, 1893, p. 465) has extracted and purified the resin soluble in alcohol. He obtained it as a soft, whitish, translucent resin which, on drying at 110° C., yielded a clear, transparent, amber-colored product having a bitter taste and the aromatic odor of the root. It constituted 6.1 per cent. of the drug. J. H. Hahn (*Proc. Penna. Ph. Assoc.*, 1896, 75) found 17.25 per cent. of fixed oil in sumbul.

Uses.—Sumbul is a nervous stimulant, belonging to the class of antispasmodics, and was originally used by the Russian physicians as such, and also in asthenic cases of *dysentery* and *diarrhœa*. It has been employed to a considerable extent in this country in *amenorrhœa, hysteria, chlorosis,* and other allied diseases of the female sex, as an adjuvant to other remedies. The best preparations for use are the tincture and the fluid and solid extracts. There has been no great precision as to dose, but from one-half drachm to two drachms (2.0 to 7.7 Gm.) of the root or its equivalent may be given at a time.

Murawieff of Russia, prepares the resin, which he considers to be the active principle, by macerating the root first in water, and then in a solution of sodium carbonate, washing it well with cold water, drying it, treating it with alcohol, filtering the tincture, adding a little lime and again filtering, separating the lime by sulphuric acid, agitating with animal charcoal, again filtering, distilling off nearly all the alcohol, mixing the residuum with water, driving off the remaining alcohol, and, finally, washing the precipitate with cold water, and drying it. The resin thus obtained is whitish, translucent, softening between the fingers, combustible without residue, of an acid taste, and an aromatic odor, like that of the root. Murawieff gives it in the *dose* of a grain or two (0.065 or 0.13 Gm.), in the form of pill, three or four times a day, with or without opium, and has found it useful in *chronic bronchitis* and *pneumonia* slow of resolution, in the *moist asthma* of old, anæmic, and scorbutic patients, in *atonic dysentery, leucorrhœa, hypochondriasis,* and *hysteria*. (*Dublin Q. J.*, Feb. 1855, p. 252.) Procter has published a formula for a fluidextract, of which the dose is from fifteen minims to a fluidrachm (0.9 to 3.75 Cc.). (*A. J. P.*, xxvii. 233.) Half an ounce of a tincture produced narcotic symptoms, such as confusion of the head, a tendency to snore, even when awake, feelings of tingling, etc., with a strong odor of the medicine from the breath and skin, which continued for a day or two and gradually passed off. (*N. R.*, Oct. 1874, p. 309.)

Dose, one-half drachm to two drachms (2.0 to 7.7 Gm.).

Off. Prep.—Fluidextractum Sumbul, *U. S.;* Extractum Sumbul, *U. S.;* Tinctura Sumbul, *Br.*

SUPPOSITORIA. U. S.

SUPPOSITORIES

(sup-pŏs-ĭ-tō′rĭ-ă)

Suppositoires, *Fr. Cod.;* Suppositoria, *P. G.;* Suppositorien, Stuhlzäpfchen, *G.;* Supositorios, *Sp.*

Suppositories are solid bodies usually intended to be introduced into the rectum with a view either of evacuating the bowels by irritating the mucous membrane of the rectum, or of producing a specific effect on the neighboring parts or on the system at large. Suppositories are also made for vaginal or urethral administration. They fulfil the same indications as enemata, and are sometimes preferable from the facility of their application, and, when the object is to produce the peculiar effect of a medicine, from the smallness of their bulk, which facilitates retention. Their form may be cylindrical, conical, or spherical, the last being preferable when the bulk is small, or they may be in the shape of the modified cone with a tapering base, as recommended by H. S. Wellcome. (*Proc. A. Ph. A.*, 1893, p. 103.) They should be of such a consistence as to retain their shape, but so soft as to incur no risk of wounding the rectum. For laxative purposes the suppository may be from one to three inches long, and about as thick as a common candle; with a view to the specific effects of medicines it should be considerably smaller, as in this case it is important that the medicines should be retained and the irritative influence of distention avoided. Soap is not unfrequently employed in this way as a laxative. A piece of solidified molasses (molasses candy) is sometimes preferred. To increase the purgative effect, and at the same time act on the uterine function, aloes may be added to the soap. A. B. Taylor of Philadelphia, in 1852 called attention to cacao butter as the best base for suppositories, having more exactly the requisite degree of consistence and fusibility than any combination of suet, spermaceti, wax, etc., that could be employed. (*A. J. P.*, 1852, p. 211.) Experience has proved the correctness of his views. It has been thought necessary to use wax, spermaceti, or some other substance having a comparatively high fusing point, in order to render the suppository sufficiently firm. Continued experience has, however, demonstrated that, except in the warmest weather, or in the case of camphor, phenol, the essential oils, and similar medicinal substances, even the commercial cacao butter will suffice. It is said that cacao butter is usually adulterated with some other fat which melts at a low temperature, and that if a pure article can be obtained any substance to increase its hardness is never required. When such a material is employed, wax is usually selected, although cetaceum is preferable. If not more than 10 per cent. of the spermaceti is added, the value of the suppository is not very materially affected, although it melts more slowly, and con-

sequently requires a longer time to act, than when the butter of cacao is used alone. Suppositories containing a considerable percentage of wax melt so slowly in the rectum as to be comparatively useless, or they may fail altogether to soften down, and be finally passed from the anus unchanged. A very good method of mixing the oil of theobroma with the hardening material is by grating with an ordinary tin grater, such as used in kitchens, and mixing the coarse powders before melting, and W. G. Ewing has proposed rubbing the powders and the medicinal substance in a mortar together, dividing the plastic mass, and shaping it with the fingers. It is better to shape them with a spatula, and roll them upon a pill tile with a little lycopodium. This plan, although having its advantages, is, however, not equal to the official one of melting the ingredients and running them into moulds. Extemporaneous moulds, made by rolling paper into cones about an inch long, may be used, but are much less convenient than permanent metallic moulds. The tendency of the hardened suppositories to adhere to the moulds may be overcome more or less perfectly by dusting the moulds with lycopodium powder, or greasing them well with olive oil, but it is far better to rely upon the natural contraction of the mass, caused by thoroughly cooling the moulds. Wm. B. Addington (*A. J. P.*, 1873, p. 257) advises lining the moulds with tin foil. The difficulty may also be met by the use of moulds that open lengthwise, which are now used almost exclusively in preference to individual moulds, and Chas. E. Dwight commends very highly the substitution of plaster of Paris moulds[1] for the metallic ones commonly employed. The mould must be very cold, so as to chill the melted liquid at once and prevent any separation of its ingredients by gravity. It has been proposed to condense the powdered ingredients of suppositories in a cold mould. (*A. J. P.*, 1875, p. 79.) It has also been recommended to form the excipient into the required shape, and then, while it is still soft, make an excavation from the base upward, into which the medicine may be introduced, and afterwards enclosed by a little of the cacao butter. But, as one of the objects of the excipient is an equable diffusion of the medicine, to prevent irritation, this method would be inapplicable to substances in any degree locally irritant.

J. Percy Remington has devised a suppository mould made of soft vulcanized rubber, it is used in the same manner as that employed for a metal mould, the advantage being mainly the facility of removal when the suppository is cold, a slight pressure with a twisting motion causes the soft rubber mould to open, and the suppository to drop out easily. (*Proc. New Jersey Pharm. Association*, 1906.)

The weight—*i.e.*, the size—of suppositories should vary according to the purposes for which they are employed. When they are to be used for infants and children, they should weigh from five to ten grains. The Br. Pharm., in conformity with the recommendation of H. B. Brady (*P. J.*, 1866, p. 544; 1868, p. 321; and 1871, pp. 193, 488, 563),[2] adopts the weight of fifteen grains. Experience has shown this to be the most useful size, and the U. S. P. 1880 adopted it, but the U. S. P. (8th Rev.) directs the weight to be thirty grains.

The U. S. P. (8th Rev.) directs as follows: "Suppositories are solid bodies of various weights and shapes, adapted for introduction into the different orifices of the human body, and melting readily at blood heat. The vehicles usually employed are Oil of Theobroma, Glycerinated Gelatin, or Sodium Stearate. For suppositories made with Oil of Theobroma the following general processes may be employed: Take of the Medicinal Substance, *the prescribed quantity;* Oil of Theobroma, grated, *a sufficient quantity.* Reduce the Medicinal Substance, if dry, to a very fine powder, or, if an extract, soften it with an appropriate liquid, then mix it thoroughly in a mortar with about an equal weight of grated Oil of Theobroma, and incorporate the remainder of the Oil of Theobroma until a homogeneous, plastic mass is obtained, adding, if necessary, a small quantity of Expressed Oil of Almond. Roll the mass on a graduated tile until a cylinder of the proper length is formed, divide this into the required number of equal parts, and with a spatula, or other convenient mechanical aid, form them into the desired shape. If the process of fusion is preferred, mix the Medicinal Substance with about an equal weight of grated Oil of Theobroma, as above directed, then thoroughly incorporate it with the remainder of the Oil of Theobroma, previously melted by a gentle heat, in a suitable vessel provided with a lip; then allow it to cool to about 38° C. (100.4° F.), and, when the mixture begins to congeal, pour it immediately into suitable well-cooled moulds. Keep the moulds at a freezing temperature until the suppositories have hard-

[1] Dwight makes these moulds in the following manner: Into a pasteboard box, about six inches long and two wide, pour liquid plaster of Paris, of the consistence of thick cream until half full. Having prepared six well-moulded suppositories of wax, immerse them in the soft plaster half their diameters, with their large end close to the edge of the box, in a row, and at a uniform distance. When the plaster has set, gently remove the wax, and with a knife smooth off the surface and trim the edges of each mould sharp, and between each depression made by the wax suppository dig a small cavity about the size and shape of a small steel pen cut through the centre. When the face has become hard, grease it with linseed oil or lard, replace the wax suppositories, and raise the edges of the box by wrapping heavy paper around it, which will extend about another inch above the surface of the face; pour a portion of the plaster, equal to the first, gently over the greased surface until it is about one inch deep. When hard, separate the parts carefully, trim the edges, and boil for an hour in linseed oil, which will prevent the adhesion of the substance to be moulded. To be substantial, the plaster must be mixed thin and well stirred.

[2] The papers of Brady upon the subject of suppositories may be consulted with advantage; also a series of articles by several other authors in *A. J. P.*, 1871.

ened and are ready to be removed. For suppositories containing hydrated chloral, phenol, their derivatives, or substances which soften the vehicle, raise the melting point of the Oil of Theobroma by the addition of from ten to fifteen percent. of spermaceti, but the melting point must not be raised above 37° C. (98.6° F.).

For suppositories made with Glycerinated Gelatin the following process may be used: Take of the Medicinal Substance, *the prescribed quantity;* Glycerinated Gelatin, Glycerin, Water, each, *a sufficient quantity.* Mix the Medicinal Substance, if solid and soluble in Water or Glycerin, or if a miscible liquid, with a little Water, and add sufficient Glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted Glycerinated Gelatin, and pour it at once into suitable moulds which have been greased with a small quantity of petrolatum. Cool the mould thoroughly before removing the suppositories. Moulds for urethral suppositories should be warmed sufficiently before pouring the mass to facilitate the proper filling of the mould. Suppositories having a firmer consistence may be prepared by substituting Mucilage of Acacia for a portion of the Water or Glycerin. If the Medicinal Substance be insoluble in Water or Glycerin, thoroughly levigate it in a warm mortar with a sufficient quantity of Glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted Glycerinated Gelatin, and pour it into suitable moulds as above directed. With bulky powders about one-half of the Glycerin may be replaced with Water before levigation. Glycerinated Gelatin suppositories should be protected against the effects of heat and moisture and dry air by keeping them in tightly closed containers in a cool place.

Rectal Suppositories should be cone-shaped or spindle-shaped, and when made from Oil of Theobroma should weigh about *two grammes.*

Urethral Suppositories (*Bougies*) should be pencil-shaped, pointed at one extremity, and either *seven centimeters* in length, weighing about *two grammes,* or *fourteen centimeters* in length, weighing about *four grammes,* when made with Glycerinated Gelatin. If prepared with Oil of Theobroma they should weigh about one-half the above quantities.

Vaginal Suppositories should be globular or oviform in shape, and weigh about *ten grammes* if made with Glycerinated Gelatin, and about *four grammes* if made with Oil of Theobroma." *U. S.*

The U. S. Pharmacopœia gives no detailed formulæ for suppositories, except in one case, *Suppositoria Glycerini.* Opium, or some one of its preparations, is very advantageously administered in the form of a suppository, in cases of irritation of the rectum, urinary passages, or genital apparatus. The other narcotics may be used in the same way, and indeed almost any other medicine, in reference to its effects on the system, provided the quantity be not too large and the effects not too pronounced. Tannic acid or other local remedies may also be very appropriately employed in this way in cases of *prolapsus* or other affections of the rectum or anus. The dose may in general be one and a half times that of the medicine given by the mouth.[1]

The inventive genius of pharmacists has been industriously applied to the construction of suppository moulds, and there are now many varieties; the principle is much the same in all, however, but for convenience they may be classed as follows: 1. Individual moulds; these were among the first to be used. Half a dozen conical, hard-metal moulds are retained in an upright position in a tray containing ice-water, or made of paper, tin-foil, etc. (See *A. J. P.,* 1861, p. 5; 1863, p. 228; 1867, p. 121; 1868, p. 52; 1870, pp. 296, 392; *Proc. A. Ph. A.,* 1902, 501.) 2. Moulds which consist of two solid pieces of metal, hinged or temporarily joined, so that when the suppository is thoroughly cooled the parts may be separated and the suppository dropped out. (See *A. J. P.,* 1871, pp. 488, 563; 1874, pp. 192, 246; 1875, pp. 98, 202; 1877, p. 569; 1879, pp. 184, 277; and *Proc. A. Ph. A.,* 1893, p. 103; 1902, 757.) 3. Soft rubber moulds. (See *Proc. New Jersey Pharm. Assoc.,* 1906.) 4. Moulds designed to be used through compression, more or less powerful. (*N. R.,* June, 1879, Jan. and March, 1880; also *Proc. A. Ph. A.,* 1897, p. 442.)

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[1] *Medicated Pessaries,* which were recommended by J. Y. Simpson of Edinburgh, so closely resemble suppositories, so far as pharmacy is concerned, as to justify a mention of them in this place. All that has been said of the materials out of which suppositories are made, and the mode of preparing them, is equally applicable to medicated pessaries. The latter, however, are considerably larger, generally weighing one or two drachms. They differ also from suppositories in the purposes to which they are applied, being used for local effect, in allaying pain, checking discharge, acting as alterative to contiguous parts, etc. For important pharmaceutical details, see an article in *A. J. P.,* 1868, p. 223.

Urethral and Vaginal Suppositories. Medicated Bougies.—These articles, which are exceedingly useful for the purpose of exerting a local action upon the urethra or the neck of the bladder in cases of inflammation, pain, or spasm, may be made in the same manner as ordinary suppositories, except in regard to size. The vaginal suppository should be about two to two and a half inches long, and three-quarters of an inch in diameter at the base. Urethral suppositories should be cylindrical, with a conical point, and about one-fourth of an inch in diameter; their length should vary according to circumstances. They should never contain wax or other substance which does not melt readily and certainly at the temperature of the body, and which might, by a possible mishap, become the nucleus of a calculus. When it is desired to reach any considerable length of the urethra, the requisite toughness may be obtained, as suggested by Jos. L. Lemberger (*A. J. P.,* 1872, p. 166), by using a mould like an old fashioned candle mould, with a candle wick running through and projecting some distance from it. When a suppository so made is used, of course the free end of the wick should be secured with sticking plaster or a drop of collodion externally, and after the requisite period of contact the whole be pulled out. These are now largely made from gelatin, water, and a little glycerin. (See Mitchell's paper, *A. J. P.,* 1878, 108; also *P. J.,* 1895, 537; 1896, 484; and *Proc. A. Ph. A.,* 1894, 614.) For *Agar-Agar Suppositories,* see *A. J. P.,* 1895, 599; also *Proc. A. Ph. A.,* 1897, 443.

SUPPOSITORIA ACIDI CARBOLICI. Br.

PHENOL SUPPOSITORIES

(sŭp-pŏs-ĭ-tō′rĭ-ă ăç′ĭ-dī cär-bŏl′ĭ-cī)

Carbolic Acid Suppositories; Suppositoires d'acide Phénique, *Fr.;* Phenol-suppositorien, *G.*

"Phenol, 12 *grains* or 0.8 gramme; White Beeswax, 24 *grains* or 1.6 grammes; Oil of Theobroma, melted, *a sufficient quantity* to form, with the Phenol and Beeswax, a mixture which will fill twelve suitable moulds. each capable of holding *fifteen to sixteen grains* or about one gramme of Oil of Theobroma. Dissolve the Phenol in the Oil of Theobroma and Beeswax previously melted together at a low temperature, and pour the mixture into the moulds; or let the mixture cool and then divide it into twelve equal parts of a conical or other convenient form for a suppository. Each of these Suppositories contains 1 *grain* or 0.067 gramme of Phenol." *Br.*

These suppositories are intended to furnish a means of administering phenol by the rectum; the wax is needed to offset the tendency to liquefy.

SUPPOSITORIA ACIDI TANNICI. Br.

TANNIC ACID SUPPOSITORIES

(sŭp-pŏs-ĭ-tō′rĭ-ă ăç′ĭ-dī tăn′nĭ-cī)

Suppositoires de Tannin, *Fr.;* Tanninsuppositorien, Tannin-Stuhlzäpfchen, *G.*

"Tannic Acid, 36 *grains* or 2.4 grammes; Oil of Theobroma, *a sufficient quantity* to form with the Tannic Acid a mixture which will fill twelve suitable moulds, each capable of holding *fifteen to sixteen grains* or about one gramme of Oil of Theobroma. Melt the Oil of Theobroma; triturate the Tannic Acid intimately with a little of the Oil, and add to the remainder; stir well; as the mixture begins to thicken pour it into the moulds; or let the mixture cool and then divide it into twelve equal parts of a conical or other convenient form for a suppository. Each of these Suppositories contains 3 *grains* or 0.2 gramme of Tannic Acid." *Br.*

As it is hardly conceivable that a rectal dose of less than five grains should be wanted for the adult, the U. S. preparation of 1870 was of the latter strength (*i.e.,* five grains). The benzoated lard formerly added by the British authorities with a view of preventing rancidity has been omitted. The remedy is especially applicable to cases of *piles* and *prolapsus of the rectum.*

SUPPOSITORIA BELLADONNÆ. Br.

BELLADONNA SUPPOSITORIES

(sŭp-pŏs-ĭ-tō′rĭ-ă bĕl-lă-dŏn′næ)

Suppositoires de Belladone, *Fr.;* Belladonnasuppositorien, *G.*

"Alcoholic Extract of Belladonna, 18 *grains* or 1.2 grammes; Oil of Theobroma, *a sufficient quantity* for twelve suppositories. Proceed as directed for Tannic Acid Suppositories. Each of these Suppositories contains, approximately, one-sixtieth *grain* or 0.001 gramme of the alkaloids of Belladonna Root." *Br.*

SUPPOSITORIA GLYCERINI. U. S., Br.

SUPPOSITORIES OF GLYCERIN

(sŭp-pŏs-ĭ-tō′rĭ-ă glĭç-ĕ-rĭ′nī)

Suppositoires de Glycerin, *Fr.;* Glycerinsuppositorien, *G.*

* "Glycerin, *thirty grammes* [or 1 ounce av., 25 grains]; Monohydrated Sodium Carbonate, *one-half gramme* [or 7.7 grains]; Stearic Acid, *two grammes* [or 31 grains]; Water, *five cubic centimeters* [or 81 minims], to make *ten rectal suppositories.* Dissolve the Monohydrated Sodium Carbonate in the Water and add it to the Glycerin, contained in a dish, on a water-bath; add the Stearic Acid, and heat the mixture carefully until carbon dioxide ceases to be evolved, and the liquid is clear. Then pour the melted mass into suitable moulds, remove the suppositories when they are completely cold, and preserve them in tightly stoppered glass vessels." *U. S.*

"Gelatin, cut small, ½ *ounce* (Imperial) or 14.2 grammes; Glycerin, 2½ *ounces* (Imp.) or 71.0 grammes; Distilled Water, *a sufficient quantity.* Place the Gelatin in a weighed evaporating dish with sufficient Distilled Water to cover it; let it stand for two minutes; pour off the excess of Distilled Water; set aside until the Gelatin is quite soft; add the Glycerin; dissolve on a water-bath; evaporate until the mixture weighs *fifteen hundred and sixty-three grains* or one hundred and two grammes. Pour the product into suppository moulds having capacities equal to *thirty, sixty, or one hundred and twenty grains* or two, four, or eight grammes of the Suppository, or of such other capacities as may be required. Each of these Suppositories contains 70 per cent. of Glycerin." *Br.*

These were official for the first time in the U. S. P. 1890. Glycerin suppositories have come into extensive use, the object being to introduce glycerin into the rectum with a minimum amount of other ingredients. Stearic acid was selected on account of its forming with sodium carbonate the hardest soap attainable, thus permitting the introduction of a suppository containing at least 90 per cent. of glycerin, the water added to dissolve the monohydrated sodium carbonate and some of the glycerin being evaporated during the manipulation. A small quantity of water is used in the process to facilitate the reaction; this is driven off subsequently by heat. This process was perfected by J. P. Remington. (See *Practice of Pharmacy,* 4th ed., 1244.) The British method, on account of the use of gelatin, permits the presence of only 70 per cent. of glycerin, the suppository not being firm enough for con-

venient application, and, in addition, the method of hydrating the gelatin is faulty. (*C. D.*, 1898, 831.) Instead of wrapping the suppositories in tin foil it will be found more satisfactory to insert each one in a small glass tube of the proper size, corked at both ends. Some protection from the moisture in the air is necessary because of the hygroscopic character of glycerin. (See *P. J.*, 1893, 63; 1895, 182; *Am. Drug.*, 1894, 91; *West. Drug.*, 1894, 141; *A. J. P.*, 1895, 599.)

Uses.—Glycerin suppositories are very much used to produce fecal discharges in *constipation.* They act by locally irritating the mucous membrane of the rectum, and are often very efficient, though never really purgative. As an occasional remedy they are useful, but their habitual employment is probably injurious to the mucous membrane.

SUPPOSITORIA IODOFORMI. Br.

IODOFORM SUPPOSITORIES

(sŭp-pŏs-ĭ-tō′rĭ-ă ī-ŏd-ō-fŏr′mī)

Suppositoires d'Iodoforme, *Fr.*; Iodoformsuppositorien, *G.*

"Iodoform, 36 *grains* or 2.4 grammes; Oil of Theobroma, *a sufficient quantity* for twelve suppositories. Proceed as directed for Tannic Acid Suppositories. Each of these Suppositories contains 3 *grains* or 0.2 gramme of Iodoform." *Br.*

These suppositories are valuable in cases of rectal inflammation and irritation. It is often possible by their use in *dysentery* to avoid the use of opium to a greater or less extent.

SUPPOSITORIA MORPHINÆ. Br.

MORPHINE SUPPOSITORIES

(sŭp-pŏs-ĭ-tō′rĭ-ă mŏr-phī′næ)

Suppositoires de Morphine, Suppositoires morphinés, *Fr.*; Morphiumsuppositorien, Morphin-Stuhlzäpfchen, *G.*

"Morphine Hydrochloride, 3 *grains* or 0.2 gramme; Oil of Theobroma, *a sufficient quantity* for twelve suppositories. Proceed as directed for Tannic Acid Suppositories. Each of these Suppositories contains ¼ *grain* or 0.017 gramme of Morphine Hydrochloride." *Br.*

This is an excellent remedy in *strangury, tenesmus,* and other cases of *irritation in the lower bowels* and *urinary passages.* It may also be used to control *vomiting,* and to produce the general effects of opium on the system.

SUPPOSITORIA PLUMBI COMPOSITA. Br.

COMPOUND LEAD SUPPOSITORIES

(sŭp-pŏs-ĭ-tō′rĭ-ă plŭm′bī cŏm-pŏs′ĭ-tă)

Suppositoires de Plomb composés, Suppositoires de Plomb opiacés, *Fr.*; Zusammengesetzte Bleisuppositorien, *G.*; Stuhlzäpfchen von Opium und Bleizucker, *G.*

"Lead Acetate, in powder, 36 *grains* or 2.4 grammes; Opium, in powder, 12 *grains* or 0.8 gramme; Oil of Theobroma, *a sufficient quantity* for twelve suppositories. Proceed as directed for Tannic Acid Suppositories. Each of these Suppositories contains 3 *grains* or 0.2 gramme of Lead Acetate and 1 *grain* or 0.067 gramme of Opium." *Br.*

An excellent remedy in some cases of *diarrhœa, dysenteric irritation of the rectum, piles* and *hemorrhage.*

SYRUPI.

SYRUPS

(sy-rŭ′pī)

Sirops, *Fr. Cod.*; Sirupi, *P. G.*; Sirupe, *G.*; Sciroppi, *It.*

Syrups are concentrated solutions of sugar in aqueous fluids, either with or without medicinal impregnation. When the solution is made with pure water, it is named *syrup* or *simple syrup;* when made with water charged with one or more medicinal agents, it is called in general terms a *medicated syrup,* and receives its special designation from the substance or substances added.

Medicated syrups are usually prepared by dissolving sugar in vegetable infusions, vinegars, decoctions, expressed juices, fermented liquors, or simple aqueous solutions. When the active matter of the vegetable is not readily soluble in water, is associated with soluble matter which it is desirable to avoid, or is volatilized or decomposed by a heat of 100° C. (212° F.), it is sometimes extracted by diluted alcohol, the spirituous ingredient of which is subsequently driven off. Medicated syrups are also occasionally prepared by adding a tincture to simple syrup and evaporating the alcohol. Another and a better mode of effecting the same object, when aromatic or other volatile substances are concerned, is to mix the tincture with sugar in coarse powder, expose the mixture to a very gentle heat or to the sun till the alcohol has evaporated, and then prepare the syrup from the impregnated sugar by dissolving it in the requisite proportion of water. Since the introduction into use of the process of percolation, or filtration by displacement, it has been applied very advantageously to the preparation of various syrups, especially those made from vegetables of which the active principle is injured or dissipated by decoction. But, unless the operator be at once skilful and careful, there will be danger of imperfectly extracting the active matters, and thus making a feeble preparation. One important practical rule is, when the liquid obtained by percolation requires concentration, to set aside the first portions of filtered liquor, which are usually strongly impregnated, and to subject only the subsequent weaker portions to evaporation. For the mode of properly conducting this process the reader is referred to page 1216.

The quality and quantity of the sugar employed are points of importance. Refined sugar should always be used, as it saves the necessity

of clarification, and makes a clearer and better-flavored syrup than the impure kinds. The U. S. Pharmacopœia simply directs sugar, but explains that it is the purified or refined sugar which is indicated by that term. In relation to the quantity of sugar, if in too small proportion, fermentation is apt to occur; if too abundant, crystallization. The proper proportion is about two parts to one of the liquid. A somewhat smaller quantity will answer where an acid, such as lemon juice or vinegar, is used.

As it is desirable, in many instances, that the active matters should be in as concentrated a state as possible in the syrup, it is often necessary to evaporate a large proportion of the aqueous fluid in which they are dissolved. This may be done either before the addition of the sugar or afterwards. In either case care is requisite not to apply a heat too great or too long continued, lest the active principles should be injured. When these are very volatile or easily decomposed by heat, it is expedient to dispense with concentration altogether. Some substances which are volatilized or decomposed at the temperature of boiling water remain fixed and unaltered at that which is necessary for the evaporation of alcohol. These, as before observed, may be dissolved in diluted alcohol, and the concentration effected by evaporating the spirituous part of the solvent. Independently of the injury which the medicinal ingredient of the syrup may sustain, the syrup itself is apt to become brown by a continued application of heat, even when the degree is not excessive. It is recommended, therefore, that syrups which admit of concentration should be boiled briskly over a lively fire, so as to accomplish the object as quickly as possible. It is important to be able to ascertain positively when syrups have attained the due consistence. An operator skilled in their preparation can judge with sufficient accuracy by various familiar signs,—such as the slowness with which the parts of a drop of syrup coalesce, when previously separated by the edge of a blunt instrument, and the receding of the last portion of each drop, when the syrup, after being cooled, is poured out drop by drop. A pellicle forming upon the surface of the syrup when it cools indicates that it has been boiled too much.

These signs, however, are not to be relied on, except by those who have acquired much experience. The proper point of concentration is best ascertained by the use of that variety of Baumé's hydrometer called a *saccharometer*, —an instrument very useful to those making syrups upon the large scale. This should stand at 30° in boiling syrup (30½° in hot weather), and at 35° in the syrup when it is cool. Another very accurate, though less ready, method is to ascertain the sp. gr. by weighing a portion of the liquid. Syrup, when boiling, should have a sp. gr. of about 1.261; when cold, of about 1.317. Thomson and Duncan are in error in giving the proper sp. gr. of cold syrup as 1.385. We found that of a specimen of simple syrup, made with two pounds and a half of sugar to a pint of water, as directed in former editions of the U. S. Pharmacopœia, to be 1.326 at 68° F.; but this strength is rather too great for practical convenience in cold weather. In the syrup now official it is only 1.313 at 25° C. (77° F.). A third method of ascertaining the proper point of concentration is by the thermometer, which, in boiling syrup of the proper consistence, stands at 105° C. (221° F.). This indication is founded on the fact that the boiling point of syrup rises with the increase of its density.

When carefully prepared with the best double refined sugar, syrups usually require no other clarification than to remove any scum which may rise to their surface upon standing, and to pour them off from any dregs which may subside. But, as the sugar employed is seldom free from impurities, it may be best, as a rule, to remove the scum as it rises during the heating process, and to strain the syrup while hot through muslin or flannel. Should syrups at any time lack the due degree of transparency, they may be filtered through paper if a hot water funnel is used, or, when likely to be injured by this treatment, may be clarified by means of the white of egg or animal charcoal, as mentioned under the head of *Syrupus*. But the active vegetable principles are so apt to be absorbed by the charcoal along with the impurities that this agent should be used with caution. The vicious habit practised by sugar refiners of "blueing" sugars by the use of ultramarine and other coloring agents cannot be too strongly deprecated. (See *A. J. P.*, 1901, 119.)

The medicated syrups are liable to undergo various alterations, according to their nature and mode of preparation. The acid syrups, when too much boiled, often let fall a copious white deposit, which is a saccharine matter analogous to the sugar of grapes, produced by the action of their acid upon the sugar. Even at ordinary temperatures, acids slowly convert common sugar into grape sugar, which, being less soluble than the former, is gradually deposited in the form of crystalline grains. Syrups containing too little sugar are subject to the vinous fermentation, in consequence of the presence of matters which act as a ferment. Those which contain too much, deposit a portion in the crystalline state, and the crystals, attracting the sugar remaining in solution, gradually weaken the syrup, and render it liable to the same change as when originally made with too little sugar. The want of due proportion of saccharine matter frequently also gives rise to mouldiness, when air has access to the syrup. It is said that syrups enclosed while they are still hot in bottles which are not full are apt to ferment, because the aqueous vapor rising to the surface and there condensing diminishes the proportion of sugar, so as to produce a commencement of chemical action, which grad-

ually extends through the whole mass, but if the bottles are filled, or are well shaken after they are cold, this result is obviated, and the syrups will generally keep better. When syrups undergo the vinous fermentation, they become covered at the surface with froth, produced by the disengagement of carbon dioxide, and acquire a vinous odor from the presence of alcohol, while their consistence is diminished by the loss of a portion of the sugar, which has been converted into that liquid. When the quantity of alcohol has increased to a certain point, the fermentation ceases, or goes on more slowly, owing to the preservative influence of that principle, and, as the active ingredient of the syrup has frequently undergone a material change, the preparation is sometimes heated to boiling, so as to drive off the alcohol and carbon dioxide and concentrate the liquid sufficiently. A syrup thus revived is never equal to a preparation which has not met with such a mishap, and it is far better to throw a fermented syrup away. It is obvious that syrups which depend for their virtues upon a volatile ingredient, or one which is readily changeable by heat, cannot be restored to their original condition.

A convenient method of preparing syrups has come into general use, called the "cold process." For some syrups it is to be preferred to the usual method of heating, and all syrups which contain a volatile principle, or one likely to be injured by heat, are preferably made by *percolation*. L. Orynski, *D. C.*, March, 1871, first drew attention to the subject, and R. Hunstock, in *A. J. P.*, Sept. 1875, and Sept. 1878, gave the results of his experience with the process. Into the lower orifice of a percolator he introduces lightly a small piece of sponge, which should be cleaned and thoroughly moistened with pure water, but any excess should be carefully pressed out before inserting it. The sugar (granulated) is then poured in, and upon this, the water, the apparatus being arranged as is usual in the process of percolation. The percolator may be covered loosely, and the operation will proceed without further attention, the syrup coming through drop by drop. If it should be necessary to use crushed sugar, the percolator must be corked at the lower orifice, and the sugar and water introduced and allowed to macerate until the former has dissolved down to *half its bulk*, when the cork may be removed and the liquid be allowed to drop. If, after the liquid has all passed, there remains a quantity of undissolved sugar in the percolator, after corking the end of the latter, enough percolate may be poured back to dissolve it, afterwards adding sufficient water to bring the whole up to the required measure. See *Am. Drug.*, July, 1903, 31. For official directions for preparing syrup by percolation see *Syrupus*, page 1217. The U. S. P. (8th Rev.) directs that a pledget of purified cotton should be used in place of the sponge; we have found by experience that some care is necessary in adjusting the pledget, but after a little practice the pledget will be preferred to the sponge.

To be successful in using the process, care in several particulars must be exercised. 1. The percolator should be cylindrical or semi-cylindrical, and cone-shaped as it nears the lower orifice. 2. The sugar must be coarse, else it will form into a compact mass, which the liquid cannot permeate. 3. The sponge or pledget must be introduced with care. If pressed too tightly in, it will effectually stop the process; if inserted too loosely, the liquid will pass too rapidly, and will, in consequence, be weak and turbid (not properly filtered). See also a practical paper on this subject in *A. J. P.*, Jan. 1881, by G. H. Chas. Klie, and *Bull. Pharm.*, 1902, 1248. For a paper on *Fruit Syrups* see *West. Drug.*, 1902, 182; *Proc. Penn. Pharm. Assoc.*, 1903, 196.

Syrups may be made (without heat) *rapidly* by putting the ingredients in a churn and agitating briskly.

"Rock Candy Syrup," the evaporated mother liquor left after crystallizing sugar in the form of large crystals, called "rock candy," has come largely into use in America. It varies much in quality as made by various manufacturers, and often contains glucose. It should never be used indiscriminately or for making the official syrups, and it should always be carefully tested before being used for any purpose. (See analyses by L. F. Kebler, in *A. J. P.*, 1895, 143.)

At best, syrups are apt to change, and various measures have been proposed for their preservation, but the best plan is to make small quantities of syrups at a time, and to keep them, unless when wanted for immediate use, in bottles quite full and well stoppered, which should be put in the cellar or other cool place. Glycerin is often used to aid in the preservation of syrups; in special cases this may be advantageous, but the solvent properties of glycerin must be remembered, and the finished preparation may possess properties (due to the glycerin) which are not found in syrups made without glycerin, and which may therefore be injurious in prescriptions (see *West. Drug.*, 1898, 444).

The following Syrups were dropped from the U. S. Pharmacopœia 8th revision: *Syrupus Allii, Syrupus Althææ, Syrupus Hypophosphitum cum Ferro* and *Syrupus Rubi Idæi*, and from the British Pharmacopœia (1898), *Syrupus Ferri Subchloridi, Syrupus Mori*, and *Syrupus Papaveris*.

SYRUPUS. U. S., Br.

SYRUP

(sy-rū'pŭs)

Syrupus Simplex; Simple Syrup; Syrupus Sacchari s. Albus; Sirop de Sucre, *Fr. Cod.*; Sirop simple, *Fr.*; Sirupus simplex, *P. G.*; Weisser Syrup, *G.*; Sciroppo semplice, *It.*; Jarabe simple, *Sp.*

* "Sugar, in dry crystalline granules, *eight hundred and fifty grammes* [or 29 ounces av., 430 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Sugar, with the aid of heat, in *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Distilled Water, raise the temperature to the boiling point, strain the liquid, and pass enough Distilled Water through the strainer to make the product, when cold, measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly. Syrup may also be prepared in the following manner:

Press down into the neck of a percolator of suitable size a pledget of purified cotton, not too tightly, in such a manner that the cotton shall nearly fill the neck of the percolator, and moisten it with a few drops of Distilled Water; introduce the Sugar into the percolator, make its surface level without shaking or jarring, then carefully pour upon it *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Distilled Water, and regulate the flow of the liquid, if necessary, so that it will pass out in rapid drops. Return the first portions of the percolate until it runs through clear, and when all the liquid has passed, follow it by Distilled Water, added in portions, so that all the Sugar may be dissolved, and the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Refined Sugar, 5 *pounds* (Imperial) or 1000 grammes; Distilled Water, boiling, *a sufficient quantity.* Add the Refined Sugar to *two pints* (Imp. meas.) or five hundred cubic centimetres of the boiling Distilled Water; heat until dissolved; make the weight of the product *seven pounds and a half* (Imp.) or one thousand five hundred grammes by the addition of boiling Distilled Water. Specific gravity 1.330." *Br.*

This syrup, when properly prepared, is inodorous, of a sweet taste without peculiar flavor, thick, viscid, nearly colorless, and perfectly transparent. If somewhat turbid, as it is apt to be when made with sugar not well refined, it may be clarified by beating the white of an egg to a froth with three or four ounces of water, mixing this with the syrup, boiling the mixture for a short time that the albumin may coagulate, and taking off the scum which rises to the surface, or separating it by filtration through paper or flannel. Two gallons of the syrup may be thus clarified. Any color and peculiar flavor which it may possess may be removed by treating it at the same time with a small proportion (about 5 per cent.) of animal charcoal.

The white of egg is beaten to a froth in order that when it coagulates it may be rendered by the air which it contains, specifically lighter than the syrup, and thus rise to the surface. If not thus treated it floats, when coagulated, in the syrup, or sinks to the bottom. Now, it is obvious that if the syrup and albumin be heated together the latter must be deprived of a portion of the air which it contains before the point of coagulation is attained, and thus become less disposed to rise to the surface. Guibourt, therefore, recommends that it should not be added till the syrup is boiling hot, and should then be poured in from a height, in order to increase the quantity of air entangled in it. Magnes-Lahens has found paper pulp to be of the greatest service in the clarification of syrup. He uses a white unsized paper of good quality, reducing it to a paste by agitation in a bottle with a portion of the menstruum to be used, heating it with the syrup during the whole process of solution, and finally filtering through a "swan's-down paper" filter. (*P. J.*, April, 1872, p. 825.)

From the observations of Maumené, it appears that a solution of pure cane sugar, when long kept, undergoes a molecular change analogous to that produced by the reaction of weak acids, the saccharine liquid becoming brown when boiled with potassium hydroxide. But, as this phenomenon is exhibited alike by uncrystallizable sugar and by glucose, the experiment does not determine which of those forms of saccharine matter has been produced. (*C. R. A. S.*, xxxix. 914.) Procter observed a similar change in simple syrup which had been kept in his cabinet for six years. (*A. J. P.*, xxvii. 430.) Schaeuffele, having noticed, on one occasion, in the preparation of simple syrup, that the foam exhibited a singular blue color, while a part of the cane sugar was rapidly transformed into the uncrystallizable variety, made investigations as to the cause, and was led to the conclusion that it was the presence of indigo in the loaves of sugar, introduced with the view of giving brilliancy and whiteness, but this conclusion was probably erroneous, as it is well known that *ultramarine,* and not indigo, is used for this purpose. The presence of a blue coloring matter in sugar has frequently been noticed in this country; syrup made from such sugar is not colorless, and in a short time deposits a dark-colored sediment. Colorless "rock candy" forms an excellent source for pure syrup (the broken crystals can be procured cheaply from the manufacturers), and syrup entirely free from impurities is required in making such preparations as syrup of hydriodic acid, syrup of ferrous iodide, etc.

Syrup is very useful in the formation of pills and mixtures, and in various other pharmaceutical operations in which sugar in solution is required.

The U. S. syrup is practically identical with that formerly official, being a trifle stronger, the sp. gr. being given as 1.313 at 25° C. (77° F.). That of the Br. syrup is 1.330 at 15.5° C. (60° F.), probably adapted to the climate of Great Britain, which is not so cold in winter as is ours, at least in the Northern and Middle States.

Off. Prep.—Confectio Sulphuris, *Br.;* Elixir Aromaticum, *U. S.;* Emulsum Olei Morrhuæ, *U. S.;* Emulsum Olei Morrhuæ cum Hypophosphitibus, *U. S.;* Emulsum Olei Terebinthinæ, *U. S.;* Massa Ferri Carbonatis, *U. S.;* Mistura Creosoti, *Br.;* Mistura Glycyrrhizæ Composita, *U. S.;* Pilulæ Aloes et Myrrhæ, *U. S.;* Pilula Ferri, *Br.;* Pilulæ Laxativæ Compositæ, *U. S.;* Pilulæ Podophylli, Belladonnæ et Capsici, *U. S.;* Vinum Ferri, *U. S.;* Vinum Ferri Amarum, *U. S.*

It is also used as the vehicle for a number of official syrups.

SYRUPUS ACACIÆ. U. S.

SYRUP OF ACACIA

(sy-rŭ'pŭs ą-cā'cĭ-æ)

Syrupus Gummosus; Sirop de Gomme, *Fr. Cod.;* Gummisirup, *G.;* Sciroppo di gomma arabica, *It.;* Jarabe de goma, *Sp.*

* "Acacia, in selected pieces, *one hundred grammes* [or 3 ounces av., 231 grains]; Sugar, *eight hundred grammes* [or 28 ounces av., 96 grains]; Distilled Water, *four hundred and thirty cubic centimeters* [or 14 fluidounces, 259 minims] to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Introduce the Acacia into an enamelled or porcelain dish, add the Distilled Water and stir occasionally until the Acacia is dissolved; then, having added the Sugar, place the dish on a water-bath and apply heat, gradually increasing the temperature, and stirring from time to time until the Sugar is dissolved. Strain the Syrup, if necessary, and add sufficient Distilled Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms].

Syrup of Acacia should be made in small quantities, and stored in small, tightly stoppered bottles, in a cool place." *U. S.* In the 18th edition of this work the process of the U. S. P. 1890[1] was condemned because of the tendency of the mucilage of acacia to spoil and thus make an unreliable syrup; the U. S. P. (8th Rev.) reintroduced the process of the U. S. P. 1870. This syrup is useful in the preparation of mixtures, pills, and troches, and is a good demulcent; but, unfortunately, the proportion of the gum to the sugar is too small to meet all the indications calling for the conjoint use of these substances. To avoid fermentation, C. B. Mann commends the use of one fluidounce of glycerin and seven fluidounces of water as the solvent. If the mucilage of acacia be made with chloroform water or a trace of chloroform be added to syrup of acacia, fermentation is measurably retarded.

[1] *Syrupus Acaciæ*, U. S. 1890. *Syrup of Acacia.* "Mucilage of Acacia, recently prepared, *twenty-five cubic centimeters* [or 406 minims]; Syrup, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims], to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Mix them. This syrup should be freshly prepared, when required." *U. S.* 1890.

SYRUPUS ACIDI CITRICI. U. S.

SYRUP OF CITRIC ACID

(sy-rŭ'pŭs ăç'ĭ-dī cĭt'rĭ-cī)

Sirop d'Acide citrique, *Fr. Cod.;* Citronensaure-sirup, *G.*

* "Citric Acid, *ten grammes* [or 154 grains]; Distilled Water, *ten cubic centimeters* [or 162 minims]; Tincture of Fresh Lemon Peel, *ten cubic centimeters* [or 162 minims]; Syrup, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Citric Acid in the Distilled Water, and mix the solution with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Syrup. Then add the Tincture of Fresh Lemon Peel, and, lastly, enough Syrup to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

This is more uniform in its character, keeps better, and is more readily prepared than lemon syrup, but does not equal it in flavor, if the latter be well made. If long kept it is prone to acquire a musty taste, and to deposit grape sugar copiously, in consequence of the action of the acid on the cane sugar. It is much employed as an agreeable and refrigerant addition to drinks, especially carbonic acid water. Tincture of fresh lemon peel is used in this syrup instead of spirit of lemon which was used in the process of the U. S. P. 1890; spirit of lemon is no longer official and the new tincture is preferable as a flavoring agent. Tartaric acid, on account of its greater cheapness, has not unfrequently been substituted for the citric acid; but the syrup made with it does not keep so well, and is more apt to be irritating to the stomach.

Off. Prep.—Liquor Magnesii Citratis, *U. S.*

SYRUPUS ACIDI HYDRIODICI. U. S.

SYRUP OF HYDRIODIC ACID

(sy-rŭ'pŭs ăç'ĭ-dī hȳ-drĭ-ŏd'ĭ-cī)

"A syrupy liquid containing about 1 percent., by weight, of absolute Hydriodic Acid [HI = 126.9], or about 1.19 Gm. in 100 Cc." *U. S.*

Sirop d'Acide Iodhydrique, *Fr.;* Jodwasserstoff-sirup, *G.*

* "Diluted Hydriodic Acid, *one hundred grammes* [or 3 ounces av., 231 grains]; Water, *three hundred grammes* [or 10 ounces av., 255 grains]; Syrup, *six hundred grammes* [or 21 ounces av., 72 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix them." *U. S.*

An unprotected aqueous solution of hydriodic acid is unstable, the iodine being in time always liberated, rendering it irritant and unfit for internal administration, and as it has been proved that syrup protects the acid efficiently, the 1880

Committee of Revision introduced the Syrup of Hydriodic Acid, with the view of furnishing a preparation which should remain, if carefully preserved, for a long time unchanged. The process for this syrup was changed at the U. S. 1890 revision. The "Buchanan" method of producing hydriodic acid by the decomposition of potassium iodide with tartaric acid was employed, the resulting acid potassium tartrate being crystallized out by the use of diluted alcohol and a reduced temperature. Decomposition and the discoloration due to the separation of a trace of iodine were obviated by the use of a small quantity of potassium hypophosphite; this in contact with tartaric acid is decomposed, and the trace of hypophosphorous acid generated is sufficient to protect the solution of hydriodic acid from change, the very small quantity of acid potassium tartrate produced at the same time crystallizing out with the rest of the salt in the diluted alcohol. In the U. S. P. (8th Rev.) the syrup is made by adding to 1 part of diluted hydriodic acid 3 parts of water and 6 parts of syrup, it having been proved that diluted hydriodic acid could be made so as to be reasonably permanent (see *Acidum Hydriodicum Dilutum,* page 30), but the principal advantage is that the syrup can now be made extemporaneously as needed for prescriptions. Diluted syrup has been proved to make a more permanent syrup than syrup of official strength. So-called syrup of hydriodic acid is found in the market in which glycerin is the principal constituent. The substitution of glucose for syrup is also practised, the reason being given that the presence of glucose prevents discoloration. (*Proc. A. Ph. A.*, 1897, 221.)

Properties.—Syrup of hydriodic acid is officially described as "a transparent, colorless, or not more than pale straw-colored liquid, odorless, and having a sweet and acidulous taste. Specific gravity: about 1.190 at 25° C. (77° F.). If a small portion of the Syrup be mixed with a little starch T.S., and a few drops of chlorine water then added, the liquid will acquire a deep blue color. Not more than a faint bluish tint should be produced in the Syrup by starch T.S. alone (limit of *free iodine*). The addition of silver nitrate T.S. to a small portion of the Syrup diluted with four volumes of water produces a pale yellow precipitate, nearly insoluble in ammonia water. If 31.73 (31.725) Gm. of Syrup of Hydriodic Acid be diluted with distilled water to measure 50 Cc., and if to 10 Cc. of this solution about an equal volume of distilled water, 8 Cc. of tenth-normal silver nitrate V.S., and 5 Cc. of diluted nitric acid be added, followed by 3 Cc. of ferric ammonium sulphate T.S., then, after thoroughly shaking the mixture, not more than 3 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 0.2 percent. of absolute Hydriodic Acid)." *U. S.*

Syrup of hydriodic acid has the general therapeutic properties of iodine and the alkaline iodides, and is used by various practitioners to obtain alterative effects in *scrofula* and similar disorders. As it contains about 1 per cent. by weight of absolute hydriodic acid, for practical purposes a teaspoonful may be said to represent between 0.5 and 0.6 of a grain of iodine and a little over 1 grain of potassium iodide. It is evident that the doses in which it is usually administered—from twenty to forty minims (1.3 to 2.5 Cc.)—are too small. It should be well diluted at the time of administration, to prevent the possibility of injury to the teeth.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS AMYGDALÆ. U. S.

SYRUP OF ALMOND

(sy-rŭ'pŭs ą-mŷg'dą-læ)

Orgeat syrup; Syrupus Emulsivus; Sirop d' Amande. *Fr. Cod.;* Sirop d'Orgeat, *Fr.;* Sirupus Amygdalarum, *P. G.;* Mandelsirup, *G.*

* "Spirit of Bitter Almond, *ten cubic centimeters* [or 162 minims]; Orange Flower Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Syrup, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

The process for this syrup was greatly simplified in the U. S. P. (8th Rev.); when made by the U. S. P. 1890 process,[1] it quickly spoiled; as the syrup is used solely as a vehicle and for its fine flavor, the new process will undoubtedly be found more practical, permanent and satisfactory. It is said to mask the odor of musk and asafetida, when mixed with them.[2] It may

[1] *Syrupus Amygdalæ. U. S.* 1890. *Syrup of Almond. Syrup of Orgeat.*—"Sweet Almond, *one hundred and forty grammes* [or 4 ounces av., 411 grains]; Bitter Almond, *forty grammes* [or 1 ounce av., 180 grains]; Sugar, *two hundred grammes* [or 7 ounces av., 24 grains]; Orange Flower Water, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Water, *one hundred and thirty cubic centimeters* [or 4 fluidounces, 190 minims]; Syrup, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Almonds, previously blanched, in a mortar with *one hundred grammes* [or 3 ounces av., 231 grains] of the Sugar and *thirty cubic centimeters* [or 1 fluidounce] of Water to a smooth paste. Mix this well with the Orange Flower Water and *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Syrup, and strain with strong expression. To the residue add *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, and express again. In the strained liquid dissolve the remainder of the Sugar, without heat, adding enough Syrup to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Keep the Syrup in well-stoppered, completely filled bottles, in a cool place." *U. S.*

[2] *Orgeat Powder.*—Enders, on account of the tendency of syrup of almond to spoil, prepares a powder by making an emulsion of twenty parts of sweet almonds with sufficient water, mixing it with seventy-two parts of sugar, rapidly evaporating with the steam bath and pulverizing the residue, and keeping it in well-corked bottles. To make one hundred parts of the syrup, sixty-eight parts of the powder are dissolved with heat in twenty-four parts of water, and five parts of orange flower water and three parts of bitter almond water are added. (*A. J. P.*, 1874, p. 362.)

be added to cough mixtures, or used as an agreeable vehicle for administering strong remedies.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS AROMATICUS. Br.

AROMATIC SYRUP

(sy-rŭ'pŭs ăr-o-măt'ĭ-cŭs)

Sirop Aromatique, *Fr.;* **Aromatischer Sirup,** *G.*

"Tincture of Orange, 5 *fl. ounces* (Imperial measure) or 250 cubic centimetres; Cinnamon Water, 5 *fl. ounces* (Imp. meas.) or 250 cubic centimetres; Syrup, 10 *fl. ounces* (Imp. meas.) or 500 cubic centimetres. Mix the Tincture of Orange and Cinnamon Water; shake the mixture with a little *powdered talc;* filter; add the Syrup." *Br.*

This preparation of the Br. Ph. 1898 is practically a simple elixir (see *Elixir Aromaticum,* p. 433); it has been introduced mainly as a vehicle or adjuvant.

SYRUPUS AURANTII. U. S., Br.

SYRUP OF ORANGE

(sy-rŭ'pŭs âu-răn'tĭ-ī)

Syrup of Orange Peel; Sirop d'Ecorce d'Orange amère, *Fr. Cod.;* **Sirupus Aurantii Corticis,** *P. G.;* **Pomeranzenschalensirup, Orangenschalensyrup,** *G.;* **Sciroppo di arancio amaro,** *It.;* **Jarabe de corteza de naranja amarga,** *Sp.*

* "Tincture of Sweet Orange Peel, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Citric Acid, *five grammes* [or 77 grains]; Magnesium Carbonate, *ten grammes* [or 154 grains]; Sugar, *eight hundred and twenty grammes* [or 28 ounces av., 405 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Magnesium Carbonate in a mortar with the Tincture, add gradually *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water, filter, and add sufficient Water through the filter to obtain *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of filtrate; in this dissolve the Citric Acid and Sugar by agitation without heat, and add sufficient Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Tincture of Orange, 1 *fl. ounce* (Imperial measure) or 30 cubic centimetres; Syrup, 7 *fl. ounces* (Imp. meas.) or 210 cubic centimetres. Mix." *Br.*

This process was changed in the U. S. P. (8th Rev.) the official 50 per cent. tincture being used in connection with magnesium carbonate, instead of making an alcoholic extract of fresh orange peel by boiling and using precipitated calcium phosphate as directed in the U. S. P. 1890.

The present U. S. formula is an improvement over that of 1870, in which evaporation was resorted to so as to deprive the tincture of orange peel of alcohol, for, although the temperature was limited to 120° F., even this was sufficient to affect the flavor of the concentrated tincture. In the U. S. P. 1880, by employing maceration and expression with a smaller quantity of alcohol, the use of heat was avoided. The proportion of alcohol directed to extract the oil from the orange peel was necessarily small; indeed, it was almost entirely absorbed by the orange peel, which should be grated. In the U. S. P. 1890 process an attempt was made to economize time by boiling the sweet orange peel in alcohol. The British preparation, which is a mere mixture of the tincture with syrup, is inferior. The use of magnesium carbonate was first suggested by John D. Finley. The syrup has an agreeable flavor, for which it is alone employed. For a process by E. E. Williams, using powdered pumice to disintegrate the orange peel, see *D. C.,* 1898, 125.

SYRUPUS AURANTII FLORUM. U. S. (Br.)

SYRUP OF ORANGE FLOWERS

(sy-rŭ'pŭs âu-răn'tĭ-ī flō'rŭm)

Syrupus Aurantii Floris, *Br.;* **Sirop de Fleur d'Oranger,** *Fr. Cod.;* **Pomeranzenblüthensyrup,** *G.;* **Jarabe de azahar,** *Sp.*

* "Sugar, *eight hundred and fifty grammes* [or 29 ounces av., 430 grains]; Orange Flower Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Sugar in *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Orange Flower Water by agitation, without heat, add enough Orange Flower Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and mix thoroughly. Syrup of Orange Flowers may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus.* Pour *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Orange Flower Water upon the Sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by Orange Flower Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Orange-flower water of commerce, undiluted, 8 *fl. ounces* (Imperial measure) or 100 cubic centimetres; Refined Sugar, 3 *pounds* (Imp.) or 600 grammes; Distilled Water, boiling, *a sufficient quantity.* Add the Refined Sugar to *sixteen fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the boiling Distilled Water; heat until dissolved; add the undiluted orange-flower water; make the weight of the product *four pounds and a half* (Imp.) or nine hundred grammes by the addition of recently boiled Distilled Water." *Br.*

The second U. S. process, by percolation, will be preferable here. This syrup is used chiefly for flavoring mixtures.

Dose, a fluidrachm (3.75 Cc.).

SYRUPUS CALCII LACTOPHOSPHATIS. U. S., Br.

SYRUP OF CALCIUM LACTOPHOSPHATE

(sy-rŭ'pŭs căl'cī-ī lăc-tō-phŏs-phā'tĭs)

Sirop de Lactophosphate (phospholactate) de chaux, *Fr.;* Calciumphospholactatsirup, *G.;* Jarabe de lactofosfato calcico, *Sp.*

* "Precipitated Calcium Carbonate, *twenty-five grammes* [or 386 grains]; Lactic Acid, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Phosphoric Acid, *thirty-six cubic centimeters* [or 1 fluidounce, 104 minims]; Orange Flower Water, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Sugar, *seven hundred and twenty-five grammes* [or 25 ounces av., 251 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. To the Lactic Acid mixed with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, and contained in a capacious mortar, gradually add the Calcium Carbonate, in portions, stirring until it is dissolved. Then add the Phosphoric Acid, diluted with *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of Water, and triturate until the precipitate at first formed is dissolved. Add *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, and filter, rinsing the mortar with *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of Water, and passing the rinsings through the filter. To the mixed filtrates add the Orange Flower Water, and, having added the Sugar, dissolve it by agitation, without heat, and strain. Lastly, pass enough Water through the strainer to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and mix thoroughly." *U. S.*

"Precipitated Calcium Carbonate, 2½ *ounces* (Imperial) or 25 grammes; Concentrated Phosphoric Acid, 4 *fl. ounces* and 262 *minims* (Imp. meas.) or 46 cubic centimetres; Lactic Acid, 6 *fl. ounces* (Imp. meas.) or 60 cubic centimetres; Refined Sugar, 70 *ounces* (Imp.) or 700 grammes; Orange-flower water of commerce, undiluted, 2½ *fl. ounces* (Imp. meas.) or 25 cubic centimetres; Distilled Water, *a sufficient quantity.* Add the Calcium Carbonate gradually to the Lactic Acid, diluted with four times its volume of Distilled Water. When solution is complete, add the Concentrated Phosphoric Acid, and triturate until the precipitate which at first forms is dissolved. Dilute with a little Distilled Water; add the undiluted orange-flower water; filter; dissolve the Refined Sugar in the mixture without the aid of heat; strain; add sufficient Distilled Water to make *five pints* (Imp. meas.) or one thousand cubic centimetres of the syrup." *Br.*

The U. S. P. 1880 syrup was almost identical with the preparation proposed by William Neergaard. Freshly precipitated calcium phosphate is soluble in lactic acid, and this preparation was such a solution protected from change and rendered more agreeable to the taste by the addition of sugar and orange flower water. As made by this formula it will usually be found to contain a precipitate of a gelatinous character, which gradually forms in the course of a few days or weeks; the means commonly used to prevent this precipitation is the addition of a fluidrachm of hydrochloric acid to a pint of the syrup,—hydrochloric acid being a better solvent for calcium phosphate than is lactic acid. The U. S. P. 1890 process [1] as well as that of the 8th Revision, prepared calcium lactate by dissolving calcium carbonate in lactic acid and subsequently adding phosphoric acid; this should be an improvement, as it simplifies the process. Precipitation can be avoided by the addition of a trace of hydrochloric acid. The process of percolation to dissolve the sugar may be advantageously substituted here for that of agitation. The syrup is sometimes prepared by dissolving two hundred grains of calcium lactophosphate (which is now furnished by the manufacturing chemists) in a pint of syrup flavored with orange flower water, a fluidrachm of hydrochloric acid being added to prevent precipitation. The British syrup is practically identical with the U. S. preparation and was modelled after it. The syrup affords an excellent means of administering calcium phosphate.

Dose, from two to four fluidrachms (7.5 to 15 Cc.), representing from three to six grains of the lime salt.

SYRUPUS CALCIS. U. S. (Br.)

SYRUP OF LIME SYRUP OF CALCIUM HYDROXIDE

(sy-rŭ'pŭs căl-cĭs)

Liquor Calcis Saccharatus, *Br.;* Saccharated Solution of Lime; Syrupus Calcariæ; Syrup of Calcium Hydroxide; Sirop de Chaux, *Fr.;* Kalksyrup, *G.*

* "Lime, *sixty-five grammes* [or 2 ounces av., 128 grains]; Sugar, *three hundred and fifty grammes* [or 12 ounces av., 151 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Slake the Lime by the addition of *thirty-five cubic centimeters* [or 1 fluidounce, 88 minims] of Water with the aid of heat, then mix it and the Sugar thoroughly in a mortar, so as to form a homogeneous powder; add the mixture to *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of boiling Water, contained in a bright copper or tinned-iron vessel, and boil for five minutes, constantly stirring.

[1] *Syrupus Calcii Lactophosphatis. Modified Formula.*—Geo. Thos. Williams has modified the formula of R. Rother and adapted it to the strength of the official preparation. It is as follows: "Take of Precipitated Calcium Carbonate 13 parts; Lactic Acid 33 parts; Phosphoric Acid, U. S. P., 18 parts; Orange Flower Water 80 parts; Sugar in coarse powder 600 parts; Distilled Water sufficient to make 1000 parts. Mix the lactic acid with 136 parts of distilled water, and gradually add the calcium carbonate, warming gently, if necessary. Add the phosphoric acid, previously diluted with 120 parts of distilled water and with the orange flower water. Filter, and pass enough distilled water through the filter to make the filtrate weigh 400 parts. Lastly, dissolve the sugar by cold percolation or by agitation, and strain."

Dilute the liquid with sufficient Water to make it measure *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims], and filter through white paper, closely covering the funnel during filtration. Then add through the filter enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and mix thoroughly. Keep the Syrup in well-stoppered bottles." *U. S.*

"Calcium Hydroxide, 1 *ounce* (Imperial) or 50 grammes; Refined Sugar, in powder, 2 *ounces* (Imp.) or 100 grammes; Distilled Water, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Mix the Calcium Hydroxide with a solution of the Refined Sugar in the Distilled Water. Set aside in a stoppered green glass bottle for a few hours, shaking occasionally; separate the clear Solution with a siphon, avoiding unnecessary exposure to air. Specific gravity 1.055. 10 grammes should require for neutralization 6.3 cubic centimetres of the *volumetric solution of sulphuric acid*. It should not afford any characteristic reaction with the tests for lead. This Solution contains nearly 2 per cent. by weight of Lime, CaO, or about 8 grains in 1 fluid ounce." *Br.* The quantity of sugar was reduced about 12 per cent. in the process of the U. S. P. 1890 as it was found by experiment that a syrup thus made was more permanent and less liable to become discolored.

Properties.—Syrup of Lime is officially described as a "transparent, pale yellow liquid, of alkaline taste and reaction. Specific gravity: about 1.145 at 25° C. (77° F.). The addition of a solution of an alkali carbonate produces a white precipitate, soluble in acids with effervescence. The addition of ammonium oxalate T.S. produces a white precipitate, insoluble in acetic acid, but soluble in hydrochloric acid." *U. S.*

The British saccharated solution of lime differs from the U. S. syrup in containing a smaller proportion of sugar and of lime. The official syrup is almost identical with that proposed by E. R. Squibb. (See 14th ed., U. S. D., p. 1288; also *Apoth.*, 1894, 18.)

Sugar forms with lime certain definite compounds which may be looked upon as sucrates. According to M. S. Benedikt (*J. P. C.*, 4e sér., xix. 96), there are at least four of these combinations. Some, if not all, of them are much more soluble than the lime itself, so that in this way a much stronger solution of lime can be obtained than by the instrumentality of water alone. The syrup remains perfectly transparent, and is in no degree disturbed by dilution with water. It has a decidedly alkaline and even caustic taste, and should always be largely diluted when administered. It was first prepared by M. Beral, and its practical use was originally suggested by Capitaine of Paris.[1]

[1] *Liquid Glue.*—It is stated that a very adhesive glue, remaining liquid at ordinary temperatures, may be prepared by dissolving glue in a solution of sucrate of lime. (*A. J. P.*, 1872, 562.)

Uses.—Syrup of lime is an active antacid and astringent, which may be used as a substitute for lime water in all cases to which that preparation is suitable. 20 minims of it (1.25 Cc.) are equal to a fluidounce of lime water.

Dose, ten to thirty minims (0.6 to 1.8 Cc.).

SYRUPUS CASCARÆ AROMATICUS. Br.

AROMATIC SYRUP OF CASCARA

(sy-rŭ'pŭs căs'ca-ræ ăr-o-măt'ĭ-cŭs)

Sirop aromatique de Cascara Sagrada, *Fr.*; Aromatischer Amerikanisch-Faulbaumrindensirup, *G.*

"Liquid Extract of Cascara Sagrada, 8 *fl. ounces* (Imperial measure) or 400 cubic centimetres; Tincture of Orange, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Alcohol (90 per cent.), 1 *fl. ounce* (Imp. meas.) or 50 cubic centimetres; Cinnamon Water, 3 *fl. ounces* (Imp. meas.) or 150 cubic centimetres; Syrup, 6 *fl. ounces* (Imp. meas.) or 300 cubic centimetres. Mix." *Br.*

This was a new syrup in the Br. Pharm. 1898. It forms a convenient means of administering cascara, the alcohol being added to aid its preservation.

Dose, from one-half to two fluidrachms (1.8 to 7.5 Cc.).

SYRUPUS CHLORAL. Br.

SYRUP OF CHLORAL

(sy-rŭ'pŭs chlō'ral)

Sirop de Chloral, *Fr. Cod.*; Chloralhydratsirup, *G.*; Jarabe de hidrato de cloral, *Sp.*

"Chloral Hydrate, 1600 *grains* or 91.43 grammes; Distilled Water, 30 *fl. drachms* (Imperial measure) or 93.75 cubic centimetres; Syrup, *a sufficient quantity*. Dissolve the Chloral Hydrate in the Distilled Water; add the Syrup until the mixed product measures *one pint* (Imp. meas.) or five hundred cubic centimetres. 1 fluid drachm of this syrup contains 10 grains of Chloral Hydrate." *Br.*

Dose, two fluidrachms (7.5 Cc.), representing twenty grains of chloral.

SYRUPUS CODEINÆ. Br.

SYRUP OF CODEINE

(sy-rŭ'pŭs cō-de-ī'næ)

Sirop de Codéine, *Fr. Cod.*; Kodeinsirup, *G.*; Sciroppo di codeina, *It.*; Jarabe de codeina, *Sp.*

"Codeine Phosphate, 40 *grains* or 4.57 grammes; Distilled Water, ¼ *fl. ounce* (Imperial measure) or 12.5 cubic centimetres; Syrup, 19¾ *fl. ounces* (Imp. meas.) or 987.5 cubic centimetres. Dissolve the Codeine Phosphate in the Distilled Water; add the Syrup; mix. 1 fluid drachm of this Syrup contains ¼ grain of Codeine Phosphate." *Br.*

This syrup of the Br. Pharm. 1898 is intended to furnish a convenient method of using codeine phosphate.

Dose, one-half to two fluidrachms (1.8 to 7.5 Cc.).

SYRUPUS FERRI IODIDI. U. S., Br.

SYRUP OF FERROUS IODIDE

(sy-rŭ'pŭs fĕr'rī ī-ŏd'ĭ-dī)

"A syrupy liquid containing about 5 percent., by weight, of Ferrous Iodide [$FeI_2 = 307.30$], or about 6.74 Gm. in 100 Cc." *U. S.*

Syrup of Iodide of Iron; Sirop d'Iodure de Fer, *Fr. Cod.*; Syrupus Ferri Jodati, *P. G.*; Eisenjodürsirup, *G.*; Sciroppo di protojoduro di ferro, *It.*; Jarabe de yoduro ferroso, *Sp.*

* "Iron, in the form of fine, bright wire, and cut into small pieces, *twelve and one-half grammes* [or 193 grains]; Iodine, *forty-one and one-half grammes* [or 1 ounce av., 203 grains]; Diluted Hypophosphorous Acid, *twenty cubic centimeters* [or 325 minims]; Sugar, *six hundred grammes* [or 21 ounces av., 72 grains]; Distilled Water, *a sufficient quantity,* to make *one thousand grammes* [or 35 ounces av., 120 grains]. Introduce the Iron into a flask of thin glass, having a capacity of about *five hundred cubic centimeters* [or 1 pint], add to it *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of Distilled Water, and afterwards the Iodine. Shake the mixture occasionally, checking the reaction, if necessary, by the affusion of cold water, and, when the solution has acquired a greenish color, and has lost the odor of Iodine, heat it to boiling and add at once *fifty grammes* [or 1 ounce av., 334 grains] of the Sugar; when this has dissolved, filter the solution into the remainder of the Sugar contained in a porcelain dish. Rinse the flask and Iron Wire with *one hundred and twenty-five cubic centimeters* [or 4 fluidounces, 109 minims] of Distilled Water and pass the washings through the filter into the Sugar. Stir the mixture with a porcelain or wooden spatula, heating the liquid on a water-bath until complete solution is effected, and, having passed the syrup through a clean muslin strainer into a tared bottle, add the Diluted Hypophosphorous Acid, and sufficient Distilled Water to make the product weigh *one thousand grammes* [or 35 ounces av., 120 grains]." *U. S.*

"Iron, in wire, ½ *ounce* (Imperial) or 25 grammes; Iodine, 726 *grains* or 83 grammes; Refined Sugar, 16½ *ounces* (Imp.) or 825 grammes; Distilled Water, *a sufficient quantity.* Add the Refined Sugar to *six fluid ounces* (Imp. meas.) or three hundred cubic centimetres of boiling Distilled Water and heat until dissolved. Dilute *half a fluid ounce* (Imp. meas.) or twenty-five cubic centimetres of the resulting syrup with an equal volume of Distilled Water and set aside. Digest the Iodine and the Iron wire in a flask with *two and a half fluid ounces* (Imp. meas.) or one hundred and twenty-five cubic centimetres of Distilled Water; heat gently, and finally boil slightly, until the froth loses its yellow color; filter the liquid while still hot into the syrup, washing the flask and the filter with the diluted syrup previously set aside and now heated to boiling. Pass sufficient boiling Distilled Water through the filter to produce, when cold, *one pint* (Imp. meas.) or one thousand cubic centimetres. Mix. The Syrup should have a specific gravity of 1.380 to 1.387. 11 minims of this Syrup contain 1 grain of ferrous iodide." *Br.*

These preparations furnish solutions of ferrous iodide rendered more permanent by sugar. The iodine should be dry, for, if moist, as commercial iodine often is, less ferrous iodide will be formed and the syrup will be proportionally weaker. In both processes a large excess of iron is taken, although the excess was reduced in the Br. Pharm. 1898. A moderate excess is useful in preventing the solution of ferrous iodide from undergoing any change from the absorption of oxygen during filtration, before it comes in contact with the sugar. The method adopted in the Pharmacopœia of 1880, of filtering the unprotected solution of ferrous iodide into the sugar contained in an open porcelain dish, and afterward straining the syrup through linen, was directly opposed to the experience of many practical pharmacists, and to the views which had been hitherto held of the action of the air upon the solution of ferrous iodide, and although with care, in skilful hands, oxidation may have been avoided, nothing was gained in time. In the U. S. P. (8th Rev.) process a small quantity of sugar is added to the solution of ferrous iodide before filtering, but the principle change was in the reduction of the strength of the finished syrup to 5 per cent. of ferrous iodide, which is *one half the quantity of ferrous iodide* that was in the former official syrup (10 per cent.). The strength of 5 per cent. is that recommended by the Brussels International Conference for the unification of the formulas for Potent Remedies. The process of the Pharmacopœia of 1890 was practically identical with the U. S. 1870 process. An improvement in this, however, would be to heat the syrup to boiling immediately before filtering the solution of ferrous iodide into it. Assuming that the iodine without loss is all converted into ferrous iodide, it is easy to calculate the strength of the official solutions. Thus, it will be found that the U. S. syrup contains about 3.84 grains, and that of the British Pharmacopœia 5.45 grains, of the dry iodide to the fluidrachm. In both preparations there is sufficient sugar to constitute a syrup,— the present U. S. process differing in this respect from that of 1850, which was denominated a solution, because containing insufficient sugar to be entitled to the name of a syrup. Indeed, the proportion of sugar in the old formula was insufficient duly to protect the iodide, and was therefore increased. In the solution of 1850, a coil of iron

wire, or a strip of bright iron, immersed in the solution, was found to assist in preserving it. Rock candy (pure crystallized sugar) has been frequently proposed as a substitute for commercial white sugar in making this syrup; there is no doubt that it is much to be preferred.

The plan of protecting the solution of ferrous iodide from change by saccharine matter originated with M. Frederking of Riga, who published a formula for the purpose in *Buchner's Repertorium* in 1839. The same plan was proposed in a paper by Procter, contained in the *A. J. P.* for April, 1840. In the *J. P. C.* for March, 1841, Dupasquier of Lyons, claims to have made a pure ferrous iodide protected by syrup of gum, as early as 1838. In the *P. J.* for August, 1841, the late A. T. Thomson published a paper in which he confirmed the results of Frederking and Procter, and proposed a formula for a *strong syrup,* which is the basis of that adopted by the British Pharmacopœia. For a practical process for making this syrup on a large scale, see *N. R.,* March, 1880.

Properties.—The U. S. syrup of ferrous iodide is "a transparent, pale green liquid, having a sweet, strongly ferruginous taste and an acid reaction. Specific gravity: about 1.349 at 25° C. (77° F.). On adding a few drops of potassium ferricyanide T.S. to a small portion of the diluted Syrup a blue precipitate will be produced. If mixed with a little starch T.S., and afterwards with a few drops of chlorine water, the syrup will acquire a deep blue color. This color should not be produced in the Syrup by starch T.S. alone (absence of *free iodine*). If 10 Gm. of Syrup of Ferrous Iodide be diluted with distilled water to measure 100 Cc., and 15.4 (15.36) Cc. of the solution be mixed with 15 Cc. of water, 6 Cc. of tenth-normal silver nitrate V.S., and 2 Cc. each of diluted nitric acid and ferric ammonium sulphate T.S., then, after thoroughly shaking the mixture, not more than 1 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to produce a permanent reddish-brown tint (each Cc. of tenth-normal silver nitrate V.S. consumed corresponding to 1 percent. of Ferrous Iodide)." *U. S.* "Dissolve 1 gramme of dried *sodium carbonate* in 10 cubic centimetres of *water,* in a flask of which the capacity to a mark on the neck is 100 cubic centimetres; pour into the flask 10 cubic centimetres (or 13.87 grammes) of the Syrup, and agitate the mixture occasionally until the precipitation of the iron is complete; then add more *water* to make the whole measure 100 cubic centimetres; mix and filter. 25 cubic centimetres of the filtrate, neutralized with *diluted nitric acid,* should require not less than 16 and not more than 16.5 cubic centimetres of the *volumetric solution of silver nitrate* for complete precipitation of the iodine, *solution of potassium chromate* being used as an indicator." *Br.* In regard to the former U. S. syrup, E. S. Wayne observed that, when kept for some time, it occasionally deposited grape sugar, into which the cane sugar was converted probably through the agency of hydriodic acid. According to J. M. Maisch, the solution was decomposed not only by light, but also by the action of atmospheric oxygen in bottles partly filled and frequently opened. The oxidation of the iron and the evolution of the iodine were accelerated by the action of light, when the solution was thus insecurely kept; but when the altered solution was transferred to air-tight bottles completely filled, and exposed to the direct light of the sun, it resumed its transparency, and its original tint was restored, or its color rendered much lighter. After this restoration the solution could not be the same, and it is probable that it contained some ferric iodate. The removal of the apparent defects of a solution of ferrous iodide by the action of sunlight is, therefore, not an admissible expedient, because it changes the nature of the solution. The same may be said of the addition of tartaric or citric acid, which has been proposed for clearing the discolored syrup. Syrup of ferrous iodide is rendered brown by sulphuric acid, and emits violet vapors when heated.

Squibb stated, in a communication to the *A. J. P.* (March, 1868, p. 99), that, after considerable experience with the U. S. 1860 syrup, he has known it to become discolored in only one instance; so that with care to avoid all injurious exposure it may be expected to keep well. But, in consequence of the facility with which it undergoes decomposition, with the liberation of iodine, it is very liable to become discolored with the least want of care. He therefore proposed, as a remedy for this inconvenience, to add to the discolored syrup a very small proportion of a solution of sodium thiosulphate, which, without injury to the preparation, removes the color and in a great degree restores the transparency. For this purpose fifteen or twenty grains of the crystallized thiosulphate may be dissolved in a fluidounce of water, and from fifteen to twenty minims of the solution are sufficient for a pint of syrup, if not darker than brown sherry. The solution is simply added to the syrup, and shaken up with it in the bottle. If the discoloration be deeper, more will be required, and the quantity requisite for the effect is a measure of the amount of change that may have occurred. The objection to the use of this salt is that a precipitate of sulphur usually takes place which is so fine that it is very difficult to separate. Syrup of ferrous iodide will on long keeping become permanently discolored through the action of hydriodic acid on the sugar, which causes caramelization, an effect frequently observed in syrups containing citric, tartaric, or other acids. This discoloration must not be confounded with that due to the liberation of iodine. J. F. Judge (*A. J. P.,* 1876, p. 159) recommended hypophosphorous acid in

small proportions to restore the pale green color, and of all the additions that have been proposed this is unquestionably the least objectionable and the most effective. (*Y. B. P.*, 1885, p. 484.) Charles Rice preserved syrup of ferrous iodide successfully on the large scale by storing it in vessels having a stopcock at the bottom and pouring a small quantity of pure olive oil upon the surface to protect from oxidation. A. G. Hammer propose1 the addition of syrup to a boiling solution of ferrous iodide before filtering from the excess of iron, and attributes the success in preservation to the fact that a portion of the cane sugar is converted into grape sugar which be believes has greater powers in preventing change. (*Pharm.*, 1876, p. 99.) Glycerin has been proposed as a substitute for sugar in this preparation; it answers the same purpose, but it may be doubted whether more effectually. Glucose or solution of grape sugar has been repeatedly recommended as superior to ordinary syrup for use in this preparation; when the glucose is pure, it is superior as a preservative.

When the syrup is concentrated it becomes brown, and when evaporated to dryness forms a mass which may be called *saccharine ferrous iodide*, and which is not entirely soluble again, a little ferric oxide being left. This saccharine iodide, being protected by the sugar it contains, is not liable to the objections which apply to the pure solid salt (see *Ferrous Iodide*, PART II),[1] and may be made into pills, but this preparation is inferior to the *Ferri Iodidum Saccharatum* U. S. P. 1890.[2]

[1] *Tasteless Salts of Iron.*—A class of preparations of iron has been introduced by J. L. A. Creuse (*A. J. P.*, xlv. 214). It has long been known that ammonium citrate has the property of rendering soluble many ordinarily insoluble preparations of iron. Creuse believes that all the salts of ferric oxide form chemical combinations with all the alkaline (ammonium, sodium, potassium, lithium) citrates, which combinations are all greenish, soluble in water, nearly insoluble in alcohol, free from ferruginous taste, perfectly stable, and so resist decomposition as to form no precipitate with cinchona bark; indeed, chemical reagents do not reveal the iron in them unless strong acids or hydrogen sulphide be used. None of these salts coagulate the blood; they cannot be used as styptics.

Tasteless Iron Iodide is prepared in the following manner: 126.3 grains of iodine are combined with iron in the usual way to obtain the solution of ferrous iodide; this is filtered and 63 grains of iodine dissolved in it; a solution of 201 grains of citric acid is saturated with potassium hydroxide and then added gradually to the first solution. When the apple-green color has been developed, the solution is evaporated, with gentle stirring, to dryness, when cauliflower-like masses of acicular crystals will be obtained. These are stable except in direct sunlight.

Tasteless Iron Chloride is made by adding an alkaline citrate in solution to a solution of iron sesquichloride, in such proportion that there shall be two molecules of the former to three molecules of chlorine. Usually from 120 to 140 grains of citric acid saturated with ammonia, sodium or potassium hydroxide are required for the preparation of an ounce of a tincture of corresponding strength to the official tincture. The addition should be made to the liquor, and the final solution must not contain more than 40 per cent. of alcohol. R. Rother affirmed that these so-called salts are mere mixtures of iron citrate and iodide or chloride of the alkali used. (*A. J. P.*, 1876, p. 171.)

[2] *Ferri Iodidum Saccharatum*, U. S. 1890. *Saccharated Ferrous Iodide.*—"Iron, in the form of fine, bright wire, and cut into small pieces, *six grammes* [or 92 grains]; Reduced Iron, *one gramme* [or 15.5 grains]; Iodine, *seventeen grammes* [or 262 grains]; Distilled Water, Sugar of Milk, recently dried, each, *a sufficient quantity*, to make *one hundred grammes* [or 3 ounces av., 231 grains]. Mix the Iron Wire, Iodine, and *twenty cubic centimeters* [or 325 minims] of Distilled Water in a flask of thin glass, shake the mixture occasionally, until the reaction ceases, and the solution has acquired a green color and lost the smell of Iodine; then filter it through a small, wetted filter into a porcelain capsule containing *forty grammes* [or 1 ounce av., 180 grains] of Sugar of Milk. Rinse the flask and Iron Wire with a little Distilled Water, pass the rinsings through the filter into the capsule, and evaporate, on a water-bath, with frequent stirring, until a dry mass remains. Transfer this quickly to a heated iron mortar, reduce it to powder, and mix it intimately, by trituration, with the Reduced Iron and enough Sugar of Milk to make the final product weigh *one hundred grammes* [or 3 ounces av., 231 grains]. Transfer the powder at once to small and perfectly dry bottles, which should be securely stoppered, and kept in a cool and dark place." *U. S.* 1890. This preparation is practically identical with the Saccharated Iodide of Iron of the German Pharmacopœia, and consists of ferrous iodide preserved by contact with sugar of milk. It is a more stable form of administering ferrous iodide than the salt in its pure state. (See *Ferrous Iodide.*) The addition of reduced iron to the preparation just before the close of the process is for the purpose of protecting it from change; any iodine which may be set free through exposure will combine with the reduced iron, and thus the irritating effects of free iodine will be avoided.

Properties.—The U. S. P. 1890 gave the following description: "A yellowish-white or grayish, very hygroscopic powder, without odor, and having a sweetish, ferruginous taste. Soluble (with exception of the added reduced iron) in 7 parts of water at 15° C. (59° F.), but only partially soluble in alcohol. When strongly heated, the compound swells up, evolves the odor of iodine and of burning sugar, and, on complete ignition, leaves a residue which should yield nothing soluble to water (absence of *salts of the fixed alkalies*). The aqueous solution has a slightly acid reaction, and gives with potassium ferricyanide test-solution a blue precipitate. If the aqueous solution be mixed with a little starch test-solution, and afterwards with a few drops of chlorine water, it will assume a deep blue color. This color should not be developed in the aqueous solution by starch test-solution alone (absence of *free iodine*). If 1.55 (1.5447) Gm. of Saccharated Ferrous Iodide be dissolved in about 20 Cc. of water, in a small flask, and to this solution be successively added, first, 22 Cc. of silver nitrate decinormal volumetric solution, then 5 Cc. of diluted nitric acid and 5 Cc. of ferric ammonium sulphate test-solution, it should not require more than 2 Cc. of potassium sulphocyanate decinormal volumetric solution to produce a reddish-brown tint which persists after shaking (corresponding to about 20 per cent. of pure Ferrous Iodide)." *U. S.* 1890.

Uses.—The medicinal properties of this preparation are identical with those of ferrous iodide. (See *Ferrous Iodide*, Part II.) The dose is from two to five grains (0.13 to 0.32 Gm.).

Liquor Ferri Iodidi, Solution of Ferrous Iodide.—Niece (*M. R.*, 1903, 70) suggested the following process for this solution of ferrous iodide as a stock preparation from which the syrup of ferrous iodide is readily made by mixing 3 parts (by volume) with 26 parts (by volume) of syrup. Glycerin and diluted hypophosphorous acid are recommended as valuable additions for preserving the solution. The iron wire must be carefully cleaned from dust and grease by washing with a 2 per cent. aqueous solution of hydrochloric acid, then with distilled water, and rapidly drying, weighing out the desired quantity and introducing it into a clean, dry pint flask, together with 2 fl. ounces of distilled water. The proportions are as follows: Iron (clean, dry, bright card teeth), 330 grains; Iodine (resublimed and dry), 1120 grains; Hypophosphorous Acid (10 per cent.), 1 fl. drachm; Glycerin, previously warmed (sp. gr. 1.25), 1 fl. drachm; Water (dis-

tilled and ammonia-free) to make 4 fl. ounces. The iodine is added in portions, one-fourth at a time, and the flask shaken after each addition until the red color disappears. After all has been thus added, the flask is heated and the contents boiled for two or three minutes—the liquid having previously assumed a greenish hue; it is then filtered, using a long-stemmed funnel, well-covered, and extending into the mixture of glycerin and hypophosphorous acid—the measure being brought to four fluidounces with the distilled water rinsings of the flask, passed through the same filter. The finished solution is preserved in one-ounce bottles of brown glass, completely filled, with the ground-glass stopper well paraffined, and stored in a cool, dark place. Well cleaned implements, entirely of glass where they come in direct contact with the solution, must be used invariably throughout the entire process.

Uses.—The syrup of ferrous iodide combines the alterative action of iodine with the hematinic action of iron. It is a popular remedy in chronic types of *tuberculosis*, especially in the *scrofula* of children. It has, however, no advantage over an extemporaneous combination of an iodide with ferruginous tonic, and has the drawback that the dose of either ingredient cannot be altered singly.

Dose, for an adult thirty to forty minims (1.8 to 2.5 Cc.); for a child of two years five to ten minims (0.3 to 0.6 Cc.).

SYRUPUS FERRI PHOSPHATIS. Br.

SYRUP OF FERROUS PHOSPHATE

(sy-rū'pŭs fĕr'rī phŏs-phā'tĭs)

Sirop de Phosphate de Fer, *Fr.*; **Eisenphosphatsirup**, *G.*

"Iron, in wire, 75 *grains* or 8.6 grammes; Concentrated Phosphoric Acid, 1¼ *fl. ounces* (Imperial measure) or 62.5 cubic centimetres; Syrup, 14 *fl. ounces* (Imp. meas.) or 700 cubic centimetres; Distilled Water, *a sufficient quantity*. Place the Iron wire and the Concentrated Phosphoric Acid, previously diluted with an equal volume of Distilled Water, in a small flask; plug the neck with cotton wool, and heat gently until the Iron is dissolved. When cold, filter into the Syrup, and pass a sufficient quantity of Distilled Water through the filter to make the product measure *one pint* (Imp. meas.) or one thousand cubic centimetres. 1 fluid drachm of this Syrup represents 1 grain of anhydrous ferrous phosphate." *Br.*

The process for this syrup of the Br. Pharmacopœia has been greatly improved. H. W. Jones (*P. J.*, 3d ser., v. 541) proposed a formula in which the phosphate was made directly from metallic iron and phosphoric acid. R. Wright (*P. J.*, 1893, 191) improved the formula, and this method is superior to the cumbersome process of preparing a precipitate of ferric phosphate, and dissolving it in phosphoric acid. The syrup is a solution of ferrous phosphate protected by sugar. The sp. gr. is about 1.270. (Umney.) For its properties and uses, see *Ferri Phosphas*, page 508.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM. U. S. (Br.)

SYRUP OF THE PHOSPHATES OF IRON, QUININE, AND STRYCHNINE

(sy-rū'pŭs fĕr'rī quĭ-nī'næ ĕt strȳch-nī'næ phŏs-phā'tŭm)

Syrupus Ferri Phosphatis cum Quinina et Strychnina, *Br.*; Syrup of Phosphate of Iron with Quinine and Strychnine; Easton's Syrup; Sirop Tonique d'Easton, *Fr.*; Eisenphosphatsirup mit Chinin und Strychnin, Eastonscher Sirup, *G.*

* "Glycerite of the Phosphates of Iron, Quinine and Strychnine, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Syrup, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them. Strain, if necessary." *U. S.*

"Iron, in wire, 75 *grains* or 8.6 grammes; Concentrated Phosphoric Acid, 1¼ *fl. ounces* (Imperial measure) or 62.5 cubic centimetres; Strychnine, in powder, 5 *grains* or 0.57 gramme; Quinine Sulphate, 130 *grains* or 14.8 grammes; Syrup, 14 *fl. ounces* (Imp. meas.) or 700 cubic centimetres; Distilled Water, *a sufficient quantity*. Place the Iron wire and the Concentrated Phosphoric Acid, previously diluted with an equal volume of Distilled Water, in a small flask; plug the neck with cotton wool, and heat gently until the Iron is dissolved; in the resulting solution dissolve the Strychnine and Quinine Sulphate; filter into the Syrup; pass sufficient Distilled Water through the filter to make the product measure *one pint* (Imp. meas.) or one thousand cubic centimetres. One fluid drachm of this Syrup represents 1 grain of anhydrous ferrous phosphate, four-fifths grain of Quinine Sulphate, and one-thirty-second grain of Strychnine." *Br.*

This preparation is now made by diluting the glycerite (see *Glyceritum Ferri, Quininæ et Strychninæ Phosphatum*) with syrup. Each fluidrachm of the syrup contains about one grain and one-seventh of ferric phosphate, one grain and one-half of quinine, and one eighty-seventh of a grain of strychnine. The Br. Ph. directs the preparation of a fresh solution of *ferrous* phosphate from iron wire and phosphoric acid, as suggested by Wright (*P. J.*, 1893, 19); it contains less quinine and strychnine and is more permanent than the U. S. syrup. Discoloration, due to light, is usually noticed in this syrup, and it has been repeatedly suggested that glucose be substituted for syrup to prevent this fault. The use of the glycerite as directed by the U. S. P. (8th Rev.) permits the extemporaneous preparation of the syrup, so that there can be no excuse

for dispensing a discolored syrup. An insoluble precipitate of basic ferric phosphate is likely to be produced when this syrup is kept.

Uses.—This syrup has the medicinal activities of its ingredients, but is a very ineligible preparation, and has not even an agreeable taste to excuse its polypharmacy. It is known as *Easton's Syrup, Aitkin's Syrup, Syrup of the Three Phosphates,* and *Syrup of Triple Phosphates.*

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS GLUCOSI. Br.

SYRUP OF GLUCOSE

(sy̆-rŭ'pŭs glu̇-cō'sī)

Sirop de Glycose, *Fr.;* Glykosesirup, *G.*

"Liquid Glucose, of commerce, 1 *ounce* (Imperial) or 25 grammes; Syrup, 2 *ounces* (Imp.) or 50 grammes. Mix, by the aid of gentle heat." *Br.*

This is a new preparation of the Br. Ph. 1898. It may be used as a vehicle for syrups which contain chemical salts liable to discoloration through the action of light, but its principal use is to take the place of *treacle* or molasses so much used in British pharmacy as a pill excipient. (See *Pilulæ,* p. 950.)

SYRUPUS HEMIDESMI. Br.

SYRUP OF HEMIDESMUS

(sy̆-rŭ'pŭs hĕm-i̤-dĕs'mī)

Syrup of Indian Sarsaparilla; Sirop de Hemidesmus, *Fr.;* Hemidesmussirup, *G.*

"Hemidesmus Root, bruised, 4 *ounces* (Imperial) or 100 grammes; Refined Sugar, 28 ounces (Imp.) or 700 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 500 cubic centimetres. Infuse the Hemidesmus Root in the Distilled Water, in a covered vessel, for four hours, and strain. Set the infusion aside until clear; then decant the clear liquid, add the Refined Sugar, and dissolve by the aid of gentle heat. The weight of the product should be *forty-two ounces* (Imp.), or one thousand and fifty grammes." *Br.*

This is a very weak preparation. The *dose* is stated at one fluidrachm (3.75 Cc.); but the syrup may be taken almost *ad libitum.* (See *Hemidesmus.*)

SYRUPUS HYPOPHOSPHITUM. U. S.

SYRUP OF HYPOPHOSPHITES

(sy̆-rŭ'pŭs hȳ-pŏ-phŏs-phī'tŭm)

Syrupus Calcii Hypophosphitis Compositus; Sirop d'Hypophosphite de Chaux composé, Sirop de Hypophosphites, *Fr.;* Hypophosphitsirup, *G.*

* "Calcium Hypophosphite, *forty-five grammes* [or 1 ounce av., 257 grains]; Potassium Hypophosphite, *fifteen grammes* [or 231 grains]; Sodium Hypophosphite, *fifteen grammes* [or 231 grains]; Diluted Hypophosphorous Acid, *two grammes* [or 31 grains]; Sugar, *six hundred and fifty grammes* [or 22 ounces av., 406 grains]; Tincture of Fresh Lemon Peel, *five cubic centimeters* [or 81 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Hypophosphites with *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Water, until they are dissolved, add the Tincture of Fresh Lemon Peel, and the Hypophosphorous Acid, and filter the liquid. In the filtrate dissolve the Sugar by agitation, without heat, and add enough water, through the filter, to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Strain, if necessary. Syrup of Hypophosphites may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

This syrup is a simple solution of calcium, sodium, and potassium hypophosphites, in water, protected by sugar, and flavored with the tincture of fresh lemon peel. The calcium hypophosphite will usually not entirely dissolve; hence the direction to use hypophosphorous acid to complete the solution. Percolation will no doubt be preferred by many to agitation, for dissolving the sugar. It has been stated that the sulphuretted odor sometimes noticed in this syrup is due to the decomposition of sulphates or sulphites (present as impurities in the salts) by the hypophosphorous acid. (*P. J.,* 1895, 143.) Each fluidrachm of the syrup contains about two and a half grains of calcium hypophosphite, and not quite one grain each of the sodium and potassium salts. This syrup affords an excellent means of administering the hypophosphites.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS HYPOPHOSPHITUM COMPOSITUS. U. S.

COMPOUND SYRUP OF HYPOPHOSPHITES

(sy̆-rŭ'pŭs hȳ-pŏ-phŏs-phī'tŭm cŏm-pŏs'i̤-tŭs)

Sirop des Hypophosphites Composé, *Fr.;* Zusammengesetzter Hypophosphitsirup, *G.*

* "Calcium Hypophosphite, *thirty-five grammes* [or 1 ounce av., 103 grains]; Potassium Hypophosphite, *seventeen and one-half grammes* [or 270 grains]; Sodium Hypophosphite, *seventeen and one-half grammes* [or 270 grains]; Ferric Hypophosphite, *two and one-fourth grammes* [or 35 grains]; Manganese Hy-

pophosphite, *two and one-fourth grammes* [or 35 grains]; Quinine, *one and one-tenth grammes* [or 17 grains]; Strychnine, *one hundred and fifteen milligrammes* [or 1¾ grains]; Sodium Citrate, *three and three-fourths grammes* [or 58 grains]; Diluted Hypophosphorous Acid, *fifteen cubic centimeters* [or 243 minims]; Sugar, *seven hundred and seventy-five grammes* [or 27 ounces av., 147 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Ferric and Manganese Hypophosphites with the Sodium Citrate, add *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of Water and warm the mixture for a few minutes, until a clear greenish solution is obtained. Dissolve the Calcium, Potassium, and Sodium Hypophosphites in *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water, to which *five cubic centimeters* [or 81 minims] of Diluted Hypophosphorous Acid has previously been added; then dissolve the Quinine and Strychnine in *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of Water with the aid of *ten cubic centimeters* [or 162 minims] of Diluted Hypophosphorous Acid, and finally dissolve the Sugar, with agitation, in these solutions, previously mixed. Strain the Syrup, if necessary, and add sufficient Water, through the strainer, to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

This syrup differs materially from the syrup of hypophosphites with iron official in the U. S. P. 1890;[1] it contains besides the hypophosphites of calcium, potassium, sodium and iron, the alkaloids quinine and strychnine, it is essentially the process of H. A. B. Dunning of Baltimore. Each fluidrachm contains 2 grains of calcium hypophosphite, 1 grain each of sodium and potassium hypophosphites, ⅛ grain each of iron and manganese hypophosphites, 1-16 grain of quinine and 1-152 grain of strychnine.

Uses.—This syrup combines the alterative action of the hypophosphites with the hematinic properties of iron and is used in conditions of mild *cachexia* or *scrofula.*

Dose, one to two fluidrachms (3.7 to 7.5 Cc.).

SYRUPUS IPECACUANHÆ. U. S.

SYRUP OF IPECAC

(sy-rŭ'pŭs ip-ę-căc-ū-ăn'hæ)

Sirop d'Ipécacuanha, *Fr. Cod.;* **Sirupus Ipecacuanhae,** *P. G.;* **Brechwurzelsirup, Ipecacuanhasirup,** *G.;* **Sciroppo di Ipecacuanha,** *It.;* **Jarabe de Ipecacuana,** *Sp.*

* "Fluidextract of Ipecac, *seventy cubic centimeters* [or 2 fluidounces, 176 minims]; Acetic Acid, *ten cubic centimeters* [or 162 minims]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Sugar, *seven hundred grammes* [or 24 ounces av., 303 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dilute the Fluidextract of Ipecac with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water to which the Acetic Acid has previously been added, and mix them thoroughly by shaking; set the liquid aside in a cool place for twenty-four hours. Then filter, and pass enough Water through the filter to obtain *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of filtrate. To this liquid add the Glycerin, dissolve the Sugar in the mixture, and add enough Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly, and strain, if necessary. Syrup of Ipecac may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus.* Mix the filtrate obtained as directed in the preceding formula with the Glycerin, pour the mixture upon the Sugar, return the first portion of the percolate, until it runs through clear, and, when all the liquid has

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[1] *Syrupus Hypophosphitum cum Ferro.* U. S. 1890. *Syrup of Hypophosphites with Iron.*—"Ferrous Lactate, *ten grammes* [or 154 grains]; Potassium Citrate, *ten grammes* [or 154 grains]; Syrup of Hypophosphites, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Ferrous Lactate and Potassium Citrate with a small quantity of the Syrup, gradually added, until they are dissolved. Then strain, and add enough Syrup of Hypophosphites to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly. This preparation should be freshly made when wanted." *U. S.* 1890.

This syrup, which was made official in the U. S. P. 1880 for the first time, has been the subject of considerable pharmaceutical discussion because of the difficulty of selecting a salt of iron which would remain in solution and not form a precipitate with the other salts. The lactate has been selected as the least objectionable in this respect, and the combination with the alkaline citrate is with the view of retaining the salts in solution in the syrup. Cloudiness in the syrup may be prevented, according to Ott, by dissolving the ferrous lactate and potassium citrate in *hot syrup* and adding this to the syrup of hypophosphites. This syrup of hypophosphites with iron contained in each fluidrachm about two and a half grains of calcium hypophosphite, with nearly one grain each of sodium and potassium hypophosphites, and three-fourths of a grain of ferrous lactate. It unites the therapeutic powers of a chalybeate with those of the hypophosphites. Dose, from one to two fluidrachms (3.7 to 7.5 Cc.).

Syrup of Hypophosphites with Iron.—Owing to the liability to change of ferrous lactate in the presence of an excess of hypophosphites, C. D. Randall substituted ferric citrate for it, with very good results, and gave the following process: Take of Calcium Hypophosphite 554 parts [or 591 grains]; Sodium Bicarbonate 95 parts [or 101 grains]; Potassium Bicarbonate 115 parts [or 123 grains]; Ferric Citrate 85 parts [or 91 grains]; Sugar, powdered, 4050 parts [or 9 troyounces]; Water a sufficient quantity to make 10,000 parts [or 16 fluidounces]. Dissolve the calcium hypophosphite, previously reduced to a fine powder, in 3500 parts [or 8 fluidounces] of water with the aid of heat, and add to the solution the sodium bicarbonate, continuing the heat until action has entirely ceased. After removing the solution from the heat, add the potassium bicarbonate in small portions, waiting after each addition until effervescence has ceased before adding more. When action has entirely ceased, filter the liquid through paper. After the liquid has ceased to drop, add enough water through the filter to make the filtrate weigh 5850 parts [or measure 10 fluidounces]. In 1200 parts [or 2 fluidounces] of this liquid dissolve the ferric citrate with the aid of heat, and add the solution to the remainder of the liquid. In this solution dissolve the sugar with or without the aid of heat and filter through paper, adding through the filter enough water to make the completed syrup weigh 10,000 parts [or measure 16 fluidounces]. (*A. J. P.,* 1884, p. 357.)

passed, follow it with Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.* By the U. S. process of 1850, a tincture of ipecac was first formed with diluted alcohol, then reduced by evaporation so as to drive off the alcohol, and afterwards diluted with water and made into a syrup with sugar. The French Codex dissolves the alcoholic extract of ipecac in water, and then mixes it with syrup, but it is obvious that the U. S. plan was preferable, as it spared the continued heat requisite to reduce the tincture to dryness. The present U. S. syrup, which is very slightly stronger than that of 1870, is made in accordance with the suggestions of Laidley of Richmond, Va., who found the syrup, as ordinarily prepared, to spoil by keeping. (*A. J. P.*, xxvi. 103, and July, 1879.) (See a practical paper on this subject by A. Robbins in *A. J. P.*, Aug. 1879.) The substitution of glycerin for a portion of the syrup in the U. S. process is an improvement, but the addition of the very small quantity of Acetic Acid is of questionable utility. For formulæ in which the drug ipecac is employed, the reader may consult *A. J. P.*, 1870, p. 127; 1871, p. 104; May, 1881.

If strictly official (8th Rev.) fluidextract of ipecac is used in making this syrup, and the process is carried out in all its details, the syrup will remain transparent; but if commercial fluidextract is used, or if the fluidextract has not been very carefully made, it will be necessary to modify the process somewhat to secure a transparent syrup. This may be effected by allowing the diluted fluidextract in the official process for making this syrup to remain for two or three days in a cool place before filtering, and adding to the sugar.

One fluidounce of this syrup should contain the virtues of about thirty grains of ipecac.

Dose, for an adult as an expectorant, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.); as an emetic, half a fluidounce (15 Cc.).

SYRUPUS KRAMERIÆ. U. S.

SYRUP OF KRAMERIA

(sy-rŭ'pŭs kra-mē'rĭ-æ)

Syrupus Ratanhiæ; Syrup of Rhatany; Sirop de Ratanhia, *Fr. Cod.*; Ratanhiasirup, *G.*

* "Fluidextract of Krameria, *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims]; Syrup, *five hundred and fifty cubic centimeters* [or 18 fluidounces, 287 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

This syrup is more conveniently made by the present process than by either of those of the U. S. Pharmacopœia of 1860,—in the first of which the powdered root was exhausted with water, the percolate evaporated, and the sugar dissolved in it by a gentle heat, while in the second process, extract of krameria was dissolved in syrup. As krameria yields a variable proportion of extract, it follows that the syrup resulting from these two modes of preparation must have differed. To obviate this evil as far as possible, care had to be taken, in following the first process, to select the best krameria, and preferably the small roots, as it was these only which would yield two ounces of good extract to the pound. We have found the syrup made from the official fluidextract perfectly transparent, and not a turbid mixture, as stated by some writers. This preparation affords a convenient mode of exhibiting krameria.

Dose, for an adult, two fluidrachms (7.5 Cc.); for a child a year or two old, from ten to twenty minims (0.6 to 1.3 Cc.).

SYRUPUS LACTUCARII. U. S.

SYRUP OF LACTUCARIUM

(sy-rŭ'pŭs lăc-tū-cā'rĭ-ī)

Sirop de Lactucarium, *Fr.*; Lactucariumsirup, *G.*

* "Tincture of Lactucarium, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Glycerin, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Citric Acid, *one gramme* [or 15 grains]; Orange Flower Water, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Syrup, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Tincture of Lactucarium with the Glycerin, add the Orange Flower Water in which the Citric Acid has been previously dissolved, and filter, if necessary. Finally, add a sufficient quantity of Syrup to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

The formula of the U. S. P. 1870 was very objectionable, and the syrup was rarely used, on account of its want of transparency, and in some measure also because of its disagreeable taste. The former of these objections it was proposed to obviate by the use of magnesium carbonate, as in the former U. S. formula for Syrup of Tolu; the latter, by the addition of one of the aromatic Waters. The rubbing with magnesium carbonate enabled the solvent to take up, as far as it was capable of doing, the matter that would otherwise have been deposited. The use of powdered pumice-stone instead of magnesium carbonate, and the rubbing of this and a little sugar with the tincture after evaporation instead of previously, were recommended by James Kenworthy. The result was a beautifully clear syrup,[1] with the flavor and

[1] *Aubergier's Syrup of Lactucarium.*—Though probably inferior in efficacy to the U. S. syrup, that of Aubergier has a great reputation on the continent of Europe, and is occasionally prescribed here instead of the official. It differs so much from ours that, when it is prescribed, pharmacists who may not have it on hand should not substitute the official for it, unless with the full knowledge of the prescriber. In order to obviate this inconvenience, it is advisable that there should be a formula, readily accessible, by which a syrup may be prepared sufficiently represent-

appearance of Aubergier's, and the virtues of that of the U. S. Pharmacopœia. (*A. J. P.*, March, 1868, p. 113.) But the present process, if official tincture of lactucarium be used, is far preferable, the only disadvantage being the slight petroleum-like taste which seems to be inseparable from lactucarium preparations made by extracting the resinous principles with petroleum benzin; the new tincture of lactucarium, notwithstanding all the care that can be given to the purification of the petroleum benzin, will still hold a trace of the benzin-residue flavor, which it communicates to the syrup. The recommendations made by various pharmaceutical writers to add a solution of an alkali to cloudy syrup of lactucarium, in order to make it transparent, are inadmissible, for Aubergier has conclusively shown that alkalies destroy the bitter principles of lactucarium.

Jos. W. England and N. D. Streeter both prefer to make the syrup directly from the lactucarium. For processes, see *A. J. P.*, 1883, pp. 393, 593.

Dose, two to three fluidrachms (7.5 to 11.25 Cc.).

SYRUPUS LIMONIS. Br.

SYRUP OF LEMON

(sy-rŭ'pŭs lĭ-mō'nĭs)

Syrupus Succus Citri; Sirop de Limon (de Citron), Sirop de suc de Limon (de citron), *Fr.*; Citronensirup, Citronensaftsirup, *G.*; Jarabe de limon, *Sp.*

"Fresh Lemon Peel, in thin slices or grated, 1 *ounce* (Imperial) or 20 grammes; Alcohol (90 per cent.), *a sufficient quantity;* Lemon Juice, 25 *fl. ounces* (Imp. meas.) or 500 cubic centimetres; Refined Sugar, 38 *ounces* (Imp.) or 760 grammes. Macerate the Lemon Peel in *one fluid ounce and a half* (Imp. meas.) or thirty cubic centimetres of the Alcohol for seven days; press; filter; add sufficient of the Alcohol to produce *two fluid ounces* (Imp. meas.) or forty cubic centimetres. In the Lemon Juice, clarified by subsidence, dissolve the Refined Sugar by the aid of gentle heat. When the resulting syrup is cold, mix with it the *two fluid ounces* (Imp. meas.) or forty cubic centimetres of alcoholic liquid. The product should weigh *four pounds and one ounce* (Imp.) or thirteen hundred grammes." *Br.*

The U. S. P. 1880 syrup of lemon was dropped at the 1890 revision; as it is frequently used, the process will be found in the foot-note.[1] The addition of lemon peel to the preparation is an improvement, but the internal white portion of the peel should be carefully removed before adding to the hot lemon juice, or the finished syrup will have a bitter taste. (See *Limonis Cortex.*) This syrup forms a cooling and grateful addition to beverages in *febrile complaints*, and serves to conceal the taste of saline purgatives in solution.

SYRUPUS PICIS LIQUIDÆ. U. S.

SYRUP OF TAR

(sy-rŭ'pŭs pī'cĭs lĭq'uĭ-dæ)

Syrupus cum aquâ piceâ; Syrupus Piceus; Sirop de Goudron, *Fr. Cod.*; Theersirup, *G.*; Jarabe de brea, *Sp.*

• "Tar, *five grammes* [or 77 grains]; Alcohol, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Magnesium Carbonate, *ten grammes* [or 154 grains]; Sugar, *eight hundred and fifty grammes* [or 29 ounces av., 430 grains]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Tar intimately, in a mortar, with *ten grammes* [or 154 grains] of clean white sand, add *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, and, after kneading the mass thoroughly with the pestle, pour off the Water and throw it away. Treat the residue with the Alcohol, and, when the Tar is dissolved, add the Magnesium Carbonate and *fifty grammes* [or 1 ounce av., 334 grains] of Sugar, and after thorough trituration add *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water; stir the mixture occasionally during two hours, and filter. Dissolve the re-

ing Aubergier's for all practical purposes. Procter, therefore, did the profession good service by preparing and publishing such a process, which we copy here. "Take of Lactucarium (German) *half an ounce;* Granulated Sugar *an ounce;* Simple Syrup *four and a half pints;* Citric Acid, in powder, *sixty grains;* Orange Flower Water *four fluidounces;* Diluted Alcohol, Water, each, *a sufficient quantity.* Triturate the Lactucarium with the Sugar until reduced to powder, put it into a funnel-shaped percolator, pour on Diluted Alcohol until the Lactucarium is nearly exhausted, or until ten fluidounces have passed, evaporate to two fluidounces, and add it to the Syrup, previously heated by boiling, and mix. Continue the ebullition slowly until the whole measures four pints and six fluidounces. Then add the Citric Acid and strain, and, lastly, when nearly cool, the Orange Flower Water, and mix them. Each fluidounce represents three and one-third grains of lactucarium. The syrup is light brown and transparent." (*A. J. P.*, 1866, p. 290.)

The French Codex has a syrup, called *Opiated Syrup of Lactucarium* (*Sirop de Lactucarium opiacé*), in which an alcoholic extract is used in double the quantity of extract of opium. One would suppose that in such a proportion the action of the opium would entirely overwhelm that of the lactucarium: but Geo. B. Wood was assured by Deschamps, as the well-ascertained result of experiments of his own and of Debout, that lactucarium given with opium, even in small proportion, very decidedly opposes the unpleasant effects caused by opium, such as nausea, stomachic spasms, headache, etc. (*Ann. Thér.*, 1868, p. 17), and hence the advantage of a preparation in which the two narcotics are combined. But to gain all the good results of this experience it is unnecessary to add a new syrup to the official list, all that is required being the addition of a little of the simple syrup of lactucarium to any preparation of opium the anticipated unpleasant effects of which it is desirable to prevent.

[1] "Lemon Juice, recently expressed and strained, *forty parts* [or seventeen fluidounces]; Fresh Lemon Peel, *two parts* [or one ounce av.]; Sugar, in coarse powder, *sixty parts* [or twenty-eight ounces av.]; Water, *a sufficient quantity*, to make *one hundred parts* [or about two pints]. Heat the Lemon Juice to the boiling point; then add the Lemon Peel, and let the whole stand, closely covered, until cold. Filter, add enough Water through the filter to make the filtrate weigh *forty parts* [or measure seventeen fluidounces], dissolve the Sugar in the filtered liquid by agitation, without heat, and strain." *U. S.* 1880.

mainder of the Sugar in the clear filtrate by gentle heat, strain, and add sufficient Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

In many sections of our country this syrup has been largely used. The process of the U. S. P. (8th Rev.) is an improvement on the one formerly official. The proportion of tar has been reduced from 75 Gm. to 5 Gm. The washed tar is dissolved in alcohol, magnesium carbonate and a little sugar added, the mixture filtered, and more sugar dissolved with the aid of a gentle heat. The process is modelled after a method suggested by A. R. L. Dohme. The preliminary washing of the tar will doubtless be regarded by many as a useless refinement, but it should on no account be omitted, as otherwise a syrup which would be irritant rather than soothing might be produced, owing to the acid constituents always present in tar. (See *Pix Liquida.*) This syrup affords an excellent method of administering small quantities of tar.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS PRUNI VIRGINIANÆ. U. S., Br.

SYRUP OF WILD CHERRY

(sy̆-rŭ′pŭs prū′nī vĭr-gĭn-ī-ā′næ)

Syrup of Virginian Prune, *Br.* 1898; Sirop d'Ecorce de Cerisier, *Fr.;* Wildkirschenrindensirup, *G.*

* "Wild Cherry, in No. 20 powder, *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; Sugar, *seven hundred grammes* [or 24 ounces av., 303 grains]; Glycerin, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Wild Cherry with a sufficient quantity of Water, and macerate for twenty-four hours in a covered vessel; introduce the Glycerin into a graduated receiving bottle; pack the Wild Cherry firmly in a cylindrical percolator, and gradually pour Water upon it; continue the percolation (shaking the percolate occasionally with the Glycerin), until the liquid measures *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims]. Dissolve the Sugar in the liquid by agitation, without heat, strain, and pass enough Water through the strainer to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly. Syrup of Wild Cherry may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the percolate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Virginian Prune Bark, in No. 20 powder, 3 *ounces* (Imperial) or 150 grammes; Refined Sugar, in coarse powder, 15 *ounces* (Imp.) or 750 grammes; Glycerin, 1¼ *fl. ounces* (Imp. meas.) or 62.5 cubic centimetres; Distilled Water, *a sufficient quantity.* Moisten the Virginian Prune Bark with Distilled Water; set aside for twenty-four hours in a closed vessel; pack in a percolator; gradually add Distilled Water until the quantity of *nine fluid ounces* (Imp. meas.) or four hundred and fifty cubic centimetres of percolate has been collected; dissolve the Refined Sugar in the liquid by agitation, without heat; add the Glycerin; strain; pour sufficient Distilled Water over the strainer to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Syrup." *Br.*

The British Pharmacopœia introduced this syrup into the 1898 edition. The process is modelled after the U. S. formula.

The U. S. process affords a handsome syrup, with the virtues of the bark unimpaired by the injurious effects of heat. It is based upon a formula proposed by Procter and Turnpenny in *A. J. P.,* xiv. 27. The introduction of the glycerin into the receiving bottle instead of mixing it with the menstruum is an improvement adopted from the Br. process; the glycerin is not needed in the menstruum to increase the astringency of the syrup but it serves a useful purpose in keeping the infusion from decomposing and precipitating a reddish, insoluble substance in the receiving bottle. This syrup should never be made by adding fluidextract to simple syrup, as the fluidextract is likely to vary greatly in quality, and frequently precipitates when mixed with syrup, the syrup when made by the above process is far superior in flavor and active properties, and is largely used as a basis for cough mixtures.[1]

Dose, half a fluidounce (15 Cc.).

SYRUPUS RHEI. U. S., Br.

SYRUP OF RHUBARB

(sy̆-rŭ′pŭs rhē′ī)

Sirop de Rhubarbe, *Fr.;* Sirupus Rhei, *P. G.;* Rhabarbersirup, Rhabarbersaft, *G.*

* "Fluidextract of Rhubarb, *one hundred cubic centimeters* [or 3 fluidounces, 183 min-

[1] *Acetous Syrup of Wild Cherry.*—Joseph P. Remington devised the following process for this form of syrup, which he believes possesses some advantages over the official syrup, particularly in that the astringency is greatly modified: Moisten 150 Gm. of wild cherry in No. 20 powder, with 50 Cc. of diluted acetic acid, U. S. P.; macerate for twenty-four hours in a close glass or earthenware vessel, pack in a non-metallic percolator, and percolate with diluted acetic acid into a receiver containing 150 Cc. of glycerin until 450 Cc. of liquid are obtained. In this dissolve 700 Gm. of sugar without heat; strain, and pass enough diluted acetic acid through the strainer to make 1000 Cc. of finished syrup. The product is light reddish-brown, has the characteristic peach-kernel flavor, and a decidedly agreeable, acidulous taste. (*A. J. P.,* May, 1899, 209–210.)

ims]; Spirit of Cinnamon, *four cubic centimeters* [or 65 minims]; Potassium Carbonate, *ten grammes* [or 154 grains]; Water, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Syrup, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Spirit of Cinnamon with the Fluidextract of Rhubarb, and add to it the Potassium Carbonate previously dissolved in the Water, and lastly enough Syrup to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Rhubarb Root, in No. 20 powder, 2 *ounces* (Imperial) or 50 grammes; Coriander Fruit, in No. 20 powder, 2 *ounces* (Imp.) or 50 grammes; Refined Sugar, 24 *ounces* (Imp.) or 600 grammes; Alcohol (90 per cent.), 8 *fl. ounces* (Imp. meas.) or 200 cubic centimetres; Distilled Water, 24 *fl. ounces* (Imp. meas.) or 600 cubic centimetres. Moisten the mixed Rhubarb Root and Coriander Fruit with a portion of the mixed Alcohol and Distilled Water, and set aside; pack in a percolator; pass the remainder of the diluted alcohol slowly through the materials; evaporate the percolate until it is reduced to *fourteen fluid ounces* (Imp. meas.) or three hundred and fifty cubic centimetres, and in this, after it has been filtered, dissolve the Refined Sugar by the aid of heat. The product should weigh nearly *two and a half pounds* (Imp.) or one thousand grammes." *Br.* This is a troublesome and imperfect method.

The U. S. syrup differs from that official before 1890 in several particulars, and, in our opinion, it is greatly improved; the activity of the rhubarb and the corrigent effects of the cinnamon are both secured without impairing the appearance of the finished syrup, while the simplicity of the manipulation must commend the process to all. Otto Miller recommends its preparation by dissolving ninety grains of potassium carbonate in twelve fluidounces of cinnamon water, adding twenty-eight ounces of sugar, heating to the boiling point, and, when the sugar is dissolved, adding four fluidounces of fluidextract of rhubarb, straining, and bringing it to the measure of two pints with cinnamon water. A pleasant, clear, efficient, and permanent syrup results. (*West. Drug.,* 1887, p. 107.)

The official syrup is a mild cathartic, adapted to the cases of infants, to which it may be given in the dose of a fluidrachm (3.75 Cc.).

Dose, for adults, two to three fluidrachms (7.5 to 11 Cc.).

SYRUPUS RHEI AROMATICUS. U. S.

AROMATIC SYRUP OF RHUBARB

(sy-rŭ'pŭs rhē'ī ăr-o-măt'ĭ-cŭs)

Spiced Syrup of Rhubarb; Sirop de Rhubarbe aromatique, *Fr.;* Gewürzter Rhabarbersaft, *G.*

* "Aromatic Tincture of Rhubarb, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; Potassium Carbonate, *one gramme* [or 15 grains]; Syrup, *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Potassium Carbonate in the Aromatic Tincture of Rhubarb. Filter, if necessary, and add sufficient Syrup to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

This syrup is nearly identical with that official in the U. S. P. 1870. The aromatic tincture is identical with that formerly used in the preparation of this syrup. The addition of a small amount of alkali has been adopted, to prevent the syrup from becoming turbid. The substitution of glycerin for one-half of the syrup, as recommended in the 14th edition of this work, would be an improvement.

The aromatic syrup of rhubarb is a warm stomachic laxative, too feeble for adult cases, but well calculated for the bowel complaints of infants; which are so frequent in our cities during the summer season, and as a remedy for which this preparation, or one analogous to it, has been long in use, under the name of *spiced syrup of rhubarb.* The dose for an infant with *diarrhœa* is a fluidrachm (3.75 Cc.), repeated every two hours until the passages indicate by their color that the medicine has operated. It should be borne in mind that the syrup, as prepared by the present formula, contains one-seventh of diluted alcohol, which, though not injurious in most cases in which this syrup is used, might render it too stimulating in some instances of diarrhœa in the very young infant.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS RHŒADOS. Br.

SYRUP OF RED POPPY

(sy-rŭ'pŭs rhœ'ă-dŏs)

Sirop de Coquelicot, *Fr. Cod.;* Sirop de Pavot rouge, *Fr.;* Klatschrosensaft, *G.*

"Red-Poppy Petals, 13 *ounces* (Imperial) or 260 grammes; Refined Sugar, 2¼ *pounds* (Imp.) or 720 grammes; Alcohol (90 per cent.), 2½ *fl. ounces* (Imp. meas.) or 50 cubic centimetres; Distilled Water, *a sufficient quantity.* Add the Red-Poppy Petals gradually to *one pint* (Imp. meas.) or four hundred cubic centimetres of Distilled Water kept hot upon a water-bath; stir frequently, and afterwards, the vessel being removed, infuse for twelve hours. Then press out the liquid; strain; add the Refined Sugar, and dissolve by the aid of heat. When nearly cold, add the Alcohol, and sufficient Distilled Water to produce *three pounds ten ounces* (Imp.) or one thousand one hundred and sixty grammes of the Syrup." *Br.*

The object of introducing the petals into water heated by a water bath is that they may shrink by being scalded, as otherwise they

could not be completely immersed in the quantity of water directed. After this has been accomplished, they should be immediately removed from the fire, lest the liquor become too thick and ropy. The fine red color of this syrup is its only recommendation. It is very liable to ferment; according to Enders, this can be obviated by evaporating the recently prepared syrup to dryness, keeping the powdered residue in well-stoppered bottles, and dissolving it, as wanted, in four-fifths of its weight of water.

Dose, as stated in the Br. Pharmacopœia, one-half to one fluidrachm (1.8 to 3.75 Cc.).

SYRUPUS ROSÆ. U. S., Br.

SYRUP OF ROSE

(sy-rŭ'pŭs rō'sæ)

Syrup of Roses, *Br.;* Syrupus Rosarum Rubrarum; Syrup of Red Rose; Sirop de Rose rouge, *Fr.;* Rosensirup, *G.*

• "Fluidextract of Rose, *one hundred and twenty-five cubic centimeters* [or 4 fluidounces, 109 minims]; Diluted Sulphuric Acid, *ten cubic centimeters* [or 162 minims]; Sugar, *seven hundred and fifty grammes* [or 26 ounces av., 199 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Fluidextract of Rose and Diluted Sulphuric Acid with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water; after allowing the mixture to stand two hours, filter, and dissolve the Sugar in the clear filtrate, by agitation. Finally, add a sufficient quantity of Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Strain, if necessary." *U. S.*

"Dried Red-Rose Petals, 2 *ounces* (Imperial) or 50 grammes; Refined Sugar, 30 *ounces* (Imp.) or 750 grammes; Distilled Water, boiling, 1 *pint* (Imp. meas.) or 500 cubic centimetres. Infuse the Red-Rose Petals in the Distilled Water for two hours; strain; press; heat the liquid to the boiling point; filter; dissolve the Refined Sugar in the liquid by the aid of heat. The product should weigh *two pounds fourteen ounces* (Imp.) or eleven hundred and fifty grammes." *Br.*

Syrup of rose is mildly astringent, but is valued most for its fine red color, on account of which it is occasionally added to mixtures. The color is developed by the small amount of diluted sulphuric acid which is added.

Dose, a fluidrachm (3.75 Cc.).

SYRUPUS RUBI. U. S.

SYRUP OF RUBUS

(sy-rŭ'pŭs rū'bī)

Syrup of Blackberry Bark, Syrup of Blackberry Root; Sirop d'Ecorce de Ronce, *Fr.;* Brombeersirup, *G.*

• "Fluidextract of Rubus, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Syrup, *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

This syrup is useful in *acute diarrhœa of relaxation* and in *chronic diarrhœa.*

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

SYRUPUS SARSAPARILLÆ COMPOSITUS. U. S.

COMPOUND SYRUP OF SARSAPARILLA

(sy-rŭ'pŭs sär-sa-pa-rĭl'læ com-pōz'ĭ-tŭs)

Syrupus Sudorificus; Sirop de Salsepareille composé, *Fr. Cod.;* Sirop sudorifique, *Fr.;* Zusammengesetzter Sarsaparillsirup, *G.;* Jarabe de zarzaparrilla compuesto, *Sp.*

• "Fluidextract of Sarsaparilla, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Fluidextract of Glycyrrhiza, *fifteen cubic centimeters* [or 243 minims]; Fluidextract of Senna, *fifteen cubic centimeters* [or 243 minims]; Sugar, *six hundred and fifty grammes* [or 22 ounces av., 406 grains]; Oil of Sassafras, *two-tenths of a cubic centimeter* [or 3 minims]; Oil of Anise, *two-tenths of a cubic centimeter* [or 3 minims]; Oil of Gaultheria, *two-tenths of a cubic centimeter* [or 3 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Add the Oils (equivalent to about *four drops* each) to the mixed Fluidextracts and shake the liquid thoroughly. Then add enough Water to make up the volume to *six hundred cubic centimeters* [or 20 fluidounces, 138 minims], and mix well. Set the mixture aside for one hour, and then filter it. Dissolve the Sugar in the filtrate with the aid of a gentle heat, allow the liquid to cool, strain, and add enough Water, through the strainer, to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.* An important change was made in this compound syrup in the U. S. P. 1890, through the substitution of fluidextracts and volatile oils for the drugs used in the U. S. P. 1880 process. It was further improved in the Eighth Revision by doubling the amount of volatile oils. The new syrup is not perfectly transparent, but the U. S. P. 1880 syrup had the same fault. The simplicity of the present formula is a welcome improvement.

In the original edition of the U. S. Pharmacopœia, published in 1820, a process for a syrup of sarsaparilla was adopted, intended to represent the famous French *sirop de cuisinier.* This was very much improved in the revised edition published in 1830, and the amended process has been retained with little alteration in the subsequent editions, the process of percolation having been substituted in the U. S.

1880 Pharmacopœia for simple maceration directed in the first of the two formulas of 1850. In the original process the sarsaparilla was subjected to long decoction with water. It has been proved that diluted alcohol more thoroughly extracts the acrid principle of the root, upon which its activity probably depends, than water, and that this principle is either dissipated or destroyed by the long-continued application of a boiling heat. In the present formula, therefore, which employs alcohol in the menstruum for the fluidextracts, the root is more completely exhausted of its active matter, while the heat applied to the concentration, being no higher than is requisite for the evaporation of the alcohol, is insufficient to injure the preparation. The spirituous menstruum has, moreover, the advantage of not dissolving the inert fecula, which encumbers the syrup prepared by decoction and renders it liable to spoil. The essential oils were intended solely to communicate an agreeable flavor, and were used in very small proportion. The only objection to the 1880 process was that a portion of the resin extracted by the alcohol from the guaiacum wood was deposited during the evaporation of the tincture; this was separated by the filtration directed in the U. S. P. 1880, and was therefore of no disadvantage to the preparation. In the present process guaiacum wood is omitted; its loss, however, will never be felt. But the practitioner should be aware that much of the sarsaparilla as it exists in the market is nearly or quite inert, and should be prepared to meet with disappointment in the use of this or any other preparation, unless satisfied of the good quality of the drug from which it is made.

Corrosive sublimate, which is often given in connection with this syrup, is said to be completely decomposed by it, being converted into calomel. Samuel Kennedy (*Ph. Rec.*, 1888, p. 201) showed that when corrosive sublimate was dissolved in this syrup precipitation invariably occurred; if an equal amount of sodium chloride was added, precipitation was greatly retarded. Lepage of Gisors, proposes as a substitute potassium iodohydrargyrate, which he has found not to undergo decomposition. (See *Potassio-mercuric iodide* PART II, and *Sirop Gibert*, p. 630.) When a decided effect is desired, the fluidextract is much more efficient.

Dose, of the syrup, half a fluidounce (15 Cc.), equivalent to somewhat less than a drachm (3.9 Gm.) of the root, to be taken three or four times a day.

SYRUPUS SCILLÆ. U. S., Br.

SYRUP OF SQUILL

(sy-rŭ'pŭs sçĭl'læ)

Syrupus Aceti Scillæ; Sirop de Scille, *Fr.;* Meerzwiebelsirup, *G.*

* "Vinegar of Squill, *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims]; Sugar, *eight hundred grammes* [or 28 ounces av., 96 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Sugar in the Vinegar of Squill with the aid of a gentle heat, then strain, and, when the strained liquid is cold, add enough Water, through the strainer, to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Vinegar of Squill, 1 *pint* (Imperial measure) or 500 cubic centimetres; Refined Sugar, 38 *ounces* (Imp.) or 950 grammes. Dissolve the Refined Sugar in the Vinegar of Squill by the aid of gentle heat. The product should weigh *three pounds ten ounces* (Imp.) [or one thousand four hundred and fifty grammes]." *Br.*

The present British formula is almost identical with the U. S. (8th Rev.), and differs from that of 1864 in taking the vinegar already formed, instead of preparing it as the first step of the process. The object of heating the vinegar to the boiling point is to coagulate albuminous matter, which is afterwards separated by filtration. The heating should be performed as quickly as possible, to prevent undue loss of acetic acid.

This syrup is much employed as an expectorant, especially in combination with a solution of tartarized antimony. It is incompatible with ammonium carbonate, but not with ammonium chloride.

Dose, about a fluidrachm (3.75 Cc.). In infantile *bronchitis* it is sometimes given, in the same dose, as an emetic.

SYRUPUS SCILLÆ COMPOSITUS. U. S.

COMPOUND SYRUP OF SQUILL

(sy-rŭ'pŭs sçĭl'læ cŏm-pŏs'ĭ-tŭs)

Hive Syrup; Sirop de Scille composé, *Fr.;* Zusammengesetzter Meerzwiebelsirup, *G.*

* "Fluidextract of Squill, *eighty cubic centimeters* [or 2 fluidounces, 338 minims]; Fluidextract of Senega, *eighty cubic centimeters* [or 2 fluidounces, 338 minims]; Antimony and Potassium Tartrate, *two grammes* [or 31 grains]; Purified Talc, *twenty grammes* [or 309 grains]; Sugar, *seven hundred and fifty grammes* [or 26 ounces av., 199 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Fluidextracts, evaporate them, in a tared dish, on a water-bath, to *one hundred grammes* [or 3 ounces av., 231 grains], and mix the residue with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. When the mixture is cold, incorporate with it, intimately, the Purified Talc, filter, pass enough Water through the filter to obtain *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of clear filtrate, and add to this the

Antimony and Potassium Tartrate previously dissolved in *twenty-five cubic centimeters* [or 406 minims] of hot Water. Dissolve the Sugar in this liquid by agitation, without heat, strain, and add enough Water, through the strainer, to make the produce measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly. Compound Syrup of Squill may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus*. Pour the filtrate obtained as directed in the preceding formula, and mixed with the solution of Antimony and Potassium Tartrate, upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

This is intended as a substitute for the popular preparation called *Coxe's hive syrup*, from which it differs chiefly in containing sugar instead of honey. Prepared as originally directed in the Pharmacopœia, it invariably fermented from the want of sufficient concentration. This defect was corrected at the revision of 1840, when sugar was substituted for honey, in consequence of the uncertain consistence and constitution of the latter. In the Pharmacopœia of 1850 two formulas were given for this syrup, in the first of which the virtues of the squill and senega were extracted by long boiling with water, in the second by percolation with water to which a small portion of alcohol was added. The latter was preferable when skilfully performed, as it avoided in great measure the injurious influence upon the senega of boiling, exhausted both this and the squill more readily in consequence of the addition of alcohol to the menstruum, and afforded a solution of their active principles less embarrassed with inert matters calculated to favor fermentation. In this process the filtered liquor was raised to the boiling point in order to coagulate the albumen, after which the evaporation was conducted at a lower temperature. The present formula is a decided improvement upon the one just described, as, diluted alcohol being employed as the menstruum, less of the albuminous and mucilaginous matter is extracted, while any disadvantage from the spirituous addition is obviated by the subsequent evaporation of the alcohol and the addition of water, the provision being retained to boil the tincture for a short time to get rid of such albumen as has been taken up. Sometimes the amount of albuminous coagulum is so great as to render the process of filtration after the boiling very tedious. According to J. C. Wharton, this can be remedied by rubbing up the muddy liquid with magnesia (*A. J. P.*, xliii. 102); to serve the same purpose precipitated calcium phosphate was substituted in the U. S. P. 1890, but in the U. S. P. (8th Rev.) purified talc is used. Percolation we have found very well adapted for dissolving the sugar and producing a transparent syrup. The present U. S. P. process has the merit of simplicity, but, unfortunately, the fluidextract of squill is never a wholly satisfactory preparation, and at present is made with a diluted acetic acid as a menstruum.

C. A. Werckshagen proposes the following modification. Evaporate one pint of vinegar of squill to the consistence of a soft extract, to remove the acetic acid, then add eighteen fluidounces of simple syrup, and apply heat; when clear, add twenty-four grains of tartar emetic and stir until dissolved; then take off the fire and add sufficient syrup to make the whole measure twenty-two fluidounces; lastly, when cold, add two fluidounces of fluidextract of senega. If the fluidextract of senega be exactly neutralized with ammonia, no gelatinization can occur. (*A. J. P.*, 1886, p. 591.)

Compound syrup of squill combines the virtues of senega, squill, and tartar emetic, of the last of which it contains about one grain in a fluidounce. It is emetic, diaphoretic, expectorant, and frequently cathartic, and may be given with advantage in mild cases of *croup*, also in the latter stages of severe cases when the object is to promote expectoration. In croup, however, a mineral emetic is much to be preferred. The dose of this syrup is, for children, from ten minims to a fluidrachm (0.6 to 3.75 Cc.), according to the age, and it may be repeated in cases of croup every fifteen or twenty minutes until it causes vomiting.

Dose, for adults as an expectorant, from twenty to thirty minims (1.3 to 1.8 Cc.).

SYRUPUS SENEGÆ. U. S.

SYRUP OF SENEGA

(sy-rŭ'pŭs sĕn'ę-gæ)

Sirop de Polygala, *Fr.*; Sirupus Senegae, *P. G.*; Senegasirup, *G.*

* " Fluidextract of Senega, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Syrup, *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them." *U. S.*

The syrup affords a very convenient mode of exhibiting senega in pectoral complaints. Owing to the pectinous principle present in senega, the syrup made directly from the root as in the process of 1870 was always turbid. It has been frequently pointed out that the addition of an alkali renders the syrup transparent, and the 1890 process directed the use of a small quantity of ammonia water, although, if the fluidextract of senega which contains alkali be used as in the U. S. P. (8th Rev.), this addition is unnecessary. This syrup may be given as a stimulant expectorant.

Dose, one or two fluidrachms (3.75 or 7.5 Cc.).

SYRUPUS SENNÆ. U. S., Br.

SYRUP OF SENNA

(sy-rŭ'pŭs sĕn'næ)

Sirop de Séné, *Fr.;* Sirupus Sennae, *P. G.;* Sennasirup, *G.*

* "Fluidextract of Senna, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Oil of Coriander, *five cubic centimeters* [or 81 minims]; Syrup, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Oil of Coriander with the Fluidextract of Senna and add a sufficient quantity of Syrup to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Senna, 40 *ounces* (Imperial) or 1200 grammes; Oil of Coriander, 10 *minims* or 0.6 cubic centimetre; Alcohol (90 per cent.), 40 *minims* or 2.4 cubic centimetres; Refined Sugar, in powder, 50 *ounces* (Imp.) or 1500 grammes; Alcohol (20 per cent.), 70 *fl. ounces* (Imp. meas.) or 2100 cubic centimetres. Moisten the Senna with *two pints* (Imp. meas.) or twelve hundred cubic centimetres of the Alcohol; pack tightly in a vessel which can afterwards be closed; set aside for three days; press strongly; reserve the liquid obtained; break up the marc; moisten it with *fifteen fluid ounces* (Imp. meas.) or four hundred and fifty cubic centimetres of the Alcohol; set aside for twenty-four hours; press strongly; add the liquid obtained to the portion previously preserved; break up the marc; mix it with the remainder of the Alcohol; set aside for three hours; press again; evaporate the resulting liquid until it is reduced to such a volume that when added to the reserved liquid the whole shall measure *two pints* (Imp. meas.) or twelve hundred cubic centimetres. Mix the evaporated liquid with the reserved liquid; heat the product in a covered vessel to 180° F. (82.2° C.) for a few minutes; set aside for twenty-four hours; filter; pass Distilled Water through the filter until the filtrate measures *forty fluid ounces* (Imp. meas.) or twelve hundred cubic centimetres; add the Refined Sugar, and dissolve in a covered vessel by the aid of gentle heat; cool; add the Oil of Coriander dissolved in the Alcohol (90 per cent.); shake well. The product should weigh *five pounds twelve ounces* (Imp.) or two thousand seven hundred and sixty grammes." *Br.*

The U. S. P. 1890 syrup resembled that of the British Pharmacopœia except in the important matter of strength; it contained only one-half the quantity of senna ordered for the British syrup, and was about one-third weaker than the U. S. 1880 syrup. This is, however, not a disadvantage, as the former syrups were nearly of the strength of the fluidextract. The process was improved in the U. S. P. (8th Rev.) by simply adding the fluidextract (made by the official method which deprived it of the griping principle) and oil of coriander to syrup.

Dose, for an adult, from two to four fluidrachms (7.5 to 15 Cc.); for children, for whom it was originally intended, not more than from one-eighth to one-half of that quantity, according to the age.

SYRUPUS TOLUTANUS. U. S., Br.

SYRUP OF TOLU

(sy-rŭ'pŭs tŏl-ū-tā'nŭs)

Sirop de Baume de Tolu, *Fr. Cod.;* Sirop balsamique, *Fr.;* Tolubalsamsirup, *G.;* Jarabe de balsamo de Tolu, *Sp.*

* "Tincture of Tolu, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Magnesium Carbonate, *ten grammes* [or 154 grains]; Sugar, *eight hundred and twenty grammes* [or 28 ounces av., 405 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Rub the Tincture of Tolu, in a mortar, with the Magnesium Carbonate and *sixty grammes* [or 2 ounces av., 51 grains] of the Sugar. Then gradually add *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Water, with constant trituration, and filter. Dissolve the remainder of the Sugar in the clear filtrate, with the aid of a gentle heat, strain the Syrup while hot, and add a sufficient quantity of Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Syrup of Tolu may also be made in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Balsam of Tolu, 1¼ *ounces* (Imperial) or 62.5 grammes; Refined Sugar, 2 *pounds* (Imp.) or 1600 grammes; Distilled Water, *a sufficient quantity.* Boil the Balsam of Tolu in *one pint* (Imp. meas.) or eight hundred cubic centimetres of the Distilled Water for half an hour in a lightly covered vessel, stirring frequently. Then remove from the source of heat and add Distilled Water, if necessary, so that the liquid when cold shall measure *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres. Filter the solution, add the Refined Sugar, and dissolve by the aid of a water-bath. The product should weigh *three pounds* (Imp.) or two thousand four hundred grammes." *Br.*

The U. S. 1890 process for this syrup was more satisfactory than that formerly official. It was practically a return to the U. S. 1870 method (based on Finley's process[1]), substi-

[1] *Syrupus Tolutanus,* U. S. 1870.—"Take of Tincture of Tolu *two fluidounces;* Carbonate of Magnesium *one hundred and twenty grains;* Sugar [refined], in coarse powder, *twenty-six troyounces;*

tuting precipitated calcium phosphate for magnesium carbonate, and using a freshly made strong tincture for the official tincture of tolu.

The U. S. Pharmacopœia (8th Rev.) process reintroduced magnesium carbonate with much advantage, and has the further improvement of using the official tincture of tolu instead of making the latter from the balsam by a special process. In the British process the soluble principles of the balsam are extracted by boiling it with water, but with great waste of the material, as the water dissolves but a small portion of the active matter. To obviate this waste, the same portion of balsam is, according to Brande, usually employed in successive operations, and it long continues to impart odor and taste to boiling water. W. H. Hostelley's modification is as follows: For making twenty-five ounces of syrup, take one ounce of balsam of tolu, one pound of granulated sugar, and water which has been previously filtered through animal charcoal, enough to make twenty-five ounces; rub the tolu to a fine powder, aided by some of the sugar, and mix this with the remainder of the granulated sugar; now prepare a percolator by placing a piece of cotton in the neck, pack the powder in it, pour in the filtered water, and receive twenty-five ounces of percolate. (*A. J. P.*, 1887, p. 290.) Syrup of tolu is a feeble preparation and is used chiefly to impart its agreeable flavor to mixtures. If a stronger syrup is desired, it is readily made by adding tincture of tolu in the desired quantity and directing the bottle to be shaken.

Off. Prep.—Mistura Ammoniaci, *Br.;* Trochisci Ammonii Chloridi, *U. S.;* Trochisci Cubebæ, *U. S.*

SYRUPUS ZINGIBERIS. U. S., Br.

SYRUP OF GINGER

(sy-rŭ'pŭs zĭn-gĭb'ẹ-rĭs)

Sirop de Gingembre, *Fr.;* Ingwersirup, *G.*

* "Fluidextract of Ginger, *thirty cubic centimeters* [or 1 fluidounce, 7 minims]; Alcohol, *twenty cubic centimeters* [or 325 minims]; Magnesium Carbonate, *ten grammes* [or 154 grains]; Sugar, *eight hundred and twenty grammes* [or 28 ounces av., 405 grains]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Fluidextract of Ginger and the Alcohol, then triturate the liquid in a mortar with the Magnesium Carbonate and *sixty grammes* [or 2 ounces av., 51 grains] of the Sugar. Then gradually add *four hundred and fifty cubic centimeters* [or 15 fluidounces, 104 minims] of Water, with constant trituration, and filter. Dissolve the remainder of the Sugar in the clear filtrate, with the aid of a gentle heat, strain the Syrup while hot, and add a sufficient quantity of Water to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Syrup of Ginger may also be made in the following manner: Prepare a percolator or funnel in the manner described under *Syrupus.* Pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it with Water, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.*

"Ginger, in fine powder, ½ *ounce* (Imperial) or 12.5 grammes; Alcohol (90 per cent.), Syrup, of each *a sufficient quantity.* Prepare *one fluid ounce* (Imp. meas.) or twenty-five cubic centimetres of a strong tincture of the Ginger by the process of percolation with the Alcohol. To this add sufficient of the Syrup to produce *twenty fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Syrup of Ginger." *Br.*

The U. S. P. process has been improved by the addition of magnesium carbonate as an aid in distributing the resinous fluidextract so as to facilitate its solution in water. It is practically a return to the U. S. 1870 method.[1]

The British syrup, being made by the simple incorporation of the tincture with syrup, has of course all the strength of the ginger, but is inferior to the U. S. preparation in appearance and flavor. The old plan of using water as the menstruum for the drug has been abandoned, as the syrup thus made is encumbered with mucilage and starch, and consequently rendered more liable to decomposition. In order that the preparation may be of the proper strength, it is necessary that the fluidextract should have been made with the best Jamaica ginger. The syrup of ginger is much used as a warm stomachic addition to tonic and purgative infusions or mixtures, and to impart flavor particularly to carbonic acid water.

Dose, a fluidrachm (3.75 Cc.) or more.

TABELLÆ TRINITRINI. Br.

TRINITRIN TABLETS

(tạ-bĕl'læ trī-nī'trĭ-nī)

Tablets of Nitroglycerin.

"Tablets of chocolate each weighing five grains (0.324 gramme) and containing one-hundredth of a grain (0.00065 gramme) of the

Water *a pint.* Rub the Tincture of Tolu first with the Carbonate of Magnesium and two troyounces of the Sugar, and then with the Water, gradually added, and filter. To the filtered liquid add the remainder of the Sugar, and, having dissolved it with the aid of a gentle heat, strain the solution while hot." *U. S.* 1870.

[1] *Syrupus Zingiberis,* U. S. 1870.—"Take of Fluid Extract of Ginger *a fluidounce;* Carbonate of Magnesium *one hundred and sixty grains;* Sugar [refined], in coarse powder, *seventy-two troyounces;* Water *forty-two fluidounces.* Rub the Fluid Extract of Ginger first with the Carbonate of Magnesium and two troyounces of the Sugar, and then with the Water, gradually added, and filter. To the filtered liquid add the remainder of the Sugar, and, having dissolved it with the aid of a gentle heat, strain the solution while hot." *U. S.* 1870.

trinitroglycerin of commerce." *Br.* Each of these tablets contains a dose of the remedy. For the properties of nitroglycerin, see *Spiritus Glycerylis Nitratis*, page 1175.

TALCUM. U. S.

TALC

(tăl'cŭm)

"A native hydrous magnesium silicate." *U. S.*

Talcum Venetum; Soapstone; Talc, *Fr. Cod.*; Talc de Venise, Craie de Briançon, *Fr.*; Talcum, *P. G.*; Talk, Talkstein, Speckstein, *G.*

Talc occurs in irregular masses of a greenish-grey color, having a peculiar wax-like appearance of the surface, and giving, when rubbed, a greasy sensation to the fingers. It is found in America and other parts of the world, the best quality at this time (1906) being obtained from New York and North Carolina. In 1905, the total production in the United States was 107,134 short tons, valued at $1,106,062, of which 67,000 tons valued at $469,000 came from New York State; most of the fibrous talc is used in the manufacture of paper.

Properties.—It is officially described as "a white or grayish-white powder or grayish-green irregular masses of waxy lustre; when rubbed upon the skin it imparts a feeling like greasiness; permanent in the air. Inodorous and tasteless. Insoluble in water, and in dilute solutions of the acids and alkali hydroxides. Specific gravity: 2.2 to 2.8. Mix 0.5 Gm. of Talc with about 2 Gm. each of anhydrous sodium and potassium carbonates, heat the mixture in a platinum crucible until fusion is complete, and treat the resulting fused mass with hot water; then neutralize the liquid with diluted sulphuric acid, and, after adding an additional 10 Cc. of the latter, evaporate the mixture until the white fumes of sulphuric anhydride are evolved, then add 20 Cc. of water, and, after boiling the mixture and filtering, an insoluble residue of *silica* should be left. If to the filtrate ammonia water and ammonium chloride T.S. be added, a white, gelatinous precipitate of *aluminum hydroxide* may be formed, while the filtrate from this, upon the addition of sodium phosphate T.S., should yield a white, crystalline precipitate (*magnesium salts*). If 1 Gm. of Talc be boiled with 25 Cc. of diluted hydrochloric acid for one-half hour, adding water from time to time to maintain approximately the original volume, and the liquid filtered, then the filtrate should yield, upon evaporating to dryness, igniting, and quickly weighing, not more than 0.05 Gm. of residue." *U. S.*

Uses.—Talc has been introduced into the U. S. P. (8th Rev.) solely for use in making purified talc. Talc should be used in medicine or pharmacy, only in the form of purified talc, as the native product contains soluble and insoluble impurities from which it must be freed.

Off. Prep.—Talcum Purificatum, *U. S.*

TALCUM PURIFICATUM. U. S.

PURIFIED TALC

(tăl'cŭm pū-rĭ-fĭ-cā'tŭm)

Talc purifié, *Fr.*; Gereinigter Talk, *G.*

"Talc, in fine powder, *five hundred grammes* [or 17 ounces av., 279 grains]; Hydrochloric Acid, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims]; Water, *a sufficient quantity*. Mix the powdered Talc with about *twenty-five hundred cubic centimeters* [or 5 pints] of boiling Water, gradually add *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of the Hydrochloric Acid, and boil the mixture during fifteen minutes, then allow it to stand for fifteen minutes. Decant, and reject the supernatant liquid containing the finer particles of Talc in suspension, and again boil the residue with *twenty-five hundred cubic centimeters* [or 5 pints] of Water, mixed with the remainder of the Hydrochloric Acid, and allow it to stand for fifteen minutes. Again decant, and reject the finer suspended particles, and wash the coarser residue with Water by repeated decantation, until a portion of the wash-water, after filtering and acidifying with nitric acid, fails to become opalescent upon the addition of silver nitrate test solution. Then transfer the magma to a close linen or muslin strainer, allow it to drain, and dry it at 110° C. (230° F.)." *U. S.* For pharmaceutical purposes powdered talc requires purification to extract iron salts and other impurities. The official process rejects the finest particles, as they are a great annoyance to the pharmacist, owing to their passing through the pores of filtering paper, thus requiring repeated filtrations. (See *Aquæ.*) Purified Talc is intended to replace magnesium carbonate, calcium phosphate, and other absorbent powders used to aid filtration, it having the advantage of insolubility, although its absorbent properties are deficient in comparison with magnesium carbonate.

Properties.—It is officially described as follows: "Purified Talc, when subjected to ignition at red heat, should lose not more than 5 percent. of its weight. If 10 Gm. of Purified Talc be boiled with 50 Cc. of distilled water for one-half hour, adding water from time to time to maintain approximately the original volume, it should yield a filtrate which is neutral to litmus paper, and one-half of this filtrate, when evaporated and dried at 110° C. (230° F.), should yield not more than 0.005 Gm. of residue (limit of *soluble substances*). The remaining half of the filtrate, after slightly acidulating with hydrochloric acid, should not yield a blue color upon the addition of potassium ferrocyanide T.S. (absence of *iron*)." *U. S.*

Uses.—Purified talc is used pharmaceutically (see above) and as a protecting, soothing powder to the skin. When in very fine powder it forms the basis of many of the proprietary preparations found on ladies' dressing tables,

and is very valuable as a dusting powder in *intertrigo, prickly heat, pruritus,* and other conditions of dermal irritation.

TAMARINDUS. U. S., Br.

TAMARIND

(tăm-ą-rīn'dŭs)

"The preserved pulp of the fruit of *Tamarindus indica* Linné (Fam. *Leguminosæ*)." *U. S.* "The fruits of Tamarindus indica, *Linn.,* freed from the brittle outer part of the pericarp and preserved with sugar." *Br.*

Fructus Tamarindorum; Tamarinier, *Fr. Cod.;* Tamarin, Pulpe brute de Tamarins, *Fr.;* Pulpa Tamarindorum cruda, *P. G.;* Tamarindemnus, Tamarinden, *G.;* Tamarindo, *It.;* Tamarindo (Pulpa de), *Sp.*

Tamarindus indica, L., *Sp. Pl.* (1753) 180; Willd., *Sp. Plant.* iii. 577; *B. & T.* 92.—The tamarind tree is the only species of this genus. It rises to a great height, sends off numerous spreading branches, and has a beautiful appearance. The trunk is erect, thick, and covered with a rough, ash-colored bark. The leaves are alternate and pinnate, composed of many pairs of opposite leaflets, which are almost sessile, entire, oblong, obtuse, unequal at their base, about half an inch long by a sixth of an inch broad, and of a dark-green color. The flowers, which are in small lateral racemes, have a yellowish calyx, and yellow petals beautifully variegated with red veins. The fruit is a broad, compressed, reddish ash-colored pod, much curved, from two to six inches long, with numerous brown, flat, quadrangular seeds, contained in cells formed by a tough membrane. Exterior to this membrane is a light-colored acid pulpy matter, between which and the shell are several somewhat branched tough ligneous strings, running from the stem to the extremity of the pod, the attachment of which they serve to strengthen. The shells are fragile and easily separated. The tree appears to be a native of the East and West Indies, Egypt, and Arabia, though believed by some to have been imported into America. Barth, the African traveller, found it abundant in the interior of Africa. De Candolle was doubtful whether the East and West India trees are of the same species. It is stated by writers that the pods of the former are much larger than those of the latter, and have a greater number of seeds, the East India tamarinds containing six or seven, those from the West Indies rarely more than three or four; but this seems not to be correct.

Calcutta appears to be the chief emporium for the tamarinds of the European markets. Tamarinds are also sent from the West Indies and Ecuador to England; when from this source they are preferred. The latter are known as American tamarinds, and are obtained from *T. indica,* var. *occidentalis,* Gärtn. They are of a light brown color, less cohesive and possess less acidity than the tamarinds from the Old World. Tamarinds are brought to us chiefly from the West Indies, where they are prepared by placing the pods, previously deprived of their shells, in layers in a cask, and pouring boiling syrup over them. A better mode, sometimes practised, is to place them in stone jars, with alternate layers of powdered sugar. They are said to be occasionally prepared in copper boilers. In the East Indies tamarinds are often prepared for market by stripping off the outer shell and pressing the pulpy interiors into a mass; sometimes they are packed as in the West Indies.

Properties.—Fresh tamarinds, which are sometimes, though rarely, brought to this country, have an agreeable, sour taste, without any mixture of sweetness. As we usually find them, in the preserved state, they form a dark-colored adhesive mass, consisting of syrup mixed with the pulp, membrane, strong, somewhat branching fibres or strings, and seeds of the pod, and having a sweet acidulous taste. The brown, flattish, quadrangular seeds, each enclosed in a tough membrane, should be hard, clean, and not swollen, the strings tough and entire, and the odor without mustiness. Tamarind is officially described as "a pulpy mass of a light reddish-brown color, darkening with age so as to become dark brown, containing some branching fibres and numerous reddish-brown, smooth, oblong or quadrangular, compressed seeds, each enclosed in a tough membrane; odor distinct; taste sweet and agreeably acid." *U. S.* From the analysis of Vauquelin, it appears that in 100 parts of the pulp of tamarinds, independently of the sugar added to them, there are 9.40 parts of citric acid, 1.55 of tartaric acid, 0.45 of malic acid, 3.25 of potassium bitartrate, 4.70 of gum, 6.25 of pectin, 34.35 of parenchymatous matter, and 27.55 of water. K. Müller (*Ph. Centralh.,* 1882), after analyzing nine commercial varieties, states that only traces of citric and malic acids are present, but that tartaric acid and acid potassium tartrate are present in considerable amount. Copper may often be detected in preserved tamarinds, derived from the boilers in which they are prepared. Its presence may be ascertained by the reddish coat which it imparts to the blade of a knife immersed in the tamarinds.

Uses.—Tamarinds are laxative and refrigerant, and infused in water form a highly grateful drink in febrile diseases. Convalescents often find the pulp a pleasant addition to their diet, and useful by preserving the bowels in a loose condition. It is sometimes prescribed in connection with other mild cathartics, and is one of the ingredients in the confection of senna. Though frequently given with infusion of senna to cover its taste, it is said to weaken its purgative power, and the same observation has been made of its influence upon the resinous cathartics in general. For a formula for *fluid-extract of tamarind,* see *Nat. Drug.,* 1892, 101.

Dose, from a drachm to an ounce (3.9 to 31 Gm.).

Off. Prep.—Confectio Sennæ, *U. S., Br.*

TARAXACUM. U. S. (Br.)

TARAXACUM [Dandelion]

(tą-răx'ą-cŭm)

"The dried root of *Taraxacum officinale* Weber (Syn. *Taraxacum Taraxacum* (Linné) Karsten) (Fam. *Compositæ*), collected in autumn." *U. S.* "The fresh and the dried roots of Taraxacum officinale, *Wiggers*. Collected in the autumn." *Br.*

Taraxaci Radix, *Br.;* Dandelion Root, Blowball, Milk, Witch, or Yellow Gowan, Lion's-tooth, Canker-wort; Pissenlit, Dent de Lion, *Fr. Cod.;* Radix Taraxaci cum herba, *P. G.;* Löwenzahn, *G.;* Tarassaco, *It.;* Taraxacon, Diente de Leon, *Sp.*

The proper botanical name of the dandelion is not that warranted by the pharmacopœias, but is *Taraxacum Taraxacum* (L), Karst., *Deutsch Fl.* (1880–83).—*Leontodon Taraxacum,* L., *Sp. Pl.* (1753).—*T. officinale,* Weber, *Prim. Pl. Holst.* (1780).—*T. Dens-leonis,* Desf., *Fl. Atlant.* (1800).—The dandelion is an herbaceous plant, with a perennial fusiform root. The leaves, which spring immediately from the root, are long, pinnatifid, generally runcinate, with the divisions toothed, smooth, and of a fine green color. The common name of the plant was derived from the fancied resemblance of its leaves to the teeth of a lion. The flower-stem rises from the midst of the leaves, six inches or more in height. It is erect, simple, naked, smooth, hollow, fragile, and terminated by a large golden-colored flower, which closes in the evening and expands with the returning light of the sun. The involucre is smooth and double, with the outer scales bent downward. The florets are very numerous, ligulate, and toothed at their extremities. The receptacle is flat and naked. The pappus is stipitate, and at the period of maturity is disposed in a spherical form, and is so light and feathery as to be easily borne away by the wind, with the achene attached. Another plant resembling the common dandelion, the achenes of which, however, are narrower and bright red or reddish brown, known as the *red-seeded dandelion,* is the product of *T. erythrospermum,* Andrz., and is supposed by some to be naturalized from Europe.

This species of Taraxacum grows spontaneously in widely separated parts of the globe. It is abundant in this country, adorning our grass plots and pasture grounds with its bright yellow flowers, which, in moist places, show themselves with the first opening of spring and continue to appear until near the close of summer. In India the plant is cultivated in various parts of the country, and its root collected for use between the months of September and February. (*P. J.,* Dec. 1871, 523.) All parts of the plant contain a milky bitterish juice, which exudes when they are broken or wounded. The leaves, when very young and blanched by the absence of light during their growth, are tender and not unpleasant to the taste, and are sometimes used as a salad. When older and of their natural color, they are medicinal. The Pharmacopœias recognize only the root, which is by far the most efficacious part. It should be full grown when collected, and should be employed in the recent state, as it is then most active. It does not, however, as stated by Duncan, lose nearly all its bitterness by drying, and the root dug up in the warmer seasons might, if dried with care, be employed with propriety in the succeeding winter. The juice of the root is thin and watery in the spring; milky, bitter, and spontaneously coagulable in the latter part of summer and autumn, and sweet and less bitter in the winter when affected by the frost. The months of July, August, and September are, therefore, the proper periods for collecting it.

Henry Barton of Brighton, England, prepared the juice from the flower-stalks by crushing and pressure, adding 25 per cent. of spirit, and, after allowing it to stand for some weeks in glass bottles, filtering to separate a very small quantity of deposit, and setting aside for use. According to Barton, it remains bright, and retains its characteristic taste. Though not so rich in solid constituents as the juice of the root, yet, having an equal bitterness, it is probably not less efficacious as a medicine, if it be true, as stated by Bentley, that the efficacy of the medicine does not depend solely on the amount of its solid constituents, but principally if not entirely on the bitter principle it contains. Barton stated that the juice is certainly one of the best preparations of taraxacum. (*A. J. P.,* 1872, p. 509.)

The fresh full grown root of the dandelion is several inches in length, as thick as the little finger or thicker, round and tapering, somewhat branched, of a light brown color externally, whitish within, having a yellowish ligneous cord running through its centre, and abounding in a milky juice. In the dried state it is dark brown, much shrunken, wrinkled longitudinally, brittle, and when broken presents a shining somewhat resinous fracture. A transverse section exhibits an exterior cortical portion, thick, spongy, whitish, and marked with concentric rings, and a smaller central portion, ligneous and yellow, though in very old roots the latter is sometimes wanting. "Cylindraceous and tapering very gradually, of variable length, and 1 to 2 Cm. thick above, crowned with several short, thickish heads, usually simple or somewhat branched, the branches closely parallel; externally blackish-brown, longitudinally wrinkled; fracture short, showing a yellowish, porous central axis, surrounded by a thick, whitish bark, containing numerous milk vessels arranged in concentric circles; inodorous; bitter." *U. S.* Taraxacum should be free from the root of *Cichorium Intybus,* Linné, which closely resembles it, but is usually paler, more bitter, and has the milk vessels in radiating lines. Contrary to the general statement, that taraxacum root contains a central wood-

cylinder without any pith, Jos. Schrenk states that he has found a distinct pith in a very large number of roots taken from commercial samples of taraxacum. From ten to fifteen fibro-vascular bundles surrounded by parenchyma-tissue include the pith, the diameter of which in some instances exceeds the thickness of the woody zone several times. In other respects the structure of the root was normal, the concentric arrangement of the laticiferous ducts in particular excluding any possibility of mistaking the specimens for chicory, etc. (*Am. Drug.*, 1887, p. 2.) Its active properties are yielded to water by boiling, and do not appear to be injured in the process. Dragendorff obtained from the root gathered in October and dried at 100° C. (212° F.) 24 per cent. of *inulin* and some sugar. The root gathered in March from the same place yielded 1.74 per cent. of inulin, 17 of uncrystallizable sugar, and 18.7 of *levulin*. This last-named substance, discovered by Dragendorff, has the same composition as inulin, but dissolves in cold water, and is devoid of any rotatory power. Mannite, which has been found in the infusion of the root, has been demonstrated by Smith of Edinburgh, not to pre-exist in the root, but to be formed by spontaneous changes consequent on exposure.

A crystallizable principle has been extracted from the juice of the root by Pollex, who has named it *taraxacin*. It is bitter and somewhat acrid, fusible but not volatile, sparingly soluble in cold water, but very soluble in boiling water, alcohol, and ether. It is obtained by boiling the milky juice in distilled water, filtering the concentrated liquor, and allowing it to evaporate spontaneously in a warm place. The taraxacin crystallizes, and may be purified by repeated solution and crystallization in alcohol or water. Kromayer (*A. Pharm.* (2), cv. 6) also obtained taraxacin, and, in addition, a second crystalline principle, *taraxacerin*, $C_8H_{16}O$, insoluble in water, but soluble in alcohol. According to Vogel, the intra-cellular substance of the root consists chiefly of pectose, which is the result of a metamorphosis of the substance constituting the membrane of the cells. L. E. Sayre found that the yield of taraxacin varies in roots collected at different seasons. (See *Proc. A. Ph. A.*, 1893, 1894, 1895, 1896, 1897.)

The roots of various plants have been largely substituted for dandelion in England and on the Continent by the herb gatherers, and we are informed that fraudulent substitution is not unfrequent, in this country, of the root of *Cichorium Intybus*, or *chicory*. It is rare to find chicory mixed with dandelion, the former being usually boldly substituted for the latter.

Uses.—Taraxacum is slightly tonic, diuretic, and aperient, and is thought to have a specific action upon the liver, exciting it when languid to secretion, and resolving its chronic engorgements. It has been much employed in Germany, and is a popular remedy with many practitioners in this country. The diseases to which it appears to be especially applicable are those connected with derangement of the hepatic apparatus and of the digestive organs generally. George B. Wood had confidence in it in the treatment of *chronic congestion* and *inflammation of the liver and spleen*, provided that there was no irritation or inflammation of the gastro-intestinal mucous membrane. He was accustomed to combine with it potassium bitartrate and aromatics when an aperient effect was desired. The dried root is sometimes mixed, in powder, with ground coffee, the taste of which covers that of the dandelion. It is also used as a substitute for coffee, being roasted and powdered and then prepared in the same manner.

Dose, one to three drachms (3.9 to 11.6 Gm.).

Off. Prep.—Fluidextractum Taraxaci, *U. S.* (*Br.*); Extractum Taraxaci, *U. S.*, *Br.*; Succus Taraxaci, *Br.*

TEREBENUM. U. S., Br.

TEREBENE

(tĕr-ę-bē′nŭm)

$C_{10}H_{16} = 135.10$

"A liquid consisting of dipentene and other hydrocarbons, obtained by the action of concentrated sulphuric acid on oil of turpentine and subsequent rectification with steam. Terebene should be kept in well-stoppered bottles, in a cool place, protected from light." *U. S.* "A mixture of dipentene and other hydrocarbons, obtained by agitating oil of turpentine with successive quantities of sulphuric acid until it no longer rotates the plane of a ray of polarized light, and then distilling in a current of steam." *Br.*

Térébène, *Fr.*; Tereben, *G.*

This is a substance which is produced by the action of sulphuric acid upon oil of turpentine. The sulphuric acid must be added gradually to the cooled oil of turpentine, in the proportion of one part of acid to twenty parts of oil, and after a day's standing the mixture is heated to boiling. After cooling, the oily layer is removed, freed from acid by calcium carbonate, and rectified. The terebene so obtained boils at 156° C., is optically inactive and of rather pleasant odor. Some cymol is always produced at the same time, and by continued action of the acid the terebene is said to be entirely converted into cymol and colophene. Jayne and Chase, however, from a study of a number of samples of commercial terebenes (*A. J. P.*, 1887, p. 65), conclude that the boiling point of the true terebene is much higher, 173° to 180° C. They found an inactive camphor, boiling at about 200° C. (probably *borneol*), to be formed also, and the residue left on rectifying was principally *colophene*.

Properties.—Terebene is officially described as "a colorless, thin liquid, having a rather agreeable, thyme-like odor, and an aromatic, somewhat terebinthinate taste. Specific gravity: about 0.850 at 25° C. (77° F.). Only slightly soluble in water, but soluble in three times its volume of alcohol. It boils at 155° to 165° C. (311° to 329° F.). On exposure to light and air, Terebene gradually becomes resinified, and acquires an acid reaction. Terebene should possess its characteristic agreeable odor, should not redden moistened blue litmus paper (absence of *acids*), and should be completely inactive toward polarized light (absence of *unaltered oil of turpentine*). If about 10 Cc. of Terebene be evaporated in a porcelain dish, on a water-bath, not more than a very slight residue should be left (absence of more than traces of *resinous substances*)." *U. S.* "A colorless liquid, having an agreeable odor and an aromatic terebinthinate taste. Specific gravity 0.862 to 0.866. Does not rotate the plane of a ray of polarized light. Should distil between 312.8° and 356° F. (156° and 180° C.), leaving only a slight viscid residue (absence of excess of resin). Not more than 15 per cent. should distil below 329° F. (165° C.)." *Br.* Power and Kleber (*Ph. Rund.*, 1894, 18) stated that pinene is not obtained by the action of sulphuric acid on oil of turpentine, that the U. S. P. 1890 boiling points 156° to 160° C. should be 170° to 185° C., and that the sp. gr. should be 0.855 instead of 0.862; also that terebene consists mainly of *dipentene* and *terpinene* with some cymol and camphene.

Uses.—Terebene is a valuable stimulant expectorant, first recommended by William Murrell (*B. M. J.*, Dec. 1885), in that form of *chronic bronchitis* often known as *winter cough*. It is very useful not only in cases of chronic bronchitis, but also in the *acute* disease, after the earlier stages have passed by. It is nearly equivalent to the oil of eucalyptus, but is a little more stimulating. It probably exerts upon other mucous membranes the same action that it does upon that of the lungs, and it has been employed with asserted good results in *dyspepsia*, especially in the flatulent intestinal variety, and may be used in chronic or subacute inflammation of the genito-urinary tract. Its action upon the general system has not been investigated, but probably resembles that of oil of turpentine. It may be given in emulsion, or, preferably, in capsules. From twenty to sixty minims (1.3 to 3.75 Cc.) of it may be given to the adult in the course of twenty-four hours, and increased, if necessary. It has been used by atomization, with asserted good results. Murrell (*B. M. J.*, July, 24, 1884) states that terebene is an active antiseptic and germicide, one part in four hundred and fifty being able to keep in check the action of the yeast plant, and one part in five hundred having a very perceptible influence on the development of bacilli and paramœcia.

Dose, three to ten minims (0.2 to 0.6 Cc.).

TEREBINTHINA. U. S. (Br.)

TURPENTINE

(tĕr-ę-bĭn'thĭ-nȧ)

"A concrete oleoresin obtained from *Pinus palustris* Miller, and from other species of *Pinus* (Fam. *Pinaceæ*)." *U. S.* "The concrete oleoresin which is scraped off the trunks of Pinus palustris, *Mill.*, and Pinus Tæda, *Linn.*" *Br.*

Thus Americanum, *Br.*; Frankincense; Common Frankincense; Crude Turpentine; Terebinthina communis; Térébenthine de Bordeaux ou Térébenthine commune, *Fr. Cod.*; Terebinthina, *P. G.*; Terpentin, Gemeiner Terpentin, *G.*; Trementina comune, *It.*; Trementina de pino, *Sp.*

Off. Prep.—Ceratum Resinæ Compositum, *U. S.*; Emplastrum Picis, *Br.*

TEREBINTHINA CANADENSIS. U. S., Br.

CANADA TURPENTINE [Canada Balsam, Balsam of Fir]

(tĕr-ę-bĭn'thĭ-nȧ căn-ȧ-dĕn'sĭs)

"A liquid oleoresin obtained from *Abies balsamea* (Linné) Miller (Fam. *Coniferæ*)." *U. S.* "The oleoresin obtained from Abies balsamea, *Mill.*" *Br.*

Balsamum Canadense; Baume du Canada, *Fr. Cod.*; Térébenthine du Canada, *Fr.*; Canadischer Terpentin, *G.*

The term *turpentine* is usually applied to certain vegetable juices, liquid or concrete, which consist of resin combined with a peculiar essential oil, called *oil of turpentine*. They are generally procured from different species of pine, fir, or larch, though other trees afford products which are known by the same general title, as, for instance, *Pistacia Terebinthus*, which yields the Chian turpentine. Some French writers extend the name of turpentine to other juices consisting of resin and essential oil, without benzoic or cinnamic acid, as copaiba, balm of Gilead, etc. We shall describe particularly, in this place, the turpentines which are either now official or have but recently ceased to be so. A brief botanical view of the plants from which they are respectively derived will be in accordance with the plan of this work. It is proper to observe first that the family Coniferæ includes about three hundred and fifty species. These may be divided into two sub-orders, as Engler and Prantl suggest,—viz., *Pinoideæ* and *Taxoideæ*. Lindley had previously recommended a similar subdivision, but considered each sub-group as deserving of family rank, and gave them the names Pinaceæ and Taxaceæ. Britton and Brown, in their *Illustrated Flora of the U. S. and Canada*, follow Lindley in this instance. The *Pinoideæ* may be further subdivided into the (A) *Abietineæ*, including Araucaria, Pinus, Cedrus, Larix, Picea, Tsuga, Abies, Sequoia,

Taxodium, etc.; and (B) *Cupressineæ,* which include Thuja, Juniperus, etc. The *Taxoideæ* include Ginkgo, Taxus, etc.

The genus Pinus is represented by about seventy species, which are widely distributed throughout the northern hemisphere of both continents. The principal centres of distribution of the species of this genus are in the Western United States (twenty-five species), Eastern United States (thirteen species), and the highlands of Mexico. It is one of the most important genera from an economic standpoint. The following species yield valuable timber: *P. palustris, P. Strobus, P. echinata, P. lambertiana, P. ponderosa, P. monticola, P. heterophylla, P. sylvestris, P. Laricio, P. nepalensis, P. Thunbergii,* and *P. densiflora.* Turpentine is obtained chiefly from the Eastern American *P. palustris* and *P. heterophylla;* it is also obtained from *P. Pinaster* and *P. halepensis* of the Mediterranean basin, and from the Himalayan *P. Roxburghii.* The edible seeds (*Pine Nuts*) of several species yield important articles of human food, the best being produced by the nut pines of Western North America, by *P. pinea* of the Mediterranean, *P. Cembra* of Europe and Asia, and *P. gerardiana* of Northwestern India. *Pine wool,* a coarse fibre manufactured from the leaves of *P. Laricio, P. sylvestris,* and other European species, is used to stuff mattresses and cushions, and, woven with animal wool, is made into hospital and military blankets and into underclothing which are reputed to possess medicinal properties. In the Southern United States carpets are woven from the leaves of *P. palustris.* The bark of several species contains sufficient tannin to make them valuable for tanning leather.

1.—*Pinus palustris,* Mill., *Gard. Dict.* (1768) 8th ed., No. 14.—*P. australis,* Michx. f., *Hist. Arb. Am.* (1810) i. 64.—Leaves in threes, from ten to fifteen inches long, subtended at the base by a conspicuous scaly sheath from one to one and a half inches long. The leaves are crowded at the ends of the branches. The cones are terminal, conical, and armed with a short recurved spine.

This is a very large indigenous tree, growing in dry, sandy soils, from the southern part of Virginia to the Gulf of Mexico. Its mean elevation is sixty or seventy feet, and the diameter of its trunk about fifteen or eighteen inches for two-thirds of its height. The leaves are about a foot in length, of a brilliant green color, and united in bunches at the ends of the branches. The names by which the tree is known in the Southern States are *long-leaved pine, yellow pine, Southern pine, hard pine, Virginia pine,* and *pitch pine;* but the first is the most appropriate. This tree furnishes by far the greater proportion of the turpentine, tar, etc., consumed in or exported from the United States. (See *Pix Liquida.*)

2.—*Pinus Tæda,* L., *Sp. Pl.* (1753) 1000; Willd., *Sp. Plant.* iv. 498; Michaux, *N. Am. Sylva,* iii. 156; *B. & T.* 259.—"Leaves in threes, elongated with elongated sheaths; strobiles oblong-conical, deflexed, shorter than the leaf; spines inflexed."

This is the *loblolly* or *old field pine* of the Southern States. It is abundant in Virginia, where it occupies the lands exhausted by cultivation. It exceeds eighty feet in height, has a trunk two or three feet in diameter, and expands into a wide spreading top. The leaves are about six inches long, and of a light green color. It yields turpentine in abundance, but less fluid than that which flows from the preceding species.

3.—*Pinus sylvestris,* L., *Sp. Pl.* (1753) 1000; Willd., *Sp. Plant.* iv. 494; Michaux, *N. Am. Sylva,* iii. 125; *B. & T.* 257. *Scotch Pine, Norway Pine, Scotch Fir.*—Leaves in pairs, rigid; strobiles ovate-conical, of the length of the leaves; scales linear-oblong, the ends much thickened, their exposed parts (apophysis) oblique, rhomboidal, with a transverse ridge and central tubercle.

This tree, when of full size, is eighty feet high, with a trunk four or five feet in diameter. It inhabits Scotland and the northern and mountainous parts of Europe. It yields a considerable proportion of the common European turpentine.

4.—*Pinus Pumilio,* Haenke, Jviasek, *Beob. Riesengeb.* (1791) 68.—*P. montana,* Mill., *Gard. Dict.,* 8th ed., No. 5.—This pine is known in gardens under several names which are given to the forms occurring in the different mountain ranges over which it is spread. Beissner, in his *Handbuch der Nadelkolzkunde,* considers *P. Pumilio,* Haenke, a synonym of *P. montana,* Mill., whereas in the *Index Kewensis* the latter is brought under the former. Most authors agree with De Candolle and Beissner in bringing *P. Pumilio,* Haenke, under *P. montana,* Mill. The latter is a small tree, with decumbent or knee-like more or less erect branches, which are covered with a dark colored persistent bark. The leaves occur two in a sheath, each of which is from two to five Cm. long, straight, or scythe-shaped, with obtuse apex; both sides are dull green and slightly glaucous. The cones are ovoid, about one and a half inches long, with a pyramidal protuberance on each scale on the outer or exposed side. It is found in the subalpine regions of Central Europe at elevations between 4000 and 8000 feet; also on the Carpathian Mountains at from 4000 to 5500 feet. From its branches by spontaneous exudation or by cutting off their ends, Hungarian balsam is obtained.

Pinus Pinaster, Salander (*P. maritima,* Poir.), which is found in the southern and maritime parts of Europe, yields much of the turpentine, pitch, and tar consumed in France, and is admitted among the official plants in the French Codex. *Pinus lambertiana* of California, produces by exudation a saccharine matter which has been found to contain a peculiar sweet principle called *pinite.* (*C. R. A. S.,* Sept. 1855.) *Pinus sabiniana,*

Dougl., known as *nut-pine* or *digger-pine* (because the nut is largely consumed by the Digger Indians), yields, on being notched, a turpentine whose volatile oil is extensively used in California under the name of *abietene.* (See page 879.) The *Pinus rigida,* or *pitch pine* of this country, and probably others besides those mentioned, are sometimes employed in the preparation of tar. *Pinus Teocotl* yields a turpentine known as Mexican or Brea turpentine, which is used in Mexico.

ABIES.—The genus Abies is represented by about twenty-three species, which are distributed in the New World from Labrador and the valley of the Athabasca River to the mountains of North Carolina and from the mountains of Alaska to the highlands of Guatemala, and in the Old World from Siberia and the mountains of Central Europe to Southern Japan, the Himalayas, Asia Minor, and the mountains of Northern Africa. The species of this genus yield soft, perishable woods and balsamic exudations, which are employed in medicine and the arts.

Abies balsamea, Mill., *Gard. Dict.* (1768) 8th ed., No. 3; Lindley, *Flor. Med.* 554.—*A. balsamifera,* Michaux, *N. Am. Sylva,* iii. 191.—*Pinus balsamea,* L., *Sp. Pl.* (1753) 1002; Willd., *Sp. Plant.* iv. 504.—"Leaves solitary, flat, emarginate or entire, glaucous beneath, somewhat pectinate, sub-erect above, recurved spreading; cones cylindrical, erect; bracts abbreviate, obovate, conspicuously mucronate, sub-serrulate."

This is the *American silver fir,* or *balm of Gilead tree,* inhabiting Canada, Nova Scotia, Maine, and the mountainous regions farther south. It is an elegant tree, seldom rising more than forty feet, with a tapering trunk, and numerous branches, which diminish in length in proportion to their height and form an almost perfect cone. The leaves are six or eight lines long, inserted in rows on the sides and tops of the branches, narrow, flat, rigid, bright green on their upper surface, and of a silvery whiteness beneath. The cones are large, erect, nearly cylindrical, of a purplish color, and covered with a resinous exudation, which gives them a glossy, rich, and beautiful appearance. It is from this tree that the *Canada balsam* is obtained.

Several other species of Abies are official. The *A. Picea* (*Abies pectinata* of De Candolle, *Pinus picea* of Linnæus), or *European silver fir,* growing in the mountainous regions of Switzerland, Germany, and Siberia, yields the *Strassburg turpentine* (*Térébentine d'Alsace* or *des Vosges*), which is much used in some parts of Europe. By the distillation of its cones with water it also affords a variety of oil of turpentine called in France *essence de templine.* By boiling the young branches of the allied *Picea Mariana* (Mill.), B. S. P. (*Pinus nigra,* Ait., *Abies nigra,* Desf.), or *black spruce* of this country, and evaporating the decoction, the *essence of spruce* is prepared. It is a thick, molasses-like liquid, with a bitterish, acidulous, astringent taste, and is used for making *spruce beer.*[1]

Abies Fraseri, Lindley.—This species, commonly called *double fir,* occurs at high elevations in the mountains of Tennessee and North Carolina. The tree is noted for its hardiness, and is used for ornamental purposes. It is also said to have been used to furnish a balsam of fir similar to that obtained from *A. balsamea,* but the data concerning this are obscure.

Russian White Pitch, "belji var," "Sos nowaja Smold," probably derived from the Siberian Fir, *Abies Pichta,* Forb. (*Picea obovata,* Ledeb.), contains, according to A. Tschirch, two free resin acids, the amorphous, *beljiabieninic acid,* $C_{13}H_{20}O_2$, and the crystalline, *beljiabietinic acid* besides *beljiresene,* $C_{13}H_{36}O$ and an essential oil. (*A. Pharm.,* Nov. 1902.)

LARIX.—The genus Larix has eight recognized species, which are now widely distributed over the sub-arctic and mountainous regions of the northern hemisphere, ranging from the Arctic Circle to the mountains of Pennsylvania in the New World and to latitude 30° in the Old World. The species produce hard, durable, valuable timber; turpentine, which is sometimes used in medicine; tar; bark rich in tannin; and a peculiar manna-like substance.

Larix Larix (L.), Kaerst.; *Pinus Larix,* L., *Sp. Pl.* (1753) 1001; Willd., *Sp. Plant.* iv. 503; Woodv., *Med. Bot.* 7, t. 4.—*Larix europæa,* De Cand., *Flor. Fr.* 2064.—*Abies Larix,* Lamb., *Illust.* t. 785, f. 2.—"Leaves fascicled, deciduous; cones ovate-oblong; margins of the scales reflexed, lacerated; bracts panduriform." The *European larch* is a large tree inhabiting the mountains of Siberia, Switzerland, Germany, and the east of France. It yields the *Venice turpentine* of commerce, and a peculiar sweetish substance called in France *Briançon manna,* which exudes spontaneously and concretes upon its bark. When the larch forests of Russia take fire, a juice exudes from the trunk during their combustion, which concretes and is called *Orenburg gum.* It is wholly soluble in water.[2]

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[1] The following is the formula: Take of essence of spruce *half a pint;* pimenta bruised, ginger bruised, hops, each, *four ounces;* water *three gallons.* Boil for five or ten minutes; then strain, and add of warm water *eleven gallons;* yeast *a pint;* molasses *six pints.* Mix, and allow the mixture to ferment for twenty-four hours.

[2] *Coniferin.*—This name has been given to a principle discovered by Hartig in the cambium of several of the Coniferæ. The species in which it has been found are *Pinus Strobus* and *P. Cembra, Picea Abies* and *A. pectinata,* and *Larix Larix,* and it probably exists in many others. It is obtained by removing the outer bark, scraping the cambium from the surface of the wood, subjecting this to pressure, boiling the viscid juice to coagulate the albumen, filtering, and evaporating the filtered liquid to one-fifth of its volume. The coniferin is deposited in crystals. The mother-water is very sweet, and contains a saccharine substance closely allied to cane sugar. The crystals are purified by dissolving them in water, decolorizing by animal charcoal, and finally crystallizing from weak alcohol. Coniferin was chemically examined by M. W. Kubel, and later by Tiemann and Haarmann, who proved that it is a glucoside and as crystallized from the juice has the composition $C_{16}H_{22}O_8 + 2H_2O$. When treated with dilute acids

In Japan, the exudation from the *Pinus densiflora* and that from the *Pinus Thunbergii* are used under the respective names of *akamatsu* and *kuromatsu*. They are said to contain about 18 per cent. of oil and 81 per cent. of resin. The distilled oil is bright and colorless, having an odor somewhat different from that of the European oil of turpentine. It boils at from 155° to 156° C., and has a specific gravity of a little under 0.87. Its index of polarization is from 55° to 61° (dextrogyrate). The resin cannot be distinguished from the European. A turpentine closely resembling the French oil is produced in Burmah from the *Pinus Khasya* and *Pinus Merkusii*. (See *P. J.*, lvi. 1896, 370.)

PISTACIA.—See *Mastiche*.

Pistacia Terebinthus, L., *Sp. Pl.* (1753) 1025; Willd., *Sp. Plant.* iv. 752; Woodv., *Med. Bot.* 29, t. 12.—This is a small tree of the family Anacardiaceæ, with numerous spreading branches, bearing alternate, pinnate leaves, which consist of three or four pairs of ovate-lanceolate, entire, acute, smooth, and shining leaflets, with an odd one at the end. The male and female flowers are diœcious, small, and in branching racemes. It is a native of Barbary and Greece, and flourishes in the islands of Cyprus and Chio, the latter of which has given its name to the *Chian turpentine* obtained from the tree. A gall produced upon this plant by the puncture of an insect has been used in Eastern Europe in pectoral affections.

We shall treat of the several varieties of turpentine under distinct heads.

1. WHITE TURPENTINE.

Terebinthina, U. S.; Thus Americanum, *Br.;* Common Frankincense; Térébenthine de Boston, *Fr.*

In former times, large quantities were collected in New England, but the turpentine trees of that section of the Union have long been entirely exhausted, and our commerce has been until recently almost exclusively supplied from North Carolina and the southeastern parts of Virginia. Latterly attention was turned to the collection of this valuable product in Georgia and Florida, and now an abundant supply is derived from the vast pine forests which occupy the southern portion of our country bordering on the Gulf of Mexico.

During the winter, deep notches or excavations of the capacity of about three pints are made in the trunk of the tree three or four inches from the ground, and for about three feet above these so-called "boxes" the tree is deprived of its bark and some of the wood scraped off. Into these the juice or "crude" begins to flow about the middle of March, and continues to flow throughout the warm season, slowly at first, rapidly in the middle of summer, and more slowly again in the autumn, the tree being scraped every eight or ten days to prevent clogging. The liquid is removed from the "boxes" as they fill, and transferred into casks, where, if left, it gradually thickens, and ultimately acquires a soft solid consistence, but most of it is separated at once by distillation into the rosin and the volatile oil.

White turpentine, as found in commerce, is yellowish white, of a peculiar somewhat aromatic odor, and a warm, pungent, bitterish taste. It is somewhat translucent, and of a consistence varying with the temperature. In the middle of summer it is almost semi-fluid and very adhesive; though brittle in the winter it is often so firm and hard as to be incapable of being made into pills without heat. "In yellowish, opaque masses, brittle in the cold; lighter internally, sticky and more or less glossy; odor and taste terebinthinate. The alcoholic solution of Turpentine has an acid reaction." *U. S.* Exposed to the air it ultimately becomes perfectly hard and dry. In the recent state it affords about 17 per cent. of volatile oil. It is likely to contain small pieces of bark, wood, or other impurity. Tschirch and Koritschoner found the following constituents in white turpentine: *palabieninic acid,* $C_{13}H_{20}O_2$, 5 per cent.; *palabietinic acid,* $C_{20}H_{30}O_2$, which is crystalline, 6 to 7 per cent.; *α-* and *β-palabietinolic acids,* together 53 to 57 per cent. Both the latter are amorphous and are separated by the differing solubility of their lead salts. All the acids are soluble in sodium hydroxide solution. The portion of the resin insoluble in NaOH solution consists of essential oil, 20 to 22 per cent., and *paloresene,* 10 per cent., with traces of a bitter principle. The essential oil has a characteristic turpentine-like odor. The sp. gr. is 0.864. It is dextrogyrate, while the resin itself and palabietinic acid are lævogyrate. The authors have furthermore examined *Russian white pitch,* a product known as "belji var," and probably derived from the Siberian fir. (*A. Pharm.*, Nov. 1902.)

2. COMMON EUROPEAN TURPENTINE.

Térébenthine de Bordeaux, *Fr. Cod.;* Térébenthine commune, *Fr.;* Gemeiner Terpentin, *G.;* Trementina comune, *It.;* Trementina comun, *Sp.*

This is the *Terebinthina vulgaris* of the former London Pharmacopœia. It is furnished by several species of pine, but chiefly by *P. sylvestris* and *P. Pinaster*. From the latter tree it is obtained largely in the maritime districts of the southwest of France, especially in the department of the Landes, and is exported from Bordeaux. Hence it is called in commerce *Bordeaux turpentine.* It is procured by making incisions into the trunk, or removing portions of the bark, and receiving the juice which flows out, in small troughs, or in holes dug at the foot of the tree. It is purified by heating, and filtering it through straw, or by exposing it to the sun in a barrel, through holes in the bottom of

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or ferments it is decomposed as follows: $C_{16}H_{22}O_8 + H_2O = C_6H_{12}O_6 + C_{10}H_{12}O_3$. When this latter compound is oxidized (or coniferin itself) by potassium dichromate and sulphuric acid, *vanillin* is obtained, $C_6H_3(OH)\begin{cases}OCH_3\\CHO\end{cases}$. Vanillin has been thus made commercially, but is now made preferably from the eugenol of oil of cloves or from benzoin.

which the melted turpentine escapes. Thus prepared, it is whitish, turbid, thickish, and separates, upon standing, into two parts, one liquid and transparent, the other of a consistence and appearance like that of thickened honey. As found in European commerce, it often consists wholly of this latter portion. It speedily hardens on exposure in thin layers to the air. The most liquid specimens are completely solidified by the addition of one part of magnesia to thirty-two parts of the turpentine. (*J. P. C.*, xxv. 499.) It is scarcely ever given internally, but furnishes large quantities of oil of turpentine and rosin. We do not import it into this country. The substance which the French call *galipot*, or *barras*, is that portion of the turpentine which concretes upon the trunk of the tree when wounded, and is removed during the winter. (Thénard.) This, when purified by melting with water and straining, takes the name of *yellow* or *white pitch*, or *Burgundy pitch*. When turpentine, whether the European or the American, has been deprived of its oil by distillation, the resin which remains is called *rosin*, and sometimes *colophony*, from the Ionian city of Colophon, where it was formerly prepared. It is the official rosin (*resina*), and is sometimes called yellow rosin (*resina flava*). White rosin (*resina alba*) is prepared by incorporating this, while in fusion, with a certain proportion of water. (See *Resina*.) Tar (*pix liquida*) is the product extracted from the wood by slow combustion and chemically altered by heat. Common pitch (*pix nigra*, or *resina nigra*) is the solid residue left after the evaporation by boiling of the liquid parts of tar.

3. Canada Turpentine.

Baume du Canada, *Fr. Cod.*; Canadischer Balsam, Canadischer Terpentin, *G.*; Trementina del Canada, *It.*

Terebinthina Canadensis, U. S., Br., is collected in Canada and the State of Maine from the *Abies balsamea*, by breaking the vesicles which naturally form upon the trunk and branches, and receiving their liquid contents in a bottle. "Viscid, pale yellowish or greenish-yellow, transparent; odor agreeable; taste terebinthinate, bitter, and slightly acrid. When exposed to the air, Canada Turpentine gradually dries and forms a transparent varnish; it solidifies on being mixed with 20 percent. of its weight of magnesium oxide previously moistened with water; it is completely soluble in ether, chloroform, or benzene." *U. S.* "Solidifying when mixed with about a sixth of its weight of *magnesia* moistened with a little *water*." *Br.* For a paper on its miscibility in alcohol, by J. E. Morrison, see *Proc. A. Ph. A.*, 1894, 309. By time and exposure it becomes thicker and more yellow, and finally solid. It is usually brought into market in bottles under the name of *Canada balsam* or *balsam of fir*. Under the microscope the hard balsam is found to be entirely free from any granular or crystalline structure. In Europe it is sometimes called *balm of Gilead*, from its supposed resemblance to that celebrated medicine. The term *balsam*, as at present understood, is improperly applied to it, as it contains no benzoic or cinnamic acid, and is in fact a true turpentine, consisting chiefly of resin and volatile oil. Bonastre obtained from 100 parts of Canada turpentine 18.6 parts of volatile oil, 40.0 of resin easily dissolved by alcohol, 33.4 of sub-resin of difficult solubility in that fluid, 4.0 of caoutchouc similar to sub-resin, and 4.9 of bitter extractive and salts, besides traces of acetic acid. Flückiger found in 100 parts 24 parts of an essential oil, $C_{10}H_{16}$, with a very small proportion of an oxygenated oil, 60 parts of a resin soluble in boiling alcohol, and 16 parts of a resin soluble only in ether. (*Pharmacographia*, 2d ed., 614.) Emmerich obtained by fractional distillation of the oil *bornyl* or *terpinyl acetate*, *pinene*, and a fragrant liquid resembling oil of lemon. (*A. J. P.*, 1895, 135. See also a paper by Hunkel, *A. J. P.*, 1895, 9.) The chief distinction between it and *Strassburg turpentine*, which is sometimes sold for it in commerce, is in the diverse odors.

According to Tschirch, Weigel and Bruening, Canada turpentine contains about 63 per cent. of acid resins, from 23 to 24 per cent. of volatile oil, and from 11 to 12 per cent. of indifferent resin. The acid portion consists of four acids, of which one—*canadinic acid*, $C_{19}H_{34}O_2$—obtained by treating the oleoresin with ammonium carbonate, with which it combines; a small amount of crystalline *canadolic acid*, $C_{19}H_{28}O_2$, and two amorphous isomeric acids—*α-* and *β-canadinolic acids*, $C_{19}H_{30}O_2$—which constitute the main portion of the acid resins. The indifferent resin has the formula $C_{21}H_{40}O$. The greater part of the volatile oil boils between 160° C. and 167° C. (*A. Pharm.*, 1900, Aug. and Sept., 401, 411 and 487.)

Abies Menziesii, Lind.—From this, a *Balsam of Fir* of the Pacific Slope, has been obtained; it is a turpentine similar to Canada balsam, but it is, however, scarcely a commercial article.

4. Venice Turpentine.

Térébenthine de Venise, *Fr. Cod.*; Térébenthine de Mélèze, *Fr.*; Venetianischer Terpentin, *G.*; Trementina di Venezia, *It.*; Trementina de alerce, Trementina de Venecia, *Sp.*

This turpentine was named from the circumstance that it was formerly an extensive article of Venetian commerce. It is procured in Switzerland, and in the French province of Dauphiny, from the *Larix europæa*,[1] or larch,

[1] Tschirch and Weigel investigated the constituents of *Larch Turpentine*—which is the oleoresin from *Larix Larix*; it contains from 60 to 64 per cent. of acid resins soluble in soda, from 20 to 22 per cent. of volatile oil, and from 14 to 15 per cent. of indifferent resin. The acid resins consist mainly of two isomeric amorphous bodies *α-* and *b*-larinolic acid, $C_{18}H_{26}O_2$, and a smaller quantity of the crystalline laricinolic acid, $C_{20}H_{30}O_2$. The greater portion of the volatile oil boils between 155° and 170°; a smaller quantity of higher boiling sesquiterpene commencing to boil at 190° C. The recently distilled oil has the sp. gr. 0.872, and possesses a characteristic turpentine odor. It is soluble in all proportions in alcohol and other solvents. (*A. Pharm.*, 1900, Aug. and Sept., 401, 411, 487.)

which grows abundantly upon the Alps and the Jura Mountains. The peasants bore holes into the trunk about two feet from the ground, and conduct the juice by means of wooden gutters into small tubs placed at a convenient distance. It is afterwards purified by filtration through a leather sieve. Genuine Venice turpentine is a viscid liquid, of the consistence of honey, flowing with difficulty, cloudy or imperfectly transparent, yellowish or slightly greenish, of a strong not disagreeable odor, and a warm, bitterish, and acrid taste. It does not readily concrete on exposure, is not solidified by one-sixteenth of magnesia, and is entirely soluble in alcohol. (Guibourt, *J. P. C.*, xxv. 500.) H. Beckurts and W. Brueche found the specific gravity at 15° C. from 1.060 to 1.190; acid number from 76 to 101 (Kremel found from 68 to 70.3); ester number from nothing to 6; saponification number from 81 to 101, and the iodine number from 137 to 149. (*A. Pharm.*, 1892, ccxxx. 83.) It yields on an average 15 per cent. of essential oil, of the composition $C_{10}H_{16}$, which has been found to be nearly pure *pinene*. The residual resin is soluble in two parts of warm alcohol of 75 per cent., and more copiously in absolute alcohol. What is sold under the name of Venice turpentine, in commerce, is usually quite brown, and is a factitious substance, prepared by dissolving rosin in oil of turpentine. According to G. Fabris the nature of these spurious Venice turpentines can readily be detected by dissolving 5 Gm. of the sample in 20 Cc. of 95 per cent. alcohol, adding a few drops of phenolphthalein and sufficient of a 10 per cent. solution of potassium hydroxide to render it alkaline. With genuine Venetian turpentine a clear solution is obtained, while the spurious drug yields a turbid solution, from which, on standing, drops of oily resin separate.

5. Chian Turpentine.

Térébenthine de Chio, *Fr. Cod.*; Cyprischer Terpentin, *G.*; Trementina Cipria, *It.*

This variety of turpentine is collected chiefly in the island of Chio, or Scio, from the *Pistacia Terebinthus*, and it is said that the whole annual product of the island is only about two hundred and twenty-four pounds. During the summer the juice flowing spontaneously, or from incisions in the bark, falls upon smooth stones, or bundles of twigs, placed at the foot of the tree, from which it is procured by boiling and straining. After straining it is again boiled with a little water until all the water is evaporated, when it is finally poured into a vessel of cold water and kneaded. At first it is of a dirty yellow color, but after kneading it becomes quite white. (*P. J.*, xvi. 385.) The annual product of each tree is very small, and the turpentine, therefore, commands a high price even in the place where it is procured. Very little of it reaches this country. It is said to be frequently adulterated with the other turpentines. It is a thick, tenacious liquid, of a greenish-yellow color, or it occurs as a viscid opaque mass. The odor [1] is peculiar, penetrating, and more agreeable than that of the other substances of the same class. The taste is mild, without bitterness or acrimony. Flückiger found nearly 14½ per cent. of essential oil, which contained a small quantity of an oxygenated oil. It leaves a glutinous residue when treated with strong alcohol. (Guibourt.) Its alcoholic solution does not redden litmus paper. (Martindale.) On exposure, liquid Chian turpentine speedily thickens, and ultimately concretes into a translucent solid, yellowish or yellowish-brown when in small pieces, greenish-brown in mass.

Besides the turpentines mentioned, various others are noticed in books on Materia Medica, though not found in commerce in this country. There are the *Strassburg turpentine*, much used in France, and obtained from the *Abies Picea* (*Abies pectinata* of De Candolle), or European silver fir, which grows on the mountains of Switzerland and Germany and bears a close resemblance, as well in its appearance as in its product, to *Abies balsamea* of Canada; the *Russian turpentine*, from *Pinus sylvestris*;[2] the

[1] The odor of Chian turpentine is variously described. As the only tests we now have of the purity of the drug are its physical characteristics, and of these the odor is the most important, we give the following description by Wm. Martindale. (*P. J.*, April, 1880.) Chian turpentine "has when fresh a distinctive odor, slightly like the pinaceous turpentines, but much more agreeable and aromatic, according to some resembling citron and jasmine; but there is always a background smell like that of mastic, which becomes more developed and distinct with age, when it has lost the more volatile portion, the essential oil. According to Pereira, the turpentine-like odor is combined with the odor of fennel, and Guibourt says, when kept in a covered glass vessel the odor is strong and agreeable, analogous to that of fennel or the resin of elemi. It probably loses this rapidly. A specimen, bearing Guibourt's name, in the Ph. Society's Museum, has now no trace of it, but the mastic odor is very persistent. If the fennel odor be very evident in it I should fear the sample was not genuine, as in a statement made in the *Lancet* the writer says what is sold as Chian turpentine 'is either greatly adulterated or a wholly factitious article, manufactured from black resin, Canada balsam, and the essential oils of fennel and juniper.' The taste of genuine Chian turpentine resembles that of mastic; it is agreeable and free from the characteristic bitterness and acridity of the pinaceous turpentines."

[2] For details as to the varieties of European turpentine and the methods of procuring them, consult *A. J. P.*, 1878, 69, 479; *Proc. A. Ph. A.*, xxiv. 203; *P. J.*, viii. 283; x. 447.

Bordeaux Turpentine.—Tschirch and Bruening find this oleoresin to have the following composition: 6 to 7 per cent. of *pimarinic acid*, $C_{14}H_{22}O_2$; 8 to 10 per cent. of *pimaric acid*, $C_{20}H_{30}O_2$; 48 to 50 per cent. of *alpha-* and *beta-pimarobic acids*, $C_{18}H_{26}O_2$; 5 to 6 per cent. of *bordoresin*, together with traces of *succinic acid*. The acid resins are soluble in sodium hydroxide solution, the pimarinic acid being separable from the other two by its property of forming with ammonium carbonate a water-soluble double salt. The volatile oil consists of two fractions, the larger fraction, amounting to about 85 per cent. of the whole, distilling easily. (*A. Pharm.*, 238, Nov. 10, 1900, 630.)

Finnan Turpentine, the oleoresin of *Pinus sylvestris*, is found by Tschirch and Niederstadt to consist of: 1.5 per cent. *silvolic acid*, $C_{14}H_{20}O_2$; 58 to 60 per cent. of *α-silvinolic acid*, $C_{15}H_{26}O_2$, and *β-silvinolic acid* ($C_{14}H_{24}O_2$); 20 to 21 per cent. of *resene*; 15 per cent. of volatile oil; and traces of bitter principle and succinic acid. Silveolic acid is crystalline; *α-* and *β*-silvinolic acids are both amorphous. The volatile oil has the sp. gr. 0.840 at 15° C., is soluble in all proportions in alcohol, ether, and chloroform, and is neutral when recently distilled, but becomes acid when exposed to the air. (*A. Pharm.*, 239, April 30, 1901, 167.) (Continued on next page.)

Damara turpentine, which speedily concretes into a very hard rosin, and is derived from *Pinus Damaris,* Lam., the *Agathis damara* of Richard, growing in the East India islands; the *cowrie* or *cowdie* resin, procured by incision from another species of Agathis, *A. australis,* in New Zealand; and the *Dombeya turpentine,* a glutinous, milky-looking fluid, of a strong odor and taste, derived from the *Araucaria Dombeyi* of Richard, also called *Dombeya excelsa,* which inhabits Chili.

Tschirch and Weigel (*A. Pharm.,* 1900, Aug. and Sept., 401, 411, 487) investigated Strassburg turpentine—the oleoresin of *Abies Picea;* it contains from 8 to 10 per cent. of an acid resin, *abieninic acid,* $C_{13}H_{20}O_2$; from 1.5 to 2 per cent. of a crystalline acid resin, *abietolic acid,* $C_{20}H_{28}O_2$; from 46 to 50 per cent. of two amorphous isomeric acid resins, *α-* and *β-abietinolic acid,* $C_{16}H_{24}O_2$; from 12 to 16 per cent. of a neutral resin, *abieto-resin;* and from 28 to 30 per cent. of volatile oil, together with traces of succinic acid, bitter principle, coloring matter, moisture and impurities. The oil when recently distilled has the sp. gr. 0.860, boiling between 148° and 165° C.; the major fraction distils between 162° and 163° C. It has a greenish fluorescence and a lemon-like odor. When the oleoresin is distilled with potassium hydroxide a pleasant rose or orange-flower odor is developed, possibly due to the liberation of a fragrant alcohol.

Properties.—The turpentines resemble one another in odor and taste, though distinguished by shades of difference. Liquid at first, they become thick and gradually solid by exposure, in consequence partly of the volatilization, partly of the oxidation of their essential oil. They are rendered more liquid or softened by heat, and at a high temperature take fire, burning with a white flame and much smoke. Water extracts only a minute proportion of their volatile oil. They are almost wholly soluble in alcohol and ether, and readily unite with the sylvestrene) of the formula $C_{10}H_{16}$, the residue consisting exclusively of rosin. (See *Oleum Terebinthinæ* and *Resina.*) Both the cones and leaves of *Abies Picea* yield oils known respectively as *pine cone oil* and *pine needle oil.* According to *Schimmel's Report* for April, 1897, they both contain pinene, limonene, and bornyl acetate. The oil from *Pinus sylvestris,* known as *fir oil,* also contains bornyl acetate to the amount of 12 per cent., according to *Schimmel's Report* for October, 1897, 47. On the other hand, the oil from *Larix Larix,* known as *larch needle oil,* contains 8.1 per cent. of bornyl acetate and 6.14 per cent. of free borneol. (*Ibid.,* 61.)

Schiff affirms that the odor of turpentine is due to the presence of a product of oxidation, probably a camphoric aldehyde, $C_{10}H_{16}O_3$, which, with the odor, may be removed by shaking the turpentine with sodium bisulphite. A non-odorless turpentine may also be obtained by washing with solution of sodium hydroxide and distilling in an atmosphere of carbon dioxide. From the experiments of Faure of Bordeaux, it appears that some of the liquid turpentines, like copaiba, may be solidified by the addition of magnesia. (*Journ. de Chim. Méd.,* 1830, 94.) According to Thierry, the same result is obtained by the addition of one part of calcium hydroxide to thirty-two parts of common European turpentine (*J. P. C.,* 3e sér., i. 315.) Crouzel (*P. J.,* 1892, 11) found tannin in the bark of *P. Pinaster,* associated with a peculiar reddish-yellow coloring matter, representing tannin in the process of formation.

Ed. Hirschsohn made experiments with the object of determining a reliable method for distinguishing artificial turpentine from the common, natural turpentine and larch turpentine, this becomes possible by the difference in the solvent effect of official ammonia water and alcohol, sp. gr. 0.863 at 15.6° C. (60° F.), upon them, under the conditions indicated in the following table:

Kind of Turpentine.	Ammonia Solution (sp. gr. 0.960), 1 p. turpentine and 5 p. ammonia solution.	Alcohol (sp. gr. 0.863), 1 p. turpentine and 3 p. alcohol.
Venice turpentine	Is not disintegrated; produces a milky fluid in the water-bath.	Yields a nearly clear solution.
Common turpentine	Easily disintegrated, forming a milky mixture, then gelatinous; becomes clear in the water-bath.	Large quantities are deposited, but the mixture becomes clear in the water-bath.
Artificial turpentine	Is disintegrated, becomes clear in the water-bath for a moment, then turbid.	Turbid solution and precipitation; turbid in the water-bath with precipitation.

fixed oils. They yield by distillation a volatile oil, called *oil of turpentine,* the composition of which is essentially uniform, it being composed of several terpenes (pinene, dipentene, and

A mixture of common turpentine with larch (Venice) turpentine is recognized by the turbidity of, and precipitate from, the solution of 1 Gm. of the sample in 3 Gm. of alcohol sp. gr. 0.863. The same occurs if the common is replaced by artificial turpentine, but the latter

Jura Turpentine.—A. Tschirch and E. Bruening have determined the following constituents of the oleoresin of *Picea vulgaris:* From 2 to 3 per cent. of *picea-pimarinic acid,* $C_{18}H_{20}O_2$; from 1.5 to 2 per cent. of *picea-pimaric acid,* $C_{20}H_{30}O_2$; from 48 to 50 per cent. of *α- and β-picea-pimarolic acid,* $C_{25}H_{44}O_2$; from 32 to 33 per cent. of volatile oil; from 10 to 12 per cent. of resene. $C_{21}H_{36}O$; and traces of succinic acid, coloring matter and bitter principle. (*A. Pharm.,* 238, Nov. 10, 1900, 616.)

is differentiated by ammonia, from the fact that in the presence of 20 to 30 per cent. of common turpentine the sample is easily disintegrated, and the solution becomes clear in the water bath, while in the presence of artificial turpentine the behavior is the same as with the pure Venice turpentine. (*Ph. Centralh.*, Nov. 26, 1903, 825 to 828.)

Uses.—The physiological activities of turpentines depend upon their volatile oils. They are so inconvenient of administration, and so variable in their activity that at present they are very rarely, if ever, used by regular practitioners of medicine. For an account of their physiological and therapeutic properties see *Oleum Terebinthinæ*, p. 877. If given at all they should be administered in emulsion. Chian turpentine has been strongly recommended as a specific in *cancer*, given in emulsion in doses of five grains (0.32 Gm.), increased *pro re nata*, and also applied locally. It is probably without value. Turpentine vapor baths have been found useful in the treatment of *chronic rheumatism;* they may be given by simply evaporating oil of turpentine in the ordinary cabinet or other vapor bath, or by driving the vapor through the fine branches and leaves of a terebinthinate plant. They probably differ in their action from the simple hot vapor bath by the stimulation of the skin due to the local action of the turpentine, and by the copious sweating which they produce. The bath should always be so arranged that the terebinthinate vapor is not inhaled by the patient.

Dose, twenty to thirty grains (1.3 to 2 Gm.).

Off. Prep.—*From Canada turpentine*, Collodium Flexile, *U. S.*, *Br.*

TERPINI HYDRAS. U. S.

TERPIN HYDRATE

(tẹr-pī′nī hȳ′drăs)

$C_{10}H_{20}O_2 + H_2O = 188.74$

"The hydrate [$C_{10}H_{18}(OH)_2 + H_2O$] of the diatomic alcohol terpin. Terpin Hydrate should be kept in well-stoppered bottles." *U. S.*

Terpine, *Fr. Cod.;* Dihydrate de Térébenthène, Hydrate de Terpilène, *Fr.;* Terpinum hydratum, *P. G.;* Terpinhydrat, *G.;* Terpina, *Sp.*

In making terpin hydrate a mixture of four parts of rectified oil of turpentine, three parts of alcohol (sp. gr. 0.863), and one part of nitric acid is put in large, shallow porcelain dishes and allowed to stand for three or four days. The crystals which have formed are then collected and allowed to drain thoroughly; they are then pressed between sheets of absorbent paper, and recrystallized in a cold solution of 95 per cent. of alcohol. The product is about 12 per cent. of the original turpentine oil. E. T. Hahn proposed the use of methyl alcohol (sp. gr. 0.801) in place of alcohol, in making terpin hydrate. (*A. J. P.*, 1897, 73.) Terpin hydrate is officially described as in "colorless, lustrous, rhombic prisms, nearly odorless, and having a slightly aromatic and somewhat bitter taste. Permanent in the air. Soluble in about 200 parts of water, and in 10 parts of alcohol at 25° C. (77° F.); in 32 parts of boiling water, and in 2 parts of boiling alcohol; also soluble in about 100 parts of ether, 200 parts of chloroform, or 1 part of boiling glacial acetic acid. Terpin Hydrate melts when quickly heated at 116° to 117° C. (240.8° to 242.6° F.), with the loss of water, and, at the temperature of boiling water, sublimes in fine needles. When heated in a flask adapted for distillation, it first loses water. At 258° C. (496.4° F.) anhydrous terpin distils over without decomposition, soon solidifying to a crystalline, hygroscopic mass, which melts at 102° to 105° C. (215.6° to 221° F.). When strongly heated on platinum foil, it burns with a bright, smoky flame, leaving no residue. If to its hot, aqueous solution a few drops of sulphuric acid be added, the liquid will become turbid and develop a strongly aromatic odor. Terpin Hydrate should not have the odor of turpentine, and its hot, aqueous solution should not redden blue litmus paper." *U. S.* The anhydrous *terpin* $C_{10}H_{18}(OH)_2$, obtained from it by the loss of water has the characters of a glycol. Dipentene dihydrochloride is its hydrochloric acid ether. By the loss of water the terpin then becomes *terpineol*, $C_{10}H_{17}(OH)$, and finally yields dipentene, terpinene, or terpinolene, according to the conditions of its treatment. Bouchardat and Voiry obtained terpineol in crystals which melt at 35° C. and remain in superfusion for long periods. (*Ann. Ch. Ph.*, 1893, 103.) For Wallach's researches on crystallized terpineol, see *P. J.*, 1893, 2.

L. Krentmann states that good results are obtained by replacing the alcohol in the process with hydrogen dioxide solution and subjecting the mixture poured into shallow dishes to light and air. The temperature should be carefully regulated so that the range will be between 15° and 20° C.

Uses.—Terpin was first physiologically investigated by Lépine, in 1855, who found it to act both upon the mucous membranes and upon the nervous system in a manner similar to the oil of turpentine. It has since been used in *chronic bronchitis* and in the advanced stages of *acute bronchitis*, especially when the secretion is unusually free; also in *chronic cystitis* and *gonorrhœa.*

Dose, two to three grains (0.13 to 0.2 Gm.), from four to six times a day, in pill or in emulsion.

THYMOL. U. S., Br.

THYMOL

(thȳ′mŏl)

$C_{10}H_{14}O = 148.98$

"A phenol [$C_6H_3(CH_3)(OH)(C_3H_7)$ 1:3:4] occurring in the volatile oil of *Thymus vulgaris*

Linné, and in some other volatile oils. It should be kept in well-stoppered bottles." *U. S.* "A crystalline substance, $C_6H_3.OH.CH_3.C_3H_7$, obtained from the volatile oils of Thymus vulgaris, *Linn.*, Monarda punctata, *Linn.*, and Carum copticum, *Benth. and Hook. f.*, purified by recrystallization from alcohol." *Br.*

Acidum Thymicum; Thymic Acid; Thymol, Acide Thymique, *Fr. Cod.*; Thymolum, *P. G.*; Thymol, Thymiansaure, Thymolkampher, *G.*; Timolo, *It.*; Timol, *Sp.*

This substance has attracted considerable attention from its possession of antiseptic properties analogous to those of phenol, salicylic acid and creosote, with which it is also analogous in composition. It may be obtained by submitting the volatile oils of several plants to a prolonged refrigeration, under the influence of which it crystallizes. Thus, it has been obtained from *Monarda didyma*, Linn., *M. punctata* and *Ptychotis coptica* (L.), Lyons (*Ammi copticum*, L., *P. Ajowan*, DC.). *Ocimum viride*, Willd., a plant which is used in Liberia as an antiperiodic, and is said to be especially valuable owing to the fact that when growing in a room it will drive mosquitoes out of the apartment, as well as the medicinally active *O. gratissimum* of India, probably depend for their activities upon thymol. (*Proc. A. Ph. A.*, xxvi. 168.) Thymol is obtained from the oils of thyme by distilling off from these the larger part of the hydrocarbons and adding warm sodium hydroxide solution to the residue, which combines with the thymol. The mixture is diluted after a time with hot water, which causes the unattacked oil to rise to the top. From the sodium hydroxide solution hydrochloric acid sets the thymol free. This collects as an oily layer, which on cooling will crystallize if a crystal of thymol is added.

Properties.—Thymol melts at 44° C. (111.2° F.), but does not readily resolidify unless touched by a solid body or by a crystal of thymol. It boils at 220° to 230° C. (428° to 446° F.). It is very slightly soluble in water, but is very soluble in alcohol, and more freely in proportion to the concentration of the menstruum. It is dissolved by ether and the fixed oils, and has no rotatory power as regards polarized light. The alkalies unite with it to form soluble salts. Like creosote, it has the property of combining with animal tissues and thus protecting them against putrefaction. Its formula is $C_{10}H_{14}O$, or $C_6H_3\begin{cases}OH\\CH_3\\C_3H_7\end{cases}$; while *thymene*, with which it is associated in the oil, is a hydrocarbon, isomeric with the oil of turpentine, and having the composition $C_{10}H_{16}$. As its formula indicates, it is a *propyl-cresol;* and it has been made synthetically by Widmann from cuminol (isopropyl benzaldehyde). This is first nitrated, then by means of phosphorus pentachloride the oxygen of the aldehyde group replaced by chlorine, the nitro group reduced, the chlorine replaced by hydrogen, and the amide group replaced by hydroxyl. The successive changes are thus indicated:

$$C_6H_4\begin{cases}C_3H_7\\COH\end{cases} \text{ to } C_6H_3\begin{cases}NO_2\\C_3H_7\\COH\end{cases}$$

$$C_6H_3\begin{cases}NO_2\\C_3H_7\\CHCl_2\end{cases} \text{ to } C_6H_3\begin{cases}NH_2\\C_3H_7\\CHCl_2\end{cases}$$

$$C_6H_3\begin{cases}NH_2\\C_3H_7\\CH_3\end{cases} \text{ to } C_6H_3\begin{cases}OH\\C_3H_7\\CH_3\end{cases}$$

A process has been patented by M. Dinesman for making *synthetic thymol* from *p* cymol (see *Ph. Centralh.*, Oct. 1901, 650).

Thymol is described in the U. S. P. (8th Rev.) as in "large, colorless, translucent rhombic prisms, having an aromatic, thyme-like odor, and a pungent, aromatic taste, with a very slight caustic effect upon the lips. Its specific gravity as a solid is 1.030 at 25° C. (77° F.), but when liquefied by fusion it is lighter than water. It melts at 50° to 51° C. (122° to 123.8° F.), remaining liquid at considerably lower temperatures. When triturated with about equal quantities of camphor, menthol, or hydrated chloral, it liquefies. Soluble in about 1100 parts of water at 25° C. (77° F.), and in less than its own weight of alcohol, ether, or chloroform; soluble in glacial acetic acid and fixed and volatile oils. Its alcoholic solution is optically inactive. If a very small crystal of Thymol be dissolved in 1 Cc. of glacial acetic acid, and then 6 drops of sulphuric acid and 1 drop of nitric acid be added, the liquid will assume by reflected light a deep bluish-green color. If 1 Gm. of Thymol be heated in a test-tube, in a water-bath, with 5 Cc. of a 10 per-cent. solution of sodium hydroxide, a clear, colorless, or very slightly reddish solution should be formed, which becomes darker on standing, but without the separation of oily drops. If to this solution a few drops of chloroform be added and the mixture agitated, a violet color will be produced. An alcoholic solution of Thymol should not be colored by ferric chloride T.S. When a crystal of Thymol is heated in an open dish, or in a watch-glass, on a water-bath, it should gradually volatilize, leaving no residue (absence of *inorganic impurities*)." *U. S.* "The crystals sink in cold water, but on heating the mixture to a temperature of 110° to 125° F. (43.3° to 51.7° C.) they melt and rise to the surface. Almost insoluble in cold *water*, freely soluble in *alcohol* (90 per cent.), *ether*, and solutions of alkalies. The crystals volatilize completely at the temperature of a water-bath. A solution of Thymol in half its bulk of *glacial acetic acid*, warmed with an equal volume of *sulphuric acid*, assumes a reddish-violet color." *Br.*

Uses.—Thymol is similar in its physiological and general therapeutic action to phenol, as a substitute for which it was proposed by Bouillon on account of its pleasant odor. In a concentrated state it has caustic properties,

which render it very useful for the cauterization of the dental nerves. Dissolved in water in the proportion of 1 to 1000, with the addition of a little alcohol, it is useful in the dressing of *unhealthy wounds.* Combined in the proportion of 4 parts of thymol with 4 of tannin, 2 of aniline, and 100 of glycerin, it has been used with great success by Paquet for the preservation of anatomical specimens. For the dressing of wounds, it may be used in the form of a lotion composed of 1 part of thymol, 4 parts of alcohol of 85°, and 995 parts of distilled water. In the form of ointment, it may be employed incorporated with lard in the proportion of from two to twenty grains to an ounce. At first much used by surgeons, it has been found disadvantageous. Its fragrant odor, while fitting it for use about the mouth, is often a great nuisance in the hospital ward, on account of attracting flies. It has been exhibited internally as an antipyretic by Balz in the amount of thirty grains (1.95 Gm.) a day, causing ringing in the ears, deafness, sweating, and in some cases alarming collapse. F. P. Henry has found it a useful intestinal antiseptic, especially valuable in *catarrh of the intestines,* given in doses of two and a half grains (0.162 Gm.) every six hours, in pill or capsule. Thymol has, however, failed to come into use as an internal remedy save as a vermicide; originally proposed by Neuma Campi as a tænicide; it has been shown by Federici, Sandwith and other clinicians to be the most effective known remedy against the ankylostoma. Sandwith gives it in thirty-grain doses, repeated in twenty-four hours, the result being the destruction of the parasites, but attended with great giddiness, lowering of the temperature from 1° to 2° C., slowing of the pulse and respiration, staggering, and sometimes even collapse.

Dose, two to ten grains (0.13 to 0.65 Gm.).

Off. Prep.—Cataplasma Kaolini, *U. S.;* Liquor Antisepticus, *U. S.*

THYMOLIS IODIDUM. U. S.

THYMOL IODIDE

(thȳ-mō′lĭs ī-ōd′ĭ-dŭm)

$C_{20}H_{24}O_2I_2 = 545.76$

"Dithymol-diiodide [$(C_6H_2.CH_3.C_3H_7.OI)_2$], obtained by the condensation of two molecules of thymol and the introduction of two atoms of iodine into the phenolic groups of the thymol; it contains 45 percent. of iodine. Thymol Iodide should be kept in amber-colored vials, protected from the light." *U. S.*

Dithymoldiiodide; Aristol; Aristolum; Diiododithymol, *Fr. Cod.;* Dithymol Biiodé, *Fr.;* Dithymoljodid, Aristol, Annidalin, Thymotol, *G.;* Aristol, *Sp.*

Preparation.—Thymol iodide contains about 45 per cent. of iodine; it is the product of the condensation of two molecules of thymol and the substitution of the hydrogen in the hydroxyl group in each by iodine. It may be prepared by decomposing a solution of iodine in potassium iodide by an alcoholic solution of thymol. For process, see *A. J. P.,* 1891, 175; *Proc. A. Ph. A.,* 1891, 572; *Bull. Pharm.,* 1891, 260. The Cincinnati Academy of Pharmacy published the following formula for thymol iodide: Thymol, 50 Gm.; potassium iodide, 58 Gm.; sodium hydroxide, 50 Gm.; solution of chlorinated soda, water, of each a sufficient quantity. Dissolve the solids in the solution with sufficient water to make 500 Cc. Collect the precipitate on a filter and wash it with water until it is free from chlorides. Remove the precipitate and dry it carefully at a temperature not exceeding 20° C. Reduce it to powder and keep it in a well-stoppered dark bottle. (*Am. Drug.,* 1898, 130.) The French Codex directs that two solutions be made, one by dissolving 16 Gm. of sodium hydroxide and 15 Gm. of thymol in sufficient water to make the solution measure 300 Cc. The other solution is made by dissolving 60 Gm. of iodine and 80 Gm. of potassium iodide in enough water to make the solution measure 300 Cc., the latter solution is added gradually to the alkaline solution of thymol with constant stirring; the resulting brown precipitate is washed with water and the product dried between 40° C. and 50° C.

Properties.—Thymol Iodide occurs as "a bright, chocolate-colored, or reddish-yellow, bulky powder, with a very slight aromatic odor. Insoluble in water and glycerin; slightly soluble in alcohol at 25° C. (77° F.); readily soluble in ether, chloroform, collodion, and in fixed and volatile oils, leaving a slight residue." *U. S.* The ethereal solution is precipitated by alcohol; when heated to the melting point it undergoes decomposition. The U. S. requires that it should answer to the following tests. "It is not soluble in solution of sodium hydroxide, either cold or warm. When heated with concentrated sulphuric acid, it is decomposed with the separation of iodine. If 0.5 Gm. be shaken with 10 Cc. of water, the mixture, on filtering, will yield a filtrate which should not become more than opalescent on the addition of nitric acid and silver nitrate T.S. (absence of *iodides*). If 0.5 Gm. be shaken with 10 Cc. of water, and the mixture filtered, no blue color should be imparted by the filtrate to red litmus paper (absence of *alkalies*). If 0.5 Gm. be shaken with 10 Cc. of water, and the mixture filtered, the filtrate should not be colored blue upon the addition of starch T.S. (absence of *free iodine*). If 0.1 Gm. of Thymol Iodide be thoroughly ignited in a porcelain crucible, it should leave not more than 0.003 Gm. of residue (limit of *ash*)." *U. S.*

Uses.—Eichhoff first stated that thymol iodide is a non-toxic and non-irritant application, having similar local properties to iodoform, and useful in the treatment of superficial *ulcerations, eczema, psoriasis,* and various other *skin affections.* The non-poisonous properties of it have been confirmed by Neisser, Quinquaud, and Fournioux. The mode of its elimination from the system has not been thor-

oughly worked out, but it appears to be partially decomposed, as iodine has been found in the urine after its ingestion. Neisser found that the powder has no effect upon the lower organisms, although its ethereal solution is germicidal, probably through decomposition of the thymol iodide and the liberation of iodic compounds as occurs with iodoform. It may be used as a substitute for iodoform, but the general trend of the reports is that it is not equal in antiseptic surgery to iodoform. It is, however, considerably used, especially in affections of the membranes of the nose and larynx. It has been employed by suppository[1] in chronic *dysentery*, three grains (0.2 Gm.) three times a day, with alleged excellent results.

Dose, from two to three grains (0.13 to 0.2 Gm.).

TINCTURA ACONITI. U. S., Br.

TINCTURE OF ACONITE

(tĭnc-tū'ra ăc-o-nī'tī)

"NOTE.—The strength of this Tincture has been reduced from 35 Gm. of Aconite in 100 Cc. (Pharm. 1890) to 10 Gm. of Aconite in 100 Cc." *U. S.*

Tinctura Aconiti Radicis, *U. S.* 1870; Tincture of Aconite Root; Teinture de racine d'Aconit, *Fr. Cod.*; Tinctura Aconiti, *P. G.*; Akonittinktur, Eisenhuttinktur, *G.*; Tintura di aconito, *It.*; Tintura alcoholica de aconito, *Sp.*

"Aconite, in No. 60 powder (containing not less than 0.5 percent. of aconitine), *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix Alcohol and Water in the proportion of *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of Alcohol to *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water. Moisten the Aconite with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, gradually adding menstruum until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] are obtained. Tincture of Aconite, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.045 Gm. of aconitine." *U. S.*

Assay. U. S. (8th Rev.)—"Transfer 100 Cc. of Tincture of Aconite to an evaporating dish and evaporate it carefully to dryness at a temperature not exceeding 60° C. (140° F.), and assay the resulting extract by the method given under *Fluidextractum Aconiti*, page 526, using the same details as there directed for 10 Cc. of Fluidextract of Aconite, with the exception that the multiplication of the product by 10 must be omitted; the result will represent the weight in grammes of aconitine contained in *one hundred cubic centimeters* of Tincture of Aconite." *U. S.*

"Aconite Root, in No. 40 powder, 1 *ounce* (Imperial) or 50 grammes; Alcohol (70 per cent.), *a sufficient quantity*. Moisten the powder with *four fluid drachms* (Imp. meas.) or twenty-five cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres. This preparation is made with two-fifths the proportion of Aconite Root ordered for the Tincture of Aconite of the British Pharmacopœia of 1885." *Br.*

The old tincture of the U. S. Pharmacopœia 1890 had seven times the strength of the British, and the title was changed from *Tinctura Aconiti Radicis* to *Tinctura Aconiti* in the U. S. 1880 revision. It was much stronger than the Tincture of Aconite Leaves, which is still used occasionally, and made of the strength of two troyounces of powdered aconite leaves in a pint of diluted alcohol, and too much caution cannot be observed to avoid mistaking one tincture for the other. A very important change was made in the strength of Tincture of Aconite in the U. S. P. (8th Rev.), see page 1252. The former 35 per cent. tincture is now replaced by a tincture of 10 per cent. An assay process was also appended (see above). In preparing it, each step of the process must be carefully attended to. The root should be thoroughly comminuted, and very carefully packed in the percolator, and the displacing menstruum very gradually added. Tartaric acid which was formerly used in accordance with the researches of Duquesnel in the U. S. 1880 tincture has been abandoned, as it was found to be unnecessary. For a paper on Tincture of Aconite by M. I. Wilbert see *Proc. A. Ph. A.*, 1902, 348. The external use of the tincture requires care, as serious symptoms have followed its too free employment. (Case, *B. M. S. J.*, Feb. 1872, 74.)[1]

[1] *Aristol Ointments.*—Osseward, *Proc. A. Ph. A.*, 1901, 176, obviates the difficulty of obtaining smooth ointments of aristol (which most dispensers have experienced when proceeding in the usual way) by adding sufficient ether to 1 oz. of aristol placed in a dry mortar, to form a paste, then stirring in 1 oz. of olive oil until a smooth paste is obtained; the ether can be dissipated during the stirring, and this 50 per cent. mixture used in making ointments by incorporating with fatty substances.

[1] *Fleming's Tincture of Aconite.*—This should always be expressly designated when prescribed. It is considerably stronger than the official; and several deaths have occurred from the use of it. The following is Fleming's formula: Take of the root, carefully dried and finely powdered, *sixteen (troy) ounces;* Alcohol, *sixteen fluidounces*. Macerate for four days, put into a percolator, and add alcohol until twenty-four fluidounces are obtained. Not more than two drops of this should be given as a commencing dose, to be increased till its peculiar effects are experienced.

Dose, of the U. S. tincture, three to ten minims (0.2 to 0.6 Cc.); of the Br. tincture, five to fifteen minims (0.3 to 0.9 Cc.).

TINCTURA ALOES. U. S., Br.

TINCTURE OF ALOES

(tĭnc-tū′rą ăl′ō-ēs)

Teinture (alcoolé) d'Aloés, *Fr. Cod.;* Tinctura Aloës, *P. G.;* Aloetinktur, *G.;* Tinctura alcoholica de acibar, *Sp.*

* "Purified Aloes, in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Glycyrrhiza, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Purified Aloes and Glycyrrhiza in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Diluted Alcohol, for seven days, with occasional agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough Diluted Alcohol through the residue to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Extract of Barbados Aloes, ½ *ounce* (Imperial) or 25 grammes; Liquid Extract of Liquorice, 3 *fl. ounces* (Imp. meas.) or 150 cubic centimetres; Alcohol (45 per cent.), *a sufficient quantity.* Place the Extract of Barbados Aloes in a closed vessel with *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres of the Alcohol; set aside for forty-eight hours, occasionally shaking until dissolved; add the Liquid Extract of Liquorice; filter; pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

The original tincture of aloes of the U. S. Pharmacopœia was prepared with the official diluted alcohol, without the addition of water. The preparation of the U. S. P. 1870 was little more than an infusion, with the addition of sufficient alcohol to prevent spontaneous decomposition. The process of the Br. Pharm. 1898 shows a marked improvement on the former British tincture. Barbados aloes replaces Socotrine, liquid extract of liquorice is used instead of the solid extract, and the time for making the tincture is reduced from a week to two days. The strength of the British tincture is only one-fourth that of the U. S. tincture. The formula of the U. S. (8th Rev.) directs glycyrrhiza instead of extract of licorice, but has returned to the process of maceration for its preparation. Ménière says of the tincture of aloes that it deposits crystals of aloin, which adhere to the sides of the bottle, and in the upper part of it a yellow resinous matter is seen. (*J. P. C.,* 1861, 289.)

Dose, as a purgative, from two to four fluidrachms (7.5 to 15 Cc.); as a laxative, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA ALOES ET MYRRHÆ. U.S.

TINCTURE OF ALOES AND MYRRH

(tĭnc-tū′rą ăl′ō-ēs ĕt mŭr′rhæ)

Tinctura Aloes Composita, *Lond.;* Elixir Proprietatis Paracelsi; Elixir de Propriété, *Fr.;* Aloëelixir, *G.*

* "Purified Aloes, in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Myrrh, in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Glycyrrhiza, in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Macerate the Purified Aloes, Myrrh, and Glycyrrhiza in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the menstruum, for seven days, with occasional agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pass enough menstruum through the residue to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture has been improved by the addition of glycyrrhiza, which not only communicates an agreeable taste and obtunds the bitterness of the aloes, but also permits the use of percolation. The tincture is a modification of the *elixir proprietatis* of Paracelsus. It is practically identical with the tincture official in 1870. Saffron, which had long been retained in compliance with old time prejudices, can add little to the efficacy of a preparation, and, being very expensive, was with great propriety omitted in the 1870 revision. It served, however, to impart a rich color to the tincture, the want of which some may consider a defect. In the U. S. P. (8th Rev.) the maceration process has been directed instead of percolation as in the U. S. P. 1890. The tincture is purgative, tonic, and emmenagogue, and is considerably employed in *chlorosis* and *amenorrhœa* when there is constipation.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA ARNICÆ. U. S., Br.

TINCTURE OF ARNICA [Tinctura Arnicæ Florum, Pharm. 1890]

(tĭnc-tū′rą är′nĭ-çæ)

Tincture of Arnica Flowers, U. S. P. 1890; Teinture (alcoolé) de Fleur d'Arnica, Teinture d'Arnica, *Fr. Cod.;* Tinctura Arnicae, *P. G.;* Arnikatinktur, *G.;* Tintura di Arnica, *It.;* Tintura alcoholica de arnica, *Sp.*

* "Arnica, in No. 20 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one*

thousand cubic centimeters [or 33 fluidounces, 6½ fluidrachms]. Macerate the Arnica with five *hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Diluted Alcohol in a closed vessel, in a moderately warm place, for three days, with occasional stirring, and express strongly. Repeat this operation twice successively with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Diluted Alcohol, macerating for twenty-four hours each time; then, having ascertained the volume of the united expressed liquids, macerate the residual marc for six hours with sufficient menstruum to make approximately *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and express as before. Mix the expressed liquids, filter through paper, and pass sufficient Diluted Alcohol through the filter to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Arnica Rhizome, in No. 40 powder, 1 *ounce* (Imperial) or 50 grammes; Alcohol (70 per cent.), *a sufficient quantity*. Moisten the powder with *one fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br. Tincture of Arnica Root* formerly official in the U. S. P. 1890 was made by percolating 100 Gm. of powdered arnica root with a mixture of alcohol 65 and water 35 until 1000 Cc. of finished tincture was obtained.

The British tincture has about one-half the strength of the U. S. P. 1890 tincture of arnica root.

Care must be used to distinguish between these tinctures which now have the same names in both Pharmacopœias. The name of the U. S. P. (8th Rev.) tincture is no longer tincture of arnica flowers but tincture of arnica. The British tincture is made from the rhizome or root and is very different from the U. S. P. tincture of the flowers; in the U. S. P. 1890 there were two tinctures of arnica, one from the root, and one from the flowers, but the U. S. P. (8th Rev.) dropped tincture of arnica root and retained tincture of arnica flowers, changing its name however to tincture of arnica, this action makes it necessary to use care not to confuse the U. S. P. tincture of arnica made from the flowers, with the Br. tincture made from the root.

The U. S. P. (8th Rev.) tincture of arnica differs from that official in 1870 in the menstruum selected, which is now diluted alcohol in place of alcohol. The change was advocated by numerous pharmaceutical writers, and there is no question of the ability of the menstruum to exhaust the arnica flowers, if they are tightly packed in the percolator. The principal objection to the change is the greater difficulty that will be experienced in mixing the tincture with liniments containing oily and alcoholic liquids.

Either alone, or diluted with water, soap liniment, etc., tincture of arnica is often applied popularly to *bruises, sprains, tumors,* and local *rheumatic pains,* under the impression that it has extraordinary healing powers. It probably acts favorably in some instances as a general irritant. In some skins it produces a violent eczematous inflammation. If given internally, the *dose* would be from ten to thirty minims (0.6 to 1.8 Cc.), increased until some effect was produced.

Dose, of the British tincture of the rhizome, twenty minims to half a fluidrachm (1.3 to 1.8 Cc.).

TINCTURA ASAFŒTIDÆ. U.S., Br.

TINCTURE OF ASAFETIDA

(tĭnc-tū'ra ăs-a-fœt'i-dæ)

Teinture (alcoolé) d'Asa fœtida, *Fr. Cod.;* **Asanttinktur, Stinkasanttinktur,** *G.;* **Tintura alcoholica de asafetida,** *Sp.*

* "Asafetida, well bruised, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Asafetida in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol, during three days, with frequent agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pass enough Alcohol through the residue to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Asafetida, bruised, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Place the Asafetida in a closed vessel with *fifteen fluid ounces* (Imp. meas.) or seven hundred and fifty cubic centimetres of the Alcohol; set aside for seven days, with occasional agitation; filter; pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

The British tincture (1898) was increased in strength 60 per cent., and is now identical with the U. S. P. preparation. This tincture becomes milky on the addition of water, in consequence of the separation of the resin. It is somewhat stronger than the tincture official in 1870, which is an improvement, particularly in view of the gradual decline in the quality of the drug.

Dose, thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

TINCTURA AURANTII AMARI. U.S. (Br.)

TINCTURE OF BITTER ORANGE PEEL

(tĭnc-tū'ra âu-răn'tī-ī a-mā'rī)

Tinctura Aurantii, *Br.;* **Tincture of Orange; Teinture (alcoolé) d'Ecorce d'Orange amère,** *Fr.;* **Tinctura Aurantii,** *P. G.;* **Pomeranzentinktur, Pomeranzenschalentinktur,** *G.*

* "Bitter Orange Peel, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24

grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Moisten the Bitter Orange Peel with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Fresh Bitter Orange Peel, cut small, 5 *ounces* (Imperial) or 250 grammes; Alcohol (90 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

It is the peel of the Seville orange that is directed in this process, and the outer part only is active. The substitution of fresh for dried orange peel was proposed in England, and its propriety considerably discussed. (See *P. J.,* Nov. 9, 1872, also April 4, 1874.) Indeed, it met with so much favor as to be introduced in the 1885 revision of the British Pharmacopœia, and was used in the *Tinctura Aurantii Recentis, Br.;* but in the Br. Pharm. 1898 the name was changed to *Tinctura Aurantii.* It will be seen that the U. S. and British tinctures are not identical, the former having a greenish-brown color and containing some hesperidin or bitter principle. The U. S. Tincture of Sweet Orange Peel (see next article) closely resembles the British Tincture of Orange. The tincture from the fresh peel is less powerful as a bitter than this preparation, but is much superior in aroma and flavor. (See *Tinctura Aurantii Dulcis.*) The tincture of bitter orange peel is employed as a grateful addition to infusions, decoctions, and mixtures.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

Off. Prep.—Confectio Sulphuris, *Br.;* Syrupus Aromaticus, *Br.;* Syrupus Aurantii, *Br.;* Syrupus Cascaræ Aromaticus, *Br.;* Tinctura Quininæ, *Br.;* Trochiscus Sulphuris, *Br.*

TINCTURA AURANTII DULCIS. U.S.

TINCTURE OF SWEET ORANGE PEEL

(tĭnc-tū'rą âu-răn'tī-ī dŭl'cĭs)

Teinture de Zeste d'Orange douce, *Fr.;* Apfelsinenschalentinktur, *G.*

* "Sweet Orange Peel, from the fresh fruit, in thin shavings and cut into narrow shreds, *five hundred grammes* [or 17 ounces av., 279 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Sweet Orange Peel in a stoppered wide-mouthed container and in a moderately warm place, with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Alcohol, during forty-eight hours, with frequent agitation; then filter through purified cotton, and, when the liquid has drained off completely, gradually pass enough menstruum through the residue to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture; finally, filter it through paper." *U. S.*

This tincture was introduced for the first time in the U. S. P. 1880, and was designed to furnish a highly flavored alcoholic preparation of orange. The official direction to *cut it into small pieces* was not definite enough if a successful percolation is desired, but the U. S. P. (8th Rev.) directs maceration and a large increase of strength, from 20 per cent. to 50 per cent. This tincture has no peculiar medicinal properties, but is used as a pleasant adjuvant and flavoring agent.

Off. Prep.—Syrupus Aurantii, *U. S.;* Vinum Ferri, *U. S.;* Vinum Ferri Amarum, *U. S.*

TINCTURA BELLADONNÆ FOLIORUM. U. S. (Br.)

TINCTURE OF BELLADONNA LEAVES

(tĭnc-tū'rą bĕl'lą-dŏn'næ fō-lī-ō'rŭm)

Tinctura Belladonnæ, *Br., U. S. P.* 1880; Tincture of Belladonna; Teinture de feuille de Belladone, *Fr. Cod.;* Belladonnatinktur, *G.;* Tintura alcoholica de belladonna, *Sp.*

* "Belladonna Leaves, in No. 60 powder (containing not less than 0.35 percent. of alkaloids), *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for three hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually pouring on Diluted Alcohol until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of percolate are obtained. Tincture of Belladonna Leaves, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.035 Gm. of the alkaloids from Belladonna Leaves." *U. S.*

Assay. U. S. (8th Rev.)—"Transfer 100 Cc. of Tincture of Belladonna Leaves to an evaporating dish and evaporate it on a water-bath until it measures about 10 Cc. Add, if

necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 528), using the same details as there directed for 10 Cc. of Fluidextract of Belladonna Root, with the exception that the multiplication of the product by 10 be omitted; the result will represent the weight in grammes of alkaloids contained in *one hundred cubic centimeters* of Tincture of Belladonna Leaves." *U. S.*

"Liquid Extract of Belladonna, 2 *fl. ounces* (Imperial measure) or 60 cubic centimetres; Alcohol (60 per cent.), *a sufficient quantity.* To the Liquid Extract of Belladonna add enough of the Alcohol to form *thirty fluid ounces* (Imp. meas.) or nine hundred cubic centimetres of the Tincture; set aside for twenty-four hours; filter. On evaporation to a low bulk, and subsequent treatment by the analytical process employed for 'Extractum Belladonnæ Liquidum,' 100 cubic centimetres of the Tincture should yield not less than 0.048 nor more than 0.052 gramme of alkaloid." *Br.*

In the U. S. P. 1890 the name of this tincture was changed to *Tinctura Belladonnæ Foliorum*, for the sake of greater precision. In the U. S. P. (8th Rev.) its strength was reduced about 33 per cent. The British tincture (1898) is made by diluting the assayed fluidextract of belladonna root, and is undoubtedly more uniform in composition than would be the unassayed tincture made from the leaves.

The U. S. tincture is an efficient preparation when made from the recently dried leaves and assayed by the official process.

Dose, of U. S. tincture, from ten to thirty minims (0.6 to 1.8 Cc.). That of the British tincture is from five to fifteen minims (0.3 to 0.9 Cc.).

TINCTURA BENZOINI. U. S.

TINCTURE OF BENZOIN

(tĭnc-tū'rą bĕn-zo-ī'nī)

Teinture (alcoolé) de Benjoin, *Fr. Cod.*; Tinctura Benzoës, *P. G.*; Benzoëtinktur, *G.*; Tintura di benzoino, *It.*; Tintura alcoholica de benjui, *Sp.*

* "Benzoin, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Benzoin with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Alcohol until a uniform magma is obtained. Transfer this to a stoppered container with the aid of *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, and set it aside in a moderately warm place, shaking frequently during three days. Then transfer the mixture to a paper filter, and, when the liquid has drained off completely, pour on enough Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture was introduced into the Pharmacopœia chiefly or solely for the purpose of adding to ointments to prevent rancidity.

Dose, twenty to thirty minims (1.3 to 1.8 Cc.).

TINCTURA BENZOINI COMPOSITA. U. S., Br.

COMPOUND TINCTURE OF BENZOIN

(tĭnc-tū'rą bĕn-zo-ī'nī cŏm-pŏs'ĭ-tą)

Tinctura Balsamica, Balsamum Commendatoris, Elixir Traumaticum; Teinture (alcoolé) balsamique, *Fr. Cod.*; Baume du Commandeur de Permes, *Fr.*; Persischer Wundbalsam, *G.*

* "Benzoin, in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Purified Aloes, in No. 40 powder, *twenty grammes* [or 309 grains]; Storax, *eighty grammes* [or 2 ounces av., 360 grains]; Balsam of Tolu, *forty grammes* [or 1 ounce av., 180 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Benzoin and Purified Aloes with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Alcohol until a uniform magma is obtained. Transfer this to a stoppered container with the aid of *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, add the Storax and Balsam of Tolu, and set the mixture aside in a moderately warm place, shaking it frequently during three days; then transfer it to a paper filter, and, when the liquid has drained off completely, pour on enough Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Benzoin, in coarse powder, 2 *ounces* (Imperial) or 100 grammes; Prepared Storax, 1½ *ounces* (Imp.) or 75 grammes; Balsam of Tolu, ½ *ounce* (Imp.) or 25 grammes; Socotrine Aloes, 160 *grains* or 18.3 grammes; Alcohol (90 per cent.), *a sufficient quantity*. Place the Benzoin, Storax, Balsam of Tolu, and Aloes with *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres of the Alcohol in a closed vessel, set aside for two days, frequently agitating; filter; pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

Compound tincture of benzoin now contains 10 per cent. of benzoin instead of 12 as in the U. S. P. 1890.

This tincture is a stimulating expectorant, occasionally used in *chronic catarrhal affections*. It has been recommended also in *chronic dysentery*, with a view to its alterative action on the ulcerated surface of the colon, but it is principally employed as a local application to *indolent ulcers, chapped nipples*, etc. It is the *balsamum traumaticum* of the older Pharmacopœias, and may be considered as a simplified form of certain complex compositions, such as *baume du commandeur, Wade's balsam, Friar's balsam, Jesuit's drops, Turlington's*

balsam,[1] etc., which were formerly in great repute, and are still esteemed by the people, as pectorals and vulneraries. The compound tincture of benzoin is decomposed by water. A variety of *court plaster* is made by applying to black silk, by means of a brush, first a solution of isinglass, and afterwards an alcoholic solution of benzoin.

Dose, from fifteen minims to one fluidrachm (0.9 to 3.75 Cc.).

TINCTURA BUCHU. Br.

TINCTURE OF BUCHU

(tĭnc-tū'rą bū'çhū)

Teinture (alcoolé) de Buchu, *Fr. Cod.;* Teinture de Bucco, *Fr.;* Buchutinktur, *G.*

"Buchu Leaves, in No. 20 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (60 per cent.), *a sufficient quantity*. Moisten the powder with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture was increased 60 per cent. in strength in the last revision of the Br. Pharm. It has the virtues of buchu leaves.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.), either simply diluted with water or as an addition to the infusion of the leaves.

TINCTURA CALENDULÆ. U. S.

TINCTURE OF CALENDULA

(tĭnc-tū'rą cą-lĕn'dŭ-læ)

Tincture of Marigold; Teinture de Souci, Teinture de Fleur de Tous-les-Mois, *Fr.;* Calendulatinktur, Ringelblumentinktur, *G.*

* "Calendula, in No. 20 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Calendula with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture was improved in the 1890 revision by substituting alcohol as a menstruum for the diluted alcohol used in the 1880 process. It is employed externally for the same purposes as tincture of arnica. When made with diluted alcohol, some precipitation takes place; alcohol is therefore preferable as a menstruum, and on account of the tincture being used externally makes it more efficient therapeutically. It is not used internally.

TINCTURA CALUMBÆ. U. S., Br.

TINCTURE OF CALUMBA

(tĭnc-tū'rą cą-lŭm'bæ)

Tinctura Colombo; Teinture (alcoolé) de Colombo, *Fr. Cod.;* Kolombotinktur, *G.;* Tintura alcoholica de colombo, *Sp.*

* "Calumba, in No. 20 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Moisten the Calumba with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for twenty-four hours; then pack it with moderate pressure, pour on enough menstruum to saturate the powder and leave a stratum above it, and allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Calumba Root, in No. 20 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (60 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

This tincture was doubled in strength at the U. S. P. (8th Rev.) in order to bring it into the class of 20 per cent. non-potent tinctures.

Joseph Ince recommends that the tincture be prepared from the root as found in commerce, without further slicing or powdering it. Made as he proposes, the tincture is clear and bright; while if the powdered root is used it will be very turbid, even after filtration. (*P. J.*, xiv. 491.) No. 20 powder is now directed instead of the No. 50 powder used in the U. S. P. 1870.[1] Tincture of calumba may be added to tonic infusions or decoctions,

[1] The following is the formula for *Turlington's balsam* adopted by the Philadelphia College of Pharmacy: "Take of Alcohol 8 pints, Benzoin 12 oz. troy, Liquid Storax 4 oz. troy, Socotrine Aloes 1 oz. troy, Peruvian Balsam 2 oz. troy, Myrrh 1 oz. troy, Angelica Root 240 gr., Balsam of Tolu 240 gr., Extract of Liquorice Root 4 oz. troy. Digest for ten days, and strain. (*A. J. P.*, v. 28.)

[1] *Tincture of Calumba.*—J. B. Moore recommends the following process: Calumba, in powder No. 20, 4 troy oz.; alcohol, 22 fl. oz.; glycerin and water, each 5½ fl. oz.; diluted alcohol, q. s. Mix the alcohol, glycerin, and water, moisten the powdered calumba with the mixture, pack in a close vessel, set aside to macerate for 6 hours; then pack in a glass funnel prepared for percolation, and gradually pour upon it the remainder of the menstruum, and, when this has passed from the surface, continue the percolation with the diluted alcohol until 32 fluidounces of tincture are obtained. (*D. C.*, May, 1877.)

to increase their stimulant power, but, like all the other bitter tinctures, should be used with caution.

Dose, one fluidrachm (3.75 Cc.).

TINCTURA CANNABIS INDICÆ. U. S., Br.

TINCTURE OF INDIAN CANNABIS

(tĭnc-tū'rą căn'ną-bĭs ĭn'dĭ-çæ)

Tinctura Cannabis, *Pharm.* 1870; Tincture of Hemp; Tincture of Indian Hemp; Teinture (alcoolé) de Chanvre de l'Inde, *Fr. Cod.;* Indischhanftinktur, *G.*

* "Indian Cannabis, in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Indian Cannabis with *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Extract of Indian Hemp, 1 *ounce* (Imperial) or 50 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Dissolve the Extract of Indian Hemp in *eighteen fluid ounces* (Imp. meas.) or nine hundred cubic centimetres of the Alcohol; filter if necessary; add sufficient of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

The American reader must take care not to confound the Indian Hemp here referred to with *Apocynum cannabinum,* known by the same name in this country. The term "Indian Hemp" should be dropped entirely, as its continued use has been the cause of at least one fatal mistake. The strength of the present tincture is about 33 per cent. less than that of the 1890 tincture.

Dose, fifteen to thirty minims (0.9 to 1.8 Cc.), or about fifty drops, to be gradually increased until some effects are experienced.

Off. Prep.—Tinctura Chloroformi et Morphinæ Composita, *Br.*

TINCTURA CANTHARIDIS. U. S., Br.

TINCTURE OF CANTHARIDES

(tĭnc-tū'rą cąn'thăr'ĭ-dĭs)

Tincture of Spanish Flies; Teinture (alcoolé) de Cantharide, *Fr. Cod.;* Tinctura Cantharidum, *P. G.;* Spanischfliegentinktur, *G.;* Tintura di cantaridi, *It.;* Tintura alcoholica de cantaridas, *Sp.*

* "Cantharides, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Cantharides with *thirty-five cubic centimeters* [or 1 fluidounce, 88 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it very firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Cantharides, in No. 40 powder, ¼ *ounce* (Imperial) or 12.5 grammes; Alcohol (90 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

An improvement was made in this tincture in the 1880 revision by substituting alcohol for diluted alcohol. It is frequently used in mixtures of castor oil and alcohol in the so-called hair tonics, and when made with diluted alcohol turbidity results. The official tincture is double the strength of that of the U. S. P. 1890. It is the most convenient form for the internal use of Spanish flies, the virtues of which it possesses to their full extent. (See *Cantharis.*) If made with diluted alcohol, when long kept it deposits fatty matter, cantharidin in rhomboidal tables, and other crystals of a quite different form. (Ménière, *J. P. C.,* Avril, 1861, p. 289.) It is occasionally employed externally as a rubefacient; but its liability to vesicate should be taken into consideration. The British tincture is too feeble, containing the virtues of only 0.68 of a grain of cantharides in a fluidrachm.

Dose, of the U. S. tincture, two to five minims (0.12 to 0.3 Cc.), repeated three or four times a day.

TINCTURA CAPSICI. U. S., Br.

TINCTURE OF CAPSICUM

(tĭnc-tū'rą căp'sĭ-cī)

Tincture of Cayenne Pepper; Teinture (alcoolé) de Piment des Jardins, *Fr.;* Tinctura capsici, *P. G.;* Spanischpfeffertinktur, *G.*

* "Capsicum, in No. 50 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims] of Alcohol with *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of Water. Moisten the Capsicum with *thirty-five cubic centimeters* [or 1 fluidounce, 88 minims] of the

menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Capsicum, in No. 20 powder, 1 *ounce* (Imperial) or 50 grammes; Alcohol (70 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

This tincture is double the strength of that of the U. S. P. 1890. The alcoholic strength of the menstruum is of unusual proportions, 19 volumes of alcohol to 1 volume of water, the reason for this is that on account of oleoresinous constituents of capsicum alcohol is required and on account of a small quantity of a constituent soluble in water and insoluble in alcohol a little water must be added to the menstruum to prevent cloudiness. It is a useful stimulant in *very low states of the system* with gastric insensibility, as in *malignant scarlet* and *typhus fevers,* and in the cases of drunkards. It may also be used, diluted with water, as a gargle. (See *Capsicum.*) Applied by means of a camel's-hair pencil to the *relaxed uvula,* it sometimes produces contraction and relieves prolapsus of that part.

Dose, five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Tinctura Chloroformi et Morphinæ Composita, *Br.*

TINCTURA CARDAMOMI. U. S.

TINCTURE OF CARDAMOM

(tĭnc-tū'rą cär-dą-mō'mī)

Teinture (alcoolé) de Cardamome, *Fr.;* Kardamomentinktur, *G.*

* "Cardamom, in No. 30 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Cardamom with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Diluted Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

The strength of this tincture was doubled in the U. S. P. (8th Rev.) in order to bring it into the 20 per cent. class; it is an agreeable but strong aromatic, and may be advantageously added to tonic and purgative infusions.

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA CARDAMOMI COMPOSITA. U. S., Br.

COMPOUND TINCTURE OF CARDAMOM

(tĭnc-tū'rą cär-dą-mō'mī cǫm-pŏs'ĭ-tą)

Teinture de Cardamome composée, *Fr.;* Zusammengesetzte Kardamomentinktur, *G.*

* "Cardamom, *twenty-five grammes* [or 386 grains]; Saigon Cinnamon, *twenty-five grammes* [or 386 grains]; Caraway, *twelve grammes* [or 185 grains]; Cochineal, *five grammes* [or 77 grains]; Glycerin, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred and fifty cubic centimeters* [or 32 fluidounces, 59 minims] of Diluted Alcohol. Reduce the Cardamom, Saigon Cinnamon, Caraway and Cochineal to a No. 40 powder, and macerate this powder in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the menstruum during seven days, with occasional agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pour on the residue, first the remainder of the menstruum, and then sufficient Diluted Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Cardamom Seeds, bruised, ¼ *ounce* (Imperial) or 12.5 grammes; Caraway Fruit, bruised, ¼ *ounce* (Imp.) or 12.5 grammes; Raisins of commerce, freed from seeds, 2 *ounces* (Imp.) or 100 grammes; Cinnamon Bark, bruised, ½ *ounce* (Imp.) or 25 grammes; Cochineal, in powder, 55 *grains* or 6.3 grammes; Alcohol (60 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

The proportion of cardamom, cinnamon and caraway in the U. S. P. (8th Rev.) was increased to 25, 25, and 12 Gm. respectively; the U. S. P. 1890 proportion being 20, 20, and 10.

This is a very agreeable aromatic tincture, occasionally used as a carminative, but more frequently as an addition to mixtures, infusions, etc., which it renders pleasant to the taste and acceptable to the stomach. The substitution of honey in the U. S. formula of 1870 for the raisins in that of 1850 was an improvement, as it facilitated the process and gave more precision to the result; but a still greater improvement was made in the process of 1880

in the substitution of glycerin, which increases the stability of the preparation and takes the place of honey which is usually found adulterated in commerce.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

Off. Prep.—Decoctum Aloes Compositum, *Br.;* Mistura Sennæ Composita, *Br.*

TINCTURA CASCARILLÆ. Br.

TINCTURE OF CASCARILLA

(tĭnc-tū'rą kăs-cą-rĭl'læ)

Teinture (alcoolé) de Cascarille, *Fr. Cod.;* Kaskarilltinktur, *G.*

"Cascarilla, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Moisten the powder with *three fluid ounces* (Imp. meas.) or one hundred and fifty cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture has the properties of cascarilla, but is seldom if ever used in this country.

Dose, from thirty minims to two fluidrachms (1.8 to 7.5 Cc.).

TINCTURA CHIRATÆ. Br.

TINCTURE OF CHIRATA

(tĭnc-tū'rą çhį-rā'tæ)

Tincture of Chiretta; Teinture (alcoolé) de Chirette, *Fr.;* Chirettatinktur, *G.*

"Chiretta, in No. 40 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This is a tonic tincture which was introduced for the first time by the U. S. P. 1880, but which even before then had been largely used in some sections of our country. It was dismissed by the U. S. P. (8th Rev.). The British tincture (1898) was decreased in strength 20 per cent., and is now uniform with the U. S. 1890 tincture.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.), three or four times a day.

TINCTURA CHLOROFORMI ET MORPHINÆ COMPOSITA. Br.

COMPOUND TINCTURE OF CHLOROFORM AND MORPHINE

(tĭnc-tū'rą çhlō-rǫ-fŏr'mī ĕt mör-phī'næ cǫm-pŏş'į-tą)

"Chloroform, 1½ *fl. ounces* (Imperial measure) or 75 cubic centimetres; Morphine Hydrochloride, 87½ *grains* or 10 grammes; Diluted Hydrocyanic Acid, 1 *fl. ounce* (Imp. meas.) or 50 cubic centimetres; Tincture of Capsicum, ½ *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Tincture of Indian Hemp, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Oil of Peppermint, 14 *minims* or 1.5 cubic centimetres; Glycerin, 5 *fl. ounces* (Imp. meas.) or 250 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Chloroform, Tincture of Capsicum, Tincture of Indian Hemp, Oil of Peppermint, and Glycerin with *nine fluid ounces* (Imp. meas.) or four hundred and fifty cubic centimetres of the Alcohol, and dissolve the Morphine Hydrochloride in the mixture; add the Diluted Hydrocyanic Acid; then mix with enough of the Alcohol to form *one pint* (Imp. meas.) or one thousand cubic centimetres of the Compound Tincture. This preparation contains in a ten-minim dose ¾ minim of Chloroform, ½ minim of Diluted Hydrocyanic Acid, and 1-11th grain of Morphine Hydrochloride,—that is, more than four times the proportion of Morphine Hydrochloride present in the corresponding preparation of the British Pharmacopœia of 1885." *Br.*

This is the official substitute for chlorodyne, the well-known British nostrum. It not only differs in strength (see above) from the preparation formerly official, but is now transparent.[1] (See also *Chlorodyne,* p. 332.)

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

TINCTURA CIMICIFUGÆ. U. S., Br.

TINCTURE OF CIMICIFUGA

(tĭnc-tū'rą cĭm-į-cĭf'ú-gæ)

Tinctura Actææ Racemosæ; Tinctura Actææ; Tincture of Actæa; Tincture of Black Cohosh, Tincture of Black Snakeroot; Teinture (alcoolé) d'Actée à Grappes, *Fr.;* Cimicifugantinktur, *G.*

* "Cimicifuga, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Cimicifuga with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above

[1] *Tinctura Chloroformi et Morphinæ Composita, B. P.,* 1898—*Improved Formula.*—W. Lyon considers it desirable that the formula for compound tincture of chloroform and morphine be so constructed as to resemble the 1885 preparation in appearance, and to be given in doses of 20 to 30 drops instead of 10 drop doses. He finds that the following formula gives a reliable preparation, which does not separate, and is miscible with water: Chloroform, 60 Cc.; morphine hydrochloride, 5 Gm.; diluted hydrocyanic acid, 45 Cc.; tincture of Indian hemp, 30 Cc.; tincture of capsicum, 15 Cc.; oil of peppermint, 1 Cc.; mucilage of gum acacia, 120 Cc.; treacle, 240 Cc.; liquid extract of liquorice, 120 Cc.; glycerin, 210 Cc.; alcohol (90 per cent.), 154 Cc. or sufficient to produce 1 liter. (*P. J.,* June 21, 1902, 581.)

it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Cimicifuga, in No. 40 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *one fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture is inferior to the fluidextract, because the medicinal powers of the menstruum are almost equal to those of the drug, although dissimilar in therapeutic action. The strength of the British tincture (1898) was injudiciously decreased 20 per cent., and it is now only half that of the U. S. tincture.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA CINCHONÆ. U. S., Br.

TINCTURE OF CINCHONA

(tĭnc-tū'rą cĭn-ȼhō'næ)

Tinctura Cinchonæ Flavæ; Tincture of Yellow Cinchona; Tincture of Peruvian Bark; Teinture (alcoolé) de Quinquina jaune, *Fr. Cod.*; Tinctura Chinæ, *P. G.*, Chinatinktur, *G.*; Tintura di china, *It.*

* "Cinchona, in No. 60 powder (yielding not less than 4 percent. of anhydrous ether-soluble alkaloids), *two hundred grammes* [or 7 ounces av., 24 grains]; Glycerin, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred and seventy-five cubic centimeters* [or 22 fluidounces, 396 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Moisten the Cinchona with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of percolate are obtained. Tincture of Cinchona, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.75 Gm. of anhydrous ether-soluble alkaloids of Cinchona." *U. S.*

An assay process was appended to the formula of this tincture in the U. S. P. (8th Rev.).

Assay. U. S. (8th Rev.).—"Transfer 50 Cc. of Tincture of Cinchona to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc., transfer the liquid to a bottle having the capacity of about 180 Cc., rinsing the dish with 10 Cc. of diluted alcohol, then assay the resulting liquid by the method given under *Fluidextractum Cinchonæ* (page 533), with the exception that the multiplication of the product should be by 4 instead of 20; the result will represent the weight in grammes of anhydrous ether-soluble alkaloids contained in *one hundred cubic centimeters* of Tincture of Cinchona." *U. S.*

"Red Cinchona Bark, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Moisten the powdered Bark with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol; set aside for twenty-four hours in a closed vessel; percolate with more of the Alcohol, until *fourteen fluid ounces* (Imp. meas.) or seven hundred cubic centimetres of percolate have been collected; press the marc; add the expressed liquid to the percolate; set aside for twenty-four hours; filter.

Take ten cubic centimetres of the resulting strong tincture, and determine its proportion of alkaloids by the assay process given under 'Extractum Cinchonæ Liquidum.' [See page 533.]

Add to the bulk of the strong tincture such a quantity of the Alcohol that one hundred cubic centimetres of the resulting Tincture shall contain one gramme of alkaloids. Ten cubic centimetres, when treated by the assay process described under 'Extractum Cinchonæ Liquidum,' should yield an amount of alkaloids representing not less than 0.95 gramme nor more than 1.05 grammes, in one hundred cubic centimetres of the Tincture." *Br.*

This tincture is very properly made with a large proportion of bark, as in the bitter tinctures it is important that the alcohol should bear as small a proportion to the tonic principle as possible. Even when strongest, however, it cannot, in ordinary cases, be given in doses sufficiently large to obtain the full effect of the bark, without stimulating too highly. The tincture of the Br. Pharm. 1898 is now made from 70 per cent. alcohol instead of the old menstruum 50 per cent., and is assayed so that it has a definite strength (100 Cc. containing 1 Gm. of alkaloids); these are undoubted improvements. (*C. D.*, 1892, 325.) A deposit is apt to form in the tincture when kept, consisting chiefly of cinchonic red holding probably a portion of the alkaloids in combination. This was found by J. Adams to be perfectly dissolved by heat, though it uniformly reappeared on the cooling of the tincture. The addition of diluted sulphuric acid did not cause its solution, and, even though it was removed by filtering the tincture, the deposition

was afterwards renewed. (*P. J.*, April, 1868, 470.) In reference to a mode of obviating in some measure this tendency to deposition, the reader is referred to the statements of M. Vauflart on the subject of deposition in the tinctures prepared by percolation. A. B. Taylor, in experimenting on this subject, prepared a tincture in which the menstruum consisted of two parts of alcohol, one part of water, and one part of glycerin, and which was kept three months without undergoing deposition. (*A. J. P.*, Jan. 1865, 50.) This suggested the addition of glycerin to the official formula, and there can be no doubt that the tincture has been thereby improved, experience having demonstrated the utility of glycerin in liquid preparations of cinchona. Tincture of cinchona is rarely employed, but may be used as a tonic.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

Off. Prep.—Tinctura Cinchonæ Composita, *Br.*

TINCTURA CINCHONÆ COMPOSITA. U. S., Br.

COMPOUND TINCTURE OF CINCHONA

(tĭnc-tū′rạ cĭn-ɕhō′næ cọm-pŏs′ị-tạ)

Compound Tincture of Peruvian Bark; Huxham's Tincture of Bark; Teinture de Quinquina composée, Elixir fébrifuge d'Huxam, *Fr.*; Tinctura Chinæ Composita, *P. G.*; Zusammengesetzte Chinatinktur, *G.*

* "Red Cinchona (yielding not less than 5 percent. of anhydrous cinchona alkaloids), *one hundred grammes* [or 3 ounces av., 231 grains]; Bitter Orange Peel, *eighty grammes* [or 2 ounces av., 360 grains]; Serpentaria, *twenty grammes* [or 309 grains]; Glycerin, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred and seventy-five cubic centimeters* [or 22 fluidounces, 396 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Reduce the Red Cinchona, Bitter Orange Peel and Serpentaria to a No. 60 powder, moisten this powder with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Dried Bitter-Orange Peel, well bruised, 1 *ounce* (Imperial) or 50 grammes; Serpentary Rhizome, in No. 40 powder, ½ *ounce* (Imp.) or 25 grammes; Cochineal, in powder, 28 *grains* or 3.2 grammes; Saffron, 55 *grains* or 6.3 grammes; Tincture of Cinchona, 10 *fl. ounces* (Imp. meas.) or 500 cubic centimetres; Alcohol (70 per cent.), *a sufficient quantity*. Mix the solid ingredients with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; set aside in a closed vessel for seven days, agitating frequently; strain; press the marc; mix the liquids; add the Tincture of Cinchona, and enough of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Compound Tincture; set aside for twenty-four hours; filter. 10 cubic centimetres, when treated by the assay process described under 'Extractum Cinchonæ Liquidum' [page 533], should yield not less than 0.045 gramme nor more than 0.055 gramme of alkaloids. 2 cubic centimetres of the Compound Tincture after evaporation should leave a residue which imparts a yellow color to *chloroform*." *Br.*

This is the preparation commonly known by the name of *Huxham's tincture of bark*. It differs from that official in the U. S. P. 1890 only in the alcoholic strength of the menstruum, which is now about in the proportion of 2.7 volumes of alcohol to 1 volume of water; it was formerly 3 volumes of alcohol to 1 volume of water. The use of glycerin is an improvement, precipitation being thus largely prevented. It will be observed that the drugs are not directed in the powdered state, the intention being to mix the drugs together and then to reduce the mixture to a *uniform* powder; in this way the volatile principles in the Serpentaria and Orange Peel are retained, and thorough exhaustion by percolation is secured. The process for the British tincture (1898) presents some novel features. Half of the quantity of the tincture is first made from four of the ingredients; this is then mixed with an equal bulk of tincture of cinchona. The reason for this was probably to avoid assaying a mixed product during the process; but the final test has to deal with the finished tincture, and the utility of the whole method is doubtful. The U. S. P. process uses assayed cinchona bark, but omits an assay of the finished tincture because the presence of the soluble principles from bitter orange peel and serpentaria renders an assay process impracticable if not useless. Compound tincture of cinchona is an excellent stomachic cordial tonic, too feeble, however, in the principles of cinchona to serve as a substitute for the alkaloids when a full effect is required.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA CINNAMOMI. U. S., Br.

TINCTURE OF CINNAMON

(tĭnc-tū′rạ cĭn-nạ-mō′mī)

Teinture (alcoolé) de Cannelle, *Fr. Cod.*; Tinctura Cinnamomi, *P. G.*; Zimmttinktur, *G.*; Tintura alcoholica de canela, *Sp.*

* "Saigon Cinnamon, in No. 50 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Glycerin, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred and seventy-five cubic centimeters* [or 22 fluidounces, 396 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Moisten the Saigon Cinnamon with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Cinnamon Bark, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity*. Moisten the powder with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The British tincture (1898) was increased 60 per cent. in the proportion of cinnamon. This tincture was doubled in strength in the U. S. P. (8th Rev.); it has the aromatic and astringent properties of cinnamon, and may be used as an adjuvant to cretaceous mixtures and astringent infusions or decoctions. By long keeping it is prone to gelatinize and become unfit for use. According to Greenish, this can be prevented by using a menstruum composed of six parts of alcohol and two parts of water. (*P. J.*, Feb. 1872, 641.)

Dose, one to four fluidrachms (3.75 to 15 Cc.). It is an agreeable flavoring to other tinctures.

TINCTURA COCCI. Br.

TINCTURE OF COCHINEAL

(tĭnc-tū'rą cŏc'cī)

Teinture (alcoolé) de Cochenille, *Fr. Cod.*; **Cochenilletinktur**, *G.*

"Cochineal, in powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (45 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

This is valued chiefly for imparting color to liquid preparations. It may, however, be given internally in nervous affections.

Dose, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.).

TINCTURA COLCHICI SEMINIS.

U. S. (Br.)

TINCTURE OF COLCHICUM SEED

(tĭnc-tū'rą cŏl'çhį-cī sĕm'į-nīs)

Tinctura Colchici Seminum, *Br.*; Tinctura Colchici, *U. S.* 1890; Teinture (alcoolé) de semence de Colchique, *Fr. Cod.*; Tinctura Colchici, *P. G.*; Zeitlosentinktur, *G.*; Tintura alcoholica de colquico, *Sp.*

* "Colchicum Seed, in No. 50 powder (containing not less than 0.55 percent. of colchicine), *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Moisten the Colchicum Seed with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of percolate. Tincture of Colchicum Seed, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.05 Gm. of colchicine." *U. S.*

Assay. U. S. (8th Rev.)—"Transfer 100 Cc. of Tincture of Colchicum Seed to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Colchici Seminis* (page 535), with the exception that the multiplication of the product by 10 be omitted; the result will represent the weight in grammes of colchicine contained in *one hundred cubic centimeters* of Tincture of Colchicum Seed." *U. S.*

"Colchicum Seeds, in No. 30 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (45 per cent.), *a sufficient quantity*. Moisten the powder with *two and a half fluid ounces* (Imp. meas.) or one hundred and twenty-five cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres. This preparation is made with rather more than one and a half times the proportion of Colchicum Seeds ordered for the corresponding preparation in the British Pharmacopœia of 1885." *Br.*

The strength of this tincture was lowered to 10 per cent. in the U. S. P. (8th Rev.) to

comply with the rule adopted for potent tinctures (see page 1293). An assay process was also appended.

It was at one time supposed that the tincture was quite as effective made from the unbruised as from the bruised seeds, but the opinion has been shown to be erroneous. (*A. J. P.*, xxvi. 120.) See also a paper by N. Rosenwasser, *Ibid.*, 1877, 436. Subsequently L. I. Morris showed that if the whole seeds were *digested* with hot diluted alcohol they could be perfectly exhausted. (*A. J. P.*, 1881, p. 6.) Maisch recommended, as a convenient method of comminuting the seeds, to macerate them for two or three days in a portion of the menstruum, then to remove them and bruise them in a clean iron mortar, taking care that none of the menstruum or of the seeds should be wasted. (*Ibid.*, xxviii. 514.)

This tincture possesses the properties of colchicum, and may be given whenever that medicine is indicated, but the wine, containing less alcohol, is generally preferred.

Dose, from fifteen to thirty minims (0.9 to 1.8 Cc.), to be repeated with caution.

TINCTURA CONII. Br.

TINCTURE OF CONIUM

(tĭnc-tū'rą cō-nī'ī)

Tinctura Conii Fructus, *Br.* 1874; Tincture of Hemlock Fruit; Teinture (alcoolé) de Ciguë (feuille), *Fr. Cod.*; Schierlingstinktur, *G.*

"Conium Fruit, recently reduced to No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity*. Moisten the powder with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture was not admitted to the U. S. P. 1890; the formula of the tincture official in 1880 is appended.[1] The British tincture (1898) was increased 60 per cent. in strength over the tincture of the Br. Ph. 1885. A strong odor of coniine should be emitted by the tincture upon the addition of an alkali. Ménière states that it lets fall, on standing, a yellow miliary deposit, resembling drops of oil, the form of which is modified under pressure. According to the experiments of John Harley of London (*P. J.*, Jan. 1867, 414), the British tincture is an uncertain preparation, two fluidounces of it sometimes failing to produce any effect. The U. S. P. 1880 tincture was, however, about 30 per cent. stronger than the British, and cannot be considered inert if care be taken to select the conium fruit properly.

Commencing *dose*, thirty minims (1.8 Cc.), to be increased if necessary.

[1] "Conium, in No. 30 powder, *one hundred and fifty parts* [or four and three-quarter ounces av.]; Diluted Hydrochloric Acid, *four parts* [or one fluidrachm]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand parts* [or two pints]. Moisten the powder with *forty-five parts* [or two fluidounces] of Diluted Alcohol, previously mixed with the Diluted Hydrochloric Acid, and macerate for twenty-four hours; then pack it moderately in a conical glass percolator, and gradually pour Diluted Alcohol upon it, until *one thousand parts* [or two pints] of tincture are obtained." *U. S.* 1880.

TINCTURA CROCI. Br.

TINCTURE OF SAFFRON

(tĭnc-tū'rą crō'cī)

Teinture (alcoolé) de Safran, *Fr. Cod.*; Safrantinktur, *G.*

"Saffron, 1 *ounce* (Imperial) or 50 grammes; Alcohol (60 per cent.), *one pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

Tincture of saffron was official in the U. S. P. 1890.[1] This tincture possesses all the properties of saffron, but is of little other use than to give color to mixtures.

Dose, from one to three fluidrachms (3.75 to 11.25 Cc.).

TINCTURA CUBEBÆ. Br.

TINCTURE OF CUBEB

(tĭnc-tū'rą cū-bē'bæ)

Tincture of Cubebs; Teinture (alcoolé) de Cubèbe, *Fr. Cod.*; Kubebentinktur, *G.*

"Cubebs, in powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (90 per cent.), *a sufficient quantity*. Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The U. S. P. 1880 tincture was about 25 per cent. weaker than that of the U. S. P. 1870, a change which was very unfortunate, almost destroying any therapeutic value the preparation may have had. The U. S. P. 1890 tincture, which is double the strength of the former tincture, undoubtedly represents cubeb.[2] Its usefulness was not sufficient, however, to warrant its being retained in the present Pharmacopœia. The British tincture (1898) is 60 per cent.

[1] "Saffron, *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Saffron with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture are obtained." *U. S.* 1890.

[2] "Cubeb, in No. 30 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture are obtained." *U. S.* 1890.

stronger than the one formerly official, and is now identical with the U. S. P. 1890 preparation.

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA DIGITALIS. U. S., Br.

TINCTURE OF DIGITALIS

(tĭnc-tū'rą dĭg-ĭ-tā'lĭs)

Tincture of Foxglove; Teinture (alcoolé) de Digitale, *Fr. Cod.;* Tinctura Digitalis, *P. G.;* Fingerhuttinktur, *G.;* Tintura di digitale, *It.;* Tintura alcoholica de digital, *Sp.*

* "Digitalis, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Digitalis with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Digitalis Leaves, in No. 20 powder, 2½ *ounces* (Imperial) or 125 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

In preparing this tincture, great attention should be paid to the selection of the leaves, according to the rules laid down under the head of *Digitalis.* From a neglect of these it is likely to be weak or inefficient. C. Focke (*Deutsche Aerzte Zeitung*) recommends keeping tincture of digitalis protected from the light. The expressed juice of the leaves, preserved by means of alcohol, prepared as the British *Succi,* would probably be found to be a useful preparation. (See page 1199.) Tincture of digitalis possesses all the virtues of that drug, and affords a convenient method of administering it, especially in mixtures. It is said by Ménière to deposit on standing a green oily matter, and some white lance-shaped crystals soluble in an excess of acid. (*J. P. C.,* Avril, 1861, p. 289.) The present U. S. preparation is weaker (one-third) than that of the U. S. P. 1890.[1]

Dose, from ten to thirty minims (0.6 to 1.8 Cc.), repeated two or three times a day, and increased if necessary, but with caution; a fluidrachm, representing about six grains of digitalis, may be given on occasion as a single dose.

TINCTURA ERGOTÆ AMMONIATA. Br.

AMMONIATED TINCTURE OF ERGOT

(tĭnc-tū'rą ĕr'gŏ-tæ ąm-mō-nĭ-ā'tą)

Tinctura Secalis Cornuti Ammoniata; Teinture Ammoniacale de Seigle Ergoté, *Fr.;* Ammoniakalische Mutterkorntinktur, *G.*

"Ergot, in No. 20 powder, 5 *ounces* (Imperial) or 250 grammes; Solution of Ammonia, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Alcohol (60 per cent.), *a sufficient quantity.* Mix the Solution of Ammonia with *eighteen fluid ounces* (Imp. meas.) or nine hundred cubic centimetres of the Alcohol; moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of this mixture, and percolate with the remainder; press the marc; mix the expressed liquid with the percolate; add enough of the Alcohol to form *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture; set aside for twenty-four hours; filter." *Br.*

This is a new official tincture of the Br. Ph. 1898; it differs from the tincture recommended by the British Pharmaceutical Conference in the use of solution of ammonia in place of aromatic spirit of ammonia.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA FERRI CHLORIDI. U. S. (Br.)

TINCTURE OF FERRIC CHLORIDE

(tĭnc-tū'rą fĕr'rī ç̣hlō'rĭ-dī)

"A hydro-alcoholic solution of Ferric Chloride [$FeCl_3 = 161.04$] containing not less than 13.28 percent. of the anhydrous salt, corresponding to 4.6 (4.58) percent. of metallic iron." *U. S.*

Tinctura Ferri Perchloridi, *Br.;* Tincture of Chloride of Iron; Tinctura Ferri Muriatis; Tincture of Perchloride of Iron; Tincture of Muriate of Iron; Tinctura Ferri Sesquichloridi; Teinture de Perchlorure de Fer, *Fr.;* Eisenchloridtinktur, *G.*

* "Solution of Ferric Chloride, *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Solu-

[1] *Fat-free tincture of digitalis* is recommended by J. W. England (*Proc. Penna. Pharm. Assoc.,* 1899, 158). It is made by exhausting the leaves, freshly ground to a No. 60 powder, with purified petroleum benzin, either by maceration, or by maceration and percolation, as may be most convenient. The residue is then dried to remove all odor of benzin, the best results being obtained by exposure to the sunlight as well as air. The tincture is then made by the official process from 100 grammes (original weight of the powder), with this difference that only 980 Cc. of percolate instead of 1000 Cc. are obtained. Ammonia water is then carefully added to neutralization, for which from 10 to 15 Cc. are required, and the final measure is made up with diluted alcohol to 1000 Cc. The product is a deep reddish-brown, almost black liquid, of a not unpleasant odor and pure bitter taste, free from the acridity of the official tincture (see also Scoville's paper, *D. C.,* 1904, 93).

tion with enough Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Let the Tincture stand, in a closely covered vessel, protected from light, at least three months; then transfer it to glass-stoppered bottles, and keep it protected from light." *U. S.*

"Strong Solution of Ferric Chloride, 5 *fl. ounces* (Imperial measure) or 250 cubic centimetres; Alcohol (90 per cent.), 5 *fl. ounces* (Imp. meas.) or 250 cubic centimetres; Distilled Water, *a sufficient quantity.* Mix the Strong Solution of Ferric Chloride with the Alcohol; add sufficient Distilled Water to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

This tincture does not differ materially from that official in 1880, the change due to making one by weight and the other by volume, and the rounding of the figures, causing a difference in specific gravity,—the U. S. P. 1880 tincture having the sp. gr. 0.980 and the U. S. P. 1890 tincture that of 0.960, the latter thus being slightly weaker. In the U. S. P. (8th Rev.) the quantity of Solution of Ferric Chloride, used in making 1000 Cc. of the tincture, is increased from 250 Cc. to 350 Cc. on account of the reduction in strength of the solution from 13 per cent. of metallic iron to 10 per cent. The strength of the new tincture, in ferric chloride, remains practically the same as the 1890 preparation.

The U. S. formula of 1870 appeared, in respect to the precise method of proceeding, to be copied from that of E. R. Squibb, published in *A. J. P.* (1857, p. 290).[1] Iron wire was chosen as the form of iron to be used, because it is generally the purest. This, which was in very slight excess, was first treated with a portion of the hydrochloric acid, which formed with it ferrous chloride, with the escape of hydrogen, producing effervescence. The action was allowed to go on spontaneously until effervescence ceased, and was then aided by heat, which caused the saturation of the acid used. The solution being filtered, the remainder of the hydrochloric acid was added, and afterwards the nitric acid gradually, the liquid having been heated to the boiling point before the latter addition. The nitric acid was decomposed, with the escape of nitrous fumes producing effervescence, while, through the influence of a portion of its oxygen and the additional portion of hydrochloric acid, the ferrous chloride was converted into ferric chloride, the conversion being completed when the effervescence ceased and the previous green color had been changed to a reddish brown. The precise reactions by which these changes are effected have been explained elsewhere. (See *Ferri Chloridum,* page 494, and *Liquor Ferri Chloridi,* page 713.) In the revision of 1870 the process was divided into two parts, and a new preparation, *Liquor Ferri Chloridi,* introduced. When this is added to the alcohol, the latter reacts gradually with the acid, producing a small proportion of an ether which gives a peculiar flavor to the tincture and probably modifies in some degree its influence on the system. For this reason it is preferable to keep the tincture a year before dispensing, and the official direction is to keep it at least three months.

Properties.—Tincture of ferric chloride is officially described as "a bright, brownish liquid, having a slightly ethereal odor, a very astringent styptic taste, and an acid reaction. Specific gravity: about 1.005 at 25° C. (77° F.). The Tincture yields a brownish-red precipitate with ammonia water, a blue one with potassium ferrocyanide T.S., and a white one, insoluble in nitric acid, with silver nitrate T.S. After the Tincture has been exposed for some time to daylight, it yields a greenish or greenish-blue color with potassium ferricyanide T.S., showing the presence of some ferrous salt, due to reduction. On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Tincture (1 in 10), the crystal should not become colored brown, nor should there be a brownish-black zone developed around it (absence of *nitric acid*). Evaporate 2.22 Gm. of the Tincture to dryness on a water-bath, add 2 Cc. of hydrochloric acid and 5 Cc. of solution of hydrogen dioxide, and again evaporate the mixture to dryness; dissolve the residue in 10 Cc. of water, pour the solution into a glass-stoppered bottle having a capacity of about 100 Cc., rinsing the vessel with 10 Cc. more of water, add 1 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and keep the mixture for half an hour at a temperature of 40° C. (104° F.), then cool and add a little starch T.S.; it should require not less than 18.3 Cc. of tenth-normal sodium thiosulphate V.S. to discharge the blue color of the liquid (each Cc. of the volumetric solution used indicating 0.25 percent. of metallic iron)." *U. S.*[2] The tincture is decomposed by the alkalies, alkaline earths and their carbonates, astringent vegetable infusions, and mucilage of acacia, which produces with it a brown semi-transparent jelly. All these substances are, therefore, incompatible with it in prescriptions.[3]

[1] This process of Squibb was given in a note in the eleventh edition of the U. S. Dispensatory, page 1052.

[2] J. C. Wharton has noticed in the tincture silky asbestos-like crystals, which he believes are due to an action of the acids upon the glass in which the drug is prepared. (*A. J. P.*, xlii. 107.) Dr. Battey believes these crystals to be calcium sulphate. (*Ibid.*, xlii. 207.)

[3] *Bestuchef's tincture,* which is much used in Europe, is simply a solution of ferric chloride in a mixture of one measure of ether and three or four measures of alcohol. Fr. Mayer recommends that the ferric chloride should be prepared by passing chlorine through a solution of ferrous chloride, until a solution of potassium ferricyanide no longer produces a blue precipitate, and then evaporating by a water-bath. In this mode crystals of ferric chloride are obtained, one ounce of which is to be dissolved in twelve ounces of ether mixed with four times its bulk of alcohol. The solution may be rendered colorless, if desired, by exposure to the direct rays of the sun. (*N. Y. J. Pharm.*, i. 233.) This decolorization, however, is effected by a chemical change which somewhat alters

Uses.—This is one of the most active and certain preparations of iron, usually acceptable to the stomach, and much employed for the purposes to which the chalybeates generally are applied. It is somewhat diuretic, and acts as a slightly stimulant astringent upon the genito-urinary organs. It is very valuable in connection with tincture of cantharides in *gleet*, and is very largely used in *chronic Bright's disease*. In passive *hemorrhages from the uterus, kidneys*, and *bladder* it has been thought to act advantageously. It is the standard remedy in *erysipelas;* but in *scarlatina, diphtheria*, and *purulent infection of the blood*, experience has shown it to be of very little value, and as a styptic it is inferior to the solution of the subsulphate. In acute febrile diseases, as *erysipelas*, the dose should be repeated every two hours. It should be given well diluted, and taken through a glass tube as it is very prone to injure the teeth.

Dose, five to thirty minims (0.3 to 1.8 Cc.), which may be gradually increased.

Off. Prep.—Liquor Ferri et Ammonii Acetatis, *U. S.*

TINCTURA GALLÆ. U. S.

TINCTURE OF NUTGALL

(tĭnc-tū'rą găl'læ)

Tinctura Gallarum, *P. G.;* Tincture of Galls; Teinture (alcoolé) de Noix de Galle, *Fr.;* Gallapfeltinktur, *G.*

* "Nutgall, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of Alcohol. Introduce the Nutgall, without moistening it, into a glass percolator, shaking down the powder evenly and compactly, and pour on sufficient of the menstruum to saturate it and leave a stratum above it. Allow the percolation to proceed slowly, pouring on the remainder of the menstruum, and then sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

The tincture of galls is powerfully astringent, but is more used as a test than as a medicine. The present official tincture is about one-third stronger than that of the U. S. P. 1870. When long kept, it ceases to evince the reactions of tannic acid, in consequence of the conversion of this into gallic acid.

Dose, from one to three fluidrachms (3.75 to 11.25 Cc.).

TINCTURA GAMBIR COMPOSITA. U. S. (Br.)

COMPOUND TINCTURE OF GAMBIR

[To replace Tinctura Catechu Composita, Pharm. 1890, Compound Tincture of Catechu]

(tĭnc-tū'rą găm'bĭr cǫm-pŏs'ĭ-tą)

Tinctura Catechu, *Br.;* Tincture of Catechu; Teinture (alcoolé) de Cachou, *Fr. Cod.;* Tinctura Catechu, *P. G.;* Katechutinktur, *G.*

* "Gambir, in No. 50 powder, *fifty grammes* [or 1 ounce av., 334 grains]; Saigon Cinnamon, in No. 50 powder, *twenty-five grammes* [or 386 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Gambir and Saigon Cinnamon in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Diluted Alcohol during forty-eight hours, with frequent agitation; then filter through purified cotton, or a plain filter, and, when the liquid has drained off completely, pass enough menstruum through the residue to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Catechu, in coarse powder, 4 *ounces* (Imperial) or 200 grammes; Cinnamon Bark, bruised, 1 *ounce* (Imp.) or 50 grammes; Alcohol (60 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

The name of this tincture was changed at the 1880 revision, so that it more accurately indicated its composition than did its former name. In the U. S. P. (8th Rev.) the name was again changed to Tinctura Gambir Composita. This was due to the introduction of gambir in place of catechu (see *Gambir*). The present tincture is one-half the strength of the U. S. P. 1890 compound tincture of catechu. Cinnamon has been present in the tincture of catechu of former Pharmacopœias in the same relatively large proportion,—2 parts of cinnamon to 3 parts of catechu,—and this disproportion has been usually overlooked. The

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the character of the preparation. The ferric chloride becomes ferrous chloride by the loss of a portion of its chlorine, which, by abstracting hydrogen from the alcohol, becomes hydrochloric acid; and this reacts with unaltered alcohol to form ethyl chloride.

A. Cushman recommends the following process for the above tincture: He first prepares the crystals of the sesquichloride by dissolving two ounces of iron filings in a mixture of eight fluidounces of hydrochloric acid and four of distilled water, then adding four fluidrachms of nitric acid, evaporating to a pellicle, and setting aside to crystallize. The crystals, having been washed in alcohol, and afterwards redissolved and crystallized, are to be dissolved in a mixture of two parts of alcohol and one of ether, the proportion being an ounce of the crystals to twelve fluidounces of the mixture. After solution, the liquid is to be filtered, and exposed for 48 hours to the direct rays of the sun. (*A. J. P.*, xxix. 461; from *Am. Med. Gaz.*)

Tasteless Tincture of Ferric Chloride.—J. Creuse introduced this preparation. We have used the following formula for it: Solution of Ferric Chloride, U. S. P., 1 fluidounce; Citric Acid, 544 grains; Sodium Carbonate, 1000 grains, or q. s.; Water, distilled, 1 fluidounce; Alcohol, q. s. Dissolve the citric acid in the distilled water, and heat to the boiling point, gradually adding the sodium carbonate until the acid is saturated. Mix this with the iron solution, which will now assume a beautiful green color, and make up the measure to 4 fluidounces with alcohol.

present tincture contains 2 parts of gambir to 1 part of cinnamon. The British tincture (1898) was increased 60 per cent. in the proportion of catechu, and is now four times the strength of the U. S. tincture. This is a grateful astringent tincture, useful in all cases to which catechu is applicable and in which small quantities of spirit are not objectionable. It may often be advantageously added to cretaceous mixtures in *diarrhœa.* It may be given with sweetened water or some mucilaginous liquid, or in port wine when this is not contraindicated. It sometimes gelatinizes when kept, and becomes unfit for use.

Dose, of the U. S. tincture of gambir, two to four fluidrachms (7.5 to 15 Cc.); of the British tincture of catechu, one-half to two fluidrachms (1.8 to 7.5 Cc.).

TINCTURA GELSEMII. U. S. (Br.)

TINCTURE OF GELSEMIUM

(tĭnc-tū′rą ǧel-sĕm′ī-ī)

Teinture (alcoolé) de Gelsemium, *Fr.;* Gelsemiumtinktur, *G.*

* "Gelsemium, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. Moisten the Gelsemium with *thirty-five cubic centimeters* [or 1 fluidounce, 88 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Gelsemium Root, in No. 40 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *one fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture has proven a valuable addition, and will be preferred to the fluidextract for internal administration, as it is safer, and can be used more satisfactorily in extemporaneous combination. The menstruum of the U. S. P. 1890 and (8th. Rev.) processes is weaker than that formerly official, alcohol having been replaced by alcohol diluted with water in the proportion of 65 to 35. The strength of the U. S. P. (8th Rev.) is one-third less than that of the U. S. P. 1890. For Farr and Wright's method of estimating this tincture, see *C. D.,* 1892, 263.

Dose, from ten to twenty minims (0.6 to 1.3 Cc.).

TINCTURA GENTIANÆ COMPOSITA. U. S., Br.

COMPOUND TINCTURE OF GENTIAN

(tĭnc-tū′rą ǧĕn-tī-ā′næ cǫm-pŏs′ī-tą)

Teinture (alcoolé) de Gentiane Composée, *Fr.;* Zusammengesetzte Enziantinktur, *G.*

* "Gentian, *one hundred grammes* [or 3 ounces av., 231 grains]; Bitter Orange Peel, *forty grammes* [or 1 ounce av., 180 grains]; Cardamom, *ten grammes* [or 154 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Reduce the Gentian, Bitter Orange Peel and Cardamom to a No. 40 powder, moisten this powder with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for twelve hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twelve hours; then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Gentian Root, cut small and well bruised, 2 *ounces* (Imperial) or 100 grammes; Dried Bitter-Orange Peel, well bruised, ¾ *ounce* (Imp.) or 37.5 grammes; Cardamom Seeds, bruised, ½ *ounce* (Imp.) or 12.5 grammes; Alcohol (45 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

An improvement has been made in the process for this tincture, in directing the drugs to be mixed and powdered together; the pulverization is facilitated, and the odorous principles of the cardamom and orange peel are absorbed by the gentian. As compared with the U. S. P. 1880 tincture, the menstruum has been strengthened slightly, three volumes of alcohol and two of water being used in place of diluted alcohol, making a more permanent tincture; the proportion of cardamom has been reduced one-half, and that of gentian slightly increased. This is an elegant bitter, much used in *dyspepsia,* and as an addition to tonic mixtures in

debilitated states of the digestive organs or of the system generally. There is, however, much danger of its abuse, especially in chronic cases.

Dose, one or two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA GUAIACI. U. S.

TINCTURE OF GUAIAC

(tĭnc-tū'rą guaĭ'ą-cī)

Tinctura Guajaci; Teinture (alcoolé) de Résine de Gayac, *Fr.;* Guajaktinktur, *G.*

* "Guaiac, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Guaiac in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol during three days, with frequent agitation; then filter, and when the liquid has drained off, pour on enough Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

Although this tincture can be prepared by percolation if care and skill are used, maceration is doubtless preferable.

This tincture is given in *chronic rheumatism* and *gout,* in the dose of from one to three fluidrachms three or four times a day. As it is decomposed by water, it is most conveniently administered in mucilage, sweetened water, or milk, by which the separated guaiac is held in temporary suspension. The following is a form of tincture of guaiac which Dewees found very efficient in the cure of *suppression of the menses* and *dysmenorrhœa.* "Take of the best Guaiac, in powder, *four ounces;* Carbonate of Soda or of Potassa *one drachm and a half;* Pimenta, in powder, *an ounce;* Diluted Alcohol *a pint.* Digest for a few days." Dewees directed a drachm or two of the spirit of ammonia to be added, *pro re nata,* to four fluidounces of the tincture. (*Treatise on Diseases of Females,* 1826, page 81.) The quantity of alkaline addition is too small to produce any other effect than to render the resin more soluble, while the pimenta can act only as a spice; so that the virtues of the tincture reside in the guaiac, and the official ammoniated tincture is probably equally effectual. Schär recommends tincture of guaiac as a reagent to detect the presence of ozonizing bodies. (*Ph. Rund.,* 1894, 254.)

Dose, one fluidrachm (3.75 Cc.) three times a day.

TINCTURA GUAIACI AMMONIATA. U. S., Br.

AMMONIATED TINCTURE OF GUAIAC

(tĭnc-tū'rą guaĭ'ą-cī ąm-mō-nī-ā'tą)

Tinctura Guaiaci Composita; Teinture (alcoolé) de Gayac ammoniacale, *Fr.;* Ammoniakalische Guajaktinktur, *G.*

* "Guaiac, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Aromatic Spirit of Ammonia, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Guaiac in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Aromatic Spirit of Ammonia during three days, with frequent agitation; then filter, and, when the liquid has drained off, pour on enough Aromatic Spirit of Ammonia to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Guaiacum Resin, in powder, 4 *ounces* (Imperial) or 200 grammes; Oil of Nutmeg, 30 *minims* or 3.1 cubic centimetres; Oil of Lemon, 20 *minims* or 2.1 cubic centimetres; Strong Solution of Ammonia, 1½ *fl. ounces* (Imp. meas.) or 75 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Strong Solution of Ammonia with *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres of the Alcohol; add the Guaiacum Resin; set aside in a closed vessel for forty-eight hours, shaking frequently; filter; dissolve the Oil of Lemon and Oil of Nutmeg in the filtrate, and pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

The British Pharmacopœia 1898 improved the process for this tincture by abandoning the distilled aromatic spirit of ammonia used as a menstruum by the former British authority and substituting alcohol containing solution of ammonia and volatile oils, the proportion of oil of lemon having been reduced 60 per cent.

This tincture is celebrated in the treatment of *chronic rheumatism,* and is frequently also used in *amenorrhœa.* It is more stimulating, and is probably more effectual, than the preceding on account of the presence of the alkali. It is precipitated by water, and should be administered emulsified with gum, so that the guaiac may be held in suspension.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA HAMAMELIDIS. Br.

TINCTURE OF HAMAMELIS

(tĭnc-tū'rą hăm-ą-mĕl'ĭ-dĭs)

Teinture (alcoolé) de Hâmamélis, *Fr.;* Hamamelistinktur, *G.;* Tintura alcoholica de hamamelis, *Sp.*

"Hamamelis Bark, in No. 20 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (45 per cent.), *a sufficient quantity.* Moisten the powder with *one fluid ounce* (Imp. meas.) or fifty cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

Dose, from thirty to sixty minims (1.8 to 3.75 Cc.).

TINCTURA HYDRASTIS. U. S., Br.

TINCTURE OF HYDRASTIS

(tĭnc-tū'rą hȳ-drăs'tĭs)

Teinture (alcoolé) de Hydrastis, *Fr.;* Hydrastistinktur, *G.;* Tintura alcoholica de hidrastis, *Sp.*

* "Hydrastis, in No. 60 powder (containing not less than 2.5 percent. of hydrastine), *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix Alcohol and Water in the proportion of *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol and *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. Moisten the Hydrastis with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of the menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding menstruum until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of percolate are obtained. Tincture of Hydrastis, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.4 Gm. of hydrastine." *U. S.*

Assay. U. S. (8th Rev.).—"Transfer 100 Cc. of Tincture of Hydrastis to an evaporating dish, and evaporate it on a water-bath until the liquid measures about 10 Cc. If any insoluble matter has separated, add sufficient alcohol to dissolve it, and then assay the resulting liquid by the method given under *Fluidextractum Hydrastis* (page 545), using the same details as there directed for 10 Cc. of Fluidextract of Hydrastis, with the exception that the weight of the residual alkaloids must be multiplied by 2 instead of by 20 as there directed, to give the weight in grammes of hydrastine contained in *one hundred cubic centimeters* of Tincture of Hydrastis." *U. S.*

"Hydrastis Rhizome, in No. 60 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.* The British tincture is half the strength of that of the U. S. P. (8th Rev.).

This tincture will probably prove useful in combination with other tinctures, or as an addition to extemporaneous mixtures where the fluidextract would not be so eligible.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA HYOSCYAMI. U. S., Br.

TINCTURE OF HYOSCYAMUS

(tĭnc-tū'rą hȳ-ŏs-cȳ'ą-mī)

Tincture of Henbane; Teinture (alcoolé) de Jusquiame, *Fr.;* Bilsenkrauttinktur, *G.;* Tintura alcoholica de beleno, *Sp.*

* "Hyoscyamus, in No. 60 powder (containing not less than 0.08 percent. of mydriatic alkaloids), *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Hyoscyamus with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually adding Diluted Alcohol until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] are obtained. Tincture of Hyoscyamus, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.007 Gm. of mydriatic alkaloids." *U. S.*

Assay. U. S. (8th Rev.).—"Transfer 100 Cc. of Tincture of Hyoscyamus to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 528), using the same details as there directed for 10 Cc. of Fluidextract of Belladonna Root, with the exception that the multiplication by 10 be omitted; the result will represent the weight in grammes of alkaloids contained in *one hundred cubic centimeters* of Tincture of Hyoscyamus." *U. S.*

"Hyoscyamus Leaves and flowering tops, in No. 20 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (45 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The strength of the British tincture (1898) was slightly reduced (20 per cent.) in order to bring it into the class of tinctures having the maximum dose of a fluidrachm. The strength was also reduced in the U. S. P. (8th Rev.) from 15 per cent. to 10 per cent. and an assay process appended.

This tincture possesses the activities of hyoscyamus. When it purges, as it sometimes does, it may be united with a very small propor-

tion of tincture of opium. The expressed juice preserved by means of alcohol may be employed for the same purposes as the tincture.[1]

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA IODI. U. S., Br.

TINCTURE OF IODINE

(tĭnc-tū'rą ī-ō'dī)

Tinctura Iodinii, *Pharm.* 1870; Teinture (alcoolé) d'Iode, *Fr. Cod.;* Tinctura Jodi, *P. G.;* Jodtinktur, *G.;* Solucion alcoholica de yodo, *Sp.*

* "Iodine, *seventy grammes* [or 2 ounces av., 205 grains]; Potassium Iodide, *fifty grammes* [or 1 ounce av., 334 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Triturate the Iodine and Potassium Iodide rapidly, in a mortar, to a coarse powder, and transfer it at once to a graduated bottle. Rinse the mortar with several successive portions of Alcohol, and pour the rinsings into the bottle. Then add Alcohol, shaking occasionally, until the Iodine and Potassium Iodide are dissolved, and the finished Tincture measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Iodine, ½ *ounce* (Imperial) or 25 grammes; Potassium Iodide, ½ *ounce* (Imp.) or 25 grammes; Distilled Water, ½ *fl. ounce* (Imp. meas.) or 25 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Place the Iodine and Potassium Iodide in a bottle with the Distilled Water; when solution has been effected, add a sufficient quantity of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture. If 10 cubic centimetres of the Tincture be diluted with 20 cubic centimetres of *water,* it should require, for complete decoloration, 19.6 cubic centimetres of the *volumetric solution of sodium thiosulphate.*" *Br.*

The process of the U. S. P. 1890 was an improvement in manipulation over that of the former Pharmacopœias, where the saving of time is an object. The iodine in the quantity directed in the formula makes nearly a saturated solution, and by coarsely powdering it, as directed, the solution is greatly facilitated; when the operator has no necessity for dissolving the iodine rapidly, it may simply be placed in the bottle with the solvent and allowed to dissolve slowly. The British tincture is much weaker than that of the U. S. P., the latter being 2.8 times as strong as the British. An important change was made in the formula of tincture of iodine in the U. S. P. (8th Rev.) by the addition of about 5 per cent. of potassium iodide; this improvement not only permits the dilution of the tincture with water without precipitating the iodine, so that the tincture can now be administered internally, but it also particularly increases the stability of the tincture.

When tincture of iodine made as in previous pharmacopœias by solution of iodine (alone) in alcohol was allowed to stand subjected to varying conditions for two months, the loss in iodine was as high as 7 per cent.; on the other hand the loss in iodine with tincture containing 5 per cent. of potassium iodide was not appreciable in the same length of time under similar treatment. The addition of potassium iodide also causes the iodine to dissolve rapidly in the alcohol. The compound solution of iodine made with water is retained, and is most suitable for internal administration. (See *Liquor Iodi Compositus.*) The iodine should be thoroughly dried before being weighed out. The tincture should be kept in well-stoppered bottles, in order to prevent the evaporation of the alcohol.[2] It should never be dispensed in cork stoppered vials because of the destructive action of the iodine on the cork; rubber or glass stoppers should be used.

Properties.—The tincture has a deep brown color. One grain of iodine is contained in about fifteen minims, or thirty drops. "If 5 Cc. of the Tincture be mixed with about 25 Cc. of water and titrated with tenth-normal sodium thiosulphate V.S., about 27.25 Cc. of tenth-normal sodium thiosulphate V.S. should be required for complete decolorization (corresponding to about 6.86 Gm. of Iodine in 100 Cc.)." *U. S.* It is at present less used internally than it formerly was, in consequence of an impression that it is apt to irritate the stomach. Water decomposes the tincture when it contains no potassium iodide and it is supposed that when this is swallowed the iodine is precipitated upon the mucous membrane. Besides, the tincture undergoes a gradual change when long kept, owing, according to Guibourt, to a reaction between the alcohol and the iodine. A portion of the latter is supposed to take hydrogen from the former, producing hydriodic acid, which dissolves another portion of the iodine to form iodized hydriodic acid, while the place of the hydrogen in the alcohol is supplied by iodine, giving rise to ethyl iodide and similar products. The new products have an agreeable odor and are soluble in water; and consequently the tincture gradually loses by time the property of being precipitated on dilution. A. Göpel found the change to be so slow, when the tincture is kept in the dark and at a low temperature, that in three months a specimen thus treated had lost but one per cent. of iodine. (*Ph. Cb.,* No. 13, 1850.) Commaille, in 1859, con-

[1] According to Donovan, the tincture when made of leaves from plants of only one year's growth is inert. (*P. J.,* 1871, p. 907.)

[2] *Tinctura Iodinii Composita.* U. S. 1870. *Compound Tincture of Iodine.*—"Take of Iodine *half a troyounce;* Iodide of Potassium *a troyounce;* Alcohol *a pint.* Dissolve the Iodine and Iodide of Potassium in the Alcohol." The compound tincture of iodine may be given internally for all the purposes which iodine is capable of answering. The dose is from fifteen to thirty drops (0.45 to 0.9 Cc.), to be gradually increased if necessary.

firmed the labors of the last-mentioned investigator. Subsequent experiments have, however, given results somewhat at variance with those of Guibourt. Carles found that after exposure in a transparent glass flask to diffuse daylight for ten months, the tincture contained only one-twelfth per cent. of hydriodic acid. He was also unable to find any of the ethyl iodide which, according to Guibourt, is formed simultaneously with the acid. (*P. J.*, 3d ser., v. 88.)

Uses.—Tincture of iodine is now employed externally almost exclusively. Locally used, if undiluted, it acts as a powerful irritant to the skin, producing inflammation, desquamation of the cuticle, etc. Nevertheless, it is much used in this state in *erysipelas, chilblains,* and other cases of *cutaneous and subcutaneous inflammation,* and with happy effects. But its application requires some caution, and in erysipelas it is better to surround the inflamed surface with a border of the tincture, embracing a portion of both the sound and the diseased skin, so as to prevent the progress of the inflammation, than to attempt a complete cure by covering the whole surface affected. The largest use of tincture of iodine is as a rubefacient in *sprains* and chronic joint affections.

It is useful in rendering the *variolous eruption* abortive. It is most conveniently applied by means of a camel's-hair pencil. Diluted with camphorated tincture of soap, or other alcoholic liquid, it is sometimes employed as an embrocation in *scrofulous tumors* and other affections requiring the use of iodine. It is much used in the radical cure of *hydrocele,* as an injection into the sac, and a similar employment of it has been extended to other serous cavities morbidly distended with fluid, as in *ovarian dropsy, ascites,* and *empyema,* but in these latter affections it should be resorted to, if at all, with great caution. In hydrocele, Velpeau employed it diluted with double its volume of water. In the other cases referred to, it has been variously diluted with from three to ten times its bulk of water or some demulcent liquid. The *Tinctura Iodi Decolorata* of the German Pharmacopœia 1872 is made by digesting at a gentle heat ten parts, each, of iodine, sodium thiosulphate, and distilled water until solution is effected, adding sixteen parts of spirit of ammonia, shaking for a few moments, then adding seventy-five parts of alcohol, allowing the mixture to stand for three days in a cool place, and filtering. This preparation and all similar ones having this name,[1] are calculated to mislead practitioners, for they contain no free iodine, but are variable mixtures, consisting principally of ammonium iodide; the former German tincture contains in addition some ethyl iodide, triethyl-ammonium iodide, and traces of sodium iodide and sulphate. Luc has found the inhalation of the fumes from slightly warmed tinctures very useful in *coryza.*

Lugol's solution is a much preferable preparation for the internal administration of iodine. Debauque, an apothecary of Mons, has ascertained that tannic acid has the property of rendering iodine soluble in water, and states that an ounce of syrup of orange-peel in four or six ounces of water will form a clear solution with a quantity of tincture of iodine containing five or six grains of the medicine. (*J. P. C.*, 3e sér., xx. 34.) Owing to the caustic effect of the iodine, and the coagulating action of the alcohol, where it is desired to get an absorption of iodine, as in the case of *enlarged glands,* a solution in glycerin or olive oil is preferable to the tincture. (See *Iodum,* page 663.)

Dose, three to five minims (0.2 to 0.3 Cc.).

TINCTURA IPECACUANHÆ ET OPII. U. S.

TINCTURE OF IPECAC AND OPIUM
[Fluid Dover's Powder]

(tinc-tū'rą ip-ę-căc-ú-ăn'hæ ĕt ō'pI-I)

• "Tincture of Deodorized Opium, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]; Fluidextract of Ipecac, *one hun-*

[1] *Tinctura Iodi Decolorata. Colorless Tincture of Iodine.*—Under this name a preparation is described by N. J. Aiken of St. Louis, Mo., which is made by mixing equal measures of Compound Tincture of Iodine and Strong Water of Ammonia. The mixture in time becomes colorless, and, if not so at the end of 24 hours, more ammonia may be added, even to the extent of one-fourth if necessary. When wanted weak, it may be diluted to any desired extent by water or glycerin. In consequence of the chemical changes which take place, *it is no longer tincture of iodine,* but a hydro-alcoholic solution of potassium and ammonium iodides, with more or less ammonia and a trace of iodoform. It is recommended for external use whenever a discutient is required, and has been used for its revulsive effects in inflammatory diseases, as *pneumonia* and *rheumatism.* It is recommended also topically in *erysipelas, furuncles, sprains, bruises,* and *neuralgic affections.* (*Am. J. M. S.*, Oct. 1865, 398.) It is stated that on the addition of ammonia some nitrogen iodide is generally precipitated; and, as this is an explosive compound, caution is necessary. The deposit, however, disappears upon the completion of the decolorization. (*A. J. P.*, July, 1869.) Chas. O. Curtman gives the following formula (*A. J. P.*, xli. 364): Take of Iodine *one ounce and a quarter;* Alcohol *thirteen fluidounces;* Strong Water of Ammonia *three fluidounces.* Dissolve the Iodine in the Alcohol, and add the Ammonia. Allow to stand for four weeks, with occasional agitation, so that the precipitate may dissolve. A rapid preparation may be made by using an excess of ammonia, and afterwards adding, cautiously, hydrochloric acid until the reaction is only feebly alkaline. Jos. L. Macmillan finds that 5.3 decigrammes of a solution of sodium hydroxide of sp. gr. 1.07 at 15.55° C. will decolorize 3.6 grammes of the British tincture. (*A. J. P.*, xliii. 360.)

Tincture of Iodides (*Ph. Rev.*, 1899, 306) was proposed by Sieker as follows: Dissolve 48.9 Gm. sodium iodide and 47.3 Gm. ammonium iodide in 155.0 Cc. of water, add 10 Cc. of ammonia water (10 per cent.), and then sufficient alcohol to make 1000 Cc. He afterwards suggested that distilled water be used, and that the alcohol be of assured purity. Ordinary alcohol generally contains matter which causes it to assume a yellowish color. This foreign matter, being derived from barrels, it may be removed by re-distillation; but a simpler method for this purpose is to shake 1000 Cc. of the alcohol with 0.5 to 1.0 Gm., or a sufficient quantity of potassium permanganate in coarse powder, until the alcohol acquires a dark purple color; then strain from the excess of permanganate, allow the alcohol to stand for a few hours, and filter. The filtrate should be perfectly colorless, and will produce a colorless tincture of iodides which keeps well in glass-stoppered bottles.

dred cubic centimeters [or 3 fluidounces, 183 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Evaporate the Tincture of Deodorized Opium, in a tared dish on a water-bath, until it weighs *eight hundred grammes* [or 28 ounces av., 96 grains]. When it has become cold, add to it the Fluidextract of Ipecac, filter the mixture, and pass enough Diluted Alcohol through the filter to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture is intended to represent Dover's powder in a liquid form. Ten minims (0.6 Cc.), the adult dose, represent one grain of powdered opium and one grain of ipecac, equivalent to ten grains of Dover's powder.

Dose, five to ten minims (0.3 to 0.6 Cc.).

TINCTURA JABORANDI. Br.

TINCTURE OF JABORANDI

(tĭnc-tū'rą jăb-o-răn'dī)

Tinctura Pilocarpi; Tincture of Pilocarpus; Teinture (alcoolé) de Jaborandi, *Fr. Cod.;* Jaborandi-tinktur, *G.;* Tintura alcoholica de jaborandi, *Sp.*

"Jaborandi Leaves, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (45 per cent.), *a sufficient quantity.* Moisten the powder with *two and a half fluid ounces* (Imp. meas.) or one hundred and twenty-five cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This preparation possesses no advantages over the fluidextract, but is undoubtedly efficient. The Br. Pharm. gives the dose as from one-half to one fluidrachm; but, as one drachm represents only eleven grains of the jaborandi, it is evidently too small.

Dose, from two to three fluidrachms (7.5 to 11.25 Cc.).

TINCTURA JALAPÆ. Br.

TINCTURE OF JALAP

(tĭnc-tū'rą ją-lā'pæ)

Teinture (alcoolé) de Jalap, *Fr. Cod.;* Jalapen-tinktur, *G.*

"Jalap, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol; pack in a percolator; gradually add more of the Alcohol until *twelve fluid ounces* (Imp. meas.) or six hundred cubic centimetres of percolate has been collected; subject the marc to pressure; add the expressed liquid to the percolate; set aside for twenty-four hours; filter. Determine the amount of Jalap Resin present in ten cubic centimetres of the resulting strong tincture by the process described under 'Jalapæ Resina' [p. 1051], and dilute the remainder of the strong tincture with a sufficient quantity of the Alcohol to produce a Tincture containing 1.5 grammes of the Resin in one hundred cubic centimetres. Treated as described under 'Jalapæ Resina,' 10 cubic centimetres of the Tincture should yield not less than 0.145 nor more than 0.155 gramme of the Resin." *Br.*

This tincture is no longer official in the U. S. Pharmacopœia. The tincture of jalap of the U. S. P. 1870 was made by percolating six troy-ounces of powdered jalap with a mixture of two measures of alcohol and one of water, until two pints of tincture were obtained.

This tincture was increased in strength 60 per cent. at the last revision of the Br. Ph. 1898. It possesses the medicinal virtues of jalap, and is sometimes added to cathartic mixtures.

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA KINO. U. S., Br.

TINCTURE OF KINO

(tĭnc-tū'rą kī-no)

Teinture (alcoolé) de Kino, *Fr. Cod.;* Kino-tinktur, *G.*

* "Kino, *fifty grammes* [or 1 ounce av., 334 grains]; Purified Talc, *ten grammes* [or 154 grains]; Glycerin, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; Alcohol, *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and triturate the Kino and Purified Talc with sufficient of the mixture to produce a thin, smooth magma. Transfer this magma to a flask by the aid of the remainder of the mixture, and, having ascertained the weight of the flask and contents, heat it on a water-bath for about one hour; allow the flask and contents to cool, and restore the original weight by the addition of sufficient Water. Then add the Alcohol, mix, and pass the Tincture through a filter of purified cotton, keeping the funnel well covered. Finally, add sufficient Alcohol through the filter to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Kino, in powder, 2 *ounces* (Imperial) or 100 grammes; Glycerin, 3 *fl. ounces* (Imp. meas.) or 150 cubic centimetres; Distilled Water, 5 *fl. ounces* (Imp. meas.) or 250 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Glycerin and the Distilled Water; rub the Kino in a mortar with a sufficient quantity of the mixture to form a smooth paste, gradually adding the remainder of the mixture; transfer to a closed vessel; add *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; set aside for twelve hours, frequently agitating; filter through a

plug of cotton wool; pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

Much inconvenience is caused by the tendency of this tincture to gelatinize and gradually lose its astringency. The present official formula is believed to furnish a tincture free from objection. It is probable that different specimens of kino vary in their tendency to gelatinize. Groves states that fresh kino will not gelatinize, and Martindale that the Australian kino is much more prone to do so than the East India drug. The air has some effect, for if this be entirely excluded the tincture will keep for a long time without undergoing the change. It should be introduced, when prepared, into very small bottles, which should be kept well corked and be opened only when wanted for use. J. D. Wood obtains a handsome preparation, which he believes to keep well and not gelatinize, by using a menstruum of 2 parts of alcohol sp. gr. 0.835, and 1 part each of water and glycerin.

L. Meyers Connor gets rid of the gelatinizing property by using magnesium carbonate in making the tincture, but it is very probable that a large part of the kino-tannic acid is removed at the same time. (*A. J. P.*, xlv. 260.) P. F. Smith of Louisville, furnished the following formula: "Take of Kino *one ounce and a half;* Ground Logwood *half an ounce;* Diluted Alcohol *a sufficient quantity.* Moisten the Logwood with a portion of the Diluted Alcohol, and introduce it into a displacement apparatus. Dissolve the Kino by triturating with successive portions of Diluted Alcohol, and percolate the solution through the Logwood until a pint of tincture is obtained." We have used this process and have not noticed gelatinization to take place in any instance. Sugar added in equal proportions with the kino employed has been recommended as a preventive of gelatinization, and R. Rother claims permanence for the following formula. Powder one and a half troyounces of kino and half a troyounce of catechu, mix them, add ten fluidounces of water, heat for ten or fifteen minutes with constant stirring, and let the mixture cool. Add water to make the mixture twelve fluidounces, and then add four fluidounces of alcohol. Pour the mixture into a bottle containing sixty grains of filter-paper, shake the whole well at intervals, and strain the tincture after twenty-four hours. (*A. J. P.*, 1886, 333.)

The important change in the process of the U. S. Pharmacopœia (8th Revision) is the employment of heat. This was due to the researches of Edmund White (*P. J.*, 1903, May, 644, and Nov. 702), who with David Hooper believes that the gelatinization of tincture of kino is due to an enzyme or oxydase present in the kino; the activity of this is destroyed by heat. Another improvement in the U. S. P. (8th Rev.) is filtration through purified cotton (instead of paper), and the use of purified talc. Tincture of kino is used chiefly as an addition to chalk mixtures in *diarrhœa.*

Dose, one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA KRAMERIÆ. U. S., Br.

TINCTURE OF KRAMERIA

(tĭnc-tū'rą krą-mē'rī-æ)

Tincture of Rhatany; Teinture (alcoolé) de Ratanhia, *Fr. Cod.;* Tinctura Ratanhiæ, *P. G.;* Ratanhiatinktur, *G.*

* "Krameria, in No. 40 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Krameria with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Diluted Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Krameria Root, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture was increased in strength 60 per cent. at the last revision of the British Pharmacopœia (1898); it is stated that the tincture made from Pará rhatany furnishes a clear solution on the addition of water, while that from Peruvian root yields a turbid mixture.

The same precaution should be observed in keeping this tincture as is recommended for tincture of kino. It is a good preparation in cases which admit of the use of small quantities of alcohol.

Dose, one or two fluidrachms (3.75 or 7.5 Cc.).

TINCTURA LACTUCARII. U. S.

TINCTURE OF LACTUCARIUM

(tĭnc-tū'rą lăc-tū-cā'rī-ī)

Teinture (alcoolé) de Lactucarium, *Fr.;* Lactucariumtinktur, *G.*

* "Lactucarium, *five hundred grammes* [or 17 ounces av., 279 grains]; Glycerin, *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims]; Alcohol, Purified Petroleum Benzin, Diluted Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic*

centimeters [or 33 fluidounces, 6½ fluidrachms]. Beat the Lactucarium in an iron mortar, with clean sand, to a coarse powder, and introduce it into a bottle; add *two thousand cubic centimeters* [or 67 fluidounces, 301 minims] of Purified Petroleum Benzin, cork the bottle tightly, set it aside for forty-eight hours, frequently agitating the mixture. Pour the mixture on a double filter, and allow it to drain. Wash the residue by gradually adding *fifteen hundred cubic centimeters* [or 50 fluidounces, 345 minims] of Purified Petroleum Benzin, and allow the Lactucarium to dry by exposing it to a current of air. When it is dry and free from the odor of Benzin, reduce it to powder, using more sand, if necessary, and pack it moderately in a conical percolator. Mix the Glycerin with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, and *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, and moisten the powder with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of the mixture. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed very slowly, gradually adding, first the remainder of the menstruum, and then Diluted Alcohol, until the Lactucarium is exhausted. Reserve the first *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of the percolate, evaporate the remainder on a water-bath, at a temperature not exceeding 70° C. (158° F.), to *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims], and mix this with the reserved portion. Filter, and add enough Diluted Alcohol through the filter to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture was first official in the U. S. 1890. It is based on the formula of J. L. Lemberger, who recommended the extraction of the resinous inert lactucerin by treatment with petroleum benzin. Great care must be observed to use *purified* petroleum benzin, as it is almost impossible to get rid of the odor and taste of petroleum in the finished preparation if the ordinary benzin be used. (See *Syrupus Lactucarii*, page 1229.)

Dose, half to one fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Syrupus Lactucarii, *U. S.*

TINCTURA LAVANDULÆ COMPOSITA.

U. S., Br.

COMPOUND TINCTURE OF LAVENDER
[Compound Spirit of Lavender]

(tĭnc-tū'rą lą-văn'dŭ-læ cŏm-pŏs'ĭ-tą)

Spiritus Lavandulæ Compositus, *U. S.* 1870; Lavender Drops; Teinture (alcoolé) de Lavande composée, *Fr.*; Zusammengesetzte Lavendeltinktur, *G.*

* "Oil of Lavender Flowers, *eight cubic centimeters* [or 130 minims]; Oil of Rosemary, *two cubic centimeters* [or 32 minims]; Saigon Cinnamon, *twenty grammes* [or 309 grains]; Cloves, *five grammes* [or 77 grains]; Myristica, *ten grammes* [or 154 grains]; Red Saunders, *ten grammes* [or 154 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Reduce the Saigon Cinnamon, Cloves, Myristica and Red Saunders to a No. 50 powder, and macerate this powder for three days in a mixture of *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, in which liquid the Oils have been dissolved. Then filter, and, when the liquid has drained off completely, pass enough of a mixture of Alcohol and Water, made in the same proportions as before, through the residue on the filter to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Oil of Lavender, 45 *minims* or 4.7 cubic centimetres; Oil of Rosemary, 5 *minims* or 0.5 cubic centimetre; Cinnamon Bark, bruised, 75 *grains* or 8.5 grammes; Nutmeg, bruised, 75 *grains* or 8.5 grammes; Red Sanders Wood, 150 *grains* or 17 grammes; Alcohol (90 per cent.), 1 *pint* (Imperial measure) or 1000 cubic centimetres. Prepare by the maceration process, adding the Oils at the completion of the process." *Br.*

The compound tincture of lavender of the U. S. Pharmacopœia is nearly twice the strength of the British preparation, although it is made with a menstruum weaker in alcohol. When properly prepared it is an excellent preparation to be used for *gastric uneasiness, nausea*, and *flatulence*.

Dose, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Liquor Potassii Arsenitis, *U. S.* (*Br.*).

TINCTURA LIMONIS CORTICIS.

U. S. (Br.)

TINCTURE OF LEMON PEEL

(tĭnc-tū'rą lĭ-mō'nĭs cŏr'tĭ-cĭs)

Tinctura Limonis, *Br.*; Tincture of Lemon; Teinture (alcoolé) de Zeste de Citron, *Fr.*; Citronenschalentinktur, *G.*

* "Lemon Peel, from the fresh fruit, in thin shavings and cut into narrow shreds, *five hundred grammes* [or 17 ounces av., 279 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Lemon Peel in a stoppered, wide-mouthed container, in a moderately warm place, with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Alcohol during forty-eight hours, with frequent agitation; then filter through purified cotton, and, when the liquid has drained off

completely, gradually pour on enough Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture, and filter." *U. S.*

"Fresh Lemon Peel, cut small, 5 *ounces* (Imperial) or 250 grammes; Alcohol (90 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

Tincture of lemon peel is a new official preparation of the U. S. P. (8th Rev.). Spirit of lemon made from oil of lemon was abandoned, because the poor quality of the oil with which it was likely to be made caused it to have a terebinthinate flavor. The 50 per cent. tincture made by macerating fresh lemon peel in alcohol was proposed by Scoville and the present formula produces a very satisfactory preparation.

This tincture was doubled in strength at the 1898 revision of the Br. Pharm., but is now only about one-half the strength of the U. S. tincture. It is made with strong alcohol instead of proof spirit formerly used. It forms a grateful aromatic addition to tonic infusions, etc.

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

Off. Prep.—Syrupus Acidi Citrici, *U. S.*; Syrupus Hypophosphitum, *U. S.*

TINCTURA LOBELIÆ. U. S.

TINCTURE OF LOBELIA

(tĭnc-tū'rą lo-bē'lĭ-æ)

Teinture (alcoolé) de Lobélie enflée, *Fr. Cod.*: Tinctura Lobeliae, *P. G.*; Lobelientinktur, *G.*; Tintura di lobelia, *It.*; Tintura alcoholica de lobelia, *Sp.*

* "Lobelia, in No. 50 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Lobelia with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Diluted Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

The strength of this tincture was decreased one-half at the last revision. For method of assay, see *C. D.*, 1893, 454; also *P. J.*, 1895, 141. It possesses the emetic and narcotic properties of lobelia, and is much used in *asthma*. The emetic dose is two fluidrachms (7.5 Cc.), but it frequently acts dangerously. A saturated tincture is strongly recommended by A. Livezey as a local application in *erysipelas*, and in the *eczematous eruption* of *Rhus poisoning*. (*B. M. S. J.*, lv. 262.)

Dose, as an expectorant, fifteen minims to one fluidrachm (0.9 to 3.75 Cc.); as an emetic, one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA LOBELIÆ ÆTHEREA. Br.

ETHEREAL TINCTURE OF LOBELIA

(tĭnc-tū'rą lo-bē'lĭ-æ æ-thē'rę-ą)

Teinture ethérée de Lobélie enflée, *Fr.*; Ätherische Lobelientinktur, *G.*

"Lobelia, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Spirit of Ether, *a sufficient quantity*. Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of Spirit of Ether, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres. This preparation is made with rather more than one and a half times the proportion of Lobelia ordered for the corresponding preparation in the British Pharmacopœia of 1885." *Br.*

Dose, from five to fifteen minims (0.3 to 0.9 Cc.).

TINCTURA LUPULI. Br.

TINCTURE OF HOPS

(tĭnc-tū'rą lū'pų-lī)

Teinture (alcoolé) de Houblon, *Fr.*; Hopfentinktur, *G.*

"Hops, 4 *ounces* (Imperial) or 200 grammes; Alcohol (60 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

This tincture might well have been omitted in the 1890 revision of the U. S. Pharmacopœia; it has little to recommend it from either a therapeutical or a pharmaceutical point of view. The strength of the British tincture (1898) has been increased 60 per cent. The menstruum is also slightly stronger in alcohol.

Care should be observed to notice that the British tincture of hops is termed "Tinctura Lupuli," a name very similar to the tincture made from lupulin official in the U. S. P. 1870.[1]

[1] *Tinctura Lupulinæ. Tincture of Lupulin. Teinture de Lupulin*, Fr.; *Lupulintinktur*, G.—"Take of Lupulin *four troyounces*; Alcohol *a sufficient quantity*. Pack the Lupulin in a cylindrical percolator, and gradually pour Alcohol upon it until two pints of tincture are obtained." *U. S.* 1870.

This is much superior to the tincture of hops of the first U. S. Pharmacopœia, in the place of which it was introduced into the second edition. In the original preparation, a certain quantity of hops was directed, from which the lupulin was to be separated by beating, and then digested in alcohol. As hops contain a variable proportion of lupulin, the tincture thus made must be of unequal strength,—an objection to which the tincture of hops, even as now prepared, is in some measure liable. Besides, the amount of lupulin contained in any quantity of hops upon which alcohol can conveniently act is too small in proportion to the alcohol to afford a tincture of the

The U. S. P. 1890 tincture of hops was made as follows: "Hops, well dried and in No. 20 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 390 minims]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one thousand cubic centimeters* [or 33 fluidounces, 390 minims] of Tincture are obtained." *U. S.* 1890.

By thoroughly drying the hops and rubbing them between the hands, or by cutting and bruising them, they may be brought to a state of division which will in a great measure obviate the disadvantages due to their light and bulky character. Yet it is well known that the narcotic virtues of hops are injured by a thorough drying. As the virtues of hops depend chiefly on the lupulin, and as the quantity of this substance is different in different parcels, the tincture is necessarily unequal in strength, and the tincture of lupulin itself is preferable. According to Ménière, tincture of hops deposits, on standing, a yellow precipitate, and a large quantity of a white crystalline substance, which he thinks may be calcium malate.

Tincture of hops is tonic and narcotic, but little reliance can be placed upon it. It is sometimes useful in the wakefulness, attended with tremors and general nervous derangement, to which habitual drunkards are liable, and which frequently precedes an attack of *delirium tremens.*

Dose, from one to three fluidrachms (3.75 to 11.25 Cc.).

TINCTURA MOSCHI. U. S.

TINCTURE OF MUSK

(tĭnc-tū'ra mŏs'kī)

Teinture (alcoolé) de Musc, *Fr. Cod.;* Moschustinktur, *G.;* Tintura di muschio, *It.;* Tintura alcoholica de almizcle, *Sp.*

* "Musk, *five grammes* [or 77 grains]; Alcohol, *forty-five cubic centimeters* [or 1 fluidounce, 250 minims]; Water, *forty-five cubic centimeters* [or 1 fluidounce, 250 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]. Triturate the Musk with the Water, a little at a time, until a smooth mixture is obtained; transfer this mixture to a bottle and allow it to stand for twenty-four hours; add the Alcohol and macerate the mixture for six days, occasionally shaking it. Then filter through a plain paper filter, and, when the liquid has drained off completely, pass enough Diluted Alcohol through the filter to make *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Tincture." *U. S.*

This tincture was reduced in strength about one-half in the U. S. P. 1890, on account of the greatly increased cost of musk. This change, in our opinion, is ill-advised, and does not secure the main object, as the patient will have to take double the dose, even if the alcohol be therapeutically contraindicated. The process has been arranged so as to make the end-product 100 Cc., as very few pharmacists will require 1000 Cc. of tincture of musk. Musk will yield its virtues to the above menstruum if the process be followed; if wanted for its odor it will be economy to add a minim of solution of potassium hydroxide to the water used to rub the musk into a smooth paste. Care should be especially taken to use pure grain musk in this preparation.

Dose, from thirty minims to two fluidrachms (1.8 to 7.5 Cc.).

TINCTURA MYRRHÆ. U. S., Br.

TINCTURE OF MYRRH

(tĭnc-tū'ra mŷr'rhæ)

Teinture (alcoolé) de Myrrhe, *Fr. Cod.;* Tinctura Myrrhae, *P. G.;* Myrrhentinktur, *G.;* Tintura di mirra, *It.;* Tintura alcoholica de mirra, *Sp.*

* "Myrrh, in moderately coarse powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Myrrh in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol during three days, with frequent agitation; then filter through purified cotton, or a plain paper filter, and, when the liquid has drained off completely, pour on enough menstruum to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Myrrh, in coarse powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Place the Myrrh with *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres of the Alcohol in a closed vessel; set aside for seven days, with frequent agitation; filter; when the liquid ceases to drop, pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

The strength of this tincture was increased 60 per cent. at the last revision of the British Pharmacopœia (1898).

Official alcohol is preferable to diluted alcohol as a solvent of myrrh, because it forms a perfectly clear tincture, which is not attainable

due strength. The tincture of lupulin is, therefore, greatly preferable. The dose is one or two fluidrachms (3.7 or 7.5 Cc.), to be given in sweetened water or some mucilaginous fluid. Under the name of *Ammoniated Tincture of Lupulin,* Dyce Duckworth proposes as the best preparation a tincture made by macerating for seven days two ounces of lupulin in a pint of aromatic spirit of ammonia, and then filtering. The dose is from half a fluidrachm to a fluidrachm (1.9 to 3.7 Cc.). (*A. J. P.,* xli. 416.)

with the latter menstruum. The addition of water to the tincture renders it turbid. According to E. B. Shuttleworth (*A. J. P.*, xliii. 369), the gum which is left behind in making the tincture may be utilized for making mucilage. The tincture of myrrh is used solely as a local application to stimulate *indolent and foul ulcers, spongy gums, aphthous sore mouth,* and *ulcerations of the throat.*

Dose, from fifteen to thirty minims (0.9 to 1.8 Cc.).

TINCTURA NUCIS VOMICÆ. U. S., Br.

TINCTURE OF NUX VOMICA

(tĭnc-tū'rą nū'cĭs vŏm'ĭ-çæ)

Teinture (alcoolé) de Noix vomique, *Fr. Cod.;* Tinctura Strychni, *P. G.;* Brechnusstinktur, Krähenaugentinktur, *G.;* Tintura di noce vomica, *It.;* Tintura alcoholica de nuez vomica, *Sp.*

* "Extract of Nux Vomica (containing 5 percent. of strychnine), *twenty grammes* [or 309 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Extract of Nux Vomica in a sufficient quantity of a mixture of Alcohol and Water, made in the proportion of *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol and *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water, to make the solution measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and filter through a well-covered filter. Tincture of Nux Vomica, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.1 Gm. of Strychnine." *U. S.*

"Liquid Extract of Nux Vomica, 2 *fl. ounces* (Imperial measure) or 100 cubic centimetres; Distilled Water, 3 *fl. ounces* (Imp. meas.) or 150 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity.* Mix the Liquid Extract of Nux Vomica with the Distilled Water; add sufficient of the Alcohol to produce *twelve fluid ounces* (Imp. meas.) or six hundred cubic centimetres of the Tincture; filter. Treated by the assay process given under 'Extractum Nucis Vomicæ Liquidum,' 100 cubic centimetres should yield not less than 0.24 nor more than 0.26 gramme of Strychnine, corresponding to about ⅛ grain in 1 fluid drachm or ¼ grain in 110 minims. This preparation contains about twice the proportion of Strychnine present in the Tincture of Nux Vomica of the British Pharmacopœia of 1885." *Br.*

Assay. U. S. (8th Rev.)—"Transfer 100 Cc. of Tincture of Nux Vomica to a porcelain dish, evaporate it to dryness on a water-bath, and assay the resulting extract by the method given under *Extractum Nucis Vomicæ* (page 482), using the same details as there directed for 2 Gm. of Extract of Nux Vomica, with the exception that the multiplication by 50 be omitted; the result will represent the weight in grammes of strychnine contained in *one hundred cubic centimeters* of Tincture of Nux Vomica." *U. S.*

The object of the U. S. (8th Rev.) process is to secure a more reliable and definite tincture than was possible under the process official prior to 1890; for this reason 2 per cent. of the standardized extract is directed to be dissolved in a mixture of 3 volumes of alcohol and 1 volume of water. On account of the very tough structure of nux vomica, percolation is accomplished usually with varying results. The amount of extract present in the percolate is to some extent a measure of its activity; hence, if a weighed portion of the percolate be evaporated to dryness, and the percentage of dry extract is noted, it is easy to calculate the amount present in the whole quantity. The strength of tincture of nux vomica U. S. P. (8th Rev.) is theoretically about one-fourth weaker than the tincture of the U. S. P. 1890. It is probable, however, that as the assay process is now based on the tincture containing 0.1 Gm. of strychnine instead of 0.3 Gm. total alkaloids in 100 Cc., that the difference in strength will be practically less than this.

The British Pharmacopœia standardizes the liquid extract (see p. 551), and makes its tincture from it of such strength that 100 Cc. shall contain 0.25 Gm. of strychnine; the menstruum used is slightly more alcoholic than that of the Br. Ph. 1885, and the tincture is two and a half times as strong as the U. S. (8th Rev.) tincture. R. Rother (*A. J. P.*, Jan. 1883) after experimenting with various substances, found that sodium chloride aided greatly in softening the bassorin-like substance in which the alkaloidal principles of nux vomica are embedded, and he proposes its use by adding it to the menstruum of diluted alcohol in the proportion of 120 grains to the pint (see U. S. D., 16th ed., p. 1527). The alcoholic extract, or strychnine, is preferable to the tincture, when the pill form is practicable.

Dose, of the tincture, ten to twenty minims (0.6 to 1.3 Cc.), to be increased if necessary.

TINCTURA OPII. U. S., Br.

TINCTURE OF OPIUM LAUDANUM

(tĭnc-tū'rą ō'pĭ-ī)

Tinctura Thebaica, Tinctura Meconii, Tinctura Extracti Opii; Teinture d'Extrait d'Opium, *Fr. Cod.;* Teinture (alcoolé) d'Opium, Teinture thébaïque, *Fr.;* Tinctura Opii Simplex, *P. G.;* Einfache Opiumtinktur, *G.;* Tintura di oppio, *It.;* Tintura alcoholica de opio, *Sp.*

* "Granulated Opium (containing 12 to 12.5 percent. of crystallizable morphine), *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, Diluted Alcohol, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Heat *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of water to boiling, and pour it on the Granulated Opium contained

in a tared vessel, weigh, and stir occasionally during twelve hours; then restore the original weight by the addition of cold Water, add *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol, pour the mixture into a bottle, and continue the maceration for forty-eight hours, occasionally shaking. Transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the liquid ceases to drop, continue the percolation slowly, pouring on sufficient Diluted Alcohol until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] are obtained." *U. S.*

The official requirements are that "Tincture of Opium, when assayed by the process given below, should contain in *one hundred cubic centimeters* not less than 1.2 nor more than 1.25 Gm. of crystallizable morphine." *U. S.*

Assay.—U. S. (8th Rev.). "Tincture of Opium, *one hundred cubic centimeters;* Ammonia Water, *three and one-half cubic centimeters;* Alcohol, Ether, Water, Lime Water, each, *a sufficient quantity.* Transfer 100 Cc. of Tincture of Opium to an evaporating dish and evaporate it on a water-bath to about 20 Cc., add 40 Cc. of water, mix thoroughly, and set the liquid aside for one hour, occasionally stirring to disintegrate the resinous flakes adhering to the dish. Then filter the liquid and wash the filter and residue with water, until all soluble matter is extracted (indicated by an almost colorless filtrate), and collect the washings separately. First evaporate the washings, in a tared dish, to a small volume, then add the first filtrate and evaporate the whole to a weight of 14 Gm. Determine the morphine in this extract by the method given under Opium (page 903, eighteenth line from the top, beginning with the word "Rotate"), using the same details as there directed for 10 Gm. of Opium, with the exception that the final multiplication by 10 be omitted. The result will represent the weight in grammes of crystallized morphine yielded by *one hundred cubic centimeters* of Tincture of Opium." *U. S.*

"Opium, 3 *ounces* (Imperial) or 150 grammes; Alcohol (90 per cent.), Distilled Water, of each *a sufficient quantity.* Rub the Opium to a paste with *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of Distilled Water, previously heated to at least 200° F. (93.3° C.); set aside for six hours; add *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of the Alcohol; mix thoroughly; set aside in a covered vessel for twenty-four hours; strain; press; mix the liquids; set aside for twenty-four hours; filter.

Determine the proportion of morphine in the resulting strong tincture by the following process: Pour 80 cubic centimetres of the liquid into a porcelain dish; evaporate on a water-bath until the volume is reduced to 30 cubic centimetres; mix the residual liquid in a mortar with 3 grammes of freshly slaked *lime;* dilute the mixture with *water* to 85 cubic centimetres; set aside for half an hour, stirring occasionally. Filter off 50 cubic centimetres of the liquid (representing 50 cubic centimetres of the strong tincture) through a plaited filter, having a diameter of about one decimetre, into a wide-mouthed stoppered bottle, having a capacity of two hundred cubic centimetres; add 5 cubic centimetres of *alcohol* (90 per cent.) and 30 cubic centimetres of *ether;* shake the mixture; add 2 grammes of *ammonium chloride;* shake well and frequently during half an hour; set aside for 12 hours for the morphine to separate. Counterbalance two small filters; place one within the other in a small funnel in such a way that the triple fold of the inner filter shall be superposed upon the single fold of the outer filter; wet them with *ether;* remove the ethereal layer of the liquid in the bottle as completely as possible by means of a small pipette, and transfer it to the filter; pour into the bottle 15 cubic centimetres of *ether;* rotate the contents and set the bottle aside; transfer the separated ethereal layer carefully, by means of the pipette, to the filter; wash the filter with a total amount of 10 cubic centimetres of *ether* added slowly, and in portions; let the filter dry in the air; pour upon it the liquid in the bottle, in portions, in such a way as to transfer the granular crystalline morphine as completely as possible to the filter. When all the liquid has passed through, wash the remainder of the morphine from the bottle with *morphinated water,* until the whole has been removed. Wash the crystals with *morphinated water* until the washings are free from color; allow the filter to drain; dry it, first by gentle pressure between sheets of bibulous paper, afterwards at a temperature between 131° and 140° F. (55° and 60° C.), finally at 230° F. (110° C.) for 2 hours. Weigh the crystals in the inner filter, counterbalancing by the outer filter. Take 0.3 gramme of the crystals, and titrate with *decinormal volumetric solution of sulphuric acid,* as directed under Opium.

Add to the weight of anhydrous morphine, indicated by the titration, 0.05 gramme (or 0.1 gramme for every 100 cubic centimetres of the original filtrate, should more than 50 cubic centimetres have been used for the estimation), a proportion representing the average loss of morphine during the process.

Having ascertained the proportion of morphine, calculated as anhydrous, present in the 50 cubic centimetres of strong tincture, the remainder is to be diluted with sufficient of a mixture of Alcohol (90 per cent.) and Distilled Water, in equal volumes, to produce a Tincture of Opium containing 0.75 gramme of morphine, calculated as anhydrous, in 100 cubic centimetres. Treated by the foregoing process, Tincture of Opium should yield an amount of morphine, reckoned as anhydrous, corresponding to not less than 0.70 gramme, nor more than 0.80 gramme, in 100 cubic centimetres. This preparation contains, on an average, the soluble matter of 32.8 grains of Opium (con-

taining 10 per cent. of morphine, calculated as anhydrous) in 1 fluid ounce, or about 1 grain of such Opium in 15 minims. Tincture of Opium may be prepared with any variety of opium containing a known percentage of morphine, calculated as anhydrous, provided that the percentage be not less than seven and a half, and provided that the resulting Tincture of Opium respond to the foregoing quantitative test." *Br.*

The proportion of opium in these formulas is not quite the same, the U. S. P. tincture containing about twelve grains more of opium in the fluidounce than the British. The Br. Pharm. 1898 does not direct opium *in powder*, but relies upon an assay to bring the product to a uniform strength. The drying and granulating of the opium are clearly useful provisions, as they insure greater uniformity in the strength of the tincture. Crude opium contains variable proportions of water, and laudanum prepared from a moist specimen will be weaker than that prepared from an equal weight of the dried. The granulation insures the previous drying of the drug, and is thus useful independently of the greater facility which it gives to the action of the menstruum; it is, however, often neglected. Deviation from the official strength in so important a preparation is certainly a great evil. There can be little doubt, we think, that the present U. S. formula insures a more complete exhaustion of the opium than did the former simple procedure of maceration for six days, while the saving in time is apparent. Granulated opium is preferred to powdered opium because of the greater facility of extraction. Opium in fine powder cannot be readily percolated with diluted alcohol, but if it be mixed with an equal weight of an insoluble powder like purified talc there will be no difficulty; percolation will necessarily be slow, but this is just what is required to secure thorough exhaustion.[1]

In the United States and Great Britain this tincture is universally known by the name of *laudanum*. As this term was formerly applied to other preparations of opium, and still continues to be so applied on the continent of Europe, the tincture is sometimes distinguished by the epithet *liquidum*, which, however, is seldom used in this country. *Tinctura Thebaica* is another title by which the preparation is known.

About two-thirds of the opium used in the preparation of the tincture are dissolved, the residue consisting chiefly of inert matter. Allowing the opium to be wholly exhausted of its active principles, one grain would be represented by very nearly 10.5 minims, according to the U. S. formula (8th Rev.); but a small quantity of morphine has been detected in the residuary matter, so that the tincture is rather weaker than the proportion of opium employed would indicate. This difference, however, is too slight to be of any practical importance. In general practice, laudanum very rarely fully comes up to the official standard, and a large proportion of that in the market is far below it. This is especially the case with the cheap laudanums which are so extensively sold to country stores.

The tincture of opium is used for all the purposes to which opium itself is applied. (See *Opium.*) The dose, equivalent to a grain of opium, is about eleven minims (0.65 Cc.), or twenty-two drops. It should be recollected that a fluidrachm or teaspoonful of laudanum (60 minims) will yield, on an average, about 120 drops. Laudanum, when long kept, with occasional exposure to the air, becomes thick from the evaporation of a portion of the alcohol and the deposition of solid matter. If given in this state, it often acts with unexpected energy, and death has resulted in infants from doses which would have been entirely safe if the tincture had been clear. *Denarcotized laudanum* may be prepared by substituting the denarcotized opium for the opium itself.

Dose, five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Linimentum Opii, *Br.*; Tinctura Camphoræ Composita, *Br.*; Tinctura Opii Ammoniata, *Br.*

TINCTURA OPII AMMONIATA. Br.

AMMONIATED TINCTURE OF OPIUM

(tĭnc-tū'rą ō'pĭ-ī ąm-mō-nī-ā'tą)

Scotch Paregoric; Teinture d'Opium ammoniacale, *Fr.*; Ammoniakalische Opiumtinktur, *G.*

"Tincture of Opium, 3 *fl. ounces* (Imperial measure) or 150 cubic centimetres; Benzoic Acid, 180 *grains* or 20.6 grammes; Oil of Anise, 1 *fl. drachm* (Imp. meas.) or 625 cubic centimetres; Solution of Ammonia, 4 *fl. ounces* (Imp. meas.) or 200 cubic centimetres; Alcohol (90 per cent.), *a sufficient quantity*. Dissolve the Oil of Anise and the Benzoic Acid in *twelve fluid ounces* (Imp. meas.) or six hundred cubic centimetres of the Alcohol; add the Tincture of Opium and the Solution of Ammonia; mix well; filter; add enough of the Alcohol to form *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture. This preparation contains the soluble matter of nearly 0.62 grain of Opium (containing 10 per cent. of morphine, reckoned as anhydrous) in 1 fluid drachm, or of nearly 5 grains of such Opium in 1 fluid ounce." *Br.*

This is an old preparation of the Edinburgh Pharmacopœia, formerly used in Scotland under the name of Paregoric Elixir. It differs, however, both in composition and in strength, from the very popular preparation known as Paregoric in the United States. As ammonia precipitates morphine from its solu-

[1] *Tinctura Opii Muriatica.*—Under this name is sometimes prescribed a preparation made by the following formula: Powdered Opium *one ounce;* Muriatic Acid *one fluidounce;* Distilled Water *fifteen fluidounces.* Macerate for 14 days, filter, and add sufficient water to make a pint.

tions, it was doubted whether the tincture contained any of that alkaloid, but if the ammonia be in sufficient excess it will redissolve the morphine. At best, however, the preparation is of doubtful propriety, for if the ammoniacal addition should not happen to have the requisite strength, or if the ammonia should escape or become carbonated by exposure, the strength of the tincture might be affected. Influenced, we presume, by considerations of this kind, the editors of the first British Pharmacopœia rejected the preparation altogether. But popular preference, although local, led to its readmission into the Br. Pharmacopœia, though in a slightly modified form, strong solution of ammonia and rectified spirit being substituted for the Edinburgh spirit of ammonia, which is not official in the Br. Pharmacopœia.

Dose, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.).

TINCTURA OPII CAMPHORATA. U. S. (Br.)

CAMPHORATED TINCTURE OF OPIUM PAREGORIC

(tĭnc-tū'rą ō'pī-ī kăm-phọ-rā'tą)

Tinctura Camphoræ Composita, *Br.;* Compound Tincture of Camphor; Elixir parégorique, *Fr. Cod.;* Teinture (alcoolé) d'Opium Camphrée, *Fr.;* Tinctura Extracti Opii Camphorata, Elixir Paregoricum, Tinctura Opii benzoïca, *P. G.;* Benzoësaurehaltige Opiumtinktur, *G.*

* "Powdered Opium, *four grammes* [or 62 grains]; Benzoic Acid, *four grammes* [or 62 grains]; Camphor, *four grammes* [or 62 grains]; Oil of Anise, *four cubic centimeters* [or 65 minims]; Glycerin, *forty cubic centimeters* [or 1 fluidounce, 169 minims]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Place all the ingredients in a stoppered container and macerate for three days with frequent agitation; then filter the mixture through a well-covered paper filter, adding sufficient Diluted Alcohol through the filter to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Tincture of Opium, 585 *minims* or 60.9 cubic centimetres; Benzoic Acid, 40 *grains* or 4.6 grammes; Camphor, 30 *grains* or 3.4 grammes; Oil of Anise, 30 *minims* or 3.1 cubic centimetres; Alcohol (60 per cent.), *a sufficient quantity.* Dissolve the Benzoic Acid, Camphor, and Oil of Anise in *eighteen fluid ounces* (Imperial measure) or nine hundred cubic centimetres of the Alcohol; add the Tincture of Opium and a sufficient quantity of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture; filter if necessary. This Compound Tincture of Camphor contains in each fluid drachm a proportion of Tincture of Opium equivalent to 1-30th grain of Morphine Hydrochloride, or to ¼ grain of Opium (containing 10 per cent. of anhydrous morphine); or to nearly 0.5 milligramme (0.00046 gramme) of anhydrous morphine in each cubic centimetre." *Br.*

This is the well-known *paregoric.* It is a very pleasant anodyne, much used to allay *cough,* to relieve *nausea* and slight *pains in the stomach and bowels,* to check *diarrhœa,* and, in infantile cases, to *procure sleep.* Half a fluidounce of the U. S. or British tincture contains rather less than a grain of powdered opium. The substitution of glycerin for the honey of the U. S. P. 1870 is an improvement which aids in retaining the transparency of the filtered tincture. Licorice was omitted in 1840, in consequence of giving the dark color of laudanum and thus leading to mistake.

Dose, for an infant, from five to twenty minims (0.3 to 1.3 Cc.); for an adult, from one to four fluidrachms (3.75 to 15 Cc.).[1]

TINCTURA OPII DEODORATI. U. S.

TINCTURE OF DEODORIZED OPIUM

(tĭnc-tū'rą ō'pī-ī dẹ-ō-dọ-rā'tī)

Deodorized tincture of opium, *U. S.* 1880; Teinture (alcoolé) d'Opium sans odeur, *Fr.;* Desodorirte Opiumtinktur, *G.*

* "Granulated Opium (containing 12 to 12.5 percent. of crystallizable morphine), *one hundred grammes* [or 3 ounces av., 231 grains]; Purified Petroleum Benzin, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims]; Alcohol, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Heat *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Water to boiling, and pour it on the Granulated Opium contained

[1] The following formulas were adopted by the Philadelphia College of Pharmacy in 1833 for the preparation of the old compound tinctures of opium so much used under the names of *Bateman's drops* and *Godfrey's cordial.* So long as these nostrums are employed, it is important that they should be prepared in a uniform manner and of a certain strength, as serious consequences may happen from diversity in the formulas when so active a substance as opium is the chief ingredient. Such diversity has existed to a very great extent; so much so that in one formula for Bateman's drops the quantity of opium was seven and a half grains to the pint, while in another it exceeded one hundred grains. It was in order to remedy this evil that the College was induced to adopt the formulas here presented.

"*Bateman's Pectoral Drops.*—Take of Diluted Alcohol 4 gallons, Red Saunders, rasped, 2 oz. tr. Digest for twenty-four hours, filter, and add of Opium in powder, 2 oz. tr., Catechu, in powder, 2 oz. tr., Camphor, 2 oz. tr., Oil of Anise 240 m. Digest for ten days." This preparation is about equal in strength to the camphorated tincture of opium or paregoric elixir of the U. S. Pharmacopœia, containing about two grains of opium to the fluidounce.

"*Godfrey's Cordial.*—Take of Tincture of Opium 24 fld. oz., Molasses (from the sugar refiners) 16 pints, Alcohol 2 pints, Water 26 pints, Potassium Carbonate 20 oz. av., Oil of Sassafras 4 fld. dr. Dissolve the Potassium Carbonate in the Water, add the Molasses, and heat over a gentle fire till they simmer; take off the scum which rises, and add the Laudanum, Alcohol, and Oil of Sassafras, having previously mixed them well together. This preparation contains the strength of rather more than one grain of opium in a fluidounce." (*A. J. P.,* v. 26 and 27.) Death has been produced by it in the infant. (*P. J.,* 3d ser., i. 199.)

in a suitable vessel, stirring the mixture frequently during twenty-four hours. Then transfer the mixture to a percolator, return the first portion of the percolate until it runs through clear, and, when the liquid ceases to drop, continue the percolation with Water until the Opium is exhausted. Concentrate the percolate by evaporation on a water-bath until it measures *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims], and, when cooled, shake it frequently and vigorously for ten minutes with *sixty-five cubic centimeters* [or 2 fluidounces, 95 minims] of the Purified Petroleum Benzin. Separate the Benzin, repeat the shaking out for a few minutes with the remainder of the Benzin, and, having carefully and completely separated this second portion of Benzin, evaporate the remaining liquid in a warm place spontaneously, until the odor of Benzin has disappeared, removing the last traces by the heat of a water-bath. Mix the deodorized liquid so obtained with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Water, filter the mixture through a paper filter, and, having mixed the Alcohol with the filtrate, wash the filter with sufficient Water to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

Assay. U. S. (8th Rev.).—"If 100 Cc. of Tincture of Deodorized Opium be assayed by the process given under *Tinctura Opii* (page 1279), it should yield not less than 1.2 nor more than 1.25 Gm. of crystallized morphine." *U. S.*

This is an excellent preparation of opium, calculated to supersede various extra-official *elixirs* or *solutions,* which have had more or less use, based upon the real advantages they afforded, in offering liquid preparations of opium exempt from certain noxious ingredients in the crude drug and in the official tinctures which rendered them so offensive to some constitutions, and in some conditions of disease, as almost to forbid their use. A liquid extract is first made from granulated opium in which are left behind all the ingredients of opium insoluble in water; and this, being well shaken with purified benzin, is further deprived of all the principles soluble in this fluid, including narcotine and the noxious odorous matter which is probably one of the most offensive and least useful constituents of opium. The purified benzin is then entirely separated, and, the residue having been dissolved in water, the solution is filtered, and mixed with enough alcohol to preserve it. It had been repeatedly recommended by several pharmacists to replace the ether used in the U. S. P. 1890 process with petroleum benzin, which removes the narcotine just as well as does the ether, and has the merit of being much cheaper. The objection, however, was that benzin almost invariably leaves a trace of a taste and an odor like those of petroleum, and hence it is not fitted for use in a remedy used almost exclusively internally, but the employment of purified petroleum benzin in the U. S. P. (8th Rev.) should obviate this objection. Patch found that acetone, which had been suggested as a substitute for ether, was open to the same objection as petroleum benzin. The following simplified process was proposed by E. C. Federer as a substitute for the official one. Macerate the dried and powdered drug in twice its weight of water at about 138° F. (a mixture of 1 part of water at about from 50° to 75° F. with 1 part at about 210° F.), overnight, or about 12 hours, in a moderately warm place not above from 80° to 90° F., in a partially closed flask. Pour the mass into a wetted double precipitate filter: when the liquid ceases to pass, rinse out the flask with 1 part more of the water at about 138° F., and pass this through the mass. Repeat this once, and, if necessary, again repeat, so as to obtain from 4 to 5 parts of moderately concentrated liquor; the residue will under these circumstances become exhausted. Cool the percolate to as near 32° F. as possible, and filter, placing a piece of ice in the filter to keep the temperature down. If necessary, repass the first portion until the liquid comes through clear; when the last portion has passed, wash the filter with sufficient ice-water to obtain a filtrate of 8 parts; lastly, add alcohol 2 parts. Federer states that a permanent, bright, clear tincture results, practically free from narcotine and thoroughly deodorized. (*D. C.*, 1887, 77.)

Frederick T. Gordon (*A. J. P.*, 1900, 576.) recommends an improved process for preparing tincture of deodorized opium in which he proposes paraffin in place of ether for deodorizing the aqueous extract of opium. The opium, in a granulated condition, is extracted with water practically as directed by the Pharmacopœia. The first 300 Cc. of percolate from 100 Gm. of drug are received, the subsequent portions are evaporated to 200 Cc., and the two portions, being mixed, are heated to 180° F. Then 150 Gm. of paraffin U. S. P. are added, and when this has melted the mixture is shaken thoroughly for five or ten minutes and set aside to cool. When the paraffin has hardened, the crust is broken and the aqueous opium solution poured out, the under side of the paraffin crusts being washed with a little water and the washings added to the decanted liquid, which is brought to 800 Cc. To this, 200 Cc. of alcohol are added and finally enough water to make 1000 Cc. of finished product. The paraffin removes the narcotine and odorous matter, but none of the morphine (the latter existing in the opium, as is well known, as meconate, and this is insoluble in the melted paraffin.) A. E. Ebert (*A. J. P.*, 1902, 157) prefers gasolin to benzin and objects to the use of paraffin, or paraffin oils because of their liability to dissolve some of the morphine; he recommends a *concentrated liquid opium* to be used in making the various galenical opium preparations.

Dose, five to ten minims (0.3 to 0.6 Cc.).

Off. Prep.—Tinctura Ipecacuanhæ et Opii, *U. S.*

TINCTURA PHYSOSTIGMATIS. U. S.

TINCTURE OF PHYSOSTIGMA

(tĭnc-tū′rą phȳ-sǫ-stĭg′mą-tĭs)

Teinture (alcoolé) de fève du Calabar, *Fr.;* Kalabarbohnentinktur, *G.*

* "Physostigma, in No. 50 powder (containing 0.15 percent. of ether-soluble alkaloids), *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Physostigma, with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture. Tincture of Physostigma, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.014 Gm. of the ether-soluble alkaloids from Physostigma." *U. S.*

Assay. U. S. (8th Rev.)—"Transfer 100 Cc. of Tincture of Physostigma to a porcelain dish, evaporate it to dryness on a water-bath, and assay the resulting extract by the method given under *Extractum Physostigmatis* (page 486), using the same details as there directed for 1 Gm. of Extract of Physostigma, with the exception that the product must be multiplied by 2 instead of 200; the result will represent the weight in grammes of ether-soluble alkaloids from Physostigma contained in *one hundred cubic centimeters* of Tincture of Physostigma." *U. S.*

This tincture was reduced from a 15 per cent. strength (U. S. P. 1890) to a 10 per cent. tincture in the U. S. P. (8th Rev.) and an assay process appended. This *tincture of Calabar Bean* is much weaker than that proposed by Fraser, which was nearly as strong as a fluidextract,—five minims representing three grains of the drug.

Dose, of the official tincture, from twenty to forty minims (1.3 to 2.5 Cc.).

TINCTURA PODOPHYLLI. Br.

TINCTURE OF PODOPHYLLUM

(tĭnc-tū′rą pŏd-ǫ-phȳl′lī)

Teinture (alcoolé) de Résine de Podophyllum, *Fr.;* Podophyllintinktur, *G.*

"Podophyllum Resin, 320 *grains* or 36.5 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Add the Podophyllum Resin to *eighteen fluid ounces* (Imperial measure) or nine hundred cubic centimetres of the Alcohol, and set aside for twenty-four hours, occasionally agitating; filter; pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture. This Tincture contains twice the proportion of Podophyllum Resin ordered for the corresponding preparation in the British Pharmacopœia of 1885." *Br.*

The introduction of this tincture is of doubtful utility.

Dose, five to fifteen minims (0.3 to 0.9 Cc.).

TINCTURA PRUNI VIRGINIANÆ. Br.

TINCTURE OF VIRGINIAN PRUNE

(tĭnc-tū′rą prū′nī vĭr-ģĭn-ĭ-ā′næ)

Teinture (alcoolé) d'Ecorce de Cerisier, *Fr.;* Wildkirschenrindentinktur, *G.*

"Virginian Prune Bark, in No. 20 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (90 per cent.), 12½ *fl. ounces* (Imp. meas.) or 625 cubic centimetres; Distilled Water, 7½ *fl. ounces* (Imp. meas.) or 375 cubic centimetres. Mix the powder with the Distilled Water; set aside in a closed vessel for twenty-four hours; add the Alcohol, and complete the maceration process." *Br.*

This is a new official tincture of the Br. Pharm. 1898; its utility is doubtful, and its new English name is more than unfortunate. The use of a little glycerin to retard precipitation would be advisable.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA PYRETHRI. U. S., Br.

TINCTURE OF PYRETHRUM

(tĭnc-tū′rą pȳ-rē′thrī)

Tincture of Pellitory; Teinture (alcoolé) de Pyrèthre (racine), *Fr. Cod.;* Bertramwurzeltinktur, *G.*

* "Pyrethrum, in No. 50 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Pyrethrum with *eighty cubic centimeters* [or 2 fluidounces, 338 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Pyrethrum Root, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Moisten the powder with *three fluid ounces* (Imp. meas.)

or one hundred and fifty cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture is a powerful local irritant, and is an ingredient in several well-known mouth and tooth washes. For its uses, which are purely external, see *Pyrethrum.*

TINCTURA QUASSIÆ. U. S., Br.

TINCTURE OF QUASSIA

(tĭnc-tū'rą quas'sĭ-æ)

Teinture (alcoolé) de Quassie Amère, *Fr.;* Quassiatinktur, *G.*

* "Quassia, in No. 50 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Alcohol with *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Water. Moisten the Quassia with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Quassia Wood, rasped, 2 *ounces* (Imperial) or 100 grammes; Alcohol (45 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

The strength of this tincture was doubled in the U. S. P. (8th Rev.) and is twice that of the present British tincture. It may be employed as an addition to tonic infusions or mixtures.

Dose, one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA QUILLAJÆ. U. S. (Br.)

TINCTURE OF QUILLAJA

(tĭnc-tū'rą quĭl-lā'jæ)

Tinctura Quillaiæ, *Br.;* Teinture (alcoolé) d' Ecorce de Quillaya, *Fr.;* Seifenrindentinktur, *G.*

* "Quillaja, in No. 20 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims]; Water, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Boil the Quillaja in a covered vessel with *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Water for fifteen minutes, strain while hot, and wash the residue on the strainer with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Water, previously heated to boiling. Then evaporate the strained liquid to *six hundred cubic centimeters* [or 20 fluidounces, 138 minims], allow it to cool, add the Alcohol, and set it aside for twelve hours. Decant the clear liquid, filter it through paper, then pour the residue on the filter, and, when the liquid ceases to drop, wash the filter with sufficient Water to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Quillaia Bark, in No. 20 powder, 1 *ounce* (Imperial) or 50 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *half a fluid ounce* (Imp. meas.) or twenty-five cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture, which was made official in the U. S. P. 1890 for the first time, is almost exclusively used as an emulsifying agent. Its medicinal activity, however, limits its use. (See *Quillaja,* p. 1035.) The British tincture is only one-fourth the strength of the U. S. preparation.

Dose, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

TINCTURA QUININÆ. Br.

TINCTURE OF QUININE

(tĭnc-tū'rą quĭ-nī'næ)

Teinture (alcoolé) de Quinine, *Fr.;* Chinintinktur, *G.*

"Quinine Hydrochloride, 175 *grains* or 20 grammes; Tincture of Orange, 1 *pint* (Imperial measure) or 1000 cubic centimetres. Dissolve the Quinine Hydrochloride in the Tincture of Orange." *Br.*

Quinine sulphate was replaced in this preparation by the hydrochloride in the 1885 Br. Pharmacopœia, because, as pointed out by Wright (*Y. B. P.,* 1884, 537), the sulphate was not always soluble in the proportion of tincture of orange peel ordered.

Dose, a fluidrachm (3.75 Cc.) (about equal to one and one-tenth grains of quinine hydrochloride).

TINCTURA QUININÆ AMMONIATA. Br.

AMMONIATED TINCTURE OF QUININE

(tĭnc-tū'rą quĭ-nī'næ ąm-mō-nī-ā'tą)

Teinture Ammoniacale de Quinine, *Fr.;* Ammoniakhaltige Chinintinktur, *G.*

"Quinine Sulphate, 175 *grains* or 20 grammes; Solution of Ammonia, 2 *fl. ounces* (Impe-

rial measure) or 100 cubic centimetres; Alcohol (60 per cent.), 18 *fl. ounces* (Imp. meas.) or 900 cubic centimetres. Mix the Solution of Ammonia with the Alcohol; add the Quinine Sulphate; shake until a clear solution is produced; set aside for three days; filter." *Br.*

Dose, one fluidrachm (3.75 Cc.), representing about one and one-tenth grains of quinine sulphate.

TINCTURA RHEI. U. S. (Br.)

TINCTURE OF RHUBARB

(tĭnc-tū'rą rhē'ī)

Tinctura Rhei Composita, *Br.;* Compound Tincture of Rhubarb; Teinture (alcoolé) de Rhubarbe, *Fr. Cod.;* Rhabarbertinktur, *G.;* Tintura di rabarbaro, *It.*

* "Rhubarb, *two hundred grammes* [or 7 ounces av., 24 grains]; Cardamom, *forty grammes* [or 1 ounce av., 180 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol, and *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Reduce the Rhubarb and Cardamom to a No. 40 powder, and moisten this powder with *ninety cubic centimeters* [or 3 fluidounces, 21 minims] of this menstruum; transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for twelve hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Rhubarb Root, in No. 20 powder, 2 *ounces* (Imperial) or 100 grammes; Cardamom Seeds, bruised, ¼ *ounce* (Imp.) or 12.5 grammes; Coriander Fruit, bruised, ¼ *ounce* (Imp.) or 12.5 grammes; Glycerin, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the solid ingredients with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol; proceed with the percolation process until a volume of *eighteen fluid ounces* (Imp. meas.) or nine hundred cubic centimetres of liquid has been obtained; agitate; set aside for forty-eight hours; filter; mix with the Glycerin." *Br.*

This tincture was doubled in rhubarb and cardamom strength in the U. S. P. (8th Rev.). The tincture of rhubarb on standing lets fall a yellow deposit. This has been shown by James T. King (*A. J. P.,* xlii.) to be in most cases largely composed of chrysophanic acid. He proposed to remedy this by the use of a stronger alcohol, or, as recommended by J. B. Moore (*A. J. P.,* xlv. 306), by the substitution of glycerin for a portion of the alcohol. We have not found that either of these plans entirely prevents precipitation, although glycerin is an aid in this direction.[1]

Dose, from one to two fluidrachms (3.75 to 7.5 Cc.).

TINCTURA RHEI AROMATICA. U. S.

AROMATIC TINCTURE OF RHUBARB

(tĭnc-tū'rą rhē'ī ăr-ǫ-măt'ĭ-cą)

Teinture (alcoolé) de Rhubarbe aromatique, *Fr.;* Aromatische Rhabarbertinktur, *G.*

* "Rhubarb, *two hundred grammes* [or 7 ounces av., 24 grains]; Saigon Cinnamon, *forty grammes* [or 1 ounce av., 180 grains]; Cloves, *forty grammes* [or 1 ounce av., 180 grains]; Myristica, *twenty grammes* [or 309 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol and *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Reduce the Rhubarb, Saigon Cinnamon, Cloves, and Myristica to a No. 40 powder, and moisten this powder with *ninety cubic centimeters* [or 3 fluidounces, 21 minims] of this menstruum; transfer it to a percolator, and, without pressing the powder, allow it to stand for twelve hours; then pack it moderately and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close

[1] *Tinctura Rhei Dulcis. U. S.* 1890. *Sweet Tincture of Rhubarb.*—"Rhubarb, *one hundred grammes* [or 3 ounces av., 231 grains]; Glycyrrhiza, *forty grammes* [or 1 ounce av., 180 grains]; Anise, *forty grammes* [or 1 ounce av., 180 grains]; Cardamom, *ten grammes* [or 154 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, Diluted Alcohol, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Rhubarb Glycyrrhiza, Anise, and Cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Mix the Glycerin with *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Alcohol and *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Moisten the powder with *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour Diluted Alcohol upon it, until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture are obtained." *U. S.* 1890.

This is a tincture which has been frequently used in Philadelphia and other sections of our country; it is preferable to the simple tincture for administration to children, on account of its more agreeable taste. The dose is from two to three fluidrachms (7.5 to 11.25 Cc.).

the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on first the remainder of the menstruum, and then sufficient of a mixture of Alcohol and Water, made in the same proportions as before, to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This is the tincture which is used in making the aromatic syrup of rhubarb. It is preferable to separate the preparations, as it is occasionally desirable to prescribe the tincture without the admixture with syrup, while the pharmacist will always prefer to make the tincture in quantity and keep it on hand, since it is permanent, and add to it syrup to make the aromatic syrup when needed.

Dose, for an adult, from one-half to one fluidrachm (1.8 to 3.75 Cc.).

Off. Prep.—Syrupus Rhei Aromaticus, *U. S.*

TINCTURA SANGUINARIÆ. U. S.

TINCTURE OF SANGUINARIA
[Tincture of Blood Root]

(tĭnc-tū'rą săn-guĭ-nā-rī-æ)

Teinture (alcoolé) de Sanguinaire, *Fr.*; Blutwurzeltinktur, *G.*

* "Sanguinaria, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Acetic Acid, *twenty cubic centimeters* [or 325 minims]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 128 minims] of Alcohol with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Water. Moisten the Sanguinaria with the Acetic Acid and *thirty cubic centimeters* [or 1 fluidounce, 7 minims] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture was reduced from 15 per cent. (U. S. P. 1890) to 10 per cent. in the U. S. P. (8th Rev.).

A precipitate will generally be found deposited upon the sides and bottoms of bottles containing this tincture. W. J. McConn (*A. J. P.,* 1884, p. 505) recommended the addition of an alkaline citrate, preferably potassium citrate, as a preventive. He found sanguinarine in the precipitate. The official menstruum now contains 2 per cent. of acetic acid, with a view of preventing precipitation. This tincture is emetic in the *dose* of from three to four fluidrachms (11.25 to 15 Cc.); but it is rather intended to act as an expectorant or an alterative, for which purpose from fifteen to sixty minims (0.9 to 3.75 Cc.) may be given.

TINCTURA SCILLÆ. U. S., Br.

TINCTURE OF SQUILL

(tĭnc-tū'rą sçĭl'læ)

Teinture (alcoolé) de Scille, *Fr. Cod.*; Meerzwiebeltinktur, *G.*; Tintura alcoholica de escila, *Sp.*

* "Squill, in No. 20 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Macerate the Squill with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of the menstruum, in a closed vessel, in a moderately warm place for three days, occasionally stirring, and express strongly. Repeat this operation with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of menstruum, macerating one day before expression; and, finally, macerate the residue for six hours in sufficient menstruum to make the united expressed liquids measure about *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Express as before, mix the expressed liquids, filter through paper, and pass sufficient menstruum through the filter to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Squill, bruised, 4 *ounces* (Imperial) or 200 grammes; Alcohol (60 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

Tincture of Squill was reduced from the strength of 15 per cent. (U. S. P. 1890) to 10 percent. U. S. P. (8th Rev.). This tincture yields a grayish, rose-colored, very bitter and acrid deposit, consisting of silky tufts. (Ménière.) The tincture possesses all the virtues of squill, and may be given whenever the spirituous menstruum is not objectionable.

Dose, as an expectorant or a diuretic, from ten to twenty minims (0.6 to 1.3 Cc.) (from twenty to forty drops).

TINCTURA SENEGÆ. Br.

TINCTURE OF SENEGA

(tĭnc-tū'rą sĕn'ę-gæ)

Teinture (alcoolé) de Polygala de Virginie, *Fr.*; Senegatinktur, *G.*

"Senega Root, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (60 per cent.), *a sufficient quantity.* Moisten the powder with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol, and

complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The Br. Pharm. 1898 increased the strength of this preparation 60 per cent. The tincture is efficient, but it is hardly needed while recourse can be had to the fluidextract or the syrup.

Dose, from thirty minims to two fluidrachms (1.8 to 7.5 Cc.).

TINCTURA SENNÆ COMPOSITA. Br.

COMPOUND TINCTURE OF SENNA

(tĭnc-tū′rą sĕn′næ cǫm-pōs′ĭ-tą)

Elixir Salutis; Teinture (alcoolé) de Séné composée, Teinture de Séné aromatique, Elixir de Salut, *Fr.;* Zusammengesetzte Sennatinktur, *G.*

"Senna, broken small, 4 *ounces* (Imperial) or 200 grammes; Raisins of commerce, freed from seeds, 2 *ounces* (Imp.) or 100 grammes; Caraway Fruit, bruised, ½ *ounce* (Imp.) or 25 grammes; Coriander Fruit, bruised, ½ *ounce* (Imp.) or 25 grammes; Alcohol (45 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

The Br. Pharm. 1898 increased the proportion of senna in this preparation 60 per cent.

This tincture is the *elixir salutis* of the old Pharmacopœias. It is a warm cordial purgative, useful in *costiveness* attended with flatulence, and in *atonic gout,* especially when occurring in intemperate persons. It is also added to cathartic infusions and mixtures. Tincture of senna yields a yellow deposit, disposed in plates, containing starch and white crystals of calcareous salts. (Ménière.)

Dose, from two to four fluidrachms (7.5 to 15 Cc.).

TINCTURA SERPENTARIÆ. U. S., Br.

TINCTURE OF SERPENTARIA

(tĭnc-tū′rą sĕr-pĕn-tā′rĭ-æ)

Tincture of Serpentary; Teinture (alcoolé) de Serpentaire de Virginie, *Fr.;* Schlangenwurzeltinktur, *G.*

* "Serpentaria, in No. 50 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. Moisten the Serpentaria with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Serpentary Rhizome, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Moisten the powder with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

Tincture of Serpentaria was doubled in strength in the U. S. P. (8th Rev.). This tincture is little other than a feebly aromatic, alcoholic stimulant. The Br. Pharm. 1898 increased the strength of this preparation 60 per cent., and it is now of the same strength as the U. S. P. tincture.

Dose, thirty minims to two fluidrachms (1.8 to 7.5 Cc.).

TINCTURA STRAMONII. U. S., Br.

TINCTURE OF STRAMONIUM

(tĭnc-tū′rą strą-mō′nĭ-ī)

Tincture of Stramonium Leaves; Teinture (alcoolé) de Stramoine (feuille), *Fr. Cod.;* Stechapfelblättertinktur, *G.*

* "Stramonium, in No. 60 powder (containing not less than 0.35 percent. of mydriatic alkaloids), *one hundred grammes* [or 3 ounces av., 231 grains]; Diluted Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Stramonium with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Diluted Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for three hours; then pack it firmly and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, gradually pouring on Diluted Alcohol until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] are obtained. Tincture of Stramonium, when assayed by the process given below, should contain in *one hundred cubic centimeters* 0.03 Gm. of mydriatic alkaloids from Stramonium." *U. S.*

Assay. U. S. (8th Rev.)—"Transfer 100 Cc. of Tincture of Stramonium to an evaporating dish, and evaporate it on a water-bath until it measures about 10 Cc. Add, if necessary, sufficient alcohol to dissolve any separated substance, and then assay the resulting liquid by the method given under *Fluidextractum Belladonnæ Radicis* (page 528), using the same details as there directed for 10 Cc. of Fluid-

extract of Belladonna Root, with the exception that the multiplication by 10, as there directed, be omitted; the result will represent the weight in grammes of alkaloids contained in *one hundred cubic centimeters* of Tincture of Stramonium." *U. S.*

"Stramonium Leaves, in No. 20 powder, 4 *ounces* (Imperial) or 200 grammes; Alcohol (45 per cent.), *a sufficient quantity.* Moisten the powder with *four fluid ounces* (Imp. meas.) or two hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

This tincture is now made from Stramonium leaves instead of the seeds as directed by the U. S. P. 1890, and the strength made 10 per cent. instead of 15 per cent., as in the U. S. P. 1890, and an assay has been appended. The Br. Pharm. 1898 increased the strength of this preparation 60 per cent., but changed the form of the drug from seed to leaves. The British tincture is now double the strength of the U. S. P. (8th Rev.) tincture.

Dose, from ten to twenty minims (0.6 to 1.3 Cc.); of the British tincture, five to fifteen minims (0.3 to 0.9 Cc.).

TINCTURA STROPHANTHI. U. S., Br.

TINCTURE OF STROPHANTHUS

(tĭnc-tū'rą strǫ-phăn'thī)

Teinture (alcoolé) de Strophantus Kombé, *Fr. Cod.;* Tinctura Strophanthi, *P. G.;* Strophanthustinktur, *G.;* Strophanthussamentinktur, *G.;* Tintura di strofanto, *It.;* Tintura alcoholica de estrofanto, *Sp.*

"NOTE.—The strength of this tincture has been increased from 5 Gm. of Strophanthus in 100 Cc. to 10 Gm. of Strophanthus in 100 Cc." *U. S.*

* "Strophanthus, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. Moisten the Strophanthus with *fifty cubic centimeters* [or 1 fluidounce, 331 minims] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Strophanthus Seeds, in No. 30 powder, ½ *ounce* (Imperial) or 25 grammes; Alcohol (70 per cent.), *a sufficient quantity.* Pack the powder in a percolator; moisten it with *one fluid drachm* (Imp. meas.) or six cubic centimetres of the Alcohol; set aside for forty-eight hours; pour on successive quantities of the Alcohol, allowing percolation to proceed slowly, until a total volume of *ten fluid ounces* (Imp. meas.) or five hundred cubic centimetres of percolate has been obtained; filter; add a sufficient quantity of the Alcohol to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture. This preparation is made with half the proportion of Strophanthus Seeds ordered for the corresponding preparation in the British Pharmacopœia of 1885 (Additions 1890)." *Br.*

Tincture of Strophanthus was doubled in strength in the U. S. P. (8th Rev.) (the U. S. P. 1890 tincture being 5 per cent.), and is now about four times the strength of the British tincture. The Br. Pharm. 1885 preparation was based on Fraser's formula, as improved by Wm. Martindale;[1] but the 1898 revision practically adopted the process of the U. S. tincture and dropped the method of previous treatment with ether to remove the fatty oil. Undoubtedly the simplest way of overcoming this difficulty is to add sufficient water to the alcoholic menstruum to prevent the solution of the oil, which is thus thrown out with the residue. Warrington subjects the tincture to a temperature of 32° F., and filters out the fatty deposit. (*West. Drug.,* 1892, 448.) Strophanthus seeds are reduced to powder with great difficulty. E. R. Squibb bruises them (after drying perfectly) in an iron mortar with broken glass. (*Ephem.,* vol. iii. 1252.) Made by either process, the tincture is usually slightly cloudy when first prepared, but on standing soon becomes of a bright amber color. Petroleum benzin has been used in place of ether in Fraser's process for extracting the fixed oil, but it has only the advantage of economy, communicating a petroleum-like taste and odor to the tincture.

Uses.—This is an efficient and popular preparation, which fully represents the crude drug. (See *Strophanthus.*)

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[1] *Tincture of Strophanthus* (Fraser's process). Strophanthus Seeds, deprived of their comose appendices, reduced to powder, and dried, 1 ounce; Ether, freed from spirit and from water, 10 fluidounces; Rectified Spirit (alcohol), a sufficiency to obtain 1 pint, or 20 fluidounces. Remove entirely the stalks and comose appendices from the seeds, reduce the seeds to a moderately fine powder, dry the powder by exposing for twelve hours to a temperature of 100° or 120° F., and weigh. Pack in a percolator, add ether until the whole of the powder is saturated and a small quantity of the ether has dropped into the receiver; arrest the percolation for twenty-four hours, and then continue percolating slowly until the whole of the ether has been used. If the last ether percolate should not be almost colorless, use more ether. Remove the powder from the percolator, expose to the air, and break up any lumps after the ether has sufficiently evaporated: continue the exposure, heating the powder, if necessary, to 100° or 120° F., until all the ether has evaporated, when a uniform, nearly white, dry powder may be easily obtained. Repack the powder in the percolator, add enough of rectified spirit to moisten it thoroughly, arrest the further flow of the spirit, macerate for forty-eight hours, and pass rectified spirit slowly through until 20 fluidounces of tincture have been obtained.

Dose, from five to ten minims (0.3 to 0.6 Cc.); of the British tincture ten to thirty minims (0.6 to 1.8 Cc.).

TINCTURA SUMBUL. Br.

TINCTURE OF SUMBUL

(tĭnc-tū′rą sŭm′bŭl)

Teinture (alcoolé) de Sumbul, *Fr.;* Moschuswurzeltinktur, Sumbultinktur, *G.*

"Sumbul Root, bruised, 2 *ounces* (Imperial) or 100 grammes; Alcohol (70 per cent.), 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Prepare by the maceration process." *Br.*

Tincture of Sumbul was not introduced into the U. S. P. (8th Rev.). The process of the U. S. P. 1890 is appended.[1]

This tincture is very little if at all employed in this country; for its properties, see *Sumbul.*

Dose, from twenty minims to a fluidrachm (1.3 to 3.75 Cc.).

TINCTURA TOLUTANA. U. S., Br.

TINCTURE OF TOLU

(tĭnc-tū′rą tō-lū-tā′ną)

Tincture of Balsam of Tolu; Teinture (alcoolé) de Baume de Tolu, *Fr. Cod.;* Tolubalsamtinktur, *G.*

* "Balsam of Tolu, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Balsam of Tolu in *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of Alcohol, shaking frequently until dissolved; then filter through paper, and wash the filter with sufficient Alcohol to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Balsam of Tolu, 2 *ounces* (Imperial) or 100 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Place the Balsam of Tolu in *sixteen fluid ounces* (Imp. meas.) or eight hundred cubic centimetres of the Alcohol; set aside in a closed vessel; agitate occasionally; when the Balsam is dissolved, filter; pass sufficient of the Alcohol through the filter to produce *one pint* (Imp. meas.) or one thousand cubic centimetres of the Tincture." *Br.*

This tincture was doubled in strength in the U. S. P. (8th Rev.). The British tincture (1898) was reduced 20 per cent. in the proportion of balsam and is half the strength of the U. S. P. (8th Rev.) tincture.

The tincture of tolu has the properties of the balsam, and may be employed as an addition to expectorant mixtures in *chronic bronchitis,* but the proportion of alcohol is too large to allow of its advantageous use in some cases. It is used in preparing the syrup of tolu. In smaller quantities it is often employed to flavor cough mixtures. It is decomposed by water.

Dose, one-half to two fluidrachms (1.8 to 7.5 Cc.).

Off. Prep.—Syrupus Tolutanus, *U. S.*

TINCTURA VALERIANÆ. U. S.

TINCTURE OF VALERIAN

(tĭnc-tū′rą vą-lē-rī-ā′næ)

Teinture (alcoolé) de Valériane, *Fr. Cod.;* Tinctura Valerianæ, *P. G.;* Baldriantinktur, *G.;* Tintura di valeriana, *It.*

* "Valerian, in No. 60 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of Alcohol with *two hundred and fifty cubic centimeters* [or 8 fluidounces, 218 minims] of Water. Moisten the Valerian with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of this menstruum, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient menstruum to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

The proportion of alcohol was increased in the U. S. 1890 tincture, to prevent precipitation, and this strength has been retained in the present revision. It is now three parts of alcohol to one part of water. The tincture possesses the properties of valerian, but cannot be given in some cases, so as to produce the full effects of the root, without stimulating too highly, in consequence of the large proportion of spirit. It deposits on standing a black, very cohesive precipitate, with starch, and a yellow extractive matter. (Ménière.)

Dose, one to four fluidrachms (3.75 to 15 Cc.).

TINCTURA VALERIANÆ AMMONIATA. U. S., Br.

AMMONIATED TINCTURE OF VALERIAN

(tĭnc-tū′rą vą-lē-rī-ā′næ ąm-mō-nī-ā′tą)

Tinctura Valerianæ Composita; Teinture de Valériane ammoniacale, *Fr.;* Ammoniakalische Baldriantinktur, *G.*

[1] "Sumbul, in No. 30 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, Water, each, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix Alcohol and Water in the proportion of *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol to *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. Moisten the powder with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture are obtained." *U. S.* 1890.

* "Valerian, in No. 60 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Aromatic Spirit of Ammonia, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Valerian with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of Aromatic Spirit of Ammonia, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Aromatic Spirit of Ammonia to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Aromatic Spirit of Ammonia to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Valerian Rhizome, in No. 40 powder, 4 *ounces* (Imperial) or 200 grammes; Oil of Nutmeg, 30 *minims* or 3.1 cubic centimetres; Oil of Lemon, 20 *minims* or 2.1 cubic centimetres; Solution of Ammonia, 2 *fl. ounces* (Imp. meas.) or 100 cubic centimetres; Alcohol (60 per cent.), 18 *fl. ounces* (Imp. meas.) or 900 cubic centimetres. Mix the liquid ingredients, and prepare by the maceration process." *Br.*

The proportion of valerian was increased 60 per cent. in the Br. Pharm. 1898, and the aromatic spirit of ammonia replaced by alcohol, solution of ammonia, and volatile oils.

The ammonia in this preparation is thought to assist the solvent powers of the alcohol, while it co-operates with the valerian in medicinal action. The quantity of valerian was very judiciously increased one-third in the U. S. revision of 1880. The tincture is employed as an antispasmodic in *hysteria* and other *nervous diseases*.

Dose, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.), in sweetened water, milk, or some mucilaginous fluid.

TINCTURA VANILLÆ. U. S.

TINCTURE OF VANILLA

(tĭnc-tū'rą vą-nĭl'læ)

Teinture (alcoolé) de Vanille, *Fr.*; Vanilletinktur, *G.*

* "Vanilla, cut into small pieces and bruised, *one hundred grammes* [or 3 ounces av., 231 grains]; Sugar, in coarse powder, *two hundred grammes* [or 7 ounces, 24 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred and fifty cubic centimeters* [or 21 fluidounces, 470 minims] of Alcohol with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 401 minims] of Water. Macerate the Vanilla in *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of the mixture for twelve hours; then drain off the liquid and set it aside. Transfer the Vanilla to a mortar, beat it with the Sugar into a uniform powder, then pack it in a percolator and pour upon it the reserved liquid. When this has disappeared from the surface, continue the percolation by gradually pouring on sufficient menstruum to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

This tincture will be easily recognized as the so-called *fluidextract of vanilla*. The object of the preliminary maceration of the cut vanilla is to soften it, so that it may be easily disintegrated when beaten up with the sugar; if the details of the above process be carefully carried out and the alcohol be deodorized, a very satisfactory preparation will result. It is used as a flavoring agent, also to make *vanilla syrup*, by adding one ounce of the tincture to sufficient syrup to make one pint. For a paper on flavoring extracts by Scoville, see *Bull. Pharm.*, 1902, 153, 188.

TINCTURA VERATRI. U. S.

TINCTURE OF VERATRUM

[Tinctura Veratri Viridis, Pharm. 1890]

(tĭnc-tū'rą vę-rā'trī)

Tincture of Green Hellebore; Tincture of American Hellebore; Teinture (alcoolé) de Vératre, *Fr.*; Tinctura Veratri, *P. G.*; Nieswurzeltinktur, *G.*

"Note.—The strength of this tincture has been reduced from 40 Gm. of Veratrum Viride in 100 Cc. to 10 Gm. of Veratrum in 100 Cc." *U. S.*

* "Veratrum, in No. 60 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Veratrum with *forty cubic centimeters* [or 1 fluidounce, 169 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

The U. S. tincture of American hellebore of 1890 was of the same strength as Norwood's tincture, which, when prepared by its author, was supposed to be saturated. This may be true of certain ingredients of the root, though probably not in reference to the active principle or principles which it may contain. The strength of this tincture was reduced by the U. S. P. (8th Rev.) from 40 per cent. to 10 per cent. in order to have it conform with the recommendations of the Brussels Congress con-

cerning potent tinctures (see *Tincturæ*). This action will probably result in increasing the use of the fluidextract, which is a better preparation.

Dose, of U. S. tincture, ten to thirty minims (0.6 to 1.8 Cc.).

TINCTURA ZINGIBERIS. U. S., Br.

TINCTURE OF GINGER

(tĭnc-tū'ra zĭn-gĭb'ĕ-rĭs)

Teinture (alcoolé) de Gingembre, *Fr. Cod.;* Tinctura Zingiberis, *P. G.;* Ingwertinktur, *G.*

* "Ginger, in No. 50 powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Alcohol, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the Ginger with *sixty cubic centimeters* [or 2 fluidounces, 14 minims] of Alcohol, transfer it to a percolator, and, without pressing the powder, allow it to stand, well covered, for six hours; then pack it firmly and pour on enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed slowly, pouring on sufficient Alcohol to obtain *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture." *U. S.*

"Ginger, in No. 40 powder, 2 *ounces* (Imperial) or 100 grammes; Alcohol (90 per cent.), *a sufficient quantity.* Moisten the powder with *two fluid ounces* (Imp. meas.) or one hundred cubic centimetres of the Alcohol, and complete the percolation process. The resulting Tincture should measure *one pint* (Imp. meas.) or one thousand cubic centimetres." *Br.*

The strength of this tincture was reduced at the 1880 revision one-third, to bring it into the 20 per cent. class; this is not a disadvantage, however, in view of the introduction of the fluidextract, and the dose is not now inconveniently large.

The tincture of the British Pharmacopœia, though more than twice as strong as was that of the London and Edinburgh Colleges, is still too weak in the proportion of ginger. In consequence of the mucilaginous matter contained in ginger, the tincture made with diluted alcohol or proof spirit is apt to be turbid. Alcohol or rectified spirit is, therefore, properly preferred. Official Jamaica ginger only should be used; for, while a darker-colored preparation is made when the inferior varieties are substituted, the apparent increase in strength is due to coloring matter, and not to the presence of a larger amount of volatile oil or resin.

The tincture of ginger is a useful carminative, and may often be beneficially added to tonic and purgative infusions or mixtures in debilitated states of the alimentary canal. It is in this country largely used for the preparation of a syrup of ginger, for which purpose, however, the fluidextract is official, and is better even than the strong tincture of the Br. Pharmacopœia 1885, which was dropped at the 1898 revision.

Dose, eight to forty minims (0.5 to 2.5 Cc.).

Off. Prep.—Acidum Sulphuricum Aromaticum, *U. S., Br.;* Liquor Sennæ Concentratus, *Br.;* Pilula Scammonii Composita, *Br.*

TINCTURÆ. U. S.

TINCTURES

(tĭnc-tū'ræ)

Teintures (Alcooliques) Alcoolés, *Fr.;* Tinkturen, *G.;* Tinture alcooliche, *It.;* Tinturas alcoholicas, *Sp.*

Tinctures, in the pharmaceutical sense of the term, are alcoholic solutions of medicinal substances, prepared by maceration, digestion, or percolation. Solutions in spirit of ammonia and ethereal spirit are embraced under the same denomination, but are severally distinguished by the titles of *ammoniated tinctures* and *ethereal tinctures.* The advantages of alcohol as a menstruum are that it dissolves principles which are sparingly or not at all soluble in water, and contributes to their preservation when dissolved, while it leaves behind some inert substances which are dissolved by water. In no instance, however, is absolute alcohol employed. The U. S. Pharmacopœia directs it of the sp. gr. 0.816 at 15.6° C. (60° F.), the British, 0.834. When of these densities it contains water, and is capable of dissolving more or less of substances which are insoluble in anhydrous alcohol, while its solvent power in relation to bodies soluble in that fluid is sufficient for all practical purposes. Diluted alcohol or proof spirit is often preferable to official alcohol, as it is capable of extracting a larger proportion of those active principles of plants which require an aqueous menstruum, while at the same time it is strong enough to prevent spontaneous decomposition, and has the advantages of being cheaper and less stimulating, although a few tinctures when prepared with proof spirit or diluted alcohol undergo some deterioration in time, in consequence of acetous fermentation taking place in the alcoholic fluid. The best preventive is to keep them in full and well-closed bottles, at a low temperature. The diluted alcohol of the different Pharmacopœias is not of the same strength; that of the United States consists of equal volumes of official alcohol and water, and has the sp. gr. of about 0.936 at 15.6° C. (60° F.), while the British has four official diluted alcohols,—70, 60, 45, and 20 per cent. Alcohol or rectified spirit is preferred as a solvent when the substance to be extracted or dissolved is nearly or quite insoluble in water, as in the instances of resins, guaiac, camphor, and the essential oils. The presence of water is here injurious, not only by diluting the menstruum, but also by exercising an affinity for the alcohol which interferes with its solvent power. Thus, water added to an alcoholic solution of one

of these bodies produces a precipitate by abstracting the alcohol from it. Diluted alcohol or proof spirit is employed when the substance is soluble both in alcohol and in water; or when one or more of the ingredients are soluble in the one fluid and one or more in the other, as in the case of vegetable bodies which contain extractive or tannin, or the natural salts of the alkaloids, or gum united with resin or essential oil. As these include the greater number of medicines from which tinctures are prepared, diluted alcohol is most frequently used. In the preparation of the tinctures, the drug should be dry, and properly comminuted by being bruised, sliced, or pulverized. It is usually better in a moderately fine than in a very fine powder; the proper degree depends, however, upon the ease with which the menstruum extracts the soluble principles.

Tinctures were at one time universally prepared by maceration or digestion. Our own Pharmacopœia formerly directed maceration at ordinary temperatures, and extended the period to two weeks. The latter plan was preferable, as it was more convenient and equally effectual, the lower temperature being compensated by the longer maceration. In several instances in which maceration is ordered in the Pharmacopœia, it is still continued for seven days, but the period is very properly altered to suit the character of the substance acted on, and sometimes continued no longer than is necessary for its solution, when it is wholly soluble, as in the tinctures of iodine and tolu. When circumstances require that the tincture should be speedily prepared, digestion may be resorted to. Care should always be taken to keep the vessels well stoppered, in order to prevent the evaporation of the alcohol. The materials should be frequently shaken during the digestion or maceration, and this caution is especially necessary when the substance acted on is in the state of powder. The tincture should not be used until the maceration is completed, when it should be separated from the dregs either by simply filtering it through paper, or, when force is requisite, by expressing it through linen, and filtering.

The plan of preparing tinctures by percolation has been extensively adopted, and has been found to answer well when skilfully executed. In the present edition of our Pharmacopœia, percolation has been adopted as the rule, maceration being directed in some instances in which it was deemed preferable. The British Pharmacopœia, preferring maceration or digestion in several instances, has adopted percolation as a rule, but, as if unprepared to trust this process alone, has combined with it a preliminary maceration of forty-eight hours, and a final expression, so as to separate the last remains of the tincture from the dregs. Perhaps these modifications may be desirable in instances where the operator is not sufficiently skilful, but percolation, properly managed, is of itself adequate to all the desired purposes, even to the removal of almost the last drop of impregnated menstruum from the dregs, and in our Pharmacopœia it is taken for granted that the apothecary has acquired the requisite skill. Where the operator cannot trust himself in this respect, it would be better to recur to the old method of maceration for safety. The reader will find rules for the proper management of the process of percolation at page 462. It has been objected to this process that it yields tinctures of variable strength, according to the skill with which it is conducted; but, from numerous experiments performed, in reference to this point, by H. Buignet of Paris, it appears that the tinctures made by percolation are quite as equable in strength as those prepared by maceration, while they uniformly contain more of the soluble matter of the drug in proportion to the quantity of menstruum. The same writer states that he has constantly found three parts of alcohol, used in this method, to one of the material acted on, sufficient to exhaust drugs almost wholly of their soluble matter. He has derived no advantage from the preliminary maceration usually practised. Fairthorne (*A. J. P.*, 1881, p. 308), in the preparation of hydro-alcoholic tinctures, preferred to macerate the ingredients for twenty-four hours alone in the alcohol, then filter, and mix the filtrate with the required quantity of water and percolate the dregs with the mixture. This plan might be of service in the case of a few drugs which are difficult to exhaust of their activity, but it would involve a useless expenditure of labor and time if used in the majority of official tinctures, and precipitation would be more common. It has been contended in opposition to percolation, applied to the preparation of tinctures, that the menstruum is apt to load itself with substances which, after the preparation of the tincture, are deposited, carrying down with them more or less of the active matter, but Vauflart asserts that more than twenty years of observation has demonstrated to him that tinctures by displacement, properly filtered, deposit no more at the end of a certain period than do those prepared by maceration. Besides, upon the same authority, this tendency to deposition may be easily obviated by mixing all the liquids proceeding from the percolation, and allowing the mixture to stand for a day before filtering. The tinctures thus obtained are, he states, richer than those furnished by ordinary maceration, and time produces in them only insignificant changes. (*J. P. C.*, 4e sér., iv. 411, 1866.) Finally, all agree that the percolated tinctures are apt to contain more of the soluble matter of the drug, and the objections resolve themselves altogether into a question of skill on the part of the operator.

The method of making tinctures by diluting fluidextracts, except in a few special cases, is not to be recommended. The menstruum directed for the fluidextract is most frequently not

identical with that used for the tincture, and precipitation of active constituents often ensues when this easy method is employed. Owing to the larger dose of the tinctures, and consequently less degree of concentration, a larger proportion of water can be used in their menstrua than in fluidextracts, and this is a distinct advantage, as tinctures are frequently prescribed in combination with aqueous solutions.

Another mode of exhausting medicines by spirit has been proposed by H. Burton. It consists in suspending in the solvent, immediately under its surface, the solid matter contained loosely in a bag. The liquid in contact with the bag, becoming heavier by impregnation with the matters dissolved, sinks to the bottom; its place is supplied with a fresh portion, which in its turn sinks, and thus a current is established, which continues until the solid substance is exhausted or the liquid saturated. During the maceration the bag should be occasionally raised above the surface of the liquor in the bottle, allowed to drain, and then again immersed. It is asserted that the period of maceration is much shortened in this way. For this mode of preparing tinctures Samuel Gale has proposed the use of a cylindrical stoneware vessel with a diaphragm capable of being supported at different heights by projections from the inner surface of the jar, with corresponding notches in the diaphragm, to permit its easy passage to the lower ledges. The material is to be placed upon the diaphragm and kept covered with the menstruum. (*A. J. P.,* xxii. 381.)

Tinctures prepared by adding alcohol to the expressed juices of plants have been long in use on the continent of Europe, and have been brought into notice in Great Britain. They are sometimes called in England *preserved vegetable juices.* The tinctures of some of the narcotic plants might no doubt be advantageously prepared in this way, as those of conium, hyoscyamus, and belladonna. See *Succus.* Squire and Bentley have paid attention to these preparations. According to Squire, the leaves only of the plants should be used, and, in the case of biennial plants, those exclusively of the second year, and they should be preferably collected when the plant is in full flower. Bentley recommends the following mode of preparation. To the expressed juice, after it has stood for 24 hours and deposited its feculent matter, alcohol sp. gr. 0.838 is to be added in the proportion of one part by measure to four parts of the juice, and after another period of 24 hours the liquor is to be filtered. This proportion of alcohol has been found sufficient for the preservation of the juice, while it causes the precipitation of the suspended mucilaginous matter. But, though these preserved juices are often energetic, yet it is obvious that tinctures prepared from the fresh plant must be still more so, as they contain necessarily not only the soluble active matter of the juice, but also that which, when the juice is expressed, is left in the solid residue of the plant.

Tinctures should be kept in bottles accurately stoppered, in order to prevent evaporation, which might in some instances be attended with serious inconvenience, by increasing their strength beyond the official standard.

Medicines which act in small doses are most conveniently administered in tinctures, as the proportion of alcohol in which they are dissolved is insufficient to produce an appreciable effect. Those which must be given in large doses should be cautiously employed in this form, lest the injury done by the menstruum should more than counterbalance their beneficial operation. This remark is particularly applicable to chronic cases, in which the use of tinctures is apt to lead to the formation of habits of intemperance. The tinctures of the weaker medicines are more frequently given as adjuvants of other remedies than with the view of obtaining their own full effects upon the system.

In the revision of the Pharmacopœia of 1890, wherever practicable, the proportion of drug to finished tincture was made either 20, 15, 10, or 5 per cent. by volume. Progressive pharmacy demands greater uniformity and simplicity in the processes, and hence in the U. S. P. (8th Rev.) practically all of the tinctures have been brought into two classes, 20 and 10 per cent. The potent tinctures which were mainly 15 per cent. in the U. S. P. 1890 have been reduced to 10 per cent. in order to comply with the recommendations of the Conference for the unification of the strength of Potent Remedies which met in Brussels in 1902. These changes caused considerable outcry at first among physicians and pharmacists, but gradually as time has progressed the wisdom of the Committee of Revision in taking this step has been justified. The tinctures from the following drugs were reduced in strength in the U. S. P. (8th Rev.): Aconite, Belladonna leaf, Benzoin (compound), Cannabis Indica, Catechu (now Gambir), Colchicum seed, Digitalis, Gelsemium, Hyoscyamus, Kino, Lobelia, Nux Vomica (slightly), Opium (slightly), Opium, deodorized (slightly), Physostigma, Sanguinaria, Squill, Stramonium, and Veratrum. The strengths of the following were increased: Calumba, Cantharides, Capsicum, Cardamom, Cinnamon, Orange (sweet), Quassia, Rhubarb, Serpentaria, Strophanthus, Tolu. Assay processes are in the U. S. P. (8th Rev.) for the following tinctures: Aconite, Belladonna leaves, Cinchona, Colchicum Seed, Hydrastis, Hyoscyamus, Nux Vomica, Opium, Opium (deodorized), Physostigma and Stramonium.

TINCTURÆ HERBARUM RECENTIUM. U. S.

TINCTURES OF FRESH HERBS

(tĭnc-tū'ræ hĕr-bā'rŭm rẹ-cĕn'tĭ-ŭm)

Alcoolatures, *Fr. Cod.;* Tincturen von frischen Pflanzen, *G.*

"Tinctures of Fresh Herbs, when not otherwise directed, are to be prepared according to

the following formula: "The Fresh Herb, cut, bruised, or crushed, *five hundred grammes* [or 17 ounces av., 279 grains]; Alcohol, *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Herb with the Alcohol in a closed vessel in a moderately warm place during fourteen days, with occasional stirring; then strongly express the liquid and filter it through paper." *U. S.*

This is a general formula introduced for the guidance of the pharmacist in securing some degree of uniformity in this class of tinctures. Tinctures from fresh herbs are coming into use to some extent, and the fresh herb is to be preferred to the dried drug where a very volatile or easily dissociated substance is the active principle. It is evident that the relative strength must vary, however, with the degree of freshness of the drug and the amount of water contained in it, which depends upon the time of collection, the state of the weather when the herb was gathered, and the amount of subsequent exposure to the atmosphere: hence an absolutely uniform relation cannot be obtained. It is asserted that the fresh tinctures of thuja and gelsemium are more active than the tinctures from the dried drug. (*Proc. A. Ph. A.*, 1878, 755.) F. J. B. Quinlan preserves medicinal plants in a fresh state for a reasonable period in the following manner. The herbs in a perfectly fresh state are bruised to a pulp in a mortar, placed in a glass bottle, and well tamped down; the stopper is then forced in so as to exclude every particle of air, and the top encased by beeswax softened by heat. The bottles are then buried in the ground at a depth of three feet. So treated, belladonna, conium, and other herbs have been kept for four months perfectly sweet and fit for pharmaceutical purposes, and it is probable that bottled herbs will keep in this manner for six or even eight months, and perhaps longer. (*Y. B. P.*, 1883, p. 491.)

TRAGACANTHA. U. S., Br.

TRAGACANTH

(trăg-ą-căn'thą)

"A gummy exudation from *Astragalus gummifer* Labillardière, or from other species of *Astragalus* (Fam. *Leguminosæ*)." *U. S.* "A gummy exudation obtained by incision from Astragalus gummifer, *Labill.*, and some other species of Astragalus, *Linn.* Known in commerce as Syrian tragacanth." *Br.*

Gummi Tragacanthæ vel Astragalorum: Gomme Adragante, *Fr. Cod.*; Tragacantha, *P. G.*; Tragant, Traganth, *G.*; Gomma adragante, Dragante, *It.*; Gomo tragacanto, *Sp.*

Numerous species belonging to this genus yield a gummy matter having the properties of tragacanth. The drug known in commerce by that name was at first erroneously supposed to be obtained from *A. Tragacantha* of Linnæus (*A. massiliensis* of Lamarck), which grows in Southern Europe and Northern Africa and is now said to yield no gum. It was afterwards ascribed, on the authority of Tournefort, to a species (*A. creticus* of Lamarck) which grows in Crete and Ionia, and on that of Olivier, to *A. verus*, which inhabits Asia Minor, Armenia, and Northern Persia. Labillardière described a species by the name of *A. gummifer* which he found growing on Mount Libanus in Syria, and from which tragacanth exudes, though not that of commerce.

Sieber denies that any of the above-mentioned species yields the official tragacanth, which he ascribes to *A. aristatus*, growing in Anatolia especially upon Mount Ida, where the gum is most abundantly collected. This plant, however, is not the *A. aristatus* of Villars, which, according to Sibthorp, furnishes tragacanth in Greece. (Mérat and De Lens.) Lindley received two specimens of plants, said to be those which furnish tragacanth in Turkestan, one of which proved to be *A. gummifer* of Labillardière which was said to yield a white variety, and the other a new species, which he called *A. strobiliferus*, and which was said to yield a red and inferior product. The fact seems to be that the commercial drug is collected from various sources; and it is affirmed that all the species of Astragalus with thorny petioles are capable of producing it. These form a natural group, and so closely resemble one another that botanists have found some difficulty in distinguishing them. They are very abundant on the mountains of Asia Minor, and, according to information received by M. J. Léon Soubeiran from Balansa, a scientific traveller who derived his knowledge from personal observation, the gum-producing species are closely analogous to the *A. creticus* of Lamarck. It is in the Anti-Taurus range that the gum is chiefly collected. Transverse incisions are made, near the base of the stem, into the medullary part, which alone yields juice. This exudes very slowly, flowing at night, and ceasing during the day; two weeks usually elapse before the pieces are large enough for collection. The shape of the pieces is influenced by the rapidity of the exudation, and the lines on their surface indicate the daily concretion. The section Tragacantha of the genus Astragalus includes the principal species which yield gum tragacanth.

According to Haussknecht, tragacanth is yielded by the following species of Astragalus: *A. adscendens*, Boiss. et Hausskn. (Southern Persia); *A. leioclados*, Boiss. (in Middle and Western Persia, by Ispahan and Hamadan); *A. brachycalyx*, Fisch. (Kurdistan and Luristan); *A. gummifer*, Labill. (widely distributed from Lebanon to Armenia and in the northern regions of the Euphrates and Tigris); *A. microcephalus*, Willd. (the same as *A. gummifer*, Labill., and also in Asia Minor); *A. pycnocladus*, Boiss. et Hausskn. (particularly in Western Persia); *A. stromatodes*, Bge. (in

Achyr Dagh, in Northern Syria); *A. kurdicus,* Boiss. (Aintab). Other species that yield a tragacanth gum are *A. heratensis,* Bge., of the Khorasan Mountains, which yields a gum known as "kutira," and *A. Parnassi,* Boiss., var. *cyllenea,* found on the mountains of Peloponnesus.

Properties.—Tragacanth is odorless and nearly tasteless. It occurs either in flaky, leaf-like pieces, irregularly oblong or roundish, or in tortuous vermicular filaments, rounded or flattened, rolled up or extended, of a whitish, yellowish-white, or slightly reddish color, marked by parallel lines or ridges, somewhat translucent, and resembling horn in appearance. In commerce certain varieties of tragacanth are recognized and usually known by the name of the locality from which they have been produced or through which they have entered commerce. The ordinary tragacanth, tragacanth in sorts, sometimes known as *traganton,* occurs in irregular pieces; Smyrna tragacanth appears usually in broad thick flakes, yellowish or brownish; Syrian tragacanth, in thin, ribbon-like, white flakes, is said really to be obtained in Kurdistan and Persia. Tragacanth is officially described as "in ribbon-shaped bands varying in size and from 1 to 3 Mm. thick, or in irregular pieces of the same, long and linear, straight or spirally twisted; externally whitish, marked by more or less pronounced longitudinal or excentric lines or ridges; translucent, horny, fracture short, tough, rendered more easily pulverizable by a heat of 50° C. (122° F.). On treating Tragacanth with 50 parts of water, it swells and gradually forms a cloudy, gelatinous mass, which, on warming with solution of sodium hydroxide on a water-bath, becomes yellow and is tinged blue on the addition of iodine T.S.; the addition of alcohol to the fluid portion causes a precipitate, but the liquid is not colored blue by iodine T.S." *U. S.*

It is hard and more or less fragile, but difficult of pulverization, unless exposed to a freezing temperature, or thoroughly dried, and powdered in a heated mortar at the temperature of 50° C. (122° F.). Its sp. gr. is 1.384. Introduced into water, it absorbs a certain proportion of that liquid, swells very much, and forms a soft adhesive paste, but does not dissolve. If agitated with an additional quantity of water, this paste forms a uniform mixture; but in the course of one or two days the greater part separates, and is deposited, leaving a portion dissolved in the supernatant fluid. Tragacanth is wholly insoluble in alcohol. It appears to be composed of two different constituents, one soluble in water and resembling gum arabic, the other swelling in water, but not dissolving. To separate the soluble from the insoluble part requires agitation with separate portions of water; the solutions are to be decanted and filtered, and the process is to be continued until water ceases to dissolve anything.

Von Sandersleben reported the discovery that when heated with dilute acids tragacanth acquired reducing properties, and formed, along with much syrup, *arabinose,* which crystallized. (Tollens, *Handbuch der Kohlenhydrate,* 1888, 218.) The explanation of this observation, now generally accepted, is that in tragacanth, like some other gums, part of the arabic acid is present in soluble form, mostly combined with bases, while another part is present in insoluble form, and is known as *traganthin.* This latter, however, under the influence of certain enzymes, is converted into the soluble form. (Lippmann, *Chemie der Zuckerarten,* 2te Auf., 1895, 925.) C. O'Sullivan states that tragacanth consists of *cellulose,* the portion insoluble in boiling water, cold dilute acids, and alkalies; also *soluble gum,* yielding a series of gum acids of the nature of *geddic acid,* and which are called *polyarabinontrigalactan-geddic acids; starch granules; bassorin,* which yields *a-tragacanthan-xylan-bassoric acid, xylan-bassoric acid* and *bassoric acid.* (*Proc. Chem. Soc.,* 1901.) Examined by Kützing by means of the microscope, tragacanth was found to consist of organized cells. (See *A. J. P.,* xxv. 37.) In conformity with this statement is the remarkable fact, discovered by Hugo von Mohl and confirmed by Wigand, that tragacanth is not a secretion of the plant, but the result of the transformation of the cells of the pith and those of the medullary rays which traverse the ligneous part of the stem and older branches. (*Ibid.,* xxxi. 243.)

It is stated by S. H. Maltass that tragacanth is adulterated, in the Levant, with worthless gums brought from Armenia and Caramania, which, as they are originally of a dark color and destitute of the flaky form of the genuine gum, are broken into small fragments and whitened by means of lead carbonate before being mixed with the tragacanth. Hanbury states, in confirmation of this, that he has detected lead in the *small tragacanth* imported into London. (*P. J.,* xv. 20.)

Uses.—Tragacanth is demulcent, but, on account of its difficult solubility, is not often given internally. The great viscidity which it imparts to water renders it useful for the suspension of heavy insoluble powders, and it is also employed in pharmacy to impart consistence to troches, for which it answers better than does gum arabic, and in making emulsions, although for these purposes it is inferior to acacia.

Off. Prep.—Confectio Sulphuris, *Br.;* Emulsum Chloroformi, *U. S.;* Glycerinum Tragacanthæ, *Br.;* Mistura Cretæ, *Br.;* Mistura Guaiaci, *Br.;* Mucilago Tragacanthæ, *U. S., Br.;* Pilulæ Ferri Carbonatis, *U. S.* (*Br.*); Pilula Quininæ Sulphatis, *Br.;* Pulvis Opii Compositus, *Br.;* Pulvis Tragacanthæ Compositus, *Br.;* Trochisci Acidi Tannici, *U. S.;* Trochisci Ammonii Chloridi, *U. S.;* Trochisci Gambir, *U. S.;* Trochisci Krameriæ, *U. S.;* Trochisci Potassii Chloratis, *U. S.;* Trochisci Santonini, *U. S.*

TRITICUM. U. S.

TRITICUM [Couch Grass]

(trĭt'ĭ-cŭm)

"The dried rhizome of *Agropyron repens* (Linné) Beauvois (Fam. *Gramineæ*), gathered in the spring." *U. S.*

Agropyrum, *Br. Add.;* Rhizoma Graminis; Radix Graminis; Couch-grass, Quick-grass, Quitch, Dog-grass, Scotch-grass, Twitch-grass, Witch-grass, Quickens; Chiendent officinal ou Petit chiendent, *Fr. Cod.;* Queckenwurzel, Grasswurzel, *G.;* Grama (Rizoma de), *Sp.*

This grass, originally a native of Europe, now abounds in meadows and cultivated grounds in the Northern United States, where it is often very troublesome as a weed. It is specifically characterized by its creeping root-stock, by its awns being absent or not more than half the length of the flower, and by its rough, flat leaves. It is probable that the rhizome of a number of other grasses share the medicinal properties of *Agropyron repens.* Of these the Scotch or Bermuda grass, *Capriola Dactylon* (L.), Kuntze, is probably as effective as the official species.

Properties.—Triticum is officially described as follows: "Of horizontal growth, subcylindrical, 1 to 2 Mm. in diameter, usually cut into sections 5 to 8 Mm. long; externally brownish-yellow to straw-colored, nearly smooth; hollow in the centre; odor slight; taste distinctly sweet." *U. S.*

Uses.—Triticum is never exhibited for the purpose of affecting the general system, but only for its influence upon the genito-urinary organs. It is much used by some surgeons in *irritable bladder,* and also in *cystitis.* It is one of the least stimulant of the remedies of its class, and may be employed very freely. In Europe its decoction is said to be used to a considerable extent as a diluent and slightly nutritious drink. It may be taken *ad libitum,* or the fluidextract may be given in doses of a fluidrachm (3.75 Cc.) every three hours in five or six ounces of water.

TRITURATIO ELATERINI. U. S. (Br.)

TRITURATION OF ELATERIN

(trĭt-ū-rā'tĭ-ō ĕl-ă-tẹ-rī'nī)

Pulvis Elaterini Compositus, *Br.;* Compound Powder of Elaterin; Trituration d'Elatérine, *Fr.;* Elaterintrituration, *G.*

* "Elaterin, *ten grammes* [or 154 grains]; Sugar of Milk, in moderately fine powder, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Mix them thoroughly by trituration." *U. S.*

"Elaterin, 5 *grains* or 1 gramme; Milk Sugar, 195 *grains* or 39 grammes. Triturate in a mortar until a fine powder is produced." *Br.*

The Br. Pharm. 1898 added the Compound Powder of Elaterin to the list of powders. It is identical with the Trituration of Elaterin, except in strength. The U. S. P. trituration contains 10 per cent. of elaterin, the British powder 2½ per cent.

This is probably the best representative of the class of triturations that could be selected for introduction into the national authority. Elaterium is at best a substance of variable quality, while the active principle is a definite product, and accurate dosage can be secured more effectually through the use of this trituration than by the employment of commercial elaterium.

Dose, from one-fourth to five-eighths of a grain (0.016 to 0.04 Gm.). The dose of the British powder is from one to four grains (0.065 to 0.26 Gm.).

TRITURATIONES. U. S.

TRITURATIONS

(trĭt-ū-rā-tĭ-ō'nēș)

Triturations, *Fr.;* Triturationen, *G.*

"Unless otherwise directed, Triturations are to be prepared according to the following formula. * Take of the Substance, *ten grammes* [or 154 grains]; Sugar of Milk, in moderately fine powder, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Weigh the Substance and the Sugar of Milk, separately; then place the Substance, previously reduced, if necessary, to a moderately fine powder, in a mortar; add about an equal measure of Sugar of Milk, mix well by means of a spatula, and triturate the powders thoroughly together. Then add fresh portions of Sugar of Milk, from time to time, until the whole is added, and continue the trituration after each addition until the Substance is intimately mixed with the Sugar of Milk and reduced to a fine powder." *U. S.*

This general formula has been introduced into the Pharmacopœia in order that a definite and uniform method be authorized of making a class of powders which has come into use in various sections of our country. While the necessity of giving recognition to the class may be questioned by many, the importance of securing uniformity in composition is evident.

TROCHISCI.

TROCHES

(trọ-ghĭs'cī)

Tabellæ; Lozenges; Tablettes, *Fr. Cod.;* Pastilli, Rotulae, *P. G.;* Pastillen, Plätzchen, Tabletten, *G.;* Pastiglie, *It.;* Tabletas, *Sp.*

Troches or *lozenges* are small, dry, solid masses, usually of a flattened shape, consisting for the most part of powders incorporated with sugar and mucilage. They are designed

to be held in the mouth and dissolved slowly in the saliva, and are, therefore, adapted for the administration of those medicines only which do not require to be given in large quantities and which are destitute of any very disagreeable flavor.

Lozenges were formerly much more used and more skilfully prepared in Europe than in this country, but at present those manufactured here are fully equal to the imported lozenges. Tragacanth, from the greater tenacity of its mucilage, is better suited for their formation than gum arabic. The following directions for preparing them are taken from the *Dictionnaire des Drogues.* A mucilage of tragacanth is first prepared with cold water and strained. With this the powders, including sugar, are thoroughly mixed by rubbing upon a marble slab, and are thus formed into a paste, which is spread out by means of a roller upon the surface of the marble, previously powdered over with a mixture of sugar and starch. The thickness of the mass is rendered uniform by a frame upon which the ends of the roller rest. The upper surface is now dusted with sugar and starch, and the mass is divided into small cakes by means of a punch. These cakes are placed upon paper, and, having been exposed to the air for twelve hours, are carried into a drying room moderately heated. When perfectly dry, they are thrown upon a sieve to separate the sugar and starch, and are then enclosed in boxes. Lozenges may be prepared from almost any medicine which it is advisable to administer in this form. The following typical formula may be found useful.

Take citric acid, in powder, a drachm; powdered sugar eight ounces; oil of lemon twelve minims; mucilage of tragacanth a sufficient quantity. Form them in the manner above directed into troches of twelve grains each. Lozenges are sometimes made by saturating blank lozenges with aromatic spirits. Currant paste or jelly has come into use of late years largely as a basis for troches.[1]

Lozenges of a cylindrical shape are extensively used, having a basis of licorice, gum, and sugar, and the manufacture of these is now an im-

[1] *Currant Paste Lozenges.*—These lozenges have been largely employed. They were introduced by Morell Mackenzie, Senior Physician to the London Hospital for Diseases of the Throat, and differ from ordinary lozenges in the use as a basis of currant paste (or jelly), of which they contain from 70 to 80 per cent.; this may usually be obtained from wholesale confectioners or grocers.

Trochisci Acidi Benzoici.—Benzoic Acid, in powder, 175 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Red Currant Paste, as much as is sufficient. Mix the dry ingredients; then add the Red Currant Paste until the whole mass weighs 1 pound; divide into 350 lozenges of 20 grains each, and dry them in a hot-air chamber at a moderate heat. Each lozenge contains about one-half grain of Benzoic Acid, and is marked B. A. Dose, one lozenge every four hours. If used as a "voice lozenge," one should be taken a quarter of an hour before using the voice.

Trochisci Acidi Carbolici.—Pure Carbolic Acid, 350 grains; Gum Acacia, in powder, 220 grains; Refined Sugar, in powder, 5468 grains (12½ ounces); Mucilage of Gum Acacia, 1 ounce; Distilled Water, as much as is sufficient. Mix the Carbolic Acid with the powders, add the Mucilage and Water to form a mass weighing 1 pound, and divide into 350 lozenges and dry them in a hot-air chamber at a moderate heat. Each lozenge contains about one grain of Carbolic Acid, and is marked C. A. Dose, one lozenge four or five times daily. Use, antiseptic and stimulant.

Trochisci Acidi Tannici.—Tannic Acid, in powder, 525 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 1½ grains of Tannic Acid, and is marked T. Dose, one lozenge every three or four hours.

Trochisci Aconiti.—Tincture of Aconite (B. P. 1885) 175 minims; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici*). Each lozenge contains the equivalent of half a minim of Tincture of Aconite (B. P. 1885) (or five-eighths of a minim, U. S. P. 8th Rev.), and is marked A. C. Dose, one lozenge every half-hour or hour. Use, in tonsillitis and febrile affections of the throat.

Trochisci Althææ.—Powdered decorticated Marshmallow Root, 400 grains; Refined Sugar, in powder, ¾ pound; Gum Acacia, in powder, ½ pound; Orange Flower Water and White of Egg, as much as is sufficient to make into 350 soft lozenges. Macerate the Marshmallow Root in a sufficient quantity of Orange Flower Water for 12 hours, strain, then add the Gum Acacia and Sugar; dissolve, and evaporate to the consistence of honey with constant stirring; add gradually the White of Egg beaten up with more Orange Flower Water. Evaporate, with stirring, till the paste will not adhere to the hand; then divide into lozenges. Dose, one lozenge every half-hour or hour. Use, emollient. Valuable after excision of tonsils or uvula.

Trochisci Ammonii Chloridi.—Ammonium Chloride, in powder, 700 grains; Tragacanth, in powder, 140 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains about 2 grains of Ammonium Chloride, and is marked M. A. Dose, one lozenge every three hours.

Trochisci Boracis.—Borax, in powder, 1050 grains; Tragacanth, in powder, 140 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 3 grains of Borax, and is marked B. O. Dose, one lozenge every three or four hours.

Trochisci Catechu.—Pale Catechu, 700 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 2 grains of Catechu, and is marked C. T. Dose, one lozenge every three hours. Use, astringent, but less powerful than the Tannic Acid Troches.

Trochisci Cubebæ.—Cubebs, in powder, 200 grains; Extract of Liquorice, 1225 grains; Tragacanth, in powder, 70 grains; Refined Sugar, 200 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains about one-half grain of Cubebs, and is marked C. B. Dose, one lozenge every three or four hours. Use, very serviceable in diminishing excessive secretion of mucus from pharynx, larynx, or trachea. These lozenges closely resemble the *Brown's Bronchial Troches,* but Black Currant Paste is employed, and less gum and sugar.

Trochisci Guaiaci.—Guaiacum Resin, in powder, 700 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 2 grains of Guaiacum, and is marked G. Dose, one lozenge every two hours in acute inflammation; three times a day in chronic affections. Use, a specific for arresting crescent inflammation of the tonsils, and useful both in acute and subacute inflammation of the pharynx, and in acute follicular disease of the tonsils, etc.

Trochisci Kino.—Kino, in powder, 700 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 2 grains of Kino, and is marked K. Dose, one lozenge every three or four hours. Use, astringent; rather less powerful than Rhatany.

Trochisci Krameriæ.—Extract of Rhatany, in powder, 1050 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Red Currant Paste, as much as is sufficient. Mix and divide into

portant industry. Franklin C. Hill devised an improved machine for making Licorice and Wistar's Lozenges. (See *A. J. P.*, 1874, 401.) For Slocum's and Harrison's improved forms of lozenge boards, rollers, etc., see *A. J. P.*, 1879, 589; 1880, 255. A. D. Marcy figured an instrument for shaping troches in *N. R.*, Feb. 1882.

The Br. Pharmacopœia 1898 adopted four bases for lozenges, as follows: fruit basis, rose basis, simple basis, and tolu basis. It will be noticed that in the British formulas the quantity of active ingredients for each lozenge is stated and the kind of basis indicated. This is done merely to avoid repetition.

Preparation with Fruit Basis.

"Take five hundred times the quantity of the drug ordered for one lozenge; mix it intimately with *fifteen and a half ounces* (Imperial) or four hundred and thirty-nine and a half grammes of Refined Sugar, in fine powder, and *three hundred grains* or nineteen and a half grammes of Gum Acacia, in powder. Make the mixture into a paste with *one fluid ounce and a quarter* (Imp. meas.) or thirty-five and a half cubic centimetres of Mucilage of Gum Acacia and *two ounces* (Imp.) or fifty-six and three-quarter grammes of the black-currant paste of commerce previously softened with boiling Distilled Water, adding any additional Distilled Water that may be necessary. Divide the mass into five hundred equal lozenges. Dry them in a hot-air chamber at a moderate temperature." *Br.*

Preparation with Rose Basis.

"Take five hundred times the quantity of the drug ordered for one lozenge; mix it intimately with *seventeen and a half ounces* (Imperial) or four hundred and ninety-six grammes of Refined Sugar, in fine powder, and *three hundred grains* or nineteen and a half grammes of Gum Acacia, in powder. Make the mixture into a paste with *five fluid drachms* (Imp. meas.) or seventeen and a half cubic centimetres of Mucilage of Gum Acacia and a sufficient quantity of the official Rose Water. Divide the mass into five hundred lozenges. Dry them in a hot-air chamber at a moderate temperature." *Br.*

Preparation with Simple Basis.

"Take five hundred times the quantity of the drug ordered for one lozenge; mix it intimately with *seventeen and a half ounces* (Imperial) or four hundred and ninety-six grammes of Refined Sugar, in fine powder, and *three hundred grains* or nineteen and a half grammes of Gum Acacia, in powder. Make the mixture into a paste with *one fluid ounce and a quarter* (Imp. meas.) or thirty-five and a half cubic centimetres of Mucilage of Gum Acacia and a sufficient quantity of Distilled Water. Divide the mass into five hundred equal lozenges. Dry them in a hot-air chamber at a moderate temperature." *Br.*

Preparation with Tolu Basis.

"Take five hundred times the quantity of the drug ordered for one lozenge; dissolve what salts of alkaloids may be ordered in *three fluid drachms* (Imperial measure) or ten and a half cubic centimetres of Distilled Water; mix the solution intimately with *seventeen ounces* (Imp.) or four hundred and eighty-two grammes of Refined Sugar, in fine powder, and *three hundred grains* or nineteen and a half grammes of Gum Acacia, in powder. Thoroughly incorporate with the mixture any other drugs ordered for the lozenges, and *three fluid drachms* (Imp. meas.) or ten and a half cubic centimetres of Tincture of Balsam of Tolu. Make into a paste with *one fluid ounce and a quarter* (Imp. meas.) or thirty-five and a half cubic centimetres of Mucilage of Gum Acacia and any additional Distilled Water that may be necessary. Divide the mass into five hundred equal lozenges. Dry them in a hot-air chamber at a moderate temperature." *Br.*

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350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 3 grains of Extract of Rhatany, and is marked R. Dose, one lozenge every three or four hours. Use, a very useful astringent. Rhatany does not disagree with the stomach, as is often the case with Tannic Acid, nor does it cause constipation to the same extent as Kino or Catechu.

Trochisci Lactucæ.—Extract of Lettuce, 350 grains; Tragacanth, in powder, 100 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 1 grain of Extract of Lettuce, and is marked L. Dose, one lozenge every hour or two. Use, soothing and mildly sedative.

Trochisci Potassii Chloratis.—Potassium Chlorate, in powder, 1050 grains; Tragacanth, in powder, 140 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 3 grains of Potassium Chlorate, and is marked P. Dose, one lozenge every three or four hours. Use, stimulant and antiseptic. Useful in thrush and aphthous ulceration.

Trochisci Potassii Citratis.—Potassium Citrate, in powder, 1050 grains; Tragacanth, in powder, 140 grains; Refined Sugar, in powder, 280 grains; Red Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 3 grains of Potassium Citrate, and is marked C. P. Dose, one lozenge every three or four hours. Use, topical sialagogue.

Trochisci Potassii Tartratis Acidæ.—Acid Potassium Tartrate, 1050 grains; Tragacanth, in powder, 140 grains; Refined Sugar, in powder, 280 grains; Red Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 3 grains of Acid Potassium Tartrate, and is marked T. P. Dose, one lozenge every two or three hours. Use, topical sialagogue.

Trochisci Pyrethri.—Pellitory Root, in powder, 350 grains; Tragacanth, in powder, 70 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains 1 grain of Pellitory, and is marked P. Y. Dose, one lozenge every two or three hours. Use, a very valuable sialagogue.

Trochisci Sedativi.—Extract of Opium, in powder, 35 grains; Tragacanth, in powder, 100 grains; Refined Sugar, in powder, 280 grains; Black Currant Paste, as much as is sufficient. Prepare and divide into 350 lozenges. (See *Trochisci Acidi Benzoici.*) Each lozenge contains one-tenth grain of Extract of Opium, and is marked S. Dose, one lozenge every three or four hours. Use, sedative, for irritative coughs and painful conditions of the pharynx. (From the *Pharmacopœia of the Hospital for the Diseases of the Throat*, 4th edition.)

The following official troches of the U. S. P. 1890 were not retained in the U. S. P. (8th Rev.): Trochisci Cretæ, Ferri, Ipecacuanhæ, Menthæ Piperitæ, Morphinæ et Ipecacuanhæ, Zingiberis. Troches of Catechu were replaced by Troches of Gambir.[1]

[1] *Trochisci Cretæ. U. S.* 1890. *Troches of Chalk.* "Prepared Chalk, *twenty-five grammes* [or 386 grains]; Acacia, in fine powder, *seven grammes* [or 108 grains]; Spirit of Nutmeg, *three cubic centimeters* [or 49 minims]; Sugar, in fine powder, *forty grammes* [or 1 ounce av., 180 grains]; Water, *a sufficient quantity*, to make *one hundred troches*. Rub the powders with the Spirit of Nutmeg until they are thoroughly mixed; then, with Water, form a mass, to be divided into *one hundred troches*." *U. S.* 1890.

These troches contain each about four grains (0.25 Gm.) of chalk, and are used as a gentle, astringent antacid in *diarrhœa*. They deserve to be used more frequently than they have been, being well adapted for children.

Trochisci Ferri. U. S. 1890. *Troches of Iron.* "Ferric Hydrate, dried at a temperature not exceeding 80° C. (176° F.), *thirty grammes* [or 1 ounce av., 25 grains]; Vanilla, cut into slices, *one gramme* [or 15 grains]; Sugar, in fine powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Mucilage of Tragacanth, *a sufficient quantity*, to make *one hundred troches*. Rub the Vanilla, first, with a portion of the Sugar to a uniform powder, and afterwards with the Ferric Hydrate and the remainder of the Sugar, until they are thoroughly mixed. Then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches*." *U. S.* 1890.

Each lozenge contains about five grains (0.3 Gm.) of ferric hydrate, and from one to six may be given, according to the effects desired. (See *Ferri Oxidum Hydratum*.)

Trochisci Ipecacuanhæ. U. S. 1890. *Troches of Ipecac.*—"Ipecac, in No. 60 powder, *two grammes* [or 31 grains]; Tragacanth, in fine powder, *two grammes* [or 31 grains]; Sugar, in fine powder, *sixty-five grammes* [or 2 ounces av., 128 grains]; Syrup of Orange, *a sufficient quantity*, to make *one hundred troches*. Rub the powders together until they are thoroughly mixed; then, with Syrup of Orange, form a mass, to be divided into *one hundred troches*." *U. S.* 1890.

Trochisci Menthæ Piperitæ. U. S. 1890. *Troches of Peppermint.*—"Oil of Peppermint, *one cubic centimeter* [or 16 minims]; Sugar, in fine powder, *eighty grammes* [or 2 ounces av., 360 minims]; Mucilage of Tragacanth, *a sufficient quantity*, to make *one hundred troches*. Rub the Oil of Peppermint and the Sugar together until they are thoroughly mixed; then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches*." *U. S.* 1890.

Useful in *slight gastric or intestinal pains, nausea,* and *flatulence.*

Trochisci Morphinæ et Ipecacuanhæ. U. S. 1890. *Troches of Morphine and Ipecac.*—"Morphine Sulphate, *sixteen centigrammes* [or 2½ grains]; Ipecac, in No. 60 powder, *fifty centigrammes* [or 8 grains]; Sugar, in fine powder, *sixty-five grammes* [or 2 ounces av., 128 grains]; Oil of Gaultheria, *two-tenths of a cubic centimeter* [or 3 minims]; Mucilage of Tragacanth, *a sufficient quantity*, to make *one hundred troches*. Rub the powders together until they are thoroughly mixed; then add the Oil of Gaultheria (equivalent to about 4 drops), and incorporate it with the mixture. Lastly, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches*." *U. S.* 1890.

Expectorant and anodyne, useful especially in *allaying cough.* The U. S. 1890 lozenges contained one-fortieth of a grain (0.0016 Gm.) of morphine salt, and one-twelfth of a grain (0.005 Gm.) of ipecac.

Trochisci Zingiberis. U. S. 1890. *Troches of Ginger.*—"Tincture of Ginger, *twenty cubic centimeters* [or 325 grains]; Tragacanth, in fine powder, *four grammes* [or 62 grains]; Sugar, in fine powder, *one hundred and thirty grammes* [or 4 ounces av., 256 grains]; Syrup of Ginger, *a sufficient quantity*, to make *one hundred troches*. Mix the Tincture of Ginger with the Sugar, and, having exposed the mixture to the air until dry, reduce it to a fine powder. To this add the Tragacanth, and mix thoroughly. Lastly, with Syrup of Ginger, form a mass, to be divided into *one hundred troches*." *U. S.* 1890.

Each lozenge contains three minims (0.2 Cc.) of the tincture, and they may be taken as required, being especially calculated to relieve *gastric pains* resulting from *flatulence.*

TROCHISCUS ACIDI BENZOICI. Br.

BENZOIC ACID LOZENGE

(trō-ĸhĭs'cŭs ăç'ĭ-dī bĕn-zō'ĭ-cī)

Tablettes de l'Acide Benzoique, *Fr.;* Benzoesaurepastillen, *G.*

"Benzoic Acid, ½ *grain* or 0.0324 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

TROCHISCUS ACIDI CARBOLICI. Br.

PHENOL LOZENGE

(trō-ĸhĭs'cŭs ăç'ĭ-dī cär-bŏl'ĭ-cī)

Tablettes de l'Acide Phénique, *Fr.;* Phenolpastillen, *G.*

"Phenol, 1 *grain* or 0.0648 gramme. Mix with the Tolu Basis to form a Lozenge." *Br.* (See p. 1298.)

TROCHISCI ACIDI TANNICI. U. S. (Br.)

TROCHES OF TANNIC ACID.

(trō-ĸhĭs'cī ăç'ĭ-dī tăn'nĭ-cī)

Trochiscus Acidi Tannici, *Br.;* Tannin Lozenges; Tablettes de Tannin, *Fr.;* Tanninpastillen, *G.*

* "Tannic Acid, *six grammes* [or 93 grains]; Sugar, in fine powder, *sixty-five grammes* [or 2 ounces av., 128 grains]; Tragacanth, in fine powder, *two grammes* [or 31 grains]; Stronger Orange Flower Water, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly mixed; then, with Stronger Orange Flower Water, form a mass, to be divided into *one hundred troches.*" *U. S.*

"Tannic Acid, ½ *grain* or 0.0324 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

These are useful in *relaxation of the uvula,* and in *chronic angina,* being allowed slowly to dissolve in the mouth. Each U. S. troche contains about one grain (0.065 Gm.) of the acid.

TROCHISCI AMMONII CHLORIDI. U. S.

TROCHES OF AMMONIUM CHLORIDE

(trō-ĸhĭs'cī ăm-mō'nī-ī ĸhlō'rĭ-dī)

Tablettes de Chlorhydrate d'Ammoniaque, *Fr.;* Chlorammoniumpastillen, *G.*

* "Ammonium Chloride, in fine powder, *ten grammes* [or 154 grains]; Extract of Glycyrrhiza, in fine powder, *twenty grammes* [or 309 grains]; Tragacanth, in fine powder, *two grammes* [or 31 grains]; Sugar, in fine powder, *forty grammes* [or 1 ounce av., 180 grains]; Syrup of Tolu, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly mixed; then, with Syrup of Tolu, form a mass, to be divided into *one hun-*

dred troches." U. S. Each troche contains about one and a half grains (0.096 Gm.) of ammonium chloride.

These troches are largely used in *congested conditions of the pharynx and larynx.*

TROCHISCUS BISMUTHI COMPOSITUS. Br.

COMPOUND BISMUTH LOZENGE

(trō-ĸĭs'cŭs bĭs-mū'thī cŏm-pŏs'ĭ-tŭs)

Troches of Bismuth; Tablettes de Sous-nitrate de Bismuth, *Fr. Cod.;* Wismuthpastillen, *G.*

"Bismuth Oxycarbonate, 2 *grains* or 0.1296 gramme; Heavy Magnesium Carbonate, 2 *grains* or 0.1296 gramme; Precipitated Calcium Carbonate, 4 *grains* or 0.2592 gramme. Mix with the Rose Basis to form a Lozenge." *Br.* (See p. 1298.)

These may be used to obtain the effects of bismuth subcarbonate on the stomach, as well as of the magnesium and calcium carbonates as an antacid, two or more being administered for a dose. They may also be found useful in *chronic inflammation of the throat and œsophagus.*

TROCHISCI CUBEBÆ. U. S.

TROCHES OF CUBEB

(trō-ĸĭs'cī cū-bē'bæ)

Tablettes de Cubèbe, *Fr.;* Kubebenpastillen, *G.*

* "Oleoresin of Cubeb, *two grammes* [or 31 grains]; Oil of Sassafras, *one cubic centimeter* [or 16 minims]; Extract of Glycyrrhiza, in fine powder, *twenty-five grammes* [or 386 grains]; Acacia, in fine powder, *twelve grammes* [or 185 grains]; Syrup of Tolu, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly mixed; then add the Oleoresin and the Oil, and incorporate them with the mixture. Lastly, with Syrup of Tolu, form a mass, to be divided into *one hundred troches." U. S.*

Each lozenge contains one-fourth of a minim (0.02 Gm.) of the oleoresin of cubeb, being about one-fourth the strength of the lozenge of 1870, and one-half the strength of the 1890 troches. The preparation is intended chiefly for effect upon the fauces and other parts of the upper alimentary passages, and may be used advantageously in some cases of *chronic cough,* and in *ulceration* or *chronic inflammation of the fauces.*

TROCHISCUS EUCALYPTI GUMMI. Br.

EUCALYPTUS GUM LOZENGE

(trō-ĸĭs'cŭs eū-că-lĭp'tī gŭm'mī)

Tablettes de Kino d'Eucalypte, *Fr.;* Eucalyptuskinopastillen, *G.*

"Eucalyptus Gum, 1 *grain* or 0.0648 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

TROCHISCUS FERRI REDACTI. Br.

REDUCED IRON LOZENGE

(trō-ĸĭs'cŭs fĕr'rī rē-dăc'tī)

Tablettes de Fer Réduit par l'Hydrogène, Tablettes de Fer, *Fr.;* Eisenpastillen, *G.*

"Reduced Iron, 1 *grain* or 0.0648 gramme. Mix with the Simple Basis to form a Lozenge." *Br.* (See p. 1298; also page 518.)

From one to five of the lozenges may be taken for a dose.

TROCHISCI GAMBIR. U. S. (Br.)

TROCHES OF GAMBIR

[To replace Trochisci Catechu, Pharm., 1890, Troches of Catechu]

(trō-ĸĭs'cī găm'bĭr)

Trochiscus Catechu, *Br.,* Catechu Lozenge; Tabellæ cum Catechu; Tablettes de Cachou, *Fr. Cod.;* Katechupastillen, *G.*

* "Gambir, in fine powder, *six grammes* [or 93 grains]; Sugar, in fine powder, *sixty-five grammes* [or 2 ounces av., 128 grains]; Tragacanth, in fine powder, *two grammes* [or 31 grains]; Stronger Orange Flower Water, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly mixed; then, with Stronger Orange Flower Water, form a mass, to be divided into *one hundred troches." U. S.*

"Catechu, 1 *grain* or 0.0648 gramme. Mix with the Simple Basis to form a Lozenge." *Br.* (See p. 1298.)

These, like the troches of tannic acid, are useful in *prolapsus of the uvula,* and in other forms of *relaxation of the fauces,* and may also be used, in the number of three or more at a dose, to obtain the effects of catechu or gambir on the *primæ viæ* and on the system. Each troche contains about one grain (0.06 Gm.) of gambir, and the taste is not disagreeable.

TROCHISCI GLYCYRRHIZÆ ET OPII. U. S.

TROCHES OF GLYCYRRHIZA AND OPIUM

(trō-ĸĭs'cī glĭç-yr-rhī'zæ ĕt ō'pĭ-ī)

Licorice and Opium Lozenges; Tablettes d'Opium, Tablettes de Réglisse opiacées, *Fr.;* Opiumpastillen, *G.*

* "Extract of Glycyrrhiza, in fine powder, *fifteen grammes* [or 231 grains]; Powdered Opium, *one-half gramme* [or 8 grains]; Acacia, in fine powder, *twelve grammes* [or 185 grains]; Sugar, in fine powder, *twenty grammes* [or 309 grains]; Oil of Anise, *two-tenths of a cubic centimeter* [or 3 minims]; Water, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly

mixed; then add the Oil of Anise (equivalent to about 4 drops), and incorporate it with the mixture. Lastly, with Water, form a mass, to be divided into *one hundred troches.*" *U. S.*

The British Pharm. 1898 no longer recognizes lozenges containing licorice and opium; the Br. 1885 process is appended.[1]

A preparation similar to the above is much used in Philadelphia and elsewhere under the name of *Wistar's cough lozenges.* Sometimes morphine sulphate is substituted in equivalent proportion for the opium, and occasionally a little tartar emetic is added; but these modifications of the official formula are not admissible without a change of title. Each U. S. troche contains about one-twelfth of a grain of powdered opium. These troches are demulcent and anodyne, and useful in allaying *cough.*

TROCHISCUS GUAIACI RESINÆ. Br.

GUAIACUM RESIN LOZENGE

(trŏ-ḳhĭs'cŭs guaĭ'ą-cī rę-ṣĭ'næ)

Tablettes de Résine de Gayac, *Fr.;* Guajakharzpastillen, *G.*

"Guaiacum Resin, 3 *grains* or 0.1944 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

TROCHISCUS IPECACUANHÆ. Br.

IPECACUANHA LOZENGE

(trŏ-ḳhĭs'cŭs ĭp-ę-căc-ū-ăn'hæ)

Tablettes d'Ipécacuanha, *Fr. Cod.;* Brechwurzelpastillen, *G.;* Pastiglie d'ipecacuana, *It.*

"Ipecacuanha Root, in powder, ¼ *grain* or 0.0162 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

These are useful expectorant lozenges in *catarrhal complaints.*

TROCHISCI KRAMERIÆ. U. S. (Br.)

TROCHES OF KRAMERIA

(trŏ-ḳhĭs'cī krą-mē'rĭ-æ)

Trochiscus Krameriæ, *Br.,* Krameria Lozenge, Rhatany Lozenge; Tablettes de Ratanhia, *Fr.;* Ratanhiapastillen, *G.*

* "Extract of Krameria, *six grammes* [or 93 grains]; Sugar, in fine powder, *sixty-five grammes* [or 2 ounces av., 128 grains]; Tragacanth, in fine powder, *two grammes* [or 31 grains]; Stronger Orange Flower Water, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly mixed; then, with Stronger Orange Flower Water, form a mass, to be divided into *one hundred troches.*" *U. S.*

"Extract of Krameria, 1 *grain* or 0.0648 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

These are astringent troches, which may be used in *chronic angina.*

TROCHISCUS KRAMERIÆ ET COCAINÆ. Br.

KRAMERIA AND COCAINE LOZENGE

(trŏ-ḳhĭs'cŭs krą-mē'rĭ-æ ĕt cō-cą-ĭ'næ)

Tablettes de Ratanhia et de Cocaine, *Fr.;* Ratanhia- und Cocain-pastillen, *G.*

"Extract of Krameria, 1 *grain* or 0.0648 gramme; Cocaine Hydrochloride, one-twentieth *grain* or 0.00324 gramme. Mix with the Fruit Basis to form a Lozenge." *Br.* (See p. 1298.)

TROCHISCUS MORPHINÆ. Br.

MORPHINE LOZENGE

(trŏ-ḳhĭs'cŭs mŏr-phĭ'næ)

Tablettes de Chlorhydrate de Morphine, Tablettes de Morphine, *Fr.;* Morphinpastillen, *G.*

"Morphine Hydrochloride, one-thirty-sixth *grain* or 0.0018 gramme. Mix with the Tolu Basis to form a Lozenge." *Br.* (See p. 1298.)

Useful for alleviating *cough,* and for other purposes which are answered by minute doses of morphine, of the hydrochloride of which each lozenge contains about one-thirty-sixth of a grain (0.0018 Gm.).

TROCHISCUS MORPHINÆ ET IPECACUANHÆ. Br.

MORPHINE AND IPECACUANHA LOZENGE

(trŏ-ḳhĭs'cŭs mŏr-phĭ'næ ĕt ĭp-ę-căc-ū-ăn'hæ)

Tablettes de Morphine et d'Ipécacuanha, *Fr.;* Morphinpastillen mit Brechwurzel; Morphin- und Brechwurzel-pastillen, *G.*

"Morphine Hydrochloride, one-thirty-sixth *grain* or 0.0018 gramme; Ipecacuanha Root, in powder, one-twelfth *grain* or 0.0054 gramme. Mix with the Tolu Basis to form a Lozenge." *Br.* (See p. 1298; also p. 790.)

Expectorant and anodyne, useful especially in *allaying cough.* The lozenges contain one-thirty-sixth of a grain (0.0018 Gm.) of morphine salt, and one-twelfth of a grain (0.0054 Gm.) of ipecacuanha.

[1] *Trochisci Opii, Br.* 1885. *Opium Lozenges.* "Take of Extract of Opium *seventy-two grains;* Tincture of Tolu *half a fluid ounce;* Refined Sugar, in powder, *sixteen ounces* [avoirdupois]; Gum Acacia, in powder, *two ounces* [av.]; Extract of Liquorice *six ounces* [av.]; Distilled Water *a sufficiency.* Add the Extract of Opium, first softened by means of a little Water, and the Tincture of Tolu, to the Extract of Liquorice heated in a water-bath. When the mixture is reduced to a proper consistence, remove it to a slab, add the Sugar and Gum previously rubbed together, and mix thoroughly. Divide the mass into 720 lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains one-tenth of a grain of Extract of Opium, equivalent to one-fiftieth of a grain of morphine." *Br.* 1885.

TROCHISCI POTASSII CHLORATIS. U. S. (Br.)

TROCHES OF POTASSIUM CHLORATE

(trō-çhĭs'cī pō-tăs'sī-ī çhlō-rā'tĭs)

Trochiscus Potassii Chloratis, *Br.,* Potassium Chlorate Lozenge, Chlorate of Potash Lozenges; Tablettes de Chlorate de Potasse, *Fr. Cod.;* Kaliumchloratpastillen, Pastillen von Chlorsaurem Kali, *G.;* Pastiglie di clorato di potassio, *It.;* Tabletas de clorato potasico, *Sp.*

* "Potassium Chlorate, in fine powder, *fifteen grammes* [or 231 grains]; Sugar, in fine powder, *sixty grammes* [or 2 ounces av., 51 grains]; Tragacanth, in fine powder, *three grammes* [or 46 grains]; Water, *a sufficient quantity,* to make *one hundred troches.* Mix the Sugar with the Tragacanth by trituration, in a mortar; then transfer the mixture to a sheet of paper, and by means of a bone spatula mix with it the Potassium Chlorate, being careful, by avoiding trituration or pressure, to prevent the mixture from igniting or exploding. Lastly, with Water, form a mass, to be divided into *one hundred troches." U. S.*

"Potassium Chlorate, 3 *grains* or 0.1944 gramme. Mix with the Rose Basis to form a Lozenge." *Br.* (See p. 1298.)

In the U. S. P. (8th Rev.) the size of these troches was reduced one-half as compared with those of the U. S. P. 1890.

These lozenges are very largely employed, and are locally useful in cases of *sore throat.*

TROCHISCI SANTONINI. U. S. (Br.)

TROCHES OF SANTONIN

(trō-çhĭs'cī săn-tō-nī'nī)

Trochiscus Santonini, Santonin Lozenge, *Br.;* Tablettes de Santonine, *Fr. Cod.;* Pastilli Santonini, *P. G.;* Santoninpastillen, *G.;* Pastiglie di santonina, *It.;* Tabletas de santonina, *Sp.*

* "Santonin, in fine powder, *three grammes* [or 46 grains]; Sugar, in fine powder, *ninety grammes* [or 3 ounces av., 76 grains]; Tragacanth, in fine powder, *three grammes* [or 46 grains]; Stronger Orange Flower Water, *a sufficient quantity,* to make *one hundred troches.* Rub the powders together until they are thoroughly mixed; then, with Stronger Orange Flower Water, form a mass, to be divided into *one hundred troches.* Troches of Santonin should be kept in dark, amber-colored vials." *U. S.*

"Santonin, 1 *grain* or 0.0648 gramme. Mix with the Simple Basis to form a Lozenge." *Br.* (See p. 1298.)

The United States process is faulty in the direction that the santonin should be in fine powder. The longer the absorption of santonin is delayed in the intestines the more prolonged and consequently the more effective is its vermicidal influence. As soon as it is absorbed it ceases to act upon the worm, and becomes a more or less deleterious substance in the system. A dose of santonin in crystals which is not poisonous may become somewhat toxic when given in fine powder. The proportion of crystals in the lozenge mass (2½ per cent.) is not sufficient to prevent the formation of a good lozenge from a pharmaceutical point of view. Each U. S. lozenge contains about half a grain (0.033 Gm.) of santonin. (See *Santoninum,* p. 1085.)

Dose, for a child (two years old) from one to two lozenges.

TROCHISCI SODII BICARBONATIS. U. S. (Br.)

TROCHES OF SODIUM BICARBONATE

(trō-çhĭs'cī sō'dī-ī bī-cär-bō-nā'tĭs)

Trochiscus Sodii Bicarbonatis, Sodium Bicarbonate Lozenge, *Br.;* Trochisci Natri Bicarbonici; Tablettes de Bicarbonate de Soude, *Fr. Cod.;* Pastilles de Vichy, Pastilles digestives, *Fr.;* Natronpastillen, Natriumbicarbonatpastillen, *G.;* Pastiglie di bicarbonato di sodio, *It.;* Tabletas de bicarbonato sodico, *Sp.*

* "Sodium Bicarbonate, *eighteen grammes* [or 278 grains]; Sugar, in fine powder, *fifty-four grammes* [or 1 ounce av., 396 grains]; Myristica, bruised, *one gramme* [or 15 grains]; Mucilage of Tragacanth, *a sufficient quantity,* to make *one hundred troches.* Triturate the Myristica with the Sugar, gradually added, until they are reduced to a fine powder, and mix this intimately with the Sodium Bicarbonate; then, with the Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches." U. S.*

"Sodium Bicarbonate, 3 *grains* or 0.1944 gramme. Mix with the Rose Basis to form a Lozenge." *Br.* (See p. 1298.)

The U. S. troche contains about three grains (0.18 Gm.) of the alkaline salt. Antacid and antilithic, useful in *heartburn* and in *uric acid gravel.* From one to six may be given for a *dose.*

TROCHISCUS SULPHURIS. Br.

SULPHUR LOZENGE

(trō-çhĭs'cŭs sŭl'phŭ-rĭs)

Tablettes de Soufre, *Fr. Cod.;* Schwefelpastillen, *G.*

"Precipitated Sulphur, 2500 *grains* or 162 grammes; Acid Potassium Tartrate, in powder, 500 *grains* or 32.4 grammes; Refined Sugar, in powder, 4000 *grains* or 259.2 grammes; Gum Acacia, in powder, 500 *grains* or 32.4 grammes; Tincture of Orange, 500 *minims* or 29.5 cubic centimetres; Mucilage of Gum Acacia, 500 *minims* or 29.5 cubic centimetres. Mix the Tincture of Orange with the powders; add the Mucilage of Gum Acacia to form a suitable mass. Divide into five hundred Lozenges. Dry them in a hot-air chamber at a moderate temperature. Each Lozenge contains *five grains* or 0.324 gramme of Precipitated Sulphur." *Br.*

These lozenges were first introduced into the "Additions" to the British Pharmacopœia 1885.

Dose, from one to six lozenges. (See *Sulphur Præcipitatum,* p. 1202.)

ULMUS. U. S.

ELM [Slippery Elm]

(ŭl'mŭs)

"The dried bark of *Ulmus fulva* Michaux (Fam. *Ulmaceæ*), deprived of its periderm." *U. S.*

Cortex Ulmi Interior, Ulmi Cortex; Elm Bark; Orme Fauve, *Fr. Cod.;* Ecorce d'Orme, *Fr.;* Ulmenrinde, Rüsterrinde, *G.*

Ulmus fulva, Michaux, *Flor. Bor. Amer.* (1803), i. 172.—*U. rubra,* Michx. f., *Hist. Arb. Am.,* iii. 278.—*U. pubescens,* Walt., *Fl. Car.* (1788), 112.—The *slippery elm,* called also *red elm,* is a lofty tree, fifty or sixty feet in height, with a trunk fifteen or twenty inches in diameter. The bark of the trunk is brown, that of the branches rough and whitish. The leaves are oblong-ovate, acuminate, nearly equal at the base, unequally serrate, pubescent, and very rough on both sides, four or five inches in length by two or three in breadth, and supported on short footstalks. The buds, a fortnight before their development, are covered with a dense russet down. The flowers, which appear before the leaves, are sessile, and in clusters at the extremities of the young shoots. The bunches of flowers are surrounded by scales, which are downy like the buds. The calyx is also downy. There is no corolla. The stamens are five, short, and of a pale rose color. The fruit is a membranaceous capsule or samara, enclosing in the middle one round seed, destitute of fringe.[1] The family Urticaceæ has been subdivided by Engler and Prantl into three distinct natural orders: 1, the Ulmaceæ, including Ulmus, etc.; 2, the Moraceæ, including Morus, Humulus, Cannabis, etc.; 3, the Urticaceæ proper, including Urtica, etc.

This species of elm is indigenous, growing in all parts of the United States north of the Carolinas, but most abundantly west of the Alleghany Mountains. It flourishes in open, elevated situations, and requires a firm, dry soil. From the *white elm* (*U. americana*) it is distinguished by its rough branches, its larger, thicker, and rougher leaves, its downy buds, and the character of its flowers and seeds. Its period of flowering is in April. The inner bark, separated from the cortex, is the part used. Large quantities are collected in the Lower Peninsula of Michigan.

It is in long, nearly flat pieces, from one to two lines thick, of a fibrous texture, a tawny color which is reddish on the inner surface, a peculiar sweetish, not unpleasant odor, and a highly mucilaginous taste when chewed. "In flat pieces varying in length and width, 3 to 4 Mm. thick; outer surface light brown, with occasional dark brown patches of the periderm; inner surface yellowish-brown; fracture fibrous and somewhat mealy; odor slight but distinct; taste mucilaginous. Ground Elm contains a few nearly spherical starch grains from 0.005 to 0.010 Mm. in diameter." *U. S.* By grinding, it is reduced to a light, grayish fawn-colored powder. It abounds in mucilaginous matter, which it readily imparts to water. The mucilage is precipitated by solutions of lead acetate and subacetate, but not by alcohol. It contains a variety of tannin which colors iron solutions green, in amount about 6.5 per cent. according to Rink, or, according to Davy, a little less than 3 per cent.

Much of the bark brought into the market is of inferior quality, imparting comparatively little mucilage to water. It has the characteristic odor of the genuine bark, but is much less fibrous and more brittle, breaking abruptly when bent, instead of being capable, like the better kinds, of being folded lengthwise without breaking. To what this inferiority is owing, whether to difference in the species or the age, or to circumstances in the growth of the tree producing it, we are unable to state. Ground elm bark is often adulterated, usually with substances containing starch. Pure elm bark contains only a trace of starch.[2]

C. W. Wright of Cincinnati, in a communication to the *Western Lancet,* states that slippery elm bark has the property of preserving fatty substances from rancidity, and that this fact was known to the Indians, who prepared bear's fat by melting it with the bark, in the proportion of a drachm of the latter to a pound of the former, keeping them heated together for a few minutes, and then straining off the fat. Wright tried the same process with butter and lard, and found them to remain perfectly sweet for a long time. (*A. J. P.,* xxiv.)

Uses.—Elm bark is an excellent demulcent, applicable to all cases in which this class of medicines is employed. It is especially recommended in *dysentery, diarrhœa,* and *diseases of the urinary passages.* Its mucilage is nutritious, and we are told that it has proved sufficient for the support of life in the absence of other food. In the case of a lad of fifteen, elm bark produced death, which was due to the effects of the numerous balls of indigestible fibre which were formed in the stomach. (*P. M. T.,* Feb. 7, 1874, p. 303.)

J. R. Dowler of Beardstown, Ill., reports the discharge of *tape worm* caused by chewing and

[1] *Fremontia californica,* Torr., or *California Slippery Elm,* is not botanically allied to *Ulmus fulva;* its bark is said, however, to have the same properties as slippery elm bark, and to be used for a similar purpose.

[2] The following test, devised by Geo. M. Beringer, seems to have practical value. Ten grains of ground or pulverized elm bark, thoroughly shaken with one fluidounce of water, will, if pure and of good quality, in fifteen minutes form a thick jelly-like mass of a good fawn color.

swallowing the bark of the elm. (*B. M. S. J.*, March 16, 1865, p. 132.) It is commonly used as a drink in the form of infusion. (See *Mucilago Ulmi.*) The powder may be used stirred in hot water, with which it forms a mucilage more or less thick according to the proportion added. The bark also serves as an emollient application in cases of *external inflammation.* For this purpose the powder may be formed into a poultice with hot water, or the bark itself may be applied, previously softened by boiling. McDowell of Virginia, recommended slippery elm bark for the dilatation of *fistulas* and *strictures* (*Med. Examiner*, i. 244); subsequently H. R. Storer of Boston, used it advantageously for *dilating the os uteri* (*B. M. S. J.*, liii. 300), and A. Abbe of the same place, succeeded in curing with it a case of *stricture of the rectum* (*Ibid.*, liv. 349).

Off. Prep.—Mucilago Ulmi, *U. S.*

UNGUENTA.

OINTMENTS

(ŭn-guĕn'tą)

Pommades, Onguents, *Fr.*; Salben, *G.*; Pomatas, Unguentos, *It.*; Pomadas, Unguentos, *Sp.*

These are fatty substances, softer than cerates, of a consistence like that of butter, and such that they may be readily applied to the skin by inunction. When ointments are prepared by merely mixing medicinal substances with *simple ointment, hydrous wool-fat, lard,* or *petrolatum,* care should be taken, if the added substance be a powder, that it be brought to the finest possible state of division before being incorporated with the unctuous matter. If soluble in water or in alcohol, it may often be advantageously rubbed with a little of one of these liquids. Gritty matter should not be allowed to enter these preparations. When an extract is added, if not uniformly soft, it should be made so by trituration with water or alcohol, according to its nature. Many of the ointments become rancid if long kept, and should, therefore, be prepared in small quantities at a time, or only when wanted for use. The tendency to rancidity may be in a considerable degree counteracted by imbuing the unctuous vehicle with benzoin, or with poplar buds, as recommended by Deschamps (*A. J. P.*, xv. 260); but care should be taken that there be no therapeutic objection to the admixture.[1] Elm bark is said to have the same effect. (See p. 1303.) According to Geisler, ten drops of spirit of nitrous ether, incorporated with an ounce of ointment, will overcome the disagreeable fatty odor. (*Ph. Cb.*, 1847, 927.) Hydrous wool-fat or lanolin, petrolatum, and glycerite of starch are now used as vehicles for ointments. (See *Adeps Lanæ Hydrosus, Petrolatum,* and *Glyceritum Amyli.*) In the selection of a vehicle for an ointment it is important to consider the object for which the ointment is to be used. Lanolin is a natural emollient of the skin, composed of cholesterin and other substances.

Glycelæum is an oleaginous compound of finely powdered almond meal 1 part, glycerin 2 parts, and olive oil 6 parts. It was proposed by T. B. Groves, *C. D.*, Sept. 14, 1867, as a substitute for plasma and other fatty bodies, and has no doubt advantages, one of which is the facility with which it can be removed from the skin by a wet sponge. It has been proposed to substitute glycerin for oils and fats in the preparation of ointments, either wholly or in part; but ointments thus prepared are altogether unfit for application by inunction, as a portion of the glycerin remains upon the skin, producing a rough sensation of adhesiveness, very different from the softness caused by oleaginous matter, and in some skin diseases glycerin in an ointment would be positively injurious.

The Cerates having been abolished as a class in the British Pharmacopœia, a few of the individual articles have been transferred to the Ointments, making the definition of the latter class of preparations, as given above, not exactly applicable to all the individual substances at present included among them in that Pharmacopœia. We consider no substance to be strictly entitled to the name of ointment which is not of such a consistence as to adapt it to application to the skin by friction or inunction. Ointments should be dispensed in glass, porcelain, or queensware pots or jars, or, if for temporary use, in tight wooden boxes. We have used a very convenient method of dispensing soft ointments by introducing them into compressible tubes. These tubes are similar to those used for holding artists' colors, and have the advantage of shielding the ointment from the oxidizing action of the air while allowing the use of the desired quantity. In the U. S. P. (8th Rev.) the following new ointments were introduced: Unguentum Acidi Borici, Hydrargyri Dilutum, Zinci Stearatis. Unguentum Stramonii is made from the extract of the leaf instead of that from the seed. The following ointments of the U. S. 1890 were not admitted: Unguentum Plumbi Carbonatis, Plumbi Iodidi.[1] For a classifica-

[1] *Populinated Lard.*—Emile Mouchon gives the following method of applying to lard the preservative influence of poplar buds and benzoin. Having prepared, by percolation, a *tincture of poplar buds* from one part of the dried buds in powder and four parts of alcohol, he adds by degrees to 1000 parts of melted lard 60 parts of the tincture, heats so that all the alcohol may be driven off, then strains, and agitates the mixture till it concretes on cooling. The same method is pursued with tincture of benzoin, in the same proportions: and tincture of guaiac will answer the same purpose. Lard thus prepared keeps perfectly well for a very long time. (*J. P. C.*, xxv. 458.) T. B. Groves has shown that oil of pimenta and balsam of Peru have in a powerful degree the same preservative influence on lard. (*P. J.*, Nov. 1864, p. 249.)

[1] *Unguentum Plumbi Carbonatis. U. S.* 1890. *Ointment of Lead Carbonate.*—"Lead Carbonate, in very fine powder, *ten grammes* [or 154 grains]; Benzoinated Lard, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Lead Carbonate with the

tion of ointments in accordance with their therapeutic use by C. S. N. Hallberg, see *West. Drug.*, 1900, 652.

UNGUENTUM. U. S.

OINTMENT

(ụn-guĕn'tŭm)

Unguentum Adipis, *U. S.* 1860; Unguentum Simplex; Simple Ointment; Pommade simple, *Fr.;* Unguentum cereum, *P. G.;* Wachssalbe, *G.*

* "White Wax, *two hundred grammes* [or 7 ounces av., 24 grains]; Benzoinated Lard, *eight hundred grammes* [or 28 ounces av., 96 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the White Wax, add the Benzoinated Lard, and heat gently until liquefied; then stir the mixture until it congeals." *U. S.*

Yellow wax was used in this ointment in the U. S. P. 1890 and objection was made to the color of the ointment. It has been very properly replaced by white wax in the U. S. P. (8th Rev.) and the lard is now benzoinated.

This is emollient, and is occasionally employed as a mild dressing to blistered or excoriated surfaces, but more frequently as a vehicle, it being the basis of several official ointments.[1]

Off. Prep.—Unguentum Acidi Tannici, *U. S.;* Unguentum Gallæ, *U. S.*

UNGUENTUM ACIDI BORICI. U. S., Br.

BORIC ACID OINTMENT

(ụn-guĕn'tŭm ăç'ị-dī bō'rị-cī)

Pommade de l'Acide Borique, *Fr.;* Unguentum Acidi Borici, *P. G.;* Borsalbe, *G.*

* "Boric Acid, in fine powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Paraffin, *one hundred grammes* [or 3 ounces av., 231 grains]; White Petrolatum, *eight hundred grammes* [or 28 ounces av., 96 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Paraffin, add the White Petrolatum, and heat gently for ten minutes. Then gradually add the hot liquid to the Boric Acid, contained in a warm mortar, triturating thoroughly, and stir the mixture until it congeals." *U. S.*

"Boric Acid, in very fine powder, carefully sifted, 1 *ounce* (Imperial) or 30 grammes; Paraffin Ointment, white, 9 *ounces* (Imp.) or 270 grammes. Mix." *Br.*

This ointment was introduced into the U. S. P. (8th Rev.); it closely resembles the British ointment.

UNGUENTUM ACIDI SALICYLICI. Br.

SALICYLIC ACID OINTMENT

(ụn-guĕn'tŭm ăç'ị-dī săl-ị-cŷl'ị-cī)

Pommade d'Acide Salicylique, *Fr.;* Salicylsalbe, *G.*

"Salicylic Acid, in powder, 10 *grains* or 0.5 gramme; Paraffin Ointment, white, 490 *grains* or 24.5 grammes. Mix." *Br.*

UNGUENTUM ACIDI TANNICI. U. S.

OINTMENT OF TANNIC ACID

(ụn-guĕn'tŭm ăç'ị-dī tăn'nị-cī)

Pommade d'Acide tannique, Pommade de Tannin, *Fr.;* Tanninsalbe, *G.*

* "Tannic Acid, *twenty grammes* [or 309 grains]; Glycerin, *twenty grammes* [or 309 grains]; Ointment, *sixty grammes* [or 2 ounces av., 51 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Tannic Acid in the Glycerin, with the aid of a gentle heat, and mix the solution thoroughly with the Ointment in a mortar, avoiding the use of iron utensils." *U. S.*

Ointment of Tannic Acid was doubled in strength at the U. S. P. 1890 revision. It is an excellent application in many cases of *piles* and *prolapsus ani*, also for *flabby ulcers*.

UNGUENTUM ACONITINÆ. Br.

ACONITINE OINTMENT

(ụn-guĕn'tŭm ạc-ŏn-ị-tī'næ)

Pommade d'Oleate d'Aconitine, Pommade d'Aconitine, *Fr.;* Akonitinoleatsalbe, Akonitinsalbe, *G.*

"Aconitine, 10 *grains* or 0.5 gramme; Oleic Acid, 80 *grains* or 4 grammes; Lard, 410 *grains* or 20.5 grammes. Rub the Aconitine with the Oleic Acid, and gently warm the mixture until dissolved; add the Lard; mix." *Br.*

For the uses of this preparation the reader is referred to the articles on *Aconitum* and *Aconitina*. Care must be taken not to apply it to an abraded or ulcerated surface, lest it produce serious constitutional effects.

UNGUENTUM AQUÆ ROSÆ. U. S., Br.

OINTMENT OF ROSE WATER

(ụn-guĕn'tŭm ă'quæ rō'sæ)

Rose Water Ointment: Unguentum Emolliens; Cold-cream, *Fr. Cod.;* Cérat cosmétique, Crême froide, *Fr.;* Unguentum leniens, *P. G.;* Cold Cream, *G.*

* "Spermaceti, *one hundred and twenty-five grammes* [or 4 ounces av., 179 grains]; White

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Benzoinated Lard, gradually added, until they are thoroughly mixed." *U. S.* 1890.

This ointment is used as a dressing to *blistered or excoriated surfaces, burns*, etc.

Unguentum Plumbi Iodidi. U. S. 1890. *Ointment of Lead Iodide.*—"Lead Iodide, in very fine powder, *ten grammes* [or 154 grains]; Benzoinated Lard, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Lead Iodide with the Benzoinated Lard, gradually added, until they are thoroughly mixed." *U. S.* 1890.

For the uses of this ointment, see *Plumbi Iodidum.*

[1] *Unguentum Simplex, Br.* 1885. *Simple Ointment.* "Take of White Wax *two ounces* [avoirdupois]; Benzoated Lard *three ounces* [av.]; Almond Oil *three fluid ounces.* Melt the Wax and Lard in the Oil on a water-bath; then remove the mixture, and stir constantly while it cools." *Br.* 1885. (See also U. S. 1850.)

Wax, *one hundred and twenty grammes* [or 4 ounces av., 102 grains]; Expressed Oil of Almond, *five hundred and sixty grammes* [or 19 ounces av., 330 grains]; Sodium Borate, in fine powder, *five grammes* [or 77 grains]; Stronger Rose Water, *one hundred and ninety grammes* [or 6 ounces av., 307 grains], to make about *one thousand grammes* [or 35 ounces av., 120 grains]. Reduce the Spermaceti and the White Wax to fine shavings and melt them at a moderate heat, add the Expressed Oil of Almond and stir, continuing the heat until the mixture is uniform; then gradually add the Stronger Rose Water, previously warmed, and in which the Sodium Borate has been dissolved, stirring the mixture rapidly and continuously until it congeals and becomes of uniform consistence. When this Ointment is to be used as a vehicle for metallic salts, the Sodium Borate should be omitted." *U. S.*

"Rose Water, undiluted, 7 *fl. ounces* (Imp. meas.) or 210 cubic centimetres; White Beeswax, 1½ *ounces* (Imp.) or 45 grammes; Spermaceti, 1½ *ounces* (Imp.) or 45 grammes; Almond Oil, 9 *ounces* (Imp.) or 270 grammes; Oil of Rose, 8 *minims* or 0.5 cubic centimetre. Melt together the White Beeswax, Spermaceti, and Almond Oil; pour the mixture into a warmed mortar and add the Rose Water gradually with constant trituration; add the Oil of Rose; continue the trituration until cold." *Br.*

In the U. S. P. 1890 process the proportion of rose water was greatly reduced,—*i.e.*, from 30 to 20 per cent.; this makes a more stable preparation, but in our opinion the usefulness of the ointment has been curtailed by the reduction, its soft consistence being one of its most valuable characteristics. Sodium borate was added to increase its whiteness; its presence may, however, prove objectionable when the ointment is used as a basis in prescriptions, by reacting with some of the ingredients ordered by the physician. The 1890 formula was retained with but slight changes in the U. S. P. (8th Rev.). The manipulation was somewhat modified to increase uniformity of the product.

This preparation is a white, very soft, and elegant ointment, deriving a grateful odor from the rose water, which remains incorporated with the other constituents if kept enclosed in glazed vessels. We have found it an improvement to add oil of rose in the proportion of one drop to eight ounces, and to use an instrument known as the "Dover egg-beater" for giving it the desired creamy appearance. It is a pleasant, cooling application to irritated and excoriated surfaces, and may be used with great advantage for *chapped lips* and *hands*, so frequent in cold weather. Cold cream is not recognized in the U. S. Pharmacopœia (8th Rev.) as an official synonym for ointment of rose water. This course became necessary because of the large number of unofficial ointments of varying composition popularly exploited as cold creams, and these were frequently dispensed, when physicians' prescriptions directed Ointment of Rose Water. The commercial cold creams must be made from substances which are not liable to rancidity, and paraffin oil, liquid petrolatum, white petrolatum, etc., largely form the basis of such, but the official ointment is to be preferred for use in prescriptions. W. C. Alpers furnishes the following formula for a cold cream which is more permanent than the official ointment. 150 parts of white wax is melted in 600 parts of paraffin oil with the aid of a gentle heat; 9 parts of borax is dissolved in 240 parts of water; the two fluids are brought to a uniform temperature, not exceeding 60° C., and the aqueous solution is poured into the oily one in a continuous stream, stirring gently for a minute or two; then 1 part of oil of geranium and a little oil of rose are added while stirring, and the product while still warm is poured into jars. The cold cream so obtained is white, soft and smooth, pleasantly odorous, keeps well in the heat of summer and the cold of winter, and becomes only slightly thinner in summer. As the ointment is liable to become rancid when long kept, and the water to separate upon exposure, Joseph Laidley has proposed the substitution for the rose water of oil of rose and glycerin, the former in the proportion of two drops, the latter in that of four fluidrachms, the quantity of spermaceti being increased by two drachms. (*A. J. P.*, xii. 119.) For some purposes the substitution is useful, but the official preparation is preferable for *chapped hands*, as the glycerin frequently leaves an unpleasant sensation of stickiness on the skin.

UNGUENTUM ATROPINÆ. Br.

ATROPINE OINTMENT

(ŭn-guĕn'tŭm ăt-rŏ-pī'næ)

Pommade d'Oleate d'Atropine, Pommade d'Atropine, *Fr.;* Atropinoleatsalbe, Atropinsalbe, *G.*

"Atropine, 10 *grains* or 0.5 gramme; Oleic Acid, 40 *grains* or 2 grammes; Lard, 450 *grains* or 22.5 grammes. Rub the Atropine with the Oleic Acid, and gently warm the mixture until dissolved; add the Lard; mix." *Br.*

For the uses of this ointment, see *Belladonna* and *Atropina*, p. 215, also p. 821. Caution must be observed that the ointment shall not come in contact with abraded, ulcerated, or wounded surfaces, and that it be not applied too freely to sound skin.

UNGUENTUM BELLADONNÆ. U. S., Br.

BELLADONNA OINTMENT

(ŭn-guĕn'tŭm bĕl-lą-dŏn'næ)

Pommade Belladonée, *Fr. Cod.;* Pommade de Bella done, *Fr.;* Belladonnasalbe, Tollkirschensalbe, *G.*

* "Extract of Belladonna Leaves, *ten grammes* [or 154 grains]; Diluted Alcohol, *five cubic*

centimeters [or 81 minims]; Hydrous Wool-Fat, *twenty grammes* [or 309 grains]; Benzoinated Lard, *sixty-five grammes* [or 2 ounces av., 128 minims], to make about *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Extract with the Diluted Alcohol until a smooth mixture is obtained; with this incorporate the Hydrous Wool-Fat; then add the Benzoinated Lard and mix thoroughly." *U. S.*

"Liquid Extract of Belladonna, 2 *fl. ounces* (Imperial measure) or 40 cubic centimetres; Benzoated Lard, 2¼ *ounces* (Imp.) or 45 grammes. Evaporate the Liquid Extract of Belladonna on a water-bath until it is reduced to a *quarter of an ounce* (Imp.) or five grammes; add the Benzoated Lard; mix. 100 parts of this Ointment should contain 0.6 part of the alkaloids of Belladonna Root." *Br.*

This is a convenient form for the external application of extract of belladonna. Care must be taken in preparing it that the extract employed have the due consistence, and, if dry and lumpy, it may be restored to the proper state by rubbing it with a little water in a heated mortar. The use of diluted alcohol, as now officially directed, is still better.

UNGUENTUM CANTHARIDIS. Br.

CANTHARIDES OINTMENT

(ụn-guĕn'tŭm cạn-thăr'ị-dīs)

Unguentum Irritans, Unguentum ad Fonticulos; Pommade Epispastique (jaune, verte), *Fr. Cod.;* Onguent de Cantharides, *Fr.;* Unguentum Cantharidum, *P. G.;* Spanischfliegensalbe, *G.;* Unguento de cantaridas, *Sp.*

"Cantharides, bruised, 1 *ounce* (Imperial) or 30 grammes; Benzoated Lard, 10 *ounces* (Imp.) or 300 grammes. Melt the Benzoated Lard, add the Cantharides, and digest at a temperature of about 120° F. (48.9° C.) for twelve hours. Strain through calico and press the residue gently; stir until cold." *Br.*

The British (1885) process was a better one than that of the U. S. Pharm. 1870.[1] Olive oil is a good solvent of cantharidin. By its use the active matter of the flies is more uniformly diffused through the ointment than when they are directly incorporated in the state of powder, with the other ingredients. The preparation is thus better calculated to meet the end proposed of maintaining the discharge from blistered surfaces without producing undue irritation. It has been said that the virtues of the flies are impaired by boiling, but the contrary has been proved to be the case, the cantharidin being neither altered nor volatilized at 100° C. (212° F.). (See *Cantharis.*) Benzoated lard as directed in the Br. (1898) process, even when kept at a temperature of 120° F. during digestion, is not as effective as olive oil as a solvent for cantharidin.

[1] "Take of Cantharides Cerate *one hundred and twenty grains;* Resin Cerate *three hundred and sixty grains.* Mix them thoroughly." *U. S.* 1870.

It should be recollected that this ointment is intended as a dressing for blisters, not to produce vesication. The Committee of Revision wisely omitted the preparation from the U. S. P. 1880, as it was frequently prescribed under the impression that it was equal in strength to the cerate, in fact, identical with it, and disappointment resulted. Such a preparation should be left to extemporaneous prescription. *Dupuytren's ointment,* employed as a local application to *prevent the loss of hair,* was made by macerating a drachm of flies in a fluidounce of alcohol, and incorporating one part of the tincture thus formed with nine parts of lard.

UNGUENTUM CAPSICI. Br.

CAPSICUM OINTMENT

(ụn-guĕn'tŭm căp'sị-cī)

Pommade de Piment des Jardins, *Fr.;* Spanisch-Pfeffersalbe, *G.*

"Capsicum Fruit, bruised, 120 *grains* or 12 grammes; Spermaceti, 60 *grains* or 6 grammes; Olive Oil, 1 *ounce* (Imperial) or 44 grammes. Digest on a water-bath for one hour, occasionally stirring; strain; set aside to cool, without stirring." *Br.*

UNGUENTUM CETACEI. Br.

SPERMACETI OINTMENT

(ụn-guĕn'tŭm cẹ-tā'cẹ-ī)

Pommade de baleine, *Fr.;* Walrathsalbe, *G.*

"Spermaceti, 20 *ounces* (Imperial) or 200 grammes; White Beeswax, 8 *ounces* (Imp.) or 80 grammes; Almond Oil, 72 *ounces* (Imp.) or 720 grammes; Benzoin, in coarse powder, 2 *ounces* (Imp.) or 20 grammes. Melt together the Spermaceti, Beeswax, and Almond Oil; add the Benzoin, and, frequently stirring the mixture, continue the application of heat for two hours; remove from the source of heat; strain; and stir the Ointment constantly until cold." *Br.*

Spermaceti cerate (U. S. P. 1890) was not admitted to the U. S. P. (8th Rev.).[1]

[1] *Ceratum Cetacei. U. S.* 1890. *Spermaceti Cerate.* "Spermaceti, *one hundred grammes* [or 3 ounces av., 230 grains]; White Wax, *three hundred and fifty grammes* [or 12 ounces av., 151 grains]; Olive Oil, *five hundred and fifty grammes* [or 19 ounces av., 175 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt together the Spermaceti and White Wax; then add the Olive Oil previously heated, and stir the mixture constantly until it is cool." *U. S.* 1890.

The direction to heat the oil before adding it to the other ingredients is important. If added cold, it is apt to produce an irregular congelation of the wax and spermaceti, and thus to render the preparation lumpy. The cerate is employed as a dressing for blisters, excoriated surfaces, and wounds, and as the basis of more active preparations. When the ingredients are pure and sweet, it is perfectly free from irritating properties. The above formula contains a little less spermaceti than that of the U. S. P. 1870. From experiments made by J. B. Barnes, it appears that this cerate keeps much better when made of unbleached materials than when prepared with olive oil and wax previously bleached. (*P. J.*, 1861, p. 352.)

This ointment is employed as a mild dressing for *blisters, wounds,* and *excoriated surfaces.* It should be made in small quantities at a time, as it is apt to become rancid when long kept.

UNGUENTUM CHRYSAROBINI. U. S., Br.

CHRYSAROBIN OINTMENT

(ụn-guĕn'tŭm ȼhrȳs-ą-rọ-bī'nī)

Pommade de Chrysarobine, Pommade de Poudre de Goa, *Fr.;* Chrysarobinsalbe, Goapulversalbe, *G.*

* "Chrysarobin, *six grammes* [or 93 grains]; Benzoinated Lard, *ninety-four grammes* [or 3 ounces av., 138 grains], to make about *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Chrysarobin with the Benzoinated Lard, previously melted, and heat the mixture on a water-bath with occasional stirring for twenty minutes; then strain and stir until it congeals." *U. S.*

"Chrysarobin, 20 *grains* or 2 grammes; Benzoated Lard, 480 *grains* or 48 grammes. Triturate the Chrysarobin gradually with the Benzoated Lard, previously melted by heat; continue the heat until the Chrysarobin is dissolved; stir until cold." *Br.*

This ointment was reduced one-half in strength at the U. S. P. 1890 revision, but was slightly increased in strength in the Eighth Revision; it is now about one-third stronger than the British ointment. It was formerly used in *psoriasis, ringworm,* and other *diseases of the skin,* but its use has been to a great extent abandoned, on account of the permanent stain it leaves upon the linen.[1] It is preferably made by dissolving the chrysarobin in a little hot benzene, mixing this rapidly with a portion of the melted lard, and subsequently stirring before adding the rest of the lard.

UNGUENTUM COCAINÆ. Br.

COCAINE OINTMENT

(ụn-guĕn'tŭm cō-cą-ī'næ)

Pommade d'Oléate de Cocaine, *Fr.;* Cocainoleatsalbe, *G.*

"Cocaine, 20 *grains* or 1 gramme; Oleic Acid, 80 *grains* or 4 grammes; Lard, 400 *grains* or 20 grammes. Rub the Cocaine with the Oleic Acid, and gently warm the mixture until dissolved; add the Lard; mix." *Br.*

UNGUENTUM CONII. Br.

CONIUM OINTMENT

(ụn-guĕn'tŭm cọ-nī'ī)

Pommade de Grand Ciguë, *Fr.;* Schirlingsalbe, *G.*

"Juice of Conium, 2 *fl. ounces* (Imperial measure) or 88 cubic centimetres; Hydrous Wool Fat, ¾ *ounce* (Imp.) or 33 grammes. Evaporate the Juice of Conium on a water-bath to one eighth of its volume, at a temperature not exceeding 140° F. (60° C.); add the Hydrous Wool Fat; mix by trituration." *Br.*

It may be applied locally to cancerous or other painful ulcers, but has little therapeutic value.

UNGUENTUM CREOSOTI. Br.

CREOSOTE OINTMENT.

(ụn-guĕn'tŭm crē-ọ-sō'tī)

Pommade Créosotée, Pommade de Créosote, *Fr.;* Kreosotsalbe, *G.*

"Creosote, 1 *ounce* (Imperial) or 30 grammes; Hard Paraffin, 4 *ounces* (Imp.) or 120 grammes; Soft Paraffin, white, 5 *ounces* (Imp.) or 150 grammes. Melt the Hard and Soft Paraffins together; add the Creosote; stir until cold." *Br.*

The British ointment is more than twice as strong as that official in the U. S. P. 1870, which was made by mixing half a fluidrachm of creosote with a troyounce of lard. For the use of this ointment, see *Creosotum.* It may sometimes be advantageously diluted with lard when found to irritate.

UNGUENTUM DIACHYLON. U. S.

DIACHYLON OINTMENT

(ụn-guĕn'tŭm dī-ăȼh'ȳ-lŏn)

Unguentum Plumbi Hebræ; Hebra's Lead Ointment; Onguent Diachylon, Pommade de Diachylon, *Fr.;* Unguentum diachylon, *P. G.;* Bleipflastersalbe, Diachylonsalbe, *G.*

* "Lead Plaster, *fifty grammes* [or 1 ounce av., 334 grains]; Oil of Lavender Flowers, *one gramme* [or 15 grains]; Olive Oil, *forty-nine grammes* [or 1 ounce av., 319 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Melt the Lead Plaster by applying a gentle heat, add the Olive Oil, and mix thoroughly; then allow the mixture to cool, add the Oil of Lavender Flowers, and stir the ointment until it congeals. It should be prepared extemporaneously." *U. S.*

This ointment has been largely used by dermatologists in *eczema* and other *skin diseases.* It is frequently called "*Unguentum Diachylon Hebræ,*" on account of its extensive use by Hebra of Vienna. Vulpius states that the ointment used at Hebra's clinic, made according to the following formula, is very superior and will keep for weeks. Twenty parts of litharge are heated with sufficient water and eighty parts of olive oil until the reaction is completed, when one part of oil of lavender is added to the strained and cooling mass.

Our experience with the ointment made by the latter formula is that the tendency to rancidity constitutes its greatest objection, and

[1] The *ointment of pyrogallic acid,* of the strength of from ten to forty grains to the ounce, has been used to some extent as a substitute for chrysarobin ointment. It is slower in its action than the ointment of chrysarobin, and also stains the hair, skin, etc. It is said when used too freely to cause constitutional disturbance, with fever, greenish urine, etc.

in warm weather it is impossible to keep it longer than a few days. If even slightly rancid, it is unfit for use in most cases. A. Deringer (*Ph. Z. R.*, 1880, p. 103; *A. J. P.*, Sept. 1880) recommended the following modification. Dissolve 200 grammes of lead acetate in 1 liter of distilled water and 300 grammes of white Marseilles soap in 1½ liters of distilled warm water, filter both solutions, mix, wash the resulting precipitate frequently with distilled water, and, after removing the moisture from it as much as possible, melt 1 part of it together with 1½ parts of the best olive oil with a steam evaporating apparatus, and triturate into a white, smooth ointment in a mortar, which then possesses all the excellent mild and healing properties of Hebra's ointment. See *Emplastrum Plumbi*, page 441.

Eisner's modification, approved by L. A. Duhring, is as follows. One part of freshly precipitated (from lead acetate) pure white lead hydroxide is rubbed with two parts of water, and mixed well with six parts of the best Lucca olive oil. It should be stirred for about two hours over a hot water bath, and cooled with constant stirring until the proper consistence is obtained. While cooling, a drachm of oil of lavender is to be added to each half-pound of ointment. (*M. T. G.*, May 7, 1881.)

UNGUENTUM EUCALYPTI. Br.

EUCALYPTUS OINTMENT

(ŭn-guĕn'tŭm eū-ca-lĭp'tī)

Pommade d'Eucalypte, *Fr.;* Eukalyptussalbe, *G.*

"Oil of Eucalyptus, 1 *ounce* (Imperial) or 30 grammes; Hard Paraffin, 4 *ounces* (Imp.) or 120 grammes; Soft Paraffin, white, 5 *ounces* (Imp.) or 150 grammes. Melt the Hard and Soft Paraffins together; add the Oil of Eucalyptus; stir until cold." *Br.*

This ointment is used as a stimulant to indolent *ulcers* and in *skin diseases.*

UNGUENTUM GALLÆ. U. S., Br.

NUTGALL OINTMENT

(ŭn-guĕn'tŭm găl'læ)

Gall Ointment; Ointment of Galls; Pommade de Noix de Galle, *Fr.;* Galläpfelsalbe, *G.*

* "Nutgall, in very fine powder, *twenty grammes* [or 309 grains]; Ointment, *eighty grammes* [or 2 ounces av., 360 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Nutgall with the Ointment, gradually added, until they are thoroughly mixed. Avoid the use of metallic utensils." *U. S.*

"Galls, in very fine powder, 1 *ounce* (Imperial) or 30 grammes; Benzoated Lard, 4 *ounces* (Imp.) or 120 grammes. Mix by trituration." *Br.*

Care should be taken to have the nutgall in very fine powder and thoroughly sifted. This ointment is used chiefly in *piles* and *prolapsus ani*, and in *flabby* or *indolent ulcers.*

Off. Prep.—Unguentum Gallæ cum Opio, *Br.*

UNGUENTUM GALLÆ CUM OPIO. Br.

GALL AND OPIUM OINTMENT

(ŭn-guĕn'tŭm găl'læ cŭm ō'pĭ-ō)

"Gall Ointment, 925 *grains* or 92.5 grammes; Opium, in very fine powder, 75 *grains* or 7.5 grammes. Mix by trituration. 100 parts of this Ointment contain 7½ parts of Opium." *Br.*

This combination of galls and opium is sometimes employed for *hemorrhoids.* From half a drachm to a drachm of camphor is sometimes added.

UNGUENTUM GLYCERINI PLUMBI SUBACETATIS. Br.

LEAD SUBACETATE OINTMENT

(ŭn-guĕn'tŭm glĭç-ĕ-rī'nī plŭm'bī sŭb-ăç-ĕ-tā'tĭs)

"Glycerin of Lead Subacetate, 1 *ounce* (Imperial) or 30 grammes; Paraffin Ointment, white, 5 *ounces* (Imp.) or 150 grammes. Mix." *Br.*

This ointment has therapeutic properties similar to those of Goulard's cerate.

UNGUENTUM HAMAMELIDIS. Br.

HAMAMELIS OINTMENT

(ŭn-guĕn'tŭm hăm-ă-mĕl'ĭ-dĭs)

Pommade de Hamamélis, *Fr.;* Hamamelissalbe, *G.*

"Liquid Extract of Hamamelis, ¼ *fl. ounce* (Imperial measure) or 10 cubic centimetres; Hydrous Wool Fat, 2¼ *ounces* (Imp.) or 90 grammes. Mix." *Br.*

This was one of the "Additions" to the British Pharmacopœia, 1885, and afterwards introduced into the Br. Pharm. 1898. It is, in our opinion, of doubtful utility, but may be rubbed in over *sprains.*

UNGUENTUM HYDRARGYRI. U. S., Br.

MERCURIAL OINTMENT [Blue Ointment]

(ŭn-guĕn'tŭm hȳ-drär'gy-rī)

Mercury Ointment; Unguentum Mercuriale, s. Neapolitanicum; Pommade mercurielle à parties égales, Onguent mercuriel double, Onguent Napolitain, *Fr. Cod.;* Pommade napolitaine, *Fr.;* Unguentum Hydrargyri Cinereum, *P. G.;* Graue Quecksilbersalbe, *G.*

* "Mercury, *five hundred grammes* [or 17 ounces av., 279 grains]; Oleate of Mercury, *twenty grammes* [or 309 grains]; Prepared

Suet, *two hundred and thirty grammes* [or 8 ounces av., 49 grains]; Benzoinated Lard, *two hundred and fifty grammes* [or 8 ounces av., 358 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Triturate the Oleate of Mercury in a warm mortar, add the Mercury gradually by means of a pipette, and when the globules are completely divided and distributed, set it aside for about fifteen minutes. Melt the Lard and Suet, allow the mixture to partially cool, and add about *twenty-five grammes* [or 386 grains] of it to the mercurial mixture, and continue the trituration until globules are no longer visible under a lens magnifying ten diameters. Then add the remainder of the Lard and Suet and mix thoroughly." *U. S.*

Assay. U. S. (8th Rev.)—"Weigh 10 Gm. of Mercurial Ointment in a tared dish, melt it, then remove it from the fire and add 50 Cc. of warm petroleum benzin. Stir the mixture well, allow the Mercury to settle completely, and decant the petroleum benzin. Wash the residue with successive portions of 10 Cc. each of warm petroleum benzin until it is entirely free from fatty matter, carefully retain all of the separated Mercury in the dish, and allow all traces of the benzin to evaporate. Add to the residue 10 Cc. of diluted hydrochloric acid, heat it gently and stir with a glass rod until the Mercury collects in a globule. Pour off the acid, warm the Mercury with a little distilled water, dry the globule on bibulous paper, and weigh. The Mercury should weigh not less than 4.9 Gm." *U. S.*

"Mercury, 1 *pound* (Imperial) or 160 grammes; Lard, 1 *pound* (Imp.) or 160 grammes; Prepared Suet, 1 *ounce* (Imp.) or 10 grammes. Triturate until metallic globules cease to be visible." *Br.*

The Pharmacopœias unite at present in recognizing but one strong mercurial ointment, which contains practically equal weights of mercury and fatty matter. When the physician wishes a weaker preparation, he may direct the ointment to be diluted with such a proportion of lard as may answer his purpose, or may use the Blue Ointment (*Unguentum Hydrargyri Dilutum,* page 1312), which contains about 33 per cent. of mercury.

The U. S. official formula is particularly adapted to the extemporaneous preparation of this ointment, it having been shown that the extinguishment of the mercury is facilitated by the use of oleate of mercury, while its presence undoubtedly adds to the efficiency of the ointment. Oleic acid was suggested by Leo Eliel (see *Indiana Pharmacist,* 1888) in the proportion of 1 per cent. for the extinction of the mercury. The addition of 4 per cent. of compound tincture of benzoin aids in the preservation of the ointment. The trituration should not be accompanied with pressure, a light, rapid motion of the pestle being most effective. In the preparation of mercurial ointment, care is requisite that the mercury should be completely extinguished. The trituration is usually performed upon the large scale in a marble mortar, as it is difficult to keep iron so clean as not to impart more or less oxide to the ointment. The mercury is known to be extinguished when a portion of the mass, rubbed upon paper or the back of the hand, exhibits no metallic globules under a magnifying glass of ten diameters. The operation cannot be considered as satisfactorily accomplished when the globules are invisible merely to the naked eye. To facilitate the process, which is very tedious, the addition of various substances has been proposed, calculated to hasten the disappearance of the metal. Turpentine and sulphur have been employed, but are inadmissible,—the former because it renders the ointment too irritating, the latter because it forms with the mercury an active sulphide. Their presence in the ointment may be detected by the peculiar odor which they respectively emit when exposed to heat. Sulphur, moreover, gives the ointment a darker color. Rancidity in the lard facilitates the extinguishment of the mercury, but is liable to the same objection as turpentine, only to a greater degree. Guibourt recommended the addition of one-sixteenth of old mercurial ointment.[1] Simonin proposed the use of lard which has been exposed in thin layers to a damp air for fifteen days. This facilitates the extinguishment of the metal, but probably renders the preparation more irritant by the chemical alteration of the lard. The following plan of preparing the ointment was proposed by Chevallier. A pound of mercury, and half a pound of fresh lard, previously melted, are introduced into a stone or glass bottle, shaken till the mixture acquires the consistence of a very thick syrup, then poured into a mortar, and incorporated, by constant stirring, with an additional half-pound of lard. In this manner, according to Chevallier, a perfect ointment may be made in half an hour. E. R. Squibb prepares this ointment by succussion in an apparatus which agitates the mixture of fats and mercury until the metal is extinguished. When prepared with lard alone, the ointment is liable, in hot weather, to become so soft as to allow the metal to separate. Hence

[1] It appears that J. Higginbottom made known, so long ago as the year 1814, this mode of extinguishing mercury. He recommends that equal weights of the old ointment and of mercury should be rubbed together, till the globules quite disappear, and the requisite proportion of lard then added. It is not necessary that the mercurial ointment should be rancid. (*P. J.*, xvi. 215.) For a process recommended by J. M. Maisch, of which the peculiarity is the use of mercury passed through chamois leather, so as to be sprinkled in minute division over the fat, see *A. J. P.* (xxviii. 107), and for another by E. H. Hance, in which melted spermaceti is employed as the extinguishing material, and which is said to answer well for small quantities, see the same journal (xxix. 15). M. E. Mouchon uses wax or stearin to facilitate extinguishment, and recommends benzoinated lard as the vehicle. (*Journ. de Chim. Méd.*, Nov. 1856, p. 652.) Geo. Boyle uses a portion of old mercurial ointment and ether. (*A. J. P.*, xlvi. 561.) Melseur affirms that the addition of glycerin very materially hastens the process. (*P. J.*, 1871, p. 339.)

the official use of suet, and even a larger proportion might be employed, during the summer season.[1] Christison states that the better plan is not to complete the process by a continuous trituration, but to operate for a short time every day and allow the ointment in the meantime to be exposed to the air. But so much time and labor are required in this process that the ointment is preferably made by machinery on the large scale. The fatty matters, kept in the fluid state by a heat of about 37.7° C. (100° F.), are triturated with the metal by means of two iron balls which are driven rapidly around in a circular trough by steam power. The extinguishment of the mercury is thus effected in about twelve hours. In buying from the manufacturer, great care should be exercised by the pharmacist, as much of the commercial ointment contains less than the official percentage of mercury. Indeed, it is sometimes found in the market without a trace of mercury, having been made by mixing up lamp black with rancid lard and suet until the proper tint is obtained. A method of preparing mercurial ointment proposed by Orosi is to precipitate metallic mercury, in the pulverulent form, from a solution of corrosive sublimate, by an excess of stannous chloride, with the addition of hydrochloric acid, and, having poured off the supernatant fluid, washed the precipitate with warm water, and dried it between bibulous paper, to incorporate it with the prescribed proportion of lard. To prevent the precipitated mercury from running into globules, it is recommended to cover with fat the interior of the vessel in which the precipitation takes place. For an account of many expedients that have been proposed to facilitate the extinguishment of the metal, see a paper by Dieterich (*A. J. P.*, 1880).

Mercurial ointment has when freshly prepared a bluish color, which becomes darker with age. It has been thought to contain the mercury in the state of mercurous oxide, but most of the metal can be separated by methods not calculated to reduce the oxide, and it is now generally admitted that by far the greater part of it exists in a state of minute division and not of chemical combination. It has been shown, however, that the metal is slightly oxidized, and the change of color which the ointment undergoes with age is attributable to further oxidation. If the ointment be kept long melted in a narrow vessel, metallic mercury subsides, and an oily liquid floats upon the surface. After this has been filtered so as to separate everything undissolved, it is blackened by hydrogen sulphide, and yields a trace of mercurial oxide to acetic acid. Christison states that he has examined various samples of the ointment, and never failed to detect mercurial oxides, and he has inferred from his observations that the oxide amounts to rather more than 1 per cent. But the proportion is variable, according to the age and mode of preparation of the ointment. It scarcely admits of a doubt that the mercurial oxide formed enters into chemical combination with the lard or one of its fatty acids. Donovan advanced the idea that the medicinal activity of the ointment depended exclusively on this compound of the lard with the mercurial oxide. An ointment made by merely mixing lard and black mercurial oxide has not the same effect, however, because there is no chemical union between the ingredients. But upon exposing such a mixture to a temperature of 176.6° C. (350° F.), and continually agitating it for two hours, he found that every ounce of lard dissolved and combined with twenty-one grains of oxide, and the resulting compound was proved to be equally effectual with the common ointment, and capable of being introduced into the system in one-third of the time. It has been proposed to substitute an ointment thus prepared for that made according to the official directions, as being more manageable and of more uniform strength. Care, however, would be required in preparing it to avoid a temperature either too high or too low, as the former might decompose the oxide, and the latter would be insufficient to effect its union with the lard. There would be danger, also, that the lard might be rendered irritant by the influence of the heat. From experiments by a committee of the College of Pharmacy of New York, it appears that mercurial ointment in time becomes unequal in strength in consequence of the settling of the metallic ingredient. The inference is that, after long standing, the contents of the jar should be triturated, so as to restore an equable strength, before being dispensed. (*A. J. P.*, xvi. 2.)

Uses.—Mercurial ointment, when rubbed upon the surface of the body, produces, in consequence of its absorption, the general effects of mercury upon the system. Half to one drachm may be used at once, in urgent cases. It may also be advantageously employed as a resolvent in local affections, as in the case of *venereal buboes,* and of *chronic glandular swellings,* upon which it may be made to operate directly by being applied in the course of the absorbents passing through the enlarged glands.

In urgent cases, or in local affections, it may also be rubbed on other parts of the body, or applied to blistered surfaces. The friction should on each occasion be continued till the whole of the ointment is absorbed. When frequently rubbed upon the same part, it is prone to produce a disagreeable eruption, which interferes with its continued application. Mercurial ointment has been employed, with some

[1] *Oleum Cinereum.*—Oleum cinereum is a mercurial preparation used by E. Lang in syphilitic complaints. It is prepared by triturating, in a cool place, lard, oil, and mercury until the latter becomes uniformly suspended, the finished preparation to contain 20 per cent. of the metal. It is used as a local dressing, also as an injection to enlarged glands, 0.01 to 0.02 Cc. being given once a week or fortnight. For use it is melted by the warmth of the hand. (*W. K. W.*, 1886.)

success, to prevent the maturation of the *small pox pustule,* and the consequent pitting. For this purpose it may be applied to the face or other part, thickly spread on patent lint or muslin, care being taken to prevent the access of air to the covered part. To be successful it must be applied before the third or fourth day of the eruption. The ointment has been recommended also in *erysipelas* and in *chilblains.* Potassium iodide rubbed with mercurial ointment is said to promote the separation of the mercury in the form of globules (*J. P. C.,* 3e sér., x. 356); but the effect will not take place if the iodide has been thoroughly dried and well powdered and the ointment is added to it in small portions at a time. (*Ibid.,* x. 421.)

Off. Prep.—Linimentum Hydrargyri, *Br.;* Unguentum Hydrargyri Compositum, *Br.;* Unguentum Hydrargyri Dilutum, *U. S.*

UNGUENTUM HYDRARGYRI AMMONIATI. U. S., Br.

OINTMENT OF AMMONIATED MERCURY

(ŭn-guĕn'tŭm hȳ-drär'gy-rī ăm-mō-nī-ā'tī)

White Precipitate Ointment; Unguentum Præcipitati Albi; Ointment of White Precipitate; Pommade de Chloramidure de Mercure, *Fr.;* Unguentum Hydrargyri Album, *P. G.;* Weisse Quecksilbersalbe, *G.*

* "Ammoniated Mercury, in very fine powder, *ten grammes* [or 154 grains]; White Petrolatum, *fifty grammes* [or 1 ounce av., 334 grains]; Hydrous Wool-Fat, *forty grammes* [or 1 ounce av., 180 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Ammoniated Mercury with an equal weight of the melted White Petrolatum, then add the remainder of the melted White Petrolatum, mix thoroughly with the Hydrous Wool-Fat, and stir the mixture until it congeals." *U. S.*

"Ammoniated Mercury, 1 *ounce* (Imperial) or 30 grammes; Paraffin Ointment, white, 9 ounces (Imp.) or 270 grammes. Mix." *Br.*

Used chiefly in cutaneous eruptions, such as *psora, porrigo,* and *herpes.*

UNGUENTUM HYDRARGYRI COMPOSITUM. Br.

COMPOUND MERCURY OINTMENT

(ŭn-guĕn'tŭm hȳ-drär'gy-rī cŏm-pŏs'ĭ-tŭm)

Pommade mercurielle composée, *Fr.;* Kampher Quecksilbersalbe, *G.*

" Mercury Ointment, 10 *ounces* (Imperial) or 150 grammes; Yellow Beeswax, 6 *ounces* (Imp.) or 90 grammes; Olive Oil, 6 *ounces* (Imp.) or 90 grammes; Camphor, in flowers, 3 *ounces* (Imp.) or 45 grammes. Mix the Beeswax, Olive Oil, and Mercury Ointment with the aid of heat; add the Camphor; triturate until cold." *Br.*

The addition of camphor to mercurial ointment has been thought to soften it and promote absorption of the mercury, but that it has such an effect is very doubtful.

UNGUENTUM HYDRARGYRI DILUTUM. U. S.

BLUE OINTMENT

(ŭn-guĕn'tŭm hȳ-drär'gy-rī dī-lū'tŭm)

* " Mercurial Ointment, *six hundred and seventy grammes* [or 23 ounces av., 207 grains]; Petrolatum, *three hundred and thirty grammes* [or 11 ounces av., 280 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Mix them thoroughly." *U. S.*

This ointment was introduced into the U. S. P. (8th Rev.) to supply the need for a weaker preparation than the official 50 per cent. ointment (see *Unguentum Hydrargyri*); it should be kept in a cool place in the summer, as otherwise the mercury may separate on account of the softening of the fatty vehicle.

UNGUENTUM HYDRARGYRI IODIDI RUBRI. Br.

MERCURIC IODIDE OINTMENT

(ŭn-guĕn'tŭm hȳ-drär'gy-rī ī-ŏd'ĭ'dī rŭ'brī)

Ointment of Red Iodide of Mercury; Pommade d'Iodure Mercurique, Pommade de Deutoiodure de Mercure, *Fr.;* Jodquecksilbersalbe, *G.*

" Mercuric Iodide, in fine powder, 20 *grains* or 2 grammes; Benzoated Lard, 480 *grains* or 48 grammes. Mix." *Br.*

This ointment is employed as a dressing to indolent *scrofulous* and *syphilitic ulcers.*

UNGUENTUM HYDRARGYRI NITRATIS. U. S., Br.

OINTMENT OF MERCURIC NITRATE
CITRINE OINTMENT

(ŭn-guĕn'tŭm hȳ-drär'gy-rī nī-trā'tĭs)

Unguentum Citrinum; Unguentum Hydrargyri Citrinum; Pommade Citrine, *Fr. Cod.;* Onguent Citrin, Pommade de Nitrate de Mercure, *Fr.;* Quecksilbernitratsalbe, Gelbe Quecksilbersalbe, *G.*

* " Mercury, *seventy grammes* [or 2 ounces av., 205 grains]; Nitric Acid, *one hundred and seventy-five grammes* [or 5 ounces av., 76 grains]; Lard, free from water, *seven hundred and sixty grammes* [or 26 ounces av., 354 grains], to make about *one thousand grammes* [or 35 ounces av., 120 grains]. Heat the Lard in a capacious glass or porcelain vessel to a temperature of 105° C. (221° F.), then withdraw the heat and gradually add *seventy grammes* [or 2 ounces av., 205 grains] of the Nitric Acid. When the reaction moderates, reapply the heat until effervescence ceases, and allow the mixture to cool to about 40° C. (104° F.). Having dissolved the Mercury in the remainder of the Nitric Acid, using sufficient heat to prevent the solution from crystallizing, add this solution to the Lard mixture. When the mass begins to congeal, stir it thoroughly with a wooden spatula, until it is of a bright citrine color. Contact with metallic utensils should be avoided." *U. S.*

"Mercury, 1 *ounce* (Imperial) or 100 grammes; Nitric Acid, 3 *fl. ounces* (Imp. meas.) or 300 cubic centimetres; Lard, 4 *ounces* (Imp.) or 400 grammes; Olive Oil, 7 *ounces* (Imp.) or 700 grammes. Dissolve the Mercury in the Nitric Acid without the aid of heat, agitating gently from time to time. Heat the Lard and Olive Oil together on a sand-bath, so that the mixture when transferred to a heated earthenware jar, capable of holding ten times the quantity, shall be at a temperature of 290° F. (143.3° C.). Add the cold mercurial solution very gradually, stirring constantly to promote disengagement of the fumes. After frothing has ceased, the mixture, which should have a temperature of not less than 200° F. (93.3° C.), must be kept stirred until it is cold. The resulting Ointment should be firm in consistence and have a pale lemon color." *Br.*

The formula for this ointment was changed in the U. S. P. (8th Rev.) by replacing the lard oil with lard; this in our opinion is not an improvement, as the present ointment is too hard in cold weather and more disposed to granulate than the ointment of the U. S. P. 1890. The introduction of a diluted citrine ointment into the Pharmacopœia similar to the one in the British Pharmacopœia would prove a great convenience.

The chemical changes which take place in the preparation of this ointment are not precisely known. They differ somewhat according to the circumstances under which the operation is performed; for example, according to the proportion and strength of the acid, the nature of the fatty matter, and the degree of heat employed. In the British process and that of the U. S. P. 1870 the mercury, in the first step of the process, is converted into a mixture of mercuric and mercurous nitrate by the addition of nitric acid in excess, with the loss of some of the free nitric acid through deoxidation. When the acid mercurial solution is added to the fatty matter, a reaction takes place, which results in the fat being oxidized at the expense of the free nitric acid, nitrogen dioxide and nitrogen tetroxide being at the same time liberated, and the olein of the fat is converted into elaidin, which change is recognized by the beautiful orange color of the fat. But the degree to which these changes take place is influenced greatly by the temperature to which the mixture is exposed. If this be low, there is little or no escape of gas; if elevated, there is a copious evolution of nitrous fumes. In the former case the changes are obviously less considerable than in the latter.

As formerly prepared, this ointment, though at first beautifully yellow and of the proper consistence, soon began to change, acquiring in time a dirty-greenish and mottled color, and becoming so hard and friable as to be unfit for use unless mixed with lard. These results were ascribed to various causes, and many different modifications of the process were proposed in order to obviate them. The U. S. process of 1850 was based upon the fact that the olive oil of the former British process is hardened by nitrous acid or mercuric nitrate, while the same effect is not produced upon neat's-foot oil. As at first published, the process was defective in the direction to add the mercurial solution to the mixed oleaginous fluid when it begins to stiffen on cooling. When this direction was complied with, at least with the acid of the ordinary strength, the preparation had a brown color and a semi-liquid consistence, but with some modifications, such as were introduced into the revised formula of the Pharmacopœia of 1860, the process yielded an excellent ointment, which, though it sometimes assumed a greenish color on exposure, retained permanently a soft unctuous consistence. We have had specimens of the ointment in our possession for several years which have retained a uniform yellowish color and a perfectly good unctuous consistence. R. Rother, however, affirmed that the fault was not in the components, but in the processes of the official formula of 1870 (*A. J. P.*, xlii. 420), especially in the use of too high a temperature,[1] and these views have been confirmed by ample experience. The present official process was based on Rother's formula, and the value of this process lies principally in the fact that the olein of the oil is first converted into elaidin by the addition of nitric acid alone and the application of heat, and when the reaction has ceased and the basis of citrine ointment, as it might be called, is prepared, and nearly cold, the mercurial solution is added. In this way decomposition of the mercuric nitrate is avoided, as it is not subjected to heat, and the result is an ointment which will retain its color and consistence a long time. The drying vegetable oils appear, like olive oil, to be converted by nitrous acid or mercuric nitrate into elaidin, and it was a fair inference that they might be employed advantageously in the preparation of citrine ointment. Accordingly, Fessenden of North Carolina, stated, in an inaugural essay, that he substituted linseed oil for the neat's-foot oil, and succeeded in obtaining a perfectly good and durable ointment. Faliéres has found the oil of the ground nut (*Arachis hypogœa*) to answer very well. (*P. J.*, 1873, p. 1031.) Purified cotton seed oil makes an excellent vehicle. Washed butter is frequently used as the fat.

[1] R. Rother's formula is as follows: "Take of Mercury 1½ troyounces; Nitric Acid, sp. gr. 1.42, 3½ troyounces; Lard, pure, 16½ troyounces. Dissolve the Mercury in 900 grains of the Nitric Acid, with the aid of heat, and keep the solution gently warm to prevent crystallization before it is used. Melt the Lard in a suitable vessel, with a moderate heat; then add the remainder of the Nitric Acid, and continue the heat, *without* stirring the mixture, as long as moderate effervescence continues; but if this becomes too violent, remove the mixture from the fire, and replace it only when the action slackens too much. Finally, when effervescence ceases, and the liquid only boils even under an increased heat, remove the mixture from the fire altogether; and when it begins to stiffen, add the mercurial solution and mix thoroughly." (*A. J. P.*, xlii. 420.) (For a formula in which neat's-foot oil is used, asserted by Thos. J. Covell to be superior to the official, and for a bibliography of the subject, see *A. J. P.*, xlii. 211.)

In the British process, when the fatty matter and the mercurial solution are mixed, care must be taken that the heat applied be not too great. Gas is extricated at 82.2° C. (180° F.), and at 100° C. (212° F.) escapes so abundantly that the mixture boils over unless the vessel is very large. (Alsop.) Besides, if the heat be too great, a portion of the mercury will be reduced, and the color of the ointment impaired. When large quantities of materials are operated upon, the reaction which occurs produces of itself a sufficient heat, but in ordinary cases the temperature should be kept at about 87.7° C. (190° F.) by means of a water bath, and if it exceed 96.1° C. (205° F.) should be reduced. It should always be sufficient to produce a copious extrication of gas. The ointment should be prepared in a glass, porcelain, or well-glazed earthen vessel, and a glass rod or a wooden spatula should be employed for stirring the mixture. Under no circumstances should an iron or steel spatula or stirrer be used in its preparation, because of the discoloration due to the action of the acid upon the iron.

Uses.—This ointment is much and very advantageously employed, as a stimulant and alterative application, in *porrigo* or *tinea capitis*, *impetigo larvalis* or *crusta lactea*, *psoriasis* and *pityriasis*, certain forms of *chronic eczema*, *psorophthalmia* and *inflammation of the eye and eyelids* connected with porrigo of the face or scalp, and various other *ulcerative* and *eruptive affections*. It should be diluted with lard, unless in cases which require a very stimulant application. Some care is requisite in its use, to avoid the risk of salivation. When hard and friable, it must be rubbed up with fresh lard before it can be applied. An ointment prepared with lard and nitric acid, called *Alyon's ointment*, after the person who first prepared it, was formerly much used in cases similar to those in which the citrine ointment is now employed. The *ointment of nitric acid* of the former Edinburgh and Dublin Pharmacopœias was of this character.

Off. Prep.—Unguentum Hydrargyri Nitratis Dilutum, *Br.*

UNGUENTUM HYDRARGYRI NITRATIS DILUTUM. Br.

DILUTED MERCURIC NITRATE OINTMENT

(ụn-guĕn'tŭm hȳ-drär'gy-rī nī-trā'tĭs dī-lū'tŭm)

"Mercuric Nitrate Ointment, 1 *ounce* (Imperial) or 25 grammes; Soft Paraffin, yellow, 4 *ounces* (Imp.) or 100 grammes. Mix." *Br.*

UNGUENTUM HYDRARGYRI OLEATIS. Br.

MERCURIC OLEATE OINTMENT

(ụn-guĕn'tŭm hȳ-drär'gy-rī ō-le-ā'tĭs)

Pommade d'Oléate Mercurique, *Fr.;* Quecksilberoleatsalbe, *G.*

"Mercuric Oleate, 1 *ounce* (Imperial) or 20 grammes; Benzoated Lard, 3 *ounces* (Imp.) or 60 grammes. Mix." *Br.*

UNGUENTUM HYDRARGYRI OXIDI FLAVI. U. S., Br.

OINTMENT OF YELLOW MERCURIC OXIDE

(ụn-guĕn'tŭm hȳ-drär'gy-rī ŏx'ĭ-dī flā'vī)

Yellow Mercuric Oxide Ointment; Pommade d'oxyde mercurique jaune, *Fr.;* Gelbe Quecksilberoxydsalbe, *G.*

* "Yellow Mercuric Oxide, in very fine powder, *ten grammes* [or 154 grains]; Water, *ten grammes* [or 154 grains]; Hydrous Wool-Fat, *forty grammes* [or 1 ounce av., 180 grains]; Petrolatum, *forty grammes* [or 1 ounce av., 180 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Yellow Mercuric Oxide with the Water until the mixture is perfectly smooth, then add the Hydrous Wool-Fat in divided portions, and incorporate thoroughly with the Petrolatum, avoiding contact with metallic utensils." *U. S.*

"Yellow Mercuric Oxide, in very fine powder, 10 *grains* or 0.5 gramme; Soft Paraffin, yellow, 490 *grains* or 24.5 grammes. Mix." *Br.*

The U. S. P. (8th Rev.) process is an improvement over the former U. S. P. 1890 method because of the use of water, hydrous wool-fat and petrolatum in place of simple ointment.

The unctuous vehicle of this ointment, without being so liquid as to allow the powder to subside, must yet melt at the heat of the body, and thus, when introduced into the eye, spread equably over the surface. It should, moreover, be as far as possible chemically indifferent to the oxide, and, while perfectly bland in its proper state, should not be liable to become irritating by rancidity. For medicinal properties, see *Unguentum Hydrargyri Oxidi Rubri.*

UNGUENTUM HYDRARGYRI OXIDI RUBRI. U. S., Br.

OINTMENT OF RED MERCURIC OXIDE
[Red Precipitate Ointment]

(ụn-guĕn'tŭm hȳ-drär'gy-rī ŏx'ĭ-dī rū'brī)

Unguentum Præcipitati Rubri; Pommade d'oxyde rouge de Mercure, *Fr. Cod.;* Pommade de Lyon, Pommade de Précipité rouge, Baume ophthalmique rouge, *Fr.;* Unguentum Hydrargyri Rubrum, *P. G.;* Rothe Quecksilbersalbe, *G.*

* "Red Mercuric Oxide, in very fine powder, *ten grammes* [or 154 grains]; Water, *ten grammes* [or 154 grains]; Hydrous Wool-Fat, *forty grammes* [or 1 ounce av., 180 grains]; Petrolatum, *forty grammes* [or 1 ounce av., 180 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Red Mercuric Oxide with the Water until the mixture is perfectly smooth and absolutely free from gritty particles, then add the Hydrous

Wool-Fat in divided portions, and incorporate thoroughly with the Petrolatum. Contact with metallic utensils should be avoided." *U. S.*

"Red Mercuric Oxide, in very fine powder, ¼ *ounce* (Imperial) or 10 grammes; Paraffin Ointment, yellow, 2¼ *ounces* (Imp.) or 90 grammes. Mix." *Br.*

The red mercuric oxide here referred to is that prepared from the nitrate and usually called *red precipitate.* It is important that the oxide should be thoroughly pulverized before being mixed with the lard, as otherwise it might prove injurious in cases of opththalmia, in which it is sometimes used. When great care is taken to have the red oxide very finely pulverized, the color is more yellowish than is usual. This ointment loses its fine red color when long kept, probably in consequence of the conversion of the red oxide into the black, or its reduction to the metallic state. It is best to prepare it in small quantities at a time. We have been informed that if the preparation be made by mixing the red oxide with poplar bud ointment it will keep a long time without change. According to R. H. Stabler of Alexandria, Va., an equally effectual method is to mix two drops of solution of potassium hydroxide with each ounce of the ointment when prepared (*A. J. P.,* xxiii. 123); but Julius Kalish states that this is not effectual. Emil Martin states that if a mixture of six parts of castor oil to two of wax be used as the basis of the ointment the red color will remain unchanged for years. (*A. J. P.,* xliv. 202.) Kalish substitutes oil of sweet almond for the castor oil, on account of the unpleasant odor of the latter. (*A. J. P.,* xlv. 69.) The U. S. P. (8th Rev.) process is an improvement over the process of the U. S. P. 1890 particularly in the choice of the vehicle. Ointment of red mercuric oxide is a highly useful stimulating ointment, much employed in *indolent and foul ulcers,* in *porrigo* of the scalp, and in *psorophthalmia* and *chronic conjunctival opththalmia,* especially when attended with thickening of the inner membrane of the eyelids, or with specks upon the cornea, but it is rapidly being supplanted by the ointment of yellow mercuric oxide, because the latter can be made smoother and less irritating, and has the same chemical composition and properties. It may be diluted with lard if found too stimulating.

UNGUENTUM HYDRARGYRI SUBCHLORIDI. Br.

MERCUROUS CHLORIDE OINTMENT

(ŭn-guĕn'tŭm hȳ-drär'gy-rī sŭb-klō'rĭ-dī)

Unguentum Calomelanos, *Br.* 1864; Ointment of Subchloride of Mercury; Ointment of Calomel; Pommade de Chlorure Mercureux, Pommade de Calomel, Pommade de Calomélas, *Fr.;* Quecksilberchlorürsalbe, *G.*

"Mercurous Chloride, ¼ *ounce* (Imperial) or 10 grammes; Benzoated Lard, 2¼ *ounces* (Imp.) or 90 grammes. Mix." *Br.*

There is little occasion for such a preparation as this. Calomel is much inferior to the mercurial ointment for affecting the system by inunction, and as an application to ulcerated surfaces the form of cerate would be better. It may, however, be useful in certain *cutaneous eruptions.*

UNGUENTUM IODI. U. S., Br.

IODINE OINTMENT

(ŭn-guĕn'tŭm ī-ō'dī)

Unguentum Iodinii, *U. S.* 1870; Pommade d'Iodure de potassium iodure, *Fr. Cod.;* Pommade d'Iode, *Fr.;* Jodsalbe, *G.*

* "Iodine, *four grammes* [or 62 grains]; Potassium Iodide, *four grammes* [or 62 grains]; Glycerin, *twelve grammes* [or 185 grains]; Benzoinated Lard, *eighty grammes* [or 2 ounces av., 360 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Iodine and Potassium Iodide in a glass mortar with the Glycerin until dissolved, then gradually incorporate the Benzoinated Lard and mix thoroughly, avoiding the use of a metallic spatula. This Ointment should be freshly made when required." *U. S.*[1]

"Iodine, 20 *grains* or 1 gramme; Potassium Iodide, 20 *grains* or 1 gramme; Glycerin, 60 *grains* or 3 grammes; Lard, 400 *grains* or 20 grammes. Triturate the Iodine, Potassium Iodide, and Glycerin, in a glass or porcelain mortar; add the Lard gradually. Mix." *Br.*

The object of the potassium iodide and water in the U. S. 1890 process was to bring the iodine into a state in which it may be equably incorporated with the lard. They were found to answer better in practice than the alcohol formerly used, but glycerin, as directed in the U. S. Pharm. (8th Rev.) process, answers still better.

The proportion of potassium iodide was increased from 1 Gm. to 4 Gm. in the U. S. P. (8th Rev.) and glycerin (12 per cent.) added. When rubbed upon the skin it imparts to it an orange color, which, however, slowly disappears with the evaporation of the iodine. It is useful as a local application in *goitre, scrofulous swellings of the glands,* and other *chronic tumefactions,* internal or external, operating probably through the medium of absorption. When continued for some time it occasionally produces a pustular eruption upon the portion of skin to which it is applied. It has also been recommended in *chilblains.* The ointment should be prepared only when wanted for use, for it undergoes change if kept, losing its deep orange-brown color, and becoming pale upon its surface.

[1] *Unguentum Iodinii Compositum.* U. S. 1870. "Take of Iodine *fifteen grains;* Iodide of Potassium *thirty grains;* Water *thirty minims;* Lard *a troy-ounce.* Rub the Iodine and Iodide of Potassium first with the Water, and then with the Lard, until they are thoroughly mixed." *U. S.* 1870.

UNGUENTUM IODOFORMI. U. S., Br.

IODOFORM OINTMENT

(ụn-guĕn'tŭm ī-ọ-dọ-för'mī)

Pommade d'Iodoforme, *Fr.;* Jodoformsalbe, *G.*

* "Iodoform, in very fine powder, *ten grammes* [or 154 grains]; Lard, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Iodoform thoroughly with about twice its weight of the Lard, then incorporate the remainder of the Lard." *U. S.*

"Iodoform, in fine powder, ¼ *ounce* (Imperial) or 10 grammes; Paraffin Ointment, yellow, 2¼ *ounces* (Imp.) or 90 grammes. Mix." *Br.*

It is important to have the iodoform in very fine powder, as officially directed, and, owing to the powerful odor of iodoform, it is usual to add oil of bitter almond or one of the other volatile oils, balsam of Peru, or a similar substance, to render the odor more bearable.

UNGUENTUM PARAFFINI. Br.

PARAFFIN OINTMENT

(ụn-guĕn'tŭm păr-ạf-fī'nī)

Pommade de Paraffin, *Fr.;* Paraffinsalbe, *G.*

"Hard Paraffin, 3 *ounces* (Imperial) or 90 grammes; Soft Paraffin, 7 *ounces* (Imp.) or 210 grammes. Melt together in a shallow evaporating dish; as the liquid cools triturate constantly, until, when cold, a uniform plastic ointment is produced. When Paraffin Ointment is used as the basis of white ointments, it should be prepared with the white variety of Soft Paraffin; and when used in colored ointments it should be prepared with the yellow variety of Soft Paraffin. The proportions of Hard and Soft Paraffins in Paraffin Ointment may be modified to meet the exigencies of climate and prevailing temperature." *Br.*

This was recognized by the Br. Ph. 1898 for use as a vehicle in the exhibition of various medicaments; its power of absorption is limited and inferior to oleic acid or lard.

Off. Prep.—Unguentum Acidi Borici, *Br.;* Unguentum Acidi Carbolici, *Br.;* Unguentum Acidi Salicylici, *Br.;* Unguentum Glycerini Plumbi Subacetatis, *Br.;* Unguentum Hydrargyri Ammoniati, *Br.;* Unguentum Hydrargyri Oxidi Rubri, *Br.;* Unguentum Iodoformi, *Br.;* Unguentum Plumbi Acetatis, *Br.;* Unguentum Plumbi Carbonatis, *Br.;* Unguentum Plumbi Iodidi, *Br.*

UNGUENTUM PHENOLIS. U. S. (Br.)

OINTMENT OF PHENOL [Unguentum Acidi Carbolici, Pharm. 1890, Ointment of Carbolic Acid]

(ụn-guĕn'tŭm phẹ-nō'lĭs)

Unguentum Acidi Carbolici, *Br.:* Pommade de Phénol, Pommade Phéniquée, Pommade d'Acide phénique, *Fr.;* Karbolsalbe, Phenolsalbe, *G.*

* "Phenol, *three grammes* [or 46 grains]; White Petrolatum, *ninety-seven grammes* [or 3 ounces av., 184 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. To the melted White Petrolatum add the Phenol, and stir the mixture until it begins to congeal." *U. S.*

"Phenol, ½ *ounce* (Imperial) or 15 grammes; Glycerin, 1½ *ounces* (Imp.) or 45 grammes; Paraffin Ointment, white, 10½ *ounces* (Imp.) or 315 grammes. Dissolve the Phenol in the Glycerin; add the Paraffin Ointment. Mix." *Br.*

The quantity of phenol in this ointment was decreased from 10 per cent. in the U. S. P. 1880 to 5 per cent. in the 1890 revision, and has been further decreased to 3 per cent. in the U. S. P. (8th Rev.). This is an improvement, for it is a very strong ointment, which for most purposes still requires dilution.

UNGUENTUM PICIS LIQUIDÆ. U. S., Br.

TAR OINTMENT

(ụn-guĕn'tŭm pĭ'cĭs lĭq'uị-dæ)

Pommade de Goudron, *Fr. Cod.;* Theersalbe, *G.*

* "Tar, *five hundred grammes* [or 17 ounces av., 279 grains]; Yellow Wax, *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; Lard, *three hundred and fifty grammes* [or 12 ounces av., 151 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Melt the Yellow Wax, add the Lard, and to the melted mixture add the Tar, previously warmed, and incorporate thoroughly; strain through muslin, and stir the mixture until it congeals." *U. S.*

"Tar, 5 *ounces* (Imperial) or 100 grammes; Yellow Beeswax, 2 *ounces* (Imp.) or 40 grammes. Melt the Beeswax at a low temperature; add the Tar; stir the mixture until cold." *Br.*

The formula for tar ointment in the U. S. P. 1890 differed from that formerly official in the use of yellow wax and lard in place of suet. The same ingredients were retained in the Eighth Revision, but the proportion of wax was slightly decreased making the ointment somewhat softer in consistence. This ointment is highly useful as a stimulant application in various *scaly* and *scabby eruptions*, particularly in *psoriasis* and *lepra*, and in that form of *porrigo* usually called *tinea capitis*, or *scald-head*. In the last-mentioned affection it should be applied night and morning, and in bad cases the patient should constantly wear a cap thickly coated internally with the ointment.

UNGUENTUM PLUMBI ACETATIS. Br.

LEAD ACETATE OINTMENT

(ụn-guĕn'tŭm plŭm'bī ăç-ẹ-tā'tĭs)

Pommade d'Acétate de Plomb, *Fr.;* Bleizuckersalbe, *G.*

"Lead Acetate, in fine powder, 20 *grains* or 2 grammes; Paraffin Ointment, white, 480 *grains* or 48 grammes. Mix." *Br.*

An official preparation of the Br. Pharmacopœia, used as a dressing for *inflamed and excoriated surfaces,* though inferior, we think, to the cerate of the subacetate.

UNGUENTUM PLUMBI CARBONATIS. Br.

LEAD CARBONATE OINTMENT

(ụn-guĕn'tŭm plŭm'bī cär-bọ-nā'tĭs)

Ointment of White Lead; Pommade de Carbonate de Plomb, *Fr. Cod.;* Onguent blanc de Rhazés, Pommade de Céruse, *Fr.;* Unguentum Cerussæ, *P. G.;* Bleiweissalbe, *G.*

"Lead Carbonate, in fine powder, ¼ *ounce* (Imperial) or 10 grammes; Paraffin Ointment, white, 2¼ *ounces* (Imp.) or 90 grammes. Mix." *Br.*

This ointment, which is no longer official in the U. S. P. (8th Rev.) (see page 1304), is used as a dressing to *blistered or excoriated surfaces, burns,* etc.

UNGUENTUM PLUMBI IODIDI. Br.

LEAD IODIDE OINTMENT

(ụn-guĕn'tŭm plŭm'bī ī-ŏd'ị-dī)

Lead Iodide Ointment; Pommade d'Iodure de Plomb, *Fr. Cod.;* Jodbleisalbe, *G.*

"Lead Iodide, in fine powder, ¼ *ounce* (Imperial) or 10 grammes; Paraffin Ointment, yellow, 2¼ *ounces* (Imp.) or 90 grammes. Mix." *Br.*

For the uses of this ointment, see *Plumbi Iodidum.*

UNGUENTUM POTASSII IODIDI. U. S., Br.

OINTMENT OF POTASSIUM IODIDE

(ụn-guĕn'tŭm pọ-tăs'sī-ī ī-ŏd'ị-dī)

Potassium Iodide Ointment; Pommade d'Iodure de Potassium, *Fr. Cod.;* Unguentum Kalii jodati, *P. G.;* Jodkaliumsalbe, Kaliumjodidsalbe, *G.*

* "Potassium Iodide, *ten grammes* [or 154 grains]; Potassium Carbonate, *six-tenths of a gramme* [or 9 grains]; Water, *ten grammes* [or 154 grains]; Benzoinated Lard, *eighty grammes* [or 2 ounces av., 360 grains], to make about *one hundred grammes* [or 3 ounces av., 231 grains]. Dissolve the Potassium Iodide and Potassium Carbonate in the Water by trituration, then gradually add the Benzoinated Lard and incorporate thoroughly. This Ointment should be prepared extemporaneously." *U. S.*

"Potassium Iodide, 50 *grains* or 5 grammes; Potassium Carbonate, 3 *grains* or 0.3 gramme; Distilled Water, 47 *grains* or 4.7 grammes; Benzoated Lard, 400 *grains* or 40 grammes. Dissolve the Potassium Iodide and Potassium Carbonate in the Distilled Water; mix the solution, gradually, with the Benzoated Lard, in a slightly warmed mortar." *Br.*

The U. S. preparation of 1870 was likely to become discolored by time in consequence of the liberation of iodine. This was due to rancidity in the lard, and the slightest change in the fat would produce some discoloration. It was prevented in the U. S. P. 1880 by the sodium thiosulphate, which also produces traces of sodium iodide and sulphur. It is said that the same object may be attained by mixing two drops of solution of potassium hydroxide with each ounce of the freshly prepared ointment. (*A. J. P.,* xxiii. 123.) The addition of potassium carbonate by the present U. S. and Br. Pharmacopœias is made with this object.

The *Bulletin de Pharmacie du Nord* recommended a concentrated solution of potassium iodide in glycerin as a basis for this ointment. One gramme of the salt is dissolved in two and a half grammes of hot glycerin, and the solution mixed with the fatty constituent in the proper proportion. The advantages of this method are that the ointment is free from crystals, and the salt more readily absorbed. The glycerin would probably not be objectionable in most cases, and potassium carbonate could be added, if desired. Ointment of potassium iodide is employed for the discussion of *goitres, scrofulous tumors,* and other *indolent swellings,* and is sometimes preferred to the ointment of iodine, as it does not, like that, discolor the skin.

UNGUENTUM STAPHISAGRIÆ. Br.

STAVESACRE OINTMENT

(ụn-guĕn'tŭm stăph-ị-sā'grī-æ)

Onguent de Staphisaigre, *Fr.;* Stephanskörnersalbe, *G.*

"Stavesacre Seeds, 2 *ounces* (Imperial) or 40 grammes; Yellow Beeswax, 1 *ounce* (Imp.) or 20 grammes; Benzoated Lard, 8½ *ounces* (Imp.) or 170 grammes. Crush the Stavesacre Seeds; digest the crushed seeds with the Benzoated Lard on a water-bath for two hours; strain and press through calico; add the Beeswax to the liquid; heat gently to dissolve; stir until cold." *Br.*

This ointment is but half the strength of that official in the British Pharmacopœia 1885; it is said to be non-irritant, and is largely used in Great Britain for destroying *body-lice,* also in *scabies, prurigo* and some other *cutaneous affections.*

UNGUENTUM STRAMONII. U. S.

STRAMONIUM OINTMENT

(ụn-guĕn'tŭm strạ-mō'nĭ-ī)

Pommade de Stramoine, *Fr.;* Stechapfelsalbe, *G.*

* "Extract of Stramonium, *ten grammes* [or 154 grains]; Diluted Alcohol, *five cubic centimeters* [or 81 minims]; Hydrous Wool-Fat, *twenty grammes* [or 309 grains]; Benzoinated

Lard, *sixty-five grammes* [or 2 ounces av., 128 grains], to make about *one hundred grammes* [or 3 ounces av., 231 grains]. Triturate the Extract with the Diluted Alcohol until a smooth mixture is obtained; with this incorporate the Hydrous Wool-Fat, then add the Benzoinated Lard, and mix thoroughly." *U. S.*

This is a more certain preparation than that of the former editions of the U. S. Pharmacopœia, which was made by boiling the fresh leaves in lard. The color of the ointment of the U. S. P. (8th Rev.) is different from that of the former Pharmacopœia, the greenish tint being due to the use of official extract of stramonium which is now made from the leaves instead of the seeds. For remarks by A. P. Sharp of Baltimore, on the preparation of this ointment, see *A. J. P.* (xxvii. 391). A useful anodyne application in *irritable ulcers, painful hemorrhoids,* and certain *cutaneous eruptions.*

UNGUENTUM SULPHURIS. U. S., Br.

SULPHUR OINTMENT

(ụn-guĕn'tŭm sŭl'phŭ-rĭs)

Pomatum Sulfuratum, Unguentum Sulfuratum Simplex; Pommade Soufrée, *Fr. Cod.;* Schwefelsalbe, *G.*

* "Washed Sulphur, *one hundred and fifty grammes* [or 5 ounces av., 127 grains]; Benzoinated Lard, *eight hundred and fifty grammes* [or 29 ounces av., 430 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Rub the Washed Sulphur with the Benzoinated Lard, gradually added, until they are thoroughly mixed." *U. S.*

"Sublimed Sulphur, finely sifted, 1 *ounce* (Imperial) or 30 grammes; Benzoated Lard, 9 *ounces* (Imp.) or 270 grammes. Mix." *Br.*

Washed sulphur was substituted in the U. S. P. 1890 for the sublimed sulphur of the former Pharmacopœia; the change is of questionable utility, as the products resulting from the slight decomposition in sublimed sulphur have value as parasiticides. In the U. S. P. (8th Rev.) the percentage of sulphur was reduced one-half. Sulphur ointment is a specific for the *itch.* It should be applied every night over the whole surface till the complaint is cured. Four applications are generally sufficient to effect a cure. Sulphur ointment applied freely over the *variolous eruption* in its early stage is said to prevent the maturation of the pustules and the consequent pitting. Its disagreeable odor may be partially concealed by oil of lemon or oil of bergamot.[1]

[1] *Unguentum Sulphuris Alkalinum.* U. S. 1880. *Alkaline Sulphur Ointment.*—"Washed Sulphur, *twenty parts* [or ninety-six grains]; Carbonate of Potassium, *ten parts* [or forty-eight grains]; Water, *five parts* [or half a fluidrachm]; Benzoinated Lard, *sixty-five parts* [or three hundred and twelve grains], to make *one hundred parts* [or about one ounce]. Rub the Sulphur with the Carbonate of Potassium and the Water, gradually add the Benzoinated Lard, and mix thoroughly." *U. S.* 1880. This ointment, dropped at the U. S. P. 1890 revision, is useful in *scabies* and other *skin affections.*

UNGUENTUM SULPHURIS IODIDI. Br.

SULPHUR IODIDE OINTMENT

(ụn-guĕn'tŭm sŭl'phŭ-rĭs ī-ŏd'ị-dī)

Pommade d'Iodure de Soufre, *Fr.;* Jodschwefelsalbe, *G.*

"Sulphur Iodide, 20 *grains* or 2 grammes; Glycerin, 20 *grains* or 2 grammes; Benzoated Lard, 460 *grains* or 46 grammes. Triturate the Sulphur Iodide and Glycerin in a slightly warmed mortar until a smooth paste results; gradually add the Benzoated Lard; stir until cold." *Br.*

This ointment is no longer official in the U. S. Pharmacopœia; that of the U. S. P. 1870 was made by rubbing thirty grains of sulphur iodide with a troyounce of lard, gradually added, until thoroughly mixed.

This is admirably adapted, as a local remedy, to the treatment of *chronic cutaneous eruptions* unattended with inflammation, and is especially useful in *psoriasis, lepra, porrigo,* and in the very advanced dry stages of *eczema* and of *impetigo.*

UNGUENTUM VERATRINÆ. U. S., Br.

VERATRINE OINTMENT

(ụn-guĕn'tŭm vĕr-ạ-trĭ'næ)

Unguentum Veratriæ, *U. S.* 1870; Pommade de Vératrine, *Fr.;* Veratrinsalbe, *G.*

* "Veratrine, *four grammes* [or 62 grains]; Expressed Oil of Almond, *six grammes* [or 93 grains]; Benzoinated Lard, *ninety grammes* [or 3 ounces av., 76 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Veratrine with the Expressed Oil of Almond, then gradually add the Benzoinated Lard, and mix thoroughly." *U. S.*

"Veratrine, 10 *grains* or 0.5 gramme; Oleic Acid, 40 *grains* or 2 grammes; Lard, 450 *grains* or 22.5 grammes. Rub the Veratrine with the Oleic Acid, and gently warm the mixture until dissolved; add the Lard. Mix." *Br.*

For the uses of Veratrine ointment, see *Veratrina* and *Oleatum Veratrinæ.* Notice should be taken of the fact that the U. S. ointment is twice as strong as the British. It should be employed with caution, and not brought in contact with abraded skin surfaces nor applied too freely to sound skin, especially in the case of children.

UNGUENTUM ZINCI OLEATIS. Br.

ZINC OLEATE OINTMENT

(ụn-guĕn'tŭm zĭn'cī ō-lẹ-ā'tĭs)

Pommade d'oleate de zinc, *Fr.;* Zink oleatsalbe, *G.*

"Zinc Sulphate, 2 *ounces* (Imperial) or 60 grammes; Hard Soap, in shavings, 4 *ounces* (Imp.) or 120 grammes; Distilled Water, boiling, Soft Paraffin, white, of each *a sufficient*

quantity. Dissolve the Zinc Sulphate in *four fluid ounces* (Imp. meas.) or one hundred and twenty cubic centimetres of the Distilled Water. Dissolve the Hard Soap in *forty fluid ounces* (Imp. meas.) or twelve hundred cubic centimetres of the Distilled Water. Mix the solutions; collect the precipitated zinc oleate; wash with hot Distilled Water until the washings afford little or no reaction for sulphate; dry on a water-bath and mix with an equal weight of the Soft Paraffin, melted; stir until cold." *Br.*

This ointment was radically changed in the Br. Ph. 1898 revision; instead of using zinc oleate made from oleic acid and zinc oxide, a process is ordered which directs the zinc oleate to be made by double decomposition between zinc sulphate and sodium oleo-stearate (hard soap). The product is a white, fine precipitate; it is, however, not a pure oleate, but a zinc oleo-stearate or oleo-palmitate. See *Unguentum Zinci Stearatis.*

This preparation has therapeutic properties similar to those of the ointment of zinc oxide, but is a little more stimulating. It is especially useful in *chronic eczema* and similar *cutaneous eruptions.*

UNGUENTUM ZINCI OXIDI. U. S., Br.

OINTMENT OF ZINC OXIDE [Zinc Ointment]

(ŭn-guĕn'tŭm zĭn'cī ŏx'ĭ-dī)

Unguentum Zinci, *Br.,* Ointment of Zinc; Unguentum de Nihilo Albo; Pommade d'Oxyde de Zinc, Cérat épulotique, *Fr.;* Unguentum Zinci, *P. G.;* Zinksalbe, *G.*

* "Zinc Oxide, in very fine powder, *two hundred grammes* [or 7 ounces av., 24 grains]; Benzoinated Lard, *eight hundred grammes* [or 28 ounces av., 96 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Rub the Zinc Oxide, which must be free from gritty particles, with an equal weight of the melted Benzoinated Lard, and with this incorporate the remainder of the Benzoinated Lard, previously melted; if necessary, strain the Ointment while warm, and stir thoroughly until it congeals." *U. S.*

"Zinc Oxide, finely sifted, 3 *ounces* (Imperial) or 75 grammes; Benzoated Lard, 17 *ounces* (Imp.) or 425 grammes. Add the Zinc Oxide gradually to the Benzoated Lard, previously melted at a low temperature; stir the mixture constantly until cold." *Br.*

The British ointment is weaker in the proportion of zinc oxide than that of the U. S. Pharmacopœia, the former containing about 15 per cent., the latter 20 per cent. *Commercial* zinc oxide should not be used, as it is usually gritty, and it is difficult to make a smooth ointment with it; the many expedients that have been suggested by various writers, such as the use of a paint mill or of a flat iron, or trituration with oil or with glycerin, are unnecessary if official or Hubbuck's zinc oxide is employed and the directions of the Pharmacopœia followed. Cerate of zinc carbonate is no longer official.[1]

This ointment is employed as a mild astringent application in *chronic ophthalmia* with a relaxed state of the vessels, in *cutaneous eruptions,* and in *sore nipples* and other cases of *excoriation* or *ulceration.* It has taken the place of the discarded *unguentum tutiæ,* or *tutty ointment,* prepared from tutty, or impure zinc oxide, by mixing it with five parts of simple ointment.

UNGUENTUM ZINCI STEARATIS. U. S.

OINTMENT OF ZINC STEARATE

(ŭn-guĕn'tŭm zĭn'cī stē-ăr-ā'tĭs)

Pommade de Stéarate de Zinc, *Fr.;* Zinkstearatsalbe, *G.*

* "Zinc Stearate, in fine powder, *fifty grammes* [or 1 ounce av., 334 grains]; White Petrolatum, *fifty grammes* [or 1 ounce av., 334 grains], to make *one hundred grammes* [or 3 ounces av., 120 grains]. To the White Petrolatum, melted on a water-bath, add the Zinc Stearate. Continue the heat until the mixture becomes smooth, then stir while cooling, until it congeals." *U. S.*

This ointment, introduced for the first time into the U. S. P. (8th Rev.), is very similar to the Unguentum Zinci Oleatis of the British Pharmacopœia (see p. 1318). It is used for the same purposes as is Ointment of Zinc Oxide.

UVA URSI. U. S. (Br.)

UVA URSI [Bearberry]

(ū'vă ûr'sī)

"The dried leaves of *Arctostaphylos Uva-ursi* (Linné) Sprengel (Fam. *Ericaceæ*)." *U. S.*
"The dried leaves of Arctostaphylos Uva-ursi, *Spreng.*" *Br.*

Uvæ Ursi Folia, *Br.;* Burren Myrtle, Mountain Box, Rock-berry, Kinnikinnic; Uva-ursi, Busserole, Raisin d'Ours, *Fr. Cod.;* Folia Uvae Ursi, *P. G.;* Bärentraube, Bärentraubenblätter, *G.;* Uva Ursina, *It.;* Gayuba, *Sp.*

Arctostaphylos Uva-ursi, Sprengel, *Syst.* ii. (1825) 287; Carson, *Illust. of Med. Bot.,* i. 61,

[1] *Ceratum Zinci Carbonatis.* U. S. 1870. *Cerate of Carbonate of Zinc.*—"Take of Precipitated Carbonate of Zinc *two troyounces;* Ointment of Lard *ten troyounces.* Mix them." *U. S.* 1870. This preparation is an imitation of the cerate recommended by Turner, and is intended as a substitute for the former Ceratum Zinci Carbonatis and the still more ancient Ceratum Calaminæ of the U. S. Pharmacopœia, as being more reliable, in consequence of the frequent falsification of calamine. It is mildly astringent, and is used in *excoriations* and superficial *ulcerations* produced by the chafing of the skin, irritating secretions, burns, or other causes.
Ceratum Calaminæ, U. S. 1850. *Turner's Cerate.* The following is the old official process: "Take of Prepared Calamine, Yellow Wax, each, *three ounces;* Lard *a pound.* Melt the Lard and Wax together, and when on cooling they begin to thicken, add the Calamine, and stir the mixture constantly until cool." *U. S.* 1850. The uses of this cerate are the same as those mentioned above.

pl. 52; *B. & T.* 163.—*Arbutus Uva-ursi,* L., *Sp. Pl.* (1753) 395.—The *uva ursi,* or *bearberry,* is a low evergreen shrub, with trailing stems, the young branches of which rise obliquely upward for a few inches. The leaves are scattered, upon short petioles, from half an inch to an inch long, obovate, or oblong-spatulate, acute at the base, obtuse at the apex, entire, with a rounded margin, thick, coriaceous, smooth, shining, deep green on their upper surface, paler and covered with a net-work of veins beneath; furnished especially near the margin or near the midrib with minute hairs, which are usually abundant in young leaves, but may be few or absent in old leaves, especially those which have been much handled. The flowers, which stand on short reflexed peduncles, are in small clusters at the ends of the branches. The calyx is small, five-parted, reddish, and persistent. The corolla is ovate or urceolate, reddish white, or white with a red lip, transparent at the base, contracted at the mouth, and divided at the margin into five short reflexed segments. The stamens are ten, with short filaments and bifid anthers; the ovary round, with a style longer than the stamens, and a simple stigma. The fruit is a small, round, depressed, smooth, glossy red berry, with an insipid mealy pulp and five cohering seeds.

This humble but hardy shrub inhabits the northern latitudes and high mountains of Europe, Asia, and America. On the American continent it extends from Hudson's Bay as far southward as New Jersey, in some parts of which it grows in abundance. It prefers a barren soil, flourishing on gravelly hills and elevated sandy plains. The leaves are the only part used in medicine. They are imported from Europe, but are also collected within our own limits, and the market of Philadelphia is supplied to a considerable extent from New Jersey. They should be gathered in autumn, and only the green leaves selected. In Europe the uva ursi is adulterated with the inert leaves of the *Vaccinium Vitis-idæa* (*Cowberry, Mountain Cranberry*); these may be distinguished by their rounder shape, their revolute edges which are sometimes slightly toothed, and the presence of fine blackish dots or bristly points upon their lower surface. Leaves of the *Chimaphila umbellata,* sometimes found among the uva ursi, may be readily detected by their greater length, their cuneiform-lanceolate shape, and their serrate edges.

Arctostaphylos glauca, Lindl., *manzanita,* is a small tree or shrub indigenous in California, where it generally grows in dry and rocky places on the west of the mountain ranges. The leaves are highly esteemed as a remedy in *diarrhœa* and *gonorrhœa,* being used in the form of decoction. Chemically examined by John Henry Flint, they were found to contain arbutin, and 9.8 per cent. of tannin, and the ashes of the incinerated leaves, amounting to 6 per cent., contained potassium, calcium, magnesium, and iron. (*A. J. P.,* May, 1873, p. 197.) The fruit of *A. arguta,* Zucco, a Mexican species, is said to be a narcotic poison.

Properties.—Uva ursi is inodorous when fresh, but when dried and powdered acquires an odor not unlike that of hay. Its taste is bitterish, strongly astringent, and ultimately sweetish. It affords a light brown, greenish-yellow powder. It is officially described as "obovate or oblong-spatulate, 15 to 30 Mm. long, obtuse, slightly revolute on the margin, tapering into a very short and stout petiole, coriaceous; upper surface dark green, finely reticulate; lower surface slightly pubescent; odor slight; taste strongly astringent and somewhat bitter." *U. S.* Water and official alcohol extract the active principles of uva ursi. Among its ingredients are tannic and gallic acids, bitter extractive, resin, gum, fatty matter, a volatile oil, and salts of potassium and calcium. The tannic acid is so abundant that the leaves are used for tanning in Russia. Neither tannic or gallic acid exists in the leaves of the *Vaccinium Vitis-idæa.*

A crystallizable principle was extracted from uva ursi by J. C. C. Hughes, to which he gave the name *ursin,* but Jungmann (*A. J. P.,* May, 1871, p. 205) afterwards showed it to be only impure arbutin. Kawalier (*Chem. Gaz.,* 1853, p. 61) obtained *arbutin,* $C_{12}H_{15}O_7$, by precipitating the decoction with lead acetate, filtering, treating the liquid with hydrogen sulphide, again filtering, evaporating to the consistence of syrup, and allowing the product to stand for several days. This gradually assumed the form of a crystalline jelly, which, being placed upon linen so as to allow the mother liquor to drain off, and then pressed, yielded nearly colorless crystals, which were purified by solution in boiling water and treatment with animal charcoal. Arbutin thus obtained is in long, acicular, colorless crystals, united in tufts, and of a bitter taste. It is soluble in water, alcohol, and ether, unchanged apparently by a heat of 100° C., but fusible at 167° to 168° C., without action on vegetable colors, and not precipitated by ferric salts or by lead acetate or subacetate. It is a glucoside, being resolvable by emulsin, or more rapidly by boiling with sulphuric acid, into glucose and *hydroquinone,* $C_6H_6O_2$ (*arctuvine* of Kawalier). The occurrence of methylhydroquinone among the products of decomposition led Hlasiwetz and Habermann to give the formula $C_{25}H_{24}O_{14}$ to arbutin, but Schiff showed that this was because arbutin was almost always accompanied by *methylarbutin,* $C_{12}H_{15}(CH_3)O_7 + H_2O$. This compound has been made synthetically by Schiff (*Ber. d. Chem. Ges.,* 1882, p. 1841) by acting upon arbutin with methyliodide and potassium hydroxide in methyl alcohol solution, and purely synthetically by Michael (*Ber d. Chem. Ges.,* 1885, p. 118) by the action of methylhydroquinone and acetochlorhydrose. It is decomposed by dilute acids into glucose and methylhydroquinone. Upon heating 1 part of

arbutin with 8 parts of manganese oxide, 2 parts of sulphuric acid, and 1 part of water, it gives off the penetrating odor of quinone. The aqueous solution is rendered blue by a small quantity of solution of ferric chloride, and green by a larger quantity. No precipitate is produced by either acids or alkalies. It blackens ammoniacal solution of silver nitrate after boiling with diluted sulphuric acid, and throws down cuprous oxide from alkaline copper solutions upon heating. It dissolves in sulphuric acid, forming a colorless solution, turning red after a short time; a trace of nitric acid turns this solution yellow-brown. An aqueous solution (1 in 20) is not changed by hydrogen sulphide. A good test for arbutin is that of Julius Jungmann, as follows: When phosphomolybdic acid is added to a solution of arbutin previously rendered alkaline by ammonia or other alkali, a blue color is produced, which is deep when the solutions are strong, but observable even when they are very dilute. (*A. J. P.*, May, 1871, p. 204.)[1] After the extraction of arbutin there is obtained from the mother liquor *ericolin*, $C_{34}H_{58}O_{21}$.[2] Another crystallizable principle has been discovered by Trommsdorf, who calls it *ursone*, $C_{30}H_{48}O_3$. It appears to be of a resinous character, although it can be obtained in silky needles, being tasteless and inodorous, insoluble in water, difficultly soluble in alcohol and ether, fusible, at a higher temperature volatilizable, and inflammable in the air. It is obtained by treating uva ursi with a very small quantity of ether by percolation, allowing the ether to evaporate, washing the crystalline extract with ether, and recrystallizing from alcohol. (*A. J. P.*, xxvii. 334.)

A. G. Perkin has obtained from the leaves of *uva ursi* a yellow coloring principle of the composition $C_{15}H_{10}O_7$, crystallizing in glistening yellow needles. On fusion with alkali, phloroglucinol and protocatechuic acid were formed. Though resembling quercetin in these points, it forms deep green solutions with diluted potassium hydroxide. (*A. J. P.*, 1898, 584.)

Uses.—Uva ursi is astringent and tonic, and is thought to have a specific direction to the urinary organs, for the diseases of which it is chiefly used. It alters the color of the urine, and its astringent principle has been detected in that secretion. Though known to the ancients, it had passed into almost entire neglect, until its use was revived by De Haen about the middle of the last century. It has acquired some reputation as an antilithic, and has undoubtedly been serviceable in *gravel*, partly, perhaps, by a direct action on the kidneys and bladder, partly by giving tone to the digestive organs. In *chronic nephritis* it is also a popular remedy, and is particularly recommended when there is reason to conjecture the existence of *ulceration in the kidneys, bladder, or urinary passages. Catarrh of the bladder, incontinence of urine, gleet, leucorrhœa,* and *menorrhagia* are also among the diseases in which it has occasionally proved serviceable. According to Hues, arbutin in the dose of one grain is a powerful diuretic; that it is free from poisonous properties was shown by Jolonowski, who took in forty-eight hours over two hundred grains of it without discomfort. After large doses the urine varies in color from pale green to dark greenish brown. The discoloration is due to the breaking up of the arbutin in the body into glucose and hydroquinone, the change probably occurring in the kidneys. There is considerable clinical testimony to show that arbutin is a useful remedy in *cystitis* when given in doses of ten to fifteen grains a day. The influence of the drug has been supposed to be due to its conversion into hydroquinone, which, as is well known, is a powerful disinfectant and antiferment. H. Paschkis states that only a small portion of the arbutin is changed into hydroquinone, and this is confirmed by Laurentz. The extract (see page 468) formerly official contains only three and a half per cent. of arbutin and sixteen per cent. of tannic acid; there is also a volatile oil in uva ursi, so that arbutin cannot be considered fully to represent the drug.

Dose, of the powder, from twenty grains to a drachm (1.3 to 3.9 Gm.), to be repeated three or four times a day; but the fluidextract is always preferred.

Off. Prep.—Fluidextractum Uvæ Ursi, *U. S.;* Infusum Uvæ Ursi, *Br.*

[1] *Arbutin* is somewhat widely diffused in the species of Ericaceæ, such as *Chimaphila umbellata* (L.), Nutt., *Chimaphila maculata* (L.), Pursh, *Epigæa repens*, L., and *Gaultheria procumbens*, L. In some others it has been supposed to exist because among the products of the dry distillation of their extract a principle has been found denominated *hydroquinone*, which is one of the products of the destructive distillation of arbutin; but, as kinic acid yields the same substance in the same way, the inference in relation to the existence of arbutin in the plants is somewhat uncertain. Nevertheless, as kinic acid yields *pyrocatechin* along with hydroquinone, while arbutin gives only the latter, a method of distinguishing the two is afforded; the plants from which only hydroquinone is obtained probably contain arbutin, while, if both principles are obtained, kinic acid is probably in the plant. (*A. J. P.*, 1874, 314.)

Analysis of Vaccinium Vitis-idæa, or *Red whortleberry*, by Gräger. The berries contain 10.185 per cent. of soluble matter, 4.204 of insoluble matter (cellulose, pectin, etc.), and 85.611 of water. The expressed juice yielded 1.975 per cent. of free organic acid (citric and malic), 5.185 of sugar, 0.476 of tannin, 2.333 of albuminous and pectinaceous substances, suspended fat, etc., 0.216 of inorganic bases (potassa, lime, magnesia, iron), and 89.815 of water. The insoluble residue yielded 0.102 per cent. of ashes containing calcium sulphate and phosphate, silicic acid, and ferric oxide. (*A. J. P.*, 1871, 543.)

[2] *Ericolin* is a wide-spread constituent of ericaceous plants, having been found in *Ledum palustre*, L., *Calluna vulgaris* (L.), Salisb., *Rhododendron ferrugineum*, L., etc.; for chemical discussion, see R. Thal, *In. Dis.*, Dorpat, 1883.

VALERIANA. U. S. (Br.)

VALERIAN

(vạ-lē-rī-ā'nạ)

"The dried rhizome and roots of *Valeriana officinalis* Linné (Fam. *Valerianaceæ*)." *U. S.*

"The dried erect rhizome and roots of Valeriana officinalis, *Linn.* Collected in the autumn." *Br.*

Valerianæ Rhizoma, *Br.;* Valerian Root; Radix Valerianæ Minoris, R. Valerianæ Sylvestris, R. Valerianæ Montanæ; Common, Garden, Cat's or Great Wild Valerian, All-heal, Summer Heliotrope, Herb Bennet, Vandal Root; Valériane officinale, *Fr. Cod.;* Racine de Valériane, Valériane, *Fr.;* Radix Valerianae, *P. G.;* Baldrian, Wilde Baldrianwurzel, Baldrianwurzel, *G.;* Valeriana, *It.;* Valeriana (Rizoma de), *Sp.*

For *Valerianæ Indicæ Rhizoma,* Br. Add., see PART II.

Valeriana officinalis, L., *Sp. Pl.* (1753) 31; Willd., *Sp. Plant.* i. 177; *B. & T.* 146.—The *official* or *great wild valerian* is a large, handsome, herbaceous plant, with a perennial root, and an erect, round, channelled stem, from two to four feet high, furnished with opposite pinnate leaves, and terminating in flowering branches. The leaves of the stems are attached by short, broad sheaths; the radical leaves are larger and stand on long footstalks. In the former the leaflets are lanceolate and partially dentate, in the latter elliptical and deeply serrate. The flowers are small, white or rose-colored, agreeably odorous, and disposed in terminal corymbs interspersed with pear-shaped bracts. The number of the stamens is three. The fruit is a capsule containing one oblong-ovate, compressed seed. The plant is a native of Europe, where it grows either in damp woods and meadows or on dry elevated grounds. As found in these different situations, it presents characters so distinct as to have induced some botanists to make two varieties. Dufresne makes four, of which three prefer marshy situations. The variety which affects a dry soil (*sylvestris,* L. Ph.) is not more than two feet high, and is distinguished by its narrow leaves. It has been generally believed to be superior to the others in medicinal virtue, but A. Buchner has demonstrated that the dried roots of the variety which grows in low moist grounds are in no respect inferior. (*Ph. Cb.,* June, 1852, 429.)[1]

The root should be collected in spring, before the stem begins to shoot, or in the autumn, when the leaves decay. It should be dried quickly, and kept in a dry place. It consists of numerous, long, slender, brittle, cylindrical, thick-barked rootlets, issuing from a tuberculated rhizome; it is officially described as "from 2 to 4 Cm. long, and 1 to 2 Cm. thick, upright, subglobular or obconical, truncate at both ends, brown or yellowish-brown, internally whitish or pale brownish, with a narrow circle of white wood under the thin bark. Roots numerous, slender, brittle, brown, with a thick bark, and slender, ligneous cord. Odor peculiar, becoming stronger and more unpleasant on keeping the drug; taste camphoraceous and somewhat bitter." *U. S.* As brought to this country, it frequently has portions of the stem attached. The English is superior to that from the continent of Europe. Valerian of good quality has been produced by the Shakers at Enfield, New Hampshire, also in Northern Vermont and New York. Thomas Doliber obtained from the American root 28.97 per cent. of alcoholic extract, and from the English 17.59 per cent., and stated that the native drug had, in our market, almost superseded the European. (*A. J. P.,* 1867, p. 70.)

Properties.—The color of the root is externally yellowish or brown, internally white. The powder is yellowish gray. The odor, which in the fresh root is slight, in the dried is strong and highly characteristic, and, though rather pleasant to many persons, is very disagreeable to others. Cats are strongly attracted by it. The taste is at first sweetish, afterwards bitter and aromatic. Valerian yields its active properties to water and alcohol. Trommsdorff found it to consist of 1.2 parts of volatile oil, 12.5 of a peculiar extractive matter, soluble in water, insoluble in ether and alcohol, and precipitated by metallic solutions, 18.75 of gum, 6.25 of a soft odorous resin, and 63 of lignin. Runge found in it a peculiar fixed acid, which produced with bases white salts, becoming green on exposure to the air. (*Chem. Gaz.,* No. 170, p. 452.) Of these constituents the most important is the *volatile oil.*[1] It is of a pale greenish color, of the sp. gr. 0.934, with the pungent odor of valerian, and an aromatic taste. It becomes yellow and viscid by exposure. Bruylants (*Ber. d. Chem. Ges.,* 1878, p. 449) has obtained from oil of valerian, 1st, a hydrocarbon or terpene, $C_{10}H_{16}$, boiling at 157° C.; 2d, a liquid compound, $C_{10}H_{18}O$, which by means of chromic acid affords common camphor, and formic, acetic, and valeric acids, which are met with in old valerian root, owing no doubt to the slow oxidation of the compound $C_{10}H_{18}O$; 3d, a crystalline compound

[1] *Valeriana mexicana.* DC.—According to the *Nueva Farmacopea Mexicana,* the roots of this plant contain a large percentage of valeric acid, which they yield readily and economically. In Mexican commerce they are said to occur in slices or fleshy disks about four centimeters or more in diameter, or in voluminous tubercles. Externally the color is grayish-yellow, internally yellow; the odor is strong and disagreeable, the taste bitter. R. McLaughlin (*A. J. P.,* 1893, 329) found 3.3 per cent. of oil in the Mexican valerian root. (See also *Schim. Rep.,* April, 1897.) *Japanese Valerian. Kesso root.*—This, formerly believed to be the product of *Patrinia scabiosæfolia,* Link, is now thought to be obtained from a variety of *V. officinalis.* It yields a volatile oil. (*P. J.,* xx. 837. xxi. 1069.) The rhizome sometimes known as *Valerianæ Radix Majoris* is obtained from *V. Phu,* L., of Southern Europe and Western Asia. It is from 4 to 6 inches long, ½ inch in thickness, brown, annulated with numerous yellowish roots, and a feeble, valerian-like odor and taste.

[1] *Oleum Valerianæ.* U. S. 1880. *Oil of Valerian.* (*Essence de Valériane,* Fr.; *Baldrianöl,* G.)—This volatile oil is obtained from the root of *Valeriana officinalis* by the usual process of distillation with water. According to Zeller, the dried root of the best quality yields 1.64 per cent. of the oil. Very good oil has been distilled from the root cultivated in this country. As first procured, it is of a pale greenish color, of the sp. gr. 0.934, with a pungent odor of valerian, and an aromatic taste. Upon exposure it becomes yellow and viscid. "A slightly acid reaction. Sp. gr. about 0.950. It is readily soluble in alcohol." The oil of valerian exercises the same influence as does the root on the nervous system, and is frequently administered as a substitute for it, in the dose of four or five minims (0.25 to 0.3 Cc.).

of the same composition, which in the root is probably combined with the three organic acids mentioned, forming corresponding esters with them; 4th, at from 285° to 290° C., a greenish, syrupy oil, which when rectified is colorless, and seems to have the composition of a *borneol oxide*, $(C_{10}H_{17})_2O$. Schimmel & Co. (*Schim. Rep.*, April, 1897) summarize the most recent researches upon valerian oil from different sources. In the oil from Dutch and Thuringian roots, the amount varying from 0.5 to 1 per cent., they find pinene, camphene, borneol, bornyl formate, bornyl acetate, and *bornyl isovalerate*, together with a sesquiterpene and an alcohol, $C_{10}H_{20}O_2$. In the oil from Japanese roots (amounting to from 6 to 6.5 per cent.) (*Kesso oil*), they find pinene, camphene, dipentene, terpineol, borneol, bornyl acetate, bornyl isovalerate, and kessyl acetate. Trommsdorff ascertained the existence in the oil of *valeric acid*.

This acid is a colorless volatile liquid, of an oleaginous consistence, having an odor analogous to that of valerian, and a very strong, sour, disagreeable taste. It is soluble in thirty parts of water, and in all proportions in ether and alcohol. It combines with salifiable bases, forming soluble salts, which retain, in a diminished degree, the odor of the acid. (*J. P. C.*, xx. 316.) The results of Bruylants just given show that the acid does not pre-exist in the oil, but is produced by the decomposition of its borneol ester. Valeric acid is obtained by distilling the impure oil with magnesium carbonate, decomposing by sulphuric acid the magnesium valerate which remains, and again distilling. The following process by T. and H. Smith of Edinburgh, avoids the inconvenience of distilling so bulky a root as valerian, while it answers the same purpose as that of Rabourdin. Boil the root for three or four hours with rather more than its bulk of water in which an ounce of sodium carbonate is dissolved for every pound of the root, replacing the water as it evaporates. Express strongly, and boil the residuum twice with the same quantity of water, expressing each time as before. Mix the liquids, add two fluidrachms of strong sulphuric acid for every pound of the root, and distil until three-fourths of the liquid have passed over. Neutralize this with sodium carbonate, concentrate the liquid, decompose the sodium valerate contained in it by sulphuric acid, and collect the valeric acid set free, by a separator, funnel, or by distillation. (*A. J. P.*, xvii. 253.) Lefort obtains the acid by the rapid oxidation of the volatile oil. He distilled 100 parts of the root with 500 of water, 10 of sulphuric acid, and 6 of potassium dichromate, and in this way procured a larger proportion of acid than by any other process. (*J. P. C.*, 3e sér., x. 194.)

The roots of *Valeriana Phu*, L., and *V. dioica*, L., are said to be sometimes mingled with those of the official plant. According to Ebermayer in Germany various ranunculaceous roots are a dangerous adulterant of valerian; they may be readily detected by their want of the peculiar odor of the official root. According to M. O. Raveil, the valerian in the markets of Paris is largely adulterated with the roots of *scabious* (*Scabiosa succisa*, L., and *S. arvensis*, L.). They are shorter than the genuine root, with larger radicles, less rough, little or not at all striated, very brittle, with a white amylaceous fracture. The roots are inodorous in themselves, but are very apt to acquire odor from contact with the valerian. (*J. P. C.*, xxvi. 209.)

Uses.—Valerian is gently stimulant, with an especial direction to the nervous system, but without narcotic effects. In large doses it produces a sense of heaviness and dull pain in the head, with various other effects indicating nervous disturbance. The oil, largely taken, is said by Barailer, from his own observation, to produce dulness of intellect, drowsiness ending in deep sleep, reduced frequency of pulse, and increased flow of urine. (See *A. J. P.*, 1861, p. 239.) It is useful in cases of irregular nervous action, when not connected with inflammation or an excited condition of the system. Among the complaints in which it has been particularly recommended are *hysteria, hypochondriasis, hemicrania,* and *low forms of fever,* attended with restlessness, morbid vigilance, or other nervous disorders. As the virtues of valerian reside chiefly in the volatile oil, the medicine should not be given in decoction or extract. The distilled water is used on the continent of Europe, and the volatile oil is occasionally substituted with advantage for the root. The dose of the oil is four or five minims (0.25 to 0.3 Cc.). Valeric acid also has been used internally. (See *Valeric Acid,* PART II.) Landerer says that, in his experience, the acid prepared from the root is preferable therapeutically to the artificial acid; this preference may be due to the presence of impurities, having medicinal properties, which are found in the acid from the root.

Off. Prep.—Fluidextractum Valerianæ, *U. S.;* Tinctura Valerianæ, *U. S.;* Tinctura Valerianæ Ammoniata, *U. S., Br.*

VANILLA. U. S.

VANILLA

(vạ-nĭl'lạ)

"The cured, full grown, but immature fruit of *Vanilla planifolia* Andrews (Fam. *Orchidaceæ*)." *U. S.*

Vanille, *Fr. Cod.;* Fructus Vanille, *P. G.;* Vanille, *G.*

Vanilla planifolia, Andrews, *Bot. Repository*, t. 538 (1808); *B. & T.* 272.—This is a fleshy, dark green, perennial climbing plant, with a very long, smooth, dark green stem, much branched, and furnished at the nodes

with aerial roots, which cling to the tree or the wooden framework supporting the plant. The dark green, tough leaves are alternate, oval, sessile, attenuate at the apex, fleshy, and veinless. The pale greenish-yellow, sessile flowers are about two inches in diameter, and occur in loose, axillary racemes of eight or ten. The fruit is a slender pod, seven or eight inches long, filled with an oily mass containing numerous small, black, shining seeds.[1] Doubts, however, exist whether commercial vanilla is entirely derived from this species, and the United States Pharmacopœia formerly ascribed it to *V. aromatica,* Swartz, considered by some botanists to be a variety of *V. planifolia,* from which it is distinguished by its ovate-oblong, nerved, opposite leaves, its waxy sepals, its acute lip, and its very long cylindrical capsules. According to R. A. Rolfe, *V. Pompona,* Schiede, yields the Guadeloupe variety, and *V. Gardneri,* Rolfe, is said to yield Brazilian and Bahia vanilla. *V. appendiculata,* Rolfe, and *V. odorata,* Presl., produce aromatic fruits, but are not known to be cultivated, while *V. phœantha,* which possesses but little perfume, is under cultivation at Jamaica and Trinidad. (*Kew Bulletin,* No. 104, 169.) *V. guayanensis* and *V. palmarum* are also said to yield an aromatic fruit. (See also below.)

This plant is a native of the West Indies, Mexico and South America, but is now extensively cultivated. The plant does well from the sea-level up to two thousand feet of altitude, requiring for its perfection, however, a moist, hot climate, with an habitual dry summer spell which seems to be necessary to bring good flowering. It is propagated by means of cuttings, sometimes two or three feet in length but preferably from ten to twelve feet long taken from growing shoots; these are planted after the dry season is over and should produce flowers in two years. Preferably placed upon trees, but sometimes on long stakes, trellises, wire supports, etc., the slip is placed with one end on the ground, covered with leaves or some light top dressing. In many cases the vines are planted so closely as scarcely to leave room for cultivators to pass, but it has been found that under these circumstances the vanilleries are especially liable to destructive fungous diseases. As the flower does not fertilize itself, fertilization (pollination) by hand is necessary; it is usually performed by women and children. It is said that a fairly trained workman can fecundate over one hundred flowers per hour. In most localities no more than thirty fertilized flowers should be left to a plant. The pods reach their full size in from five weeks to eight months, according to the altitude of the locality and to the amount of shade. The first indication of ripening is a slight yellowing of the whole pod; as soon as this occurs the pods should be picked, and sorted, and the curing process commenced. If left to ripen further the pods are prone to split and otherwise deteriorate. For the purpose of curing them the pods are kept in a heated room for some days (about 110° F.), then transferred to a cooler one (90° F.), and finished at ordinary temperature. During the process, which lasts some months, there is a loss of 70 to 80 per cent. of weight. For details as to culture, see *Bulletin* 21, 1898, U. S. Department of Agriculture, Division of Botany. The practice of curing the beans by placing them under blankets in the sun is still in vogue, but that of using a regulated artificial heat is more certain, and it is the modern method.

When thoroughly cured the beans are sorted and tied into bundles, which are wrapped in sheet lead or placed in small metallic boxes. In doing this it is essential that the bundle be wrapped in a thin vegetable parchment paper, as chemical action occurs when the beans come in contact with the metal.

Fruits which have not been picked early enough are inferior and are frequently cut into short pieces and sold as "cuts." If by chance the fruit should be picked too early the quality of the resulting product is distinctly inferior. The fruit as first picked has no aroma, the *vanillin* during the process of curing being produced from the glucoside *coniferin* in the interior of the fruit. This was shown to be converted into *coniferyl alcohol* and glucose, and the former of these subsequently changed into vanillin.

The cultivation of vanilla has extended from South America throughout the tropics, so that at present although the wild plant is abundant in the Mexican States of Vera Cruz and Oaxaca the vanilla of the markets comes almost exclusively from vanilleries. Holland is supplied from the Java plantations; France from Tahiti, Madagascar, Réunion, Guadeloupe, and other of her colonies. From Mauritius and the Seychelles the product goes to London. In the markets most of the varieties are known by the name of the country in which they are produced. The finest of the varieties is the Mexican although of recent years the Bourbon beans have so improved that they almost rival it in strength and flavor. At present the Mexican bean is sold at somewhat less than double the price of the Bourbon; the Bourbon at almost double the price of the Tahiti, the latter bean being commonly much injured by carelessness in the process of curing.

[1] The following account of the structure of vanilla fruit is adapted from that of S. E. Jelliffe. The transverse section of the vanilla bean displays a thick-walled, irregular triangular cavity, into which the placenta, supporting two rows of fine black seeds, projects. The wall of the ovary is lined with minute papillæ bearing unicellular papillose hairs, which project into the central cavity and are believed to secrete the materials out of which the vanillin is elaborated. Beneath the epicarp or external part of the fruit is a lax tissue, in which there is an oily substance with the characteristics of vanillin and numerous fine acicular crystals of calcium oxalate. The polygonal mesocarpal cells are for the most part finely pitted, some irregularly marked. The vascular bundles of the mesophyll are irregularly scattered or radially or tangentially arranged. Spiral ducts are abundant, annular ducts few. In the tissue of the mesophyll irregular resinous masses and prisms of vanillin occur.

Of *Mexican vanilla*,[1] the first quality occurs in pods from eight to ten inches long, flattened, two-eighths to three-eighths of an inch in diameter, with the lower end slightly attenuated, the upper end gradually tapering for about a quarter of the length of the pod, usually curved and slightly twisted near the point. The color is dark brown, the pods fairly plump, the surface ridged longitudinally, and with an incrustation of fine crystals beginning at the ends, gradually extending; when fresh somewhat viscid, but always roughish to the touch. For an interesting account of the Mexican vanilla plant by Charles E. Hires, see *A. J. P.*, 1893, 576.

Bourbon vanilla, produced in the Isle of Réunion to the amount of 200,000 pounds a year, resembles Mexican vanilla, but is scarcely so long in the tapering portions, is of a dark-brown almost black color, is not so firm as the Mexican, has the surface smooth and waxy, and soon becomes covered with a coating of acicular crystals known as "frost." The odor of this vanilla is said to resemble that of Tonka bean rather than that of Mexican vanilla.

The *Seychelles* and *Mauritius vanilla* (*inferior Bourbon* of the trade) has the pods about six inches in length, not over a quarter of an inch in width, and characterized by the pale color, the faint odor, and a smooth but not waxy surface.

South American or *Guadeloupe vanilla* resembles the Mexican bean, but is usually recognizable, when the bean is entire, by the latter being broad and flattened, usually half an inch or more wide, slightly tapering at the lower end, and at the upper sharply attenuated an inch or so at the point. It has a reddish-brown color, and is of a rank odor. It is very pulpy, with a surface intermediate in feel between the Bourbon and the Mexican, and having but few crystals. One variety of this vanilla, sold under the name of *vanillons*, has the odor of heliotrope and is much used by perfumers and tobacco manufacturers. See foot-note.

Tahiti vanilla, "*transplanted Mexican vanilla*," has its pods from six to seven inches long, flat, from three-eighths to half an inch wide, with a reddish-brown color. They are almost destitute of vanilla flavor, and have an odor suggesting heliotrope. It is said they contain piperonal and also vanillin. (*Ph. Cb.*, 45.)

Java vanilla, which is almost exclusively consumed in Holland, has a pod from four to six inches long, with a flavor as fine as that of the Mexican bean, and a much stronger odor.

The importations of vanilla beans into the United States for 1904 amounted to 550,316 lbs., valued at $1,424,763, and for 1905 to 608,576 lbs., valued at $872,124.

Properties.—Vanilla is officially described as "linear, narrowed, and bent or hooked at the rather oblique base, about 15 to 20 Cm. long and about 7 Mm. thick; externally blackish-brown, longitudinally wrinkled, glossy, frequently covered with an efflorescence of vanillin in acicular crystals, flexible and tough, 1-celled, containing a blackish-brown pulp and numerous minute, blackish, ovoid and flattened seeds; odor and taste characteristic and very agreeable." *U. S.* Vanilla beans from which the vanillin has been removed by means of a solvent are sometimes offered for sale. The fraud is to be detected by the absence of flavor and odor. Such beans, and also beans of an inferior quality, are sometimes "improved" in appearance and in odor by the use of benzoic acid. For the detection of this fraud the pharmacist should avail himself of the fact that while the crystals of benzoic acid are flattened and rhomboidal and generally lie upon the bean, those of vanillin are usually acicular and stand out at right angles from the surface of the fruit. The absence of the crystalline coating on the vanilla beans seems to be no proof of inferiority, for Henri Lecomte affirms that it is not rarely absent in the best Mexican bean. (*B. Sc. Pharm.*, 1901.)

According to Bucholz, vanilla does not yield volatile oil when distilled with water, and the aroma appears to depend on chemical changes which may take place during and after the curing of the fruit. Many years since, vanilla was analyzed by Bucholz and Vogel, the former of whom found in it a disagreeable-smelling fixed oil, a soft resin having a feeble odor of vanilla when heated, a bitterish extractive resembling tannin, sugar, starch, and benzoic acid. But the characteristic odorous principle was not isolated until Gobley obtained *vanillin* by acting on vanilla with solvents (see *Vanillinum*). Although the latter substance has been largely manufactured, it does not take the place of the preparations of vanilla, the flavor and odor of the latter being

[1] Of the Mexican vanillas the most valuable variety, called *ley*, or *vainilla mansa*, by the Spaniards, consists of cylindrical, somewhat flattened pods, six or eight inches long, three or four lines thick, nearly straight, narrowing towards the extremities, bent at the base, shining and dark brown externally, wrinkled longitudinally, soft and flexible, and containing within their tough shell a soft black pulp, in which numerous minute, black, glossy seeds are embedded. It has a peculiar, strong, agreeable odor, and a warm, aromatic, sweetish taste. The interior pulpy portion is most aromatic. In it are more or less numerous, minute crystals. Another variety, called *vainilla simarona* by the Spaniards, is smaller, of a lighter color, and less aromatic. The pods are said to be very dry and to contain no vanillin. (*Nueva Farmacopea Mexicana.*) According to Schiede, it is yielded by a distinct species, the *Vanilla sylvestris*, Schiede. A third variety is the *vainilla pompona* of the Spaniards (*boba vainilla*, or *plátano vainilla*). In this, the pods are from five to seven inches long, from six to nine lines broad, shaped somewhat like a plantain, almost always open, very dark brown or nearly black, soft, viscid, and of a strong odor. Schiede states that it is the product of the *Vanilla Pompona*, Schiede. The variety *vainilla vezacate* is said to be derived from pods gathered long before maturity. (*Nueva Farmacopea Mexicana.*) The *vainilla pompona* of the Spaniard is evidently the *vanillons* of European commerce, which are usually from 4 to 5 inches long and from ⅜ to an inch in diameter, frequently sharply angled, brown to red-brown in color, usually split open and free from efflorescence. Owing to the transverse markings by twine with which they have been wrapped during the process of curing, the beans have a peculiar twisted appearance. Their odor, which resembles that of heliotrope, is due to the presence in them of *heliotropin*, in lieu of *vanillin*.

greatly preferred. It passes with water in distillation. If vanilla, finely divided, be distilled with water, a turbid liquid passes, which becomes clear by agitation with ether, and the ether on evaporation yields crystals of vanillin. Vanilla, in the fresh state in which it is gathered, does not in the least possess the characteristic fragrant odor. H. Lecomte (*J. P. C.*, 1903, 343) studied the conditions which bring about the formation of vanillin. According to his researches, there exist in the vanilla plant two ferments, which differ in a marked degree from each other in their functions. The one, an oxydase, is present in the individual organs of the plant, such as the leaves, shoots and their aqueous extracts, in the green and ripe fruit, and in the prepared commercial fruit. Lecomte detected it in the organs of plants of different origin, by means of G. Bertrand's reactions. At the same time, the presence of manganese salts was observed in all products, which renders it not impossible that they stand in some relation to the above-named ferment. The second ferment is contained in the sap of the vanilla, and acts as a hydrolyzing ferment. With regard to the mechanical treatment of vanilla, it would appear in the first instance as if it counteracted the function of the ferment. It consists, as is well known, of the immersion of the fruit during twenty seconds in water at 85° C. (185° F.), a manipulation which might bring about the destruction of the ferment. But the author has convinced himself that a temperature of about 50° C. (122° F.), such as the interior of the fruit probably only reaches during the short duration of the process, really promotes the function of the oxydase. Both ferments, the oxydase as well as the one possessing the hydrolytic action, appear to be necessary for the formation of vanillin in the plant, and their action may possibly be explained thus: During the preparation, the coniferin produced by the plant is split up into glucose and coniferyl alcohol. This process would explain also the occurrence of grape-sugar in vanilla. The oxydase then converts the coniferyl alcohol into vanillin. Tiemann and Haarmann obtained from Mexican vanilla 1.69 per cent. of vanillin, from Réunion vanilla 2.48 per cent., from Java vanilla 2.75 per cent. Stokeby found in vanilla, resin, wax, a fixed oil, a brown resinous matter, tannic acid changing the salts of iron to green, gum, sugar, phosphates, and sulphates: hydrochloric acid separated from it oxalic acid, and potassium hydroxide, humic acid. (*J. P. C.*, 4e sér., iii. 76, 1866; see also paper by Clay W. Holmes, *Proc. A. Ph. A.*, 1887, 526.)

Uses.—See *Vanillinum.*[1]

Off. Prep.—Tinctura Vanillæ, *U. S.*

[1] *Vanilla Poisoning.*—Many years ago, Orfila recorded cases of poisoning by the eating of vanilla ices, and recently many cases have occurred both in Europe and in this country. The symptoms are those of intense gastro-intestinal irritation, and closely resemble those of cholerine. That the attacks have not simply been cholera morbus induced by the ingestion of cold ices is shown by the fact that many of the flavored dishes were pies and even simple farinaceous puddings. Elaborate chemical investigations have proved the absence of metallic poisons in the ingesta. Schroff believes the poison to be cardol derived from the oil of cashew nut placed upon the vanilla pod to preserve it, but there does not seem to be any proof of this, and it is stated that cardol could not be found in the vanilla pods obtained from the Vienna café at Berlin, where poisoning had occurred. (*P. J.*, 1874, p. 853.) Again, it has been believed that the poisoning was the result of copper derived from vessels in which the ice cream had been preserved, but chemical analysis has disproved this. Certain chemists have been inclined to suppose that the poisoning was caused by ptomaines or other products of decomposition of the cream before freezing. Layot (*J. P. C.*, x.) believes that the poisoning is really due to the vanilla, and especially to an inferior variety of bean known as "vanillon," the pods of which are free from rime, soft, viscous, and nearly always open. If, however, it be correct, as asserted (*P. J.*, xv. 241), that the poisoning has been caused by ice cream flavored with artificial vanillin, it is almost certain that the symptoms are due to alterations in the cream itself. This is confirmed by the studies of V. C. Vaughan, who, in 1885, succeeded in isolating from cheese a peculiar poisonous ptomaine, *tyrotoxicon*. (See *A. J. P.*, 342, 1886.) Subsequently, Vaughan obtained the same poison from milk, and in June, 1886, melted ice cream taken from a mass which had produced serious poisoning in eighteen persons, with some of the vanilla which had been used in flavoring the cream, was submitted to him for analysis. (See *A. J. P.*, xvi. 452.) The ingestion of the vanilla in doses of thirty drops of an extract failed to develop in Vaughan or his assistants any symptoms, and he was able to separate the tyrotoxicon from the ice cream itself and to poison animals with it. H. C. Wood has seen violent poisoning, with gastro-intestinal irritation and symptoms resembling those of the so-called vanilla poisoning, produced by the ingestion of stale cream puffs in which no vanilla had been put, and it is more than probable that in most cases of the so-called vanilla poisoning tyrotoxicon or some allied substance is the cause of the symptoms. If the case reported by Rosenthal be accurately stated (*P. J.*, xv. 24), it must be allowed, however, that in some instances the vanilla itself is at fault.

VANILLINUM. U. S.

VANILLIN

(vȧ-nĭl-lĭ'nŭm)

$C_8H_8O_3 = 150.92$

"Methylprotocatechuic aldehyde [$C_6H_3.OH.OCH_3.COH$ 4:3:1], occurring naturally in vanilla, or made artificially from several orthodihydroxybenzene derivatives." *U. S.*

Vanilline, *Fr. Cod.*; Vanillin, Vanillekampher, Protocatechualdehydmethylaether, *G.*

Preparation.—Vanillin was first obtained from vanilla by Gobley, who, by exhausting vanilla with 85 per cent. alcohol, evaporating the resulting tincture to an extract, softening this with water, and agitating in a flask with ether so long as it gave color to that fluid, then evaporating the ethereal liquid and treating the residue with boiling water, obtained on the evaporation of the water a crop of crystals having the odor of vanilla. Purified by treatment with animal charcoal and recrystallization, the principle appeared in the form of colorless, long, four-sided needles terminated by two faces. It has a strong odor of vanilla, with a hot, biting taste, and is frequently seen in acicular crystals upon the external surface of the bean. This compound, for which Gobley

proposed the name *vanillin,* is now recognized as the methyl-ether of protocatechuic aldehyde, $C_6H_3\begin{cases}OCH_3\\OH\\COH,\end{cases}$ or $C_8H_8O_3$, and is known to occur somewhat diffused in the vegetable kingdom, being found in the sugar beet and in the wood-tissue of many plants. It forms crystalline needles fusing at 80° to 81° C., difficultly soluble in cold water, readily soluble in hot water, easily soluble in alcohol and ether, chloroform, and carbon disulphide. It oxidizes slowly in damp air to *vanillic acid,* $C_8H_8O_4$; when heated with diluted hydrochloric acid to 200° C., it breaks up into methyl chloride and protocatechuic acid. Tiemann and Haarmann (*Ber. d. Chem. Ges.,* 1874), who first ascertained the true character of vanillin, also found that it could be made synthetically from *coniferin,* a glucoside contained in the cambium layer of the pine. This coniferin, $C_{16}H_{22}O_8 + 2H_2O$, or the compound $C_{10}H_{12}O_3$, which with glucose results from its decomposition, is oxidized by sulphuric acid and potassium dichromate with the production of vanillin. Artificial vanillin was made in this way from coniferin under Tiemann and Haarmann's patents, and was made by Reimer and Tiemann from guaiacol by heating it with sodium hydroxide and chloroform, but it is now made from *eugenol,* $C_6H_3\begin{cases}OH\\OCH_3\\CH_2.CH:CH_2\end{cases}$. This on heating with alcoholic potash is changed into *isoeugenol,* $C_6H_3\begin{cases}OH\\OCH_3\\CH:CH.CH_3\end{cases}$, and this is then oxidized, when *vanillin,* $C_6H_3\begin{cases}OH\\OCH_3,\\CHO\end{cases}$ is formed. A larger yield is obtained if the isoeugenol is first acetylated, as the acetisoeugenol is more stable under the influence of oxidizing agents. The product acetvanillin is readily decomposed, with the liberation of the vanillin The oxidation is effected by a variety of oxidizing agents. Sodium peroxide has been used with success, or more recently the isoeugenol sodium has been oxidized at the positive pole of an electrolytic cell, using an alkaline hydroxide as the cathode liquid. Oil of cloves is therefore used as a basis for the manufacture of artificial vanillin.

Properties.—It is officially described as in "fine, white, crystalline needles, having the odor and taste of vanilla, and having an acid reaction. Soluble in about 100 parts of water at 25° C. (77° F.), and in 15 parts at 80° C. (176° F.). It is easily soluble in alcohol, ether, glycerin, or chloroform. When heated to between 80° and 81° C. (176° and 177.8° F.), it melts, and at 285° C. (545° F.) it can be distilled without decomposition in a current of carbon dioxide, leaving no residue. It is easily soluble in aqueous solutions of alkali hydroxides, and from the combinations thus formed it is precipitated at once by the addition of acids. An aqueous solution of Vanillin gives, with ferric chloride T.S., a blue color; if the mixture be boiled, the blue color changes to brown, and on cooling a white precipitate of dihydro-divanillin separates. Vanillin is extracted completely from its solution in ether by shaking with a saturated aqueous solution of sodium bisulphite, from which solution it is precipitated by the addition of sulphuric acid. An aqueous solution of Vanillin will give, on the addition of lead acetate T.S., a white precipitate of a lead compound of vanillin, soluble in hot water, and crystallizing, on cooling, in scales. On warming 0.1 Gm. of Vanillin with concentrated alcoholic solution of sodium hydroxide, adding chloroform and again warming, it should not give an odor of phenyl-isocyanide (absence of *acetanilide*)." *U. S.*

Uses.—According to Grasse, vanillin produces in frogs spinal convulsions followed by paralysis due to a direct action upon both the spinal cord and motor nerves. It has been suggested as a stomachic and excito-motor given in doses of three-fourths of a grain (0.048 Gm.). (*A. Pharm.,* Aug. 1896.) Neither it nor vanilla, however, are used for other than flavoring purposes. The fact that while the vanilla beans have steadily risen in price for a number of years that of the artificial vanillin has enormously fallen, indicates that as a flavoring agent vanillin is not equal to the natural product. It is said that articles flavored with it leave a peculiar, disagreeable after-taste and retain their flavor only a very short time.

VERATRINA. U. S., Br.

VERATRINE

(vĕr-ą-trī'ną)

"A mixture of alkaloids obtained from the seed of *Asagræa officinalis* (Chamisso and Schlechtendal) Lindley (Fam. *Liliaceæ*). It should be kept in well-stoppered, amber-colored vials." *U. S.* "An alkaloid, or mixture of alkaloids, prepared from cevadilla, the dried ripe seeds of Schœnocaulon officinale, *A. Gray.*" *Br.*

Veratria, *U. S.* 1870; Vératrine, *Fr. Cod.;* Veratrinum, *P. G.;* Veratrin, *G.;* Veratrina, *It., Sp.*

"Cevadilla of commerce, 2 *pounds* (Imperial) or 1 kilogramme; Distilled Water, Alcohol (90 per cent.), Solution of Ammonia, Hydrochloric Acid, of each *a sufficient quantity.* Macerate the cevadilla with half its weight of boiling Distilled Water, in a covered vessel, for twenty-four hours; remove the cevadilla; squeeze it; dry it thoroughly in a warm place; then beat it in a mortar, and separate the seeds from the capsules. Reduce the seeds to powder; moisten the powder with the Alcohol; pack firmly in a percolator; pass the Alcohol through the marc until the percolate ceases to be colored; concentrate the alcoholic solution by

distillation, so long as no deposit forms, and pour the residue, while hot, into twelve times its volume of cold Distilled Water; filter through calico; wash what remains on the filter with Distilled Water, until the filtrate ceases to precipitate with Solution of Ammonia. To the filtrate add Solution of Ammonia in slight excess; let the precipitate completely subside; pour off the supernatant liquid; collect the precipitate on a filter; wash it with Distilled Water until the filtrate passes colorless; distribute the moist precipitate through *twelve fluid ounces* (Imp. meas.) or four hundred cubic centimetres of Distilled Water; add gradually, with diligent stirring, sufficient Hydrochloric Acid to make the liquid feebly but persistently acid; add *sixty grains* or four grammes of the purified animal charcoal of commerce; digest with moderate heat for twenty minutes; filter; allow the liquid to cool; add Solution of Ammonia in slight excess, and, when the precipitate has completely subsided, pour off the supernatant liquid; collect the precipitate on a filter and wash it with cold Distilled Water until free from chloride; dry the precipitate, first by imbibition with filtering paper, and then by the application of warmth." *Br.*

The U. S. P. (8th Rev.) very properly does not give a process for veratrine, as it cannot be made profitably by the pharmacist. (See *Sabadilla*, PART II.)

In the U. S. process of 1870 [1] the first step is to obtain a tincture of cevadilla, which is evaporated to the consistence of an extract. This contains the veratrine combined with a vegetable acid, probably gallic, as it exists in the seeds. From the extract the alkaloid is dissolved by the acidulated water, which at the same time converts it in great measure into a sulphate, a small portion possibly remaining in the solution combined with an excess of the natural acid. The magnesia combines with the acids and throws down the veratrine, which is then taken up by alcohol and again yielded in a purer state by evaporation. To purify it still further, it is redissolved in water by the agency of sulphuric acid, is submitted to the action of animal charcoal, and is finally precipitated by ammonia. In the British process, the tincture is concentrated until it begins to let fall a precipitate, and is then poured into water, which throws down the resin and oil with a portion of the coloring matter and retains the salt of veratrine. This is then decomposed by ammonia, and the precipitated veratrine is slightly washed with cold water to free it from adhering impurities. If much water be employed in the washing, a considerable portion of the veratrine will be lost, in consequence of impure veratrine being in some degree soluble in water. The remaining steps of the British process consist in the purification of the veratrine by forming a hydrochloride in solution, decolorizing this by animal charcoal and again precipitating by ammonia.[2]

The U. S. process of 1870 is essentially that of Couërbe. The veratrine obtained by it, though not pure, is sufficiently so for medicinal use. A drachm of it, in this state, may be procured from a pound of cevadilla. Meissner, in 1819, applied the term *sabadilline* to an alkaloid extracted by him. Pelletier and Caventou had probably produced the same preparation when they announced the discovery of veratrine in the same year. This substance is the veratrine described as prepared by Couërbe's process. Couërbe, in 1834, announced the discovery of an additional alkaloid, to which he gave Meissner's old name of sabadilline, and Weigelin, in 1871, announced the discovery of a third alkaloid, which he called *sabatrine*. G. Merck, in 1855, obtained veratrine in a crystallized state by solution and separation from strong alcohol.

Wright and Luff (*J. Chem. S.*, 33, p. 338) have brought order from this confusion by a careful study of the whole subject. They

[1] *Veratria*, U. S. 1870.—"Take of Cevadilla, in moderately fine powder, *twenty-four troyounces;* Alcohol, Sulphuric Acid, Magnesia, Water of Ammonia, Purified Animal Charcoal, Water, each, *a sufficient quantity*. Digest the Cevadilla with eight pints of Alcohol, for four hours, in a distillatory apparatus, with a heat approaching to boiling, and pour off the liquid. To the residue add eight pints more of Alcohol mixed with the portion distilled, and, having digested for an hour, pour off the liquid as before. Digest for a third time with the same quantity of Alcohol, together with the portion last distilled, and again pour off. Press the remains of the Cevadilla, mix and strain the liquids, and, by means of a water-bath, distil off the Alcohol. Boil the residue three or four times in Water acidulated with Sulphuric Acid, mix and strain the liquids, and evaporate to the consistence of syrup. Add Magnesia in slight excess, shake the mixture frequently, then express, and wash what remains. Repeat the expression and washing two or three times, and, having dried the residue, digest it with a gentle heat several times in Alcohol, and strain after each digestion. Distil off the Alcohol from the mixed liquids, boil the residue for fifteen minutes in water mixed with a little Sulphuric Acid and Purified Animal Charcoal, and strain. Having thoroughly washed what remains, mix the washings with the strained liquid, evaporate with a moderate heat to the consistence of thin syrup, and drop in sufficient Water of Ammonia to precipitate the Veratria. Lastly, wash the alkaloid with Water, and dry it with a gentle heat." *U. S.* 1870.

[2] James Beatson, manufacturing chemist of the U. S. Naval Laboratory at New York, recommended the following method of preparing veratrine as less complicated than the U. S. P. 1870 process, and quite satisfactory in its results. Take 73 pounds (avoirdupois) of cevadilla, rub it upon a coarse wire sieve so as to separate the seeds from the capsules, and reduce the former to a coarse powder by a Swift's drug mill. Pass the capsules also through the mill, separate the finer portion, and mix it with the ground seeds. Moisten the mixture with alcohol, and allow it to stand 12 hours; then introduce it into a displacement apparatus, and pour upon it 30 gallons of alcohol. When a convenient quantity of the liquid has passed, submit it to distillation, and return the distilled alcohol to the displacement apparatus, and proceed in the same way until the cevadilla is thoroughly exhausted. Collect all the alcoholic liquor from the exhausted seeds, and continue the distillation until the tincture has a syrupy consistence. Pour this while hot into eight times its volume of cold water, throw the whole on a calico filter, and wash until the washings cease to indicate the presence of the veratrine. Mix the washings with what first passed through the filter, and add ammonia water in excess (about 4 pounds). Wash the precipitated veratrine with cold water, and dry it with a very gentle heat. Beatson obtained by this process eleven and a quarter ounces of veratrine but faintly tinged with coloring matter. (*A. J. P.*, xxvi. 5.)

found three alkaloids in sabadilla seeds: *cevadine,* $C_{32}H_{49}NO_9$ (the alkaloid hitherto known as the veratrine of Merck); *veratrine,* $C_{37}H_{53}NO_{11}$; and *cevadilline,* $C_{34}H_{53}NO_8$. Of these, the cevadine (formerly veratrine) forms, when crystallized from alcohol, needles or compact crystals which fuse at 205° C. (401° F.), effloresce rapidly in the air, and become opaque, are insoluble in water, easily soluble in alcohol and ether, and dissolve in warm concentrated hydrochloric acid with a dark violet color, which on boiling becomes intensely red. When heated with alcoholic potassium hydroxide they are decomposed into *methyl-crotonic* (*tiglinic*) *acid* and *cevine,* $C_{27}H_{43}NO_8$. The veratrine of Wright and Luff is obtained from the mother liquor of the cevadine by extraction with ether. It forms an uncrystallizable resinous mass, fusing at 180° C., but yields crystallized salts. Boiled with sodium hydroxide it is decomposed into *dimethyl-protocatechuic* (*veratric*) *acid* and *verine,* $C_{28}H_{45}NO_8$. Cevadilline remains after the extraction of the veratrine, insoluble in ether. It is also uncrystallizable, nearly insoluble in ether and in boiling benzene, but easily soluble in fusel oil.

Flückiger recognized only two of these alkaloids, and made them both of the composition $C_{32}H_{49}NO_9$. The first, which he called *cevadine,* he stated is decomposed by boiling with barium hydroxide when in alcoholic solution, and yielded products as follows:

$$C_{32}H_{49}NO_9 + 2H_2O = C_5H_8O_2 + C_{27}H_{45}NO_9$$

The first of these products is *methyl-crotonic acid,* and the second is *cevine.* The other alkaloid he called *veratridine,* and gave its decomposition as follows:

$$2C_{32}H_{49}NO_9 + 4H_2O = C_9H_{10}O_4 + C_{55}H_{92}N_2O_{16} + 2H_2O$$

The first of these products is *dimethyl protocatechuic acid,* and the second he called *veratroïn.* (Flückiger, *Pharm. Chem.,* 1888, ii. p. 532.) Merck still terms the cevadine of Wright and Luff veratrine, and prepares it in white crystals of the formula $C_{32}H_{49}NO_9$, fusing at 202° C. Frankforter (*A. J. P.,* 1897, 372) confirmed this formula, $C_{32}H_{49}NO_9.H_2O$, but gave to the purified veratrine the melting point from 146° to 148° C.

Two acids have also been found in sabadilla,—the *sabadillic* or *cevadic acid* of Pelletier and Caventou, forming needle-like crystals fusing at 20° C., and the *veratric acid* of Merck, which Koerner showed to be dimethyl-protocatechuic acid.

Properties.—Veratrine is officially described as "a white, or grayish-white, amorphous powder, odorless, but causing intense irritation and sneezing when even a minute quantity reaches the nasal mucous membrane; having an acrid taste, and leaving a sensation of tingling and numbness on the tongue. *It should be tasted with great caution.* Slightly hygroscopic in moist air. Soluble in 1750 parts of water, 2.2 parts of alcohol, 3 parts of ether, and in 1 part of chloroform at 25° C. (77° F.); soluble in 1300 parts of water at 80° C. (176° F.); very soluble in benzene and amyl alcohol; insoluble in petroleum benzin. When heated to 145° C. (293° F.), it softens, and melts at 152° C. (305.6° F.). Upon ignition it is consumed, leaving no residue. Its alcoholic solutions are alkaline to red litmus paper. On triturating Veratrine with sulphuric acid, in a glass mortar, the yellow or orange-red solution exhibits, by reflected light, a greenish fluorescence, which becomes more intense upon the addition of an equal volume of acid. Upon standing, the solution gradually assumes a deep red color. Sulphuric acid when heated with Veratrine gives a cherry-red color. Sulphuric acid containing a trace of selenous acid produces a brownish-green color. Sulphuric acid added to a mixture of 1 part of Veratrine and 6 parts of sugar produces a green color, changing to blue, and the mixture then becomes colorless." *U. S.* "Pale gray, amorphous; without odor, but, even in the most minute quantity, powerfully irritating the nostrils; strongly and persistently bitter, and intensely acrid; insoluble in *water,* soluble in 3 parts of *alcohol* (90 per cent.) or of *chloroform,* in 6 parts of *ether,* and in diluted acids, leaving slight traces of an insoluble brown resinous matter. It dissolves in *nitric acid,* yielding a yellow solution. Warmed with *hydrochloric acid,* it dissolves with production of a blood-red color lasting several days. Treated with fifty or sixty times its weight of *sulphuric acid,* the mixture turns yellow, subsequently acquires a yellowish-green fluorescence which becomes more distinct on the addition of more acid and slowly changes to bright red, or, if warmed, violet-red. Heated with access of air, Veratrine melts to a yellow liquid, and at length burns away, leaving no residue (absence of mineral impurity)." *Br.*

Uses.—Veratrine is locally irritant, and exercises a peculiar influence on the nervous system. Rubbed upon the skin it excites a sensation of warmth and a peculiar tingling. Sometimes an evanescent blush is produced, and still more rarely an eruption upon the skin, but, in general, no decided signs of inflammation are evinced. Upon the denuded cutis, however, veratrine and its salts are powerfully irritating; in the mouth and fauces they produce an almost insupportable sense of acrimony, and snuffed up the nostrils excite violent sneezing. Magendie states that when taken internally in the dose of a quarter of a grain they promptly produce abundant alvine evacuations, and in larger doses provoke more or less violent vomiting. Experimenters have observed similar effects.

When it is taken in toxic doses veratrine causes violent vomiting, serous purging, often with intense burning in the mouth and throat, and general muscular weakness. No fatal case of poisoning is on record; but in the experiments of Esche on himself a half-grain of the acetate produced collapse, with a pale, cold,

wet skin, pinched features, a rapid, thready, irregular pulse, violent vomiting, and marked muscular tremblings. The phenomena of veratrine poisoning in dogs, rabbits, etc., are failure of muscular power, along with violent muscular twitchings and convulsions, which are often plainly excited by external irritants, severe vomiting, generally but not always accompanied by purging, and disturbance of motion, respiration, and circulation. The pulse is at first, if the dose be not too large, quickened and strengthened, but in a very short time it becomes slower and weaker, and finally very frequent, thready, and irregular. When very large doses are given, the animal often dies at once of a universal paralysis. Veratrine is a powerful muscle poison, producing a primary stage of muscular hyperexcitability and a condition in which momentary stimuli produce tetanic spasms, and a final stage of rigidity and complete loss of contractility. It is paralyzant to the motor nerves, and probably also to the sensory nerves. Upon the cerebral centres it has little action; its exact influence upon the spinal cord has not been determined. It is a powerful depressant to the respiratory centre, and acts upon the heart muscle as upon the voluntary muscles. In the earlier stages of its action it slows the pulse and increases the blood pressure by stimulating the inhibitory cardiac nerves, and probably also by stimulating the muscle fibres in the heart itself and in the walls of the arterioles.

Veratrine has been chiefly employed in *gout, rheumatism,* and *neuralgia,* and has also been praised in *epilepsy* and various other nervous diseases. Its remedial value is very doubtful, and in this country it is very rarely administered. One-thirtieth of a grain (0.002 Gm.) may be given in the form of pill, and repeated every three or four hours till the effects of the medicine are experienced. Some prefer the salts for internal use. Any one of these salts may be prepared by treating veratrine with water acidulated with the acid to perfect neutralization, and then carefully evaporating to dryness. It is employed to some extent as an alterative counter-irritant, locally applied in *chronic swellings, stiffening,* and *induration of the joints,* whether from *rheumatism,* from *scrofula,* or simply from *local injuries,* as *sprains.*

Veratrine may be used either dissolved in alcohol, or rubbed up with lard or other unctuous substance in the proportion of from five to twenty grains to the ounce. It is advisable that the alkaloid should be dissolved in a little alcohol or oleic acid before being mixed with the lard. Of the ointment thus prepared, a portion of the size of a filbert may be rubbed upon the skin over the part affected, night and morning, from five to fifteen minutes, or until the more urgent symptoms are relieved. Veratrine may be used in this way to the amount of from two to four grains in the day. Care must be taken to see that the cuticle to which the ointment is applied is sound. When the skin is irritable, smaller quantities than those above mentioned must be used.

Dose, one-thirtieth of a grain (0.002 Gm.).

Off. Prep.—Oleatum Veratrinæ, *U. S.;* Unguentum Veratrinæ, *U. S., Br.*

VERATRUM. U. S.

VERATRUM [Veratrum Viride, Pharm. 1890]

(vẹ-rā'trŭm)

"The dried rhizome and roots of *Veratrum viride* Aiton (American Hellebore) or *Veratrum album* Linné (White Hellebore) (Fam. *Liliaceæ*)." *U. S.*[1]

V. viride: Green Hellebore, American Hellebore, Big or False Hellebore, Swamp Hellebore, Indian Poke, Itch-weed, Tickle-weed, Bugbane; Vératre vert, *Fr.;* Grüner Germer, *G.;* Vedegambre verdo, *Sp.*

V. album: White Hellebore, White Veratrum, Lingwort, Sneezewort, Neezewort; Hellébore blanc, *Fr. Cod.;* Vératre blanc, *Fr.;* Rhizoma Veratri, *P. G.;* Weisse Nieswurzel, Weisser Germer, *G.;* Vedegambre blanco, *Sp.*

Veratrum viride, Aiton, *Hort. Kew.* (1789) 422; Willd., *Sp. Plant.* iv. 896; Bigelow, *Am. Med. Bot.,* ii. 121; *B. & T.* 286. *V. album,* Michaux, not *V. album,* Sereno Watson, which is *V. californicum,* Durand.—The American hellebore, known also by the names of *Indian poke, poke root,* and *swamp hellebore,* has a perennial, thick, fleshy rhizome, the upper portion of which is tunicated, the lower solid, and beset with numerous whitish roots. The stem is annual, round, striated, pubescent, and solid, from three to six feet in height, furnished with bright green leaves, and terminating in a panicle of greenish-yellow flowers. The leaves gradually decrease in size as they ascend. The lower are from six inches to a foot long, oval, acuminate, plaited, nerved, and pubescent, and embrace the stem at their base, thus affording it a sheath for a considerable portion of its length. Those on the upper part of the stem, at the origin of the flowering branches, are oblong-lanceolate. The panicle consists of numerous flowers, distributed in racemes with downy peduncles. Each flower is accompanied by a downy, pointed bract, much longer than its pedicel. The perianth consists of six oval acute segments, thickened on the inside at their base, with the three alternate segments longer

[1] The revisers of the U. S. P. (8th Rev.) seem to us to have made an error in recognizing the two veratrum rhizomes as one drug. That the two species are very closely allied, and the two rhizomes histologically, chemically, and toxicologically very similar is indisputable, but similarity is not identity. The European plant seems to be more actively poisonous than is the American, and has been said by some chemists to contain a larger proportion of the alkaloids. It usually also has a distinctly greater action upon the intestinal tract and it is probable that the proportionate amounts of the alkaloids differ in the two species. The conclusions reached in an elaborate physiological research made by H. C. Wood and H. C. Wood, Jr., for the Committee of Revision was that the drugs can scarcely be distinguished physiologically but that the European plant is more likely to disturb the intestines and that in the absence of any cogent reason for recognizing V. album, Veratrum viride should alone be retained.

than the others. The six stamens have recurved filaments and roundish two-lobed anthers. The ovary is ovoid, tri-carpellary; styles three and persistent. Some of the flowers have only the rudiments of pistils. Those on the upper end of the branchlets are barren, those below fruitful. The fruit is a three-lobed capsule, three-celled, and containing flat imbricated seeds. This indigenous species of veratrum inhabits swamps, wet meadows, and the banks of mountain streamlets. It is more abundant northward, but reaches as far south as Georgia. From May to July is the season for flowering. It is doubtful whether the root should be collected in autumn or just before flowering. It should not be kept longer than one year, as it deteriorates by time.

Veratrum album, L. *V. viride,* Roehl., but not *V. viride,* Aiton.—The specific difference between this plant, which is a native of Europe and Northern Asia, and *V. viride* of North America has been questioned by various botanists, but it is now generally acknowledged that the two species are distinct. (See *Index Kewensis;* also Engler and Prantl.) *V. album* resembles closely the American species, but is distinguished by its yellowish-white flowers. The rhizome of *V. nigrum* of Central Europe is said to be sometimes substituted for that of *V. album,* but is much smaller. According to the Pharmacographia, that of the Mexican species, *V. frigidum,* Schl., exactly resembles that of *V. album.*

Properties.—As found in commerce, veratrum is usually in small pieces or fragments, but sometimes it comes whole or sliced, so that its characteristic form may be observed. In this condition it is seen to consist of a rhizome one to three inches in length by somewhat less than an inch in thickness where broadest, tapering to a very obtuse or truncated extremity, simple or divided, compact but light, of a dark-brown color externally, and either closely invested with numerous yellow rootlets often several inches long, or exhibiting marks on the surface whence they have been removed. When sliced, the cut surface is of a dingy-white color. The rootlets are from three to six inches long, about as thick as a large knitting needle, or somewhat thicker, obviously much shrunk in drying, and marked by numerous closely set indentations, which give them a characteristic appearance. Not unfrequently portions of the dried stem or leaf-stalks remain attached to the rhizome, which should always be rejected, as they were ascertained by Procter to be inert. (*A. J. P.,* 1864, p. 99.)

Veratrum is officially described as follows: "Rhizome upright, ovoid or obconical, 2.5 to 7 Cm. long and 2 to 5 Cm. thick, externally light to dark brown or blackish, frequently bearing at the summit some coarsely fibrous remains of leaf bases; internally grayish- or yellowish-white, showing numerous short irregular wood-bundles. Roots emanating from all sides of the rhizome, numerous, shrivelled, whitish or light yellowish-brown, from 10 to 20 Cm. long, and 1 to 2 Mm. thick. Inodorous, but strongly sternutatory when powdered; taste bitterish and very acrid." *U. S.* The Committee of Revision of the U. S. Pharm. (8th Rev.) do not distinguish between the rhizomes of the two species of veratrum. It has been asserted that the color of *V. album* is much lighter than that of *V. viride,* but this certainly is practically incorrect, however it may apply to carefully preserved specimens. Very commonly the roots have been removed from commercial *V. album,* while in America they are generally allowed to remain on the rhizomes. According to R. H. Denniston, no microscopic differences can be detected in the rhizomes, but in the roots distinction is possible owing to the fact that directly beneath the epidermis in the *V. viride* the collenchyma region consists of but two or three veins of large, irregular and distorted cells, while in *V. album* this region is generally made up of seven to eight rounded, thicker-walled and smaller cells, which are not in the least distorted. Any such test is, of course, inapplicable to the drug in powder. In the color test proposed by R. H. Denniston, sulphuric acid is added to the powder; with *V. album* a brick-red color, with *V. viride* an orange-red color, will be produced. Of course the test is of little value in determining the character of a powder, as it does not possess sufficient differentiation.

Pelletier and Caventou, in 1819, found in the rhizome of *Veratrum album* a substance which they regarded as identical with the veratrine just announced by Meissner as contained in sabadilla seeds. Simon (*Ann. Ch. Ph.,* 24, p. 214), in 1837, found the alkaloid *jervine* also in *Veratrum album.* Worthington (*A. J. P.,* 1839, p. 89) found an alkaloid in *Veratrum viride* which he considered to be the veratrine then known from other sources. Richardson, in 1857, and Percy, in 1864, confirmed his results. Bullock (*A. J. P.,* 1865, p. 321) shortly after, found on examination of *Veratrum viride,* that while it contained at least two characteristic alkaloids, neither of these was veratrine. The alkaloids noted by Bullock were named in a former edition of this work *viridine* and *veratroidine.* Peugnet (*N. Y. M. R.,* 1872, p. 120), in 1872, showed the identity of the first of these with jervine, and this was confirmed by Mitchell (*A. J. P.,* 1874), who also made out a distinct alkaloid in *Veratrum album,* to which he applied the name of *veratralbine.* The veratroidine discovered by Bullock in *Veratrum viride* in 1865 was also found in *Veratrum album* by Tobien in 1877. In a paper published in the *A. J. P.,* April, 1876, Bullock expressed his doubt as to the existence of veratroidine as a distinct alkaloid, considering that it might have been only jervine admixed with resin. Here the matter rested until the elaborate researches of Wright and Luff (*J. Chem. S.,* 35, pp. 405, 421), who found in *Veratrum album, jervine,* $C_{26}H_{43}NO_2 + 2H_2O$, *rubijer-*

vine, $C_{26}H_{43}NO_2$, *pseudojervine,* $C_{29}H_{43}NO_7$, and *veratralbine,* $C_{28}H_{43}NO_5$(?), and also traces of an alkaloid having sternutatory power (possibly *cevadine*). In *Veratrum viride* they found jervine, pseudojervine, cevadine, very little rubijervine, and traces of veratrine and veratralbine. Of these, rubijervine probably agrees with Bullock's veratroidine, although as prepared by Bullock in his earlier experiments it was undoubtedly mixed with resin, as the fusing point given (270° to 275° F.) is much lower than that given by Wright and Luff for their pure crystals, which fused at 236° C. (456.8° F.). Pseudojervine forms crystals very similar to those of jervine, but it fuses at 299° C. (570.2° F.), instead of 231° to 237° C. (447.8° to 458.6° F.). Pehkschen (*A. J. P.,* 1891) finds *jervine* in both the Veratrum species. Obtained by recrystallization from absolute alcohol it forms snow-white crystals of the formula $C_{14}H_{22}NO_2$ (determined by the analysis of the base and of its hydrochloride and sulphate). It melts at 237.7° C., and is slightly lævogyre. He finds *veratroidine* (rubijervine of Wright and Luff), and gives it the formula $C_{32}H_{53}NO_9$ (determined both by analysis and by molecular weight determination). It melts at 149.2° C., and is optically inactive. He obtained, thirdly, an alkaloid in rhombic crystals, which is probably a purer form of Wright and Luff's *pseudojervine.* Its formula is $C_{29}H_{49}NO_{12}$. It melts at 259.1° C., and is optically inactive. No color reactions could be obtained with this base, but if the slightest quantity of veratroidine or jervine is added, color reactions agreeing with Wright and Luff's pseudojervine are obtained. A very small quantity of a fourth alkaloid (Wright and Luff's veratralbine) was obtained, but not enough to allow of present investigation. Salzberger (*A. J. P.,* 1891) obtained the three bases *jervine, rubijervine,* and *pseudojervine,* and two new ones *protoveratrine* [1] and *protoveratridine,* from the rhizome of *Veratrum album;* the first of these two bases has the formula $C_{32}H_{51}NO_{11}$, and crystallizes in microscopic four-sided plates, which melt with charring at 245° to 250° C. The base is exceedingly poisonous and violently sternutatory. It is insoluble in water, benzene, and petroleum benzin, slightly soluble in chloroform, boiling 96 per cent. alcohol, and ether. Dilute acids, with the exception of acetic acid, dissolve it. *Protoveratridine,* $C_{26}H_{45}NO_8$, occurs as colorless four-sided plates, which melt at 265° C. It is not poisonous, and does not cause sneezing. It is almost insoluble in the common solvents, but is soluble in dilute acids. Worthington pointed out the presence of gallic acid and sugar in *Veratrum viride.*

[1] According to the experiments of Watts Eden (*A. E. P. P.,* xxix.), protoveratrine is in mammals twenty times more poisonous than crystallized veratrine, paralyzing the vagus, affecting the muscles, at first increasing but soon markedly depressing their excitability and power, and causing death by a centric disturbance of respiration. The alkaloid also affects the heart, and is a powerful local anæsthetic.

Uses.—When taken in small doses by man, veratrum first reduces the force without much lessening the frequency of the pulse, but after a time the pulse rate falls very much. If any exertion be made during this stage of depression, the slow pulse will be suddenly converted into an exceedingly rapid one. The slow pulse is sometimes moderately full, but is always very soft and compressible; the rapid pulse is exceedingly feeble and small, often thready, and may become imperceptible. Severe nausea and vomiting accompany or follow the reduction of the pulse rate. That the latter is not due to gastric disturbance is, however, shown by the fact that it often precedes the stomachic symptoms, and may exist without them. During the stage of depression there is always a decided muscular weakness and relaxation. After a poisonous dose the symptoms above noted are increased in intensity and become very alarming. A running, almost imperceptible pulse, a cold, clammy skin, intense nausea and incessant attempts at vomiting, or retching, or hiccough, absolute muscular prostration, faintness, vertigo, loss of vision, and semi-unconsciousness, make up the group of extreme symptoms. For full details as to the method in which these symptoms are produced, the reader is referred to H. C. Wood's *Treatise on Therapeutics;* the allotted space here will allow us only to state that veratrum viride is a powerful spinal and arterial depressant, exerting little or no direct influence upon the cerebral centres; it lowers the pulse rate by a direct action on the muscle (jervine) and by stimulating the inhibitory nerves (rubijervine); it diminishes the force of the heart beat by a direct influence on the cardiac muscle (jervine), and produces a general vasomotor paralysis (jervine) more or less complete according to the size of the dose. By the action especially of the jervine the spinal motor centres are directly depressed. Neither the sensory centres nor the motor or sensory nerves are distinctly affected. Veratrum viride is used in practical medicine to reduce *arterial excitement* and to quiet *spinal spasms.* In *adynamic fevers* it should never be administered, but in the first stage of *frank pneumonia,* or in any disease when true sthenic arterial excitement is to be combated, except it be in *gastritis* or *peritonitis,* it may be employed as a prompt, efficient, and very safe remedy,—very safe, since it is almost incapable of producing death in the robust adult unless used with great recklessness and in repeated doses. In chronic *cardiac diseases* it may be employed in precisely those cases in which digitalis is contra-indicated—*i.e.,* where there is excessive hypertrophy.

In poisoning, vomiting should be encouraged by large draughts of warm water until the stomach is well washed out. Then the patient should be forced to lie flat upon the back, with the head lower than the feet, and the efforts at vomiting should be restrained. If they cannot be checked, and if the prostration be severe,

on no account should the patient be allowed to rise up, but must be made to vomit into a towel. A full dose of tincture of opium should be given by the rectum, and brandy or whisky administered by the mouth. These will sometimes be retained only when given undiluted, and in such form they will often quiet the stomach at once. If the stomach refuse alcohol in any shape, the rectum should be utilized. Ammonia may be employed as an adjuvant to alcohol, and in extreme cases should be injected hypodermically, or even into a vein. Strychnine and digitalis should in all severe cases be used hypodermically. The use of external heat is important, and mild flagellations, rubbing with coarse towels, sinapisms, etc., may be used to keep up the external capillary circulation. The drug should always be administered in the form of the *fluidextract,* dose, one to three minims (0.05 to 0.15 Cc.); or of the *tincture* (U. S. P., 8th Rev.), dose, fifteen minims (1 Cc.), to be given every hour or two, and closely watched. The occurrence of nausea should be the signal for the suspension of the remedy.

Whenever a full physiological effect of the drug is desired, the practitioner should order, and if possible obtain, *Veratrum viride, not veratrum,* and thereby avoid probability of untoward effects and also personal responsibility.

Dose, two grains (0.13 Gm.).

Off. Prep.—Fluidextractum Veratri, *U. S.;* Tinctura Veratri, *U. S.*

VIBURNUM OPULUS. U. S.

VIBURNUM OPULUS [Cramp-bark]

(vī-bŭr'nŭm ŏp'ū-lŭs)

"The dried bark of *Viburnum Opulus* Linné (Fam. *Caprifoliaceæ*)." *U. S.*

Wild Guelder-rose, Cherry-wood, Red or Rose Elder, Pincushion Tree, Squaw Bush; in cultivation Snowball Bush; Obier, *Fr.;* Wasserholderrinde, Wasserschwelke, *G.*

Besides the official species of this genus, the *V. obovatum,* Walt., a tree shrub growing from Virginia southward, which is botanically very closely allied to *V. prunifolium,* is said to be an antiperiodic. (*A. J. P.,* 1878.) *V. lantana,* L., (*V. trilobum,* Marsh), a European species, probably shares the therapeutic properties of the official species. *Viburnum Opulus, cranberry-tree* or *high bush cranberry,* belongs to the section of the genus which has peduncled cymes, light red, acid, roundish drupes, with very flat orbicular not sulcate stones, palmately veined leaves, and scaly winter buds. It is a large bush, reaching the height of ten feet, growing in low grounds from New Brunswick far westward, and southward to Pennsylvania. The leaves are from three- to five-ribbed, strongly three-lobed, broadly wedge-shaped or truncate at the base, with the spreading pointed lobes mostly toothed in the sides and entire in the sinuses. The petioles bear two glands at the apex. The *snow-ball tree,* or *Guelder rose,* is a variety in which the whole inflorescence has been turned into a mass of showy sterile flowers.

Properties.—The bark is officially described as "in somewhat transversely curved pieces, occasionally in quills, of variable length, and 0.5 to 2 Mm. thick; outer surface grayish-brown, longitudinally wrinkled, with large brown lenticels and brownish-black fruit-heads of a lichen; inner surface light brown, longitudinally striate; fracture uneven, fibrous; transverse sections showing several bands of bast fibres; odor slight; taste somewhat astringent and bitter." *U. S.* For studies of Viburnum barks, see *A. J. P.,* 1895, 387, 394; also *Ph. Post,* 35, 773. Gibson (*Proc. Indiana Pharm. Assoc.,* 1900, 112) believes that there is a glucoside present in the bark of *V. Opulus;* he describes it as resinous, greenish in color, soluble in alcohol, slightly soluble in water.

Uses.—This bark has been so little employed in medicine that we are at a loss to understand the reason of its introduction into the Pharmacopœia. Its berries are used domestically to a considerable extent as a substitute for the ordinary cranberry, and are antiscorbutic. It may be that the bark shares the medicinal properties of *V. prunifolium,* but this has not been demonstrated.

Dose, thirty to sixty grains (2.0 to 3.9 Gm.).

Off. Prep.—Fluidextractum Viburni Opuli, *U. S.*

VIBURNUM PRUNIFOLIUM. U. S. (Br. Add.)

VIBURNUM PRUNIFOLIUM [Black Haw]

(vī-bŭr'nŭm prū-nį-fō'lī-ŭm)

"The dried bark of the root of *Viburnum prunifolium* Linné, or of *Viburnum Lentago* Linné (Fam. *Caprifoliaceæ*)." *U. S.*

Viburnum, *Br. Add.;* also *U. S.* 1880; Stagbush, Sheep-berry.

Viburnum prunifolium, L.—A tall, very handsome shrub, which is quite common in the Middle and Southern United States, east of the Mississippi, flowering in May and ripening in the early autumn its ovoid or oblong blackish fruit. It is specifically characterized by its acuminate, glabrous winter buds, by its acuminate, sharply serrulate, ovate leaves on long, slender, sometimes broadened and wavy margined petioles. Its sessile cymes are 2 to 5 inches broad and bear oval bluish-black drupes.

Viburnum Lentago, L., *Sheep Berry, Sweet Viburnum,* resembles the previous species, but has the winter buds smaller, less acute and often reddish pubescent, and its leaves stouter petioled and not acuminate at the apex. Its geographical limit overlaps that of *V. prunifolium,* but extends much further westward

and northward, even to Manitoba. The bark of *V. dentatum,* L., or *Arrow wood,* is said to be sometimes substituted for the official drug.

Properties.—The bark is officially described as "in irregular or quilled pieces, rarely exceeding 4 Mm. thick; externally dingy brown, shallowly fissured and slightly scaly; inner surface rust-brown; fracture weak, short, and uneven, the inner layer whitish, the middle rust-brown, the outer dark brown; groups of stone cells readily distinguishable in transverse section; odor slight, peculiar; taste very bitter, somewhat astringent." *U. S.* (For microscopic characters of bark see *P. J.*, 70, p. 197.) Herman van Allen found the following constituents in viburnum: 1, a brown resinous body, of a very bitter taste, from which it was found impossible to separate the sugar; 2, a greenish-yellow resin or neutral principle of a bitter taste, slightly soluble in water, freely so in alcohol, called by Krämer *viburnin;* 3, valeric acid; 4, a tannic acid giving a greenish-black color with ferric salts; 5, oxalic acid; 6, citric acid; 7, malic acid; 8, sulphates; 9, calcium, magnesium, potassium, and iron chlorides. (*A. J. P.*, 1880, 443.) As the result of elaborate investigation, T. Shennan (*Royal Coll. Phys. Lab. Rep.,* Edinburgh, vi. 1897) concludes that the *Viburnum prunifolium* contains *viburnic—i.e.,* valeric—acid, and a non-volatile alkaloid which, however, he failed to obtain in a pure condition.

Uses.—D. L. Phares, who first called the attention of the profession to this drug, affirms that it is nervine, antispasmodic, astringent, diuretic, and tonic, and is especially useful in the *nervous diseases of pregnancy* and in the prevention of *miscarriage.* R. L. Payne, Jr., has found that when given in toxic amount to the lower animals viburnum produces muscular weakness, ending in complete paralysis with loss of reflex action, which he believes to be due to an influence upon the motor side of the spinal cord. In warm blooded animals there is also marked lowering of the arterial pressure, believed by Payne to be the result of a direct action of the drug upon the heart. The experiments of Payne have in a measure been confirmed by those of T. Shennan, who finds that large amounts of the drug injected directly into the veins of a warm blooded animal lower blood pressure, while in the frog the extract produces distinct depression of the voluntary muscles and also of the heart. As Shennan took six drachms of the fluidextract within thirty minutes, with no demonstrable effect except a doubtful decrease of the rate and force of the pulse, it is plain that the drug is very feeble. It has, however, come into some vogue as a remedy in the treatment of *dysmenorrhœa, after-pains,* and *ovarian irritation;* it has also received especial commendation in those cases in which there is a persistent disposition to *miscarriage.* In *menorrhagia* it may be given in full doses several days before the coming on and during the continuance of the menstrual hemorrhage. The solid extract (*dose,* from three to ten grains) does not represent the drug completely, owing to loss of volatile acid; so that the fluidextract should be preferred, in doses of from one-half to one fluidrachm (1.8 to 3.75 Cc.).

Dose, thirty to sixty grains (2.0 to 3.9 Gm.).

Off. Prep.—Fluidextractum Viburni Prunifolii, *U. S.*

VINA MEDICATA.

MEDICATED WINES

(vī'nạ mĕd-ĭ-cā'tạ)

Vins médicinaux, Œnolés, *Fr.;* **Medicinische Weine,** *G.*

The advantages of wine as a pharmaceutical menstruum are that, in consequence of the alcohol it contains, it dissolves substances insoluble in water, and, to a certain extent, resists their tendency to spontaneous change, while at the same time it is less stimulating than strong or diluted alcohol, owing to its smaller proportion of alcohol. The acid which it usually contains serves in some instances to increase its solvent power. But most wines, particularly the light varieties, are liable to undergo decomposition, and even the strongest acquire such a liability from the principles which they extract from vegetable substances; so that medicated wines, though they keep much better than infusions or decoctions, are inferior in this respect to the tinctures. The proportion of alcohol, moreover, is not constant, and the preparations, therefore, made with them were formerly of unequal strength. From these causes, few medicated wines are at present retained. In the choice of wine, the purest and most generous should be selected. The medicated wines, in consequence of their liability to change, should be prepared in small quantities, from wine of proper strength, and should be kept in a cool place. *Detannated wine* may be made by carefully adding tincture of ferric chloride to the wine, a little at a time, until a further addition does not produce a dark color, then pouring about 6 fl. oz. of fresh milk into each gallon of the wine, shaking the mixture well, allowing to stand a little while and filtering (*M. R.,* 1904, 40).

In the U. S. P. (8th Rev.) one medicated wine was admitted—Vinum Cocæ, and one was dismissed—Vinum Colchici Radicis.

VINUM ALBUM. U. S. (Br.)

WHITE WINE

(vī'nŭm ăl'bŭm)

Vinum Xericum, *Br.;* Spanish wine; Vinum Generosum Album; Vin blanc, *Fr.;* Weisswein, *G.;* Vino blanco, *Sp.*

"An alcoholic liquid, made by fermenting the juice of fresh grapes, the fruit of *Vitis vinif-*

era Linné (Fam. *Vitaceæ*), freed from seeds, stems, and skins, and subjected to the usual cellar-treatment for fining and aging. When White Wine is prescribed without further specification, it is recommended that a dry White Wine of domestic production be employed. White Wine should be preserved in well-closed casks filled as full as possible, or in well-stoppered bottles, in a cool place." *U. S.* "A Spanish wine." *Br.* (See *Vinum Rubrum*, page 1339.)

VINUM ANTIMONII. U. S. (Br.)

WINE OF ANTIMONY

(vī'nŭm ăn-tĭ-mō'nĭ-ī)

Vinum Antimoniale, *Br.;* Antimonial Wine; Vin antimonié, Vin émétique, Vin stibié, *Fr.;* Vinum Stibiatum, *P. G.;* Brechwein, *G.;* Vino emetico, *Sp.*

* "Antimony and Potassium Tartrate, *four grammes* [or 62 grains]; Boiling Distilled Water, *sixty-five cubic centimeters* [or 2 fluidounces, 95 minims]; Alcohol, *one hundred and seventy-five cubic centimeters* [or 5 fluidounces, 440 minims]; White Wine, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Antimony and Potassium Tartrate in the Boiling Distilled Water. Add this solution to a mixture of the Alcohol with *seven hundred and twenty-five cubic centimeters* [or 24 fluidounces, 247 minims] of White Wine; mix well, and allow the mixture to stand until it has cooled. Then filter and add sufficient White Wine through the filter to make the liquid measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

"Tartarated Antimony, 40 *grains* or 4 grammes; Distilled Water, boiling, 1 *fl. ounce* (Imperial measure) or 44 cubic centimetres; Sherry, *a sufficient quantity.* Dissolve the Tartarated Antimony in the Distilled Water; mix the solution with sufficient Sherry to form *one pint* (Imp. meas.) or eight hundred and seventy-five cubic centimetres of Antimonial Wine." *Br.*

The Br. Ph. 1898 formula contains 2 grains of tartar emetic in the fluidounce, the U. S. preparation (8th Rev.) directs less of the antimonial salt, as it contains about 1.8 grains in a fluidounce.

Considerable difficulty is often experienced in effecting a solution of tartar emetic in wine, and precipitation is likely to occur after the solution has been effected. These results are attributable either to impurity in the antimonial salt, which frequently contains potassium bitartrate and various insoluble substances, or to inferiority in the character of the wine, which holds in solution vegetable principles that form insoluble compounds with the antimony. Paris stated that he had seen the decomposition of the tartar emetic so complete that no traces of the salt could be detected in the supernatant liquid. The difficulty is not avoided by the plan adopted in the U. S. Pharmacopœia of first dissolving the antimonial in water and then adding the wine; for, even allowing that the solution may be accomplished, the same ingredients are present, and their mutual reaction must ultimately result in the same effects. The proper course is to select perfectly pure crystallized tartar emetic, and sound wine, which make a permanent solution. To obviate the risk of decomposition, the Dublin College directed water and rectified spirit in about the proportion in which these exist in the wines just mentioned. The only objection to this menstruum is the want of color, which renders the preparation liable to be confounded with less active liquids.

The advantages of antimonial wine are that it affords the means of administering minute doses of tartar emetic, and that it is more permanent than an aqueous solution of that salt, which is liable to spontaneous decomposition. It is usually administered in small doses as a diaphoretic or an expectorant, or as an emetic in infantile cases. When a considerable quantity of tartar emetic is requisite, it should always be given in extemporaneous aqueous solution.

Dose, as an expectorant or a diaphoretic, from ten to thirty minims (0.6 to 1.8 Cc.), given frequently; as an emetic for children, from thirty minims to a fluidrachm (1.8 to 3.75 Cc.), repeated every fifteen minutes till it operates.

Off. Prep.—Mistura Glycyrrhizæ Composita, *U. S.*

VINUM AURANTII. Br.

ORANGE WINE

(vī'nŭm âu-răn'tĭ-ī)

Vin de Ecorce d'orange amère, *Fr.;* Pomeranzenwein, *G.*

"Wine made by the fermentation of a saccharine solution to which Fresh Bitter-Orange Peel has been added." *Br.*

This is officially described as "a vinous liquid, having a golden sherry color, and a taste and aroma derived from the Bitter-Orange Peel. It contains 10 to 12 per cent. by volume of ethyl hydroxide. It is but slightly acid to *litmus-paper.* When a mixture of 50 cubic centimetres of this Wine and 50 cubic centimetres of *water,* acidulated with 5 cubic centimetres of the *volumetric solution of sulphuric acid,* is distilled, the distillate, after the rejection of the first 10 cubic centimetres, shaken with *ether,* and the ethereal liquid separated and its ether removed by evaporation, the residue should not yield a violet coloration when mixed with *test-solution of ferric chloride* (absence of salicylic acid). It should yield not more than the slightest reactions with the tests for sulphites." *Br.*

This wine is used as a vehicle, and when the feeble tonic action of orange peel is desired.

Off. Prep.—Vinum Ferri Citratis, *Br.;* Vinum Quininæ, *Br.*

VINUM COCÆ. U. S.

WINE OF COCA

(vī'nŭm cō'cæ)

Vinum Erythroxyli; Vin de Coca, *Fr. Cod.;* Œnolé de Coca, *Fr.;* Cocawein, *G.;* Vino de coca del Peru, *Sp.*

* "Fluidextract of Coca, *sixty-five cubic centimeters* [or 2 fluidounces, 95 minims]; Alcohol, *seventy-five cubic centimeters* [or 2 fluidounces, 257 minims]; Sugar, *sixty-five grammes* [or 2 ounces av., 128 grains]; Red Wine, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Sugar in *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of Red Wine, add the Alcohol and Fluidextract of Coca, and enough Red Wine to make the liquid measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Set the mixture aside for two days; then filter through paper, in a well-covered funnel." *U. S.* This wine was introduced into the U. S. P. (8th Rev.) for the first time; it may be necessary to allow the liquid to stand longer than two days if subsequent filtration is to be avoided.

Uses.—This is used as a stimulating tonic in cases of *debility,* especially in the convalescence from acute fevers. It must, however, be employed with caution, as there is grave danger of the formation of a habit.

Dose, two to eight fluidrachms (7.5 to 30 Cc.).

VINUM COLCHICI. Br.

COLCHICUM WINE

(vī'nŭm cŏl'çhĭ-cī)

Vinum Colchici Radicis; Wine of Colchicum Root; Vin de Bulbe de Colchique, *Fr. Cod.;* Œnolé de Bulbe de Colchique; Zeitlosenknollenwein, *G.;* Vino con colchico, *It.*

"Colchicum Corm, in No. 20 powder, 4 *ounces* (Imperial) or 200 grammes; Sherry, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Macerate as directed for tinctures." *Br.*

Wine of colchicum root was not admitted to the U. S. P. (8th Rev.) because of the variable quality of colchicum root as found in the market and the superiority of the seeds in uniformity (see *Vinum Colchici Seminis*); the process of the U. S. P. 1890 is appended.[1]

The British 1898 colchicum wine is only half the strength of the U. S. 1890 preparation. The latter was intended to be a saturated vinous tincture of colchicum. As the colchicum bulb imported into the United States is of variable strength, the only method by which an active preparation can be insured is to employ a large quantity of it in proportion to that of the menstruum, but with even this method there is uncertainty in the strength of the resulting wine. A wine made from the fresh bulb is occasionally imported from England, and is thought by some to be more efficacious than the official preparation, but we have seldom been disappointed in obtaining the effects of colchicum from the wine prepared according to the directions of the U. S. P. 1890. In *gout* it is frequently given in connection with magnesia and its sulphate. It is a violent poison in overdoses. Two fluidrachms and a half (9.3 Cc.) of it are said to have caused death.

Dose, ten to forty minims (0.6 to 2.5 Cc.).

[1] *Vinum Colchici Radicis.* U. S. 1890. *Wine of Colchicum Root.*—"Colchicum Root, in No. 30 powder, *four hundred grammes* [or 14 ounces av., 48 grains]; Alcohol, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; White Wine, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Alcohol with *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of White Wine. Moisten the powder with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of the menstruum, pack it moderately in a conical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and afterwards enough White Wine to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

VINUM COLCHICI SEMINIS. U. S.

WINE OF COLCHICUM SEED

(vī'nŭm cŏl'çhĭ-cī sĕm'ĭ-nĭs)

Vin de Semence de Colchique, *Fr.;* Vinum Colchici, *P. G.;* Zeitlosenwein, Zeitlosensamenwein, *G.*

* "Fluidextract of Colchicum Seed, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims]; White Wine, *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them. Set the mixture aside for two days; then filter through paper, in a well-covered funnel." *U. S.*

As the seeds of colchicum are less liable to injury than the bulb, and are, therefore, of more uniform strength, there is not the same necessity for preparing a wine of the root. The wine of the U. S. P. (8th Rev.) is made from the assayed fluidextract and is of 10 per cent. strength instead of 15 per cent., as in the U. S. P. 1890. Williams, who introduced the seeds into use, supposed that their active properties resided in their coating, and that it was, therefore, not advisable to bruise them in preparing the wine or tincture. But this view was contradicted by the experiments of Bonnewyn, who asserted that he found a larger proportion of colchicine in a tincture of the bruised than in a tincture of the unbruised seeds. (See *A. J. P.,* xxvi. 120.) L. I. Morris has shown, however, that by *digesting* instead of macerating the whole seeds the colchicine can be all extracted. (See *Tinctura Colchici.*) In order that the seeds may be properly comminuted, Maisch recommended that they be macerated for two or three days in a portion of the wine, before being bruised. (*Ibid.,* xxviii. 514.) It is stated that sometimes this tincture becomes turbid from the development of the yeast fungus in it. (Vulpius, *A. J. P.,* xliv. 212.) Two fluidounces (60 Cc.) have proved fatal.

Dose, thirty minims to two fluidrachms (1.8 to 7.5 Cc.).

VINUM ERGOTÆ. U. S.

WINE OF ERGOT

(vī'nŭm ĕr'gŏ-tæ)

Vin (Œnolé) de Seigle Ergoté, *Fr.;* **Mutterkornwein,** *G.*

* "Fluidextract of Ergot, *two hundred cubic centimeters* [or 6 fluidounces, 366 minims]; Alcohol, *fifty cubic centimeters* [or 1 fluidounce, 331 minims]; White Wine, *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them. Set the mixture aside for two days; then filter through paper, in a well-covered funnel." *U. S.*

This wine is now made from the fluidextract, and, although the proportional strength is greater than that of the U. S. P. 1890 (20 per cent. of fluidextract in the U. S. P. (8th Rev.) to 15 per cent. of ergot in the U. S. P. 1890), the probabilities are, that as ergot is not among the assayed drugs, the two preparations will be about equal in strength as found in commerce.

Dose, of this wine, for a woman *in labor,* from two to four fluidrachms (7.5 to 15 Cc.); for other purposes, from one to two fluidrachms (3.75 to 7.5 Cc.), to be repeated several times a day, and gradually increased if necessary.

VINUM FERRI. U. S. (Br.)

WINE OF IRON

[Vinum Ferri Citratis, Pharm. 1890, Wine of Ferric Citrate]

(vī'nŭm fĕr'rī)

Vinum Ferri Citratis, Vinum Chalybeatum, *Br.;* Wine of Iron Citrate; Vin Chalybé, Œnolé ferrugineux, Vin ferrugineux, *Fr. Cod.;* Eisenwein, *G.*

* "Iron and Ammonium Citrate, *forty grammes* [or 1 ounce av., 334 grains]; Tincture of Sweet Orange Peel, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Syrup, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; White Wine, *a sufficient quantity,* to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Iron and Ammonium Citrate in *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims] of White Wine. Add to this the Tincture of Sweet Orange Peel, and the Syrup, and, lastly, enough White Wine to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Set the mixture aside for two days; then filter through paper, in a well-covered funnel." *U. S.*

"Iron and Ammonium Citrate, 160 *grains* or 18.3 grammes; Orange Wine, *a sufficient quantity.* Dissolve the Iron and Ammonium Citrate in sufficient Orange Wine to form *one pint* (Imperial measure) or one thousand cubic centimetres. Agitate occasionally for three days; filter." *Br.*

Care must be observed not to confound this preparation with the "*Vinum Ferri*" of the British Pharmacopœia (see next article), which is a very different preparation. The name "Vinum Ferri" was adopted by the U. S. P. (8th Rev.) for the "Vinum Ferri Citratis" of the U. S. P. 1890.

This chalybeate preparation was made official by the U. S. P. 1880; previous to that time it had varied much in composition, from the lack of an authoritative formula.

Dose, one fluidrachm (3.75 Cc.), containing about two and a quarter grains of the iron salt; of the British wine of iron citrate, one to four fluidrachms (3.75 to 15 Cc.).

VINUM FERRI. Br.

IRON WINE

(vī'nŭm fĕr'rī)

Vinum Chalybeatum, s. Martiatum; Eisenwein, Stahlwein, *G.*

"Iron, in wire, 1 *ounce* (Imperial) or 50 grammes; Sherry, 1 *pint* (Imp. meas.) or 1000 cubic centimetres. Set aside for thirty days in a closed vessel, the Iron wire being almost, but not quite, immersed in the Sherry, the vessel being frequently shaken, and the stopper occasionally removed; filter." *Br.* (See also *Vinum Ferri* above.)

When wine is made to react on metallic iron with presence of air, the metal is oxidized, and then unites with the excess of acid of the potassium bitartrate, which is the characteristic salt of wines. The ferruginous salt, therefore, formed is iron and potassium tartrate, or the tartarated iron of the Br. Pharmacopœia, and this was the old method of preparing the Wine of Iron. But it is obvious that the strength in iron cannot be entirely uniform, as the quantity dissolved must depend on the proportion of the bitartrate in the wine, which is variable, and on various circumstances of the manipulation. In consideration of these objections, it was thought best, in the Br. formula of 1864, to substitute a simple solution in the wine of the iron and potassium tartrate already formed, and to abandon the old tedious formula. But it is obvious that a solution of the ferruginous salt in wine is not exactly the same as the wine of iron prepared with the metal, as it contains the potassium bitartrate unaltered. For this and other reasons, the Br. Pharmacopœia has returned to the old method.

Dose, one to four fluidrachms (3.75 to 15 Cc.).

VINUM FERRI AMARUM. U. S.

BITTER WINE OF IRON

(vī'nŭm fĕr'rī ą-mā'rŭm)

Vinum Chinæ Ferratum; Vin (Œnolé) de Quinquina ferrugineux, *Fr. Cod.;* **Bitter Eisenwein, Chinaeisenwein,** *G.*

* "Soluble Iron and Quinine Citrate, *fifty grammes* [or 1 ounce av., 334 grains]; Tincture

of Sweet Orange Peel, *sixty cubic centimeters* [or 2 fluidounces, 14 minims]; Syrup, *three hundred cubic centimeters* [or 10 fluidounces, 69 minims]; White Wine, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Dissolve the Soluble Iron and Quinine Citrate in *five hundred cubic centimeters* [or 16 fluidounces, 435 minims] of White Wine. Add to this the Tincture of Sweet Orange Peel and the Syrup, and, lastly, enough White Wine to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Set the mixture aside for two days; then filter through paper, in a well-covered funnel." *U. S.*

Bitter wine of iron, made official in the U. S. P. 1880, has been very largely used in this country, although the objections to the introduction of elixirs into the Pharmacopœia might be made with equal force to its acceptance. It is a mild ferruginous tonic, a fluidounce representing twenty-two grains of iron and quinine citrate of official strength.[1]

Dose, from two to four fluidrachms (7.5 to 15 Cc.).

VINUM IPECACUANHÆ. U. S., Br.

WINE OF IPECAC

(vī'nŭm ĭp-ē-căc-ū-ăn'hæ)

Ipecacuanha Wine; Vin (Œnolé) d'Ipécacuanha, *Fr.;* Brechwurzelwein, *G.*

* " Fluidextract of Ipecac, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; White Wine, *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims], to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix them. Set the mixture aside for two days; then filter through paper, in a well-covered funnel." *U. S.*

" Liquid Extract of Ipecacuanha, 1 *fl. ounce* (Imperial measure) or 50 cubic centimetres; Sherry, 19 *fl. ounces* (Imp. meas.) or 950 cubic centimetres. Mix; set aside for forty-eight hours; filter." *Br.*

The preparations of the two Pharmacopœias are not of the same strength,—the U. S. wine containing in a fluidounce the virtue of about 45 grains, the British of only somewhat more than 22 grains. Wine of ipecac possesses all the medicinal properties of the root, and may be used as a substitute when it is desirable to administer the medicine in a liquid form. As it is milder, without being less efficacious, than antimonial wine, it is preferable as an emetic. It is also much used as an expectorant and a diaphoretic, and the effects of the Dover's powder may be obtained by combining it with a liquid preparation of opium.

Dose, as an emetic for an adult, a fluidounce (30 Cc.); as an expectorant and a diaphoretic, from ten to thirty minims (0.6 to 1.8 Cc.). A fluidrachm (3.75 Cc.) may be given as an emetic to a child one or two years old, and repeated every fifteen minutes until it operates.

VINUM OPII. U. S.

WINE OF OPIUM [Sydenham's Laudanum]

(vī'nŭm ō'pī-ī)

Laudanum de Sydenham, Vin d'Opium composé, *Fr. Cod.;* Tinctura Opii Crocata, *P. G.;* Safranhaltige Opiumtinktur, *G.;* Vino oppiato composto, *It.;* Vino de opio compuesto, *Sp.*

* " Granulated Opium, *one hundred grammes* [or 3 ounces av., 231 grains]; Saigon Cinnamon, in No. 60 powder, *ten grammes* [or 154 grains]; Cloves, in No. 30 powder, *ten grammes* [or 154 grains]; Alcohol, White Wine, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *one hundred and fifty cubic centimeters* [or 5 fluidounces, 35 minims] of Alcohol and *eight hundred and fifty cubic centimeters* [or 28 fluidounces, 356 minims] of White Wine. Macerate the Opium, Saigon Cinnamon, and Cloves in a stoppered container, in a moderately warm place, with *seven hundred and fifty cubic centimeters* [or 25 fluidounces, 173 minims] of this menstruum, during seven days, with occasional agitation; then filter through purified cotton, in a well-covered funnel, returning the first portions until the filtrate passes perfectly clear, and finally pass enough menstruum through the residue to make the liquid measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.*

Wine of opium now contains the virtues of one grain of granulated opium in about 10 minims. The British wine of opium (1885) contained 22 grains of extract of opium, nearly, in 1 fluidounce, so that each fluidrachm contained about half a grain of morphine.

The wine made according to the directions of the U. S. P. (8th Rev.) is a vinous tincture of opium and no assay process is appended because the presence of the aromatics interferes with the accurate extraction of the morphine. The aromatic additions are thought to adapt it to certain states of the stomach or system in which laudanum is found to produce unpleasant effects. On being long kept it deposits insoluble

[1] *Bitter Wine of Iron.*—The following formula, in which Calisaya bark and gentian are used, is said by Chas. L. Mitchell to yield an elegant preparation: Take of ground Calisaya Bark 192 grains; ground Gentian Root 128 grains; Soluble Ferric Citrate 192 grains; Sherry Wine 13 fluidounces; Brandy 1 fluidounce; Alcohol 1 fluidounce; Oil of Orange 12 minims; Sugar 2 ounces; Solution of Iron Tersulphate 2 fluidounces; Ammonia Water q. s. Dissolve the Oil in the Alcohol and mix with the Sherry Wine and Brandy. Percolate with this the ground drugs, recover 15 fluidounces of tincture by pouring on water. Dilute the iron solution with twice its bulk of water, and add Ammonia in slight excess. Wash and drain the precipitate thoroughly. Mix this with the tincture, and agitate occasionally until a filtered portion has a light yellow color and does not precipitate with tincture of Ferric Chloride. Filter, dissolve the Ferric Citrate and Sugar, and bring up the measure with a little water to 16 fluidounces; a fluidounce represents 12 grains of Calisaya Bark, 8 grains of Gentian Root, and 12 grains of Ferric Citrate. Dose, from one to three fluidrachms (3.75 to 11.25 Cc.).

matter, a sample of which Bihot of Malines, has shown to consist mainly of narcotine, with possibly a little codeine, without any discoverable trace of morphine. (*J. P. C.*, xxx. 200.) Ware recommended it as a local application to the eye in the latter stages of *ophthalmia*, when the vessels of the conjunctiva still remain turgid with blood. Two or three drops are introduced into the eye every morning until the redness disappears.

Dose, of wine of opium, five to ten minims (0.3 to 0.6 Cc.).[1]

VINUM QUININÆ. Br.

QUININE WINE

(vī'nŭm quĭ-nī'næ)

Vin (Œnolé) de Quinine, *Fr.*; Chininwein, *G.*

"Quinine Hydrochloride, 20 *grains* or 2 grammes; Orange Wine, 1 *pint* (Imperial measure) or 875 cubic centimetres. Dissolve; set aside; filter if necessary." *Br.* The Br. Ph. 1898 replaced quinine sulphate used in the 1885 process by quinine hydrochloride on account of the greater solubility of the latter. Each fluidounce contains one grain of quinine hydrochloride.

Dose, one-half to one fluidounce (15 to 30 Cc.).

VINUM RUBRUM. U. S.

RED WINE

(vī'nŭm rŭ'brŭm)

"An alcoholic liquid, made by fermenting the juice of fresh red-colored grapes, the fruit of *Vitis vinifera* Linné (Fam. *Vitaceæ*), in presence of their skins, and subjected to the usual cellar-treatment for fining and aging. When Red Wine is prescribed without further specification, it is recommended that a dry Red Wine of domestic production be employed. Red Wine should be preserved in well-closed casks filled as full as possible, or in well-stoppered bottles, in a cool place." *U. S.*

Vin rouge, *Fr.*; Rothwein, *G.*; Vino tinto, *Sp.*

Wine is the fermented juice of the grape, the fruit of *Vitis vinifera* of botanists. The juice of sweet grapes consists of a considerable quantity of grape sugar, certain nitrogenized principles, which act as ferments when the proper conditions are developed, and a small portion of extractive, tannic acid, potassium bitartrate, calcium tartrate, common salt, and potassium sulphate, the whole dissolved or suspended in a large quantity of water. Sour grapes contain, in addition, a peculiar acid isomeric with tartaric, called *racemic acid*. (See page 85.) Grape juice, therefore, embraces all the ingredients essential to the production of the vinous fermentation, and requires only the influence of the atmosphere and a proper temperature to convert it into wine.

Owing to the growing excellence in quality of American wines, the Committee of Revision of the U. S. P. 1880 decided to abandon the former titles *Vinum Xericum* and *Vinum Portense*, to adopt the old titles *Vinum Album* and *Vinum Rubrum*, and to permit any wine to be used, whether American or foreign, provided it complies with the requirements of alcoholic strength and purity. The British Pharmacopœia 1898 makes *Vinum Xericum* the only official unmedicated wine, defining it simply as "a Spanish wine," but providing that it shall contain not less than 16 per cent. of alcohol by volume.

Preparation.—The juice expressed from the ripe grapes by various methods runs into vats and constitutes the "*must*." The temperature of the air being about 15.5° C. (60° F.), fermentation gradually takes place in the must, and becomes fully established after a longer or shorter period. In the meantime, the must becomes sensibly warmer, and emits a large quantity of carbon dioxide, which causes the more solid parts to be thrown to the surface in a mass of froth having a hemispherical shape called the *head*. The liquor from being sweet becomes vinous, owing to the conversion of the grape sugar into alcohol. After a while the fermentation slackens, when it becomes necessary to accelerate it by thoroughly mixing the contents of the vat. When the liquor has acquired a strong vinous taste and become perfectly clear, the wine is considered formed, and is racked off into casks. But even at this stage of the process the fermentation continues for several months longer. During the whole of this period a frothy matter is formed, which for the first few days collects around the bung, but afterwards precipitates along with coloring matter and tartar, forming a deposit which constitutes the wine-lees.[1]

Division and Nomenclature.—Wines, according to their color, are divided into the red

[1] *Rousseau's laudanum* is a tincture of opium made with very weak alcohol, according to the following formula: "Take of White Honey *twelve ounces*; Warm Water *three pounds*. Having dissolved the honey, set the solution aside in a warm place; and, as soon as fermentation begins, add of selected opium *four ounces*, previously dissolved in *twelve ounces* of water. Allow the mixture to stand for a month at the temperature of 24° Réaumur (86° F.); then strain, filter, and evaporate to *ten ounces*; finally strain, and add *four ounces and a half* of alcohol of 20° B. Seven drops contain about a grain of opium." (*Pharm. Univ.*, ii. 265.)

[1] In certain parts of France the wine makers are in the habit, during the fermentation of the wines upon the marc, of adding plaster of Paris, under the impression that it improves the color and insures the stability of the wines. The process is called by the French *plâtrage*. It has the drawback of increasing the percentage of potassium sulphate notably, and its practice is now controlled by law in France. Other methods of treatment are the addition of dicalcium phosphate, known as *phosphotage*, and neutralizing the excess of acidity in the must by the addition of marble dust, known as *chaptalization*. The addition of sugar and water to the must is called *gallization*, and the addition of glycerin to the finished wine is known as *schellization*. For fuller particulars, see Sadtler's *Industrial Chemistry*, 3d ed., p. 206.

and the white, and, according to their taste and other qualities, are either spirituous, sweet, dry, light, sparkling, still, rough, or acidulous. *Red wines* are derived from the must of black grapes, fermented with their skins and seeds, or what is collectively called the *marc; white wines,* from white grapes, or from the juice of black grapes, fermented apart from the marc. The coloring matter of the grape is almost insoluble in water, and hence the juice of the red grape is nearly colorless, and will produce a white wine if fermented alone, but when fermented with the presence of the grape the alcohol generated dissolves the coloring matter, which is soluble in that liquid, and thus the wine becomes red. The other qualities of wines depend on the relative proportions of the constituents of the must, and on the mode in which the fermentation is conducted. The essential ingredients of the must, as a fermentable liquid, are water, sugar, and a ferment. The exact composition of the must is shown by the analysis of must given below,[1] obtained from different sources and ranging through a number of years.

If the juice be very saccharine, and contain sufficient ferment to sustain the fermentation, the conversion of the sugar into alcohol will proceed until checked by the production of a certain amount of the latter, and there will be formed a *spirituous* or *generous* wine. If, while the juice is highly saccharine, the ferment be deficient in quantity, the production of alcohol will be less, and the redundancy of sugar proportionately greater, and a sweet wine will be formed. It is stated by M. G. Fleury that levulose undergoes the vinous fermentation much less readily than glucose, and that the sugar of sweet wines is chiefly levulose. Whether a grape yields a sweet or a dry wine seems, then, to depend, to some extent, upon the character of its sugar. (*J. P. C.*, 4e sér., viii. p. 323.) When the sugar and ferment are in considerable amount, and in the proper relative proportions for mutual decomposition, the wine will be strong-bodied and sound, without marked sweetness or acidity, and of the kind called *dry*. A small proportion of sugar can give rise only to a small proportion of alcohol, and consequently the less saccharine grapes will generate a comparatively weak or *light wine*, which will be sound and stable in its constitution in case the ferment is not in excess, but otherwise liable to pass into the acetous fermentation and become sharp. In case the wine is bottled before the fermentation is fully completed, the process will go on slowly in the bottles, and the carbon dioxide generated, not having vent, will impregnate the wine and render it effervescing and *sparkling*. The *rough* or *astringent* wines owe their flavor to a portion of tannic acid derived from the marc of the grape, and the *acidulous* wines to the presence of carbon dioxide, or of an unusual proportion of tartar. Several of the above qualities often coexist. Thus, a wine may be spirituous and rough, sweet and rough, light and sparkling, etc. Wines are made in many countries, and are known in commerce by various names, according to their source. Thus, *Portugal* produces Port and Lisbon; *Spain*, Sherry, San Lucar, Malaga, and Tent; *France*, Champagne, Burgundy, Hermitage, Vin de Grave, Sauterne, and Claret; *Germany*, Hock and Moselle; *Hungary*, Tokay; *Sicily*, Marsala or Sicily Madeira, and Lisa; the *Cape of Good Hope*, Constantia; *Madeira* and *the Canaries*, Madeira and Teneriffe.

In the United States the first attempt to manufacture wine, on an extended scale, was made towards the close of the last century, at Spring Mill, near Philadelphia, by Peter Legaux, agent of the Pennsylvania Vine Company, and proved unsuccessful. The native grape found most suitable by the Company, after the foreign had failed on account of the climate, was the *Schuylkill muscatel grape*. The next attempt was made by the Swiss at Vevay, Indiana, with the Schuylkill grape, and was partially successful, a rough red wine being manufactured which met with a ready sale in the neighboring States. In a very few years the manufacture of this wine languished, foreign wines superseding it. The foreign grape, after numerous trials, not succeeding as a wine grape, investigations were undertaken to determine the adaptation of our various native grapes for making wine. Among these the *Catawba grape*, a native of North Carolina, introduced to public notice by Major Adlum of Washington City, about 1825, has been largely cultivated in Southern Ohio as a wine grape. The chief objection to it is its liability to the rot. Within a few years various other varieties of grape have come into vogue, and native wines are constantly improving in quality. The climate of Texas is peculiarly favorably to the growth of the grape vine. The *El Paso grape* is found in the vicinity of the falls of the Rio Grande, and the *great mustang* grows luxuriantly in every part of the State, and yields a superior red wine. California produces an immense amount of wine, which is now coming into general use. Considering its advantages

[1] Composition of Wine-must.

	Sp. Gr.	Water, Per Cent.	Nitrogenous Material.	Sugar.	Acid.	Other Non-nitrogenous Material.	Ash.
Minimum	1.0690	51.53	0.11	12.89	0.20	1.68	0.20
Maximum	1.2075	82.10	0.57	35.45	1.18	11.62	0.63
Mean	1.1024	74.49	0.28	19.71	0.64	4.48	0.40

(König's *Nahrungs- und Genussmittel*, vol. ii. p. 436.)

of soil and climate, there is good reason to believe that it may at no very distant time rank among the most productive wine regions of the globe.[1]

The world's production of wine for 1905 is given by the *Revue Vinicole* as follows, in millions of gallons:

France	1584.0	Portugal	46.2
Italy	840.4	Austria	41.8
Spain	632.5	Turkey and Cyprus	41.8
Russia	187.0	Argentine	35.2
Roumania	184.8	Peru	33.0
Chile	59.4	Switzerland	26.4
United States	50.6	Greece	24.2
Germany	48.4		
Bulgaria	46.2	Total	3881.9

(*J. Soc. Chem. Ind.*, 1905, p. 1329.)

Properties.—Wine, considered as the name of a class, may be characterized as a spirituous liquid, resulting from the fermentation of a fruit juice, or, in its more restricted use, of a grape juice, and containing coloring matter, and other substances, either combined or intimately blended with the spirit. It always contains a small proportion of aldehyde. All its other qualities vary with the nature of each particular wine. The principal varieties of foreign wines are briefly characterized below. *American* wines are classed as Sherries, Ports, Dry Red, Dry White, Champagnes, Sweet Catawbas, and special brands.

[1] There can be no doubt that the California wines are steadily advancing in quality, and that many of them now rival the European wines of high class. At the French Exposition (1889) a California wine made from the Carbenet Sauvignon grape of the Château-Lafitte type received the highest award for excellence over all other wines offered in competition, including the finest vintage of France, while the second award for brandies was also given to a California product. J. De Barth Shorb, late President of the California State Viticultural Commission, informed us, as the results of numerous analyses made under the auspices of the Commission, that the California red wines or clarets average from 10 to 14 per cent. of alcohol, the white wines 8 to 12 per cent., the ports 18 to 22 per cent., the sherries 17 per cent. The grapes of which these wines are made are not native to California, as is often thought, but are the offspring of cuttings originally introduced from France, Germany, Spain, and Italy. The so-called "Mission grape," of California, is evidently of Spanish origin, having been brought over by Roman Catholic missionaries in the early history of the country. It varies so much in different localities that it probably comes from various original stocks. Shorb states that while there are really some hundreds of varieties of grapes recognized by the viticulturists of California, the following are most esteemed. All are foreign grapes except the Lenoir, an American grape, which has been introduced into France, where it is known as Le Jacque:

Red Wines, Clarets.
Carbenet Sauvignon.
Burgundy Varieties.
Carignan.
Metaro.
Grenache.
Zinfandel.
Black Malvoisie.
Lenoir.

White Wines, Hocks.
Sauvignon Vert.
Riesling.
Golden Chasselas.
Bergher.

Ports and Sherries.
Old Mission.
Trousseau.
Charbonneau.
Black Burgundy.
Pedro Ximenes.

Brandies.
Follé Blanche (Cognac grape). "West's Prolific" (and numerous other hybrids).
All the white varieties.

For *raisins:* Muscat of Alexandria and Gordo Blanco.

See also *Bulletin No. 72*, U. S. Dept. Agriculture, Bureau of Chemistry.

Sherry (*Vinum Xericum*, Br. 1898, U. S. 1870) is of a deep amber color, and when good possesses a dry aromatic flavor and fragrance, with very little acidity. It is officially defined as "a Spanish wine," and described as "a pale yellowish-brown liquid containing not less than 16 per cent. of ethyl hydroxide by volume." *Br.* It is prepared in the vicinity of Xeres, in Spain, whence its English name *sherry*. This wine is supposed to have been the *sack* of Shakespeare, so called from the word *sec* (dry). Henry Long has found about a grain of sulphuric acid in an ounce and a half of sherry wine, and supposes it to be free, but in the light of the experiments of Bussy and Buignet it is, we think, more likely to be in the state of potassium bisulphate, resulting from the reaction between potassium bitartrate and calcium sulphate used in preparing the wine. (*P. J.*, 1867, 732.)

Port (*Vinum Portense*, U. S. 1870) is of a deep purple color, and in its new state is a rough, strong, and moderately sweet wine. When kept a certain time in bottles, it deposits a considerable portion of its astringent matter, loses the greater part of its sweetness, acquires more flavor, and retains its strength. If too long kept, it deposits the whole of its astringent and coloring matter, and becomes deteriorated. Considerable quantities of brandy are usually added to it, which causes its heating quality on the palate. It is one of the strongest wines in common use. According to Muspratt of Liverpool, the alcohol in genuine port never exceeds 19 per cent. (*M. T. G.*, 1856, p. 355.)

Madeira was the strongest of the white wines formerly in use. It was somewhat acid, and, when of proper age and in good condition, had a rich, nutty, aromatic flavor. It rarely occurs in the market, however, and is of very variable quality, on account of the adulterations and admixtures to which it is subjected after importation.

Teneriffe is a white wine, of a somewhat acid taste, and, when of good quality, of a fine aromatic flavor. Its average strength is about the same as that of sherry. It is made from the same grape as Madeira, to which it bears a close resemblance.

Claret, called in France *vin de Bordeaux*, from its being produced near that city, in the district of Médoc, is a red wine, and from its moderate strength is ranked as a light wine. It has a deep purple color, and, when good, a delicate taste, in which the vinous flavor is blended with some acidity and astringency. The most esteemed kinds are the clarets called *Château-Margaux*, *Château-Lafitte*, and *Château-Latour*. Another celebrated variety is the *Château-Haut-Brion* of the Pays de Grave. Claret is the French wine most extensively consumed in the United States.

Official Requirements.—The U. S. Pharmacopœia (8th Rev.) does not recognize any special variety of wine, but only the general classes of white and red. (See page 1334). In

selecting wines for pharmaceutical purposes the apothecary should see that they conform to the following description and tests of the Pharmacopœia. *White Wine* is "a pale amber-colored or straw-colored liquid, having a pleasant odor free from yeastiness, and a fruity, agreeable, slightly spirituous taste without excessive sweetness or acidity. The specific gravity, at 15.6° C. (60° F.), should not be less than 0.990, nor more than 1.010. If a portion of White Wine be evaporated, the residue, when dried during twelve hours on a water-bath, should amount to not less than 1.5 nor more than 3 percent.; this residue ignited at a low temperature and burned gradually to whiteness, moistened with a small portion of ammonium carbonate T.S., and again carefully ignited, should weigh not less than 0.14 Gm. nor more than 0.26 Gm. for each 100 Cc. of White Wine tested. To neutralize 50 Cc. of White Wine should require not less than 3 nor more than 5.2 Cc. of normal potassium hydroxide V.S. (limit of *free acid*), litmus T.S. being used as indicator. If 10 Cc. of White Wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride T.S., only a faint, greenish-brown color should make its appearance (absence of more than traces of *tannic acid*). If 75 Cc. of White Wine be acidified with 5 Cc. of diluted sulphuric acid (1 in 3), and thoroughly shaken in a separator with a mixture of equal parts of petroleum benzin and ether, and if the solvent, after separation, be transferred to a porcelain dish, allowed to evaporate spontaneously, and the residue dissolved in 3 Cc. of water, the solution should not have a sweet taste (absence of *saccharin*), nor should it give a violet color upon the addition of a diluted solution of ferric chloride (1 in 200) (absence of *salicylic acid*).

Tested by the following method, White Wine should be found to contain not less than 7 percent. nor more than 12 percent., by weight (equivalent to 8.5 percent. to 15 percent. by volume), of absolute alcohol: Take the specific gravity (to four decimals) of a sufficient portion of the White Wine carefully measured at the temperature of 15.6° C. (60° F.), evaporate the Wine in a tared dish to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities deducted from 1.0000 corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the Wine under examination, the corresponding percentage being ascertained by referring to the alcohol tables. (See PART III.)" *U. S.* "Pale yellowish-brown, containing not less than 16 per cent. of ethyl hydroxide by volume. When a mixture of 50 cubic centimetres of this wine and 50 cubic centimetres of *water*, acidulated with 5 cubic centimetres of the *volumetric solution of sulphuric acid*, is distilled, the distillate, after rejection of the first 10 cubic centimetres, shaken with *ether*, the ethereal liquid separated and its ether removed by evaporation, the residue should not yield a violet coloration when mixed with *test-solution of ferric chloride* (absence of salicylic acid)." *Br. Red Wine* is "a deep red liquid, having a pleasant odor free from yeastiness, and a fruity, moderately astringent, pleasant, and slightly acidulous taste, without excessive sweetness or acidity. The specific gravity, at 15.6° C. (60° F.), should not be less than 0.989 nor more than 1.010. If a portion of Red Wine be evaporated, the residue, when dried during twelve hours on a water-bath, should amount to not less than 1.6 percent. nor more than 3.5 percent.; this residue, ignited at a low temperature and burned gradually to whiteness, moistened with a small portion of ammonium carbonate T.S., and again carefully ignited, should weigh not less than 0.22 Gm. nor more than 0.34 Gm. for each 100 Cc. of Red Wine tested. To neutralize 50 Cc. of Red Wine should require not less than 3 Cc. nor more than 5.2 Cc. of normal potassium hydroxide V.S. (limit of *free acid*), litmus T.S. being used as indicator. If 10 Cc. of Red Wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride T.S., the liquid should acquire a brownish-green color (presence of *tannic acid*). With lead acetate T.S. Red Wine forms a heavy precipitate which may vary in color from bluish-green to green. If 50 Cc. of Red Wine be treated with a slight excess of ammonia water, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 Cc. of ether, the greater portion of the ethereal layer removed, and evaporated in a porcelain dish with an excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color (absence of *red aniline colors*). If 25 Cc. of Red Wine, heated to about 45° C. (113° F.), be well agitated with 25 Gm. of manganese dioxide, the liquid filtered off and acidulated with hydrochloric acid, it should not acquire a red color (absence of *acid fuchsine*). If 75 Cc. of Red Wine be acidified with 5 Cc. of diluted sulphuric acid (1 in 3) and thoroughly shaken in a separator with a mixture of equal parts of petroleum benzin and ether, and if the solvent after separation be transferred to a porcelain dish, allowed to evaporate spontaneously, and the residue dissolved in 3 Cc. of water, the solution should not have a sweet taste (absence of *saccharin*), nor should it give a violet color upon the addition of a diluted solution (1 in 200) of ferric chloride (absence of *salicylic acid*).

Tested by the following method, Red Wine should be found to contain not less than 7 percent. nor more than 12 percent., by weight (equivalent to 8.5 percent. to 15 percent. by volume), of absolute alcohol: Take the specific gravity (to four decimals) of a sufficient portion of the Red Wine accurately measured at the temperature of 15.6° C. (60° F.), evaporate the Wine in a tared dish to one-third of its

original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities deducted from 1.0000 corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the Wine under examination, the corresponding percentage being ascertained by referring to the alcohol tables. (See PART III.)" *U. S.*

The official method of ascertaining the alcoholic strength is based upon the following plan of Horsley's. Note the specific gravity of the wine. Then take 5 fluidounces of it, boil it down in a flask to 2 fluidounces, and allow it to cool. All the alcohol is thus driven off. Add to the residuary liquid sufficient distilled water to bring it to the original measure of 5 fluidounces, and ascertain the specific gravity of the mixture. Deduct the excess of its specific gravity over 1.000, which is the specific gravity of distilled water, from the specific gravity of the wine as at first noted, and the difference will be the specific gravity of the alcohol and water in the wine. Then by consulting the tables giving the percentage in alcohol of liquids containing alcohol and water the percentage of alcohol in the wine will be obtained. Thus, suppose the specific gravity of the wine to be 0.997, and that of the liquid, after treatment as directed, 1.020. Then 0.020, the excess of the latter specific gravity over that of water or 1.000, deducted from 0.997, gives 0.977 as the specific gravity of the mixed alcohol and water in the wine, which, by referring to the table in PART III, will be found to indicate a percentage by weight of 15.67 of absolute alcohol.

The intoxicating ingredient in all wines is the alcohol which they contain, and hence their relative strength depends upon the quantity of that substance entering into their composition. The alcohol, however, naturally in wine is so blended with its other constituents as to be in a modified state, which renders it less intoxicating and injurious than the same quantity of alcohol separated by distillation and diluted with water. This is hardly true of the alcohol which is usually added to wines by manufacturers.

H. Bence Jones has ascertained the acidity of equal bulks of foreign wines, except Teneriffe, expressed in grains of sodium hydroxide. The bulk taken was that of 1000 grains of water at 60° F., and the numbers express the extremes of acid: sherry, 1.95 to 2.85; port, 2.10 to 2.55; Madeira, 2.70 to 3.60; claret, 2.55 to 3.45. The same authority has determined the proportion of sugar to the ounce in sherry, port, and Madeira, expressed in grains: sherry, 4 to 18; port, 16 to 34; Madeira, 6 to 20. Claret contains no sugar. Assuming that the sugar becomes acid in the system, the order of acidity of these wines, beginning with the least acid, is claret, sherry, Madeira, and port. (*Chem. Gaz.*, Jan. 16, 1854, p. 35.)

Wines of great diversity of flavor, acidity, and alcoholic strength are produced in America; there seems to be no difficulty in procuring wines in the market of assured purity and freedom from dangerous adulteration, yet nearly all of them contain alcohol and sugar, which have been added for the purpose of either preserving the wine or improving its taste. Glycerin and glucose are frequently added to wines when they naturally lack body. Additional analyses of American wines, made in the U. S. Government Laboratory in 1884 and 1888, will be found in *Bulletin No. 13*, Part 3, of the U. S. Department of Agriculture.

Later analyses of California wines will be found in *Bulletins No. 59* and *72*, Bureau of Chemistry, U. S. Department of Agriculture.

Christison considered it a mistake to suppose that wines become stronger by being kept a long time in casks. His experiments appear to prove the reverse. While wine is not rendered more alcoholic by age for some time, its flavor is improved, and its value thus increased. It becomes less acid, partly by the deposition of tartar, and probably also by the reaction between the acids and the alcohol resulting in the production of esters. Most light wines, if not fortified, finally spoil even when well bottled.

Composition.—Wines consist mainly of water and alcohol. They contain also volatile oil, œnanthic ether, grape sugar, sometimes glycerin in minute proportion (*J. P. C.*, Oct. 1859, p. 292), gum,[1] extractive, coloring matter, tannic, malic, phosphoric, carbonic, and acetic acids, potassium bitartrate (tartar),[2] and calcium tartrate. The volatile oil has never been isolated, but is supposed to be the cause of the delicate flavor and odor of wine, called the *bouquet*. According to F. L. Winckler, the bouquet depends upon the presence of a nitrogenous compound of a volatile organic acid with a volatile base, which has a different odor in different wines. *Œnanthic ether* (ethyl acetate, caproate, and pelargonate) was discovered in wine by Pelouze and Liebig. It is obtained towards the end of the distillation of wine on the great scale for making brandy. It forms only one part in ten thousand of the wine. It is a colorless liquid, having a peculiar vinous odor, and a taste at first slight, but afterwards acrid. It is considered to be identical with *pelargonic ether*, under which head, in PART II, it is more fully described. Œnanthic ether must not be confounded with the substance which gives rise to the bouquet of wine. The other ingredients of wine, just enumerated, are sometimes present and sometimes absent.

[1] For a paper on the effect of gum upon the determination of the amount of glucose in wine, see *J. P. C.*, Oct. 1875, p. 274.

[2] Phipson has recognized in some wines, especially a red wine of Meudon and some clarets from Bordeaux, *acid potassium racemate* or *paratartrate*, which he distinguished by the shape of its crystals floating in the wine, and afterwards separated and examined chemically. The crystals are in octagonal tables, partially colored by the red matter of the wine. He considers its presence an evidence of good quality in the wine. (*J. P. C.*, 4e sér., iii. 274, 1866.)

Thus, sugar is present in sweet wines, tannic acid in rough wines, and carbon dioxide in those that effervesce. The different kinds of wine derive their various qualities from the mode of fermentation, the nature of the grape, and the soil and climate in which it may have grown. The alcohol in pure wine is that which results from the vinous fermentation, and is intimately united with the other ingredients of the liquid, but with almost all the wines of commerce a portion of brandy is mixed, the state of union of which is probably different from that of the natural alcohol of the wine. By the British custom house regulations, 10 per cent. of brandy may be added to wines after importation, but to good wines not more than 4 or 5 per cent. is added.

Most wines on being kept form deposits, whether in the cask or in bottles. L. Pasteur divided these deposits into three kinds. 1. One consists of crystals of potassium bitartrate, of neutral calcium tartrate, or of a mixture of the two salts. This does not adhere to the sides of the vessel, but has sufficient weight to collect in a small bulk on repose. It is productive of little inconvenience physically, and has no injurious chemical effect on the wine. 2. A second deposit, often confounded with the first, but altogether distinct, is formed of the coloring substances which adhere to the sides of the bottles, especially the most dependent. It is owing to the oxidation, through the air, of the soluble coloring matters of the wine, which thus become insoluble. In consequence of its adhesion to the bottle, it allows the wine to be poured off quite clear. Its formation is generally coincident with improvement in the wine, which becomes at the same time lighter-colored, so that after many years the red wines, like port, will be almost as light as Madeira. 3. The third kind of deposit is the most troublesome and injurious. It consists of cryptogamic vegetations, which, in the opinion of Pasteur, give rise to all the alterations in wines commonly known as maladies. These never adhere to the sides of the bottle, unless confined by the coloring matter, which occurs very rarely. They are little bodies so light that the least movement of the bottle disturbs them and the liquid becomes turbid to a considerable extent. In a mere physical point of view, therefore, they are very inconvenient, by interfering with the decanting of the wine, while, acting as ferments, they cause great mischief not only by change of the principles of the wine, but also by adding to it new products, the direct result of their own action. As most wines are under their influence, the injury they produce in destroying the better qualities of wine is incalculable. (*J. P. C.*, 4e sér., 1865, ii. 40.) The remedy for this disorder in wines, suggested by Pasteur, is to destroy the cryptogams by the aid of heat. All that is necessary is, by means of a water bath, to expose the wine, in bottles, to a heat of 140° to 160° F. Experience has shown that in this way the wine soon clarifies itself, and keeps well afterwards, with an improved flavor. The process of heating their wines was to some extent employed by the ancients. Appert was the first in modern times to try it, and in fact it is nothing more nor less than his own peculiar process for preserving vegetable liquids. De Vergnette-Lamotte also experimented with wines with the same effect, but the theory of the change was first made known by Pasteur. (*Ibid.*, 1866, iii. 118.)

Adulterations.—Wines are very frequently adulterated, and counterfeit mixtures are often palmed upon the public as genuine wine. Free sulphuric acid in red wines cannot be detected by barium salts, for all wines contain a small quantity of the soluble sulphates. It may be discovered, however, by dropping the suspected red wine on a piece of common glazed paper containing starch. If the wine be pure, the spot, when dry, will be violet blue, and the paper unaltered in texture, but if the wine contain even a thousandth part of sulphuric acid, the paper will be spotted rose-red, and prove brittle and friable when slightly rubbed between the fingers. (Lassaigne, O. Henri, and Bayard.) Formerly the wine dealers were in the habit of putting litharge into wines that had become acescent. The lead oxide formed with the acetic acid, lead acetate, which, being sweet, corrected the defect of the wine, but at the same time rendered it poisonous. At the present day this criminal practice is wholly abandoned. The adulteration is readily detected by hydrogen sulphide, which causes a black and flocculent precipitate. Brande, among the numerous samples of wine of suspected purity which he examined, did not find one containing any poisonous ingredient fraudulently introduced. Lead, in minute quantity, may sometimes be detected, but it is derived invariably from shot in the bottle, or from some analogous source. Rhenish wines, when acid from the presence of free tartaric or acetic acid, may be restored by the addition of neutral potassium tartrate, which gives rise to the formation of cream of tartar. Spurious mixtures, frequently containing very little of the fermented juice of the grape, and which are sold as particular wines, may not be poisonous, but they are, notwithstanding, highly pernicious in their effects upon the stomach, and always produce mischief and disappointment when depended on as therapeutic agents. The wines most frequently imitated are port and Madeira; cider is often the chief ingredient in the spurious mixtures. *English port* is sometimes made of a small portion of real port, mixed with cider, juice of elderberries, and brandy, and rendered astringent with logwood and alum. According to Stracke, genuine wines do not contain salts of potassium in quantity sufficient to yield a precipitate with platinic chloride. If, therefore, a suspected wine be evaporated to dryness, and the extract, after being washed with alcohol so long as this is colored

by it, and then dissolved in water, give a precipitate with platinic chloride, the presence of cider may be suspected. (*J. P. C.*, Mai, 1862, p. 442.) By most dealers in wine, coloring is employed, made usually of elderberries and alum. The practice of coloring wines is very reprehensible. In France coloring is openly sold with impunity, and extensively employed, although the wine dealer who uses it is liable to fine and imprisonment.[1]

The weaker wines often spoil by keeping. In this case they are prone to dissolve any tartar that may have been deposited, and have been found to contain propionic acid. The result is ascribed by Nicklés to a fermentative decomposition of the tartar. Of course in this state such wine contains potassium salts, and would not respond favorably to the test of platinic chloride. (*J. P. C.*, Août, 1862, p. 90.) Lactic acid is one of the products of the changes which take place in the spontaneous deterioration of wine, and Balard has succeeded in discovering the peculiar lactic acid ferment in spoiled wines. The appearance of this is preceded by that of globules similar to those of yeast, and after the completion of the lactic acid fermentation, and the commencement of the putrefactive, a throng of vibriones is observable. After the cessation of the vinous fermentation, and during the progress of that of lactic acid, all disengagement of gas ceases.[2]

Besides the grape, a number of other fruits yield juices susceptible of the vinous fermentation. These are all wines; thus, *cider* is the wine obtained by fermenting the juice of the apple, *perry* is the fermented juice of the pear. Fruit wines may be distinguished from grape wines by the absence in the former of tartaric acid or its salts. The infusion of malt, also, is capable of undergoing this process, and by its fermentation are produced the so-called *malt liquors,—i.e., ale, porter, brown stout,* and *lager beer.* Of these malt liquors lager beer is produced by a slow fermentation at a low temperature; porter, brown stout, and ale, by a rapid fermentation at a high temperature. Porter and brown stout differ from ale in that some of the *malt* out of which they have been made has been partially charred, the torrefaction being carried further in the manufacture of porter, whence the dark color of the latter. Brande gives the following percentage of alcohol in certain wines and malt liquors: currant wine, 20.55; gooseberry wine, 11.84; orange wine, 11.26; elder wine, 8.79; cider, from 5.21 to 9.87; perry, 7.26; mead, 7.32; Burton ale, 8.88; Edinburgh ale, 6.20; brown stout, 6.80; London porter, 4.20; small beer, 1.28. In the manufacture of these minor wines sugar is often freely added to the liquor before fermentation, and it is evident that in this way has been obtained the excessive alcoholic strength of some of the wines examined by Brande. H. Bence Jones gives the following percentages of alcohol in the undernamed liquors, cider, from 5.4 to 7.5; bitter ale, from 6.6 to 12.3; porter, from 6.5 to 7.0; brown stout, from 6.5 to 7.9. According to L. Hoffmann, Burton ale consists, in the 100 parts, of carbon dioxide 0.04, absolute alcohol 6.62, extract of malt 14.97, and water 78.37; and pale ale, of carbon dioxide 0.07, absolute alcohol 5.57, extract of malt 4.62, and water 89.74. All malt liquors contain, besides water and alcohol, solid substances, which together constitute the so-called extract,—*i.e.*, that which is left behind when the alcohol and water are evaporated. The most important of these are dextrin, grape sugar, glycerin, succinic, acetic, lactic, propionic, and glucic acids, carbon dioxide, albumen and albuminous principles, bitter and resinous matters and essential oil from the hop, alkaline and earthy salts.

Uses.—As wine depends chiefly for its activity upon alcohol it may be used as a means of producing alcoholic stimulation in the various diseases or conditions in which such stimulation is indicated. It has, however, certain properties differing from those of simple alcohol, which make its substitution by a dilute alcohol very disadvantageous, and make its selection for use as contrasted with the stronger liquors, advantageous or disadvantageous according to the circumstances of the case. Owing perhaps chiefly to their ethereal constituents, the stronger wines, when dry, often agree better with digestion than do other alcoholic drinks; while the lighter wines, and especially the sweet or not dry wines, are prone to disarrange

[1] *The Detection of Coloring Matter in Wine.*—Alum may be detected in red wine by boiling it for a few minutes. If alum be present, even in 1–3000th part, the wine gradually becomes turbid, and furnishes a flocculent precipitate; while a pure red wine is not rendered turbid, even by long boiling. (J. L. Lassaigne.) Lapeyrère states (*J. P. C.*, 4e sér., xi. 291) that logwood may be detected by means of bibulous paper which has been saturated with a neutral copper acetate; a strip of this, if dipped for a moment into natural wine, takes a gray or grayish rose color, but if logwood be present the tint will be a violaceous blue. M. de Cherville dissolves a piece of potassium hydroxide in the wine; if no sediment appear, and the wine become greenish, it is uncolored; if a precipitate fall, it has been colored; a violet sediment indicates elder or mulberries; red, beet root or Pernambuco wood; violet red, logwood; yellow, "phytolac" berries; violet blue, privet berries; pale violet, sunflower. (*P. M. T.*, iv. 639.) A. Dupré recommends that a small cube of jelly (prepared by dissolving 5 grammes of gelatin in 100 Cc. of warm water, and allowing to cool) be placed in the wine. After from 24 to 48 hours the jelly is removed and washed. If the coloring matter be artificial, it will have penetrated the whole cube; if it be natural, only the surface. *Nessler's reagent for wine* consists of 7 parts of alum and 10 parts of sodium acetate in 100 parts of water. Natural-colored wines are not affected by this; artificial colors are altered to a dingy blue. (*Proc. A. Ph. A.*, xxvii. 213.)

[2] *Unfermented Wine.*—Under this misnomer the unfermented juice of the grape has had a large sale in America; it cannot properly be called wine, because the alcoholic fermentation is an essential part of wine making. Grape juice may be preserved by heating, in order to coagulate albuminous principles, filtering, and subsequently heating the bottles containing the filtrate to destroy micro-organisms; this process necessarily affects the flavor. Another method is to add a preservative like salicylic acid or boric acid to the grape juice, and to filter without the use of heat: this preserves the flavor, but is objectionable on account of the presence of the foreign bodies. Welch's *grape juice* is a preserved juice containing no alcohol and is not a wine.

digestion. The small amount of alcohol which they contain, in contrast especially with their cost, counts very strongly against their use when very active stimulation is desired, hence they are at present seldom employed in severe acute disease. On the other hand, their agreeable taste, and the immediate pleasantly stimulating action, something apart from that of simple alcohol, which many of them exert upon the nervous system, make them very useful in cases of convalescence and of chronic diseases with long continuing exhaustion. In such cases they should be taken with food.

In selecting a wine for any case especial attention should be paid to its constituents other than alcohol. Thus, in patients suffering from gouty or uric acid diathesis, sweet and sour wines are alike especially contra-indicated. Champagne is especially contra-indicated when there is a gouty diathesis and in certain cases of indigestion. On the other hand, in irritable stomach with a tendency to vomit of nervous origin, it often acts happily. Sour wines, sweet wines, champagne and even claret should usually be forbidden when there is a tendency to looseness of the bowels, port wine or brandy being preferred under these circumstances. In cases of acute adynamia, with markedly irritable stomach, *wine whey* sometimes affords a means of giving a delicate food and stimulant which will be taken when everything else is rejected. It is made by adding to a pint of boiling milk, just removed from the fire, from a gill to half a pint of white wine, straining without pressure to separate the curd, and sweetening if necessary for the taste of the patient; usually the less sugar the better the result.

The question of the habitual use of wine is so large a one as not to be capable of proper discussion at this place. The result of modern science may, however, be epitomized as showing that in persons who are well fed, especially who take an abundance of meat and other nitrogenous foods, the daily use of wine is not only unnecessary, but even when the amounts taken are moderate has a distinct tendency to deteriorate health and bring about serious disease and even death as the subject progresses towards middle life or old age. On the other hand, when people are underfed and habitually take a minimum amount of nitrogenous food, the use of wine may not only be not deleterious but distinctly helpful. To give a practical example, Americans, even of the so-called working classes, eat much more than is required by the needs of the system, and in this eating partake very largly of nitrogenous food, to them the daily use of wine is distinctly injurious. On the other hand, the Italian peasant, laboriously employed, with almost no food except bread, macaroni, or some other grain product, and the same article of food being often taken three times a day, is better off for the large quantity of light wine which he takes.

Off. Prep.—*From white wine*—Vinum Antimonii, *U. S.* (*Br.*); Vinum Colchici Seminis, *U. S.* (*Br.*); Vinum Ergotæ, *U. S.*; Vinum Ferri, *U. S.* (*Br.*); Vinum Ferri Amarum, *U. S.*; Vinum Ipecacuanhæ, *U. S.*, *Br.*; Vinum Opii, *U. S.*

From red wine—Vinum Cocæ, *U. S.*

XANTHOXYLUM. U. S.

XANTHOXYLUM [Prickly Ash]

(xạn-thŏx'y-lŭm)

"The dried bark of *Xanthoxylum americanum* Miller (Northern Prickly Ash), or of *Fagara Clava-Herculis* (Linné) Small (Southern Prickly Ash) (Fam. *Rutaceæ*)." *U. S.*

X. americanum: Toothache Tree, Angelica Tree, Suter-berry, Pellitory Bark, Yellow-wood; Clavalier, Frêne épineux, *Fr.*; Zahnwehholz, Zahnwehrinde, *G.* *Fagara Clava-Herculis;* Sea Ash, Hercules' Club, Pepper-wood.

Xanthoxylum americanum, Miller, *Gard. Dict.*, 8th ed., No. 2; Torrey and Gray, *Fl. of N. Am.* i. 214.—Northern Prickly Ash is a shrub from five to twenty-five feet in height, with alternate branches, which are covered with strong, sharp, scattered prickles. The leaves are alternate and pinnate, consisting of four or five pairs of leaflets, and an odd terminal one, with a common footstalk, which is sometimes prickly on the back, and sometimes unarmed. The leaflets are nearly sessile, ovate, acute, slightly serrate, and somewhat downy on their under surface.

The flowers, which are small and greenish, are disposed in sessile umbels near the origin of the young shoots. The plant is polygamous, some shrubs bearing both male and perfect flowers, others only female. The number of stamens is five, of the pistils three or four in the perfect flowers, about five in the pistillate. The capsules are stipitate, oval, punctate, of a greenish-red color, with two valves, and one oval blackish seed. This species of xanthoxylum is indigenous, growing in woods and in moist shady places throughout the Northern, Middle, and Western States. The flowers appear in April and May, before the foliage. The leaves and capsules have an aromatic odor, recalling that of oil of lemon.

Fagara Clava-Herculis[1] (L.), Small; *X. Clava-Herculis,* L., *Sp. Pl.* (1753) 270; Gray, Chapman, Britton.—Southern Prickly Ash va-

[1] *X. americanum,* Miller, is the Northern prickly ash. *X. Clava-Herculis,* Lamarck (not Linné); *X. fraxinifolium,* Marshall; *X. fraxineum,* Willdenow; *X. mite,* Willdenow; *X. ramiflorum,* Michaux; *X. tricarpum,* Hooker; and *Thylax fraxineum,* Rafinesque.

X. Clava-Herculis, Linné, the Southern prickly ash. *X. fraxinifolium,* Walter (not Marshall); *Fagara fraxinifolia,* Lamarck; *X. carolinianum,* Lamarck; *X. aromaticum,* Willdenow; *X. tricarpum,* Michaux; *Kampmannia fraxinifolia, Pseudopetalon glandulosum, P. tricarpum,* and *X. catesbianum,* the last four names being used by Rafinesque in his different writings.

Botanists are not agreed concerning the distinction of the genus Fagara from Xanthoxylum. Thus, the authors of the Index Kewensis consider the two genera identical, while Engler and Prantl separate them. The most important character separating them seems to be the absence of sepals in Xanthoxylum. Most of the species of the genus Fagara are tropical trees.

ries in size from a large bush to a small tree. Its bark is armed with warty prickles, and large prickles occur on the branches and the petioles. The alternate leaves have from seven to nine ovate-lanceolate, crenate-serrulate, unequal-sided leaflets, smooth and shining on the upper surface. It grows on dry soil, westward as far as Western Texas, and perhaps into Mexico, eastward to the Atlantic coast, and northward to Southern Virginia, especially affecting the coast region.

The fruits (*Prickly ash berries*) of both of the official species are possessed of medicinal activity and probably contain the same principles found in the barks.

There has been much confusion in regard to the nomenclature of the prickly ashes. *Aralia spinosa,* L., or angelica tree, which grows in the Southern States, is occasionally confounded with *F. Clava-Herculis,* in consequence partly of being sometimes called, like the latter, *prickly ash.* Its bark is nearly smooth externally, is beset with slender prickles in transverse rows and has a taste different from that of *F. Clava-Herculis.* Besides the official trees, the bark of *F. flava* (Vahl.), Frug. and Urban (*X. caribæum,* S. Wats.), the *satin-wood* of semi-tropical Florida and the West Indies, has appeared in commerce under the name of *yellow Hercules club* or *yellow thorn.* This bark is thin, with an odor like that of Angustura bark, a bitter, disagreeable, acrid taste, and a canary-yellow color, which it imparts to the saliva when chewed. It would seem, also, that under the name of *prickly yellow wood, yellow wood,* or *fustic,* the products of other West Indian xanthoxylums and allied plants find their way into commerce.

Xanthoxylum veneficum, Bailey, of Australia is, according to J. H. Maiden, a violent convulsive poison, 5 grains of the extract being a fatal dose for a cat. *Xanthoxylum scandens* is said to be used by the natives of Java as a fish poison, and according to Van der Haar, contains an alkaloid. (*P. J.,* 71, 134; 73, 814.)

Properties.—Although the bark of the Southern prickly ash was not recognized by the U. S. Pharmacopœia until the revision of 1880, as long ago as 1864 Bridges pointed out that it had entered commerce, and gave the physical characteristics separating it. (*Proc. A. Ph. A.*) The characteristics of the two barks are very well given in the following official description.

"*Northern Prickly Ash.*—In curved or quilled fragments, about 1 Mm. thick; outer surface brownish-gray, with whitish patches, and minute, black dots, faintly furrowed, with some brown, glossy, straight, two-edged spines, linear at the base, and about 5 Mm. long; inner surface whitish, smooth; fracture short, non-fibrous, green in the outer and yellowish in the inner layer; inodorous; taste bitterish, very pungent.

Southern Prickly Ash.—In very large quills or sheets, 1 to 2 Mm. thick, externally of a light purplish-gray with large silvery-gray patches, and marked by many large corky projections, frequently 2 Cm. high, which often bear stout brown spines; otherwise like the Northern Prickly Ash. Xanthoxylum should not be confounded with the bark of *Aralia spinosa* Linné (Fam. *Araliaceæ*), which is nearly smooth externally, and beset with slender prickles in transverse rows." *U. S.*

W. L. Cliffe after careful examination demonstrated that the bark of Southern prickly ash exceeded that of the Northern prickly ash in active properties. (*A. J. P.,* 1901, 562.) In 1829, Edward Staples isolated from *X. americanum* a crystalline *xanthoxyline* which was again found by J. U. Lloyd in 1876. Subsequently, from the same plant Edward T. Moffet (*A. J. P.,* 1886, 417) obtained a supposed alkaloid in yellow crystals, soluble in alcohol and chloroform, insoluble in petroleum benzin, ether, and benzene. G. H. Colton (*A. J. P.,* 1880, p. 191) separated from the Southern prickly ash, tasteless, colorless, silky acicular crystals, soluble in alcohol, ether, and chloroform, less soluble in benzene, and insoluble in water. The identity of all these principles was assumed until E. G. Eberhardt (*A. J. P.,* 1890, 231) obtained from the Southern prickly ash a colorless crystalline principle agreeing in solubilities with that of Colton. On analysis it gave figures indicating the formula $C_{20}H_{12}O_6$ or $C_{30}H_{28}O_9$. At the same time he analyzed a sample of Lloyd's crystalline principle from *X. fraxineum* (*X. americanum,* Mill.), which had been preserved in the cabinet of the Philadelphia College of Pharmacy, and found for it the formula $C_{29}H_{27}O_8$. Numerous reactions also indicated that the two principles were different. Thus, Lloyd's crystals dissolve in concentrated sulphuric acid with light red color, and on the addition of an excess of water produce a whitish precipitate which is taken up by chloroform; the crystals from the *F. Clava-Herculis,* dissolve in concentrated sulphuric acid with dark red color, and on dilution separate a purplish precipitate, which is not taken up by chloroform. Lloyd's principle melts, moreover, at 129.5° C., while Eberhardt's melts at 119° C. In 1863, J. D. Perrin separated from the Caribbean *Xanthoxylum Clava-Herculis* an alkaloid which he considered to be *berberine.* This had also been described as early as 1826 by Chevallier and Pelletan under the name of *xanthopicrite.* *X. senegalense* (*artar root*) was analyzed by Giacosa and Soave (*A. J. P.,* 1890, 500), who found a fixed oil, a neutral crystalline substance, melting at 120° C., and two alkaloids. The first of these they call *artarine,* and give to it the formula $C_{20}H_{17}NO_4$ (which makes it agree with *berberine*), or $C_{21}H_{23}NO_4$, in which case they consider that it may be *methylhydroberberine.* The second alkaloid, crystallizing in blood-red needles, they did not analyze.

Uses.—Xanthoxylum is stimulant, producing, when swallowed, a sense of heat in the stomach, with more or less general arterial excitement,

and a tendency to diaphoresis. It is thought to resemble mezereum and guaiac in its remedial action, and is given in the same diseases. As a remedy in *chronic rheumatism,* it enjoys some reputation in this country. The bark, used as a masticatory, is a popular remedy for *toothache.* Xanthoxylum is capable of being used as a counter-irritant, and great relief is sometimes afforded in various forms of chronic pelvic disease in women by means of a hot pack, applied to the lower part of the trunk, of two to four ounces of fluidextract of xanthoxylum and an ounce of tincture of cayenne pepper to two quarts of water. A decoction prepared by boiling an ounce in three pints of water down to a quarter may be given in the quantity of a pint (473 Cc.), in divided doses, during the twenty-four hours.

Dose, fifteen to thirty grains (1 to 2 Gm.).

Off. Prep.—Fluidextractum Xanthoxyli, *U. S.*

ZEA. U. S.

ZEA [Corn Silk]

(zē'ą)

"The fresh styles and stigmas of *Zea Mays* Linné (Fam. *Gramineæ*)." *U. S.*

Stigmata Maydis; Filament de Mais, *Fr.*; Maisgriffel, *G.*

This drug is the so-called "silk" of the ear of ordinary Indian corn or Maize, cultivated in the warmer temperate and subtropical countries of the world. It consists of "a matted mass of slender filaments, 5 to 15 Cm. long, thread-like, yellowish or brownish; nearly inodorous; taste faintly sweetish with a characteristic flavor." *U. S.* Rademaker and Fischer (*A. J. P.,* 1886, p. 369) determined the presence of 2.25 per cent. of *maizenic acid* in dried corn silk. It was first described, however, by Vautier. It is freely soluble in water, alcohol, and ether, but insoluble in benzin. Rademaker and Fischer found, in addition to the acid, fixed oil, resin, chlorophyll, sugar, gum, extractive, albuminoids, phlobaphene salt, cellulose, and water.

Uses.—Zea has been highly recommended by various surgeons as a mild stimulant diuretic, useful in *acute* and *chronic cystitis,* and in the bladder irritation of *uric acid* and *phosphatic gravel.* It has also been employed in *gonorrhœa,* and has been affirmed by Landreux to be a useful diuretic and even cardiac stimulant in the *dropsy of heart disease.* It probably is, however, a feeble remedy comparable to triticum, an infusion of which (two ounces in a pint of boiling water) may be taken almost *ad libitum,* or whose fluidextract may be given in doses of one to three fluidrachms, every two or three hours.

Concerning the activity of *maizenic acid* we have little definite knowledge, but it probably represents whatever physiological power the drug possesses; it has been given in the dose of one-eighth of a grain (0.008 Gm.).

Dose, one to three drachms (3.9 to 11.6 Gm.).

ZINCI ACETAS. U. S., Br.

ZINC ACETATE

(zĭn'cī ą-cē'tăs)

$Zn(C_2H_3O_2)_2 + 2H_2O = 217.82$

"It should contain in the uneffloresced condition not less than 99.5 percent. of pure Zinc Acetate [$(CH_3.COO)_2Zn + 2H_2O$], and should be kept in well-stoppered bottles." *U. S.* "Zinc Acetate, $Zn(C_2H_3O_2)_2,3H_2O$, is prepared by neutralizing acetic acid with zinc carbonate." *Br.*

Acetas Zincicus; Acétate de Zinc, *Fr. Cod.*; Zincum Aceticum, *P. G.*; Zinkacetat, Essigsaures Zink, Essigsaures Zinkoxyd, *G.*

In the U. S. process of 1870 [1] the zinc oxide is acted upon directly by the acetic acid. During the evaporation of the solution of the zinc acetate, a small portion of the acetic acid is lost; and hence the necessity of acidulating with a few drops of acetic acid before crystallizing. Though not economical, these processes have the recommendation of being easily performed, and of yielding a pure product. In relation to zinc acetate, see a paper by Ambrose Smith, *A. J. P.* (vii. 14).

Properties.—Zinc acetate is in "soft, white, six-sided, monoclinic plates, of a pearly lustre, having a faintly acetous odor, and in dilute solutions an astringent, metallic taste. Exposed to the air, the salt gradually effloresces and loses some of its acid. Soluble in about 2.5 parts of water, and in 36 parts of alcohol at 25° C. (77° F.); soluble in 1.5 parts of boiling water, and in 0.6 part of boiling alcohol. On protracted boiling with water acetic acid is lost, and an insoluble basic salt formed. When heated, the salt is partially fused, losing water and acid. At a higher temperature it is decomposed, evolving acetone and other combustible vapors, and leaving a residue of zinc oxide. Its aqueous solution reddens blue litmus paper. The aqueous solution of the salt (1 in 20) yields, with potassium ferrocyanide T.S., a white gelatinous precipitate, and with ammonium sulphide T.S. a pure white precipitate. Ten Cc. of the aqueous solution of the salt (1 in 20), to which 1 Cc. of hydrochloric acid has been added, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. The addition of a few drops of ferric chloride T.S. to an aqueous solution of the salt (1 in 20) produces a red color. Ammonium carbonate T.S., or potassium hydroxide

[1] Take of Commercial Zinc Oxide *two troyounces;* Acetic Acid *eight fluidounces and a half;* Distilled Water *five fluidounces.* Mix the Acid and Water, and digest the Zinc Oxide in the mixture for half an hour, then heat to the boiling point, filter while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother-liquor to one-half, slightly acidulating with acetic acid, and crystallizing." *U. S.* 1870.

T.S., when added in small portions to the aqueous solution of the salt (1 in 20) produces at first a precipitate of a pure white color, which dissolves completely upon the addition of an excess of the reagent. The aqueous solution of the salt (1 in 20), after the addition of a few drops of diluted nitric acid, should remain clear upon the addition of either barium chloride T.S. (absence of *sulphate*) or silver nitrate T.S. (absence of *chloride*). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "In thin translucent and colorless crystalline plates, of a pearly lustre, with a sharp unpleasant taste; soluble in 2.5 parts of *water*. It affords the reactions characteristic of zinc and of acetates. It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium, magnesium, sodium, potassium, ammonium, chlorides, or sulphates." *Br.*

The Br. Pharmacopœia gives in its formula for zinc acetate three molecules of water. Although the U. S. Pharmacopœia of 1880 adopted the formula giving to zinc acetate three molecules of water, Dibbit states that it contains but two molecules. Franchimont has confirmed this, and proved that both of these two molecules are lost at the temperature of 100° C. (212° F.). (*Ber. d. Chem. Ges.*, 1879, p. 11; *A. J. P.*, May, 1879.) The U. S. P. has adopted this view, and recognizes two molecules. The precipitate thrown down by ammonia from the pure salt is entirely redissolved by an excess of the precipitant, but if ferric oxide be present it will be left undissolved. Zinc acetate is decomposed by the mineral acids, with the escape of acetous vapors.

Uses.—Zinc acetate is used almost exclusively as a local remedy. It is employed principally as an astringent collyrium in *ophthalmia*, and as an injection in *gonorrhœa*, after the acute stage in these affections has passed. The strength of the solution usually prescribed is one or two grains to a fluidounce (0.065 or 0.13 Gm. to 30 Cc.) of distilled water.

ZINCI BROMIDUM. U. S.

ZINC BROMIDE

(zĭn'cī brō'mĭ-dŭm)

$ZnBr_2 = 223.62$

"It should contain, when anhydrous, at least 97 percent. of pure Zinc Bromide, and should be kept in small, glass-stoppered bottles." *U. S.*

Zincum Bromatum; Bromure de Zinc, *Fr.*; Bromzink, Zinkbromid, *G.*; Bromuro zincico, *Sp.*

Zinc Bromide may be made either by the direct combination of zinc and bromine, or by dissolving zinc in a solution of hydrobromic acid. L. Lyons proposes to make this salt by dissolving potassium bromide and crystallized zinc sulphate, each, in the smallest quantity of hot water, and mixing while hot. When the mixture has cooled, twice its bulk of alcohol is added, and the whole filtered through asbestos to separate the potassium sulphate. The filtrate is then evaporated to dryness.

Properties.—It is officially described as "a white, granular powder; odorless, having, even in dilute solutions, a sharp, saline and metallic taste. Very deliquescent. Readily soluble in water and alcohol. When heated to 394° C. (741.2° F.), the salt fuses, and, with a careful increase of heat, may be sublimed in the form of needle-shaped prisms. Its aqueous solution gives a slightly acid reaction with blue litmus paper. The aqueous solution of the salt (1 in 20) yields a pure white precipitate with hydrogen sulphide T.S. and ammonium sulphide T.S., and also with potassium ferrocyanide T.S. Silver nitrate T.S. produces a yellowish-white precipitate insoluble in nitric acid and in a moderate excess of ammonia water. If to 10 Cc. of the aqueous solution of the salt (1 in 20) 1 Cc. of chloroform be added, then chlorine water (which has been diluted with an equal volume of water), cautiously introduced, drop by drop, with constant agitation, the liberated bromine will dissolve in the chloroform, imparting to it a yellow to orange color, free from any violet tint (absence of *iodide*). On adding ammonium carbonate T.S. to the aqueous solution of Zinc Bromide, a white precipitate is produced, which should completely redissolve in an excess of the reagent. The aqueous solution of the salt (1 in 20), to which sufficient hydrochloric acid has been added to insure a clear solution, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. Another portion of this aqueous solution should not be rendered turbid by the addition of barium chloride T.S. (absence of *sulphate*). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 1 Gm. of Zinc Bromide be dissolved in 50 Cc. of acetic acid, 2 Gm. of lead dioxide (free from chloride) be added, and the mixture evaporated in a small beaker to at least 10 Cc., then the residue, diluted with 10 Cc. of distilled water and filtered, should give not more than a slight turbidity on the addition of 2 Cc. of nitric acid and a few drops of silver nitrate T.S. (limit of *chloride*). If 0.3 Gm. of the anhydrous salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate T.S. be added, it should require not less than 26 Cc. nor more than 26.8 Cc. of tenth-normal silver nitrate V.S. to produce a permanent red color, corresponding to not less than 97 percent. of the pure salt." *U. S.*

Uses.—Zinc bromide is capable in excessive doses of acting as an irritant poison. It has been commended in *epilepsy*, but is of no value.

Dose, one to two grains (0.065 to 0.13 Gm.).

ZINCI CARBONAS PRÆCIPITATUS. U. S. (Br.)

PRECIPITATED ZINC CARBONATE

(zĭn'cī cär'bo-năs præ-cĭp-ĭ-tā'tŭs)

"Hydrated Zinc Carbonate, which, upon ignition, should yield not less than 72 percent. of zinc oxide [ZnO = 80.78]." *U. S.* "Zinc Carbonate or zinc hydroxycarbonate, $ZnCO_3(Zn H_2O_2)_2,H_2O$, is produced by the interaction of zinc sulphate and sodium carbonate." *Br.*

Zinci Carbonas, *Br.*, Zinc Carbonate; Zinci Carbonas Præcipitata, *U. S.* 1870; Carbonate of Zinc; Zincum Carbonicum, Carbonas Zincicus; Carbonate (sous-) de Zinc Hydraté, Hydrocarbonate de Zinc, *Fr. Cod.*; Carbonate de Zinc, *Fr.*; Zinkcarbonat, Kohlensaures Zinkoxyd, *G.*

Calamina, U. S. 1850, was dropped from the U. S. Pharmacopœia in 1860 on account of its impurities, and in the 1880 revision the formula for its substitute was also omitted. In the U. S. formula of 1870 [1] a double decomposition takes place between the salts employed, resulting in the formation of sodium sulphate in solution, and basic zinc carbonate which is precipitated. Sodium carbonate is preferable to potassium carbonate for decomposing the sulphate, since the former gives rise to sodium sulphate, which is more easily washed away than the potassium sulphate derived from the latter. Boiling water is properly used in the process, in order to obtain a pulverulent precipitate, which is readily washed. If cold solutions are used, a gelatinous precipitate is formed, which is washed with difficulty. When a solution of zinc sulphate is precipitated by an excess of acid potassium carbonate, a normal zinc carbonate is obtained. With normal sodium carbonate, on the other hand, taken as a precipitant, a basic salt results.

Properties.—It is officially described as "an impalpable, white powder, of somewhat variable chemical composition, without odor or taste. Permanent in the air. Insoluble in water or alcohol; completely soluble in diluted acids with copious effervescence; also soluble in ammonia water, and in ammonium carbonate T.S. When strongly heated, the salt loses water and carbon dioxide, and leaves a residue, which is yellow while hot, but becomes white on cooling. When a small portion of the salt is moistened with a drop of cobaltous nitrate T.S., and heated before the blow-pipe, it will assume a vivid green color. For making tests of identity and purity, make a solution by adding 10 Cc. of diluted sulphuric acid and 10 Cc. of water to 1.25 Gm. of the salt, and, after effervescence has ceased, remove the undissolved excess by filtration. In a portion of this solution a white gelatinous precipitate is produced by potassium ferrocyanide T.S., and a pure white precipitate by ammonium sulphide T.S. Another portion of the solution, acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. Another portion of the solution should yield, with ammonium carbonate T.S., a white precipitate, which should redissolve completely in an excess of the reagent. If 1 Gm. of the salt be placed in a flask with 10 Cc. of boiling water, and 2 drops of phenolphthalein T.S. added, not more than 1 Cc. of tenth-normal hydrochloric acid V.S. should be required to discharge the red color (limit of *alkali*). One Gm. of Zinc Carbonate, after strong ignition in a porcelain crucible, should leave a residue of zinc oxide weighing not less than 0.720 Gm." *U. S.* "A white, tasteless, inodorous powder, insoluble in *water,* entirely soluble in *diluted nitric acid.* It affords the reactions characteristic of zinc and of carbonates. It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium, magnesium, sodium, potassium, or ammonium, and only the slightest reactions with the tests for chlorides or sulphates." *Br.* If adulterated with chalk it will be only partly soluble in oxalic acid solution. Precipitated zinc carbonate is often sold under the incorrect name of *flowers of zinc,* a name which properly belongs only to the oxide, as obtained by combustion. When obtained from solutions of zinc sulphate and sodium carbonate it has a variable composition, as different hydrated basic carbonates are formed, according to the temperature used, etc.; the higher the temperature and the larger the quantity of water used, the more basic the carbonate becomes. According to the Br. Pharmacopœia, it consists, as thus prepared, of one molecule of zinc carbonate and two molecules of zinc oxide, with three molecules of water ($ZnCO_3 + 2ZnO + 3H_2O$). Its composition is sometimes stated as $(ZnCO_3)_2 3Zn(HO)_2 = 546.96$. The basic character of the salt official in the U. S. P. 1870 is explained by the fact that effervescence of carbon dioxide takes place on mixing the solutions.

Uses.—It is employed for the same purposes as prepared calamine, and is gradually superseding the spurious article usually sold under that name. The U. S. P. 1870 ordered a cerate made from it as a substitute for calamine cerate.

Off. Prep.—Liquor Zinci Chloridi, *U. S., Br.*

[1] "Take of Sulphate of Zinc, Carbonate of Sodium, each, *twelve troyounces;* Water, *eight pints.* Dissolve the salts separately, with the aid of heat, each in four pints of the Water. Then mix the solutions, and, having stirred the mixture, set it by, that the powder may subside. Lastly, having poured off the supernatant liquid, wash the precipitate with hot water until the washings are nearly tasteless, and dry it with a gentle heat." *U. S.* 1870.

ZINCI CHLORIDUM. U. S., Br.

ZINC CHLORIDE

(zĭn'cī ¢hlō'rĭ-dŭm)

$ZnCl_2 = 135.26$

"It should contain, when anhydrous, not less than 99.5 percent. of pure Zinc Chloride, and

should be kept in small, glass-stoppered bottles." *U. S.* "Zinc Chloride, $ZnCl_2$, is produced by the interaction of hydrochloric acid and zinc." *Br.*

Butter of Zinc; Chloruretum Zincicum; Chlorure de Zinc, *Fr. Cod.;* Zincum Chloratum, *P. G.;* Zinkchlorid, Chlorzink, *G.;* Cloruro zincico, *Sp.*

The British Pharmacopœia does not give a detailed process for making this salt; that of the Br. Pharm. 1885 follows.

"Take of Granulated Zinc *one pound* [avoirdupois]; Hydrochloric Acid *forty-four fluidounces* [Imperial measure]; Solution of Chlorine *a sufficiency*; Carbonate of Zinc *half an ounce* [av.], or *a sufficiency;* Distilled Water *one pint* [Imp. meas.]. Put the Zinc into a porcelain basin, add by degrees the Hydrochloric Acid previously mixed with the water, and aid the action by gently warming it on a sand-bath until gas is no longer evolved. Boil for half an hour, supplying the water lost by evaporation, and allow it to stand on a cool part of a sand-bath for twenty-four hours, stirring frequently. Test a few drops of the resulting liquid for iron or lead by adding excess of ammonia and then sulphydrate of ammonium, when a black precipitate will be produced if iron or lead be present.

In the latter case filter the remainder of the product into a gallon bottle, and pour in the solution of chlorine by degrees, with frequent agitation, until the fluid acquires a permanent odor of chlorine. Add the carbonate of zinc, in small quantities at a time, and with renewed agitation, until a brown sediment appears, and the whole of the iron or lead is thus precipitated. Filter through paper into a porcelain basin, and evaporate until a portion of the liquid, withdrawn on the end of a glass rod and cooled, forms an opaque white solid. Pour it out now into proper moulds, and when the salt has solidified, but before it has cooled, place it in closely-stoppered bottles. If no iron or lead be present, filter and evaporate, etc., at once." *Br.* 1885.

In the U. S. process of 1870 [1] the zinc chloride is obtained by evaporating the previously formed solution. The British first prepares the zinc chloride in solution, and in order to get rid of the iron uses chlorine, which combines with the iron to form ferric chloride, and, zinc carbonate being added, the zinc combines with the chlorine to increase the product of zinc chloride, while ferric oxide is deposited and carbon dioxide is set free. As this preparation is used chiefly as a caustic, it is melted and cast into moulds as the last step in the Br. process. In relation to this chloride, the reader is referred to a paper by B. J. Crew in *A. J. P.*, 1853. Rhighini prepares this chloride by double decomposition between solutions of barium chloride and zinc sulphate. Barium sulphate is precipitated, and zinc chloride remains in solution, from which it is obtained in white flaky crystals by due evaporation. As zinc sulphate is obtainable in considerable quantities as a cheap by-product in the washing of pyrites and other sulphide ores containing zinc, as well as from the so-called "pickle waste" solutions from brass foundries, this is sometimes used as a commercial source for the manufacture of zinc chloride. Finely ground salt is added to the zinc sulphate solution, and the mixture chilled, when the sodium sulphate produced by the reaction crystallizes out, leaving zinc chloride in solution.

Properties.—It is officially described as "a white, granular powder, or porcelain-like masses, irregular, or moulded into pencils; odorless, *of such intensely caustic properties as to make tasting dangerous,* unless the salt be dissolved in much water; the dilute solution has an astringent, metallic taste. Very deliquescent. Soluble in about 0.4 part of water at 25° C. (77° F.), forming a clear solution, which, on protracted boiling, deposits a basic salt; very soluble in alcohol. When heated to 115° C. (239° F.), Zinc Chloride fuses to a clear liquid. At a higher temperature it is partly volatilized in dense, white fumes, and partly decomposed, leaving a residue of zinc oxide. Its aqueous solution reddens blue litmus paper. The aqueous solution of the salt (1 in 20) yields, with potassium ferrocyanide T.S., a white gelatinous precipitate, and with ammonium sulphide T.S. a pure white precipitate. Silver nitrate T.S. produces a white precipitate insoluble in nitric acid. The aqueous solution (1 in 20) should be clear, or at most only very slightly opalescent; and if it be mixed with an equal volume of alcohol, a single drop of hydrochloric acid should suffice to render 10 Cc. of the mixture perfectly clear (limit of *oxychloride*). The aqueous solution of the salt (1 in 20), to which 1 Cc. of diluted hydrochloric acid has been added, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. If ammonium carbonate T.S. be added, in small portions, to the aqueous solution (1 in 20), the precipitate produced should be of a pure white color, and should redissolve completely in an excess of the reagent. The aqueous solution of the salt (1 in 20), after the addition of 1 Cc. of diluted hydrochloric acid, should not be rendered turbid by the addition of barium chloride T.S. (absence of *sulphate*). Dissolve 0.5 Gm. of Zinc Chloride in 200 Cc. of boiling distilled water, add about 5 drops of phenolphthalein T.S., and then sufficient sodium carbonate T.S., with constant stirring, to cause the solution to assume a permanent red color; transfer the resulting precipitate to a plain filter, wash it with boiling distilled water until all soluble matter

[1] "Take of Solution of Chloride of Zinc *a convenient quantity.* Evaporate the Solution to dryness in an evaporating dish, fuse the dry mass, pour the liquid on a flat stone, and when it has congealed, break the mass in pieces, and keep the fragments in a well-stopped bottle." *U. S.* 1870.

has been removed, then dissolve it in a sufficient quantity of nitric acid, evaporate the solution to dryness, and ignite the salt until it ceases to lose weight; the residue should weigh not less than 0.297 Gm." *U. S.* "In colorless opaque rods or tablets, very deliquescent and caustic; almost entirely soluble in *water, alcohol* (90 per cent.), and *ether*. It affords the reactions characteristic of zinc and of chlorides. It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium, magnesium, sodium, potassium, ammonium, or sulphates." *Br.*

When pure, it is wholly soluble in water, alcohol, and ether, but as prepared by the U. S. formula it contains some oxychloride, which is left undissolved by water. According to Lassaigne, commercial zinc chloride sometimes contains as much as 12 per cent. of zinc arsenate, which, being insoluble in solution of zinc chloride, will be left undissolved when the chloride is treated with water. By filtration, therefore, it may be entirely separated. It yields with ammonium and potassium hydroxide a white precipitate, soluble in those reagents when added in excess. It tends to form basic insoluble compounds, the so-called *oxychlorides*, of which Sorel's mass, $Zn \begin{cases} OH \\ Cl \end{cases}$, is an example. These are used for cements and as a filling for teeth. The potassium and sodium carbonates also throw down white precipitates, which are not dissolved by an excess of the precipitants. Zinc chloride has a strong tendency to combine with organic bases, forming crystallizable compounds, as with strychnine, morphine, quinine, cinchonine, etc., in this respect resembling certain other metallic chlorides, as platinum, palladium, gold, and mercury chlorides. (*J. P. C.*, 4e sér., iii. 56.) When exposed to heat, zinc chloride first melts and then sublimes. It has been obtained in small deliquescent octahedrons of the formula $ZnCl_2 + H_2O$, by evaporating its hydrochloric acid solution to a syrup, and then adding a little concentrated hydrochloric acid. It consists of one atom of zinc and two of chlorine.[1]

Uses.—Zinc chloride was introduced into medicine by Papenguth of St. Petersburg, and subsequently recommended by Hancke of Breslau, and Canquoin of Paris. Internally it has been given as an alterative and antispasmodic in *scrofula, epilepsy, chorea,* and other nervous diseases, but is of little or no value. Its chief use has been as an escharotic in *cancerous affections*. As a caustic it has the advantage of not causing constitutional disorder from absorption. Canquoin prepared zinc chloride as an escharotic by thoroughly and quickly mixing it with wheat flour and water into a paste of four different strengths, containing severally an ounce of the chloride incorporated with two, three, four, and five ounces of flour, fifteen drops of water being added for every ounce of flour, or sufficient to form the paste.[2] According to the French Codex, *Caustique au Chlorure de Zinc*[3] (*Canquoin's Paste*) is prepared by dissolving 8 parts of zinc chloride in 1 part of cold water and incorporating a mixture of 6 parts of flour with 2 parts of zinc oxide.

It is applied in cakes from a twelfth to a third of an inch in thickness, and produces an eschar more or less deep (from a line to an inch and a half), according to the thickness and strength of the paste, the length of the application, and the nature of the part acted on. Canquoin's strongest paste is applied to lardaceous and fibro-cartilaginous structures; the second, to *carcinomatous tumors,* and very painful *cancers* which have not much thickness; and the third, to *cancerous affections* in persons who have a dread of the use of the knife. These preparations, applied to the skin denuded of its cuticle by means of a blister, excite in a few minutes a sensation of heat, and afterwards violent burning pain. The eschar, which is white, thick, and very hard, falls off, with the aid of an emollient poultice, between the eighth and twelfth days. In all cases the caustic is to be reapplied, after the falling off of the eschar, until the whole morbid structure is destroyed. When the skin is unbroken, it is usual to destroy not merely the cuticle, but the true skin also, by means of acid mercuric nitrate, to the extent to which the chloride is desired to operate. This is applied spread on lint, and the dressing is covered with a portion of cotton wadding, to absorb any discharge and to preserve a uniform temperature. The surrounding skin should be protected from the caustic by a thickly-spread dressing of simple cerate.

Instead of flour, Alex. Ure of Glasgow, mixes the chloride with pure anhydrous calcium sulphate in impalpable powder. He states that this has the advantages of furnishing a porous medium from which the escharotic gradually exudes into the morbid structure, and of forming afterwards, by acquiring a firmer consistence, an impervious case for the eschar. Cock of Guy's Hospital, has imitated this mode of preparing the chloride, so as to form a caustic which may be limited in its action and does not run. It may be prepared as a caustic

[1] For the chemistry of its influence on camphor, see *Chem. News*, xx. 1869, p. 229.

[2] *Felix's Caustic Paste* (*L. L.*, vol. ii. 1887) is made according to the following formula: Starch, 37 grammes; Wheat Flour, 112 grammes; Mercuric Chloride, 1 gramme; Dry Zinc Chloride, 110 grammes; pure Iodol, 10 grammes; Croton Chloral, 10 grammes; Camphor Bromide, 10 grammes; Crystallized Carbolic Acid, 10 grammes; Distilled Water, sufficient to form a stiff homogeneous paste. The hand should be wetted when applying it. The paste is allowed to remain on from six to twenty-four hours, according to the amount of eschar it is desired to form.

[3] P. Carles states that the official paste is too hygroscopic; he triturates in a mortar 10 grammes of fused zinc chloride with 2 grammes of 60 per cent. alcohol, and incorporates, with constant trituration, 15 grammes of wheat flour. This mass may be formed into cylinders of suitable size, and when once dry is but little affected by atmospheric humidity. (*L'Union Pharm.*)

seton by thickly covering a waxed cotton wick with Canquoin's caustic paste, and then rolling it out in the form of a cylinder, according to the plan of Ancrénis of Lyons. A thread is wound spirally round the cylinder to give it firmness.

In overdoses, zinc chloride acts as a corrosive poison, producing burning pain in the gullet and stomach, nausea and vomiting, cold sweats, depression of the pulse, and cramps of the legs. The antidotes are weak alkalies, or their carbonates, and, if these be not immediately at hand, soap.[1] Zinc chloride is not used internally.

Zinc chloride is a useful disinfectant, being inexpensive and comparatively non-poisonous.

ZINCI IODIDUM. U. S.

ZINC IODIDE

(zĭn'cī ī-ōd'ĭ-dŭm)

$ZnI_2 = 316.70$

"It should contain, when anhydrous, not less than 98 percent. of pure Zinc Iodide, and should be kept in small, glass-stoppered bottles protected from light." *U. S.*

Zincum Iodatum; Iodure de Zinc, *Fr.*; Zinkjodid, Jodzink, *G.*

This iodide may be formed by digesting an excess of zinc, in small pieces, with iodine diffused in water. Combination takes place, and, by evaporation, a deliquescent, very soluble saline mass is obtained, having a metallic styptic taste, resembling that of zinc sulphate. It may also be obtained by heating in a flask a mixture of 20 parts of zinc and 170 of iodine, and subliming into a vial. Thus prepared, it is in the form of white needles. This salt is very liable to spontaneous decomposition.

Properties.—The U. S. Pharmacopœia (8th Rev.) describes it as "a white, granular powder; odorless, and having a sharp, saline and metallic taste. Very deliquescent, and, upon exposure to air and light, becoming brown from liberated iodine. Readily soluble in water, alcohol, or ether. When heated to about 446° C. (834.8° F.), the salt fuses to a colorless liquid, and at a higher temperature sublimes, forming quadratic needles, while a small part is decomposed and leaves a residue of zinc oxide. Its aqueous solution reddens blue litmus paper. An aqueous solution of the salt (1 in 20) yields a white gelatinous precipitate with potassium ferrocyanide T.S., and a pure white precipitate with ammonium sulphide T.S. With silver nitrate T.S. it yields a pale yellow precipitate, insoluble in ammonia water; with mercuric chloride T.S., a red precipitate, soluble in potassium iodide T.S. The aqueous solution of the salt (1 in 20), to which sufficient diluted hydrochloric acid has been added to insure a clear solution, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. Another portion of the aqueous solution should not be rendered turbid upon the addition of barium chloride T.S. (absence of *sulphate*). If ammonium carbonate T.S. be added to the aqueous solution of the salt (1 in 20), a pure white precipitate will form, which should redissolve completely in an excess of the reagent. Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17). If 1 Gm. of Zinc Iodide be mixed with 5 Cc. of distilled water, and sufficient ammonia water be added to redissolve the precipitate formed, followed by a solution of 1.5 Gm. of silver nitrate in 10 Cc. of water, then, after shaking and filtering, the filtrate should not be rendered more than slightly turbid by the addition of an excess of nitric acid (limit of *chloride*). If 0.5 Gm. of dry Zinc Iodide be dissolved in 20 Cc. of water, and if 35 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of nitric acid, and 3 Cc. of ferric ammonium sulphate T.S. be added, and the mixture well shaken, then the addition of not less than 3.4 Cc. nor more than 4 Cc. of tenth-normal potassium sulphocyanate V.S. should be required to give a permanent reddish-brown tint to the solution." *U. S.*

Uses.—Zinc iodide was proposed by Barlow as an alterative remedy in *chorea, scrofula,* and *hysteria* (*M. T. G.,* Nov. 1853), but has failed to come into general use. The best form of administration is in *syrup,* to protect it from change.[2] Zinc iodide has been used as an external application. A solution containing from one to two grains (0.065 to 0.13 Gm.) to the fluidounce (30 Cc.) of water has been used as an astringent injection in *gonorrhœa.*

Dose, one-half to two grains (0.032 to 0.13 Gm.).

[1] *Solution of Zinc Hypochlorite.*—This may be prepared by the process of R. F. Fairthorne, as follows: "Take of Chlorinated Lime, 12 troyounces; Zinc Sulphate, 24 troyounces; Water, 12 pints. Dissolve the zinc sulphate in three pints of water. Triturate the chlorinated lime, a little at a time, with portions of the water added slowly, and mix thoroughly with the remainder of the water. Allow it to stand until the lime has subsided. Pour off the clear liquid. Transfer the sediment to a muslin strainer, and allow it to drain until sufficient liquid has passed to measure 8 pints with the decanted portion of the solution. Mix this with the solution of zinc sulphate, and, having set it aside for twelve hours, pour off the clear portion of the liquid and place the remaining portion on a piece of muslin to drain. Mix these liquids, and pour more water on the precipitate, if necessary, so as to make 11½ pints of the finished product." (*A. J. P.,* March, 1881.) This solution is recommended as having advantages over solution of chlorinated soda, in not being alkaline, and as combining astringent and antiseptic properties, and thus useful as an ingredient in gargles, injections, or lotions.

[2] *Syrup of Zinc Iodide.*—A. B. Taylor prepared a *syrup of zinc iodide* by gently heating, in an evaporating dish, *twelve drachms and two scruples* of iodine and *an ounce* of finely granulated zinc, with *nine fluidounces* of water, until they unite, filtering the solution, while hot, on *a pound* (av.) of sugar, contained in a wide-mouthed bottle holding a little more than a pint, and adding, through the filter, sufficient water to make the whole measure a pint. This syrup is perfectly clear and colorless, is styptic to the taste, and contains a drachm of zinc iodide in each fluidounce. (*A. J. P.,* Jan. 1852, p. 33.) The dose of this syrup is from twenty to fifty minims (1.3 to 3.1 Cc.), sufficiently diluted with water, three times a day.

ZINCI OXIDUM. U. S., Br.

ZINC OXIDE

(zĭn'cī ŏx'ĭ-dŭm)

$ZnO = 80.78$

"It should contain not less than 99.5 percent. of pure Zinc Oxide." *U. S.* "Zinc Oxide, ZnO, may be prepared by exposing zinc carbonate to a dull red heat, or from metallic zinc by combustion." *Br.*

Flores Zinci; Oxydum Zincicum; Oxyde de Zinc par voie sèche, Fleurs de Zinc, *Fr. Cod.*; Zincum Oxydatum, *P. G.*; Philosophenwolle, Zinkblumen, Zinkoxyd, *G.*; Oxido zincico, *Sp.*

Preparation.—The British Pharm. 1885 and the U. S. P. 1870[1] prepared the zinc oxide from the carbonate already formed. By referring to the article on Precipitated Zinc Carbonate, it will be found that it is obtained in the process from zinc sulphate, by the decomposing influence of sodium carbonate. Other methods of obtaining the zinc carbonate are by the mutual decomposition of the sodium chloride and carbonate and the ammonium sulphate and carbonate, but the former official plan is preferred. Lefort found it to furnish a carbonate which is washed with facility and is convertible by calcination into a pure oxide, readily reduced to an impalpable and very light powder. (*J. P. C.*, 3e sér., xi. 329.) It is, besides, more economical. The zinc carbonate, in whatever way obtained, is exposed to heat to drive off the carbon dioxide and water, in order to obtain the oxide. According to Mohr, a full red heat is not necessary, a temperature between 280° and 300° C. (536° and 572° F.) being sufficient. It is probable that an unnecessarily high heat injures the oxide as a therapeutic agent.

Zinc oxide may be obtained by the combustion of the metal, and in this way it was formerly prepared by the Dublin College. Zinc melts at 433° C. (801.4° F.), and immediately becomes covered with a film of gray oxide. When the temperature reaches nearly to redness, it takes fire and burns with an intense white light, generating the oxide in the form of very light and white flocculi, resembling carded wool, which quickly fill the crucible, and are in part driven into the atmosphere by the current of air. The late G. D. Midgely of London, several years ago, called attention to the production of zinc oxide by combustion, and gave a description of the apparatus by which he was enabled to prepare from one to two hundredweight of the oxide at one operation. It consisted of a large muffle, heated to redness in a suitable furnace, and supplied with zinc from time to time as the combustion proceeded. The necessary draught of air was conveyed from the muffle by a tube passing through the top of the furnace and terminating in a vessel of water, in which the portion of oxide carried up by the current was retained. The resulting oxide was freed from particles of metallic zinc by being passed through a sieve. Zinc oxide has been very largely produced from calamine by the so-called "furnace and bag" process, at Bethlehem, Pa., by the Lehigh Zinc Company. The process is as follows: The ore is first ground fine by a stone crusher, and then carefully mixed with coal known as "buckwheat," next in grade to "pea." It is then transferred to the furnaces, of which there are fifty-four, with 1390 feet of grate-surface. Within these the mixed coal and ore are reduced by the direct action of heat and the cold blast upon a furnace bed having a multiplicity of small holes, each producing the reducing flame of the blow-pipe. The zinc oxide rises, and passes through a huge combustion flue to a large circular tower, 50 feet high, in which the oxide and ashes separate. The ashes being heavier than the oxide, the velocity of the fans which impel the product forward lifts the oxide to the top, and the ashes drop to the bottom. The oxide is forced onward through a cooling-room, size 80 by 40 feet, and heated to from 400° to 700° F. Thence the oxide is blown through large flues into the "bag" room. This is in a large building, devoid of furniture, except bags of muslin, 45 feet long, in which the oxide is deposited. It is now very white, and, after being kiln-dried and bolted, is by heavy pressure reduced in bulk and barrelled, ready for shipment. The production of zinc oxide for pigment purposes has assumed large proportions, amounting in 1904 to 63,363 short tons, valued at $4,808,482, and in 1905 to 65,403 short tons, valued at $5,232,240.

Properties.—The official zinc oxide is described in the U. S. Pharmacopœia as "a very fine, amorphous, white or yellowish-white powder, free from gritty particles, without odor or taste; it gradually absorbs carbon dioxide from the air. Insoluble in water or alcohol. Completely soluble without effervescence, in diluted acids; also in ammonia water, and in ammonium carbonate T.S. When heated, it assumes a yellow color, which disappears on cooling. If a small portion of Zinc Oxide be moistened with a drop of cobaltous nitrate T.S., and heated before the blow-pipe, it will assume a vivid green color. For making tests of identity and purity, digest 1 Gm. of Zinc Oxide, with occasional agitation, in a mixture of 10 Cc. of diluted hydrochloric acid and 10 Cc. of water until saturated; then remove the undissolved Zinc Oxide by filtration. In a portion of the filtrate a white gelatinous precipitate is produced by potassium ferrocyanide T.S., and a pure white precipitate by ammonium sulphide T.S. Another portion of the filtrate, acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test

[1] "Take of Precipitated Carbonate of Zinc *twelve troyounces*. Expose it, in a shallow vessel, to a low red heat until the water and carbonic acid are wholly expelled." *U. S.* 1870.

No. 121); in applying this test the addition of ammonia water should be omitted. Another portion of the filtrate should yield, upon the gradual addition of ammonium carbonate T.S., a pure white precipitate, which should almost completely redissolve in an excess of the reagent. If 1 Gm. of Zinc Oxide be placed in a flask with 10 Cc. of boiling water, and 2 drops of phenolphthalein T.S. be added, not more than 1 Cc. of tenth-normal hydrochloric acid V.S. should be required to discharge the red color (limit of *alkali*). If 1 Gm. of Zinc Oxide be dissolved in a sufficient quantity of diluted nitric acid, the solution should remain clear upon the addition of silver nitrate T.S. (absence of *chloride*), and not become more than slightly turbid upon the addition of barium chloride T.S. (limit of *sulphate*). If 1 Gm. of freshly ignited Zinc Oxide be digested with 30 Cc. of normal hydrochloric acid V.S. until solution is complete, and 2 drops of methyl-orange T.S. be added, not more than 5.4 Cc. of normal potassium hydroxide V.S. should be required for neutralization (each Cc. of normal hydrochloric acid consumed corresponding to about 4 percent. of zinc oxide). The normal potassium hydroxide V.S. should be added slowly with constant stirring, waiting until the precipitated zinc hydroxide has redissolved before adding further portions of the reagent." *U. S.* "Prepared from the carbonate it is a soft, nearly white, tasteless and inodorous powder, becoming pale yellow when heated; prepared by combustion it is white. It affords the reactions characteristic of zinc. It should be entirely soluble when rubbed, and, if necessary, warmed, with *solution of ammonia* mixed with *strong solution of ammonia* (absence of metallic zinc). It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium, magnesium, sodium, potassium, ammonium, carbonates, chlorides, or sulphates." *Br.* As obtained by combustion, it is perfectly white. It dissolves in solution of potassium and sodium hydroxides, but not in their carbonates. Being anhydrous, it is insoluble in ammonia, but the impure oxide found in commerce, being generally hydrated, is soluble in that alkali. At a low white heat it fuses, and at full whiteness sublimes. When prepared by combustion it was formerly called *pompholix, nihil album, lana philosophica,* and *flowers of zinc.* Prepared by the old official process,—namely, by precipitating zinc sulphate with ammonia,—it contains the subsulphate, the acid of which may be detected by dissolving the oxide in nitric acid and precipitating by barium nitrate. Sometimes it is obtained by precipitating zinc chloride with ammonia, in which case the oxide contains subchloride, easily detected by silver nitrate. If it contains white lead or chalk, it will not be entirely soluble in diluted sulphuric acid, but an insoluble lead or calcium sulphate will be left. If iron be present, brownish-red flocks of ferric oxide will remain undissolved when the hydrochloric acid solution of the zinc oxide is treated with ammonia in excess.

The powder sold in commerce as zinc oxide is often very impure. Sometimes the carbonate is substituted for it, showing that the exposure to a red heat has been omitted. In this case the preparation will effervesce with acids. Some samples contain a large proportion of subsulphate, showing that the discarded but productive process of precipitating the solution of zinc sulphate by ammonia has been employed. Again, other samples contain oxychloride. These impure oxides are pointed out by Redwood of London, as occurring in the English market, and no doubt are sold in the United States. (See *P. J.*, 1855, p. 301.) A sample of commercial zinc oxide is noticed in *N. R.*, Aug. 1878, which proved to be powdered gypsum. Unfortunately, a white oxide is preferred by purchasers, though whiteness is generally a sign of impurity; the yellowish-white official oxide should be exclusively used by pharmacists.

Uses.—This oxide is antispasmodic and astringent. It has been given in *chorea, epilepsy, whooping cough,* and *gastric* and *intestinal catarrhs.* Externally it is employed as an exsiccant to excoriated surfaces and in various *skin diseases,* sometimes by sprinkling it on the affected part, but generally in the form of ointment. (See *Unguentum Zinci Oxidi.*) It has also been used in *gonorrhœa.* (*N. R.*, July, 1874.) As a cosmetic it has the great advantage over the preparations of lead of not being poisonous.

Zinc oxide, prepared by combustion, called commercial zinc oxide, is extensively used in painting as a substitute for white lead, over which it has the advantage of not being discolored by hydrogen sulphide. It is stated that it has greater covering power as a color than white lead, 10 parts being equal to 13 of white lead. It is, however, dearer, so that the pure oxide has not replaced white lead. The oxide thus prepared, even though pure, should not be substituted for the official, as it has not the smoothness and freedom from gritty particles possessed by the latter. There is an English preparation known as *Griffith's zinc white,* or *lithophone,* made by precipitating zinc sulphate by barium sulphide; it is, therefore, a mixture of zinc sulphide and barium sulphate. If this be roasted in a current of superheated steam the zinc sulphide will be converted into zinc oxide. This process has been patented in Germany by Meissner. (Wagner's *Chem. Technol.*, 11th ed., p. 159.) It has, moreover, the merit of not producing injurious effects on the workmen at all comparable to those caused by white lead. It is, indeed, usually considered innocuous; but a case of chronic poisoning by it has been reported by Botkin. (*B. F. M. R.*, ii. 1873.)

Dose, two to five grains (0.13 to 0.32 Gm.), preferably in pill form.

Off. Prep.—Unguentum Zinci Oxidi, *U. S.* (*Br.*).

ZINCI PHENOLSULPHONAS. U. S. (Br.)

ZINC PHENOLSULPHONATE [Zinc Sulphocarbolate]

(zĭn'cī phē-nŏl-sŭl'phŏ-năs)

$Zn(C_6H_5O_4S)_2 + 8H_2O = 551.56$

"It should contain, in uneffloresced crystals, not less than 99.5 percent. of pure Zinc Paraphenolsulphonate [$(C_6H_4(OH)SO_3)_2Zn$ 1 : 4 + $8H_2O$], and should be kept in small, well-stoppered bottles." *U. S.* "Zinc Sulphocarbolate, or zinc phenol-para-sulphonate, $Zn(OH.C_6H_4SO_3)_2,H_2O$, may be obtained by heating a mixture of phenol and sulphuric acid, and saturating the product with zinc oxide." *Br.*

Zinci Sulphocarbolas, *Br.*; Zincum Sulphophenolicum; Zinc Paraphenolsulphonate; Sulphophénate de Zinc, *Fr.*; Phenolsulfosaures Zink, Sulfokarbolsaures Zink, *G.*

Properties.—It is officially described as in "colorless, transparent, rhombic prisms or tabular crystals; odorless, and having an astringent, metallic taste. Exposed to the air the salt effloresces, and upon exposure to light and air may become slightly pink. Soluble in 1.7 parts of water or alcohol at 25° C. (77° F.), and in 0.3 part of boiling water, and 0.56 part of boiling alcohol. When heated to 100° C. (212° F.), the salt loses 6 molecules of water of crystallization, and it loses the remainder at 125° C. (257° F.). At a higher temperature it chars, emitting inflammable vapors having the odor of phenol, and finally leaves a residue amounting to about 14.6 percent. of the original weight. Its aqueous solution reddens blue litmus paper. A dilute solution of the salt (1 in 100) is colored pale violet by ferric chloride T.S. The aqueous solution of the salt (1 in 20) yields, with potassium ferrocyanide T.S., a white gelatinous precipitate, and, with ammonium sulphide T.S., a pure white precipitate. Ammonium carbonate T.S., or potassium hydroxide T.S., when added in small portions to the aqueous solution of the salt (1 in 20), produces a precipitate of a pure white color, which dissolves completely upon the addition of an excess of the reagent. The aqueous solution of the salt (1 in 20), to which 1 Cc. of diluted hydrochloric acid has been added, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. The aqueous solution of the salt (1 in 20) should not become turbid upon the addition of barium chloride T.S. (absence of *sulphate*), nor silver nitrate T.S. (absence of *chloride*). Five Cc. of the aqueous solution of the salt (1 in 10) should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "Colorless, transparent, tabular, efflorescent crystals; soluble in 2.5 parts of *alcohol* (90 per cent.), and in 2 parts of *water.* The aqueous solution is colored violet by *test-solution of ferric chloride,* and affords a white precipitate with *solution of ammonium hydrosulphide.* It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium, magnesium, sodium, potassium, ammonium, acetates, or chlorides, and only the slightest reactions with the tests for sulphates." *Br.*

Uses.—Zinc phenolsulphonate has been employed as an antiseptic astringent stimulant to indolent or foul *ulcers,* and in subacute inflammations of the mucous membrane. The solutions used may be a little stronger than those of zinc sulphate employed for similar purposes. It has also been used as an intestinal antiseptic.

Dose, one to three grains (0.065 to 0.2 Gm.).

ZINCI STEARAS. U. S.

ZINC STEARATE

(zĭn'cī stē'ăr-ăs)

Stéarate de Zinc, *Fr.*; **Zinkstearat, Stearinsaures Zinkoxyd, Talgsaures Zinkoxyd,** *G.*

Preparation.—Zinc stearate may be made by Hallberg's formula as follows: Castile Soap, granular and dried, *two hundred grammes;* zinc acetate, *seventy-five grammes;* distilled water, *a sufficient quantity.* Add the soap to 3000 Cc. of hot distilled water; stir until dissolved; strain the liquid, and set it aside until cold. Dissolve the zinc acetate in 5000 Cc. of cold distilled water, and filter the solution into the soap solution, stirring constantly. Draw off the liquid, and wash the precipitate thoroughly several times with water; collect the magma on a muslin strainer without expression, and let it dry by exposure to air, without heat, protecting it against dust. Zinc stearate may also be made by mixing a solution of potassium stearate with one of zinc acetate, washing, and then drying the precipitate. For a process for zinc oleostearate by F. E. Niece in which he uses oleic and stearic acids and solution of zinc acetate, see *Proc. Penna. Pharm. Assoc.,* 1902, 135. Zinc stearate differs from the oleate of zinc of the U. S. P. 1890; the latter was a soft ointment-like solid.[1]

Properties.—It is officially described as "a very fine, white powder, tasteless, and having a very faint odor, resembling that of fat. Zinc Stearate contains a small but varying proportion of zinc palmitate. Insoluble in water, alcohol, or ether. When heated, the salt fuses. At a higher temperature it is decomposed, giving off inflammable vapors and the odor of burning fat, and finally leaves about 15.5 per-

[1] *Oleatum Zinci.* U. S. *Oleate of Zinc.*—"Zinc Oxide, *fifty grammes* [or 1 ounce av., 334 grains]; Oleic Acid, *nine hundred and fifty grammes* [or 33 ounces av., 223 grains], to make *one thousand grammes* [or 35 ounces av., 120 grains]. Introduce the Oleic Acid into a capacious capsule, and gradually add to it the Zinc Oxide by sifting it upon the surface of the Acid, and incorporate it by continuous stirring. Set the mixture aside for a few hours, and then heat it on a water-bath, frequently stirring, until the Oxide is dissolved." *U. S.* 1890.

This oleate was found for the first time in the U. S. Pharmacopœia of 1890. It was official in the British Pharmacopœia of 1885. (See *Unguentum Zinci Oleatis.*)

cent. of residue, which consists chiefly of zinc oxide. The salt should have a neutral reaction to moistened litmus paper. If 0.5 Gm. of Zinc Stearate be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of hydrochloric acid, stearic acid will be liberated and float as an oily layer on the surface of the liquid. If, after filtering this liquid through a small wetted filter, all of the zinc be precipitated by ammonium sulphide T.S., the filtrate should leave no fixed residue on evaporation (absence of *alkalies, alkali earths,* etc.). If 0.5 Gm. of Zinc Stearate be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of nitric acid, and filtered, the filtrate should not become more than slightly turbid upon the addition of silver nitrate T.S. (absence of more than traces of *chlorides*). If 1 Gm. of Zinc Stearate be boiled with 50 Cc. of distilled water containing 2 Cc. of nitric acid, and filtered through a wetted filter, after thoroughly washing the precipitate with boiling water, the filtrate and washings, when evaporated to dryness and ignited, should leave a residue weighing not less than 0.14 Gm., and not more than 0.16 Gm." *U. S.*

Uses.—Zinc stearate is employed in *eczema, acne* and other cutaneous diseases, in the form of powder, or made into an ointment.

Off. Prep.—Unguentum Zinci Stearatis, *U. S.*

ZINCI SULPHAS. U. S., Br.

ZINC SULPHATE

(zĭn'cī sŭl'phăs)

$ZnSO_4 + 7H_2O = 285.41$

"It should contain, in uneffloresced crystals, not less than 99.5 percent. of pure Zinc Sulphate [$SO_2.O_2Zn + 7H_2O$], and should be kept in well-stoppered bottles." *U. S.* "Zinc Sulphate, $ZnSO_4,7H_2O$, is formed by the interaction of diluted sulphuric acid and zinc." *Br.*

Sulfas Zincicus, Vitriolum Album; White Vitriol; Sulfate de Zinc officinal, *Fr. Cod.;* Zincum Sulfuricum, *P. G.;* Zinksulfat, Schwefelsaures Zinkoxyd, Weisser Vitriol, Galitzenstein, *G.;* Solfato di zinco, *It.;* Salfato zincico, *Sp.*

The Pharmacopœias no longer give detailed processes for preparing this salt. The Br. Ph. 1885 process will be found in the foot-note.[1]

Strong sulphuric acid is but slightly acted upon by zinc, some hydrogen sulphide being evolved by the reduction of the acid; but when it is *diluted,* the acid is instantly decomposed, and, while hydrogen escapes with rapid effervescence, it is replaced by the zinc with the production of zinc sulphate. From this it will be perceived that *hydrogen* is a collateral product of the process. The proportion of the zinc to the strong acid in the process is as 4 to 5.53. The molecular weights give the ratio of 4 to 6 almost exactly,—which indicates that the metal is somewhat in excess. If the materials are mixed at once, without any precaution, the effervescence of hydrogen is apt to be excessive, and to cause the overflowing of the liquid. This may be avoided by commencing the solution of zinc with a very dilute acid, which, as the action slackens, is made by degrees stronger and stronger by the addition, at intervals, of small portions of fresh acid. As the zinc of commerce generally contains iron, this would contaminate the product, unless precautions were taken to prevent it. Hence the addition of chlorine, which reacts with ferrous sulphate to form ferric sulphate and ferric chloride, which, upon the addition of zinc carbonate, yield sulphuric acid and chlorine to the zinc, ferric oxide being deposited and carbon dioxide set free. The former is separated by filtration, the latter escapes during the evaporation, the additional zinc sulphate crystallizes with that first formed, and the zinc chloride remains in the mother waters.

Preparation on the Large Scale.—Impure zinc sulphate, as it occurs in commerce, is called *white vitriol.* It is manufactured by roasting *blende* (native zinc sulphide) in a reverberatory furnace. This mineral, besides zinc sulphide, contains small quantities of iron, copper, and lead sulphides, and by roasting is converted, in consequence of the oxidation of its constituents, into zinc sulphate, mixed with iron, copper, and lead sulphates. The roasted matter is then lixiviated, and the solution obtained, after having been allowed to settle, is concentrated by evaporation, so that, on cooling, it may concrete into a white crystalline mass. In this state it always contains ferrous sulphate, and sometimes a small proportion of copper sulphate. It may be purified from these metals by dissolving it in water and boiling the solution with zinc oxide, which converts the iron and copper sulphates, by precipitating their bases, into zinc sulphate. The purified solution is then decanted or filtered, and, after due evaporation, allowed to crystallize. It has generally been proposed to purify the white vitriol of commerce by digesting its solution with metallic zinc, under the impression that this is capable of precipitating all the foreign metals; but, according to Berzelius, though it will precipitate copper readily, it has no action on iron.

[1] "Take of Granulated Zinc *sixteen ounces* [avoirdupois]; Sulphuric Acid *twelve fluid ounces* [Imperial measure]; Distilled Water *four pints* [Imp. meas.]; Solution of Chlorine *a sufficiency;* Carbonate of Zinc *half an ounce* [av.], or *a sufficiency.* Pour the sulphuric acid previously mixed with the water on the zinc contained in a porcelain basin, and, when effervescence has nearly ceased, aid the action by heat. Test a few drops of the resulting liquid for iron by adding excess of ammonia and then sulphydrate of ammonium, when a black precipitate will be produced if iron be present. In the latter case filter the remainder of the fluid into a gallon bottle, and add gradually with constant agitation the solution of chlorine until the fluid acquires a permanent odor of chlorine. Add now with continued agitation the carbonate of zinc until a brown precipitate appears and the whole of the iron is thus precipitated. Let the precipitate subside, filter the solution, evaporate till a pellicle forms on the surface, and set aside to crystallize. Dry the crystals by exposure to the air on filtering paper placed on porous tiles. More crystals may be obtained by again evaporating the mother-liquor. If no iron be present, filter, and evaporate, etc., at once." *Br.* 1885.

F. Stolba recommends a process which has been used successfully for the purification of zinc sulphate by the use of zinc carbonate and zinc permanganate. (See *A. J. P.*, 1877, p. 72.)

Properties.—Zinc sulphate is in "colorless, transparent, rhombic crystals, or a granular, crystalline powder, without odor, and having an astringent, metallic taste. Efflorescent in dry air. Completely soluble in 0.53 part of water at 25° C. (77° F.), and in 0.2 part of boiling water; soluble in about 3 parts of glycerin; insoluble in alcohol. When rapidly heated, the salt melts. At a higher temperature it is partly decomposed, losing both water and sulphuric acid. When very gradually heated to 50° C. (122° F.), it loses 5 molecules of its water of crystallization (31.2 percent.) without melting. At 100° C. (212° F.) a sixth molecule is lost, while the last is removed, with decomposition of the salt, at a temperature of about 240° C. (464° F.). Its aqueous solution shows an acid reaction with blue litmus paper. The aqueous solution of the salt (1 in 20) yields a white gelatinous precipitate with potassium ferrocyanide T.S., and a white precipitate with ammonium sulphide T.S., and with barium chloride T.S. If a small portion of the salt be moistened with a drop of cobaltous nitrate T.S., and heated before the blow-pipe, it will assume a vivid green color. The aqueous solution of Zinc Sulphate (1 in 20), after being acidulated with hydrochloric acid, should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. The aqueous solution should yield, with ammonium carbonate T.S., a white precipitate, which should redissolve completely in an excess of the reagent. The aqueous solution (1 in 20) should not be rendered more than slightly turbid by silver nitrate T.S. (limit of *chloride*). If 1 Gm. of Zinc Sulphate, in small fragments, be agitated for some time with 10 Cc. of alcohol, the filtrate should not redden moistened blue litmus paper (absence of *free acid*)." *U. S.* "Colorless transparent prismatic crystals with a strong metallic styptic taste. Soluble in less than an equal weight of cold *water*. It affords the reactions characteristic of zinc and of sulphates. It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, aluminium, calcium, magnesium, sodium, potassium, ammonium, or acetates, and only the slightest reactions with the tests for iron or chlorides." *Br.* Its crystals have considerable resemblance to those of magnesium sulphate. It effloresces slightly in dry air, and, though neutral in composition, reddens vegetable blues. When heated it dissolves in its water of crystallization, which gradually evaporates, and by a prolonged ignition the whole of the acid is expelled, and the zinc oxide left. The alkaline carbonates precipitate the metal in the state of white carbonate. Pure zinc sulphate is precipitated white by potassium ferrocyanide and ammonium sulphydrate. What is thrown down by barium chloride or lead acetate (barium sulphate or lead sulphate) is not dissolved by nitric acid. If copper be present, ammonia will produce a blue tinge; if iron, the potassium ferrocyanide will cause a bluish-white precipitate instead of a white one, and tincture of galls a purple color. Cadmium and arsenic may be detected by acidulating the solution with sulphuric acid and passing a stream of hydrogen sulphide through it, when, if either of these metals be present, it will be thrown down as a yellow sulphide. Zinc sulphate is incompatible with alkalies and alkaline carbonates, sulphides, lime water, the soluble lead salts, and astringent infusions.

The impure commercial variety of zinc sulphate is in the form of irregular white masses having some resemblance to lump sugar. The lumps usually exhibit, here and there on the surface, yellow stains, produced by ferric oxide. It is less soluble than the pure salt, on account of its containing less water of crystallization.

Composition.—Crystallized zinc sulphate consists of one sulphuric acid group, SO_4, one atom of zinc, and seven molecules of water. The *white vitriol* of commerce contains but three molecules of water.

Uses.—This salt is tonic, astringent, and, in large doses, a prompt emetic, producing very little depression, and much used when it is desired simply to evacuate the stomach. In *gastric catarrh* it is sometimes useful, in the dose of one-fourth of a grain (0.016 Gm.) before meals, in pill. It was formerly used in *night sweats, epilepsy, chorea,* and other nervous diseases, but has now entirely passed out of vogue as a remedy in such affections. As an astringent it is chiefly employed externally. Its solution constitutes a good styptic to bleeding surfaces, and is frequently resorted to as an injection in *fluor albus* and *gonorrhœa,* and as a collyrium in *ophthalmia,* also as a stimulant application to *ulcers* both of the mucous membrane and of the skin. Simpson of Edinburgh, employed dried zinc sulphate in the form of powder, paste, or ointment, as a powerful, rapid, manageable, and safe caustic in indurated inflammatory ulcers of the cervix uteri; in *lupus;* in *ulcerous forms of skin diseases;* and in removing *urethral caruncles, condylomata, warty excrescences,* etc. The dried salt should be finely levigated. The caustic paste is made by incorporating an ounce of the powder with a drachm of glycerin; and the caustic ointment, by thoroughly mixing the same quantity of the powder with two drachms of lard. (See *Am. J. M. S.*, April, 1857, p. 485.)

Zinc sulphate, in an overdose, acts as an irritant poison. Besides vomiting and incessant retching, it produces anxiety, distressing restlessness, and extreme prostration. Few cases are on record of fatal poisoning by this salt, the patient being generally relieved by

its prompt expulsion in vomiting. Death is said to have been caused, however, by an ounce and a half. The treatment consists in the free administration of bland drinks, the use of opium to allay irritation, and the employment of the usual antiphlogistic remedies should symptoms of inflammation arise.

Dose, from one-fourth to one-half grain (0.016 to 0.032 Gm.); as an emetic, from ten to thirty grains (0.65 to 2.0 Gm.). When used as a collyrium, an injection, or a gargle, or as a wash for indolent ulcers, from one to three grains (0.065 to 0.2 Gm.) or more may be dissolved in a fluidounce (30 Cc.) of water. For medicinal purposes the crystallized salt only should be used.

Off. Prep.—Unguentum Zinci Oleatis, *Br.*

ZINCI VALERAS. U. S. (Br.)

ZINC VALERATE

[Zinci Valerianas, Pharm. 1890, Zinc Valerianate]

(zĭn'cī văl'ę-răs)

$Zn(C_5H_9O_2)_2 + 2H_2O = 301.28$

"It should contain not less than 99 percent. of pure Zinc Valerate $[(C_4H_9.COO)_2Zn + 2H_2O]$, and should be kept in small, well-stoppered bottles." *U. S.* "Zinc Valerianate, or zinc iso-valerianate, $Zn(C_5H_9O_2)_2$, may be prepared by saturating iso-valerianic acid with zinc carbonate, or by the interaction of zinc sulphate and sodium iso-valerianate." *Br.*

Zinci Valerianas, *Br.;* Zincum Valerianicum; Valerianas Zincicus; Valérianate de Zinc, *Fr. Cod.;* Valérate de Zinc, *Fr.;* Zincvalerianat, Baldriansaures Zinkoxyd, *G.;* Valerianato zincico, *Sp.*

Zinc valerianate was formerly included among the preparations of the U. S. Pharmacopœia, but at the revision of 1880 no process was inserted. The British Pharmacopœia no longer gives a formula for its preparation; for former formulas see foot-note.[1]

Properties.—This salt is in "white, pearly scales, having the odor of valeric acid, and a sweetish, astringent, and metallic taste. On exposure to the air, it slowly loses valeric acid. Soluble in about 50 parts of water, and in about 35 parts of alcohol at 25° C. (77° F.); somewhat more soluble in absolute alcohol. Boiling renders the aqueous solution turbid from loss of acid and formation of a basic salt. When heated, the salt melts. At a higher temperature it is decomposed, giving off inflammable vapors, and finally leaving a residue of zinc oxide. Its aqueous solution reddens blue litmus paper. If 0.5 Gm. of Zinc Valerate be dissolved in a mixture of 0.5 Cc. of hydrochloric acid and 9 Cc. of water, the valeric (isovaleric) acid will be liberated and float as an oily layer on the surface of the liquid. After filtering through a small wetted filter, the clear solution should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted. If 0.5 Gm. of Zinc Valerate be dissolved in a mixture of 0.5 Cc. of nitric acid and 4.5 Cc. of distilled water, and the mixture filtered through a small wetted filter, the filtrate should remain clear upon the addition of either barium chloride T.S. (absence of *sulphate*) or silver nitrate T.S. (absence of *chloride*). Zinc Valerate should dissolve without residue in ammonium carbonate T.S. If 0.5 Gm. of Zinc Valerate be triturated with 3 Cc. of water, and 0.2 Cc. of ferric chloride T.S. added, the filtrate should not show a red color (absence of *acetate*). If a concentrated solution of copper acetate in water be added to a concentrated aqueous solution of Zinc Valerate, the mixture should remain perfectly clear (absence of *butyrate*). If 0.5 Gm. of Zinc Valerate be heated with a mixture of 9.5 Cc. of distilled water and 0.5 Cc. of hydrochloric acid and filtered, the filtrate should not respond to the Modified Gutzeit's Test for *arsenic* (see PART III, Test No. 17)." *U. S.* "In white pearly tabular crystals, with a disagreeable odor, and a metallic taste; very slightly soluble in cold *water* or in *ether,* soluble in hot *water* and *alcohol* (90 per cent.). On heating to redness, after moistening with a small quantity of *nitric acid,* it should yield not less than 26 nor more than 30 per cent. of zinc oxide. It should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, iron, aluminium, calcium,

[1] "Take of Valerianate of Soda *two troyounces and a half;* Sulphate of Zinc *two troyounces and four hundred and twenty grains;* Distilled Water *a sufficient quantity.* Dissolve the salts separately, each in twenty fluidounces of Distilled Water, and, having heated the solutions to 212° F., mix them, and set the mixture aside to crystallize. Decant the mother-water from the crystals, and put them upon a filter in a funnel to drain. Mix the mother-water and the drainings, evaporate at a heat not exceeding 200° F. to four fluidounces, and again set aside to crystallize. Add the crystals, thus obtained, to those in the funnel, wash the whole with a little Distilled Water, and, having removed them with the filter, spread them on bibulous paper, and dry them with a heat not exceeding 200° F." *U. S.* 1870.

"Take of Sulphate of Zinc *five ounces and a half* [avoirdupois]; Valerianate of Sodium *five ounces* [av.]; Distilled Water *a sufficiency.* Dissolve the Sulphate of Zinc and the Valerianate of Sodium, each, in two pints [Imperial measure] of the Water; heat both solutions to near the boiling point, mix them, cool, and skim off the crystals which are produced. Evaporate the mother-liquor at a heat not exceeding 200° F., till it is reduced to four [fluid] ounces; cool again, remove the crystals which have formed, and add them to those which have been already obtained. Drain the crystals on a paper filter, and wash them with a small quantity of cold Distilled Water, till the washings give but a very feeble precipitate with chloride of barium. Let them now be again drained, and dried on filtering paper at ordinary temperatures." *Br.*

These formulas are essentially the same as the formula of the late Dublin Pharmacopœia. In the formation of the salt a double decomposition takes place between the reacting salts, resulting in the production of zinc valerianate and sodium sulphate. Upon mixing the hot solutions, crystals of the sparingly soluble zinc valerianate form on the surface of the liquid, and during the progress of its concentration to one-tenth, more of them are successively produced. These are then washed with cold distilled water to separate adhering sodium sulphate, drained on a filter, and dried.

magnesium, sodium, potassium, ammonium, acetates, or carbonates, and only the slightest reactions with the tests for chlorides or sulphates. When heated with *diluted sulphuric acid* it gives a distillate which, when mixed with *solution of copper acetate,* does not immediately affect the transparency of the liquid, but forms after a little time oily drops, which gradually pass into a bluish-white crystalline deposit (absence of butyrates)." *Br.* The salt, as obtained by the British 1885 and U. S. P. 1870 formulas, contained one molecule of water; but when formed by saturating zinc carbonate, made into a paste with water, with valeric acid, it contains six molecules of water, and when dried at 50° C. (122° F.), perfectly resembles the official salt. (Wittstein.) Other authorities (Flückiger, *Pharm. Chem.,* and Roscoe and Schorlemmer's *Chem.,* vol. iii. part i.) give the formula of the stable crystallized salt as $Zn(C_5H_9O_2)_2 + 2H_2O$. Zinc acetate impregnated with oil of valerian has been substituted for this salt; but at present, from the relative costliness of the oil, there is no inducement to this fraud. Zinc butyrate has been sold in Paris for the valerate, and is so like it as not to be distinguished by its physical properties. The two salts, however, may be differentiated by adding a concentrated solution of the acid of the suspected salt obtained by distillation with sulphuric acid, to a concentrated solution of copper acetate. If the acid be the butyric, its addition to the solution of the acetate will disturb the transparency of the latter, by the formation of a bluish-white precipitate; if it be the valeric, no change will be produced. (Larocque and Huraut, *J. P. C.,* 3e sér., ix. 430.)

Uses.—Zinc valerate was proposed as a remedy, on theoretical grounds, by Prince Louis-Lucien Bonaparte. Upon trial it was found to possess antispasmodic properties, and has been used in *diabetes insipidus.* By some of the Italian physicians it has been extolled as a remedy in *neuralgia.* F. Devay of Lyons, found it useful in *epilepsy,* and in the nervous affections which accompany *chlorosis.*

Dose, one to two grains (0.065 to 0.13 Gm.), repeated several times a day, and given in the form of pill.

ZINCUM. U. S., Br.

ZINC

(zĭn'cŭm)

$Zn = 64.9$

"It should contain not less than 99 percent. of pure metallic Zinc." *U. S.* "The laminated or granulated metal." *Br.*

Speltrum; Zinc pur, *Fr. Cod.;* Speltre, Zinc, *Fr.;* Zink, *G.;* Zinco, *It.;* Zinc, *Sp.*

Zinc occurs native in two principal states, as a sulphide, called *blende,* and as a carbonate or silicate, to which the name of *calamine* is applied indiscriminately. In this country there are two additional ores that are worked for zinc. Both occur at Franklin and Mine Hill, New Jersey, and are characteristic of those localities. They are the native oxide, called *red oxide* or *zincite,* and a mixture of zinc oxide with manganese and iron oxide, known as *franklinite.* Zinc has been detected in the vegetable kingdom in a peculiar violet, *Viola calamina,* growing on the calamine hills of Rhenish Prussia. It is largely produced in Belgium, Germany, and this country, the chief American localities being the southwestern section of Missouri, together with the neighboring counties of Kansas, the New Jersey localities before mentioned, Lehigh County, Pennsylvania, Virginia, and Wisconsin. The metal is extracted generally from blende or calamine. This is roasted and mixed with charcoal powder, and the mixture heated in iron cylinders placed horizontally over a furnace. When the reduction of the zinc commences, iron receivers are adapted to the opening of the cylinder to condense the volatilized metal. The metal is then melted and run into moulds, and forms *spelter,* or the zinc of commerce. In this state it contains iron, and traces of lead, cadmium, arsenic, copper, sulphur, and charcoal. To purify it from these substances, it must be subjected to a second distillation in a crucible, furnished with a tube passing through its bottom and open at both ends, its upper extremity reaching a little more than half-way up the interior of the crucible, and its lower end terminating above a vessel of water. The impure zinc being placed in the crucible, the cover luted on, and the fire applied, the pure zinc is volatilized, and, passing down the tube by a descending distillation, condenses in the water below. In the arts zinc is purified sufficiently for commercial purposes without volatilization.

The production of spelter in the United States for the year 1904 amounted to 186,704 tons, and for 1905 to 203,849 tons. The world's production for the same years amounted to 693,022 tons and 727,141 tons respectively. The percentage of production for the United States in these years was 26.9 per cent. and 28 per cent., respectively. The largest producing countries after the United States are Belgium and Germany.

Properties.—Zinc has a bluish-white color, a peculiar taste, and a perceptible odor when rubbed. Its texture is laminated, and its fracture crystalline. Its malleability and ductility are not very great. When perfectly pure, it may be reduced to thin leaves at ordinary temperatures; but the zinc of commerce requires to be heated to a temperature between 100° C. and 148.8° C. (212° F. and 300° F.) to render it sufficiently malleable to be rolled into sheets. The softness of zinc is peculiar, as shown by the circumstance that it clogs the file when the attempt is made to reduce it to filings; and hence to have it in the divided form it is necessary to melt it, and triturate it at the

moment of solidification.[1] Subjected to heat it fuses at 398° C. (773° F.). According to A. von Riemsdyk, it volatilizes to some extent before fusion at a temperature of 268.3° C. (515° F.). (*A. J. P.*, 1869, p. 424.) At full redness it boils, and in close vessels may be distilled over; but in open vessels it takes fire, and burns with a dazzling white flame, giving off dense white fumes. It dissolves in most of the acids with disengagement of hydrogen, and precipitates all the metals either in the metallic state or in that of oxide. It forms but one oxide (a monoxide) and but one sulphide. The monoxide is official, and has been described under another head. (See *Zinci Oxidum.*) The official zinc is described as "a bluish-white metal, showing a crystalline fracture; in the form of thin sheets, or in irregular, granulated pieces, or moulded into thin pencils, or in fine powder, and having a specific gravity ranging from 6.9 when it is cast to 7.2 after it is rolled. Soluble in diluted sulphuric or hydrochloric acid with evolution of hydrogen. When heated above 100° C. (212° F.) and not above 150° C. (302° F.), the metal becomes malleable and ductile; above 200° C. (392° F.) it becomes sufficiently brittle to be powdered in an iron mortar; at 412° to 415° C. (773.6° to 779° F.) it melts, and at 940° C. (1724° F.) it boils and may be readily distilled. If 1 Gm. of Zinc be added to 20 Cc. of diluted hydrochloric acid, the liberated hydrogen should not have a disagreeable odor, nor should it color a strip of paper moistened with lead acetate T.S. (absence of *sulphur*), or with silver nitrate T.S. (absence of *arsenic, antimony,* and *phosphorus*). The resulting solution should be clear and colorless, and should yield a white gelatinous precipitate with potassium ferrocyanide T.S., and a white precipitate with ammonium sulphide T.S. If 1 Gm. of Zinc be dissolved in a mixture of 10 Cc. each of nitrohydrochloric acid and water, the solution evaporated to dryness, the residue moistened with 2 Cc. of hydrochloric acid and again evaporated, and the final residue dissolved in 10 Cc. of water, this solution should not respond to the Time-Limit Test for *arsenic, cadmium, lead,* and *copper* (see PART III, Test No. 121); in applying this test the addition of ammonia water should be omitted." *U. S.*

Zinc of good quality dissolves in diluted sulphuric acid, with the exception of a scanty grayish-black residue. If absolutely pure, it would be wholly dissolved. The solution is colorless, and yields white precipitates with potassium ferrocyanide and ammonium sulphydrate. Ammonia throws down from this solution a white precipitate, which is wholly dissolved when the alkali is added in excess. Zinc is extensively employed in the arts. It is the best metal that can be used, in conjunction with copper or carbon, for galvanic combinations. Its solution in diluted sulphuric acid furnishes the readiest method for obtaining hydrogen. With copper it forms *brass,* and, in the form of *sheet zinc,* it is employed to cover the roofs of houses, and for other purposes. It is also applied to the covering of iron, to protect it from oxidation, in the same manner as tin, forming what is commercially known as *galvanized iron.* A fine powder, known as *zinc dust,* obtained by the condensation of zinc vapor in the distillation of zinc from its ores, is much used in chemical laboratories as a convenient reducing agent in many reactions. Zinc should never be used for culinary vessels, as it is soluble in the weakest acids. Zinc and its oxide are dissolved to a certain extent by water containing common salt, a double zinc and sodium chloride being produced in solution. (*J. P. C.*, Nov. 1867, p. 397.)

The compounds of zinc are poisonous, but not to the same extent as those of lead. The zinc oxide, used in painting as a substitute for white lead, is said to be capable of producing a colic resembling that caused by lead, and called *zinc colic.* It attacks the workmen exposed to the dust of the oxide while engaged in packing it in barrels, and is said to yield to the remedies appropriate to the treatment of lead colic. This latter statement, however, is, to say the least, very questionable.

Uses.—Zinc is never used as a medicine in the metallic state, but is employed in this state to prepare zinc sulphate and zinc chloride, and the Reduced Iron of the Br. Pharmocopœia. In combination it forms a number of important preparations.[2]

[1] *Zincum Granulatum. Br.* 1885. *Granulated Zinc.* "Take of Zinc of commerce *one pound.* Heat it in an earthen crucible, and immediately the metal is fused remove the crucible from the fire and pour the fluid in a thin stream into a vessel containing about two gallons of cold water. Drain off the water and dry the granulated zinc." *Br.* 1885.

[2] *Zinc Nitrate* is sometimes used as a caustic either in the form of *paste* or in *pencils.* Lefort prepares it by dissolving commercial zinc with heat in equal volumes of nitric acid and water, maintaining an excess of zinc, and concentrating until a slight basic precipitate is formed, which carries down any iron present. Boiling water is then added, and, when cool, the solution is filtered, and evaporated at a gentle heat until slight ebullition takes place; if then left to cool, it forms a cake, which should be broken up and drained in a glass funnel. Of the zinc nitrate so prepared, 100 grammes are dissolved in 50 grammes of water, and afterwards incorporated with 50 grammes of wheaten flour. This forms a homogeneous paste, which remains soft, spreads easily over surfaces without afterwards contracting, and does not spread at the edges through absorption of moisture. When made into cylinders, it should not be dried by heat, as it slightly decomposes and becomes yellow and friable; it may be kept dry by placing it in a tin box with some pieces of quicklime, but not in contact with them. (*L. M. R.*, June 18, 1873; *A. J. P.*, Dec. 1873.) Chas. Rice prepares pencils by pouring fused zinc nitrate into paper cylinders which are made by rolling paper around a lead-pencil and sealing with wax. (See *N. R.*, 1876, p. 44; also *Hydrargyri et Zinci Cyanidum,* PART II.) The mixed *mercury and zinc cyanide* was originally suggested as a practical antiseptic by Lister, who claimed for it the advantages of being non-volatile, unirritating, insoluble in water, and soluble only in three thousand parts of blood serum; so that it is not easily washed off the gauze by discharge from wounds. Its germicidal value is said to be very slight, but its inhibitory power to be such that a one-twelve-hundredth solution will permanently prevent putrefaction in animal fluids. *Cyanide gauze* may be made actively germicidal by impregnation with a solution of one to four thousand of corrosive sublimate. One great objection to the preparation is the difficulty of making gauze with it. The statements of Lister in regard to the best method of preparing the gauze are devoid

ZINGIBER. U. S., Br.

GINGER

(zĭn'gĭ-bẽr)

"The dried rhizome of *Zingiber officinale* Roscoe (Fam. *Zingiberaceæ*)." *U. S.* "The scraped and dried rhizome of Zingiber officinale, *Roscoe*." *Br.*

Gingembre (gris et blanc), *Fr. Cod.*; Rhizoma Zingiberis, *P. G.*; Ingwer, *G.*; Zenzero, *It.*; Jengibre (Rizoma de), *Sp.*

Zingiber officinale, Roscoe, *Trans. Lin. Soc.* (1807), viii. 348; Carson, *Illust. of Med. Bot.*, ii. 55, pl. 98.—*Amomum Zingiber*, L., *Sp. Plant.* 1753, 1; *B. & T.* 270.—The ginger plant has a biennial or perennial, creeping rhizome, and an annual stem, which rises two or three feet in height, is solid, round, erect, and enclosed in an imbricated membranous sheathing. The leaves are lanceolate, acute, smooth, five or six inches long by about an inch in breadth, and stand alternately on the sheaths of the stem. The flower-stalk rises by the side of the stem from six inches to a foot, and, like it, is clothed with oval acuminate sheaths; but it is without leaves, and terminates in an oval, obtuse, bracteal, imbricated spike. The flowers are of a dingy yellow color, and appear two or three at a time between the bracteal scales.

The plant is a native of Hindostan, and is cultivated in all parts of India. It is also cultivated in the West Indies, whither it was transplanted from the East, and at Sierra Leone in Africa. The flowers have an aromatic odor, and the stems when bruised are slightly fragrant; but it is in the rhizome that the virtues of the plant reside. This is fit to be dug up when a year old. The rhizome of the ginger is lifted from the soil by a single thrust of the fork at the time when the stems of the plant turn white, before the rhizome has begun to get tough and fibrous. The root is scalded in boiling water and rapidly dried, when it constitutes the *black* or ordinary ginger of commerce.

In Jamaica the so-called *white* or *Jamaica ginger* is produced by carefully peeling the fresh rhizomes so that only the epidermis is removed, the cells immediately beneath the epidermis being the richest in volatile oil and resin. The peeled pieces are macerated sometimes in water and sometimes in lime juice, and not rarely the color of the ginger is improved by finally coating it with chalk. An inferior white ginger is also produced in the East Indies. The thoroughness of desiccation is a matter of commercial importance. The moisture in ginger should not exceed 10 per cent., but in the poorer specimens may constitute one-fourth of the whole weight. In China the fresh ginger is rasped into a powder and as such dried. Formerly *East Indian ginger* was imported into the United States from Calcutta, while the *Jamaica* or *West Indian ginger* came usually through London. At present the cultivation of ginger is spread almost over the whole sub-tropical world, and the drug is produced in St. Lucia, Dominica and Africa, Cochin-China, Japan, etc. In Martinique a ginger is said to be obtained by the cultivation of *Zingiber Zerumbet*, Rosc.

The ginger of Siam is said to be produced by *Alpinia Galanga*, and is the same drug, therefore, as the *Grater* or *Java Galanga Root*. The large, ordinary, *preserved ginger* of China is, according to C. Ford (*Kew Bulletin*, 1891) also the product of *A. Galanga*. It is made by boiling young, tender, carefully selected and decorticated rhizomes in syrup. Preserved ginger from the West Indies is made from the official plant. According to Hartwich and Swanlund, the rhizome of the *Zingiber Mioga*, which is cultivated in China and Japan, has a taste less pungent than that of the official ginger, and distinctly recalling bergamot. In commerce the varieties of ginger are known by the place of their production. African and Cochin ginger on an average yield more resin and volatile oil than do the older varieties.[1]

The recent root is from one to four inches long, somewhat flattened on its upper and under surface, knotty, obtusely and irregularly branched or lobed, externally of a light ash color with circular rugæ, internally yellowish white and fleshy. It sometimes begins to grow when kept in a damp atmosphere. The *common* or *black ginger* is of the same general shape, but has a dark ash-colored wrinkled epidermis, which, being removed in some places, exhibits patches of an almost black color, apparently the result of exposure. Beneath the epidermis is a brownish, resinous, almost horny cortical portion. The interior parenchyma is whitish and somewhat farinaceous. The powder is of a light yellowish-brown color. This variety is most extensively used. The *Jamaica* or *white ginger* is white or yellowish white on the outside. The pieces are rounder and thinner, and afford when pulverized a beautiful yellowish-white powder.

The uncoated ginger of the East Indies resembles the Jamaica, but is darker, being gray rather than white. As the Jamaica commands a much higher price than even the uncoated East India production, the latter is occasionally altered to simulate the former. This is some-

of the accuracy essential to pharmaceutical success. His method is by "mixing a pretty strong solution of starch with the double cyanide powder, and adding to this a quantity of ground potassium sulphate. The resultant precipitate is dried, and when used is diffused in water in a trough, at the bottom of which the absorbed gauze is placed in layers; when soaked the gauze is drawn out and dried, or if to be used immediately is folded for a moment or two in a towel. When used the gauze may be wet with the corrosive sublimate solution, one to four thousand." (See *B. M. J.*, ii. 1889; also *Annals of Surgery*, Jan. 1891.)

[1] For tables giving analyses of varieties of ginger and for discussion of the methods of discovering the presence of *spent ginger* see *The Analyst*, vol. xviii. and xix.; *A. J. P.*, 1881, 894; *Bulletin No. 13*, Part II, U. S. Dept. of Agriculture, 1887; *P. J.*, vol. lxvi.

times done by coating the exterior with calcium sulphate or carbonate, sometimes by bleaching with the fumes of burning sulphur or in other ways, by which not only the exterior but also the internal parts are rendered whiter than in the unprepared root. Powdered ginger which has been exhausted in the preparation of essence, technically known as "*spent ginger*," is used to a large extent in the adulteration of powdered ginger. Its detection without assay of some sort is almost impossible, unless so much is present as to sensibly alter the taste of the powder. Allen and Moor rely upon the proportion of cold water extract yielded and the soluble ash. Dyer and Gilbard state that the fixed ethereal extract is of little value, on account of its variability in genuine ginger, but that the extract obtained by alcohol after ether affords a valuable criterion. In genuine ginger the average yield is 2.9 per cent. while in spent ginger it is 1.2 per cent. They also affirm that in genuine ginger the ash produced is 2.7 per cent., in the exhausted ginger it is 0.3 per cent. A. Russell Bennett concludes that spent ginger can be detected by noting the alcoholic and cold water extracts and the soluble ash, affirming that ginger should yield not less than 5 per cent. of extract with 90 per cent. alcohol, 8.5 per cent. of cold water extract and 1.5 per cent. of soluble ash.

Properties.—The U. S. Pharmacopœia describes this rhizome as in "laterally compressed, irregularly branched pieces; externally whitish or pale buff, longitudinally striate; fracture short-fibrous, mealy, showing numerous small oil and resin cells and circular groups of fibro-vascular bundles; odor agreeably aromatic; taste aromatic and pungent." *U. S.* The odor of ginger is aromatic and penetrating, the taste spicy, pungent, hot, and biting. These properties gradually diminish, and are ultimately lost, by exposure. The virtues of ginger are extracted by water and alcohol.

The peculiar flavor of the root appears to depend on the volatile oil, its pungency partly on the resinous or resino-extractive principle. A considerable quantity of pure white starch may be obtained from it. The volatile oil, examined by A. Papousek, was yellow, of the odor of ginger, and of a hot aromatic taste. Its sp. gr. was 0.893, and its boiling point 246.1° C. (475° F.). Deprived of water by distillation over phosphoric oxide, it consisted of carbon and hydrogen, with the formula $C_{10}H_{16}$, and therefore belongs to the terpenes. Thresh considers that the essential oil is mainly made up of a hydrocarbon, $C_{15}H_{24}$, or isomers of it, which boil at from 245° to 270° C. (*P. J.*, No. 586, 1881.) Schimmel & Co. (April, 1897) state that the essential oil contains *camphene* and *phellandrene*, and hence the terpenes have the formula $C_{10}H_{16}$, as first stated. Flückiger obtained from one hundred and twelve pounds of Jamaica ginger four and a half ounces of the oil, or about one-fourth of one per cent. He states, however, that Schimmel & Co. of Leipsic, informed him that they obtained as much as 2.2 per cent. from good ginger. (*Pharmacographia*, 2d ed., p. 637.) H. von Soden and W. Rojahn (*Ph. Ztg.*, 1900, 414) obtained a new sesquiterpene from oil of ginger by fractioning the saponified oil. They have named it *zingiberene*. It has the sp. gr. 0.872 at 15° C. Those pieces of ginger which are very fibrous, light and friable, or worm eaten, should be rejected. The commercial powder of ginger is very frequently adulterated, rice starch, powdered ginger which has been exhausted in making preparations, and even brick dust and chalk, being used, and the loss of pungency made good by the addition of capsicum or mustard.

Uses.—Ginger is a grateful stimulant and carminative, and is often given in *dyspepsia, flatulent colic,* and the feeble state of the alimentary canal attendant upon *atonic gout.* It is an excellent addition to bitter infusions and tonic powders, imparting to them an agreeable, warming, and cordial operation upon the stomach. Externally it is rubefacient. Under the name of "*Essence of Ginger*" cheap alcoholic preparations of ginger have been much sold and used as an intoxicant. A number of cases of blindness produced by such use have been recorded, the amblyopia having been due to the large use of methyl alcohol in the making of these "essences." The infusion may be prepared by adding half an ounce of the powdered or bruised root to a pint of boiling water, and may be given in the dose of one or two fluidounces (30 to 60 Cc.).

Dose, ten to twenty grains (0.65 to 1.3 Gm.).

Off. Prep.—Fluidextractum Zingiberis, *U. S.;* Infusum Sennæ, *Br.;* Oleoresina Zingiberis, *U. S.;* Pilula Scillæ Composita, *Br.;* Pulvis Aromaticus, *U. S.* (*Br.*); Pulvis Jalapæ Compositus, *U. S.;* Pulvis Opii Compositus, *U. S.;* Pulvis Rhei Compositus, *U. S., Br.;* Pulvis Scammonii Compositus, *Br.;* Syrupus Zingiberis, *U. S.* (from fluidextract), *Br.;* Tinctura Zingiberis, *U. S., Br.*

PART II

DRUGS AND MEDICINES NOT OFFICIAL

In the present section it is proposed to consider remedies which are not recognized in the United States or British Pharmacopœias, but which on account of their use in domestic or professional medicine, their toxic properties, their history, or the probability that they may prove in the future remedies of power, or valuable products, require notice in an encyclopedic work like the United States Dispensatory. The limit of the present volume forbids a complete description of all these substances, but the attempt is made to give at least the information where to look for an account of almost everything used in medicine. As the substances treated of in this part are not official, they are not considered to be of as great importance as those found in Part I. and hence the type and arrangement of titles are different; experience has shown that this method educates the reader to distinguish between official and unofficial substances.

Abrastol. *Asaprol.—Calcium a-monosulphonate of β-naphthol,* $\begin{matrix} C_{10}H_6\left\{\begin{matrix} OH \\ SO_3 \end{matrix}\right. \\ C_{10}H_6\left\{\begin{matrix} SO_3 \\ OH \end{matrix}\right. \end{matrix}\!\!>\!Ca.$ This is a white powder, soluble in water and alcohol, and resembling the salicylates in its taste. It is said to be neutral in reaction, readily soluble in alcohol and water, and not altered by heat, non-irritant, slightly toxic, well borne by the digestive tract, and rapidly eliminated by the kidneys. Asaprol was originally brought forward by A. Stackler as a germicide, antipyretic, and antirheumatic, to be used in doses of from fifteen to sixty grains (1–3.9 Gm.) in *rheumatism, typhoid fever,* etc. (*B. G. T.*, 1892.) Dujardin-Beaumetz (*Ibid.*, Jan. 1894) finds that when given by the mouth to rabbits in the dose of 0.25 gramme per kilo it has no deleterious effect, although less than one gramme per kilo proves fatal. It escapes from the kidneys in the form of *sulphuric ether-naphthol,* which is to be recognized by the dark blue coloration of the urine on the addition of ferric chloride. In acute *rheumatism,* Dujardin-Beaumetz believes that the remedy is equal to salicylates, and that it has the advantage of not producing tinnitus aurium or eruptions upon the skin. From sixty to ninety grains (3.9–5.8 Gm.) may be given daily in capsules or aqueous solution. Buck (*Ther. Woch.*, 1897) confirms the value of asaprol in *rheumatism.* Moncorvo (*B. G. T.*, March and April, 1895) recommends it in *chorea* and in *malarial diseases.* He also affirms that, used locally, it is an excellent antiseptic, hæmostatic, and cicatrizant. He uses it in aqueous solution, 1 to 4 per cent., or as an ointment with vaseline. He even asserts that a 1 per cent. solution applied to the periglotteal region will rapidly cure *whooping cough.*

Abroma. *Abroma angusta,* L. f. (Fam. Sterculiaceæ.)—Under the name of *Olutkombul,* the glutinous sap of this plant has long been used in India in *dysmenorrhœa.* According to Sircar (*Indian Medical Gazette,* 1900) and other English practitioners, it is a very efficient remedy in congestive and neuralgic *dysmenorrhœa* when given in doses of two drachms (7.7 Gm.) at the time of the first premonitory pains and continuing to the end. The fresh root is sometimes used. *Dose,* half a drachm (2 Gm.).

Abrus. *Abrus precatorius,* L. *Jequirity. Kunch. Ratti.* (Fam. Leguminosæ.)—The seeds of this plant, which grows in India and also in Brazil, are employed in India as a standard weight, and also for criminal poisoning. They are said to be inert when taken whole into the stomach. They contain *abric acid,* $C_{12}H_{24}N_3O$, and, according to the researches of Sidney Martin (*P. J.*, Sept. 1887; *Proc. Roy. Soc.*, vol. xlvi., 1889), two proteid poisons, a paraglobulin and an albumose (together called *abrin*), which are almost identical in their physiological properties with principles found in snake venom, although less powerful. According to Flexner, the toxic action of these substances also closely resembles that of true toxins, the most characteristic result being focal necroses in various organs. Flexner suggests that these in turn are due to a lesion in the blood vessel walls caused by the abrin. (*J. Ex. M.*, 1897, vol. ii.) The ordinary lethal dose of abrin for animals is said to be 0.00001 Gm. per kilo of weight. (Consult *The Non-Bacillous Nature of Abrus Poisoning,* J. H. Warden and L. A. Waddel, Calcutta, 1884; Bufalini, *Ann. di Chim. e di Farm.*, No. 2, 1886; Kobert, *W. M. Bl.*, Nov. 1889.) The root is used as a substitute for licorice, and, according to David Hooper, contains *glycyrrhizin.* (*P. J.*, 1894.) The

infusion of jequirity was formerly used as a local remedy in *granular conjunctivitis*, *pannus*, *trachoma*, and other diseases of the eye; but the preparation has been supplanted by a definite solution of abrin. According to Ehrlich, the solution of abrin should not be stronger than one part in 500,000; any increase of strength must be made with great care. Both Ehrlich and Calmette succeeded in immunizing rabbits against abrin, and obtained an antitoxin serum. P. Römer (Graefe's *Archiv f. Ophthal.*, vol. lii., 1901) has introduced two preparations: *jequiritol*, an abrin solution, sterilized, of four different strengths; *jequiritol serum*, which, as commercially supplied, has such immunizing power that 0.1 Cc. suffices to protect a white mouse from the effects of a hundredfold lethal dose of jequiritol when the latter and jequiritol serum are injected conjointly. (For details and methods of use, see *Th. M.*, May, 1902; *M. R.*, 1902; also Kattwinkel, *Jequiritol*, Bonn, 1902.)

Absinthium. *U. S.* 1890. *Wormwood.*—"The leaves and tops of *Artemisia Absinthium*, L. (nat. ord. Compositæ)." *U. S.* 1890. Several species of Artemisia have enjoyed some reputation as medicines. The leaves of *A. Abrotanum*, L., or *southernwood*, are reported by Craveri to contain a crystallizable alkaloid, *abrotine;* they were formerly employed as a tonic and anthelmintic. *A. pontica*, L., has been substituted for common wormwood, but is weaker. *A. vulgaris*, L., or *mugwort*, has been used in Germany in *epilepsy*, *chorea*, and *amenorrhœa*. *A. ludoviciana*, Nutt., a native of the southwestern regions of the United States, has been commended as a stimulant to the hair. (*A. J. P.*, 1872, p. 106.) In China, *moxa* is prepared from *A. chinensis*, L., and *A. indica*. Wormwood is a perennial plant, with branching, round, and striated or furrowed stems, which rise two or three feet in height, and are paniculed at their summit. The radical leaves are triply, those of the stem, doubly or simply pinnatifid. The floral leaves are lanceolate. The flowers are of a brownish-yellow color, hemispherical, pedicelled, nodding, and in erect racemes. The plant is a native of Europe, where it is also cultivated. It is among our garden herbs, and has been naturalized in the mountainous districts of New England. It should be gathered in July or August, during flowering. "Leaves about 5 Cm. long, hoary, silky-pubescent, petiolate, roundish-triangular in outline; pinnately two- or three-cleft, with the segments lanceolate, the terminal one spatulate; bracts three-cleft or entire; heads numerous, about 3 Mm. long, subglobose, with numerous small, pale-yellow florets, all tubular and without pappus; odor aromatic; taste persistently bitter." *U. S.* 1890. The volatile oil (*oleum absinthii*) is usually dark green, sometimes yellow or brownish, having a strong odor of the plant, an acrid peculiar taste, and the sp. gr. 0.925 to 0.950. It is sometimes adulterated with alcohol, oil of turpentine, etc., which lessen its specific gravity. It is composed of *thujone* (*absinthol*), which has the specific gravity 0.926, composition $C_{10}H_{16}O$, boiling point 200° C. (392° F.) to 205° C., and when heated with phosphorus pentasulphide or zinc chloride yields *cymene* ($C_{10}H_{14}$); *thujyl alcohol* ($C_{10}H_{18}O$), both free and as the *esters* of *acetic*, *isovaleric*, and *palmitic acids;* *phellandrene* and possibly *pinene;* *cadinene;* and a *blue oil* of as yet undetermined composition. (Gildemeister and Hoffmann, *Aetherische Oele*, 1899.) According to Braconnot, wormwood also contains chlorophyll, albumen, starch, saline matters, and lignin, malic and acetic acids. The cold infusion becomes olive-green and turbid on the addition of ferric chloride, indicating the probable existence of a little tannic acid. (Pereira.) The *absinthic acid* found by Braconnot is said to be succinic acid. Caventou first obtained *absinthin* in an impure condition. (See U. S. D., 14th ed., p. 5.) E. Luck prepared pure absinthin in 1851. (*A. J. P.*, xxiii. 358.) A. Kromayer (*A. Pharm.* (2), cviii. 129) gave to absinthin the formula $C_{20}H_{28}O_4 + \frac{1}{2}H_2O$. P. Senger (*A. Pharm.*, 230, p. 94) has obtained absinthin as a yellow substance of an intensely bitter taste melting at 55° C. He gives it the formula $C_{15}H_{20}O_4$ and considers it to be a glucoside, as on boiling with diluted sulphuric acid it yields dextrose and absinthic acid. Absinthin is soluble in water, alcohol, and ether. Adrian and Trillat isolated a new crystalline body ($C_{53}H_{51}O_{20}$) from wormwood by treating an alcoholic extract with amyl alcohol, the absinthin having been previously removed. They also isolated another crystalline principle, *anabsinthin*, $C_{18}H_{24}O_4$ (*P. J.*, 1899, 1, 75). The old *salt of wormwood* (*sal absinthii*) was impure potassium carbonate, made from the ashes of the plant.

Wormwood, which was formerly in vogue as a stomachic tonic, antiperiodic, and anthelmintic, is at present very seldom used by regular practitioners. The volatile oil is an active narcotic poison. In dogs and rabbits from thirty to fifty drops (1.5–2.5 Cc.) of it will cause trembling, stupor, lebetude, and it may be insensibility; one to two fluidrachms (3.75–7.5 Cc.) of it, violent epileptiform convulsions, with involuntary evacuations, unconsciousness, and stertorous breathing, which may or may not end in death. (Marcé, *B. G. T.*, Mai, 1864; Magnan, *L'Union Méd.*, Août, 1864; Amory, *B. M. S. J.*, March, 1868, p. 83.) In man the oil acts similarly; a half-ounce (15 Cc.) of it caused, in a male adult, insensibility, convulsions, foaming at the mouth, and a tendency to vomit; though the patient recovered under the use of emetics, with stimulants and demulcents. (*L. L.*, Dec. 6, 1862.) According to J. L. Corning, the volatile oil is a powerful local anæsthetic, locally useful in *rheumatic pains*. Böhm and Kobert affirm that the oil escapes through the kidneys unchanged. *Dose*, of wormwood in substance, from twenty to forty grains (1.3–2.6 Gm.); of the infusion (one ounce in a pint of boiling water), from one to two fluidounces (30–60 Cc.); of the oil, one to two minims (0.06–0.12 Cc.).

Absinthe is a liqueur containing oils of wormwood, angelica, anise, and marjoram. According to Baudrimont the *absinthe ordinaire* contains 47.66 per cent. of alcohol, the *demi-fine* 50 per cent., the *fine* 68 per cent., and the *absinthe Suisse* 80.66 per cent. The preparation, if manipulated properly, possesses naturally a bright green color, brought to an olive-green by slight addition of caramel coloring; but artificial coloring is often resorted to, and indigo, turmeric, cupric acetate, and aniline green have been used to produce the proper shade. *Absinthism* differs from ordinary alcoholism in its manifestations; its characteristic symptoms are restlessness at night, with disturbing dreams, nausea and vomiting in the morning, with great trembling of the hands and tongue, vertigo, and a tendency to epileptiform convulsions.

Acacia Bark. *Acaciæ Cortex. Br. Add.* Under the name of *Acacia Bark* the British Addendum recognizes under one name the dried barks of the *Acacia arabica* (Lam.), Willd., and of the *Acacia decurrens*, Willd., or *Black Wattle* of Australia.

Acalypha. *Br. Add.*—The fresh and the dried herb, *Acalypha indica*, L. This euphorbiaceous plant is said to have expectorant and emetic properties similar to those of ipecac, and also to be employed by the native Indian practitioners in the form of the fresh leaves as a poultice for *ulcers*, and as a suppository for *constipation* in children. The *Succus Acalyphæ*, Br. Add., is prepared by adding one volume of 90 per cent. alcohol to three volumes of the juice expressed from fresh leaves, with subsequent filtration. It is given in doses of from one to four fluidrachms (3.75–15 Cc.). The *liquid extract* (*Extractum Acalyphæ Liquidum*, Br. Add.), made with a menstruum of 90 per cent. alcohol, is given in doses of from five to thirty minims (0.3–1.8 Cc.).

Acetal. $C_6H_{14}O_2$ or $CH_3CH(OC_2H_5)_2$.—*Ethylidene diethylic ether*, a limpid liquid boiling at 104° to 106° C. (219°–223° F.), sparingly soluble in water, readily soluble in alcohol, is stated to be narcotic in the *dose* of thirty minims (1.8 Cc.).

Aceto-Ortho-Toluid. $C_7H_7.NH.C_2H_3O$.—Colorless needles, easily soluble in hot water, alcohol, and ether; powerfully depressant to animal temperature, although feebly poisonous. (E. Barbarini, *T. Mod.*, 1892, 532.)

Acetophenone. *Hypnone. Phenyl-methyl-ketone*, C_8H_8O or $C_6H_5CO.CH_3$.—A colorless liquid, boiling at 200° C. (392 F.), having a very tenacious, persistent odor, recalling that of bitter almonds, not inflammable, not soluble in water or in glycerin, but very soluble in alcohol, ether, chloroform, petroleum benzin, and also certain oils, especially that of sweet almonds. It is made by distilling a mixture of calcium acetate and benzoate. Originally proposed as a hypnotic by Dujardin-Beaumetz, it has been shown by the concordant researches of Laborde, Grasset, Mairet, and Combemale to be very uncertain as a hypnotic and very toxic in its action on the lower animals. The researches of Regnier, confirmed by Kamensky, have demonstrated that it acts powerfully on nutrition, rapidly lessening the hæmoglobin in the blood and causing loss of weight. In agreement with this, it has been found to be in man an uncertain hypnotic. Norman, however, claims excellent results from hypodermic injections of from five to twelve minims (0.3–0.7 Cc.) in *insanity* (*J. M. S.*, xxxiii.). *Dose*, from three to ten minims (0.2–0.6 Cc.), although Rey has given as much as twenty-three grains (1.5 Gm.) without producing sleep.

Acetophenone-Paramidophenol Ether.—This substance, prepared by G. Vignolo, has been studied physiologically by F. Badano (*Arch. I. C. M.*, xxxvi. 1897), who finds that it powerfully reduces bodily temperature by lessening the heat production; that in poisonous doses it causes the formation in the blood of methæmoglobin, and kills by respiratory paralysis.

Acetopyrine. *Antipyrinæ Acetyl-salicylas.* This occurs as a white crystalline powder, having an odor resembling acetic acid; sparingly soluble in cold but freely in warm water; freely soluble in alcohol, chloroform, and in warm toluol; less so in ether and in petroleum benzin. It was originally introduced into medicine by Winterberg and Braun (*W. K. W.*, 1900, No. 39) as combining the activities of antipyrine and salicylic acid, into which substances, according to W. Meitner (*St. P. M. W.*, xx. 1900), it is broken up in the stomach; the acetyl-salicylic acid undergoing further decomposition in the intestines. Acetopyrine has been much used as an analgesic in *migraine, sciatica, neuritis*, and also as an antipyretic in *typhoid* and other low fevers. It has also been employed as an antirheumatic, especially in subacute and chronic cases. Goldmann (*All. W. M. Z.*, April, 1901) claims that it is valuable in *bronchitis;* and Bolognesi (*B. G. T.*, March, 1901) recommends it in *gonorrhœa*. Its physiological and therapeutic activities are probably those of its constituents. It may be given in *doses* of five to ten grains (0.32–0.65 Gm.), in capsules or suspended in water, and repeated up to thirty grains (2 Gm.) in the twenty-four hours when necessary. In fevers two doses may be given two hours apart about the time of the exacerbation.

Acetylene. C_2H_2.—Acetylene was first prepared by Berthelot, who obtained it by passing the electric spark between carbon points in an atmosphere of hydrogen. It is now prepared on a large scale by the decomposition of carbides like calcium carbide with water according to the reaction:

$$C_2Ca + 2H_2O = C_2H_2 + Ca(OH)_2$$

The product so obtained is almost always contaminated with phosphine, and this should always be removed by washing the acetylene with bromine water.

Calcium carbide, CaC_2, is prepared by melting a mixture of powdered lime and coke dust in an electrical furnace. It is a grayish-brown, dense substance having a crystalline metallic fracture and the specific gravity of 2.26. It evolves a peculiar odor when exposed to the atmosphere, due to the action of moisture which causes partial decomposition with the production of acetylene. When exposed to the air, in lumps, it becomes coated with a layer of calcium hydroxide, which to a great extent protects the interior of the lumps from further deterioration. Calcium carbide is not inflammable and one pound if pure yields 5.9 cubic feet of acetylene gas at 18° C. The production of calcium carbide in the United States in 1904 was 31,642,000 pounds, valued at $1,088,420.

Acetylene is a colorless gas of ethereal odor, slightly soluble in water, more readily in alcohol and ether, and most abundantly in acetone. It burns ordinarily with a very smoky flame, but from a burner with a fine slit gives a clear white flame. It forms an explosive mixture with air, also a series of explosive acetylides with copper, silver, and other metals.

According to Mosso and Ottolengui (*Rendiconti Della R. Accademia dei Lincei.*, 1896) acetylene gas is an active poison, causing death in the dog in about one minute through respiratory failure, and always producing a fatal result when present in the air in more than twenty per cent. Rosemann (*A. E. P. P.*, xxxvi. 1895) asserts that its toxic properties are very feeble, and that it has no action upon hæmoglobin.

In Moissan's experiments from 40 to 79 per cent. of the vapor was necessary in the air breathed before toxic manifestations were produced (*C. R. A. S.*, cxxi), while Oliver found that no symptoms were caused so long as even a moderate amount of atmospheric air was main-

tained with the vapor, and when the animal was made to breathe pure acetylene gas the symptoms were very similar to, if not identical with, those of asphyxiation. (*B. M. J.*, i. 1898.)

Acetylphenylhydrazin. $C_6H_5NH,NH.CH_3CO$. This substance, first introduced into medicine in an impure form, under the name of *pyrodin*, has since been used in an alleged pure condition under the name of *hydracetin*. It is chemically closely allied to acetanilide, differing solely in the possession of one imido-group (NH); it is, as indicated by its name, hydrazin in which hydrogen atoms are replaced by phenyl and acetyl. It is made by heating together phenylhydrazin and glacial acetic acid, and purifying the product by recrystallization. It forms colorless, inodorous crystals, melting at 128.5° C. (263° F.), soluble in fifty parts of water and readily soluble in alcohol. Guttmann (*Pr. M. W.*, 1889) demonstrated that this substance is a powerful poison, seven and a half grains (0.5 Gm.) being sufficient to kill a rabbit, with a remarkable destruction of the red blood cells. He found it a powerful antipyretic, in *doses* of from one and a half to two and a half grains (0.096–0.16 Gm.), but believes it to be a very dangerous remedy on account of its action on the blood. Externally he considered it to be safe, and allied to pyrogallic acid in its influence upon *skin diseases;* but Basch (*L. L.*, 1890) has seen very violent poisoning from the use of a 10 per cent. ointment, without benefit to the *psoriasis*. On the other hand, Lemoine (*B. M.*, 1889) finds it, in *doses* of three-fourths of a grain (0.048 Gm.), a valuable remedy in the treatment of *hectic fever of phthisis*, reducing the temperature and checking night-sweats. When the dose of two and a half grains (0.16 Gm.) per day is exceeded, violent symptoms are apt to be produced.

Achillea. *U. S.* 1870.—The flowering tops of *Achillea Millefolium*, L. *Milfoil*, or *yarrow*, is a perennial herb, very common both in Europe and America. It is from a foot to eighteen inches high, and is specifically distinguished by its doubly pinnate, downy, minutely divided leaves, with linear, dentate, mucronate divisions, from which it derived the name of milfoil, by its furrowed stem and involucre, and by its dense corymbs of whitish flowers, which appear throughout the summer, from June to September. The whole herb is medicinal. *Achillea nobilis*, L., and *A. moschata*, Jacq., or *Iva* of Europe, are sometimes used as substitutes for *A. Millefolium*.

Both the flowers and leaves of *A. Millefolium* have an agreeable, though feeble aromatic odor, which continues after drying, and a bitterish, astringent, pungent taste. The aromatic properties are strongest in the flowers, the astringency in the leaves. The plant contains, besides, a blue volatile oil, tannin, and a peculiar principle, *achillein*, which was discovered by Zanon. (*Ann. Ch. Ph.*, lviii. 21.) As analyzed by von Planta (*Ann. Ch. Ph.*, clv. 1870) its formula is $C_{20}H_{38}N_2O_{15}$. It occurs in a brownish-red mass of a strongly bitter taste, soluble in water, more feebly in alcohol, and not at all in ether. *Achilleic acid*, also discovered by Zanon, is affirmed by Hlasiwetz to be identical with aconitic acid. The oil, which may be obtained separately by distillation with water, has a beautiful azure-blue color, and the peculiar flavor of milfoil. Schimmel & Co. (*Ber. d. Chem. Ges.*, 1894, p. 50) found its most important constituent to be *cineol*, $C_{10}H_{18}O$. The high boiling blue portion is probably identical with the azulein of chamomile oil. *Ivain*, $C_{24}H_{42}O_5$, has also been isolated; it occurs as a dark yellow resinous mass, insoluble in water, readily soluble in alcohol, and producing an intensely bitter solution.

The active principles of the drug are extracted both by water and alcohol. *A. Millefolium* is a mild aromatic sudorific tonic and astringent, and is sometimes used in acute *suppression of the menses*, in the form of a hot infusion. *Dose*, from four to six fluidounces (120–180 Cc.); the volatile oil has been used in doses of twenty or thirty drops (1.0–1.5 Cc.). Pappi states that *achillein* given in divided doses up to from thirty to seventy-five grains (2–5 Gm.) causes marked irregularity of the pulse.

Acoine. $HCl.C(NHC_6H_4O(CH_3))(=NC_6H_4O(C_2H_5))(NHC_6H_4O(CH_3))$.

Di-para-anisyl-mono-para-phenetyl-guanidine Hydrochloride.—A white crystalline powder, soluble in water (six parts to one hundred). It is incompatible with iodine or alkaline iodides. Acoine was introduced as a local anæsthetic by Trolldenier (*Th. M.*, xiii.; also *Zeit. T. M.*, 1901). It has been specially used by the ophthalmologists in a 1 per cent. aqueous solution, stronger solutions being very irritant or even corrosive. It is not absorbed through a normal conjunctiva, but when the epithelial covering is destroyed, or when the drug is injected into the sub-conjunctival tissues, it is said to act more powerfully than cocaine, and to be specially efficacious in the relief of deep seated ocular pains. It is also actively germicidal, the 1 per cent. solution remaining free from bacteria. Acoine has also been used with asserted excellent results in dentistry and in operations upon the nose. For dental purposes a 2 per cent. solution is preferred. One per cent. of common salt should be added to hypodermic solutions, which are preferably made with distilled water.

Acrolein. *Acrylic Aldehyde.* $CH_2=CH.CHO$. Acrolein is a fluid which emits an intensely pungent odor, is soluble in two or three parts of water, and boils at 52.5° C. (126.5° F.). It is asserted by E. Koch and G. Fuchs (*Cb. B.*, 1899, xxvi.) to be a valuable bactericide, but its exceedingly disagreeable odor and tendency to undergo decomposition will probably prevent its coming into use.

Actæa. *Actæa spicata*, L. *Baneberry. Herb Christopher. Radix Christophoriana. Racine de Saint Christophe*, Fr. *Christophswurz, Wolfswurz*, G.—This is a perennial, herbaceous plant (Fam. Ranunculaceæ) growing in the woods of mountainous regions from Japan to Central Europe as well as in Siberia. Its dark-brown, bitterish, somewhat acrid root resembles that of *Helleborus niger*, for which it is said to be occasionally substituted. It is an active emeto-purgative, capable of producing when in overdose dangerous effects. There are two American species which probably have medicinal properties similar to those of *A. spicata*,—namely, *A. alba* (L.), Mill., or *white cohosh*, and *A. rubra* (Ait.), Willd., or *red cohosh*, distinguished by the color of their berries. (*Proc. A. Ph. A.*, 1858.)

Actinomeris. *Actinomeris helianthoides*, Nutt. *Gravel Weed. Diabetes Weed.* (Syn., *Verbesina helianthoides.*) (Fam. Compositæ.)—The root is said to be largely used in Upper Georgia in *dropsy* and *chronic cystitis*. *Dose* of infusion (ounce to a pint), one fluidounce (30 Cc.).

Adansonia. *Adansonia digitata*, L. *Baobab.* A tree of enormous magnitude, belonging to *Bombacaceæ*. It is a native of Africa, extending quite through that continent from Senegal to Abyssinia, and has been introduced into the West Indies. The leaves and bark of this tree abound in mucilage, and have little odor or taste. By the Africans the leaves are used as a diaphoretic, and the subacid pulp of the fruit in *dysentery*. Under the name of *cream-of-tartar tree* various trees whose fruit contains or has been supposed to contain potassium bitartrate are spoken of in books. The most important of these is the *Adansonia Gregorii*, F. Muell., of North Australia. Another cream-of-tartar fruit is yielded by a tree of South Africa, which, according to E. M. Holmes, is probably the *Adansonia madagascariensis*, Baillon. This fruit has been examined by E. J. Millard (*P. J.*, April, 1890), who found that it contains no cream of tartar at all. It is probably identical with a cream-of-tartar fruit examined by F. L. Slocum. (*A. J. P.*, 1880.) It is worthy of remark that Heckel and Schlagdenhauffen (*Nouv. Rem.*, xxi. 487) have found in the fruit of the *Adansonia digitata*, or the baobab tree, as much as 2 per cent. of free tartaric acid and 12 per cent. of potassium bitartrate. Duchassaing of Guadeloupe, West Indies, and Pierre of France, commend the bark of *A. digitata* highly as an antiperiodic. (*A. G. M.*, 3e sér., xxiii. 535.) It is said to be acceptable to the stomach, and to produce no other observable physiological effect than increase of appetite, increased perspiration, and perhaps diminished frequency of pulse. An ounce may be boiled in a pint and a half of water to a pint, and the whole taken in a day. (*J. P. C.*, 3e sér., xiii. 412 and 421.)

Adenanthera. *Adenanthera pavonina*, L. *Zangavara.*—Rochebrune (*Toxicologie Africaine*) states that he has obtained from this plant a crystalline principle which resembles in its activity physostigmine, but does not affect the muscles.

Adenia. *Adenia venenata.*—A climbing passion-flower of Africa, said by Schweinfurth to be used as a vesicant. (*P. J.*, March, 1874.)

Adhatoda. *Br. Add.* (Nat. Ord. Acanthaceæ.) The fresh and the dried leaves of *Adhatoda vasica*, Nees. (*Justicia Adhatoda*, L.) "The fresh leaves are five or six inches (about twelve and a half to fifteen centimetres) long and an inch and a half (nearly four centimetres) broad, lanceolate, entire, taper-pointed, smooth on both sides. The dried leaves are of a somewhat dark green color which becomes much lighter when the leaves are powdered. They have a strong characteristic tea-like odor and a bitter taste." The leaves are stated to contain an alkaloid, *vasicine*, and an organic acid, *adhatodic acid* (see *Pharmacog. Indica*, vol. iii.). Vasicine, isolated by Hooper, is soluble in water, sparingly in benzin and carbon disulphide, readily soluble in ether and chloroform. The claim is made for it that it exerts a powerful toxic influence upon lower forms of vegetable and animal life, and is not poisonous to the higher animals. The leaves are stated to be actively poisonous to frogs and are considerably used in India as an expectorant and antispasmodic, especially in the treatment of *asthma*. The Br. Add. recognizes the *liquid extract* (*Extractum Adhatodæ Liquidum*, Br. Add.), made with alcohol and given in doses of from twenty to sixty minims (1.3–3.75 Cc.); the freshly *expressed juice* (*Succus Adhatodæ*, Br. Add.), dose, from one to four fluidrachms (3.75–15 Cc.); the *tincture* (*Tinctura Adhatodæ*, Br. Add.), dose, from one-half to one fluidrachm (1.8–3.75 Cc.).

Adiantum. *Maidenhair.*—Tradition has attached to various species of this genus of ferns properties according to which it is valuable in chronic pulmonic *catarrhs*, as well as in other conditions. *A. pedatum*, L., of America; *A. Capillus-Veneris*, L., of Europe; *A. lunulatum*, Burm., of India, are the most important of these alleged medicinal species. The European species is sometimes employed on the Continent as an emmenagogue under the name of *polytrichi*, *polytrichon*, or *kalliphyllon*, and is given in the form of infusion, sweetened with sugar or honey, and a syrup prepared from it is said to be popular in France under the name of *sirop de capillaire*, official in the *Codex*.

Adonis. *Adonis vernalis*, L.—This ranunculaceous plant of Northern Europe and Asia has long been used as an abortifacient, while its rhizome sometimes occurs in commercial black hellebore as an adulteration. Linderos examined the leaves and found in them 10 per cent. of *aconitic acid*. (*Ann. Ch. Ph.*, 1876, 340.) Cervello, in 1882, obtained from the plant a glucoside, to which he gave the name of *adonidin*. For improved method of preparation, see *P. J.*, vol. xvi. 145, and *A. J. P.*, 1887, 609. This glucoside occurs in the form of a somewhat hygroscopic, canary-yellow powder of an intensely bitter taste; soluble in water, alcohol, and in amyl alcohol; insoluble in anhydrous ether, chloroform, oil of turpentine, and petroleum benzin. Its reaction is neutral. It reduces Fehling's solution, if previously heated with a few drops of hydrochloric acid. It exists in small quantities in all portions of the plant. For further details as to reactions, see *P. J.*, xv. 145. Podwyssotzki found commercial samples of adonidin to be mixtures of the active principle with other constituents of the plant. He gives the name of *picroadonidin* to the active principle, which he describes as an amorphous glucoside having an excessively bitter taste, possessing the properties of a cardiac poison in the highest degree, and being easily soluble in water and alcohol and entirely soluble in ether. (*P. J.*, xix. 1888, 346.) According to Cervello (*A. E. P. P.*, xv.), adonidin exists also in the *Adonis cupaniana* of Southern Europe, and F. Borgiotti affirms the value of *A. æstivalis*, L., in heart affections. (*D. M. Ztg.*, Aug. 1888.) Tahara asserts that the glucoside of *Adonis autumnalis*, L., is distinct, and calls it *adonin* ($C_{24}H_{40}O_9$) (*Ber. d. Chem. Ges.*, xxiv.), while Y. Inoko (*A. E. P. P.*, xxviii.) affirms that the glucoside of *A. amurensis* of Japan is also peculiar, and assigns to it the formula $C_{20}H_{40}O_9$, allied to adonidin, but much less powerful.

Merck has described an additional crystalline principle, which fuses at 102° C. (216° F.), is very soluble in water and warm alcohol, and crystallizes in clear needle-like prisms. It has a neutral reaction, does not reduce Fehling's solution, and is not colored brown by alkalies. Its analysis seems to indicate a formula $C_5H_{12}O_5$, and Merck considers that it is a hitherto undescribed pentatomic alcohol, and calls it *adonite*. Whether it be identical with the *adonidulcite* announced in a preliminary communication by Podwyssotzki shortly before his death, Merck is not able to state, as no details of fusing point, formula, or chemical reactions were given by the former. (*M. Bull.*, Jan. 1893.) E. Fischer (*Ber. d. Chem. Ges.*, 1893, 633) confirms the formula $C_5H_{12}O_5$ given by

Merck, as well as the statement that it is a pentatomic alcohol; by oxidation with sodium hypobromite it is changed into *ribose*, $C_5H_{10}O_5$, which treated with sodium amalgam again yields adonite.

According to Cervello and H. A. Hare, adonidin at first slows the action of the frog's heart, increasing at the same time the force of the systole, and finally produces arrest. Hare states that this arrest is diastolic; Cervello, that it is systolic. Both experimenters found that in mammals adonidin increases very markedly the arterial pressure while decreasing the pulse rate, and that after toxic doses the primary rise is followed by a marked fall of arterial pressure, with irregularity of the heart's action. The primary rise of the pressure appears to be chiefly cardiac, although there is some reason for supposing that the drug does exert some influence upon the vasomotor system. The first slowing of the pulse was found by Hare to be due to stimulation of the inhibitory nerves, as it was prevented by their previous section, while finally the fall of pressure was at least in great part owing to the vasomotor palsy.

In 1879 Bubnow introduced adonis vernalis as a very valuable cardiac stimulant, and a number of papers have been published with the general concordant statements that the action of the drug resembles that of digitalis, but that it is more prompt and with less cumulative tendency. It does not appear to be superior to digitalis in diuretic action, and in some cases produces so much vomiting and diarrhœa that it cannot be used (Lublinski and Huchard). In a case reported by Durand, in which three grains (0.2 Gm.) of adonis were given by mistake every half-hour, violent vomiting and diarrhœa were the most troublesome symptoms. Notwithstanding the many favorable reports adonis vernalis does not seem to have come into general use in the treatment of *cardiac dropsies*. The statements of Bechterew, that adonis vernalis is useful in *epilepsy* in conjunction with bromides, is confirmed by Gianni, who found on the other hand that, given by itself, adonis had no influence. The infusion, four to eight parts in one hundred and eighty parts of water, was administered by Bubnow in tablespoonful (15 Cc.) doses every two hours. Durand gives the *dose* of adonidin as one-third of a grain (0.021 Gm.), repeated at intervals of three or four hours.

Æsculus. *Horse-chestnut.*—This genus, which is generally recognized by botanists as belonging to a natural order of its own, contains about fifteen species, the most famous of which is the true horse-chestnut (*Æsculus Hippocastanum*, L.), said to have been originally a native of Asia, but introduced about the middle of the sixteenth century into Europe, whence it has spread to this country. It is to this species that this article especially applies, though it is probable that any medicinal properties which the tree may have, are shared by the other species of the genus. The fruit or nut abounds in starch, but its bitter, disagreeable taste has prevented its general use as a food, although as long ago as 1856 starch was made from it in France, and recently a pleasant and nutritious article of diet is said to have been prepared by removing its bitter principle by means of alcohol. In the leaves Rochleder found *quercitrin*, and a bitter principle, *esculin;* and in the capsules of the fruit a peculiar acid, *capsulæsic acid* (*J. P. C.*, May, 1859; Aug. 1860). (For Rochleder's method of extracting esculin, see U. S. D., 18th edition; for a second process, see *A. J. P.*, xliv. 400.) Esculin is in shining white, prismatic crystals, inodorous, bitter, but slightly soluble in cold water, more soluble in boiling water, and very readily so in boiling alcohol and in alkaline solutions. Its solution is precipitated by lead subacetate, and its formula, according to Schiff, is $C_{15}H_{16}O_9$. When treated with dilute sulphuric acid, it is converted into grape sugar and a substance called *esculetin*, $C_9H_6O_4$, which is now known to be a *dioxycoumarin*, $C_6H_2(OH)_2\begin{matrix}O-CO\\ \\ CH=CH\end{matrix}$. Tannin is found in all parts of the tree, including the *leaves* as well as the bark and fruit. According to Rochleder, when pure, it is white and soluble in water, alcohol, and ether; becomes red by the absorption of oxygen; colors ferric salts green, but violet on the addition of a little alkali; fluorescent when it is in alkaline solution; in concentrated solution is precipitated, at least partially, by sulphuric, hydrochloric, and metaphosphoric acids, while acetic acid is opposed to this result, and forms also, with potassium and sodium sulphites and ammonium sulphide, precipitates which are readily dissolved by dilute acetic acid. (*J. P. C.*, Jan. 1868, 72.) The powdered kernel of the nut is a sternutatory. The extract of the wood is said to be used in dyeing silk black. The fixed oil, extracted from the kernels by ether, has been employed in France as a topical remedy in *rheumatism;* and the bark as an antiperiodic in doses of half an ounce (16 Gm.) in the twenty-four hours, given in the form of decoction. In the United States a decoction of the leaves is popularly employed for *whooping cough*, and to the seeds themselves, when "carried in the pocket of the patient," is attributed the marvellous property of curing *hemorrhoids*. Esculin has also been successfully administered in *malarial disorders*, in fifteen-grain (1 Gm.) *doses* repeated once during the intermissions. (*Ann. Thér.*, 1859, 1860.)

The fruit of the *Æsculus Pavia*, L., or *Red Buckeye* of the Southern United States, is said to be an active convulsant. E. C. Batchelor (*A. J. P.*, xlv. 144) found in the cotyledons of the seeds about 2½ per cent. of a peculiar glucoside. *Æsculus glabra*, Willd., the *Ohio Buckeye*, is asserted to be useful in *portal congestion*. (*N. P.*, ii. 21.)

Æthusa. *Æthusa Cynapium*, L.—Poisonous properties have been alternately attributed and denied to this British plant. (See *P. J.*, 1874, 202; Nov., 1880, 438.)

Agaric. *Touchwood. Spunk. Tinder. Fungus laricis. Purging Agaric. Agaric blanc, Agaric purgatif*, Fr. *Larchenschwamm*, G.—The term Agaric is more properly applied to the fungi of the genus Agaricus. *White agaric*, however, or *purging agaric* of medical writers (*agaricus albus*), is referred to *Polyporus officinalis*, Fries (*Boletus Laricis*, Jacquin; *B. purgans*, Persoon), which is found upon the old trunks of the European larch and upon *Larix sibirica*, Ledebour, of Asia. It is of various sizes, from that of the fist to that of a child's head, or even larger, hard and spongy, externally brownish or reddish; but, as found in commerce, it is deprived of its exterior coat, and consists of a light, white, spongy, somewhat farinaceous, friable mass, which, though capable of being rubbed into powder upon a sieve, is not easily pulverized in the ordinary mode, as it flattens under the pestle. That which is most esteemed is said to be brought from Siberia; but it is probably produced wherever the European larch grows. Wm.

M. McPheeters (*St. L. M. S. J.*, x. 421) found a specimen brought from the Rocky Mountains decidedly cathartic in doses of twenty-four grains (1.6 Gm.). An agaric growing on the *Larix leptolepis*, and used in Japan as a sacred medicine under the name of *Toboshi* or *Eburiko*, has been found by Y. Inoko to contain agaric acid. (*Sei-I-Kwai*, April, 1891.) Agaric has a sweetish very bitter taste. *Agaric acid*, as described by Hofmeister, has the formula $C_{14}H_{27}(OH)\begin{cases}COOH\\COOH\end{cases} + H_2O$. The pure acid forms a white, silky, lustrous powder, only slightly soluble in cold water, but moderately soluble in hot water. From this hot solution the acid separates out on cooling in a finely crystalline state. It fuses at 140° C. (284° F.). According to J. Schmieder, agaric contains a small amount of a soft resin, $C_{15}H_{20}O_4$, extracted with petroleum benzin, and from 4 to 6 per cent. of a fatty body, which is made up of 1. *agaricol*, $C_{10}H_{16}O$, fusing at 223° C.; 2. *phytosterin*, $C_{26}H_{44}O$; 3. solid hydrocarbons, $C_{23}H_{46}$ and $C_{29}H_{54}$; 4. *cetyl alcohol*, $C_{16}H_{33}.OH$; 5. a liquid aromatic alcohol, $C_9H_{18}O$; 6. a fatty acid, $C_{14}H_{24}O_2$; and 7. *ricinoleic acid*, $C_{18}H_{34}O_3$. (Schmidt, *Lehrbuch der Pharm. Chem.*, ii., 3te Auf., 1528.) J. D. Riedel has produced two phenetidides of agaric acid, for which antipyretic and anhidrotic properties are claimed. (*Ph. Ztg.*, xlvii.)

Medicinal Properties.—The physiological properties of agaric are not well known. In overdose it is said to cause purging. Under the name of *agaricin* an impure alcoholic extract of agaric has been much used, in doses of from one to three grains (0.065–0.2 Gm.) three times a day, against *colliquative sweats*. It is certainly a valuable remedy, free from danger, and effective, although it has some tendency to produce purging. *Agaricinic* or *agaric acid* was found by Hofmeister to act upon the lower animals as an anhidrotic, and unless in enormous doses to have little other influence except as an irritant to the gastro-intestinal canal. Doses of from one-sixteenth to one-third of a grain (0.0039–0.021 Gm.) were well borne by phthisical patients, and promptly controlled the *night sweats*. (*A. E. P. P.*, xxv.) Köhler, Combemale, Klemperer, and other clinicians have confirmed these results, and it would seem that the acid is one of the most certain remedies of its class, and may be used almost indefinitely without affecting the general system. *Dose*, from one-third to three-fourths of a grain (0.021–0.048 Gm.), given in pill three times a day. A tincture of the agaric of the Canadian larch has been used successfully in *rheumatism* by J. A. Grant. (*British-Am. Journ.*, April, 1862.) For study of the precipitate found in tincture of *Boletus Laricis*, see *Proc. A. Ph. A.*, 1889, 194.

Thoerner obtained from *Agaricus atramentosus* crystalline, dark-brown scales, which he believed to be *dioxykinon*. (*Ber. d. Chem. Ges.*, 1878, 533.) According to T. L. Phipson, *Agaricus ruber* contains a rose-red coloring matter, *ruberin*, which appears bright blue by transmitted light; being soluble in water, it is washed out of the head of the fungus by a heavy fall of rain. Ether extracts from the fungus a yellowish-white alkaloid, *agarythrine*, which has a bitter, afterwards burning taste, somewhat like aconitine; its chloride is soluble, but the sulphate insoluble in water, the latter dissolving in alcohol; it dissolves in nitric acid with red color, and is colored red by chlorinated lime and afterwards bleached. On agitating the solution of the alkaloid with ether, it is oxidized by the air to a red coloring matter, which is probably the cause of the red color of the surface of the fungus. (*Chem. News*, 1882, 199.)

Fungus chirurgorum. Boletus chirurgorum, Wundschwamm, G.—*Surgeon's agaric* is the product of *Polyporus fomentarius* (L.), Fries, which is found upon the oak and beech trees of Europe. It is shaped somewhat like the horse's foot, with a diameter of from six to ten inches. It is soft like velvet when young, but afterwards becomes hard and ligneous. It usually rests immediately upon the bark of the tree, without any supporting footstalk. On the upper surface it is smooth, but marked with circular ridges of different colors, more or less brown or blackish; on the under, it is whitish or yellowish, and full of small pores; internally it is fibrous, tough, and of a tawny-brown color. It is composed of short tubular fibres compactly arranged in layers, one of which is added every year. The best is that which grows on the oak, and the season for collecting it is August or September. It has neither taste nor odor. Among its constituents, according to Bouillon-Lagrange, are extractive, resin in very small proportion, nitrogenous matter also in small quantity, potassium chloride, and calcium sulphate, and in its ashes are found iron, and calcium and magnesium phosphate. It is prepared for use by removing the exterior rind or bark, cutting the inner part into thin slices, and beating these with a hammer until they become soft, pliable, and easily torn by the fingers. In this state it was formerly much used by surgeons for arresting *hemorrhage*, being applied with pressure. *P. ignarius* (L.), Fries, and *P. marginatus*, Fries, yield similar products.

When prepared polyporus (so-called agaric) is steeped in a solution of nitre, and afterwards dried, it constitutes *spunk, punk*, or *tinder*, the *amadou* of the French, which occurs in flat pieces, of a consistence somewhat like that of very soft, rotten buckskin leather, of a brownish-yellow color, capable of absorbing liquids, and inflammable by the slightest spark. It is said to be prepared also from various other species of *Polyporus*, as *P. ungulatus, P. ribis*, etc.

Agathin. $C_6H_4(OH).CH = N.N(CH_3).C_6H_5$. *Salicyl-a-methyl-phenyl-hydrazine.*—This is obtained by the reaction of salicylic aldehyde upon *a*-methyl-phenyl-hydrazin. It is a colorless or greenish-white crystalline substance, without odor or taste, is insoluble in water, soluble in alcohol and ether, and melts at 74° C. It was proposed as a remedy by Israel Roos, and is said by E. Rosenbaum to act like salicylic acid. Although excellent results (see *D. M. Ztg.*, 1892, Nos. 50, 93) have been claimed for it in *neuralgia* and *rheumatism*, without unpleasant effects other than headache, in trials by H. C. Wood it did not seem serviceable. *Dose*, from eight to ten grains (0.5–0.65 Gm.).

Agave. *Agave americana*, L. *American Agave. American Aloe. Maguey.* (Fam. Amaryllidaceæ.)—An evergreen succulent plant, indigenous to Florida, Mexico, and other parts of tropical America, and largely cultivated, chiefly for hedges, in the south of Europe, especially in Spain. Although the *Agave americana* is the best known form, botanists have described of the genus one hundred and fifty species, about one-half of which are indigenous to Mexico, and many of which contribute to the economic products produced in that country from the agave plant. The number of

these products is very great. *Sisal grass* or *sisal hemp* and *Tampico hemp* are the most important of the various fibres obtained from the agave leaves, though a number of other forms are locally known in Mexico. From a number of species of *Agave* are produced in Mexico large quantities of fermented liquors, known as *pulque*, and distilled liquors known as *mescal* or *tequila*. All of the pulque agaves have thick leaves. When they are about to bloom the central bud is cut out, leaving a large cavity into which the sap (*aguamiel* or *honey water*) exudes rapidly. At first clear green, yellowish or whitish, this sap soon by fermentation becomes milky and acquires a cider-like taste or, if the process is allowed to go on, is rapidly converted into vinegar. *Pulque* is said to contain about 7 per cent. of alcohol, and is very largely used as a beverage by the Mexicans, but its odor and taste are disagreeable to unaccustomed palates. The juice has in it an optically inactive reducing sugar, *agavose*, $C_{12}H_{22}O_{11}$. The leaves and roots and stocks of the agave contain saponin and are used in Mexico in the place of soap. The fresh juice is said to be laxative, diuretic, and emmenagogue, and in doses of two fluidounces (60 Cc.) useful in *scurvy*. The leaves are said to be used as counter-irritants, and Lenoble has found in them an acrid volatile oil (*J. P. C.*, xv.). *Agave Gum* has been compared to gum arabic, but differs in containing a much larger proportion of lime, and in being only partially soluble in water, the soluble portions resembling pure gum, but the larger insoluble portions having all the characteristics of bassorin.

Agave virginica, L., which grows in our Southern States, and is known in South Carolina by the name of *rattlesnake's master*, has a very bitter root, which is used, in the form of tincture, in *colic*. (Robert King Reid, *In. Dis.*, 1849.)

Agelæa. *Agelœa Lamarckii*, Plan.—Under the name of *Cephan-Mahi, Soandrou, Vahé-mainti*, this African plant is used as an anti-blenorrhagic. According to Rochebrune (*Toxicologie Africaine*) it contains a poisonous glucoside, *agelœtoxine*.

Ageratum.—*Ageratum conyzoides*, L., a Brazilian plant commonly known in cultivation as ageratum (Fam. Compositæ), is said by Barker Smith (*C. D.*, May 15, 1876) to be used as an emmenagogue.

Agopyrin.—This is said to be a mixture of salicin, ammonium chloride, and cinchonine sulphate. It has been exploited as an antipyretic.

Agrimonia. *Agrimonia Eupatoria*, L. *Common Agrimony. Herba Agrimoniœ. Aigremoine, Eupatoire des Grecs*, Fr. *Odermœnnig, Leberklette*, G. (Fam. Rosaceæ.)—This species of agrimony is a perennial herb, inhabiting Asia, Europe, and North America. Its stem, which rises from one to three feet in height, is hairy, furnished with interruptedly pinnate leaves, and terminated by a long simple spike of yellow flowers. Both the herb and root have been employed. A volatile oil may be obtained from the plant by distillation. Agrimony is a mild astringent. *Dose*, one drachm (3.9 Gm.) or more. (See 16th ed. U. S. D.)

Agurin.—This substance, which consists of five parts of *theobromine-sodium* and two of *sodium acetate*, is a white powder of slightly bitter taste, freely soluble in water. It is alleged that it is less irritant and more actively diuretic than theobromine. The powder should be taken in dilute solution in doses of ten to fifteen grains (0.65–1 Gm.) three or four times a day.

Ailanthus. *Ailanthus glandulosus*, Desf. *Tree of Heaven. Chinese Sumach. Tree of the gods. Götterbaum*, G.—This well-known shade-tree belonging to the Fam. Simarubaceæ, in its general aspect and the character of its foliage appears like a gigantic sumach, and was at one time considered to be a Rhus. In France it is cultivated for the sake of its leaves, upon which the Chinese silk-worm is fed, and is known by the name of *Japan varnish* (*vernis de Japon*), from its having been mistaken for the true Japan varnish tree, which is a species of Sumach. (*P. J.*, vii. 370.) According to Hetet, the bark is an active vermifuge. When in powder it is of a greenish-yellow color, a strong, narcotic, nauseating odor, in its recent state, and of a strongly bitter taste. When chewed, it is said to produce a general uneasiness, a sense of increasing weakness, dazzling, cold sweats, with shivering and a sensation of nausea. It has been found to contain lignin, chlorophyll, a yellow coloring principle, a gelatinous substance (pectin), a bitter substance, an odorous resin, traces of a volatile oil, a nitrogenous fatty matter, and several salts. F. H. Davis detected traces of a crystallizable organic acid, but no alkaloid or glucoside. (*A. J. P.*, 1885, 600.) By the action of alcohol, there is obtained from the bark an *oleoresin* which has the consistence of tar, a very dark greenish-brown color, and in a high degree the odor and taste of the bark. Hetet found the bark to produce in dogs copious stools and the discharge of worms. The resin purged, but rarely acted as an anthelmintic. The vapors of the volatile oil, according to Hetet, cause in man vertigo, cold sweats, and vomiting, though none of the preparations of the bark have that effect when taken internally. The powdered bark has been used successfully against the *tape worm*. *Dose*, from seven to thirty grains (0.45–2.0 Gm.). The oleoresin produces the same effect in a somewhat smaller dose, and keeps better than the bark, which loses its powers with age. (*J. P. C.*, Mars, 1859, 163.) In China the bark is very popular as a remedy in *dysentery* and other *bowel complaints*. (*A. J. P.*, 1874, 276; *P. J.*, vii. 372.)

In India the bark of the *Ailanthus excelsa*, Roxb., is used as a bitter tonic. It occurs in rough, dirty-green pieces. Narayan Daji found in it a bitter uncrystallizable principle and a bitter nitrogenous acid, *ailanthic acid*, to which he attributes medicinal virtues. (*P. J.*, Aug. 1870, Oct. 1876, June, 1877.) This acid is not used medicinally in this country.

Airol. *Bismuth Oxyiodogallate.* $C_6H_2(OH)_3COO(BiOHI)$.—Lüdy describes it as a grayish-green, unirritating, tasteless, and odorless powder which is a basic combination of bismuth, oxygen, iodine, and gallic acid, containing in 100 parts 44.6 parts of bismuth trioxide and 24.3 parts of iodine.

When airol is brought in contact with surgical secretions it becomes red from the liberation of iodine. According to the researches of Carl S. Haegler (Bruns, *B. k. Ch.*, xv. 1896), it is about as feeble a germicide as is iodoform, but as in the case of iodoform the substances liberated by its decomposition in wounds are actively germicidal. It has been largely used as a local remedy in all cases for which iodoform has been employed, having the superiority over that substance of being nearly free from odor. It does not irritate, but rapidly desiccates ulcerated surfaces. Theoretically, in overdose it should produce symptoms

of both bismuth and iodoform poisoning, but in the only case of poisoning by it which we have found recorded the symptoms of bismuth poisoning followed the injection into the cavity of an abscess of nine and a half fluidrachms (35 Cc.) of its 10 per cent. glycerin solution (Nemmer). Haegler took fifteen grains (1 Gm.) of airol in the course of three days without the production of any disagreeable symptoms. *Bruns' Paste*, which has been much used in various skin diseases and ulcerations, is made according to the following formula; airol, one part; mucilage, two parts; glycerin, two parts; argilla alba (kaolin), sufficient to make a soft paste. If the paste becomes too dry, use glycerin; if it be too soft, kaolin may be added. No metal instruments should be employed in preparing the paste, since many metals liberate iodine from airol. For the same reason, no water, only glycerin, should be used in the preparation. The paste is preserved in well-stoppered glass or porcelain jars, which are to be kept closed. (See *Cataplasma Kaolini*, p. 306.)

Injected into the peritoneal cavities of the lower animals in the dose of from one to two grammes per kilo, airol causes clonic convulsions, with coma, nephritis, and fatty degeneration of the liver. It is insoluble in ordinary menstrua, but may be dissolved in alkaline solutions or in diluted mineral acids, and, like iodoform, can be used for the production of antiseptic gauze or other dressings. It may be used as a powder or as a 10 to 20 per cent. salve, which should be prepared with lard or vaseline free from water, since with water, airol undergoes rapid decomposition. The 10 per cent. glycerin solution has been much employed for *tubercular* and other *abscesses*. It has been used in the form of suppositories made with cacao butter, with alleged excellent results, in *metritis*, *vaginitis*, *rhinitis*, etc., and its emulsion has been injected into *cold abscesses*.

Ajuga.—Of this genus *A. Chamæpitys* (L), Schreb., or *Ground Pine; A. reptans*, L., *Mountain Bugle*, or *Common Bugle;* and *A. pyramidalis*, L., all of them European species, the last naturalized in America, have been used in medicine, and are probably mild astringents and tonics. The ground pine is said to contain a volatile oil, and has been used to some extent in *amenorrhœa* and in various forms of *rheumatism*, in *doses* of from one to two drachms (3.9–7.7 Gm.). *Ajuga Iva* (L.), Schreb., of Sardinia, is said to be a depressomotor, an active bactericide, and an antiperiodic. (*A. I. B.*, xxxiv.)

Akazga. *Boundou. Quai. Ikaga. Icaya.*—An ordeal poison, largely used in a district on the west coast of Africa, extending far into the interior, north and south of the equator. It occurs in bundles consisting usually of long, slender, crooked stems, with the root generally attached; sometimes of the branches, but seldom of the whole plant. This is about six feet high, with a yellowish-orange bark, in some parts light red, and covered by a gray efflorescence. The leaves are opposite, oval-acuminate, with a linear prolongation at the end more than an inch long. The precise botanical character of the plant is unknown, but it is thought to belong to one of the Loganiaceæ. Thomas R. Fraser found in the plant an alkaloid, *akazgine*. It is colorless, crystallizable with difficulty, soluble in 60 parts of cold absolute alcohol, 16 parts of official alcohol, 130 parts of anhydrous ether, and 13,000 parts of water at 15.5° C. (60° F.). It is freely soluble in chloroform, carbon disulphide, benzene, and ether of sp. gr. 0.735. The alcoholic extract or the alkaloid acts on the system similarly to nux vomica. (*Chem. News*, Oct. 18, 1867, 203; see also *A. J. P.*, March, 1867.)

Alangine.—This alkaloid, according to Scheriff, occurs in the bark of the stem and root of *Alangium Lamarckii*, Thwaites (*Karangolum Lam.* (Thwaites), Kze.). It is very bitter, soluble in alcohol, chloroform, and acetic ether, but insoluble in water. In small doses it acts as a febrifuge; in *doses* of fifty grains (3.2 Gm.) it is emetic.

Alanin Mercury. *Hydrargyri Amidopropionas. Hydrargyrum Amidopropionicum.*—Lucca asserts that this compound may be administered internally or subcutaneously, in *doses* of 0.10 Gm., with great advantage over other antisyphilitics. To prepare "alanin mercury," crystallized amidopropionic acid is dissolved in water, heated to boiling, and mercury added as long as it is dissolved. The filtrate is rapidly evaporated, and the compound then separates in white crystalline needles.

Albargin. *Gelatose Silver.*—This substance, which is a compound of silver and gelatose, is a yellowish bulky powder which, in either cold or warm water, freely forms neutral dialyzable solutions. It contains 15 per cent. of silver. It affects albumin slowly and also precipitates cocaine solutions, but may be used with the alkaloid providing the double solution be freshly prepared at the time of administration. It is not quickly reduced by light, but should be preserved in amber-colored bottles. It was introduced by Bornemann (*Ther. Geg.*, March, 1901) for the treatment of *gonorrhœa*. When there is much irritation, the 1 per cent. aqueous solution may be injected four or five times a day; in more chronic conditions the solution should be 2 per cent.

Alboferine.—A light-brown, odorless, non-hygroscopic and permanent powder, freely dissolving in cold water and possessing a slightly saline taste. Its composition is stated to be as follows: albumin, 90.14 per cent.; iron, 0.68 per cent.; phosphorus, 0.32 per cent.; amido nitrogen, 0.13 per cent., and mineral substances, 9.5 per cent. This preparation has been recommended by a number of German clinicians as a good ferruginous tonic in *anæmia*, *scrofulosis*, *rickets*, and other diseased conditions. *Dose*, for a child, fifteen to forty-five grains (1–3 Gm.); for adults, forty-five to seventy-five grains (3–5 Gm.) a day.

Alchemilla. *Alchemilla vulgaris*, L. *Lady's Mantle.* (Fam. Rosaceæ.)—This astringent, bitterish perennial European herb was formerly employed in *diarrhœa*. By the ancients it was highly esteemed; extraordinary powers were ascribed to it by the alchemists. (*P. J.*, 1885, 791.)

Alcornoque.—For an account of this bark, which has long since fallen into entire neglect, see 16th edition U. S. D., p. 1545.

Aldehyde. C_2H_4O. *Acetic Aldehyde. Acetaldehyde. Aldéhyde acétique* (*vinique*), Fr.—Aldehyde is a generic term understood by chemists to apply to a class of bodies holding an intermediate position between the alcohols and the acids derived from them by oxidation. Acetic aldehyde is always meant when the term aldehyde is used by itself. The word means alcohol deprived of hydrogen (*alcohol dehydrogenatum*). (Liebig.) Aldehyde may be prepared in many ways, usually, however, by the oxidation of alcohol in some form. W. and R. Rodgers (*J. P. C.*, 40, 248) give the following: 1 part of alcohol

sp. gr. 0.842, and 1 part of potassium dichromate, are introduced into a large tubulated retort, and 1½ parts of sulphuric acid dropped in through the tubulure. Sufficient heat is evolved to start the distillation, but heat must be applied towards the end. The distillate is slightly contaminated with acetic acid. If the aldehyde be desired pure, the distillate is to be mixed with twice its volume of ether, surrounded with cold water, and dry ammoniacal gas passed in to saturation. Aldehyde-ammonia crystallizes out. This is to be decomposed in a retort by a mixture of 3 parts of sulphuric acid and 4 parts of water, and the distillate rectified and dried by contact with calcium chloride. Aldehyde is a colorless, mobile, inflammable liquid, having a decidedly pungent, ethereal, and suffocating odor. Its sp. gr. is 0.790, and boiling point 22° C. (71.6° F.). It mixes in all proportions with water, alcohol, and ether, and is rapidly converted into acetic acid on exposure to the air, through absorption of oxygen. It possesses very marked anti-putrescent properties, meat being preserved for months by its 2 per cent. aqueous solution. The intoxication caused by it in animals is characterized by a very great loss of sensibility. It appears to paralyze the vagi, although its cardiac action is comparatively feeble. Upon the respiration it exerts a most powerful influence, in small doses quickening it, in large doses depressing it. The temperature is much diminished. Applied locally aldehyde is very irritating. (*M. T. G.*, Sept. 1875.)

Iodaldehyde may be made by mixing together iodine, iodic acid, and a solution of aldehyde and separating by adding water. (See paper by P. Chautard, *P. J.*, 1886, 224.)

Aletris. *Aletris farinosa*, L. *Star Grass. Blazing Star. Mealy Starwort. Colic Root. Alétris farineux*, Fr. *Mehlige Aletris*, G. (Fam. Liliaceæ.)—An indigenous perennial plant, the leaves of which spring immediately from the root, and spread on the ground in the form of a star. The root, which was formerly included in the U. S. secondary list, is small, crooked, branched, blackish externally, brown within, and intensely bitter. The bitterness is extracted by alcohol, and the tincture becomes turbid upon the addition of water. The decoction is moderately bitter, but much less so than the tincture. It affords no precipitate with the salts of iron. (Bigelow.) In small doses of about ten grains (0.65 Gm.) it appears to be a simple bitter tonic. In very large doses it is said to be cathartic and emetic. It has been employed, with asserted benefit, in *colic*, *dropsy*, and *chronic rheumatism*. *Aletrin*, a resinoid, is prepared by exhausting the drug with alcohol and evaporating the percolate to dryness, treating with water, and drying the residue. It is asserted to be a *uterine stimulant* in *doses* of from one to two grains (0.065–0.13 Gm.).

Algarobilla, the pod of *Balsamocarpon brevifolium*, Clos., *Cæsalpinia brevifolia*, Baill. (Fam. Leguminosæ), a drug containing over 60 per cent. of tannin and a quantity of *ellagic acid*, is obtained from Chili. (Gehe's Report, *N. R.*, 1878, 332; *J. Chem. S.*, 1891, 918.)

Alisma. *Alisma Plantago-aquatica*, L. *Water Plantain. Plantain d'eau. Pain de grenouilles*, Fr. *Froschlöffel, Wasserwegerich*, G. (Fam. Alismaceæ.)—A perennial herbaceous plant, common to Asia, Europe, and the United States. The *root* has when fresh an odor like that of Florentine orris, but loses it when dried. Its taste is acrid and nauseous. It contains a pungent volatile oil and an acrid resin, to which all its virtues must be ascribed. The Calmucks in Russia are said to use it for food. The *leaves* are rubefacient, and will sometimes even blister. They have been recommended in *gravel* and *cystitis*. *Dose*, a drachm (3.9 Gm.).

Alkanet. *Alkanna. Orcanette*, Fr. *Alkannawurzel.* G.—This is the root of *Alkanna tinctoria* (L.), Tausch (*Anchusa tinctoria*, L.), or *dyers' alkanet*, an herbaceous perennial plant, of the Fam. Boraginaceæ, growing in the Grecian Archipelago and the south of Europe, where it is cultivated. See E. M. Holmes, *P. J.*, 1897, p. 61. For an account of Syrian alkanet and allied plants, see *Proc. A. Ph. A.*, 1896, 565. Alkanet, as found in commerce, is in pieces three or four inches long, from the thickness of a quill to that of the little finger, somewhat twisted, consisting of a dark red, easily separable bark, and an internal ligneous portion, which is reddish externally, whitish near the centre, and composed of numerous distinct, slender, cohering fibres. As it comes to us it is usually much decayed internally, very light, and of a loose, almost spongy texture. The fresh root has a faint odor, and a bitterish, astringent taste; but when dried it is nearly inodorous and insipid. Its coloring principle, which abounds mostly in the cortical part, is soluble in alcohol, ether, and the oils, to which it imparts a deep red color, but is insoluble in water. It may be obtained by first exhausting the root with water, and then treating it with a weak solution of potassium or sodium carbonate, from which the coloring principle may be precipitated by an acid. According to Pelletier, by whom it was discovered, it possesses acid properties, forming with the alkalies and earths neutral compounds, which are of a blue color, and soluble in alcohol and ether. Its weak acid character resembles that of alizarin, to which it is chemically related, as when distilled with zinc dust it yields *methyl-anthracene*. It has also received the names of *anchusin* and *alkannin*. The *anchusin* has been extracted and studied by C. J. S. Thompson. (*A. J. P.*, 1886, 409.) He finds it to vary in amount between 5.25 and 6.02 per cent. It is red, resin-like, insoluble in water, soluble in oils, alcohol, chloroform, and ether, and with a rich deep blue color in alkali hydroxides, the color changing again to crimson on addition of an acid. According to A. Gawalowski, the red coloring matter of alkanet root consists of two distinct bodies, the one turning blue, the other green by the action of alkalies. The first of these, *alkanic acid*, is extracted by ether and alcohol. The second, *anchusic acid*, is obtained by extraction with benzene. Both form characteristic colored salts. (*Ph. Ztg.*, 1902, 817.) Alkanet is somewhat astringent, and was formerly used in several diseases; but it is now employed exclusively for coloring oils, ointments, and plasters, which are beautifully reddened by one-fortieth of their weight of the root. The best way to use it with this object in view is to suspend the alkanet, after tying it in a piece of flannel, in the melted fat. It is said also to be used in the preparation of spurious *port wine*.

Allamanda.—*Allamanda cathartica*, L., is a shrub of the Fam. Apocynaceæ, growing in Porto Rico, the extract of whose bark is said to be an excellent hydragogue cathartic, in *doses* of from one to two grains (0.065–0.13 Gm.).

Alliaria. *Alliaria officinalis*, Andrz. *Sisymbrium Alliaria*, Scop. *Erysimum Alliaria*, L.

Alliaria Alliaria (L.), Brit. *Hedge Garlic.*—A perennial European herb, a native also of Northern Asia, and naturalized from Canada to Virginia, having an alliaceous odor when rubbed, and a bitterish, somewhat acrid taste. When eaten it communicates its odor to the breath. Wertheim obtained from the root a volatile oil, apparently identical with that of mustard. (*Ann. Ch. Ph.*, liii. 52.) The herb and seeds are esteemed diuretic, diaphoretic, and expectorant, and are used as external applications in *gangrenous affections*, and to promote *suppuration*.

Allium. *U. S.* 1890. *Garlic. English Garlic.* The genus Allium includes a large number of species, of which nearly seventy are indigenous in this country. Many, and perhaps all, of these species contain volatile oil upon which their activity depends. The cultivated garlic, of which the bulbs were formerly recognized in the U. S. Pharmacopœia, is *Allium sativum*, L., for which, according to Griffith, *A. canadense*, L., has been substituted and found efficient.

Allium sativum, L., is a perennial plant with numerous bulbs which have a common membranous covering, from the base of which the fibres that constitute the proper root descend. The stem is simple, and rises about two feet. The leaves are long, flat, and grass-like, and sheathe the lower half of the stem. At the termination of the stem is a cluster of flowers and bulbs mingled together, and enclosed in a pointed spathe, which opens on one side and withers. The flowers are small and white, and make their appearance in July. This species of garlic grows wild in Sicily, Italy, and the south of France. The bulbs, or so-called cloves, are usually six or eight in number, oblong or wedge-shaped, and covered with dry membranous scales, with a pungent odor and a disagreeable and acrid taste. The U. S. Pharmacopœia 1890 directed that they should be used without having been dried. The *oil of garlic* is of a dark brownish-yellow color, heavier than water, and decomposed at its boiling temperature. It may be purified by repeated distillation in a salt water bath, and is then lighter than water, of a pale yellow color, and not decomposed by boiling. Semmler obtained from garlic bulbs 0.09 per cent. of the volatile oil, sp. gr. at 14.5° C. (58° F.) 1.0525; it was yellow, having an intense odor and optically inactive. By fractional distillation he obtained four products, $C_6H_{12}S_2$, $C_6H_{10}S_2$, $C_6H_{10}S_3$ and $C_6H_{10}S_4$, which decomposed during distillation, and hence could only be obtained by distillation in vacuo. The oil, according to Semmler, is free from allyl sulphide, the latter having the sp. gr. 0.8991. (*A. Pharm.*, 1892, p. 434.) The impure oil has an exceedingly pungent odor and a strong acrid taste, and, when applied to the skin, produces much irritation and sometimes even blisters. The pure oil combines with silver nitrate, forming a precipitate soluble in heated alcohol and afterwards separating in crystals. Besides this oil, fresh garlic, according to Cadet de Gassicourt, contains, in 1406 parts, 520 of mucilage, 37 of albumen, 48 of fibrous matter, and 801 of water. Bouillon-Lagrange mentions among its constituents sulphur, a saccharine matter, and a small quantity of fecula. The fresh bulbs yield upon pressure nearly a fourth part of juice, which is highly viscid, and so tenacious as to require dilution with water before it can be easily filtered. When dried, it serves as a lute for porcelain. It has the medicinal properties of the bulbs. Water, alcohol, and vinegar extract the virtues of garlic. Protracted boiling renders it inert. According to Semmler (*A. Pharm.*, 1887, p. 927), *Allium ursinum* contains a volatile oil which consists mainly of *vinyl-sulphide*, C_4H_6S or $(C_2H_3)_2S$.

Medicinal Properties and Uses.—The use of garlic as a medicine and as a condiment can be traced to earliest antiquity. When taken internally, and even when applied externally, the oil is absorbed and imparts its odor to the breath, urine, perspiration, etc. The oil of garlic has some influence upon the human system as a general mild stimulant. Its chief value in medicine is for its local action upon the stomach and as a stimulant expectorant. The garlic itself is sometimes employed as a rubefacient which, by yielding its volatile oil to absorption, stimulates the nervous system, especially in the case of young children. The oil may often be given with great advantage in *chronic bronchitis* and in the advanced stages of *obstinate acute bronchitis*. It is especially valuable in the treatment of children when there is a distinct nervous element. In *catarrhal pneumonia* of young children the bruised garlic cloves are often applied as a poultice to the lungs, and similar applications were formerly used upon the feet for the *nervous restlessness* or even the *convulsions* of young children. Garlic clove may be swallowed either whole or cut into pieces of a convenient size, but the syrup has replaced most other methods of administration. The dose in substance is from half a drachm to two drachms (2–7.7 Gm.) of the fresh bulb. That of the juice is half a fluidrachm (1.8 Cc.).

Syrupus Allii, U. S. 1890, was prepared according to the following formula: "Fresh Garlic, sliced and bruised, *two hundred grammes* [or 7 ounces av., 24 grains]; Sugar, *eight hundred grammes* [or 28 ounces av., 96 grains]; Diluted Acetic Acid, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Macerate the Garlic with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Diluted Acetic Acid during four days, and express the liquid, avoiding the use of metallic utensils. Then mix the residue with *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] more of Diluted Acetic Acid, and again express. Mix the expressed liquids, and filter. Pour the filtrate upon the Sugar, contained in a suitable vessel, and stir or agitate until the Sugar is dissolved. Lastly, add enough Diluted Acetic Acid to make the product measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms], and mix thoroughly. Keep the Syrup in well-stoppered, completely filled bottles, in a cool place. *Syrup of Garlic* may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrup (see *Syrupus*); pour the filtrate obtained as directed in the preceding formula upon the Sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it by Diluted Acetic Acid, until the product measures *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix thoroughly." *U. S.* 1890.

This preparation is made upon correct principles, as vinegar is a better solvent of the active matter of garlic than water. The syrup is given in *chronic bronchitis* and the advanced stages of *acute bronchitis* of the lungs, and is particularly beneficial in infantile cases. A teaspoonful (3.75 Cc.) may be given for a dose to a child a year old.

Allyl Tribromide. $C_3H_5Br_3$. *Tribromhydrin.* This incorrectly named substance is a colorless or faintly yellowish liquid at the ordinary temperature, but solidifying when cooled below 10° C. (50° F.) to a mass having a specific gravity of 2.430, which has been used with alleged good results in *hysteria* and *asthma*, given in capsules containing each five drops (0.25 Cc.). (*Ph. Post*, Dec. 1888.)

Alnus.—Of this genus of small trees or bushes, *A. glutinosa* (L.), Medic., *Common European Alder, Black Alder; A. rugosa* (Du Roi), K. Koch (*A. serrulata*, Willd.), or *American Alder; A. incana* (L.), Willd., or *Tag Alder*, are tonic and astringent, and have been used in intermittent fever, the bark being the part employed. *A. glutinosa*, or "*The European Alder*," has been used for dyeing and also for tanning. According to Eitner, the bark contains from 16 to 20 per cent. of tannic acid. (Gerber, 1878, 85 and 124.) The tannic acid, however, appears to differ from that of galls and oak bark, as, according to Stenhouse, it does not yield glucose when acted on by sulphuric acid. (*P. J.*, Dec. 1861.) F. Dreykorn and E. Reichardt, however, state that it is resolved by sulphuric acid into *alnine red* and sugar. (*A. J. P.*, xlii. 403.)

Alphol.—*Salicylic Ether of Alpha-naphthol*, $C_6H_4\{^{OH}_{COOC_{10}H_7}$, is obtained by reaction between salicylic acid and alpha-naphthol. It is a white, crystalline powder, melting at 83° C. (181.4° F.). Soluble in alcohol, ether, and fixed oils; insoluble in water. Used as an antiseptic and antirheumatic. *Dose*, eight to fifteen grains (0.5–1.0 Gm.).

Alstonia. *Br. Add. Echites.*—Under Alstonia the Br. Add. recognizes the dried barks of *Alstonia scholaris* (L.), R. Br. (*Echites scholaris*, L.), of India and the Philippine Islands, and *Alstonia constricta*, F. Muell., of Australia, two apocynaceous trees whose barks are quite dissimilar in appearance, and, as far as our present knowledge goes, contain different alkaloids. These barks are respectively described as follows: "The bark of *Alstonia scholaris* is usually in irregular fragments one-eighth to half an inch (three to twelve millimetres) thick, of a somewhat spongy texture and a short, coarse fracture; the external layer is unevenly rough and fissured and of a brownish-gray color with occasional blackish spots, the internal layer bright buff. A transverse section shows the inner layer to be finely marked with numerous small medullary rays. Almost without odor. When chewed it develops a bitter taste. The bark of *Alstonia constricta* is usually in curved pieces or quills which may have a width of two and a half inches (sixty-four millimetres) or more, and a thickness of half an inch (twelve millimetres). It is covered with a thick periderm varying from one-tenth of an inch to one-fourth of an inch (two and a half to six millimetres) in thickness; of a rusty-brown color, strongly rugose, and marked with large, deeply-fissured reticulations; it sometimes bears small white foliaceous lichens. Internally the bark is of a cinnamon-brown color, and is marked with strong, coarse longitudinal striæ. On transverse section the bark exhibits the dark brown periderm covering the inner orange-brown tissues, in which may be observed, with a lens, numerous small shining particles. The fracture is short and granular in the outer layers, but fibrous in the liber portion. It has a faint aromatic odor and a very bitter taste." *Br. Add.*

From the bark of *Alstonia scholaris, dita bark*, M. Gruppe extracted an uncrystallizable, hygroscopic, bitter principle, *ditaine*. (*J. P. C.*, 4e sér., xviii. 225; xix. 84; *P. J.*, Aug. 1875.) Harnack (*Ber. d. Chem. Ges.*, 1878) first obtained ditaine in pure crystallized form, and gave it the formula $C_{20}H_{30}N_2O_4$. According to Erich Harnack (*Ditaine*, Leipsic, 1877), ditaine in the frog acts as a paralyzant upon the motor nerve centres and the motor nerve trunks, and also upon the vagi. Upon mammals its influence resembles closely that of curare. The peripheral nerve endings are paralyzed by it, as are also the peripheral vagi and the vasomotor nerves. O. Hesse (*P. J.*, Oct. 23, 1880) finds in dita the following principles. Three alkaloids: *ditamine*, $C_{16}H_{10}NO_2$, the relative amount of which he estimates at 0.04 per cent.; *echitamine*, $C_{22}H_{28}N_2O_4 + H_2O$ (identical, according to Hesse, with Harnack's ditaine); and *echitenine*, $C_{20}H_{27}NO_4$. Of these, the second is the strongest base, and resembles ammonia in its chemical characters. Hesse considers the compound given above with one molecule of water as the hydroxide of a strong basic radical, *echitammonium*, $C_{22}H_{29}N_2O_4$. The solutions of *echitammonium hydroxide* are so strongly basic that they precipitate the hydroxides of copper, iron, aluminum, and lead, and decompose sodium and potassium chlorides, liberating the corresponding hydroxides. Hesse considers echitammonium the most strongly basic of all the alkaloids. Hesse also obtained by extraction with petroleum benzin *echicaoutchin, echiretin, echicerin, echitin*, and *echitein*, of which the three last mentioned are crystalline. (See *A. J. P.*, 1895, 166.)

From *Alstonia constricta*, F. V. Müller and A. Rummel obtained *alstonine*. Oberlin and Schlagdenhauffen found in 1879 another alkaloid, *alstonicine*. Hesse subsequently analyzed the bark and found alstonine, the *chlorogenine* of a former investigation, which has the composition $C_{21}H_{20}N_2O_4$, *porphyrine*, $C_{21}H_{25}N_3O_2$, and *alstonidine*. The alkaloids and their salts in acidulated solutions show decided blue fluorescence.

The bark of *Alstonia scholaris* is used as a bitter tonic and as an antiperiodic. Ditaine, probably impure, has been employed with alleged most excellent results in the *malarial fever* of the Philippines, given in *doses* of one drachm (3.9 Gm.). (See *Proc. A. Ph. A.*, 1877.) Under the name of the *Australian Fever Bark*, or *Bitter Bark*, the bark of *Alstonia constricta* is said to be largely employed in the treatment of fevers in the Australian colonies.

The Br. Add. recognizes an *infusion* (*Infusum Alstoniæ*, Br. Add.), one ounce to a pint; *dose*, one-half to one fluidounce (15–30 Cc.); also a *tincture* (*Tinctura Alstoniæ*, Br. Add., 8 per cent.); *dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Aluminum Acetate as well as the *subacetate* has been employed to some extent in medicine as a substitute for the sulphate. The deliquescent acetate may be made by the direct combination of hydrated alumina with acetic acid or by reaction between aluminum sulphate and lead acetate,

$$Al_2(SO_4)_3 + 3Pb(C_2H_3O_2)_2 = 3PbSO_4 + Al_2(C_2H_3O_2)_6$$

Alsol, a 50 per cent. aqueous solution of *aluminum aceto-tartrate*, has been patented. It is used as a gargle. (*Ph. Era*, 1898, 362.)

Aluminum and Iron Sulphate. *Ferroso-Aluminic Sulphate. Sulphate of Aluminum and Iron.* $AlFe(SO_4)_2,12H_2O$.—This double salt was

brought forward by Sir James Murray of Dublin, as an astringent, styptic, and vermifuge. His method of preparing it is not very clearly expressed, but it may be presumed to be formed by dissolving alumina and ferrous carbonate, both recently precipitated, in sulphuric acid, and duly evaporating the solution. Klauer states that it is produced in crystalline tufts when a solution of the component salts mixed with an excess of sulphuric acid is left to stand in a warm place. (*Watt's Dict.*, vol. v. 583.) Murray recommended it in *chronic dysentery, diarrhœa, fluor albus,* and the *colliquative sweats* and *diarrhœa* which attend *hectic fever* and *consumption.* Externally he found it a powerful styptic, useful as a gargle in *relaxation of the tonsils and uvula,* and in *salivation,* as an injection in *hemorrhages,* and as a wash for foul and flabby *ulcers. Dose,* from five to ten grains (0.32–0.65 Gm.), dissolved in some aromatic water.

Aluminum Boroformate occurs in lustrous crystals, and may be prepared by introducing freshly precipitated alumina into a mixture of two parts of formic acid, one part of boric acid, and seven parts of water. The solution is evaporated and crystallized. (*Ph. Rund.*, 1894, 256.)

Aluminum Caseinate.—A yellowish-white, tasteless powder containing five per cent. of aluminum; insoluble in water, sparingly dissolved when macerated in saliva, and yielding aluminum to dilute acids. It was introduced by Rud. Meyer (*Ap. Ztg.*, Sept. 23, 1899, 566) as a remedy in *intestinal catarrh,* given in doses of four to five grains (0.26–0.32 Gm.). It is prepared as follows: Milk, freed from albumin by repeated heating to 62° C. (143.6° F.), and straining, and then sterilized, is precipitated with solution of aluminum acetate (*liquor alumini acetici*); the precipitate is washed completely with water, and after removing the water with alcohol, deprived of fat by means of ether. The product is dried at a moderate temperature, and while drying powdered.

Even the soluble salts of aluminum have very little influence upon the general organism, but Siem (*Ueber die Wirkung des Aluminiums und des Berylliums auf den thier. Organismus,* Dorpat, 1886) has shown that the *aluminum* and *sodium lactate* or *tartrate,* given in sufficient doses, will produce in frogs and also in mammals a centric general muscular relaxation, deepening into a complete loss of reflex excitability, and general paralysis. When administered in continuous doses for a series of days, these salts cause in the lower animals loss of appetite, constipation, depression, lessening of general sensibility, pronounced apathy with great weakness, ending commonly in paralysis, with convulsive tremblings, fall of temperature, stupor, and death, which sometimes occurs in the midst of tetanic convulsions, more usually through an almost imperceptible diminution of the respiratory movement. These results have been confirmed by Döllken (*A. E. P. P.*, Bd. xl., 1897), who finds the symptoms to be due to an action exerted upon the nerve centres, with demonstrable anatomical changes in the ganglionic cells.

Alumnol. *Aluminum beta-naphthol-disulphonate.*—A whitish, non-hygroscopic powder, easily soluble in cold water and glycerin, slightly soluble in alcohol, which has been locally used as a powerful astringent, desiccant, and antiseptic. Its aqueous solution has a slight bluish fluorescence, feeble acid reaction, and is colored blue by iron chloride. The solution of 40 per cent. is made with hot water and remains clear on cooling. Its aqueous solutions are incompatible with alkalies and ammonia. Though it coagulates albumin, it is said to be dissolved in an excess of albumin, and, therefore, to be able to reach deep recesses of wounds. It has been strongly recommended in nasal, urethral, and other catarrhal inflammations. The strength of the solution employed varies from 1 per cent. in *gonorrhœa* to 10 per cent. in *abscesses.* (See *B. K. W.*, 1892; *Dermatologen-Congress zu Wien,* 1892; *Th. M.*, 1892, 644.) Two to ten parts of alumnol mixed with ten parts of starch, has been used by insufflation in cases of laryngitis. Alumnol, however, would appear to be very feeble and slowly acting as a germicide, a 1 per cent. solution requiring twenty-four hours to destroy bacilli of anthrax. As a surgical dressing from 1 to 2 per cent. solution may be used. In *infected wounds* the caustic 20 per cent. solution is employed. In diseases of the skin alumnol is used with talc or starch as a powder, or with lanolin as an ointment, the strength varying from 2 to 20 per cent.

Amanita.—Of the fungus genus Amanita, some species, such as *A. cæsarea,* are edible, while many others are violently poisonous. Among these may be mentioned the *A. phalloides,* Fries, or *skunk mushroom,* and the *A. muscaria* (L.), Pers., or *fly fungus.* The most characteristic symptom of poisoning by the former is the saffron color of the urine, deepening as the poisoning progresses into purple; the symptoms otherwise resembling those caused by the more notorious *A. muscaria,* which has been employed from time immemorial by the Tartars as a means of producing intoxication. *A. pantherina,* used in Japan as a fly poison, is said to be exceedingly active. According to Inoko, it contains 1 per cent. of a mixture of alkaloids, the greater part of which is *choline* and the rest *muscarine.* It grows chiefly in woods and under trees, and is variable in color, being found scarlet, carmine, orange, greenish yellow, pale brown, and even white in hue. The pileus, which is often seven or eight inches in diameter, is covered with whitish, angular warts or spongy scales, which when moist are viscid. When growing it is convex, but becomes flat or depressed when it has attained its full size; the stem is not so solid as that of the mushroom, and is bulbous below, and covered at the base with scales. The gills are white and broad.

The active principles of probably all poisonous species of amanita are choline and muscarine, $C_5H_{15}NO_3$. According to S. Pouchet the toxicity of muscarine is greatly increased by certain albuminoids contained in the fly agaric, though these albuminoids themselves are not poisonous. (*B. G. T.*, p. cxxxvii.)

Muscarine was first obtained by Schmiedeberg and Koppe in a state of purity. (*Das Muscarin,* Leipzig, 1869.) The alkaloid may be produced artificially by gently heating choline platinochloride with strong nitric acid. Potassium chloride is used to decompose the muscarine platinochloride and produce muscarine hydrochloride; treatment with moist silver oxide yields the muscarine as a hydrate ($C_5H_{15}NO_3H_2O$). Muscarine resembles physostigmine somewhat in its physiological action, and is antagonistic to atropine, producing free salivation and weeping, vomiting, diminution of the force and frequency of the pulse, dyspnœa, great muscular weakness deepening into paralysis and finally death, usually by arrest of respiration. The pupil is intensely contracted,

but dilates before death. The diastole of the heart is very much prolonged, and after very large doses diastolic arrest occurs. This is due to an action upon the inhibitory nerves, and if atropine be given so as to paralyze them the cardiac movements re-occur. The vasomotor nerves are said to be paralyzed. The action on the abdominal viscera is very marked. The muscles of the intestines, bladder, and spleen are tetanically contracted. Thus the intestines are transformed into hard white cords, or afterwards, becoming somewhat relaxed, exhibit a tumultuous peristalsis. The abdominal secretions are greatly increased. Most of the physiological results obtained by Schmiedeberg and Koppe have been confirmed by J. L. Prevost. (*J. P. C.*, 4e sér., xx. 385; *Congrès Méd. Internat.*, Geneva, 1878. See also *A. E. P. P.*, xxxi.)

Amber. *Succinum. Ambre, Succin*, Fr. *Bernstein*, G.—Amber is a fossil resin, occurring generally in small detached masses, in alluvial deposits, in different parts of the world. According to Goefert, there are about fifty species of extinct coniferous trees of which amber represents the resinous exudation. It is found chiefly in Prussia, either on the seashore, where it is thrown up by the Baltic, or underneath the surface. Large deposits occur in some lakes on the eastern coast of Courland, and an extensive bed of yellow amber was discovered in 1854, on sinking a well in the coal mines near Prague. The largest mass of amber yet found weighed thirteen pounds. Amber also occurs in considerable quantities near Catania, in Sicily. It is usually associated with lignite, and sometimes encloses insects and parts of vegetables. In the United States, it was found at Cape Sable, Maryland, by Troost. In this locality it is associated with lignite and iron pyrites. It has also been discovered in New Jersey. The amber consumed in this country is brought from the ports of the Baltic. A mine of it is said to have been discovered near Rockwood in Australia.

It is a brittle solid, generally in small irregular masses, permanent in the air, having a homogeneous texture and vitreous fracture, and susceptible of a fine polish. It becomes negatively electric by friction. Its color is generally brownish yellow, either light or deep, but is occasionally reddish brown or bluish from staining with ferric phosphate. It has no taste, and is inodorous when cold, but exhales a peculiar, aromatic odor when heated. It is usually translucent, though occasionally transparent or opaque. Its sp. gr. is about 1.07. Water and alcohol scarcely act on it. When heated in the open air, it softens, melts at 286.7° C. (548° F.), swells, and at last inflames, leaving, after combustion, a small portion of ashes. Subjected to distillation in a retort furnished with a tubulated receiver, it yields, first, a yellow acid liquor, and afterwards a thin yellowish oil, with a yellow waxy substance, which is deposited in the neck of the retort and the upper part of the receiver. This waxy substance exhausted by cold ether of the part soluble in that menstruum, is reduced to a yellow micaceous matter, identical with the *chrysen* of Laurent. A white crystalline substance, identical with the *idrialin* of Dumas, may be separated from the micaceous substance by boiling alcohol. Both chrysen and idrialin are hydrocarbons. (Pelletier and Walter, *J. P. C.*, v. 60.) As the distillation proceeds, a considerable quantity of combustible gas is given off, which must be allowed to escape. By continuing the heat, the oil gradually deepens in color, until, towards the end of the distillation, it becomes black and of the consistence of pitch. The oil obtained is called *oil of amber*, and the acid liquor is a solution of impure *succinic acid*. Repeatedly distilled from nitric acid, amber yields an acid liquor, from which, after it has been neutralized with potassium hydroxide, ether separates pure camphor. (Doepping, *J. P. C.*, vi. 168.) Borneol is also obtained by distilling to dryness powdered amber with an extremely concentrated solution of potassium hydroxide (G. Reich, *Ibid.*, xiii. 33).

Tschirch (*Harze und Harzbehälter*, 278) has made within recent years a careful study of amber. He finds the main constituents to be a *succinoabietic ether of borneol*, which is extracted by prolonged treatment with alcohol, and amounts to 30 per cent. of the amber, and the *succinic ester of succinoresinol*, which is insoluble in alcohol and makes up 70 per cent. of the amber. This latter compound holds a small amount of sulphur (about 0.47 per cent.).

Amber was held in high estimation by the ancients as a medicine, but at present is never so used. The *oil of amber* is an empyreumatic product which is prepared by destructive distillation of amber. The heat requisite for the complete decomposition of amber cannot be supported by a glass retort; and, in order that all the oil which it is capable of yielding may be collected, the distillation should be performed in a tubulated iron or earthenware retort, which may be placed immediately upon the fire; sand is added to prevent the amber from swelling too much. The oil may be separated from the acid liquor by means of the separating funnel. As first procured, it is a thick, very dark-colored liquid, of a peculiar, strong, empyreumatic odor. In this state it is occasionally employed as a liniment, but for internal use it should be rectified. It has the composition $C_{10}H_{16}$. It is almost impossible to procure pure oil of amber in commerce.

The U. S. Pharmacopœia of 1870, under the name of *Oleum Succini Rectificatum*, or *Rectified Oil of Amber*, gave the following process. "Take of Oil of Amber *a pint;* Water *six pints*. Mix them in a glass retort, and distil until four pints of Water have passed with the Oil into the receiver; then separate the Oil from the Water, and keep it in a well-stopped bottle." *U. S.* 1870.

By successive distillations oil of amber becomes thinner and more limpid, till at length it is obtained colorless. The first portions which distil are less colored than those which follow, and may be separated for keeping, while the remainder is submitted to another distillation. For practical purposes, however, the oil is sufficiently pure when once redistilled. As usually found in commerce, the rectified oil is of a light yellowish-brown or amber color. As first distilled it has an amber color, sp. gr. 0.903 at 15.6° C. (60° F.), and a boiling point from 170.5°–186.1° C. (339°–367° F.). (Ebert.) When quite pure it is said to be colorless, as fluid as alcohol, of the sp. gr. 0.758 at 23.8° C. (75° F.), and to boil at 85.5° C. (186° F.). It has a strong, peculiar, unpleasant odor, and a hot acrid taste. It imparts these properties in some degree to water, without being perceptibly dissolved. It is soluble in eight parts of alcohol of the sp. gr. 0.847, in five parts of the sp. gr. 0.825, and in all proportions in absolute alcohol, ether, chloroform, carbon disulphide, and the fixed oils. (Ebert.) On exposure to light

and air, it slowly changes in color and consistence, becoming ultimately black and solid. It appears, when quite pure, to be a hydrocarbon of the terpene class. It is said to be sometimes adulterated with oil of turpentine, which may be detected by passing hydrochloric acid gas through the suspected oil. If pure it will remain wholly liquid; while oil of turpentine, if present, will give rise to the formation of solid artificial camphor. (*P. J.*, xiii. 292.) It was officially described as "a colorless or pale yellow, thin liquid, becoming darker and thicker by age and exposure to air, having an empyreumatic, balsamic odor, a warm, acrid taste, and a neutral or faintly acid reaction. Sp. gr. about 0.920. It is readily soluble in alcohol. When mixed with fuming nitric acid, it acquires a red color, and, after some time, is almost wholly converted into a brown, resinous mass of a peculiar musk-like odor." *U. S.* 1870.

Rectified oil of amber is stimulant and antispasmodic, and occasionally promotes the secretions, particularly that of urine. It has been employed with advantage in *amenorrhœa*, *hysteria*, and *whooping cough*. The *dose* is from five to fifteen minims (0.3–0.9 Cc.), diffused in some aromatic water by means of sugar and gum arabic. Externally applied the oil is rubefacient, and is considerably used as a liniment in *chronic rheumatism*, and in certain spasmodic disorders, as *whooping cough* and *infantile convulsions*. In the latter affection it should be rubbed along the spine.

Ambergris. *Ambra grisea* (*cinerea*). *Ambre, Ambre gris*, Fr. *Amber, Graue Ambra*, G.—This substance, which is found floating on the sea, particularly in the southern hemisphere, is now generally believed to be produced in the intestines of the *Physeter macrocephalus*, L., or *spermaceti whale*. It is in roundish or amorphous pieces, usually small, but sometimes weighing as much as 50, 100, or even 200 pounds. These pieces are often composed of concentric layers. They are of various colors, usually gray, with brownish, yellow, and white streaks, often dark brown or blackish on the external surface. They are opaque, lighter than water, and of a consistence like that of wax. Ambergris has a peculiar aromatic agreeable odor, is almost tasteless, softens with the warmth of the hand, melts under 100° C. (212° F.), is almost completely volatilizable by heat, and is inflammable. It is insoluble in water, but is readily dissolved, with the aid of heat, by alcohol, ether, and the volatile and fixed oils. It consists chiefly of a peculiar fatty matter analogous to cholesterin, and denominated by Pelletier and Caventou *ambrein*. This may be obtained by treating ambergris with heated alcohol, filtering the solution, and allowing it to stand. Crystals of ambrein are deposited. It is incapable of forming soaps with the alkalies. When pure it has little or no odor. Beauregard and Gouchet believe that ambergris is a calculus composed of crystals of *ambrene* mixed with black pigment and star-coral débris. When fresh it is soft in consistence and disagreeable in odor. If kept for a year or two in air tight containers it loses its excrementitious odor and acquires the characteristic perfume for which it is valued. This change Beauregard believes is due to a microbe (*Spirillum recti physeteris*). (*C. R. A. S.*, cxxv. 254.) Ambergris is very frequently adulterated, and it then does not exhibit its ordinary odor, fusibility and volatility.

Ambergris was long regarded as a cordial and antispasmodic, somewhat analogous to musk; useful in *typhoid fevers*, and various nervous diseases. It formerly entered into many official preparations, and is still retained in some European pharmacopœias. The French Codex directs a tincture to be prepared by macerating, for ten days, 100 parts of powdered ambergris with 1000 parts of alcohol at sp. gr. 0.864, expressing and filtering. Stan. Martin assures us that the tincture will keep better, deposit nothing, and have a more agreeable odor, if the ambergris, instead of being merely powdered in a mortar, be subjected to porphyrization, especially with the addition of washed sand. Heat, he says, should never be used in its preparation. (*J. P. C.*, 4e sér., i. 448.) It is, however, feeble as a remedy, and is chiefly used in perfumery. *Dose*, five grains to a drachm (0.32–3.9 Gm.).

Ambrosia. *Ambrosia trifida*, L. *Ragweed. Ambrosie*, Fr. *Traubenkraut*, G. (Fam. Compositæ.)—This and another indigenous annual, *A. artemisiæfolia*, L., are deemed by the eclectics astringent and stimulant, and are given in low forms of fever. L. W. Schwab has found in *A. artemisiæfolia* a bitter glucoside (*A. J. P.*, 1890), and Schimmel & Co. have obtained from it about 0.15 per cent. of a green volatile oil (sp. gr. 0.876). (*Schim. Rep.*, 1904, p. 96.)

Amidoacetal. $H_2N.CH_2CH(O.C_2H_5)_2$.—According to the experiments of A. Mallèvre (*A. Phys.*, xlix.), this substance is an active poison, causing death in mammals by respiratory paralysis.

Amidophenols. (Derivatives of *p-amidophenol*, $C_6H_4(OH)NH_2$.)—In an elaborate series of experiments (*Cb. I. M.*, 1897) Treupel and Hinsberg find that derivatives from amidophenol are active as antipyretics in proportion as they are decomposed in the system, and that the decomposition is to be measured by the amount of indophenol in the urine. The most important of these substances is *dulcin*, called also *para-phenetolcarbamide* and *sucrol*, $CO\begin{cases} NH.C_6H_4.OC_2H \\ NH_2 \end{cases}$, which occurs in colorless crystals, melting at from 173°–174° C. (343.4°–345.2° F.), soluble in 800 parts of cold and 55 of boiling water, and 25 of alcohol, having a taste which is said to be two hundred times sweeter than sugar. It has been recommended as a substitute for sugar in *diabetes*, and, on account of its slight solubility, to improve the flavor of castor, cod liver, or other oils. According to Treupel and Hinsberg, fifteen grains (1 Gm.) of it will reduce the temperature in fever about one degree centigrade in the course of about three hours, and no unaltered dulcin is to be found in the urine, but indophenol.

Besides dulcin, Treupel and Hinsberg examined physiologically the following amidophenol derivatives: *Lactylamidophenolethylcarbonate, benzoylacetamidophenol, ethyldiacetamidophenol, oxyphenacetinsalicylate.*

Aminol.—This is an antiseptic liquid, colorless, slightly turbid, and having the odor of trimethylamine. It is alkaline in reaction. Sp. gr. 1.01. It is obtained commercially from herring pickle. A tablespoonful (15 Cc.) diluted with a fluidounce of water may be used for a lotion, gargle, or spray.

Ammi. *Ammi Visnaga*, Lam.—The fruit of this umbelliferous plant, indigenous in the countries around the Mediterranean, contains a crystalline principle, *kellin* (*C. R. A. S.*, August, 1879), which is said (*Union Méd.*, April, 1886) to act

upon the heart and spinal cord. Mild antipyretic and antilithic properties have been attributed to the fruit.

Ammonium Arsenate. *Ammonii Arsenas.* $(NH_4)_2HAsO_4$.—This salt is obtained in crystals by saturating a concentrated solution of arsenic acid with ammonia or ammonium carbonate, and allowing it to evaporate spontaneously. The crystals, which belong to the trimetric system, effloresce on exposure to the air, and lose half their ammonia. Its solution is alkaline. It has been used with advantage by Biett in several inveterate *diseases of the skin.* It is administered in solution, one grain of the salt in a fluidounce of distilled water. *Dose*, twenty to twenty-five minims (1.0–1.25 Cc.) given in divided portions in the course of the day, and gradually increased.

Ammonium Bicarbonate. *Acid Carbonate of Ammonium.* $H(NH_4)CO_3$.—This salt was brought into notice by Wm. Procter, with reference to its antacid properties. It is formed by exposure of the ordinary carbonate to the air, and is found in considerable quantities on the sides of casks in which that salt is imported, and less largely even in the bottles in which it is kept in commerce. Crystals of this salt are sometimes found in Patagonian guano and in the purifiers of gas works. When pure, the ammonium bicarbonate is white, having the same crystalline form as potassium bicarbonate, of a saline, slightly ammoniacal taste, and a feeble odor of ammonia, ascribable to a very slow volatilization. On exposure to heat, it gives off carbon dioxide. It is soluble in eight parts of water at 15.6° C. (60° F.), is nearly insoluble in official alcohol, but soluble in diluted alcohol, and its solution has an alkaline reaction with syrup of violets. It may be prepared by treating commercial ammonium carbonate (ammonium sesquicarbonate) with official alcohol, whereby the neutral carbonate is dissolved and the bicarbonate left. To render this still purer it should be washed with alcohol and dried. It is obtained as a crystalline precipitate by adding alcohol to a saturated solution of the ordinary carbonate, or by passing carbon dioxide through the same solution. It may be used as an antacid in the same manner and the same doses as sodium bicarbonate, being preferable to that salt when a stimulant impression on the stomach is desired. (*A. J. P.*, July, 1869, 294.)

Ammonium Borate. *Ammonium Metaborate.* $2NH_4BO_2HBO_2 + 3H_2O$.—Only acid salts are known. By dissolving one part of boric acid in excess, in three parts of heated water of ammonia, sp. gr. 0.960, and allowing the solution to cool slowly, this salt is obtained in crystals. These are rhombic octahedrons, with truncated summits, and often truncated edges, and are semi-transparent. The taste of the salt is alkaline, and it has an alkaline reaction. On exposure, it effloresces, losing ammonia, and becoming in time the tetraborate. It is soluble in about twelve parts of water. (Gmelin, ii. 435.) Becker has used it with asserted great advantage in *stone in the bladder* and *renal colic.* Under its influence the urine becomes loaded with uric acid and the earthy phosphates. It is said also to be an excellent remedy in *chronic catarrh of the bladder.* It is believed by Beeker to be the *ludus* of Paracelsus, which had a great reputation in the treatment of urinary calculi. *Dose*, ten to twenty grains (0.65–1.3 Gm.) every hour, in water sweetened with licorice. (*Journ. de Thérap. Méd.-Chir.*, Sept. 1, 1866.)

Ammonium Caseinate. *Ammonii Caseinas. Eucasinum. Casein-ammonium.*—A compound made by passing ammonia over casein until it is soluble in water, forming a nearly clear solution. In the form of a white or slightly yellow powder, almost without odor or taste. It is recommended as a dietetic, given in soups, chocolate, etc.

Ammonium Embelate. *Ammonium Embelicum.*—A compound of ammonia with *embelic acid*, an organic acid ($C_{18}H_{28}O_4$) derived from the fruit of *Embelia Ribes*, Burm. According to the experiments of G. Coronedi (*Sperimentale*, 1892, fasc. 2), this substance is a practical anthelmintic for *tape worm. Dose*, three grains (0.2 Gm.) in pill, three times a day for a child, seven times for an adult.

Ammonium Nitrate. *Ammonii Nitras. U. S.* 1890. *Nitrate of Ammonia.* NH_4NO_3.—Ammonium nitrate may be prepared by treating commercial ammonium carbonate by nitric acid so long as effervescence takes place, or to saturation, filtering, and evaporating the solution. By careful evaporation and slow refrigeration the salt may be obtained in well-defined crystals. If crystallized after rapid concentration by boiling and sudden cooling, it forms long, flexible and elastic threads. If the solution be heated till all the water has been driven off and the fused mass kept at a temperature not exceeding 160° C. (320° F.), the commercial salt is produced.

"Colorless crystals, generally in the form of long, thin, rhombic prisms, or in fused masses, without odor, having a sharp, bitter taste, and somewhat deliquescent. Soluble, at 15° C. (59° F.), in 0.5 part of water, and in 20 parts of alcohol; very soluble in boiling water, and in 3 parts of boiling alcohol. When gradually heated, it melts at 165°–166° C. (329°–330.8° F.); at a temperature between 230° and 250° C. (446°–482° F.) it is decomposed into nitrogen monoxide gas and water, leaving no residue. The aqueous solution of the salt is neutral to litmus paper, and when gently heated with potassium or sodium hydrate test-solution, it evolves the odor of ammonia. On heating the salt with sulphuric acid, it emits nitrous vapors." *U. S.* 1890.

At all temperatures between —15° C. (5° F.) and 25° C. (77° F.), if exposed to a current of dry ammoniacal gas, its crystals absorb the gas and melt, yielding a colorless liquid, which, if the absorption has taken place at —10° C. (14° F.), contains two molecules of the gas for each molecule of the salt, and would be represented by the formula $NH_4NO_3 + 2NH_3$. It is not frozen by a mixture of salt and snow. Its sp. gr. is 1.05. Heated moderately it boils, with loss of ammonia, and is changed into a crystalline mass, containing 22.41 parts of the gas in 100 of the salt by weight, corresponding with the formula $NH_4NO_3 + NH_3$, thus retaining one-half the gas absorbed. By exposure to increased heat, this loses ammonia, and at 80° C. (176° F.) has been reconverted to pure ammonium nitrate. This preparation may be used for obtaining small quantities of pure ammonia, when wanted, by exposing it to a gentle heat in a small retort. To be fit for this purpose, it must be kept at a low temperature. (*P. J.*, June, 1872.) "A 10-per-cent. aqueous solution of the salt, when acidulated with nitric acid, should not be affected by silver nitrate test-solution (absence of *chloride*), nor by barium chloride test-solution (absence of *sulphate*)." *U. S.* 1890.

For the mode of preparing nitrogen monoxide (hyponitrous oxide), or nitrous oxide gas, from ammonium nitrate, see *Nitrogen Monoxide.*

Ammonium Persulphate, $(NH_4)_2S_2O_8$, is prepared by electrolyzing an acid solution of ammonium sulphate, and is a most efficient oxidizing agent in acid, neutral, or alkaline solutions. It occurs in small, colorless crystals, soluble in water. Its solution evolves oxygen when heated, and is used as an antiseptic for preserving meat and other food, and as a cheap and effective mouth wash. Ammonium persulphate is much used in photography as a reducing agent. In medicine it is chiefly valuable as forming the basis of *Klett's test* (*Chem. Ztg.*, 1900, p. 690) for indican in urine. To 10 Cc. (160 minims) of urine add 5 Cc. (80 minims) of 25 per cent. hydrochloric acid together with a crystal of ammonium persulphate, to which add chloroform, when a blue color develops in the latter.

Ammonium Sulphate. *Ammonii Sulphas. U. S.* 1880. *Sulphate of Ammonium.* $(NH_4)_2SO_4$; 131.21. *Ammonium Sulphuricum. Sal Ammonium Secretum Glauberi. Sulfate d'Ammoniaque, Sel secret de Glauber,* Fr. *Schwefelsaures Ammon, Ammonium, Ammoniak,* G.—Gas liquor is distilled with lime and the gas received in sulphuric acid, which yields a purified product. Most of the ammoniacal liquor is worked up into ammonium sulphate at present. The English production from gas works, shale distilling, and coke ovens amounted in 1902 to 221,500 tons, that of Germany to 100,000, and France 35,000 tons. In the United States the production from gas works amounted in 1890 to 11,000 tons, and has probably not increased because of the general introduction of water gas processes, in which no ammoniacal liquor is formed; on the other hand, the production in connection with the coking of coal has increased very rapidly. The total production of ammonia from gas works and coke ovens, as reported for 1904, was, when reduced to terms of ammonium sulphate, 52,463 tons (*Mineral Resources of the U. S.*, 1904). "Colorless, transparent, rhombic prisms, permanent in the air, odorless, having a sharp, saline taste and a neutral reaction. Soluble in 1.3 parts of water at 15° C. (59° F.) and in 1 part of boiling water; insoluble in absolute alcohol, but slightly soluble in alcohol of sp. gr. 0.817; when heated to about 140° C. (284° F.), the salt fuses, is gradually decomposed, and on ignition is wholly dissipated. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid. A 1 per cent. solution of the salt should not be blackened by test-solution of sulphide of ammonium (lead and iron), nor, when acidulated with nitric acid, should it be rendered more than opalescent by test-solution of nitrate of silver (limit of chloride)." *U. S.* 1880. It is not used as a medicine, but enters into the composition of ammonium alum and the iron and ammonium sulphate.

Ammonium Urate. *Ammonii Uras.* $C_5H_3(NH_4)N_4O_3$—This is an acid salt, and may be formed by digesting uric acid in solution of ammonia, or by adding sal ammoniac to the solution of other urates. Uric acid is frequently obtained from the dried and powdered excrements of the boa serpent, and of other large snakes, by dissolving it in a weak solution of potassium hydroxide with the aid of heat, and precipitating the uric acid from the filtered solution by hydrochloric acid, added in excess. Ammonium urate is a white, amorphous, very sparingly soluble salt. It is a constituent of some varieties of guano. It has been used with asserted good effects externally in chronic *eczema,* in the form of an ointment (twenty grains to the ounce). (See 16th edition U. S. D.) Neubauer found that when given internally to rabbits it causes increase in the urea, uric acid, and oxalates of the urine. (*Ranking's Abstract,* 1857.)

Ammonol.—This proprietary remedy is stated by its manufacturers to be *ammoniated-phenylacetamide.* It has been used internally as an analgesic in doses of from five to ten grains (0.3–0.65 Gm.). According to the analysis of George M. Beringer (*A. J. P.,* lxix. p. 150), it is composed of acetanilide, 10 Gm.; sodium bicarbonate, 5 Gm.; ammonium bicarbonate, 5 Gm.; metanil-yellow, 0.005 Gm.

Amygdophenin. *Phenyl-glycolyl-phenetidine.* This is a derivative of *p-amidophenol,* analogous to phenacetin. In constitution it is a light, crystalline, grayish-white powder, soluble with difficulty in water. It is obtained by the action of mandelic acid upon *p-phenetidin* in the presence of dehydrating agents. R. Stüve asserts that it is practically free from antipyretic properties; that it is an analgesic which is often useful in *neuralgias* and the pains of *spinal scleroses;* and that it is very useful in *rheumatism,* it having had more effect in some comparative trials than the salicylates. It is best administered in capsules, fifteen grains (1 Gm.), from three to six times a day.

Amyl Alcohol. *Alcohol Amylicum. Amylic Alcohol,* $C_5H_{11}OH$. *Fusel Oil. Hydrated Oxide of Amyl. Fousel Oil. Hydrate of Amyl. Grain Oil. Potato Spirit Oil. Alcool Amylique, Huile de Grain,* Fr. *Amylalcohol, Fuselöl,* G.—This oil is always present in the products of alcoholic fermentation, and, according to the experiments of L. Perdrix (*J. Chem. S.*, 1892, 90), the bacillus *B. amylozymicus* produces a fermentation in starch resulting in the large production of amyl alcohol. It is an ingredient in the ardent spirit obtained from various grains, but is most abundant in that procured from fermented potatoes. In grain spirit it is present in the proportion of about one part in five hundred by measure. When grain or potato whisky is distilled for the purpose of obtaining alcohol, the pure spirit will continue to come over for a certain time, after which, if the distillation be continued, a milky liquid will be obtained, which, upon standing, will be covered with a stratum of this peculiar oil. Subjected to distillation, the milky liquid will at first boil at a comparatively low temperature, and yield water and a little of the oil: but after a time the boiling point will rise to 132° C. (269.6° F.), when the oil will come over pure, and by changing the receiver may be so collected.

Properties.—Amyl alcohol is an oily, colorless liquid, of a strong, offensive odor, and an acrid, burning taste. As usually prepared it has a pale yellow color. Its sp. gr. is 0.818; that of its vapor 3.15. It boils at 132° C. (269.6° F.), and congeals at —25° C. (—13° F.) in the form of crystalline leaves. It is very sparingly soluble in water, but unites in all proportions with alcohol, ether, and essential oils. It dissolves iodine, sulphur, and phosphorus, and is a good solvent for fats, resins, camphor, and alkaloids. When dropped upon paper it does not leave a permanent greasy stain. It does not take fire like alcohol by the contact of flame, but requires to be heated to a temperature of about 54.5° C. (130° F.) before it begins to burn. Pasteur first observed that the

ordinary amyl alcohol of fermentation was a mixture of two distinct alcohols, one present in smaller amount, optically active, lævogyrate, and the other, the main portion, optically inactive. Their boiling points are very close, but they may be separated by the difference in solubility of the barium amyl-sulphates, and yield different sets of derivatives. (*C. R. A. S.*, 41, 296.) Amyl alcohol consists of five atoms of carbon 59.55, twelve of hydrogen 12, and one of oxygen 15.8 = 87.43. It is recognized as the hydroxide of the radical amyl (C_5H_{11}), and its formula is, therefore, $C_5H_{11}.OH$. Heated with phosphoric oxide, it loses a molecule of water, and forms a hydrocarbon, C_5H_{10}, homologous with ethylene, called *amylene* or *valerene*, which has been proposed as an anæsthetic. According to Long and Linebarger, American fusel oil consists chiefly of active and inactive amyl alcohol, with some isobutyl alcohol, isopropyl and ethyl alcohols, and traces of normal propyl and normal butyl alcohols. (*Chem. News*, lxi. 185–187.) Amyl alcohol should not affect the color of litmus paper, previously moistened with water, should leave no fixed residue upon evaporation, should require to dissolve it about 40 parts of distilled water at 15° C. (59° F.), and should become not more than slightly turbid upon mixture with petroleum benzin (absence of more than a little alcohol, or water). (See *Amylene* below.) When subjected to oxidizing agents, it loses two atoms of hydrogen and gains one of oxygen, and becomes $C_5H_{10}O_2$, or *valeric acid*, the acid found in valerian. Hence the test given in the Br. Pharmacopœia of 1885: "exposed to the air in contact with platinum-black, it is slowly oxidized, yielding valerianic acid." This acid bears the same relation to amyl alcohol that acetic acid does to ethyl alcohol, and formic acid to methyl alcohol. The free amyl, $(C_5H_{11})_2$, has been isolated by E. Frankland. It is a colorless pellucid liquid, of the sp. gr. 0.7704. (*Chem. Gaz.*, March 15, 1850.) Its hydride, $C_5H_{11}H$, was discovered to be an energetic anæsthetic by Simpson of Edinburgh.

Crude fusel oil may be obtained from the alcohol distillers. Kent of New York, found in it, as impurities, water, alcohol, acetic and valeric acids, oxide of iron, and an amyl compound analogous to *œnanthic ether*. Fusel oil has been used largely by the manufacturers of alkaloids as a solvent and in the preparation of *amyl acetate* (*pear oil*), which is used in the manufacture of pyroxylin varnishes and smokeless powder. This manufacture of amyl acetate for solvent purposes now consumes the great bulk of the fusel oil obtained from the rectifiers.

Fusel oil was formerly recognized by both the United States and the British Pharmacopœias as an artificial source of valeric acid.

Amyl alcohol is a very active narcotic, and under the name of *Faints* is used in England and Northern Europe for the purpose of increasing the activity and prolonging the effects of ordinary liquors. In small doses it is said to be especially efficacious in controlling the nervous weakness and irritability of confirmed drunkards, while larger doses produce headache, giddiness, double vision, staggering, unconsciousness, fall of temperature, abolition of reflexes, muscular rigidity, followed by complete relaxation, pronounced cyanosis, and a peculiar odor from the breath suggesting that of a Jargonelle pear.

T. B. Futcher (*Am. Med.*, August, 1901, p. 210) has shown that both in animals and also in man, when taken in toxic doses, fusel oil affects profoundly the blood, causing methæmoglobinuria, also glycosuria, attended with the presence of combined glycuronic acid, and in some cases violent nephritis. The size of the fatal dose probably varies very much. It is affirmed that death occurred from the taking of a single fluidounce (30 Cc.), but in another case recovery resulted after six fluidounces (180 Cc.) had been swallowed.

Amyl Salicylate. *Salicylic Amylester.*

$$C_6H_4\begin{cases}OH\\CO_2C_5H_{11}\end{cases}$$

A colorless and refracting fluid, emitting an odor resembling that of salol, having the sp. gr. 1.065 at 15° C. and made by the action of chlorine on a solution of salicylic acid in amyl alcohol. It boils at 270° C. (518° F.). The preparation dissolves in ether, alcohol, and chloroform, but it is almost insoluble in water. This substance has been proposed by B. Lyonnet (*R. T.*, lxviii. No. 2) as a substitute in *rheumatism* for methyl salicylate, over which it has the advantage of less pronounced odor and taste. It is given internally usually in gelatin capsules, three to five minims (0.2–0.3 Cc.) each, eight or ten times a day. It has also been found very useful as a local application, one-half to one drachm (2.0–3.9 Gm.), being applied to rheumatic joints and covered with wax paper, or other impervious dressing.

Amyl Valerate.—This liquid is said by W. F. Wade of Birmingham, to act similarly to valerian, and to afford a most valuable remedy. He dissolves one part of it in nineteen parts of alcohol and 2 per cent. of a spirit of amyl acetate (one part to twenty). The dose of this mixture is from six to eight minims (0.4–0.5 Cc.).

Amylamine Hydrochloride, *Amylamine Chloride*, $C_5H_{13}N.HCl$, crystallizes either in efflorescent scales or in quadratic octahedrons. According to Dujardin-Beaumetz (*C. R. A. S.*, lxxvii. 1247), in small doses (from $\frac{1}{64}$–$\frac{1}{15}$ grain (0.001–0.005 Gm.) to a rabbit) this salt lowers the temperature and also the force and frequency of the pulse. In larger amounts it produces profound nervous disturbance, with tonic and clonic convulsions, ending often in death. In man, doses of from seven to fifteen grains (0.45–1.0 Gm.) diminish the pulse and temperature.

From amylamine hydrochloride by boiling with an excess of calcium chloride is formed *amyldichloramine*, a yellowish-green oily liquid, the smelling of which produces violent irritation of the nose, followed by severe headache and vertigo. According to the researches of Boinet (*Congrès Français de Méd.*, 1, 1894), it is not only a violent local irritant, but also a powerful centric poison, producing death by asphyxia. Boinet has also examined physiologically *propyldichloramine* and *isobutyldichloramine*, finding that they are similar in their toxic influence to amyldichloramine.

Amylene. *Valerene. Pentene.* C_5H_{10}.—This compound was alluded to under amyl alcohol. The name is given to the isomeric hydrocarbons of the *olefin* series, having the formula C_5H_{10}, of which five are possible. Amylene is prepared by distilling amyl alcohol with a concentrated solution of zinc chloride, which acts by dehydrating, withdrawing a molecule of water. The product is redistilled, and that which comes over first, constituting the more volatile part, is separately collected, and agitated with concentrated sulphuric acid, when the amylene, freed from water, will

rise to the surface. Amylene is a colorless, very mobile liquid, having the density 0.655 at 10° C. (50° F.). Its boiling point is 34° C. (93.2° F.). Its odor is peculiar and disagreeable. It is soluble in alcohol and ether in all proportions, but very sparingly so in water. When pure it does not act on potassium, and is not colored by a prolonged contact with potassium hydroxide.

In 1857, Snow of London, proposed amylene as an anæsthetic. It was soon shown, however, to be dangerous, the French Academy of Medicine formally condemning it.

Amylene Hydroxide. Tertiary Amyl Alcohol. Dimethylethylcarbinol ($C_5H_{12}O$ or $(CH_3)_2C_2H_5COH$) is a clear, colorless liquid, of a strong, penetrating odor, soluble in eight parts of water, and miscible with alcohol, ether, chloroform, petroleum benzin, glycerin, and fixed oils in almost all proportions; sp. gr. 0.812 at 12° C. (53.6° F.).

In 1887, von Mering proposed the use of amylene hydroxide as a soporific, stating that it stood midway between hydrated chloral and paraldehyde, one drachm (3.9 Gm.) of hydrated chloral, two drachms (7.7 Gm.) of amylene hydroxide, and three drachms (11.6 Gm.) of paraldehyde being about equivalent in power. In cases of poisoning, reported by C. Dietz, by the amylene hydroxide, the symptoms were deep narcosis, dilated pupils, loss of corneal reflexes, slow, deep, irregular breathing, small, slow pulse, and fall of temperature. Amylene hydroxide is a safe, rapidly acting, and occasionally useful but not analgesic hypnotic, in doses of from thirty to forty minims (1.8–2.5 Cc.). According to Brackmann, confirmed by W. Niessen, it is very valuable in *diabetes insipidus*, lessening thirst and polyuria. *Dose*, fifteen minims (0.9 Cc.) morning and evening.

Pental. Trimethylethylene. β-isoamylene, $(CH_3)_2C=CH.CH_3$, or C_5H_{10}, is obtained from crude amylene, which consists of pentane (C_5H_{12}), pental (C_5H_{10}), and α- and γ-amylene. If the mixture be shaken with diluted sulphuric acid at a low temperature, —20° C. (—4° F.), the trimethylethylene and γ-amylene will be decomposed and amylsulphuric acid produced, which after dilution with water yields tertiary amyl alcohol and trimethylethylene; by fractional distillation the pental is obtained in a pure state.

Pental is a colorless, highly inflammable liquid; sp. gr. 0.678; boiling point 38° C. (100° F.). It was highly commended by W. Lombardino as an anæsthetic of great practical value. H. C. Wood and David Cerna have, however, shown that pental acts upon the lower animals as a powerful cardiac depressant, and is probably a dangerous anæsthetic. The more recent clinical trials of the drug have proved that this danger is real, there having been, according to the statistics of Gurlt, in six hundred pental narcoses, six deaths. Moreover, N. Kleindienst found that very frequently in man severe albuminuria, and not infrequently hæmaturia and hæmoglobinuria, occurred three or four days after pental narcosis.

Pentane.—Amyl hydride, $CH_3CH_2CH_2CH_2CH_3$, was discovered by E. Frankland of Manchester. It is a saturated hydrocarbon, and has been proved to be one of the light products in American petroleum, being the portion boiling at from 37°–39° C. (99°–102° F.) (Schorlemmer). Amyl hydride is a colorless, volatile, mobile liquid, possessing a grateful fruity odor, having no taste. It is one of the lightest liquids known, having the sp. gr. 0.626 at 17° C. (63° F.). It boils at 38° C. (100° F.), and the sp. gr. of its vapor is 2.5. It is very inflammable, and burns with a brilliant white flame. It is readily soluble in alcohol and ether, but insoluble in water. Belonging to the paraffin or saturated series of hydrocarbons, it is a very stable compound, resisting the action of fuming sulphuric acid and the most powerful oxidizing agents. This substance was proposed by Simpson as an anæsthetic, but has not sustained the claims made for it.

Amylene Chloral. *Dormiol.*

$$CCl_3.CH\begin{matrix}OH\\OC_5H_{11}\end{matrix}.$$

This is an alcoholate formed by the union of chloral and amylene hydroxide. It is a colorless, oily fluid of sp. gr. 1.24, having a peculiar camphor-like odor and a cooling, pungent taste. It is insoluble in water but is miscible in all proportions with alcohol, ether, acetone, and fixed oils. There is a large amount of clinical evidence as to the value of dormiol in all forms of insomnia which are not dependent upon the existence of pain. It is employed largely in insane asylums and the testimony is uniform that it acts favorably in about 70 per cent. of the cases, that it produces no disagreeable after-effects, and that when continuously exhibited it produces no chronic poisoning. It is further claimed that it may be used in cardiac cases when hydrated chloral would be dangerous. It acts promptly and produces a quiet sleep, which is often of very short duration; further, patients become rapidly accustomed to its use. *Dose*, ten minims to a fluidrachm (0.6–3.75 Cc.). It may be given in capsules or emulsion, but it is well taken when dropped in cold water and rapidly swallowed.

Amyloform is a patented chemical compound of formaldehyde and starch, introduced by Claassen as a substitute for iodoform. It is stated to be odorless, innocuous, and non-irritant. *Dextroform* is a similar compound, in which dextrin is used in place of starch. Dextroform is soluble in water and glycerin. Amyloform can be heated to 180° C. without decomposition, and therefore is readily sterilized. It is said to be non-poisonous, and has been used by Langgard, Krabbel, and others as a dusting powder in the treatment of infected *ulcers* and wounds of all kinds. It is said to act more energetically in lessening secretion and as a disinfectant than iodoform.

Amytin.—Under the name of amytin, Unna has introduced into medicine a 33 per cent. aqueous solution of *ichthyol-sulphonic acid*, which has the property of dissolving ichthyol, various ethereal oils, phenol, and camphor, forming solutions which are known by Unna as *Amytoles*. Many of these amytoles, especially those made with a phenol, are powerfully antiseptic. The 10 per cent. cresol solution is said to entirely disinfect catgut ligatures in from thirty-six to forty-eight hours, after which time the ligatures must be removed and preserved in alcohol. Amytin is more or less irritant to the skin, and is affirmed to be useful in those skin diseases which need stimulation. It is stated that a 3 per cent. solution of the cresol amytole affords an excellent means of disinfecting the hands, and is very actively poisonous against the diphtheritic bacillus.

Anacahuite Wood.—In the year 1860 considerable quantities of this wood were imported from Mexico, into Germany, as a supposed remedy in *phthisis*, but it failed to sustain its first reputation. It is the product of *Cordia Boissieri*, De Cand. (See *P. J.*, Dec. 1862, 272, with figure.)

Anacardium. *Anacardium occidentale*, L. *Cassuvium pomiferum*, Lam. *Cashew-nut. Acajou à Pommes*, Fr. *Caschunuss*, G.—A small and elegant tree of the Fam. Anacardiaceæ, growing in the West Indies and other parts of tropical America. A gum exudes from the bark, which bears some resemblance to gum arabic, but is only in part soluble in water, and consists of true gum and bassorin. It is the *gomme d'acajou* of the French writers. Peckoldt describes *cashew gum* as occurring in hard, fragile pieces which are more or less transparent, yellowish-brown, uviolar and stalactite-shaped; it is as soluble in water as acacia. (*Zeit. Oest. Apoth. Ver.*, 1893, 501.) The fruit is a fleshy, pear-shaped receptacle, supporting at its summit a hard, shining, ash-colored, kidney-shaped nut, an inch or more in length and three-quarters of an inch broad, consisting of two shells, with a black juice between them, and of a sweet oily kernel. The receptacle is red or yellow, and of an agreeable subacid flavor with some astringency. It is edible, and affords a juice which has been recommended in *uterine complaints* and *dropsy*. This juice is converted by fermentation into a vinous liquor, which yields by distillation a spirit used in making punch, and said to be powerfully diuretic. The nuts are well known under the name of *cashew-nuts*. The black juice contained between their outer and inner shell is extremely acrid and corrosive, producing, when applied to the skin, severe inflammation, followed by blisters or desquamation. Staedeler found in it two peculiar principles,—*anacardic acid* and a yellow, oleaginous liquid, *cardol*. (See *J. P. C.*, 3e sér., xiii. 459.) The juice is used in the West Indies for the cure of *corns*, *warts*, *ringworms*, and obstinate *ulcers*, and even of *elephantiasis*. It is said to be sometimes applied to the face by women, in order to remove the cuticle, and produce a fresher and more youthful aspect. In a case of external poisoning which came under our notice, in a lady who was exposed to the fumes of the roasting nuts, the face was so much swollen that for some time not a feature was discernible. (*N. J. Med. Rep.*, 1855, 187.) In the case of a boy the tongue, face, neck, hands, forearms, scrotum, etc., were red and enormously swollen, and very painful. The tincture of iodine was found useful as a local application. The kernel has a sweet, agreeable taste, and is eaten like chestnuts, either raw or roasted, in puddings, and as a chocolate when ground with cocoa. By age it becomes rancid. The black juice of the nut and a milky juice which flows from the tree after incision are used for almost indelibly marking linen.

Anæsthesin. *The ethyl-ester of p-amido-benzoic acid*, $C_6H_4\begin{cases}NH_2\\COOC_2H_5\end{cases}$. This name is given by E. Ritsert to the ethyl-ester of *p*-amido-benzoic acid. It is a white, inodorous, crystalline powder, melting at 89.5° C. (193° F.), sparingly soluble in cold water, readily soluble in acetone, ether, petroleum benzin, chloroform, and in ethereal and fatty oils. The solutions do not alter even when exposed to light.

Anæsthesin hydrochloride is soluble in 100 parts of water. This solution when injected, however, causes some unpleasant burning sensation and may be diluted to one-fourth. It is claimed for anæsthesin that while not poisonous it is an active local anæsthetic and may be freely injected in solution for surgical purposes. In the experiments of Binz colossal doses given to rabbits were found to produce only a transient methæmoglobinæmia. No renal irritation or methæmoglobinuria were ever observed. Dunbar commends the following formula: Anæsthesin hydrochloride, 0.25; sodium chloride, 0.15; morphine hydrochloride, 0.005 to 0.015; water, 100; the solution can be sterilized. Anæsthesin is strongly commended internally, for the relief of *gastric pain* and *vomiting*. Lozenges containing from three-tenths to six-tenths of a grain (0.019–0.038 Gm.) are stated to be effective in relieving irritation of the throat and palate. Anæsthesin has been found very useful, in the form of suppositories containing from three to eight grains (0.2–0.5 Gm.), for the relief of painful *hemorrhoids;* it is also used in soluble bougies (five grains or 0.3 Gm.) in the *vesical tenesmus* of women; in the form of an ointment (10 per cent.) in *pruriius vulvæ* of *diabetes* and other conditions, also in various *eczemas* about the genitalia. *Dose*, five to seven grains (0.3–0.45 Gm.).

Anagallis. *Anagallis arvensis*, L. *Scarlet Pimpernel. Red Chickweed. Weather-glass. Mouron rouge*, Fr. *Gauchheil, Rothe Miere*, G. (Fam. Primulaceæ.)—An annual plant, growing in Europe and the United States. It has little odor, but a bitterish, somewhat acrid taste. The ancients esteemed it a counter-poison, and Orfila found three drachms of its extract to cause fatal gastro-enteritis in a dog. It has been recommended as a local application to old and ill-conditioned *ulcers*, and has been given internally in *visceral obstructions*, *consumption*, *dropsy*, etc. J. A. Heintzelman obtained from it a volatile oil of a strong peculiar odor, a pungent and somewhat acrid taste, and the sp. gr. 0.987. Four drops (0.2 Cc.) of it produced intense headache and nausea, lasting for twenty-four hours, with pains throughout the body. According to Daccomo and Tommasoli, anagallis contains an active ferment, which rapidly digests raw meat. (*Rassegna di Sci. Med.*, 1892, No. 4.) *A. cærulea*, Lam., is probably a variety of *A. arvensis*, and shares its medicinal properties.

Anagyris. *Anagyris fœtida*, L. (Fam. Leguminosæ.)—Hardy and Gallois have separated from *Anagyris fœtida* an alkaloid, *anagyrine*. This alkaloid, according to Loewi (*A. L. P.*, vol. vii. p. 66), is physiologically related to lobeline, acting primarily upon the nerve endings as a paralyzant and later upon nerve centres, but having no direct influence upon the muscles. It lessens the cardiac frequency and decreases the force of the systole in the frog, but is said in the mammal to have very little influence upon the blood pressure, death occurring through respiratory paralysis.

Analgen. *Ortho-ethoxy-anamonobenzoylamidoquinoline. Benzanalgene. Quinalgene. Labordin.* $C_{18}H_{16}N_2O_2$.—The name analgen was first given to the acetyl derivative, but it was found that the benzoyl radical gave a more desirable product, and this is now made exclusively and the name analgen applied to it. It is in colorless crystals, insoluble in water, soluble in hot alcohol, melting point 208° C. (406° F.).

First produced and brought forward by Vis as an antipyretic, analgesic, and antirheumatic remedy, it was subsequently investigated by Maass (*Z. K. M.*, xxviii. 1895), who found that in sufficient dose it depresses the heart and the reflexes, finally causing convulsions with loss of power, and death by centric paralysis of respiration. Both it and its derivative, *oxyethylamidoquinoline*, act upon the peripheral nerves as local anæsthetics. The fatal dose for the lower animals was found

by Maass to be three grammes per kilo. The continuous use of small doses produces emaciation, feebleness, and lessening of the reflexes. In cases of fever it causes active depression of temperature, often with free sweating, and usually decrease in the urinary secretion, and especially of the nitrogenous elimination. After chronic poisoning in the lower animals fatty degeneration was found in the liver and kidneys. The urine of patients taking it is said to become red, owing to the presence of *oxyethylamidoquinoline urate.* In *headaches* and the other nervous disturbances of *chlorotic neurasthenic* individuals it is said to act well without affecting digestion. It is said also to relieve the pain of organic diseases, and to be distinctly anti-malarial. (See *B. A. M.*, xxxvi.) *Dose*, eight to fifteen grains (0.5–1.0 Gm.), increased to seventy-five grains (5 Gm.) a day if required; best administered in capsule or in acidulated water.

Anchietea. *Anchietea salutaris*, St. Hil. *Cipo Suma. Cipo Carneiro. Pirageia.*—The bark of the root of this Brazilian plant contains *anchietine*, an alkaloid isolated by Peckoldt. (*Ber. d. Chem. Ges.*, 1897, No. 3, p. 98.) It is used in Brazil in treating *scrofula, erysipelas*, and *eczema.* Given in *doses* of two drachms (7.7 Gm.), it acts as an aperient, while three drachm (11.6 Gm.) doses produce vomiting.

Anchusa. *Anchusa officinalis*, L. *Bugloss. Oxtongue.* (Fam. Boraginaceæ.)—The root, leaves, and flowers of this European biennial plant were at one time recognized by the U. S. Pharmacopœia, but probably are practically devoid of medicinal properties. In France the *Anchusa italica*, which is there known as *buglosse*, is substituted for *A. officinalis.*

Andrographis. *Br. Add. Andrographis paniculata*, Nees. (Nat. Ord. Acanthaceæ.)—Under the name of *Kiryat* this plant is stated to be used to some extent in India as a bitter tonic, having similar properties to chiretta. It appears scarcely to enter commerce at all, although exposed in the shops of the herbalists. The Br. Add. recognizes the *infusion* (*Infusum Andrographidis*, Br. Add., one ounce to a pint), *dose*, one-half to one fluidounce (15–30 Cc.); the *concentrated liquor* (*Liquor Andrographidis Concentratus*, Br. Add.), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.); and the *tincture* (*Tinctura Andrographidis*, Br. Add.), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Andromeda. *Oxydendrum arboreum* (L.), DC. (*Andromeda arborea*, L.), *Sour Wood*, or *Sorrel-tree*, grows in the valleys of the Alleghanies, from Pennsylvania to Florida. Barton in his *Collections* states that a decoction of *Pieris Mariana* (L.), B. and H. (*Andromeda Mariana*, L.), or *stagger-bush*, is employed in the Southern States as a wash in ulcerations of the feet. The powder of the leaves and buds of *Leucothöe racemosa* (L.), A. Gray (*Andromeda racemosa*, L.), is said to be a powerful errhine. J. F. Eykman of Japan, found a poisonous glucoside, *asebotoxin*, in *Andromeda* (*Pieris*) *japonica.* (*N. R.*, 1882, 290.) In 1883, Plügge separated from *Andromeda japonica* a colorless crystallizable poisonous principle, *andrometoxin.* Subsequently he found that various ericaceous plants contain it. (*A. Pharm.*, xxvi.; also *A. J. P.*, 1889.) It exists in *Azalea indica* and *Rhododendron maximum*, L., and has been found by De Zaayer (*Chem. Ztg.*, July, 1887) in *Rhododendron ponticum*, and in *Kalmia angustifolia*, L., and *K. latifolia*, L.; also in *Monotropa uniflora*, L., by A. J. M. Lasché (*Ph. Rund.*, Sept. 1889). It occurs in acicular crystals, melting at from 228° to 229° C. (442°–444° F.), soluble in alcohol, amyl alcohol, chloroform, ether, benzene, much more soluble in cold than in boiling water, yielding solutions of an alkaline reaction, but not precipitated by ordinary alkaloidal reagents nor by solutions of metallic salts. For further tests, see reference; also *P. J.*, vol. xviii. 171. The *poisonous honey* of Xenophon, derived from the flowers of *R. ponticum*, probably owed its toxic properties to andrometoxin. (See also *Ph. Z. R.*, 1883, xxii.) The oil of *A. Leschenaultii*, of India, was found by J. Broughton to be methyl salicylate. (*P. J.*, Oct. 1871.)

Aneson. *Anesin. Anäsin.*—This is a patented 1 per cent. aqueous solution of *tri-chlor-pseudo-butyl-alcohol* or *acetone-chloroform*, $HO.C(CH_3)_2CCl_3 + 1\frac{1}{2}H_2O$. This compound is obtained when acetone combines with chloroform in the presence of caustic alkalies.

It was first studied pharmacologically by J. Kossa, and subsequently by Zoltán von Vámossy. (*D. M. W.*, xxiii.) It is alleged that it is a powerful local anæsthetic, equivalent to a 2½ per cent. solution of cocaine, and having the advantage of being non-irritant and non-toxic, and of not being mydriatic. Its anæsthetic effects are said to be of slow development, as it seemingly does not pass rapidly through the mucous membrane. Internally acetone-chloroform is affirmed to resemble hydrated chloral in its hypnotic action in *doses* of from eight to fifteen grains (0.5–1.0 Gm.).

Angelica. *Racine d'Angélique*, Fr. *Engelwurzel*, G.—*Angelica atropurpurea*, L. (Fam. Umbelliferæ), sometimes called *masterwort*, grows throughout the Eastern United States. The whole plant was formerly official. It has a strong odor and a warm aromatic taste. The juice of the recent root is acrid, and is said to be poisonous; but the acrimony is dissipated by drying. The medicinal virtues of the plant are similar to those of the garden angelica of Europe, for which it has been proposed as a substitute. It is however inferior to the European angelica.

Angelica Archangelica, L. (*Archangelica officinalis*, Hoffm.)—*Garden angelica* has a long, thick, fleshy, biennial root, furnished with many fibres, and sending up annually a hollow, jointed, round, channelled, smooth, purplish stem, which rises five feet or more in height, and divides into numerous branches. The leaves, which stand upon round fistulous footstalks, are very large, doubly pinnate, with ovate-lanceolate, pointed, acutely serrate leaflets, the terminal being three-lobed. The flowers are small, greenish white, and disposed in very large, many rayed terminal umbels, composed of numerous dense, hemispherical umbellets. This plant is a native of the north of Europe, and is found in the high mountainous regions in the southern section of that continent, as in Switzerland and among the Pyrenees. It is often cultivated. The whole plant is aromatic, but the root and the fruit only were official. The root should be dug up in the autumn of the first year, as it is then least liable to become mouldy and worm eaten. It is spindle-shaped, an inch or more thick at top, and beset with long descending radicles. The fresh root has a yellowish-gray epidermis, a fleshy yellow parenchyma, and when wounded yields a honey-colored juice, having all the aromatic properties of the plant. The dried root is grayish brown and much wrinkled ex-

ternally, whitish and spongy within, and breaks with a starchy fracture, exhibiting shining resinous points. It is very apt to be attacked by worms, and is said to keep best, in the state of powder, in full and well-closed vessels. The odor is strong and fragrant, and the taste at first sweetish, afterwards warm, aromatic, bitterish, and somewhat musky. These properties are extracted by alcohol, and less perfectly by water. The constituents of the root, according to the younger Buchner, are volatile oil, a volatile acid which he called *angelicic acid*, a wax-like substance, a crystallizable sub-resin, a brittle amorphous resin, a bitter principle, tannic acid, malic acid, sugar, starch, albumen, pectic acid, fibrin, and various salts. Five hundred parts yield nearly four parts of the volatile oil. Schimmel & Co. (*Ber. d. Chem. Ges.*, April, 1889) report the results of an examination of *Japanese angelica*, believed to be roots of *A. refracta* or *A. anomala*. It contained a small quantity of volatile oil, which had an extremely persistent odor. The *angelicic acid* of Buchner is now known as *angelic acid*, $C_5H_8O_2$, a monatomic acid of the acrylic acid series. *Valeric acid*, $C_5H_{10}O_2$, has also been recognized as occurring in the root. The volatile oil has been examined by Beilstein and Wiegand, who found three terpenes: one boiling at 158° C. (316° F.), forming no crystallizable hydrochloride; the second boiling at 175° C. (347° F.) and forming a crystalline hydrochloride having the properties of artificial camphor, and constituting the main body of the oil; and a third, boiling at 250° C. (482° F.). (*Ber. d. Chem. Ges.*, 1882, 1741.) The main terpene product is now recognized as *phellandrene*. Besides valeric (*methyl-ethylacetic*) acid, *oxymyristic*, $C_{14}H_{28}O_3$, and *oxypentadecylic acids* ($C_{15}H_{30}O_3$), have been identified. (*Schim. Rep.*, April, 1897.) The *seeds*, as the fruit is commonly called, are two or three lines long, oval, obtuse, or somewhat notched at the ends, flat, with a longitudinal furrow on one side, convex with three angular ridges on the other. They are ash-colored, and have the odor and taste of the root. They are said to keep well.

Garden angelica is an aromatic tonic. The Laplanders, in whose country it flourishes, esteem it highly as a condiment and medicine. In Europe the stems are frequently made into a preserve. The *dose* of the root or seeds is from thirty grains to a drachm (2–3.9 Gm.).

Angræcum. *Angræcum fragrans*, Thouars. This is an orchidaceous plant, indigenous to the Isle of Réunion and Mauritius, where the leaves have been long used, under the name of *faham*, for the same purposes as Chinese tea. For description, see *P. J.*, 1881, 913. They have a somewhat pungent aromatic taste, and a strong and highly agreeable odor, scenting the whole apartment with a delicious perfume. Given in infusion, they appear to have an effect on the system, somewhat similar to that of Chinese tea, and they have been introduced into Paris as a rival of that popular beverage. The drink is made by putting the leaves and stalks, in the proportion of fifteen grains (1 Gm.) to a teacupful, into cold water, boiling for about ten minutes, and then pouring into a closed vessel, and sweetening it when used. (*A. J. P.*, 1866, 441.)

Anhalonium.—Under the name of *Pellote* are used in Mexico for narcotic purposes certain cacti whose tops have entered commerce under the name of *Mescal Buttons*. In a mass of such cactus tops sent to the Pharmaceutical Institute of Leipzig from Mexico as pellote, experts have recognized the products of *Anhalonium fissuratum*, *A. prismaticum*, *Lophophora Williamsii* (Lem.), Coult., and *L. Lewinii* (Henn.), Thompson. Moreover from *A. jourdanianum*, L., Lewin obtained traces of an alkaloid (*A. E. P. P.*, xxxiv.), so that there is little doubt but that various species of anhalonium are active and are represented in the commercial drug. The most important of these plants are *L. Lewinii* and *L. Williamsii*, which inhabit the valley of the Rio Grande in Mexico and are furnished with stems reaching about half an inch above the surface of the ground, surmounted by a top composed mainly of the blunt leaves of the plant, bent around a tuft, of from half an inch to an inch in diameter, composed of short yellow-white filaments or hairs. It is this top which constitutes the *mescal button*, which is from an inch to an inch and a half in diameter, one-fourth of an inch in thickness, with a convex under surface, a texture which is brittle and hard when dry, but becomes soft when moistened, a very bitter disagreeable taste, and an odor when moist which is peculiar and disagreeable, and is especially marked in the powdered drug. According to C. H. Thompson the buttons of *L. Lewinii* and *L. Williamsii* are readily distinguished by the fact that the surface of *L. Lewinii* is traversed by thirteen shallow narrow furrows giving the appearance of there being as many irregular or much broken ribs or obtuse ridges, while in *L. Williamsii* the furrows and ridges are eight in number and regular. These species, formerly referred to *Anhalonium*, belong to Coulter's genus, *Lophophora*, which is characterized by a flexible epidermis, its freedom from spines and tubercles and its segments not assuming the form of a projecting or leaf-like organ. (*Reports of Missouri Botanical Gardens*, 1898.)

In 1888, L. Lewin separated from *L. Lewinii* an alkaloid, *anhalonine*, which has the formula $C_{12}H_{15}NO_3$, and crystallizes in small white prisms, soluble in ether, alcohol, and chloroform. Subsequently, by treating the powdered buttons with 70 per cent. alcohol, filtering, alkalizing with ammonia, and consecutively employing chloroform and ether, Heffter (*Ber. d. Chem. Ges.*, 1896) separated from *L. Lewinii*, besides *anhalonine*, three alkaloids: *mescaline*, $C_{17}H_{17}NO_3$, in white needles melting at 151° C.; *anhalonidine*, $C_{12}H_{15}NO_3$, fusing at 160° C., and *lophophorine*, $C_{13}H_{17}NO_3$. (See also *A. E. P. P.*, xl. 1898.)

Kander (*A. Pharm.*, 1899, vol. 237) has found that in commercial mescal buttons, besides the alkaloids already mentioned are two other bases, *pellotine* and *anhalamine*, so that Merck has offered as commercial products the following salts: *Anhaloninæ Hydrochloridum* cryst., *Anhalonidinæ Hydrochloridum* cryst., *Lophophorinæ Hydrochloridum* cryst., *Mescalinæ Sulphas* cryst., *Pellotinæ Hydrochloridum* cryst. According to the researches of Heffter, pellotine, $C_{13}H_{19}NO_3$, is contained exclusively in *L. Williamsii*, but as this cactus is present in most if not all of the commercial buttons it was naturally found by Kander in analyzing the commercial drug. Moreover, the correctness of the conclusion of Heffter is challenged by Merck's chemists, who, in the analysis of *L. Williamsii*, found the same quantity of the same alkaloids as is present in the true mescal button. For a description of these alkaloids see *M. R.*, 1898 and 1900. E. White (*J. P.*, xxv.) obtained *mescaline*, 1.16 per cent.; *anhalonidine*, 1.16 per cent.; *anhalonine*, 0.46 per cent.; *loph-*

ophorine, 0.14 per cent. *Anhaline*, $C_{10}H_{17}NO$, is an alkaloid crystallizing in colorless stellate prisms, which has been extracted from *L. fissuratum*.

From time immemorial the Kiowa Indians of the Rio Grande have used the mescal buttons for the purpose of producing intoxication during their religious ceremonies. Attention was first called to the peculiar cerebral action of the drug by D. W. Prentiss and Francis P. Morgan (*T. G.*, 1895), who found that from two hundred and fifteen to two hundred and thirty grains (14–15 Gm.) (four to five buttons) will produce a peculiar cerebral excitement attended with an extraordinary visual disturbance, characterized by an incessant flow of visions of infinite beauty, grandeur, and variety, of both color and form, often followed after a time by the seeing of monsters, grotesque faces, and gruesome shapes. During the intoxication there are dilatation of the pupil, muscular relaxation, and some slowing of the pulse. Loss of sense of time, partial anæsthesia, weakened heart's action, great muscular relaxation, wakefulness, and in some cases nausea and vomiting also have been noted, but no distinct alteration of the respiration. These results have been confirmed by several observers.

A. Mogilewa (*A. E. P. P.*, 49, 137) found that mescaline, anhalonidine, anhalonine, lophophorine, and pellotine acted similarly in lessening the frequency and force of the isolated fever heart, varying simply in quantitative power. The most thorough research upon the anhalonium alkaloids is that of W. E. Dixon (*J. P.*, xxv.), whose report is somewhat marred by the fact that he does not state in his experiments which one of the alkaloids was employed; he simply affirmed that anhalonine and anhalonidine are identical in physiological activity, that lophophorine differs only in being more toxic, and that mescaline has a physiological action almost indistinguishable from that of its associated alkaloids. He finds that "the alkaloid" is not locally anæsthetic; that increased salivation is one of the most characteristic symptoms of its action; that it rarely causes vomiting; that in therapeutic doses, in man at least, it produces constipation, but that in toxic dose it causes diarrhœa and bloody stools; that no effect is produced by it on the blood; that its main circulatory effect is upon the cardiac muscle and contained ganglia, whereby it produces slowing of the heart, and causes in mammals a rise of arterial pressure; that it has no effect upon voluntary muscles; that it kills by action on the respiratory centres so that in man the most serious result of an overdose is rapid, shallow breathing, with a sense of suffocation; that upon the nervous system it acts most powerfully, influencing in the lower animals and especially in man the cerebral cortex, producing in the frog and to a lesser degree in the mammal, increasing loss of muscular power with heightened reflexes, believed to be due to spinal stimulation. The motor nerves appear to be again depressed rather than stimulated, since they are paralyzed when the drug is applied locally to them.

Experiments were performed by Dixon upon two human subjects, with the alkaloid, which was found to produce wide dilation of the pupils, with uncertainty of gait like that of alcoholic intoxication, tremors, and heightened reflexes although sensation was distinctly blunted. The psychical symptoms caused by the largest doses resemble somewhat those from cannabis indica; these being, however, not only overestimation of time, sense of dual existence, and delirium, but also pronounced visual hallucinations with undulatory motion of light, similar to those seen in ophthalmic migraine, and a regular kaleidoscopic play of colors. There was also a very extraordinary effect upon hearing, each note produced by the piano becoming the centre of a "medley of other notes which appeared to me surrounded by a halo of color pulsating to the music." The alkaloid was excreted by the kidneys and acted somewhat as a diuretic. The dose of the alkaloid used by Dixon was three and eight-tenths grains (0.25 Gm.).

In Heffter's experiments *pellotine* was found to be physiologically feeble, $\frac{1}{3}$ grain (0.005 Gm.) causing only temporary stiffness in the legs of the frog, $\frac{2}{3}$ grain (0.01 Gm.) producing stiffness, heightened reflexes, strychnine-like tetanus, lasting from three to four days, ending in recovery. In man, from seven-tenths to nine-tenths of a grain (0.045–0.058 Gm.) produced only temporary sleeplessness with sense of weariness. Pilcz (*W. K. W.*, ix. 1896) has used pellotine as a calmative in fifty-eight cases of *insanity* in doses of from one-third to one grain (0.021–0.065 Gm.). About half the cases were markedly affected, sleep coming on in from half an hour to an hour and a half after the hypodermic injection and continuing through the night. No disagreeable results and no collapse occurred, although Langstein is said to have seen collapse following the dose of seven-tenths of a grain (0.045 Gm.).

The value of mescal buttons as a remedial agent is doubtful; it has been employed to a slight extent in various forms of *neurasthenia* and *hysteria*, and is asserted by S. F. Landry (*T. G.*, 1888) to be especially valuable in cases of *asthma*. It has also been alleged to be useful in *neuralgic* and *rheumatic affections*. It may prove of value as a nerve stimulant in cases of *hypochondriasis* and similar states where there is a tendency to failure of the heart. Prentiss and Morgan give the *dose* of the crude drug as from seven to fifteen grains (0.45–1.0 Gm.); of the fluidextract, from ten to fifteen minims (0.6–0.9 Cc.); of the 10 per cent. tincture, from one to two teaspoonfuls (3.75–7.7 Cc.).

Anilina. *Aniline. Amidobenzene. Phenylamine.* ($C_6H_5NH_2$.)—This is an organic base obtained from coal tar or more immediately from nitrobenzene. It was first discovered by Unverdorben, in 1826, among the products of the dry distillation of indigo, and was named by him *crystalline*. Fritzsche, who obtained it afterwards from indigo by another process, seems to have been the first to give it the name of aniline, from the Portuguese word *anil* (indigo). In 1837, Runge obtained three volatile principles from coal tar, which he named *kyanol*, *leucol*, and *pyrrhol*. Of these, kyanol was afterwards found by Hofmann to be identical with aniline, and leucol has been ascertained to be the same as *quinoline* (*chinoline*). Nitrobenzene is now the source whence most of the aniline of commerce is derived. Nitrobenzene, hydrochloric acid, and iron turnings, in equal weights, are introduced into a cast iron vessel, care being taken that the heat does not rise too high, when the following reactions take place:

$$C_6H_5NO_2 + H_6 = C_6H_5NH_2 + 2H_2O$$
$$C_6H_5NH_2 + HCl = C_6H_5NH_2HCl$$

The semi-solid mass which soon forms consists principally of ferrous chloride and aniline hydrochloride. This is distilled, after the addition of milk of lime, in a large cast iron cylinder, and the

distillate redistilled, the portion coming over between 175° C. (347° F.) and 190° C. (374° F.) being collected, and considered sufficiently pure for manufacturing purposes.

Properties.—Pure aniline is a thin colorless fluid, of an oily appearance; but as found in commerce it is generally more or less colored, and sometimes of a deep reddish brown. It has a peculiar, not disagreeable odor, and a pungent, aromatic, burning taste; its sp. gr. is 1.020 (Hofmann), 1.028 (Fritzsche). It is not solidified at —20° C. (—4° F.), boils at 182° C. (360° F.), and its vapors are condensed unchanged. It is slightly soluble in water, but dissolves in all proportions in ether, alcohol, methyl alcohol, acetone, carbon disulphide, and the oils, fixed and volatile. Though possessed of strong basic powers, it does not restore the color of reddened litmus, nor does it change turmeric. It changes, however, the violet color of dahlias to green. With the acids it forms soluble and readily crystallizable salts. It is inflammable, and absorbs oxygen from the air, becoming at first yellowish, afterwards reddish, and ultimately brown. A characteristic property is that it produces instantly a deep blue or purple color when brought into contact with chlorinated lime or other hypochlorite. Letheby described a very delicate test for this base. If a drop of a very weak solution of aniline sulphate be placed on a piece of clean platinum foil and touched with the negative pole of a galvanic battery the solution acquires a bluish, then a violet, and ultimately a pink color. (*P. J.*, Sept. 1862, 128.) It is a derived ammonia, having the group C_6H_5 in place of a hydrogen atom of the NH_3 molecule. It is hence often called *phenylamine*. The chief value of aniline at present is for the coloring matters derived from it, or rather from its derivative, *rosaniline*, contained in commercial aniline oil. Beautiful reds, purples, yellows, blues, and various other tints are obtained from it. For the mode of making inks from these colors, see *Roscoe and Schorlemmer's Chemistry*, vol. iii., part 3, pp. 318, etc. The following table shows the solubilities of aniline colors in water and alcohol:

Aniline color.	Per cent. soluble in water.	Per cent. soluble in alcohol.
Aurin	nearly insoluble.	40.00
Bismarck-brown	3.00	0.35
Corallin	2.00	0.50
Dahlia-blue	3.00	1.00
Eosin	2.00	1.00
Ethyl-orange	0.02	nearly insoluble.
Fuchsin	0.30	10.00
Gentian-violet	1.50	3.00
Luteolin	0.25	0.60
Magenta-red	0.20	2.50
Malachite-green	4.00	5.00
Manchester-yellow	2.00	0.15
Methylene-blue	3.00	1.50
Methyl-green	7.00	0.25
Methyl-violet	2.00	1.50
Safranin	0.60	0.40
Tropæolin OO	0.05	0.10
Vesuvin	2.00	0.20

—*Ph. Centralh.*, 1887, 385.

Aniline-black or *nigrosin* was discovered by Wolff in 1863. As it occurs in commerce it is a salt having the composition $C_{36}H_{29}N_3HCl$; if prepared from pure aniline it is of a deep blue color; if toluidine is present, it approaches a black in direct proportion to the amount of toluidine in it; it is very soluble in water, and ten grains dissolved in one fluidounce of water makes a good *nigrosin ink*, which, however, should not be exposed to too strong a light, as all aniline inks fade in time. *Böttger's test* for detecting cotton in linens consists in dipping a portion of the texture in an alcoholic solution of aniline-red, then washing it with water till the washings are colorless, and putting it into an aqueous solution of ammonia. If cotton be present, its threads will be deprived of color, while the linen will continue of a bright rose-color. (See *A. J. P.*, Jan. 1866, 86.) Under the name of *aniline oil* a liquid is to be found in commerce which consists of a mixture of aniline, toluidine, xylidine, cumidine, and varying quantities of by-products found in the "tailings;" the boiling point ranges between 180° C. (356° F.) and 210° C. (410° F.), and the sp. gr. is also variable; it is used as a solvent for rubber, copal, etc.

Aniline-blue, or *triphenyl-rosaniline*, according to Iwanoff, possesses antimalarial properties similar to those of methylene blue. Five grains (0.32 Gm.) may be given in capsules three times a day.

Methyl-violet or *pyoktanin*, according to Liebreich, is a mixture of aniline compounds. The *pyoktaninum cæruleum* is methyl-violet, a mixture of the hydrochlorides of *penta-* and *hexamethyl-para-rosaniline*, $C_{24}H_{28}N_3Cl$ and $C_{25}H_{30}N_3Cl$, while *pyoktaninum aureum* is *auramine*, $C_{17}H_{24}N_3OCl$, or *amido-tetramethyl-di-amido-diphenyl-methane*, known commercially as *auramine O*. *Appoinin*, introduced as an antiseptic similar to pyoktanin, is a yellow crystalline powder slightly soluble in cold water, soluble in alcohol. *Methylene blue*, $C_{16}H_{18}N_3SCl$, official as *Methylthioninæ Hydrochloridum* [p. 779], or *tetra-methyl-thionine-chloride*, is a derivative of diphenylamine, occurring in dark blue or reddish-brown bronze-tinged crystals, slightly soluble in water and alcohol.

Medicinal Properties.—The symptoms which are produced by the inhalation or ingestion of aniline are great prostration, heaviness in the head, giddiness, vomiting, violent neuralgic pains, and, if the dose has been large enough, cyanosis, coma with dilatation of the pupils, excessive perspiration, loss of reflexes and of voluntary movement, hurried weak pulse, rapid or irregular respiration, hæmoglobinuria, a peculiar discoloration of the skin, and, if the patient survives sufficiently long, jaundice with great increase in the biliary pigment of the urine. At the autopsy reported by Müller (*A. J. P.*, 1887), in a woman killed by the swallowing of about a fluidounce (30 Cc.) of aniline, the blood was chocolate brown, and gave the spectrum of methæmoglobin; the urine was free from sugar, albumin, or blood, but contained paramidophenol, and its distillates gave aniline reactions. The hæmoglobinuria is evidently connected with an extraordinary destruction of the red blood corpuscles, for in the case reported by Dehio (*A. J. P.*, 1888), in a woman who had taken one hundred and fifty grains (9.8 Gm.) of aniline, the red blood corpuscles fell from normal 5,000,000 per Cc. to 2,700,000 on the seventh, and 1,400,000 on the eleventh day. The globules were replaced slowly; on the eighteenth day their number was about one-third of the normal quantity.

The violent local effects which have been noticed as produced by some aniline dyes have probably been due to the presence of arsenic, which is used in the production of aniline and may remain as a contamination. Sée and Morau (*Méd. Mod.*, 1890) believe that *safranin* and *methyl-violet* are

practically free from poisonous properties; and Penzoldt, in a series of experiments, found that methyl-violet (0.05 Gm. per kilo) caused only local alterations,—viz., extensive gangrene of the skin; *malachite-green* (0.1 Gm. per kilo) caused motor paralysis and cramps, fatal on the ninth day; *trimethyl-rosaniline* (0.02 Gm. per kilo) caused similar symptoms; *Bengal-rose* (0.25 Gm. per kilo), *phenyl-blue* (0.1 Gm. per kilo), and *methylene-blue* (0.075 Gm. per kilo) caused no special symptoms.

In an elaborate research (*B. G. T.*, Avril, 1891) Combemale determined that in the guinea-pig the fatal dose of *methyl-blue*, hypodermically given, is three decigrammes per kilo in weight and that the symptoms produced are great prostration, loss of responding to external irritants, anuria, and chocolate discoloration of the blood. For a physiological study of *fuchsine* and of *pararosaniline*, see *Lyons Thesis*, 1892, L. Dupays.

According to J. Stilling, the aniline dyes are possessed of active germicidal properties, the most active of them being the methyl-blue or violet, to which he has given the name of *pyoktanin*, certain auramines being next in rank. In Stilling's experiments, two parts of methyl-violet per thousand indefinitely prevented flour paste, milk, butter, lard, etc., from turning sour or rancid; while the solution of the strength of one to four thousand was sufficient to prevent the development of bacteria of putrefaction; the staphylococcus pyogenes aureus was found to be very susceptible to the germicidal power of the methyl-violet. Penzoldt also found that contact for one month with a concentrated solution of methyl-violet, malachite-green, trimethyl-rosaniline, and phenyl-blue was sufficient to kill the anthrax bacilli. Sée and Morau found that one part to twenty-five hundred of safranin and cyanin would destroy the organisms of diphtheria and of pus. Janicke, experimenting with the pathognomonic organisms of pus, of anthrax, of cholera, of typhus, and of pneumonia, found the activity of pyoktanin even greater than asserted by Stilling, and noticed a very remarkable difference in the susceptibility of different species of bacteria, making the further important observation that those bacteria that were most readily stained by the methyl-violet were most readily influenced by it. On the other hand, Valude states (*Intern. Med. Congress*, 1890) that immersion for at least one hour in a 1 per cent. solution of pyoktanin was required to effect the same result on pathognomonic bacteria as was caused in ten minutes by 1 to 4000 corrosive sublimate. The practical value in surgery of pyoktanin has been asserted by Stilling, by Sée and Morau, by Patterson, and by numerous other surgeons, but the remedy has not come into general use. It has even been used with alleged success superficially and parenchymatously in *epithelioma* and *cancer*, but the majority of the reports are in these affections unfavorable. In *gonorrhœa*, the strength used has varied from 0.2 to 2 per cent.; in *ulcers*, *carbuncles*, and *cancers* it may be employed pure after free incision, or be parenchymatously injected. Stilling uses the following preparations, insisting at the same time on the great necessity of having the methyl-blue absolutely pure: 1. *Pure methyl-violet.*—To be used as powder for large wounds and ulcers. 2. *Large pencils.*—For small wounds, burns, etc. For purulent cases the blue pencil is better than the yellow, on account of its greater antiseptic property. 3. *Small pencils.*—For application to the eye, in cases of corneal ulcer, etc. 4. *Powders.*—Of 1 in 1000 strength for mild cases of conjunctivitis, and for more severe cases (blennorrhœa) of 2 per cent. strength. These can also be used as a snuff in affections of the nasal mucous membrane. 5. *Ointments.*—In strength varying from 2 to 10 per cent. 6. *Solutions.*—Used in strengths of 0.1 to 1 per cent. The 1 in 1000 solution is to be employed for ordinary cases of *conjunctivitis*, *keratitis*, etc. The solutions should be filtered and kept in dark glass bottles, and changed every eight days. E. Vonder Goltz has proposed to substitute for methyl-violet a 10 per cent. alcoholic solution of aniline-red to be diluted according to needs of surgeon. (*M. M.*, July, 1890.)

Aniline sulphate was employed as a nervine by Fraser and Davis many years ago (*M. T. G.*, Aug. 1865) with success, especially in the treatment of *chorea*, the dose being five grains (0.32 Gm.) three times a day, and the immediate results some headache and giddiness and staining of the mouth and nails. The practice was followed to some extent, but never gained the confidence of the profession.

Aniline Camphorate.—This is a compound which has been used by Tomaselli in *doses* of from eight to twelve grains (0.5–0.78 Gm.) a day as an antispasmodic. (*P. J.*, June, 1887.)

Anilipyrine.—Gilbert and Yvon have given this name to a substance obtained by the melting together of one part of acetanilide and two parts of antipyrine. Anilipyrine is stated by Gilbert and Yvon to be extremely soluble in water and to be toxically very feeble. The fatal dose for the guinea-pig is 1.8 Gm. per kilo. Anilipyrine has been used by its introducers as an antipyretic and analgesic in *migraine*, *neuralgia*, *rheumatism*, etc. The *dose* is eight grains (0.5 Gm.) from two to four times a day.

Animé. *Gum Animé.*—The substance known at present by the name of animé is a resin supposed to be derived from the *Hymenœa Courbaril*, L., a leguminous tree of South America, though this origin was denied by Hayne. According to W. Hamilton, the resin exudes from wounds in the bark, and is found also underneath the surface of the ground, between the principal roots. (*P. J.*, vi. 522.) It is in small irregular pieces, of a pale lemon-yellow color, sometimes inclining to reddish, more or less transparent, covered with a whitish powder, brittle and pulverizable, with a shining fracture, a weak but agreeable odor, and a mild, resinous taste. It softens in the mouth, adheres to the fingers when in powder, and readily melts with heat, diffusing its agreeable odor in an increased degree. It consists of two resins, one soluble, the other insoluble in cold alcohol, and of a small proportion of volatile oil. There is a variety of a darker color, less transparent, and with small cavities in the interior, in other respects resembling the preceding. Another variety is the East Indian, supposed to be derived from *Vateria indica*, L. (Fam. Dipterocarpaceæ), but this never reaches American commerce. According to W. C. Ondaatje, the bark of this plant is in daily use by the natives of Ceylon to arrest the alcoholic fermentation of the juice of the Jaggery palm, *Caryota urens*, L., a favorite beverage. (*P. J.*, 1883, 818.) Animé formerly entered into the composition of various ointments and plasters; but it is now used only as incense, or in the preparation of varnishes. The Brazilians employ it internally in *diseases of the lungs*.

Aniodol.—This commercial product is a clear fluid with a garlic-like odor, lost on dilution. It is said to be an aqueous 1 per cent. solution of *trioxymethylene* (*paraformaldehyde*) to which is added a little glycerin and an allyl derivative, which is not specified. Aniodol is stated to be an antiseptic which is especially valuable because the 1 per cent. solution may be employed to sterilize tuberculous sputa without interfering with the morphology or staining properties of the bacilli. For disinfecting instruments, 1 to 5000 solution; for the mucous membrane of the nose and mouth, 0.5 per cent. solution; for wounds 0.25 per cent., gradually intensified—are recommended by Sedan.

Anisodus. *Anisodus luridus*, Link and Otto. (*Scopola lurida*, Dun.)—This is a Himalayan solanaceous plant in which Siebert has found *atropine* and *hyoscyamine*. (*A. Pharm.*, Feb. 1890; *P. J.*, March, 1890.)

Annatto. *Orleana. Annotta. Arnotta. Terre de la Nouvelle-Orléans*, Fr. *Orellana, Orlean*, G.—The coloring substance called *annatto, arnatta*, or *roucou*, is the reddish pulp surrounding the seeds in the fruit of *Bixa Orellana*, L. (Fam. Bixaceæ), a middle-sized tree native to Northern South America, but widely cultivated in tropical Asia and Africa. The pulp is separated by bruising the fruit, mixing it with water, then straining through a sieve, and allowing the liquid to settle. The mass which remains is dried and formed into flat cakes or cylindrical rolls. Another mode is to bruise the seeds, mix them with water, and allow the mixture to ferment. The coloring matter is deposited during the fermentation, after which it is removed and dried. In commerce there are two kinds of annatto, the Spanish or Brazilian, and the French, the former coming in baskets from Brazil, the latter in casks from French Guiana. The French, which is also called *flag annatto*, has a disagreeable odor, probably from having been prepared by the fermenting process; but is superior, as a dye stuff, to the Spanish, which is without any disagreeable odor. Annatto is of a brownish-red color, usually rather soft, but hard and brittle when dry, of a dull fracture, of a sweetish peculiar odor, and a rough, saline, bitterish taste. It is inflammable, but does not melt with heat. It softens in water, to which it imparts a yellow color, but does not dissolve. Alcohol, ether, the oils, and alkaline solutions dissolve the greater part of it. The South American Indians are said to produce directly from the annatto seeds, without fermentation, a color similar to and almost as brilliant as carmine. (*P. J.*, April, 1903.) For a proximate analysis of the leaves, see *Ap. Ztg.*, 1899, p. 35. It contains a peculiar coloring principle, to which Preisser, its discoverer, gave the name of *bixin*. This has the formula $C_{28}H_{34}O_5$, and when pure is a dark red somewhat crystalline substance. It is accompanied by a yellow coloring matter, *orellin*, which has been but little studied. (Wynter Blyth, *Foods: Composition and Analysis*, 507, London, 1882.) The chief uses to which annatto is applied are for dyeing silk and cotton orange-yellow, and for coloring cheese and butter. The color, however, which it imparts to cloth is fugitive. It has been given internally as a medicine: but is not now used, and probably exercises little influence upon the system. In pharmacy it is employed to color plasters, and has occasionally been substituted for saffron. It is frequently adulterated with red ochre, powdered bricks, colcothar, farinaceous substances, chalk, calcium sulphate, turmeric, etc. The mineral substances, if present, will be left behind when the annatto is burned. (See, in reference to its adulteration, *P. J.*, xv. 199, 299, and 323; also xvi. 646.) *Tincture of annatto* is made by extracting 100 parts of annatto with 100 parts of water containing 1½ per cent. of potassium carbonate, and evaporating to 60 parts, mixing with 12 parts of alcohol and filtering.

Anona.—The seeds of *A. squamosa*, L., *Sugar Apple* or *Sweet Sop* of the West and East Indies, are said to be poisonous and to be used to kill lice, while the bark is a drastic cathartic. The seeds of *A. muricata*, L., *A. palustris*, L., and *A. spinescens*, Mart., are employed to poison fish and to exterminate destructive insects. (*Ph. Rev.*, Oct. 1896.)

Anthrakokali.—For an account of this preparation, which was introduced by Polya, see 16th ed. *U. S. D.*, p. 1711.

Anthrarobin. *Anthro-arobin.* $C_6H_4\begin{Bmatrix}C(OH)\\CH\end{Bmatrix}C_6H_2(OH)_2$.—This substance, which is produced from commercial alizarin by reduction, was first described by Liebermann (*Ber. d. Chem. Ges.*, 1888), and proposed as a substitute for chrysarobin. It is a yellowish-white granular powder, almost insoluble in water and acidulated solutions, sparingly soluble in chloroform and ether, and readily soluble in alcohol and weak alkaline solutions. It mixes readily with fats to form ointments. It is a powerful deoxidizing agent, which seems to be less toxic than chrysarobin, and probably equally effective in the treatment of *diseases of the skin*, it having been used by G. Behrend, E. B. Bronson, Köbner, and other clinicians, with asserted advantage in those diseases for which chrysarobin is employed. Behrend recommends the following. *Solution of anthrarobin:* anthrarobin, 10 parts; borax, 8 parts; water, 80 parts. *Glycerite of anthrarobin:* anthrarobin, 10 parts; glycerin, 80 parts. (*Th. M.*, 1888.) As a topical application, the ointment or the alcoholic solution (each 10 per cent.) may be used.

Anthriscus. *Anthriscus Cerefolium* (L.), Hoffm. *Chærophyllum sativum*, Lam. *Scandix Cerefolium*, L., *Chervil.*—An annual European plant of the Fam. Umbelliferæ, cultivated in gardens as a pot-herb, and naturalized in Eastern and Southern Pennsylvania. It has a strong agreeable odor, and a pungent, slightly bitterish taste. It contains a volatile oil of very feeble medicinal power, but it has been used as an emmenagogue and diuretic.

Antiarin.—A glucoside obtained from the upas tree, *Antiaris toxicaria* (see *Arrow Poisons*, p. 1397). It forms small needle-shaped crystals and is soluble in alcohol. Antiarin causes the frog's heart to be arrested in systole. Its toxicity towards the frog's heart is greater than any known member of the digitalis group, surpassing both strophanthin and digitoxin. It shows a marked antagonism upon the heart to hydrocyanic acid, the latter being able to re-establish rhythmic contractions in the heart arrested by antiarin. Antiarin also causes strong pulsations in the heart paralyzed by hydrocyanic acid. It is a muscle poison, causing first strong fibrillary contractions in the voluntary muscles, followed by a rapid and marked decrease in the irritability, with final loss. This paralysis is directly upon the muscle substance rather than upon the motor nerve endings. There is no similarity be-

tween the antiarin muscle curve and that of veratrine. Experiments with the crude drug had exactly the same results as the glucoside.

Antiarigenin, a destructive product of antiarin, shows a similar but distinctly greater action than the glucoside itself.

Antihydropin. *Pulvis Taracanæ.*—The powdered Russian cockroaches (*Blatta lapponica, Blatta orientalis*) are asserted, in the *dose* of from ten to fifteen grains (0.65–1.0 Gm.), to be actively diuretic and useful in *dropsy*. Bogomolow (*Ph. Cb.*, July, 1879) found in them a crystalline principle, *antihydropin*, or *taracanin*. L. Reuter (*A. Pharm.*, 1889, 868–873) affirms that the discredit into which cockroaches have fallen is due to the indifferent quality of the powdered insects in the market, and gives tests for their purity.

Antimony Arsenate.—This is a heavy snow-white powder, containing 56 per cent. antimonous oxide (or antimony trioxide) and 44 per cent. arsenic oxide (or pentoxide). It is stated that it is used in Russia as an alterative in *doses* of one-fiftieth of a grain (0.0013 Gm.) four times a day. (*A. J. P.*, xliv. 301.)

Antimony Crocus. *Crocus of Antimony. Saffron of Antimony.*—This compound is formed during the deflagration of a mixture of equal weights of antimony trisulphide and potassium nitrate, to which one-twelfth of hydrochloric acid has been added. Fused crocus of antimony is in masses of a liver-brown color; the unfused is a saffron-brown insoluble powder, containing about four-fifths of trioxide, and one-fifth of trisulphide. It was formerly used in making tartar emetic.

Antimony, Diaphoretic. *Antimonium Diaphoreticum. Potassii Biantimonias. Antimoine diaphorétique lavé*, Fr.—This compound is directed, in the French Codex, to be formed by deflagrating in a red hot crucible, and keeping red hot for half an hour, a mixture of pure antimony with twice its weight of potassium nitrate, both being in fine powder. The product, washed with water and dried, is *washed diaphoretic antimony*. For improved process, see 14th edition of U. S. D., p. 1640. *Dose*, from two to three drachms (7.7–11.6 Gm.). This form of antimony is weak, variable, and rarely used.

Antimony Glass. *Vitrum Antimonii.*—This is prepared from antimony trisulphide by a partial roasting and subsequent fusion. Glass of antimony is in thin irregular pieces, which have a vitreous fracture, and a metallic steel-gray lustre. When well prepared, it is transparent, and, upon being held between the eye and the light, appears of a rich orange-red or garnet color; but if of inferior quality it is black and opaque. It is hard and brittle, and rings when struck with a hard substance. It is insoluble in water, but it is readily rendered soluble by acids and strong solution of potassium bitartrate, with the exception of a few red flocculi. Its essential constituents are the trioxide and trisulphide, united in variable proportions. Sometimes *glass of lead* is sold for glass of antimony, a fraud readily detected by the difference between the two substances in specific gravity, glass of lead having a density of nearly seven, while that of glass of antimony is not quite five. Glass of antimony is an active antimonial; but, owing to its variable composition and unequal operation, it is very seldom used.

When the levigated powder is mixed with one-eighth of its weight of melted yellow wax, and the mixture roasted over a slow fire, with constant stirring, until it ceases to exhale vapors, a coal-like pulverizable mass is formed, the *cerated glass of antimony* of the old Edinburgh Pharmacopœia.

Antimony Iodide. SbI_3. *Antimonii Iodidum. Antimony Triiodide or Teriodide.*—According to W. Copney of London, this iodide may be conveniently prepared by gently heating, in a Florence flask, metallic antimony and iodine, in the proportion of one atom to three. The elements combine with sudden heat and liquefaction, and, upon the withdrawal of the heat, the iodide formed solidifies, and is removed by breaking the flask. Antimony iodide, as thus prepared, forms a somewhat crystalline, foliated mass, which, when pulverized, yields a deep orange-red powder. By the action of water it is decomposed. It has been tried as an alterative in *doses* varying from one-fourth of a grain to a grain (0.016–0.065 Gm.), given in pill.

Antimony Sulphide. *Antimonium Nigrum*, Br. 1864; *Black Antimony.* (*Prepared Sulphuret of Antimony*, Br.) *Stibium Sulfuratum Crudum et Lævigatum, Antimonium Crudum, Sulfuretum Stibicum; Artificial Sulphuret of Antimony; Sulfure d'Antimoine du commerce*, Fr. Cod.; *Antimoine sulfuré, Antimoine cru*, Fr.; *Stibium sulfuratum nigrum*, P. G.; *Schwefelantimon, Schwefelspiessglanz*, G.; *Antimonio crudo*, Sp.; *Antimonii Sulphidum*, U. S. 1890. *Antimony Trisulphide.* Sb_2S_3; 334.09.—"Native antimony sulphide, purified by fusion and as nearly free from arsenic as possible." *U. S.* 1890.

Preparation.—The antimony sulphide which is found in commerce is obtained from the native sulphide, called *antimony ore*, by different processes of purification, the following being an outline of that generally pursued. The ore is placed in melting pots in a circular reverberatory furnace, and these are made to connect, by means of curved earthen tubes, with the receiving pots, situated outside the furnace. This arrangement affords facilities for removing the residue of the operation, and allows of the collection of the melted sulphide without disturbing the fire, and, consequently, without loss of time or fuel. In the U. S. Pharmacopœia 1890, it was directed to be melted in order to purify it from infusible substances; in the British, to be reduced to fine powder, to fit it for pharmaceutical use. In order to bring it to this state, it should be submitted to the process of levigation. (See *Antimonium Nigrum Purificatum*, p. 153.) Much of the "Black Antimony" of commerce has been shown by Warder to contain no antimony whatever, but to be simply powdered coal and marble, and such can be easily distinguished by a rough test, as follows: Fill a dry, tared one-ounce bottle with the powder; after shaking it down it will be found that it will hold two and a quarter ounces of powdered black antimony, but only one and a quarter ounces of powdered coal. (*Proc. A. Ph. A.*, 1885, 479; see also S. W. McKeown's paper, *Proc. Ohio State Pharm. Assoc.*, 1885.)

Properties.—Antimony sulphide is mostly prepared in France and Germany. It is called, in commerce, antimony, or *crude antimony*, and occurs in fused conical masses, denominated loaves. "Steel-gray masses of a metallic lustre and a striated crystalline fracture, forming a black or grayish-black, lustreless powder, without odor or taste, and permanent in the air. Insoluble in water or alcohol, but soluble in hydrochloric acid with the evolution of hydrogen sulphide. At

a temperature below a red heat, the Sulphide fuses to a dark brown liquid. If 1 Gm. of the powdered Sulphide be digested and finally boiled with 10 Cc. of hydrochloric acid, it should dissolve without leaving more than 1 per cent. of residue. This acid solution, completely deprived of hydrogen sulphide by boiling, yields, when added to water, a white precipitate, which is soluble in a solution of tartaric acid. After the separation of the precipitate by filtration, the filtrate yields an orange-red precipitate with hydrogen sulphide test-solution." *U. S.* 1890. The quality of the sulphide cannot well be judged of, except in mass; hence it ought never to be bought in powder. Arsenic, which is often present in considerable quantities, may be detected by the usual tests for that metal. (See *Arseni Trioxidum*, page 197.)

The official antimony sulphide is a trisulphide consisting of two atoms of antimony and three of sulphur. When prepared by pulverization and levigation, it is in the form of an insoluble powder, without taste or odor, usually of a dull blackish color, but reddish brown when perfectly pure. By exposure to the air, it absorbs, according to Buchner, a portion of oxygen, and becomes partially converted into trioxide.

Uses.—This preparation is very uncertain in its operation, and ought not to be used in practical medicine. It has, however, been employed as a diaphoretic and alterative in *scrofula, glandular obstructions, cutaneous diseases*, and *chronic rheumatism*. It is used in the United States solely in veterinary practice. The *dose* is from ten to thirty grains (0.65–2.0 Gm.), to be given in powder or bolus.

Antimony Trichloride. *Butter of Antimony.* $SbCl_3$.—Prepared by subliming antimony sulphide with mercuric chloride, by the action of dry chlorine on the sulphide or metal, or by dissolving the sulphide in hydrochloric acid and concentrating the solution of the chloride, which is usually colored by contamination with iron, but by distilling the product the pure chloride will finally pass over, the distillate solidifying in a mass of fine white crystals. It forms a deliquescent, soft mass, known as butter of antimony which melts at 72° C. and boils at 223° C. It is very hygroscopic and corrosive. The addition of water produces the oxychloride known, when dry, as *powder of Algaroth*. A solution was recognized in the Br. Ph. 1885, and is used in medicine as a caustic. It is extensively used to give a bronze surface to iron and steel ware.

Antinonnin.—According to Harz and von Miller, this yellowish pasty compound is *potassium ortho-di-nitro-cresolate*. It is said to be actively germicidal, odorless, and poisonous. On account of its being very effective, non-volatile, and inexpensive, it has been highly recommended for spraying plants, etc., when attacked with mildew or other vegetable parasites: 1 to 2000 in soap solution may be used. It stains bright yellow.

Antipyrine Benzoate.—*Benzopyrine*, $C_{11}H_{12}N_2O.HC_6H_5O_2$, made by adding antipyrine to a boiling solution of benzoic acid. It is in the form of a yellow liquid, practically insoluble in hot and cold water but soluble in alcohol and ether.

Antipyrine Tannate.—This is described as a yellow powder, insoluble in water, soluble in alcohol, and containing 37 per cent. of antipyrine. It is stated that it may be made by adding concentrated aqueous solutions of its constituents in the proportion of fifty parts of antipyrine to twenty-eight and a half parts of tannic acid. It has been specially recommended on account of its tastelessness, but is probably not an eligible preparation.

Antisepsin. *Asepsin. Monobromacetanilide. Parabromacetanilide.* $C_6H_4Br.NH(C_2H_3O)$.—This substance has been used by Cattani as an antipyretic and analgesic (*G. M. P.*, 1890), but as such seems to be dangerous. Cattani affirms it to be a valuable antiseptic. *Dose*, from six to seven grains (0.40–0.45 Gm.). Another compound, called antisepsin (or *antiseptin*), has been exploited as *iodo-boro-thymolate of zinc*, which, according to Squibb, is a mixture of zinc sulphate, boric acid, zinc iodide, and thymol. (*Ph. Post*, 1893, 106.)

Antiseptol.—Under this name Yvon has recommended *cinchonine iodosulphate* as a substitute for iodoform. It contains 50 per cent. of iodine. Yvon prepares it as follows. Twenty-five grammes of the cinchonine sulphate are dissolved in two thousand grammes of water; to this solution is added sufficient of a solution of iodine to cause a precipitate, avoiding an excess; this solution is made by dissolving ten grammes each of iodine and potassium iodide in one thousand grammes of water. The precipitate is placed on a filter and well washed with water until the washings are free from iodine, and it is then air-dried. (*Nouv. Rem.*, July, 1890.)

Antispasmin. $C_{23}H_{26}NO_8Na + 3C_6H_4(OH)COONa$.—In this compound 1 molecule of *narceine-sodium* is considered to have united with 3 molecules of sodium salicylate. This white, slightly hygroscopic powder contains about 50 per cent. of narceine, and is said to have the advantage over the other narceine preparations of readily forming with water a somewhat permanent solution. According to Demme, it is a valuable hypnotic and analgesic, especially advantageous in painful *cramps*. It has also been recommended for *whooping cough*. *Dose*, from one-half to one grain (0.032–0.065 Gm.).

Antithermin. *Phenylhydrazin-lævulinic acid.* $C_6H_5.N_2H=C(CH_3).C_3H_6O_2$.—This substance, which is obtained by the action of phenylhydrazin upon *acetopropionic acid*, occurs in colorless crystals, insoluble in cold water, soluble in ether and hot alcohol, melting point 108° C. (226° F.). It was first proposed in 1887 by Nicot as an antipyretic, and it has been especially experimented upon by Drobner (*W. M. P.*, 1892, 540), who finds it very active in *doses* of from eight to ten grains (0.5–0.65 Gm.). It produces, however, pallor, cephalic distress, excessive sweating, and other evidences of vasomotor depression, which require great caution in its use, and not more than three grains (0.2 Gm.) should be given.

Antitussin.—*Di-fluor-di-phenyl*, $(C_6H_4F)_2$, occurs as colorless crystals melting at 87° C. (189° F.). It forms the active ingredient of antitussin, which has been strongly recommended by Max Heim (*B. K. W.*, Dec. 1899) in the treatment of *whooping cough*. It is used as an ointment consisting of five parts of di-fluor-di-phenyl, ten parts of vaselin and eighty-five parts of lanolin. For a child a year old, about one-half drachm (2 Gm.) is slowly rubbed into the skin daily on the back, chest, and abdomen, about a drachm (3.9 Gm.) being used for a child five years old.

Anusol.—A proprietary suppository, alleged to contain a bismuth compound of *iodo-resorcin-sulphonic acid*, has been recommended for the treatment of *hemorrhoids*. Zinc oxide, resorcinol, bismuth oxyiodide, balsam of Peru, and cacao butter are the ingredients. (*West. Drug.*, 1898, 75.)

Anytoles.—These are proprietary preparations in which substances like phenol, cresol, volatile oils, camphors, etc., are dissolved in water by means of *anytin*, a substance formed by the action of sulphuric acid on various mineral oils, resin oils, and hydrocarbons. The ammonia salt of the hydrocarbons, containing 10 per cent. of chemically combined sulphur, has been found the most useful solvent. The following are some of the anytoles which have been prepared: *Phenol-anytole, cresol-anytole, meta-cresol-anytole, creosote-anytole, guaiacol-anytole, benzene-anytole, eucalyptol-anytole, peppermint-anytole, wintergreen anytole, turpentine-anytole, camphor-anytole*, and *iodine-anytole*—all containing a good proportion of the active ingredient. It has been claimed for these anytoles that they are superior in bactericidal power to the disinfecting substances they contain. Wilhelm Koelzer has strongly commended meta-cresol-anytole in the treatment of *erysipelas*.

Apium. *Apium graveolens*, L. (Fam. Umbelliferæ.) *March, Céleri*, Fr. *Sellerie, Eppich*, G. The ordinary *celery* of the gardens is believed by some persons to possess antispasmodic properties, and has been used as a nerve stimulant. It contains *apiol*, although in much less quantity than does parsley.

Apium nodiflorum (L.), B. & H. (*Sium nodiflorum*, L.) *Water parsnip.*—This is a perennial umbelliferous aquatic European plant, growing also in the southern section of the United States. It is commonly considered poisonous; but the fresh juice has been used by Withering and others, in the *dose* of three or four ounces every morning, for scrofulous *lymphadenitis* and obstinate *skin diseases*.

Apium petroselinum, L. *Petroselinum, U. S.* 1870. *Ache, Persil*, Fr. *Petersilie*, G. *Prezzemolo*, It. *Petroselinum sativum*, Hoffman, *Umb.*, i. t. 1, f. 2.—*Parsley* is an umbelliferous plant having a biennial root, with an annual, round, furrowed, jointed, erect, branching stem, about two feet in height. *Parsley root* is spindle-shaped, about as thick as the finger, externally white, and marked with close annular wrinkles, internally fleshy and white, with a yellowish central portion. It has a pleasant odor and a sweetish, slightly aromatic taste, but loses these properties by long boiling and by time.

The plant is a native of Sardinia and other parts of Southern Europe, is naturalized in salt marshes on the coast of California, and is cultivated everywhere in gardens. All parts of it contain a volatile oil, to which it owes its odor and mainly its taste, as well as its use in seasoning. This oil consists of a hydrocarbon, $C_{10}H_{16}$, and apiol, $C_{12}H_{14}O_4$, crystallizing in white silky needles, which fuse at 30° C. (86° F.), and boil at about 300° C. (572° F.), subliming with partial decomposition. Braconnot obtained from the herb a peculiar substance, resembling pectic acid in appearance, which he named *apiin*. It is procured by boiling the herb in water, straining the liquor, and allowing it to cool. The apiin then forms a gelatinous mass, which requires only to be washed with cold water. Von Gerichten (*Ber. d. Chem. Ges.*, 1876, 1121) found that by repeated dissolving of this gelatinous mass in alcohol and precipitation by water it could be purified and then obtained from concentrated alcoholic solution in silky needles of the formula $C_{27}H_{32}O_{16}$. Joret and Homolle found the seeds to contain a volatile oil, a crystallizable fatty matter, pectin, what they believe to be the apiin of Braconnot, chlorophyll, tannin, a coloring matter, extractive, lignin, various salts, and, in addition to these, a peculiar substance to which they gave the name of *apiol*. This is a yellowish oily liquid, not volatile, heavier than water, of a peculiar and tenacious odor distinct from that of the plant, and an acrid pungent taste. It is inflammable, insoluble in water hot or cold, very soluble in alcohol, and dissolved in all proportions by ether and chloroform. It is analogous to the fixed oils, but is not chemically modified by the alkalies. It contains no nitrogen.

According to L. Wolff (*A. J. P.*, 1877, 2), commercial apiol is merely the oleoresin; he proposes a very simple process for true apiol. Powdered parsley seed is exhausted with petroleum benzin, and the liquid is spontaneously evaporated; the residue is a mixture of fixed oil, wax, and apiol; the apiol alone being soluble in alcohol can easily be separated by repeated washings with strong alcohol; the washings evaporated over a water bath at a gentle heat leave as a residue "true apiol." L. Ough (*C. D.*, 1894, 17) obtains apiol by percolating freshly powdered parsley seeds with alcohol, recovering the alcohol from the percolate by distillation, and separating the oily residue from the deposited waxy solid.

Ciamician and Silber (*Ph. Post*, 1888, 391) have investigated apiol, and state that the pure substance occurs in white crystals having the composition $C_{12}H_{14}O_4$, melting at 30° C. (86° F.), and boiling at 294° C. (561° F.). *Isapiol, apiolic acid, apiolaldehyde*, and *apion* are decomposition products. They state that isapiol has physiological properties resembling those of pure apiol.

H. C. Whitney (*N. R.*, January, 1880) proposed to change the name of commercial apiol, and call it *oil of parsley seed*. He believed that the volatile oil of parsley seed is the active and emmenagogue principle, and obtained it by distilling the freshly powdered seed with salt water. The yield is 4.27 per cent. of an oil which corresponded closely with Joret and Homolle's apiol. Von Gerichten (*Ber. d. Chem. Ges.*, 16, 17) obtained besides the peculiar terpene, *parsley camphor*, which he thinks is alone entitled to the name of apiol. He gives its melting point as 30° C. (86° F.), boiling point 300° C. (572° F.), and sp. gr. 1.015.

Parsley root in the recent state is said to be aperient and diuretic, and is occasionally used in *nephritic* and *dropsical affections*. The *juice* of the fresh herb and the *seeds* have been employed in *intermittents*. According to Joret and Homolle, *apiol* produces, in the *dose* of about fifteen grains (1 Gm.), a slight cerebral excitation without unpleasant effects of any kind, and, in double or quadruple the quantity, a species of intoxication, with giddiness, morbid sights and sounds, and frontal headache. They found it to cure *intermittents*, but subsequent observations have shown that it has very little antiperiodic power. Joret and Baillot commend it in *amenorrhœa* and *dysmenorrhœa*, in the *dose* of about four grains (0.26 Gm.) morning and evening; in the former affection in anticipation of the menstrual period, in the latter during its continuance. Experience has confirmed its value as an emmenagogue, but it is best used in a single *dose* of fifteen grains (1 Gm.), given in capsules, at the time of the molimen. *Isapiol* is said to produce headache and temporary intoxication, and to have no practical advantages over apiol.

Aplopappus. *Aplopappus Baylahuen* (*Haplopappus Baylahuen*, Remy). *Hysterionica Baylahuen.*—This composite herb is a native of Chili, where it is said to be relied upon as a stimulant in *flatulent dyspepsia* and *chronic inflammation* with *hemorrhage* of the lower bowels. It has been analyzed by H. H. Rusby (*A. J. P.*, 1890, 488), and later by H. Kahn (*A. J. P.*, 1891, 377). The former found a volatile oil, a fatty oil which had the specific odor of the plant, a brown acid resin of sharp taste, and tannin. The latter determined the percentage of volatile oil as 6.65, and of resin as 21.15. He also considers that this resin is a mixture of four different resins. G. Baille asserts (*B. G. T.*, Feb. 1889) that the remedy is valuable not only in *dysentery*, but in genito-urinary catarrhs, and also as a stimulating expectorant. One-half to one tablespoonful (7.5–15 Cc.) of a strong decoction, one part to five, may be given every two hours; or the fluidextract, *dose*, from five to twenty minims (0.3–1.3 Cc.).

Apocodeine Hydrochloride.—Apocodeine has been investigated physiologically by W. E. Dixon (*B. M. J.*, 1902) who found that it lowered blood pressure by dilating the blood vessels and increased the intestinal peristalsis. Foy and Combemale have both employed it hypodermically as a laxative with pleasing results. Thirty minims (1.8 Cc.) of a 1 per cent. solution may be injected deeply into the muscles.

Apolysin. *Monophenetidin Citrate.* $C_3H_4OH(COOH)_2CO.NH.C_6H_4OC_2H_5$.—A compound of citric acid and paraphenetidin. It is a crystalline, yellowish-white powder of peculiar odor and taste, less acid than citric acid. Its melting point is 72° C. (161.6° F.). It is soluble in cold water (1 in 25), alcohol, and glycerin, and in concentrated sulphuric acid without change of color. The solution in nitric acid turns a pale orange color. The aqueous solution is not clouded by silver nitrate, nor the acid solution by hydrogen sulphide. R. Seifert (*D. M. W.*, xxi. 1895) asserts that in *doses* of from eight to twenty-four grains (0.5–1.6 Gm.), three or four times a day, it is a valuable remedy as an antipyretic in various febrile diseases, and possessed of great power as an analgesic, similar in range of usefulness to acetphenetidin, but free from poisonous properties or disagreeable after effects.

Aquilegia. *Aquilegia vulgaris*, L. *Columbine.* A perennial herbaceous plant of the Fam. Ranunculaceæ, indigenous to Europe, but cultivated in our gardens. All parts of it have been medicinally employed. The root, leaves, and flowers have a disagreeable odor, and a bitterish acrid taste. From the small black shining seeds A. T. De Rochebrune (*Toxicol. Africaine*, i. 1897) has separated an alkaloid, *aquilegine*, in the form of long, prismatic, slightly iridescent crystals. The same investigator found that the extract of the plant produces in the lower animals symptoms very similar to those caused by aconite. At one time considered diuretic and diaphoretic, columbine is not at present used in practical medicine.

Aralia. *Aralia nudicaulis*, L. *False Sarsaparilla. Wild Sarsaparilla. Shotbush. Small Spikenard. Wild Licorice. Racine d'aralie nue, Petitnard*, Fr. *Nackte Aralienwurzel*, G.—This plant is an indigenous perennial, belonging to the Fam. Araliaceæ. It grows from Canada to the Carolinas, inhabiting shady and rocky woods, and delighting in a rich soil. The root is horizontal, creeping, sometimes several feet in length, about as thick as the little finger, more or less twisted, of a yellowish-brown color externally, of a fragrant odor, and a warm, aromatic, sweetish taste. Alpers and Murray (*Proc. A. Ph. A.*, 1897, 182) found in it 3.05 per cent. of resin, 0.33 per cent. of oil, tannin, an acid, albumen, mucilage, and cellulose.

W. C. Alpers (*A. J. P.*, Aug. 1899) states that the sesquiterpene of *Aralia nudicaulis* is distinct from isomeric compounds and proposes the name of *araleine* for it. He states that the volatile oil consists principally of this sesquiterpene, $C_{15}H_{24}$, and an alcohol, $C_{15}H_{25}.OH$ with a small quantity of azulene. The sesquiterpene has a specific gravity of 0.9086 at 20° C. (68° F.), boiling point, 270° C. (518° F.); [a]D equals —7 to —8; N[D] equals 1.49936. It forms oily compounds with HCl and Br, and derivatives with nitrous acid. Treated with hydrochloric-acetic acid it forms a compound of a permanent blue color. Chloroform and sulphuric acid produce a purple-red color; acetic acid and sulphuric acid a wine-red color. *Aralia racemosa*, L. (*American spikenard*), is distinguished by its herbaceous widely branched stem, which is furnished with leaves whose leaflets are heart-ovate, pointed, doubly serrate, slightly downy, and also by its blackish or dark purple fruit being in very numerous umbels, and so clustered as to make a large compound panicle. Its rhizome is short, two or more inches thick, furnished with closely placed, large, nodose stem-scars, and numerous roots from one to two feet long, which are much branched below. In odor and taste it resembles *A. nudicaulis*, but is more spicy. *Aralia hispida*, Vent. (*Bristly Sarsaparilla, Dwarf Elder*), closely resembles *A. nudicaulis*, but is distinguished by its larger stem, which is also bristly and leafy. Its root has been used as a diuretic in *dropsy*. (*A. J. M. S.*, xix. 117.) For microscopic description with illustrations of the root of *A. nudicaulis*, by E. S. Bastin, see *West. Drug.*, 1885, 314; also Burt E. Nelson in *M. R.*, 1899, p. 441.

The roots of *Aralia racemosa* and *A. nudicaulis* have been used especially in domestic practice for their gently stimulant diaphoretic and alterative action, chiefly in *rheumatic, syphilitic*, and *cutaneous affections*, in the same manner and dose as genuine sarsaparilla. W. R. Monroe (*A. J. P.*, Oct. 1898) found in the rhizome of the *Aralia californica*, S. Wats., a small amount of a pale yellow, very aromatic, volatile oil, but failed to detect saponin.

Aralia spinosa, L. *Angelica-tree. Hercules club. Toothache-tree. Prickly Elder. Prickly Ash.*—The name "*prickly ash*" should be dropped, as it belongs properly to a species of *Xanthoxylum*. Angelica tree is an arborescent shrub which grows in Southeastern North America. The bark, root, and berries are medicinal.

The bark (*Ecorce d'aralie épineuse*, Fr.; *Dornige Aralienrinde*, G.), as in the shops, is usually in small quills or half quills, from two or three lines to half an inch in diameter, thin, fibrous, grayish externally, and armed with prickles or the remains of them, yellowish within, of an odor somewhat aromatic, and a bitterish taste, which becomes slightly acrid on chewing, and leaves a lasting sense of pungency upon the tongue. It yields its virtues to boiling water. C. W. Elkins found in the bark starch, glucose, gum, pectin, two acrid resins, volatile oil in small quantity, and what he believed to be an uncrystallizable alkaloid. (*A. J. P.*, Aug. 1880.) L. H. Holden (*A. J. P.*, 1880, 390) found along with tannin and other ingredients a glucoside, *araliin*. J. K.

Lilly (*A. J. P.*, 1882, 433) obtained the glucoside by adding ether to the alcoholic extract. The glucoside is thrown out, then dissolved in water, precipitated first with neutral lead acetate and then the filtrate with basic acetate. This precipitate decomposed with hydrogen sulphide yields the glucoside, which is recrystallized out of alcohol. Decomposed by boiling with diluted hydrochloric acid, it yields sugar and *araliretin*. The virtues of *Aralia spinosa* are those of a stimulant diaphoretic. According to Elliot, an infusion of the recent bark of the root is emetic and cathartic. The remedy is used in *chronic rheumatism* and *cutaneous eruptions*, and in some parts of the South has been employed in *syphilis*. Pursh states that a vinous or spirituous infusion of the berries is remarkable for relieving rheumatic pains, and a similar tincture is said to be employed in Virginia with advantage in violent *colic* The pungency of this tincture has also been found useful in relieving *toothache*. The bark is best administered in decoction.

Archidendron. *Archidendron Vaillantii.*—The bark and black beans of this leguminous plant of New South Wales are said to be an active paralyzant to the motor side of the spinal cord. (Bancroft, *Proc. Roy. Soc. N. S. W.*, 1886.)

Areca Nut. *Semen Arecæ. Betel Nut. Noix d'Arec*, Fr. *Arekanüsse, Betelnüsse*, G.—The *Areca Catechu*, L., is an East India palm. The fruit, which is about the size and shape of a small egg, and of an orange-yellow color, contains the nut embedded in a fibrous, fleshy envelope, and invested with a brittle shell which adheres to the exterior flesh. The kernel, the betel nut of commerce, is of a roundish-conical shape, rather larger than a chestnut, externally of a deep brown, diversified with a fawn color, so as to present a reticular appearance, internally brownish red with whitish veins, very hard, of a feeble odor when broken, and of an astringent, somewhat acrid taste. It abounds in tannin, and contains also gallic acid, a fixed oil, gum, a little volatile oil, lignin, and various saline substances. Flückiger found that the tannic acid gives a green color turning to brown with ferric salts. (*Pharmacographia*, 671.) It yields its astringency to water, and in some parts of Hindostan an extract is prepared from it having the appearance and properties of catechu. A red coloring matter known as *Areca red* is extracted, probably resulting from the decomposition of a tannin. It is insoluble in cold water and ether, soluble in boiling water and alkaline liquids, out of which it is precipitated by acids. E. Jahns (*Ber. d. Chem. Ges.*, 1888, 3404) has found three alkaloids in areca nut: 1. *Arecoline*, $C_8H_{13}NO_2$, identical with the *arekane* of Bombalon. 2. *Arecaine*, $C_7H_{11}NO_2 + H_2O$, which occurs in permanent, colorless crystals, soluble in water, insoluble in absolute alcohol, ether, chloroform, and benzene. 3. An alkaloid which exists in such small quantities that sufficient was not obtainable for close examination. On heating arecoline with strong hydrochloric acid to 150° C. (302° F.) it is decomposed into methyl chloride, CH_3Cl, and *arecaidine*, $C_7H_{11}NO_2$. This latter base forms colorless plates, stable in the air, fusing at from 223° to 224° C. (433.4°–435.2° F.), easily soluble in water, difficultly soluble in strong alcohol, and insoluble in ether and chloroform. Arecaidine has been shown to be *methyltetrahydronicotinic acid*, and has been made synthetically from nicotinic acid. The third alkaloid of Jahns is probably *guvacine*, $C_6H_9NO_2$, of which the methyl derivative is the base arecaidine before mentioned. Immense quantities of areca nut are consumed in the East, mixed with the leaves of the Betel pepper (*Piper Betle*, L., *Chavica Betle* (L.), Miq.) and with lime, forming the masticatory so well known by the name of *Betel*. The red color which this mixture imparts to the saliva and the excrements is owing to the areca nut, which is also powerfully astringent, and, by its internal use, tends to counteract the relaxation of bowels to which the heat of the climate so strongly predisposes. (See *N. R.*, 1876, 71.) Marmé affirms that arecoline resembles muscarine in its action upon the heart, and is a respiratory depressant. According to Jahns (*B. G. T.*, 1889), *arecaine* is the active principle of the areca nut, and a powerful *tænicide*, resembling in its action pelletierine. It is an active poison, half a grain (0.032 Gm.) sufficing to kill a rabbit in a few moments. Its general action seems to be like that of muscarine, but it influences the respiration as well as the heart, causes tetanic convulsions, and has an extraordinary influence in increasing intestinal peristalsis. Locally applied, or when given internally, it contracts the pupils. (*Ph. Ztg.*, Feb. 1889.) *Arecaine* is said to resemble in its physiological action methyl-nicotinic acid.

Arecoline hydrobromide, a commercial salt, according to the experiments of Fröhner, is more powerful as a stimulant to the salivary glands than pilocarpine, and more active as a laxative than eserine. It is especially commended by veterinarians in the *colic* of horses, given subcutaneously in the dose of from five to ten grains (0.32–0.65 Gm.). In human medicine it has been used in the dose of from one-fifteenth to one-tenth grain (0.004–0.006 Gm.) against the *tape worm* and as a myotic. As pointed out by Lavagna in 1895, arecoline is a very active myotic, and the hydrobromide has been considerably used. A one-half to one per cent. solution produces a violent myosis, which reaches its maximum in about ten minutes and begins to subside in half an hour. It is affirmed that the action of arecoline in intensity is superior to that of pilocarpine and inferior to that of eserine. It is especially claimed by various ophthalmologists that though in *glaucoma* its action is very transient, it produces a more considerable reduction of the intraocular pressure than can be obtained either with pilocarpine or eserine. It may cause considerable irritation but does not injure the continuity of the epithelium.

In India the areca nut has long been used as a vermifuge, the dose being a teaspoonful of the freshly grated nut, and its value against the *tape worm* has been confirmed by various European and American practitioners. The usual dose is from one to two drachms (3.9–7.7 Gm.). In this country the nut has also been used for the making of a hard charcoal, employed as a basis of tooth-powder.

Argemone. *Argemone mexicana*, L. *Prickly Poppy. Argémone*, Fr. *Stachelmohn*, G.—An annual plant, belonging to the Papaveraceæ, growing in our Southern and Western States, Mexico, the West Indies, Brazil and in many parts of Africa and Southern Asia. The whole plant abounds in a milky, acrid juice, which becomes yellow on exposure, and has been used as a local application in obstinate *cutaneous diseases*, especially that affection known in Upper India as *dhad*, and also in cases of *warts* and even *chancres*. The small,

round, black, and roughish seeds are emetic in two drachms (7.7 Gm.), or in smaller dose purgative. They contain a light yellow, transparent, fixed, drying oil which, according to Charbonnier, retains its fluidity at 5° C. (41° F.), and is entirely soluble in five to six measures of alcohol at 32.2° C. (90° F.). Flückiger assigns to the oil a sp. gr. of 0.919, and finds that it is not soluble in six parts of alcohol. According to Charbonnier it is gently cathartic in *doses* of from fifteen to twenty-five drops (0.75–1.25 Cc.); in larger *doses* emetic. (*J. P. C.*, May, 1868.) The alleged presence of morphine in *Argemone mexicana* has been disproven by J. O. Schlotterbeck (*Proc. A. Ph. A.*, 1901, p. 247), who finds that the plant contains *berberine*, besides an alkaloid, *protopine* (*argemonine* of Peckoldt). The seeds of the plant have been used in *colic*, 8 grains (0.5 Gm.), given in emulsion, and repeated if necessary every half hour until three doses have been taken. (*P. J.*, xiii. 642.)

Argentamin.—Argentamin is a solution of silver phosphate in ethylene diamine. It is a clear, strongly alkaline liquid, sp. gr. 0.97, which does not precipitate albumin. It is said to contain 10 per cent. of the silver salt. Its use in medicine was proposed in 1894 by Jean Schaeffer (*Zeitsch. f. Hyg. u. Infektions*, 1894, xvi. Bd. ii.). Hoor used it in a large number of eye cases; he asserts that it causes less pain and irritation than the silver nitrate, and penetrates deeper. He used a 5 per cent. solution in the eye from one to four times a day in the same cases as those in which silver nitrate is useful. According to Aschner (*Orv. hetil.*, 1895), it is well borne by the posterior urethra in a strong solution, as 1 to 250; but the anterior urethra will not bear more than 1 to 2000.

Argonin. *Argentum Casein.*—This is a white powder, of neutral reaction, prepared by mixing a solution of a sodium compound of casein with silver nitrate and precipitating with alcohol. It is readily soluble in warm or albuminous water, with difficulty in cold water. A 10 per cent. solution in warm water is said to be permanent in the dark. (A. Leibrecht, *Th. M.*, vii. 1895.) Fifteen grains (1 Gm.) of this substance contain as much silver as does one grain (0.065 Gm.) of the silver nitrate. It makes a neutral solution in water, and has been very highly recommended by both German and American clinicians in the treatment of acute and chronic cases of *gonorrhœa*. Its 10 per cent. solution causes no pain in acute gonorrhœa. According, however, to the elaborate study of H. M. Christian, it is not of much service in the treatment of *posterior urethritis*. One hundred and sixty minims (10 Cc.) of a 2½ to 3 per cent. solution may in the acute stages of the disease be injected into the urethra and allowed to remain there for five minutes. A solution—0.3 ammonia water, 0.6 argonin, 100 of water—is said by R. Mayer to be much more powerful than argonin itself.

Argyrol.—A proteid salt of silver, *silver vitellin*, in the form of black, hygroscopic scales representing about 30 per cent. of metallic silver. The aqueous solution, it being soluble in all proportions in water, is not readily decomposed and will not precipitate chlorides or coagulate albumin. Alkalies do not precipitate it from solution, but it is precipitated by zinc sulphate, lead acetate, fluid hydrastis and acids. It is used locally, in solutions as strong as 50 per cent., without irritation.

Arheol.—Arheol is an alcohol of the formula $C_{15}H_{26}O$, obtained from oil of sandal wood and constituting from 60 to 90 per cent. of the latter. It is an oily liquid, and is marketed in three grain (0.2 Gm.) capsules, six to twelve of which are given per day. It is affirmed to have the same remedial action as oil of sandal wood, but to be free from the tendency to cause gastric disturbance. *Dose*, 5 to 10 minims (0.3–0.6 Cc.).

Aristochin. *Aristoquin. Aristoquinine. Diquinine carbonic ether.* $(C_{20}H_{23}N_2O)_2CO_3$.—A white or pinkish-white amorphous powder, soluble in alcohol, ether, chloroform, glycerin, and dilute acids, but insoluble in water. It is said to contain 96 per cent. of quinine, and probably is an effective antiperiodic, but has been chiefly used in *whooping cough*, given in *doses* of 1 to 5 grains (0.065–0.32 Gm.), three times a day.

Aristolochia. *Br. Add.*—There are several species of the genus Aristolochia which are found in the herbalists' stores of India but do not enter commerce. Of these *A. bracteata*, Retz, is employed as an emmenagogue. Aristolochia of the Br. Add. is the dried stem and root of *Aristolochia indica*, L. As sold in commerce this drug consists chiefly of stems with attached roots and is employed for the cure of snake bite and to produce abortion. The possession by it of any distinct medicinal properties is very doubtful. The Br. Add. recognizes the *concentrated liquor* (1 in 2 of 20 per cent. alcohol) (*Liquor Aristolochiæ Concentratus*, Br. Add.), *dose*, one-half to two fluidrachms (1.8–7.5 Cc.); the *tincture* (1 in 5 of 70 per cent. alcohol) (*Tinctura Aristolochiæ*, Br. Add.), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Armeria. *Armeria vulgaris*, Willd. (*Statice Armeria*, L.) *Maiden Pink.* (Fam. Plumbaginaceæ).—This plant, found in Europe, Asia, and Western North America, is said to be an active diuretic. (*Ph. Post*, May, 1890.)

Aromatic Wine. *Vinum Aromaticum. Vin aromatique*, Fr. *Aromatischewein*, G.—"Lavender, *one part* [or seventy-two grains]; Origanum, *one part* [or seventy-two grains]; Peppermint, *one part* [or seventy-two grains]; Rosemary, *one part* [or seventy-two grains]; Sage, *one part* [or seventy-two grains]; Wormwood, *one part* [or seventy-two grains]; Stronger White Wine, a *sufficient quantity*, to make *one hundred parts* [or one pint]. Mix the solid ingredients, and reduce them to a coarse (No. 20) powder. Moisten the powder with *four parts* [or six fluidrachms] of Stronger White Wine, pack it moderately in a conical glass percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh *one hundred parts* [or measure one pint]." *U. S.* 1880.

This preparation of the U. S. Pharmacopœia of 1880 is practically identical with the *Vin aromatique* of the French Codex, which is made by macerating one hundred parts of aromatic species (a mixture of equal parts of the herbs used in our official aromatic wine, and in addition wild thyme and hyssop) with one hundred parts of *Teinture vulnéraire* (a tincture containing the same herbs, and ten more of similar properties) and one thousand parts of red wine. This wine is principally used as an astringent and stimulating lotion to *chancres, open buboes*, and other *indolent ulcers*. In many cases it should be diluted, but on occasion it may be employed of full strength. It is never given internally, and is rarely used in this country.

Arrow Poisons.—Up to the seventh century poisoned arrows were used in Europe in warfare, and they seem not to have disappeared from Spain until the sixteenth century, while poisoned daggers and poisoned swords were used even later for assassinations. The nature of the poisons employed is obscure, though it is stated that *Veratrum album*, L., and snake venom were used. The peregrinations of English and American travellers in Africa, and the various political changes and fomentations which have been the fruit of their discoveries,—the war with Spain and the consequent bringing of attention to the Philippine Islands,—have developed so much general interest in the wild natives of these various remote regions that we have thought it proper to prepare for our readers a general summary of what is known in regard to the poisons used by these various natives for the killing of game and the destruction of their enemies. In doing this we have thought that a geographical arrangement might well suffice. We shall omit strophanthus and the wooraris, which have become commercial products.

So far as our knowledge goes no poisonous arrows have ever been used in North America or in Northern Asia, unless, indeed, the statements made by Kracheninikow be correct. In the second volume of his *Voyage en Sibérie*, French edition, 1768, this traveller states that the roots of the plant known as *Zgate* are employed by several tribes living in the far north of Asia as an arrow poison, and it has been suggested, probably with insufficient reason, that the plant is an anemone. We have met with no recent author who has seen this poison.

Of the *Asiatic arrow poisons* the most important are those which have long been used by the natives of Java and other East India islands under the names of *Upas antiar* and *Upas tieute*. The *Upas antiar* is a gum-resinous exudation obtained from the *Antiaris toxicaria*, Lesch., a large tree belonging to the Artocarpaceæ, growing in Java, Celebes, and the neighboring islands. Like certain species of Rhus, this plant exhales an aëriform matter which very unpleasantly affects some of those who approach it, causing eruptions upon the skin attended with much swelling; hence the fable of the *deadly upas tree*. The juice is mixed with various substances to give it due consistency. Whether taken internally or introduced into the system through a wound, upas acts with extreme violence, producing vomiting, great prostration, a feeble, irregular pulse, involuntary evacuations, and convulsive movements, which are soon followed by death. Pelletier and Caventou obtained from it a glucoside, *antiarin*, crystallizable, soluble in water and alcohol, but scarcely so in ether, and of the formula $C_{14}H_{20}O_5$. Upas antiar depends for its activity upon *antiarin*, the crude drug and its active principles causing similar symptoms. Antiarin is a muscle poison, producing first strong fibrillary contractions of the voluntary muscles, followed by rapid decrease in irritability and finally paralysis, the sarcolemma of the muscles and not the motor nerve endings being the part attacked. It also belongs to the digitalis group of cardiac stimulants, raising the blood pressure at first, but finally arresting the heart in systole and being capable of re-establishing rhythmic contractions in the heart paralyzed by hydrocyanic acid. It appears to be the most active of known cardiac poisons. According to Stockman, antiarin diminishes the irritability of the peripheral vagi and stimulates the vasomotor centres. The relative powers of *strophanthin*, *urechitin*, and *antiarin* are such that $\frac{1}{4500}$ gr. strophanthin, $\frac{1}{2600}$ gr. urechitin, $\frac{1}{6400}$ gr. antiarin are equivalents. (See Maurice Doyen, *A. de P.*, 1892; Kiliani, *P. J.*, lvii.; Headborn, *A. E. P. P.*, xlv.; W. Straub, *A. E. P. P.*, xlv. 1901.) H. W. Bettink claims (*Ned. Tijdschr. v. Pharm.*) that besides antiarin there are present in *Upas antiar* two other active principles, *œpaïn* and *toxicarine*. Headborn states that *antiarigenin*, a derivative of antiarin, is more powerful than antiarin itself.

The *Upas tieute* is said to be obtained from a climbing woody plant growing exclusively in Java, the *Strychnos Tieute* of Leschenault. This author states that a decoction of the bark of the root is concentrated to the consistence of a thin syrup, then mixed with onions, garlic, pepper, etc., and allowed to stand until it becomes clear. This poison produces death in violent convulsions, and strychnine is said to have been found in it. (*Am. J. M. S.*, 1860; *C. D.*, 1863.)

It is very probable that different extracts are employed by different tribes in the islands of the Malay Archipelago. Braidwood (*Ed. M. J.*, 1864) found the arrow poison known as *Dajaksh* to be a cardiac paralyzant. It is not clear whether this is the same as a Borneo arrow poison examined by Leubuscher. (*Cb. I. M.*, Bd. xvii. 1896.) This is a blackish-brown, structureless extract, with yellowish streaks through it; it is believed by Leubuscher to contain an alkaloid which he failed to isolate. This poison produced in the lower animals great muscular relaxation, with convulsive movements and direct cardiac arrest in systole, but had no direct effect on the respiration, the peripheral nerves, or the muscles. In the higher animals the blood pressure was reduced even by minute doses.

The arrow poisons used by the natives of the Philippine Islands are, according to the researches of P. C. Plugge (*A. J. P.*, ii. 1896), obtained from the *Rabelaisia philippinensis*. Plugge has found in it a non-nitrogenous glucoside, *rabelaisin*. This given in very large doses produced in animals some convulsive movements, followed by profound muscular relaxation, loss of reflexes, and general paralysis, ending in death from asphyxia. On the heart it acted as an energetic stimulant, belonging to the digitalin group. In the frog one-ninth grain (0.007 Gm.) produced great cardiac excitement. (See also I. Rosenthal, *Sitzungsb. f. Physk. u. Med. Soc.*, Erlangen, 1894.)

An arrow poison is used by the Malays, under the name of *Ipoh;* it is said to be obtained from *Derris* (Pterocarpus) *elliptica* (Fam. Leguminosæ), or the *tuba root*, which is much used in Java as a fish poison. It contains an active acid resin, to which the name of *derrid* has been given. Derrid appears to be one of the most powerful fish poisons known, as one-five-millionth part stupefied gold fish in a few moments, and killed them within half an hour. (*P. J.*, vol. xxi. 1890.) Later researches seem to throw doubt upon the distinctness of ipoh poison from Upas antiar. (See *P. J.*, 1892.)

The natives of Perak, in the Straits Settlements, use an arrow poison stated to be a combination of aqueous extracts from the root bark of three trees, the individual extracts being known as *ipoh aker*, *aker lampong*, and *prual*. Ipoh aker and aker lampong are believed to be obtained from undescribed species of Strychnos; extracts were prepared from the root bark of these trees by Ralph

Stockman (*Lab. Rep. Roy. Soc. Edinburgh*, vol. vi. 1897), and found to be of similar physiological power, each of them having a digitalis-like action and also a well marked curare-like action, causing arrest of the heart in systole and loss of power in the motor nerve endings. *Prual* is said to be made from the root bark of *Coptosapella flavescens* (Fam. Aparinaceæ); in the experiments of Stockman it was found to be a violent poison, very rapidly killing the muscle at the point of inoculation, and soon involving in a fatal influence the whole muscular system, so that the animal after a large dose collapsed almost at once with diastolic cardiac arrest.

The *African arrow poisons* are quite numerous. *Exuja* or *Echugin* is a blackish-brown, crumbly, odorless, and intensely bitter arrow poison, used by the Ovambos of Southwest Africa. It is said to be yielded by an apocynaceous shrub, *Idaneum* (*Adenium*) *boehmianum*. From it R. Böhm (*Cb. M. W.*, 1889) isolated the crystalline glucoside ($C_5H_8O_2$), *echugin*, and a resinous body, *echugon*. The glucoside crystallizes in small, colorless, satiny, rhombic plates, easily soluble in water and alcohol, and insoluble in ether. It is present to about 10 per cent. in the crude substance, and is said to very closely resemble strophanthin in its physiological properties.

The arrow poison used by the pygmies of Central Africa has been obtained by Surgeon Parke, and is described in the *P. J.*, April, 1891. It has been found to contain two active alkaloids, *erythrophlœine* and *strychnine*.

The Sakayes, the Somangs, and the Wa Kamba tribes in Eastern Africa produce arrow poisons whose relations with one another are still obscure. *Hippo*, according to Laborde, causes in the lower animals vomiting, followed by tetanic convulsions and an almost simultaneous arrest of the respiration and cardiac action. (*P. J.*, July, 1887.) *Vakamba* of Laborde (*Ibid.*) is probably the same as the *ukambin* which has been studied by H. Paschkis, who found its active principle to be a crystalline body belonging to the digitalis group, and causing in the lower animals elevated blood pressure, fibrillary contractions of the muscles, and systolic arrest of the heart. (*Cb. M. W.*, 1862.)

An exceedingly bitter arrow poison, used by the tribes who inhabit the country of Segon in the French Soudan, has been examined by Ferré and Busquet (*A. de P.*, vii. 1895), who find that its active principle is a crystalline glucoside which is a very powerful muscle poison, affecting directly the heart, and producing very rapidly general paralysis, with salivation, exophthalmia, disturbance of respiration and of circulation. The first influence is to increase greatly the arterial pressure. The whole action of the poison is very similar to that of strophanthin.

The botanical sources of the rare African arrow poisons just mentioned are unknown, and it is uncertain whether these poisons are or are not distinct from better known African poisons. It is certain that several species of the apocynaceous genus *Acocanthera* afford several arrow poisons to the natives of Africa. Of the four principal species, *A. Schimperi*, B. and H., is found abundantly in the highlands of Abyssinia and through a great portion of Eastern Africa; *A. deflersii*, Schwf., which resembles the last-named species closely but, according to Schweinfurth, differs in that its flowers are larger, sweet-smelling and pure white, has been found in the neighborhood of Yemen; *A. Ouabaïo*, Arnaud, is a native of Somaliland, and *A. venenata*, Don, of South Africa. For details, see Engler, *Botanische Jahrbücher*, Bd. xvii.

The Wa Nyika, the Wa Gyriama, and the Wa Kamba tribes of Eastern Africa, and the natives of Obok on the Gulf of Aden, prepare vegetable arrow poisons probably from different species of plants, although the names *ouabaïn*, *wabayo*, and *ouabaïo* seem to have been used as synonyms by missionaries and others sending the extract to Europe. Varigny and Langlois found that of ouabaïo, coming from Obok, one-twelfth of a grain (0.006 Gm.) was sufficient to kill rabbits quickly, the heart and respiration being fatally poisoned. (*B. M. J.*, 1888.) One of these ouabaïo extracts is certainly made from the root of *Acocanthera Schimperi*, Benth. and Hook. (See *P. J.*, July, 1895.)

In 1882 Arnaud obtained from an unidentified species of the genus Acocanthera (which he named provisionally *A. Ouabaïo*), a crystalline glucoside, and in 1893 Lewin separated from the *Acocanthera deflersii* an amorphous glucoside.

The French investigator, Arnaud, assigned to *ouabaïn* the formula $C_{30}H_{46}O_{12}$, and says that when injected into the stomach it is not poisonous, but when taken directly into the blood is most deadly, the one-sixty-fourth of a grain (0.001 Gm.) being sufficient to kill a man, and acting both upon the heart and the respiratory centres. Gley states that this *ouabain* is a local anæsthetic, having ten times the power of cocaine, and in this he has been largely corroborated by Sailer, Lewin, and others. (*C. R. S. B.*, ii. 1895.)

From the arrow poison of the Wa Kamba, von Brieger has separated a crystalline principle of extraordinary activity, assigning the formula $C_{29}H_{46}O_{19}$. It is a question whether this is or is not ouabaïn. The substance extracted by E. Baroni (*Annali di Medicina navale*, 1900) from the Somali poison appears to have been ouabaïn.

For the glucoside produced by the *Acocanthera Schimperi*, Fraser proposes the name of *acocantherin*. In his experiments it crystallized from water in the form of colorless, transparent, quadrangular plates; from alcohol in needle-shaped crystals, often grouped in tufts and rosettes; had a melting point of about 186° C. (366.8° F.); was slowly soluble in water, more so in alcohol; and yielded to Dobbin the formula $C_{30}H_{48}O_{13}$. (See *P. J.*, lx. 1895.) Physiologically Fraser found this glucoside to act very much like strophanthin; it is a muscle poison, which affects directly the heart muscle and thereby causes rise of the arterial pressure. Its influence upon the blood vessels appears to be very much less than is that of digitalin. The fatal dose of acocantherin for frogs is 0.00000049 per gramme; for the rabbit, 0.00028 per kilogramme.

From *Acocanthera abyssinica* is prepared *Shashi-poison* of German Eastern Africa; from it E. S. Faust (*A. E. P. P.*, 48, 272, and 49, 446) separated a glucoside which he believes to be distinct from acocantherin in being amorphous and optically inactive.

The researches of Lewin in 1893 (*V. A. P. A.*, Bd. cxxxiv.) strongly indicate that the glucosides of the North African species—that is, of *A. deflersii*, *A. Ouabaïo*, and *A. Schimperi*—are identical, but that the glucoside of *A. venenata* is diverse, it differing from the others chemically in not being precipitated by tannic acid, and in not producing with concentrated sulphuric

acid a typical green fluorescence. It was found by Lewin when injected hypodermically to act with great rapidity in the production of violent dyspnœa and great weakness. It is from that species, *A. venenata*, Don, that the Bushmen of South Africa make an arrow poison by pounding the bark between stones, boiling it with water, then straining and boiling the water again until a jelly is formed, into which the point of the arrow is dipped. It is said that no snake poison is added; but it is further affirmed that under the name of *Incwadi* the Bushmen also use the bulbous amaryllidaceous plant, *Buphane disticha*, in poisoning their arrows.

Animal Poisons.—The use of animal arrow poisons is very uncommon, though the Choco Indians, in Colombia, South America, are said to prepare a very deadly extract by holding a tree-frog, the *Phylobates chocœnsis*, on a stick near a fire, and scraping off the subsequent exudate from the skin. As it is asserted that an exudate can be obtained from the skin of the ordinary European toad which is a violent heart poison, the extract employed by the Choco Indians is probably a cardiac paralyzant. Again, according to Livingstone, confirmed by Baines, some of the Bushmen prepare a poison from a cream-colored grub or caterpillar, which they term *'Nga*, said to be the first stage of the beetle *Diamphidia locusta*. The grub is gradually squeezed between the forefinger and thumb, and the colorless exudate smeared over the arrow-head. Boehm and his pupil Starcke have found this poison to be similar in its action to the snake poisons, to be dependent for its activity upon a toxic albumose, and to be non-toxic when given by the mouth. As previously stated, it is also probable that snake venom is sometimes mixed with the various vegetable poisons used by barbarians.

Artabotrys. *Artabotrys odoratissimus*, R. Br. *A. hamatus*, Bl. *Uvaria sinensis* (Fam. Anonaciæ) and *Unona uncinata*, Blanco. *Ilag-ilag de China*, Sp.-Fil. *Alag-ilag Sonson*, Tag.—A decoction of the leaves of this plant is used in the Philippine Islands in the treatment of *cholera;* the overdose is said to be capable of producing abortion.

Artar Root.—This is a drug coming from the west coast of Africa, possibly the product of *Xanthoxylum senegalense*, DC. (Fam. Rutaceæ), the leaves of which have been found in commercial specimens. Two alkaloids have been discovered in it by Giacosa and Nionari, one of which is said to resemble somewhat in its action veratrine, and to be a stimulant to the heart. (*Ph. Centralh.*, No. xxv. 1887.)

Artemisia Frigida, Willd. *Sierra Salvia. Colorado Mountain Sage.* (Fam. Compositæ.) This Rocky Mountain plant, which is found growing in immense quantities in Western America, is said to be much used in that region as a diaphoretic, antiperiodic, and mild cathartic. F. A. Weiss (*A. J. P.*, 1890) found indications of a glucoside. The *dose* of cold infusion (2 oz. in pint) is a wineglassful three times a day. One or two drachms (3.9 or 7.7 Gm.) of the powdered leaves, or one or two fluidrachms (3.75 or 7.5 Cc.) of the *fluidextract*, may be administered in hot infusion every half hour until perspiration has set in.

Arum.—The root or corm of *Arum maculatum*, L., is occasionally used as a medicine in Europe. Its properties closely resemble those of *Arisæma triphyllum*. Its constituents, according to Enz, are a neutral acrid volatile principle soluble in ether, starch, gum, mucilage, sugar, lignin, albumen, saponin, fixed oil, resin, and phosphate of calcium, the fresh corm containing 58.4 per cent. of water, 5.2 of lignin, and 27.2 of starch. (*A. J. P.*, xxxi.)

Arisæma triphyllum (L.), Torr. *Arum triphyllum* (L.). *Gouet à trois feuilles*, Fr. *Dreiblättriger Aron*, G. (Fam. Araceæ.) *Dragon-root, Indian Turnip, Jack-in-the-pulpit*, or *Wake-robin*. This plant is a native of North and South America, and is common in all parts of the United States, growing in moist shady places. The corm was formerly official. It is roundish, flattened, an inch or two in diameter, covered with a brown, loose, wrinkled epidermis, and internally white, fleshy, and solid. In the recent state it has a peculiar odor, and is violently acrid. It was found by D. S. Jones, besides the acrid principle and from 10 to 17 per cent. of starch, to contain albumen, gum, sugar, extractive, lignin, and salts of potassium and calcium. (*A. J. P.*, xv. 83.) The acridity has been ascribed to the raphides of calcium oxalate by R. A. Weber (*J. Am. C. S.*, 1891, p. 215). This has been denied, Schneegans proving that *A. maculatum* contains *saponin* and Spica and Biscaro ascribe the acridity to saponin (*Ph. Centralh.*, 1895, p. 731). The Indian turnip may be preserved fresh for a year, if buried in sand.

From both *Arum maculatum* and *Arum italicum*, Herbert and Heim (*P. J.*, July 31, 1897) separated a saponin, also a brownish, oily, liquid alkaloid closely resembling coniine in its properties, but less active. They also found a saponin in the arum tubers.

Both the European and American arum are, in their fresh state, violent irritants to the mucous membranes, producing when chewed insupportable burning in the mouth and throat. Taken internally, this plant causes violent gastro-enteritis, which may end in death. (See *Ann. Thér.*, 1862.) The fresh, partially dried root has been used internally as a stimulant to the secretions, especially in *asthma, whooping cough, chronic catarrh*, and *rheumatism. Dose*, ten grains (0.65 Gm.), two or three times a day, increased to half a drachm (2 Gm.). The perfectly fresh root should not be used, and the fully dried root is inactive.

The corm of the European arum contains much starch, and a farina is prepared from it, in small quantities, in the Isle of Portland, on the south coast of England, and called *Portland arrow root*, or *Portland sago*. The root of *A. esculentum*, L. (more correctly *Colocasia esculenta* (L.), Schott.), which abounds in starch, is much used by the natives of the Hawaiian and other islands of the Pacific as an article of food, having been previously deprived of its acrimony by heat.

Asarabacca.—*Asarum europœum*, L., is an acrid, herbaceous perennial plant, of the Fam. Aristolochiaceæ, growing in Europe, between 37° and 60° north latitude, in woods and shady places. The root is about as thick as a goose-quill, of a grayish color, quadrangular, knotted and twisted, and sometimes furnished with radicles at each joint. It has an odor analogous to that of pepper, an acrid taste, and affords a grayish powder. The leaves, which have long footstalks, are kidney-shaped, entire, somewhat hairy, of a shining deep green color when fresh, nearly inodorous, with a taste slightly aromatic, bitter, acrid, and nauseous. According to Feneulle and Lassaigne, the *root* contains a concrete volatile oil, a very acrid fixed oil, a yellow substance analogous to *cystin*, starch, albumen, mucilage, citric acid, and

saline matters. Gräger found in the *root* a liquid volatile oil, two concrete volatile substances called respectively *asarum-camphor* or *asaron*, and *asarite*, a peculiar bitter principle called *asarin*, tannin, extractive, resin, starch, gluten, albumen, lignin, citric acid, and various salts; in the *leaves* asarin, tannin, extractive, chlorophyll, albumen, citric acid, and lignin. Rizza and Butlerow give to *asaron* the formula $C_{12}H_{16}O_3$, and state that it melts at 59° C. (138.2° F.), boils at 296° C. (564.8° F.), has the sp. gr. 1.165 at 18° C. (64.4° F.), is inodorous, has a faintly pungent taste, is somewhat soluble in boiling water, and crystallizes on cooling in delicate needles and scales. Gräger's *asarite* is merely asaron crystallized in fine needles. (*Ber. d. Chem. Ges.*, 1884, 1159.) Poleck (*Ibid.*, 1415) gives the fusing point of asaron as 61° C. (141.8° F.), and its formula as $C_8H_{10}O_2$. The active principles appear to be the volatile oil, which is lighter than water, glutinous, yellow, of an acrid and burning taste, and an odor like that of valerian, and the *asarin*, which is soluble in alcohol and very bitter, and is probably the same as the *oystin* of Feneulle and Lassaigne. (See *Cytisus*.) The volatile oil of the plant has been examined by Petersen: it consists of an oil which has the composition $C_{11}H_{14}O_2$, and is identical with the *methyl ether of eugenol*, and a terpene, $C_{10}H_{16}$, boiling between 162° C. (323.6° F.) and 165° C. (329° F.). (*A. Pharm.*, 1888–89, 123.) The root and leaves of asarabacca are powerfully emetic and cathartic, in *doses* of from thirty grains to a drachm (2.0–3.9 Gm.), but are used almost exclusively as an errhine in *headache*, and *rheumatic affections* of the face, mouth, and throat. One or two grains (0.065–0.13 Gm.), snuffed up the nostrils, produce much irritation, and a copious, persistent flow of mucus.

Asarum. *Wild Ginger*, or *Canada Snake-root*. *Asaret du Canada*, Fr. *Canadische Hasselwurzel*, G.—Under this name the U. S. Pharmacopœia formerly recognized the rhizome of the indigenous *A. canadense*, L. (Fam. Aristolochiaceæ.) The plant has in all its parts an aromatic odor and an aromatic slightly bitter taste, which it imparts to alcohol and hot water. The rhizome occurs in long, more or less contorted pieces, from the thickness of a straw to that of a goose-quill, brownish and wrinkled externally, whitish within, hard and brittle, and frequently furnished with short fibres. The chief constituent is the volatile oil, now largely used in perfumery. According to Petersen, the oils of *Asarum europæum* and *Asarum canadense* are composed in the main of one compound, which is identical with the *methyl ether of eugenol*, $C_6H_3(OCH_3)_2.C_3H_5$, a compound which had been made synthetically but not previously found in nature. According to the latest researches of Power and Lees (*Trans. Chem. Soc.*, 1902) the oil of *Asarum canadense* contains the following substances: a phenol, $C_9H_{12}O_2$; pinene, apparently a mixture of the d- and l- forms; d-linalool, l-borneol, l-terpineol, geraniol, eugenol-methyl-ether, a blue oil, of undetermined composition, consisting of oxygenated substances of alcoholic nature; a lactone, $C_{14}H_{20}O_2$, palmitic acid, acetic acid, and a mixture of fatty acids intermediate between acetic and palmitic acids. For formulas for fluidextract, syrup, and oleoresin, see *A. J. P.*, 1876, 155. F. P. Streeper (*A. J. P.*, 1888, 6) proved that strong alcohol was the proper menstruum for the fluidextract. The medicinal properties of this drug are those of a feeble aromatic. From a half to one drachm (2–3.9 Gm.) may be used. It is employed as an aromatic adjuvant to tonic mixtures and infusions. From *Asarum arifolium*, Michx., E. R. Miller obtained from 7 to 10 per cent. of volatile oil having a sassafras odor, sp. gr. 1.0585 (*P. J.*, lxix.); see also *Schim. Rep.*, 1902, p. 12.

Asbestos.—This term is applied to several mineral substances which occur in long capillary crystals placed side by side, the whole producing a fibrous mass which possesses qualities that render asbestos very valuable in the arts. Asbestos is incombustible, insoluble, and a poor conductor of heat. It is usually hydrated *magnesium silicate*, or a compound of silicon, lime, and magnesium (for analysis see *P. J.*, 1901, p. 575), and is found in Italy, in the Tyrol, Corsica, Savoy, in the Pyrenees, in Cornwall, Scotland, and elsewhere in Europe. It is largely mined in Canada and the United States, the production of the latter, in 1904, having been 1,480 tons, valued at $25,740. For its general properties and uses, see *Ph. Rec.*, 1885, 232. In the laboratory it is used for filters, for which it is admirably adapted. (See *Talcum*, page 1238; and *A. J. P.*, 1883, 37; *Ph. Rund.*, 1885, 252.)

Asbolin.—Under this name Braconnot has introduced a brownish-yellow syrupy liquid, prepared from an aqueous infusion of lamp black. Bélal and Desvignes state that it consists mainly of pyrocatechin and homopyrocatechin. It has been used in the treatment of *tuberculosis*.

Asclepias. *U. S.* 1890.—Besides the American species *Asclepias tuberosa*, *A. syriaca*, and *A. incarnata*, which were formerly recognized by the U. S. Pharmacopœia, various other species of the genus have been used medicinally. Gram has found in the *Asclepias Curassavica*, *A. incarnata*, *A. Vincetoxicum*, and *A. officinale*, a glucoside, *asclepiadin*, which he believes to be a pure form of the asclepiadin of Harnack and the *asclepin* of Feneulle, and closely to resemble emetine in its physiological action, but to be so unstable as to be of no practical value. From *A. Vincetoxicum*, L. (*Cynanchum Vincetoxicum* (L.), Pers.), Tanret (*C. R. A. S.*, c. 277) has isolated two glucosides, soluble and insoluble *vincetoxin*, with the formula $C_{16}H_{12}O_6$. The soluble vincetoxin is a clear yellow amorphous powder, easily soluble in water, alcohol, and chloroform, insoluble in ether. It begins to decompose at 130° C. (266° F.). The insoluble vincetoxin dissolves readily in alcohol, chloroform, and ether, but in water only in the presence of the soluble vincetoxin. It fuses at 59° C. (138.2° F.). Decomposed by dilute acids, they each yield an uncrystallizable, inactive, unfermentable sugar. An indigenous species, *A. verticillata*, L., is used in the Southern States as a remedy in *snake bites* and the *bites of venomous insects*. Twelve fluidounces (360 Cc.) of a saturated decoction are said to cause an anodyne and sudorific effect, followed by a gentle sleep. (*Va. Med. Journ.*, Dec. 1858.)

A. syriaca, Willd. *A. Cornuti*, Decaisne.—*Common silk weed*, or *common milk weed*, is very abundant in the Middle United States, flowering in July and August. Its milky juice has a faint odor, a sub-acrid taste, and an acid reaction. According to Schultz, 80 parts of it contain 69 of water, 3.5 of a wax-like fatty matter, 5 of caoutchouc, 0.5 of gum, 1 of sugar, with salts of acetic acid, and 1 of other salts. (*Ph. Cb.*, 1844, p. 302.) C. List found the chief solid ingredient of the juice to be a peculiar resinous crystalline substance (*asclepion*,

$C_{20}H_{34}O_3$) allied to lactucon. To obtain it, the juice is coagulated by heat, filtered, and the filtrate digested with ether, which dissolves the asclepion, and yields it by evaporation. To purify it, the residue must be treated repeatedly with anhydrous ether, which leaves another substance undissolved. It is white, crystalline, tasteless, inodorous, fusible, insoluble in water and alcohol, soluble in ether, oil of turpentine, and concentrated acetic acid. A hot solution of potassium hydroxide does not affect it. (*Ann. Ch. Ph.*, Jan. 1849. See also *A. J. P.*, liii.) Anodyne, cathartic, and alterative properties have been claimed for the root of this plant, and it has been especially commended in *asthma* and in *scrofula*, but probably is of very little medicinal value. A fluidrachm (3.75 Cc.) of it in decoction may be given two or three times a day.

Asclepias tuberosa, L.—*Butterfly weed*, or *pleurisy root*, grows throughout the Eastern United States, most abundantly southward. The roots, which alone are used in medicine, were officially described as "large and fusiform, dried in longitudinal or transverse sections, from 2 to 15 Cm. long, and about 2 Cm. or more in thickness; the head knotty, and slightly but distinctly annulate, the remainder longitudinally wrinkled, externally orange-brown, internally whitish; tough, and having an uneven fracture; bark thin, and in two distinct layers, the inner one whitish; wood yellowish, with large, white, medullary rays. It is inodorous, and has a bitterish, somewhat acrid taste. When long kept it acquires a gray color." *U. S.* 1890.

When dried, it is easily pulverized, and its taste is bitter, but not otherwise unpleasant. E. Rhoads discovered in it a peculiar principle, which he obtained by treating the cold infusion with tannic acid, mixing the precipitate, previously washed and expressed, with litharge, drying the mixture and exhausting it with hot alcohol, and finally decolorizing and evaporating the alcoholic liquor. The product was a yellowish-white powder, having the taste of the root, soluble in ether, and much less readily so in water, from which it was precipitated by tannic acid. Rhoads also found evidence of the existence in the root of tannic and gallic acids, albumen, pectin, gum, starch, a resin soluble and another insoluble in ether, fixed oil, a volatile odorous fatty matter, and various salts, besides from 30 to 35 per cent. of lignin. (*A. J. P.*, xxxiii.) Quackenbush (*A. J. P.*, 1889) found in it and also in *A. Cornuti* a crystalline glucoside.

To the root of the *A. tuberosa* have been ascribed diaphoretic, expectorant, and cathartic properties. In the Southern United States the drug has been given in *pulmonic catarrhs* in *doses* of from twenty grains to a drachm (1.3–3.9 Gm.) in a powder or in the form of a decoction; as a diaphoretic, a teacupful of the decoction (1 in 30) every hour until some effect is produced.

The formula for *fluidextract of asclepias* official in the U. S. P. 1890 is as follows: *Extractum Asclepiadis Fluidum. U. S.* 1890. *Fluid Extract of Asclepias.*—"Asclepias, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Asclepias is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

This fluidextract has a deep brownish-red color. The *dose* is from twenty minims to a fluidrachm (1.3–3.75 Cc.).

Asclepias Curassavica, L. *Bastard Ipecacuanha. Redhead. Blood Weed.* (Fam. Asclepiadaceæ.) This is a native of the West Indies, abounding especially in Nevis and St. Kitts. Both the root and expressed juice are emetic, the former in the *dose* of twenty to forty grains (1.3–2.6 Gm.), the latter in that of a fluidounce (30 Cc.) or more. They are also cathartic and vermifuge in somewhat smaller doses. (*A. J. P.*, xix. 19.) For analysis, see *A. J. P.*, 1887, 347. According to the *Kew Bulletin*, 1897, this plant has insecticidal properties, being especially obnoxious to fleas. The rooms are thoroughly swept with rough brooms made from the weed and the pests are said to disappear. D. St. Cyr commends it in *phthisis* (*P. J.*, 1903, 714).

Asimina. *Asimina triloba* (L.), Dunal. (Fam. Anonaceæ.)—J. U. and C. G. Lloyd have found in the common *pawpaw* an alkaloid, *asiminine*, besides a volatile oil. (*A. J. P.*, 1886.) T. M. Fletcher failed to find an alkaloid, but gives the principal constituents as fixed oil, 3.53 per cent.; resin, 3.43 per cent.; resin insoluble in ether, 9.5 per cent.; glucose and extractive, 8 per cent. (*A. J. P.*, 1891, 476.)

Asparagus. *Asparagus officinalis*, L. *Asperge*, Fr. *Spargel*, G. *Esparaguera*, Sp. (Fam. Convallariaceæ.)—This well-known garden vegetable is a native of Europe. It is perennial and herbaceous. The *root*, which is inodorous, and of a weak, sweetish taste, is used in France as a diuretic, aperient, and purifier, in the form of decoction, made in the proportion of one or two ounces of the root to a quart of water. Hayne asserts that, in the dried state, it is wholly inert. In the *berries* H. Reinsch has found a large proportion of glucose and a yellowish-red coloring matter, *spargin*. (*A. J. P.*, xlii. 371.) From the juice of the young shoots Robiquet and Vauquelin obtained a peculiar crystallizable principle, called *asparagin*, $C_4H_8N_2O_3$, which has since been found in a number of plants. (See *Althæa.*) Asparagin is said to be obtained with facility by the process of dialysis. If the thick viscid mucilage of the marshmallow (*Althæa officinalis*) be put into a dialyzer, with distilled water outside, the asparagin passes into the water, and may be obtained in crystals by evaporating the solution. (See *P. J.*, May, 1862, 572.) It might probably be obtained in the same way from an infusion of asparagus. The seeds are said to be used as a substitute for coffee. They are black in color, measuring about 4 millimeters in length and 3 in width, rounded on one side, squared on the other, with wrinkled seed capsule. W. W. Peters found in them a fixed, quickly drying oil of reddish-yellow color. Its sp. gr. at 15° C. (59° F.)

is 0.928, and the Zeiss refractometer at 25° C. (77° F.) shows 75° (1.75). The saponification figure is 194.1, the iodine figure after eighteen hours is 137.1. The acetyl-acid figure is 179.2, the acetyl-saponification figure 204.4, and the acetyl figure therefore 25.2. The oil in question was found to consist of the glycerides of palmitic, stearic, oleic, linoleic, linolenic, and isolinolenic acids. The average amount of water in the seeds was 11.52 per cent., the cellulose 8.25 per cent., the proteids 18.99 per cent. No starch was found, but 37.53 per cent. of mannose.

There is at present no sufficient reason for believing that asparagus is of value in practical medicine. The peculiar heavy odor which it imparts to the urine has been the chief foundation for the belief in its diuretic properties; but Nencki (*Provincial Med. Journ.*, March, 1891) appears to have demonstrated that this odor is due to the presence in the urine of *methyl-mercaptan*, a gas which is frequently produced in minute quantities in the intestines by the decomposition of proteids. A. Dedrick affirms that eight grains of asparagin caused marked reduction and irregularity of the pulse, frontal headache, and muscular weakness, lasting less than two hours. (*V. A. P. A.*, Bd. xciv. and xcviii.) According to Justin D. Lyle (*N. Y. M. J.*, July, 1892), eating asparagus causes the urine to answer Trommer's, Fehling's, and Böttger's glycosuria tests, although sugar is not present. The effect of asparagin upon tissue change has been studied by several physiologists, with somewhat diverse results. Weiske and his students are in accord with Zuntz in the conclusion that in herbivorous animals it reduces the destruction of albuminous material, while Munk, Politis, and Mauthner, experimenting upon dogs and rats, have reached the conclusion that asparagin has no influence, at least in carnivora, upon tissue change. (*Z. B.*, x. 1892.) Asparagus may be administered internally in the form of the syrup produced from the fresh juice or from the tincture.

Asphodelus. *Asphodelus bulbosus.* (Fam. Liliaceæ.)—Under the name of *Tsinisse*, the corm of this plant is used in the East for mucilage and the adulteration of salep powder.

Aspidosperma. *U. S.* 1890. *Aspidosperma Quebracho. Quebracho Bark. Quebracho Blanco.* "The bark of *Aspidosperma Quebracho-blanco* Schlechtendal (nat. ord. *Apocynaceæ*)." *U. S.* 1890. Quebracho is an evergreen tree which sometimes reaches the height of one hundred feet, and is remarkable for its erect stem and its wide-spreading crown reaching out over the cacti and lower bushes among which it grows. The wood of the quebracho tree is not met with in commerce, but is said to be very hard, distinctly marked with rings of growth, and of a bright chocolate-brown color, except the very young wood, which is yellowish or reddish. According to Hesse and Penzoldt, the wood contains no alkaloids; it is used for tanning purposes in some parts of South America.

Quebracho bark is remarkable for the extreme thickness of the corky layer which often constitutes more than half of its entire substance, and is separated from the lower layer by a more or less sharply defined outline. The corky layer is usually externally dirty gray, or where it has been rubbed appears yellowish red. As seen with the magnifying glass it is traversed by nearly parallel yellowish lines having numerous whitish points between them. The inner portion of the bark is uniform, except for whitish points. These characteristics of the bark are more plainly observed after moistening the surface. In different specimens the color of the inner bark varies up to light yellow. When examined with high powers the outer layer is seen to be composed of superimposed parenchymatous cells, traversed by bands of small, thick-walled cork cells, constituting the parallel lines before mentioned. The whitish points spoken of are groups of sclerenchymatous cells whose membrane has been so thickened by secondary deposits that the cavity is nearly obliterated. The inner portion of the bark is composed of parenchymatous cells, usually of a cinnamon brown color, rich in starch, and containing a light brown granular substance, with groups of sclerenchymatous cells similar to those already mentioned, but containing a dark yellow substance, which seems to be in drops. These sclerenchymatous cells are more abundant in the inner part of the bark, and are arranged in spindle-shaped fibres, which can be readily separated by scraping the inner surface of the bast. The fibres are surrounded by angular bodies, composed of numerous small cells, each containing a crystal of calcium oxalate. The U. S. P. 1890 description of aspidosperma is as follows: "In nearly flat pieces, about 1 to 3 Cm. thick; the outer surface yellowish-gray or brownish, deeply fissured; inner surface yellowish-brown or reddish-brown, distinctly striate; fracture displaying two sharply defined strata, of about equal thickness, and both marked with numerous whitish dots and striæ arranged in tangential lines; the fracture of the outer, lighter colored layer rather coarsely granular, and that of the darker colored, inner layer short-splintery; inodorous; taste very bitter and slightly aromatic." *U. S.* 1890.

In 1878, Fraude (*Ber. d. Chem. Ges.*, 1878, p. 2189; 1879, p. 1560) discovered in the quebracho-blanco an alkaloid, *aspidospermine*, $C_{22}H_{30}N_2O_2$; but a series of experiments have led F. Penzoldt to the conclusion that it does not represent the whole medicinal activity of the bark, and O. Hesse has found five other alkaloids, *aspidospermatine*, $C_{22}H_{28}N_2O_2$, and isomeric with it *aspidosamine*, $C_{22}H_{28}N_2O_2$, *quebrachine*, $C_{21}H_{26}N_2O_2$, and isomeric with this *hypoquebrachine*, $C_{21}H_{26}N_2O_2$, and *quebrachamine*. (*Ber. d. Chem. Ges.*, xiii. 2308.) *Aspidospermine* fuses at 205°–206° C. (401°–403° F.), is soluble in about 6000 parts of water at 15° C. (59° F.), the solution having a decidedly bitter taste, soluble in about 48 parts of absolute alcohol, in 106 parts of ether, insoluble in glycerin; it dissolves readily in fats and fixed oils, cod liver oil dissolving a larger proportion than it does of quinine. Its *sulphate* and *hydrochloride* are very soluble. The *citrate* is crystallizable, and very soluble. The yield of aspidospermine is small, 0.33 per cent. of the bark. *Aspidospermatine* is crystalline, and fuses at 162° C. (323.6° F.); *aspidosamine* is amorphous, and fuses at 100° C. (212° F.); *quebrachine* in colorless crystals fuses at 214°–216° C. (417.2°–420.8° F.); *hypoquebrachine* is a yellowish mass resembling albumin, and fuses at 80° C. (176° F.); *quebrachamine* forms colorless silky needles, only slightly soluble in alcohol, ether, chloroform, and benzin, and fuses at 142° C. (287.6° F.). Two new sugars have also been extracted by Tanret, *quebrachite* and *lævogyrate inosite*. Tannin and starch have also been found in the bark.

The formula for the *fluidextract of aspidosperma*, official in the U. S. P. 1890, is as follows: *Extractum Aspidospermatis Fluidum. U. S.* 1890. *Fluid Extract of Aspidosperma.*—"Aspidosperma, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix the Glycerin with *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol and *three hundred cubic centimeters* [or 10 fluidounces, 70 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of Alcohol and Water, made in the proportion of *two hundred cubic centimeters* [or 6 fluidounces, 366 minims] of Alcohol to *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Water, until the Aspidosperma is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

This preparation, which has been largely used under the name of *fluidextract of quebracho*, well represents the drug. The *dose* is fifteen minims to a fluidrachm (0.9–3.75 Cc.).

Medicinal Properties and Uses.—Quebracho bark, originally suggested as an antiperiodic, has been frequently used as a remedy in *cardiac* and *asthmatic dyspnœa*. Our knowledge of the physiological action of its various alkaloids is not sufficient for definite conclusions; it would even appear that some of its alkaloids are reported to be antagonistic to each other. As was first stated by Penzoldt, and subsequently proven by H. C. Wood, Jr., and Hoyt, the commercial aspidospermine produces a great increase both in the rate and depth of the respirations, this increase being followed by depression if the dose has been large enough to kill. The blood in the veins becomes of a bright red hue, a color which was attributed by Penzoldt to a loss of power in the corpuscles to yield up their oxygen. It has been shown, however, by Wood, Jr., and Hoyt, that its color is simply due to an excessive aeration of the blood produced by the violent breathing, the blood rapidly assuming a venous hue all over the body if the supply of air be mechanically interfered with. According to Wood and Hoyt, commercial aspidospermine produces a marked fall of the blood pressure, which appears to be due to a depressing action of the alkaloids upon the cardiac muscles.

Quebracho has been used to some extent in *emphysema, bronchitis, chronic pneumonia, uræmic dyspnœa*, etc. The aspidospermine of commerce is a more or less impure mixture of all the alkaloids, and may be considered to represent the activity of the drug. *Dose*, from one-fourth to one-half a grain (0.016–0.032 Gm.). The fluidextract may be given in *doses* of from fifteen minims to one fluidrachm (0.9–3.75 Cc.); the solid extract is said to be ten times the strength of the crude bark, and may be given in *doses* of from one to three grains (0.065–0.2 Gm.).

Aspirin. *Acetyl-salicylic Acid.* $C_6H_4\begin{cases}OC_2H_3O\\COOH\end{cases}$. It forms white crystalline needles, melting at 135° C., only slightly soluble in water; soluble in alkaline fluids with decomposition. Aspirin is probably decomposed by the alkaline juices of the intestines with the liberation of salicylic acid, which is then absorbed. The presence of salicylic acid in the urine can be recognized in twenty minutes to half an hour after the ingestion of the drug, but, according to Filippi and Bufalini, excretion takes place much more slowly than after sodium salicylate; so that it is probable that the intestinal decomposition of aspirin takes place slowly and that the drug exerts a more continuing influence upon the system than do the alkaline salicylates.

Aspirin is entirely capable of producing cinchonism and all the other disagreeable symptoms sometimes caused by the salicylates, but is certainly less prone to interfere with digestion than are the older preparations of the acid, and is a valuable, effective remedy in the subacute forms of *rheumatism*. The powder should not be given in capsules if there be any irritability of the stomach, but diffused in milk or in water. *Dose*, ten to fifteen grains (0.65–1.0 Gm.) three or four times a day.

Asplenium. *Asplenium Filix-fœmina* (L.), Bern. *Female Fern. Polypodium Filix-fœmina*, L. *Athyrium Filix-fœmina*, Roth.—The rhizome of the female fern has been supposed to possess similar vermifuge properties to that of the male fern. At present, however, it is not used. The vulgar name of *female fern* is also given to the *Pteris aquilina*, or *common brake*, which is further said by some authors to have the property of destroying the *tape worm*. The leaves of two species of Asplenium, *A. Trichomanes*, L., or *common spleenwort*, and *A. Adiantum-nigrum*, L., or *black spleenwort*, are mucilaginous, and have been used as substitutes for the *maidenhairs* (*Adiantum Capillus-veneris*, L., and *A. pedatum*, L.) as pectorals, though destitute of their aromatic flavor.

Aster. *Aster puniceus*, L. (Fam. Compositæ.) The aromatic astringent rootlets of this indigenous plant have been employed as a stimulating diaphoretic in *rheumatic* and *catarrhal affections*.

Asteracantha. *Asteracantha longifolia*, Nees. (Also known as *Hygrophila spinosa*, T. Anders.) *Ik Kirit.* (Fam. Acanthaceæ.)—This Indian plant is said by A. Jayesingba to be an energetic hydragogue diuretic. (*Ph. Z. R.*, Sept. 1887.)

Asterol. *Mercury paraphenolsulphonate with ammonium tartrate.* $C_{12}H_{10}O_8S_2Hg.4C_4H_4O_6(NH_4)_2 + 8H_2O$.—A micro-crystalline reddish-white powder freely soluble in warm water. This substance was brought forward by Steinmann (*B. K. W.*, 1899, No. 11, p. 229) as being almost as active as corrosive sublimate in its antiseptic powers without having local corrosive properties, and also not losing its bactericidal action in albuminous media. Vertun (*B. K. W.*, 1899, No. 20), however, finds that these assertions are not warranted.

Atherosperma. *Atherosperma moschatum*, Labill. *Australian Sassafras.* (Fam. Monimiaceæ.) The bark of this tree, a native of Southern Australia, is said to have been long used by the aborig-

ines, and later by the settlers, in *rheumatism* and in secondary *syphilis*, and has been highly commended by Greeves (*L. L.*, 1862) in acute *bronchitis*. It has been stated that both the bark and the volatile oil are powerful poisons, and Zeyer (*Vierteljahrschr. f. Pract. Pharm.*, x. 504) obtained from the drug an alkaloid, *atherospermine* ($C_{30}H_{20}NO_5$); see also Wittstein's *Organic Constituents of Plants*, 20. The abundant volatile oil is light yellow, and has a pleasant aromatic odor and taste, resembling those of oil of sassafras. Ralph Stockman (*Lab. Rep. Royal Coll. Phys.*, vi. 1897) found it to resemble in its physiological action oil of sassafras and other allied volatile oils. He took repeatedly ten minims (0.6 Cc.) without any pronounced effect, and one fluidrachm (3.75 Cc.) given to a rabbit caused only temporary stupor, with slowing of the respiration, but not of the pulse. Three fluidrachms (11.25 Cc.) caused in the rabbit marked depression of the heart and of the respiration, coma, and death in twelve hours by asphyxia.

Atoxyl. *Meta-arsenous-acid anilid.*—This is a white, odorless powder having a slightly saline taste, which is soluble up to 20 per cent. in hot water, 2 per cent. crystallizing out on cooling. If left standing the aqueous solution becomes of a yellowish color. Atoxyl contains 37.6 per cent. of metallic arsenic. According to F. Blumenthal, it is forty times less poisonous than is arsenic acid, although it contains about one-half as much metallic arsenic as does the acid. In sufficient doses Blumenthal found that it is capable of producing fatal gastric enteritis and hemorrhagic nephritis, and its physiological, toxic, and remedial properties are probably in direct proportion to its power of setting arsenic free in the system; so that there is no reason for supposing it superior to the older arsenical preparations, unless, as claimed by Schild, it is especially adapted for hypodermic use. Schild gives from three to fifteen minims (0.2–0.9 Cc.) of the twenty per cent. solution, hypodermically, for five days, subsequently on alternate days. He believes that it is a cardiac depressant, which is contra-indicated by weakness of the heart.

Azadirachta. *Neem. Margosa Bark, Br. Add. Azedarach, U. S.* 1880. *Pride of India. Pride of China. Ecorce d'Azédarach, Ecorce de Margousier*, Fr. *Zedrachrinde*, G.—While the U. S. P. formerly recognized the bark of the root, the Br. Add. directs the bark of the stem of *Melia Azadirachta*, L. (nat. ord. Meliaceæ), a beautiful tree, thirty or forty feet high, with a trunk fifteen or twenty inches in diameter. This species of Melia is a native of Syria, Persia, and the north of India, and is widely cultivated. It is abundant in our Southern States. North of Virginia it does not flourish. "The bark [root] is in curved pieces or quills of variable size and thickness; outer surface red-brown, with irregular, blackish longitudinal ridges; inner surface whitish or brownish, longitudinally striate; fracture more or less fibrous; upon transverse section tangentially striate, with yellowish bast-fibres; inodorous, sweetish, afterwards bitter and nauseous. If collected from old roots, the bark should be freed from the thick, rust-brown, nearly tasteless, corky layer." *U. S.* 1880. The bark of the tree is "externally of a rusty-gray color, internally yellowish, and much foliated; coarsely fibrous; inodorous, bitter and slightly astringent; structure and thickness varying according to age." *Br. Add.* (For a description of the leaves and root bark, see *Ph. Rev.*, 1896, p. 231.) Jacobs (*A. J. P.*, 1879, 444) believes that the active principle is a yellowish-white resin, and that the activity of the bark resides in the liber. Hanausek (1878) states that two kinds of *oil of azedarach* are used in Eastern Asia,—one from the fruit and the other from the seeds; the former is used medicinally, the latter only for burning. For characters of oil, see *P. J.*, Oct. 1888.

Azadirachta indica, A. Juss. (*Melia Azadirachta*, L.), or *Melia bark*, according to Broughton (*P. J.*, 1873, 992) contains a bitter amorphous resin, $C_{36}H_{50}O_{11}$, which fuses at 92° C. (197.6° F.), and a crystallizable principle, melting at 175° C. (347° F.). (See also *Ph. Rev.*, 1896, 231.) Cornish (*Ind. Ann. Med. Sci.*, 4, 104) had previously announced the presence of a bitter alkaloid, to which he gave the name *margosine*, from the Portuguese name for the tree, *margosa*.

The decoction of azedarach is affirmed to be cathartic and emetic, and in large doses narcotic; but in a number of experiments made by H. C. Wood with extracts from the dried bark and fruit, it was found impossible to poison frogs or rabbits. Robins eating of the sweetish fruit, of which they are very fond, are often rendered so far insensible as to be picked up under the tree; though they usually recover in a few hours. It has been suggested that sufficient alcohol is produced by the spontaneous fermentation of the berries to cause intoxication, but this is highly improbable. Children are said to eat the fruit without inconvenience, and possibly the robins simply choke themselves with the large berries. The bark is considered in the Southern States an efficient anthelmintic. The form of decoction is usually preferred. A quart of water is boiled with four ounces of the fresh bark to a pint, of which the *dose* for a child is a tablespoonful every two or three hours, until it affects the stomach or bowels. Another plan is to give a dose morning and evening for several successive days, and then to administer an active cathartic. The *fresh* bark and the fruit are said to be superior as vermifuges. The Br. Add. recognizes an *infusion* (*Infusum Azadirachtæ Indicæ*, Br. Add.), eighty-eight grains in a pint of cold water, *dose*, one-half to one fluidounce (15–30 Cc.); also a *tincture* (*Tinctura Azadirachtæ Indicæ*, Br. Add.), two ounces in a pint of 45 per cent. alcohol, *dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Azoles.—The chemical substances which were gathered together by Hantzsch under the name of azoles have been the subject of considerable physiological study. As, however, so far, these subjects, with the exception of antipyrine, have yielded no practical result, it is sufficient here to point out the article of Tappeiner (*A. E. P. P.*, xxxvii. 1896), which contains references to the previous articles upon the subject.

Baccharis. *Baccharis cordifolia*, DC. *Mio Mio.*—This composite plant of Southeastern South America is notorious from its deadly effect upon sheep and cattle. Pedro N. Arata has isolated from it an alkaloid *baccharine*. (*P. J.*, x. 6.)

Bacillol.—This is an oily fluid of faint alkaline reaction, dark brown color, and specific gravity of 1.100, which forms clear solutions with water, and even when concentrated is only slightly irritating. It is asserted to be a preparation of cresol. Solutions of the strength of 0.5 per cent. markedly affect the action of pancreatin, while 0.2 per cent. prevent the growth of micro-organisms in agar

tubes. It is alleged that it does not attack instruments, is inexpensive compared with phenol, and relatively free from toxicity. According to Franz Werner, a 1½ per cent. solution kills the anthrax bacilli in from one to five minutes. (See *W. K. R.*, vol. xv. p. 73, and *Th. M.*, vol. xv. 1901.)

Bael Fruit. *Belæ Fructus. Br. Add.*—"The fresh half-ripe fruit of *Ægle Marmelos*, Correa." *Br. Add.* The so-called *Bengal quince* is a rather large aurantiaceous tree, growing in India, with an erect stem, few and irregular branches, an ash-colored bark, strong, very sharp, axillary thorns, single or in pairs, leaves and large white flowers, ternate. The fruit is a berry of delicious flavor, of about the size of a large orange, with a hard smooth shell, and from ten to fifteen cells containing besides the compressed, woolly seeds a large quantity of exceedingly tenacious mucilage, which when dried is hard and transparent. "Rind about one-eighth of an inch (3 Mm.) thick, firm, and covered with a nearly smooth pale brown or grayish firmly adherent epicarp. The pulp is juicy, becoming hard and brittle on drying and acquiring an orange-brown or cherry-red color externally; it has a faint aromatic odor, and its taste is mucilaginous, slightly acid, and faintly astringent." *Br. Add.* The mucilage about the seeds is applied to various purposes in the arts, on account of its viscid properties. The rind is used in dyeing. The flowers are deemed refrigerant by the native physicians. The fresh leaves yield by expression a bitterish and somewhat pungent juice, which, diluted with water, is occasionally used in the early stage of catarrhal and other *fevers*. The bark of the stem and root is thought to possess febrifuge properties.

The dried fruit is imported into England in vertical slices, or in broken pieces consisting of a part of the rind with the adherent pulp and seeds. The rind is about one-eighth of an inch thick, covered with a smooth pale brown or grayish epidermis, and internally, as well as the dried pulp, pale brownish-orange, or cherry-red. When moistened the pulp becomes mucilaginous. The fruit is astringent to the taste, and yields its virtues to water by maceration or decoction. Pollock found in it tannic acid, a concrete essential oil, and a vegetable acid (*Am. T. G.*, Feb. 1864), but Flückiger states that the drug does not contain any appreciable quantity of tannin.

The difficulty of obtaining bael in England is said to have led to the substitution for it of *mangosteen*, the fruit of *Garcinia Mangostana*, L. This is in irregular fragments of the rind, without adhering pulp. The pieces are convex, three or four lines or more in thickness, externally covered with a smooth, deep reddish-brown, easily separable coating, and internally pale reddish-brown or reddish-yellow, smooth, with projecting vertical lines. (*P. J.*, May, 1867.)

Bael is employed in *diarrhœa*, *dysentery* with debility of the mucous membrane, and other diseases of the bowels with relaxation. The *decoction*, two ounces of dried fruit in a pint of water boiled down to four fluidounces, is used in *doses* of one to two fluidounces (30–60 Cc.) every two to six hours; or the *Liquid Extract of Bael*,[1] *Br. Add.*, may be given in *doses* of 1 to 2 fluidrachms (3.75–7.5 Cc.).

[1] Bael Fruit, bruised, 20 ounces (or 1000 grammes); Distilled Water, 15 pints (or 15 litres); Alcohol (90 per cent.), a sufficient quantity. Macerate the bruised bael fruit for twelve hours in five pints (or five litres) of the distilled water; pour off and reserve the clear liquor; repeat the maceration a second and third time for one hour, using for each maceration five pints (or five litres) of the distilled water; press the marc, and filter the mixed liquids through flannel. Evaporate to fifteen fluidounces (or 750 Cc.), and, when cold, add enough of the alcohol to produce one pint (or 1000 Cc.) of the liquid extract. Filter or otherwise clarify if necessary. *Br. Add.*

Balanites. *Balanites Roxberghii. Agialida.* (Fam. Zygophyllaceæ.)—The fruit of this plant is used medicinally in India. It contains a principle closely resembling *saponin*. The ripe seed yield about 50 per cent. of a fixed oil (*zachun oil*), which is used for burning. The unripe fruit is anthelmintic and purgative.

Balata. *Gum Chicle. Chicle. Tuno Gum. Leche de Popa*, Fr. *Zapota Gum.*—This is the dried milky juice of the *Bully Tree, Mimusops Kanki*, L. (*Mimusops Balata*, Crueg.; *Achras Balata*, Aub.; *Sapota Muelleri*, Blume), of the Fam. Sapotaceæ, a native of Northern South America from Mexico to Guiana. It is an oxidized hydrocarbon, both physically and chemically closely related to caoutchouc and gutta-percha, of a grayish-white color, with dark spots and veins; specific gravity 1.05; tasteless, but emitting an agreeable odor when warmed. It has the general properties of gutta-percha, differing, however, in being but slightly elastic, a property which specially fits it for the manufacture of transmission belts. Solid and somewhat crumbling at ordinary temperature, it softens at 49° C. (120.2° F.), and can be moulded like gutta-percha. It is used as a substitute for gutta-percha, but more especially in the manufacture of chewing gum, for which purpose it is imported in large amounts from Mexico. It is not used in medicine.

Balm of Gilead. *Balsam of Gilead. Mecca Balsam. Balsamum Meccæ v. Judiacum. Balsamum Gileadense. Baume de la Mecque*, Fr.—The genuine balm of Gilead is the resinous juice of *Commiphora Opobalsamum* (Forst.), Engl. (*Amyris gileadensis*, Linn., *Balsamodendron gileadense*, Kunth) (Fam. Burseraceæ), a small evergreen tree, growing on the Asiatic and African shores of the Red Sea. It was in high repute with the ancients, and is still esteemed by the Eastern nations as a medicine and cosmetic. In Western Europe and in this country it is seldom found in a state of purity, and its use has been entirely abandoned. It is described as a turbid, whitish, thick, gray, odorous liquid, becoming solid by exposure. It possesses no medicinal properties not existing in other balsamic or terebinthinate juices. It was formerly known as *opobalsamum*, while the dried twigs of the tree were called *xylobalsamum*, and the dried fruit, *carpobalsamum*.

Balsam of Cativo. *Cativo Balsam.*—This substance appeared in the London market in 1902 as a substitute for copaiba. It is a balsamic resin, opaque, of a dirty light brown color and slightly bitter taste, and having an extremely adhesive quality. According to Umney it is not soluble in 90 per cent. alcohol, but is soluble in ether and consists chiefly of acid resins with the addition of an oily substance. According to Weigel's analysis it consists of 80 per cent. of resin acids and 2 per cent. of volatile oil. It is said to be used by the natives as a drug, but more probably will be employed to manufacture fly paper and similar substances on account of its viscosity. It is supposed to be a product of *Prioria copaifera* (Fam. Leguminosæ). (See *P. J.*, vol. lxix.; and *Ph. Centralh.*, March, 1903.)

Balsam of Cebur or **Tagulaway.**—*Cebur* or *Tagulaway Balsam* is prepared in the Philippine Islands by boiling the root and twigs of *Parameria vulneraria*, Radl. (Fam. Apocynaceæ), in cocoanut oil, so as to form a yellowish-white, oily liquid, which is used with asserted excellent results for *skin diseases* and *wounds*. (*A. Pharm.*, Nov. 1885.)

Balsam of Lagam. *Lagam Balsam.*—A thick, yellowish, fluorescent liquid, of a peculiar aromatic odor, and bitterish, acrid taste, resembling copaiba. (*A. J. P.*, 1883.)

Balsam of Riga. *Riga Balsam. Balsamum Carpaticum. Balsamum Libam.*—This is usually stated to be a product of *Pinus Cembra*, L. (Fam. Coniferæ), a large tree growing in the mountainous regions and northern latitudes of Europe and Asia. The juice exudes from the extremities of the young twigs, and is collected in flasks suspended from them. It is a thin, white fluid, having an odor analogous to that of the juniper, and possessing the ordinary terebinthinate properties. In this country it is very rare; but it is occasionally brought from Riga or Cronstadt in bottles. Keller of Darmstadt, affirms that Riga Balsam is nothing but the product of the ordinary *Pinus palustris*, Mill. A similar product, called *Hungarian balsam*, is obtained in the same manner from *Pinus Pumilio*, Haenke, growing on the mountains of Switzerland, Austria, and Hungary. The oil derived from the young branches of the *Pinus Pumilio* (*Oleum pini pumilionis, Oleum templinum, Krummholzöl, Pumilinc*) is the most potent agent in the so-called *pine-cure* in the German spas. Schimmel & Co. (*Schim. Rep.*, April, 1897) find it to contain *lævo-pinene, lævo-phellandrene*, and other terpenes, and from 4 to 7 per cent. of *bornyl acetate*, boiling above 185° C. (365° F.). When pure, it is said to be a very fragrant volatile oil, especially adapted for the purposes of inhalation. Internally it may be given in *doses* of from five to ten minims (0.3–0.6 Cc.), in capsules, as a stimulant expectorant.

Balsam of St. Thome. *Pan Oleo, Belam Pu.* A balsam obtained from *Santiriopsis balsamifera* (Fam. Burseraceæ). It is a resinous juice obtained by incisions in the trunk of the tree. It is used as a vulnerary and in diseases of the bladder and respiratory organs. (*Ap. Ztg.*, 1898.)

Balsam of Sulphur. *Oleum lini sulfuratum. Oleum Sulphuratum.*—The old Edinburgh Pharmacopœia directed to boil *eight parts* of olive oil and *one part* of sublimed sulphur together, over a gentle fire, in a large iron pot, stirring them constantly until they united. As the vapors which rose were apt to take fire, a lid was to be at hand to cover the pot, and thus extinguish the flame if necessary. In this way the oil was partly decomposed, and the resulting preparation was an extremely fetid, acrid, viscid, reddish-brown fluid, which was formerly thought useful in *chronic catarrh, consumption*, and other *pectoral complaints;* but inconvenience arose from its acrid properties, and its internal use was abandoned. It is sometimes applied as a stimulant to *foul ulcers*. The *dose* is from five to thirty minims (0.3–1.8 Cc.).

Balsam Wood. *Palo Balsamo.*—This is a South American wood, derived from an unknown tree, which is believed to contain *guaiacin*, and which yields to distillation nearly six parts of a thick viscous aromatic oil. This contains as its chief constituent a crystalline solid of alcoholic character melting at 91° C. (195.8° F.) and corresponding closely to the formula $C_{14}H_{24}O$. It has found employment in perfumery. (*Schim. Rep.*, April and Oct. 1892.)

Balsamorhiza. *Balsamorhiza terebinthinacea* (Hook.), Nutt. (Fam. Compositæ.)—The root of this plant, obtained from Idaho and Oregon, has a strong terebinthinate odor, and is used medicinally in the Western States. It contains volatile oil, fixed oil, resin, organic acid, and sugar (Herman T. Kelly, *D. C.*, 1897, 32).

Baptisia. *Baptisia tinctoria* (L.), R. Br. *Sophora tinctoria*, L. *Podalyria tinctoria*, Michx. *Wild Indigo. Indigo sauvage*, Fr. *Baptisie*, G. (Fam. Leguminosæ.)—This is an indigenous perennial plant, abundant throughout the Eastern United States, in woods and dry barren uplands. The root, which is used medicinally, is of a dark brown color, of a slight peculiar odor in the dried state, and of a nauseous, bitter, somewhat acrid taste. Its virtues appear to reside chiefly in the cortical portion. B. L. Smedley thought that he had found in it a peculiar alkaloid. (*A. J. P.*, July, 1862, 311.) Jno. A. Weaver has shown this to be a salt of lime. (*A. J. P.*, xliii. 251.) F. V. Greene, U. S. N., obtained in a crystalline condition the hydrochloride of an alkaloid. (*A. J. P.*, 1879, 577.) Von Schroeder (*Ph. Post*, Oct. 1885) affirms that there are in baptisia root three active principles: a glucoside, *baptisin*, insoluble in water; a glucoside, *baptin*, soluble in water, and an alkaloid, *baptitoxine*. Of these baptisin is an indifferent, bitter substance, baptin a feeble laxative, and baptitoxine an active poison, causing at first acceleration of respiration and increase of reflex activity, and afterwards death from central paralytic asphyxia. Plugge (*A. Pharm.*, 233, 4te Heft, 1895) finds the alkaloid of *Baptisia tinctoria* to be *cytisine*. K. Gorter (*A. Pharm.*, No. 5, p. 235, 1897, p. 321) investigated baptisin and by hydrolization produced *baptigenin*. By boiling this with solution of sodium hydroxide he obtained *baptigenetin*. He believes baptitoxine to be identical with cytisine. He examined Merck's baptisin and obtained crystalline needles of *pseudobaptisin*, $C_{27}H_{30}O_4$. Both the seeds and root contain the alkaloid. For a process for preparing baptisin, see Ouch's method (*C. D.*, 1897, p. 524). In large doses wild indigo is said to operate violently as an emetic and cathartic; in smaller, to produce only a mild laxative effect. Stevens has employed a decoction of the root advantageously in *epidemic dysentery*. (*N. Y. M. J.*, iv. 358.) A pale blue coloring substance has been prepared from the plant as a substitute for indigo, but is greatly inferior. Another species, *B. alba* (L.), R. Br., or *prairie indigo*, which is abundant on our northwestern prairies, is said to have similar properties, and to be sometimes used as a substitute for *B. tinctoria*.

Barbados Nuts. *Purging Nuts. Physic Nuts. Semen Ricini Majoris. Pignon d'Inde* (*des Barbades*), *Semences du Médicinier*, Fr. *Purgirnuss, Schwarze Brechnuss*, G.—These are the seeds of the *Curcas purgans*, Adanson (*Jatropha Curcas*, L.) (Fam. *Euphorbiaceæ*), growing in Brazil, the West Indies, and on the western coast of Africa. The fruit is a three-celled capsule, containing one seed in each cell, and is about the size of a walnut. The seeds are blackish, oval, about eight lines long, flat on one side, convex on the other, and the two sides present a slight longitudinal prominence. They yielded to Soubeiran fixed

oil, an acrid resin, sugar, gum, a fatty acid, glutin, a free acid, and salts. A. Siegel (*Bot. Centralb.*, xlvii. 120) found in the seeds a poisonous principle, *curcin*, which he states is analogous to *ricin*, and places in the class of toxalbumins. The oil may be separated by hot expression. When fresh it is without odor or color, but becomes yellowish and slightly odorous by time. When cold it deposits a white substance, which is probably *palmitin*. Alcohol does not readily dissolve it. It is sometimes called *jatropha oil*. It is colorless, odorless, of sp. gr. 0.91 at 19° C. (66.2° F.), solidifies to buttery consistence at —8° C. (17.6° F.). Bouis believed it to be the glyceride of a peculiar acid, *isocetic acid*, but it is now considered to be a mixture of palmitin and myristin. Its purging quality is, however, undoubtedly due to the presence of *ricinoleic acid*. From three to five of the *seeds*, slightly roasted and deprived of their envelopes, operate actively as a cathartic, and not infrequently produce nausea and vomiting, with a sense of burning in the stomach. The *oil* purges in the *dose* of twelve or fifteen drops (0.6–0.75 Cc.), and is analogous in its action to croton oil, though less powerful. The cake left after the expression of the oil is an acrid emeto-cathartic, operating in the *dose* of a few grains. Either of these substances may produce serious consequences in overdoses. The leaves of the plants are rubefacient, and the juice is said to have been usefully employed as a local remedy in *piles*. (*A. J. P.*, 1893, 335.) The seeds of *Curcas multifidus* (L.), Endl. (*Jatropha multifida*, Linn.), have similar properties, and yield a similar oil. This species also grows in Brazil and the West Indies. (See Peckoldt, *A. Pharm.*, 1887, 415.)

Jatropha gossypifolia, Linn., of South America, is used as a local application in *leprosy* and to indolent *ulcers*, and probably has similar physiological influence to curcas. *Jatropha urens*, L., must be excessively poisonous, as accidental contact of the wrist of a gardener in Kew with a young plant produced such symptoms that for five minutes the man was thought to be dead. (*P. J.*, April, 1872, 863.)

The roots of the *Jatropha cardiophylla*, Muell. Arg., are largely employed in Southern Arizona and Mexico for tanning purposes. According to the analysis of Josiah C. Peacock they contain, when thoroughly dried, over 5 per cent. of tannic acid. (*A. J. P.*, 1900, 432.)

Barium Chloride. *Barii Chloridum. U. S.* 1870. *Chlorure de Baryum*, Fr. *Chlorbarium, Chlorbaryum*, G. $BaCl_2.2H_2O$.—"Take of Carbonate of Barium, in small pieces, Muriatic Acid, each, *four troyounces;* Water *a pint*. Mix the Acid with the Water, and gradually add the Carbonate of Barium. Towards the close of the effervescence apply a gentle heat, and when chemical action has ceased, filter the liquor, and evaporate so that crystals may form when it cools." *U. S.* 1870. Another plan is that which procures it from the sulphate, as directed in the old Edinburgh Pharmacopœia. In this the sulphate, previously ignited and powdered, is mixed with charcoal and exposed to a low white heat, by which its constituents are deoxidized, and barium sulphide produced, the oxygen escaping in combination with the carbon as carbon dioxide. The barium sulphide, after having been dissolved in water, is decomposed by the addition of hydrochloric acid, hydrogen sulphide being evolved, and barium chloride formed in solution, from which, in the usual manner, the solid salt is obtained. The reactions for these two processes are:

$$BaCO_3 + 2HCl = BaCl_2 + H_2O + CO_2$$
$$BaSO_4 + C_4 = BaS + 4CO$$
$$BaS + 2HCl = BaCl_2 + H_2S$$

Of these processes, that in which the native carbonate is used is the simplest and most convenient; but the carbonate is comparatively a rare mineral, and, as the sulphate in fine powder is a cheap article of commerce under the name of *blanc fixé*, or *permanent white*, and the most abundant ore is also the native sulphate (barytes), this compound is almost always used for obtaining barium chloride and the other barium salts.

Barium chloride is a permanent white salt, possessing a bitter and disagreeable taste. It crystallizes in rhombic tables with bevelled edges. It dissolves in about two and a half times its weight of cold water, and in a little more than its own weight at 106° C. (222.8° F.), the boiling point of a saturated solution. It is scarcely soluble in absolute alcohol, but dissolves in rectified spirit. Alcohol impregnated with it burns with a greenish flame. When exposed to heat, it decrepitates and loses its water of crystallization, and at a red heat fuses. It is decomposed by the sulphates, oxalates and tartrates, and the alkaline phosphates, borates, and carbonates; also by silver nitrate, *mercurous* salts, and lead acetate. When pure it does not deliquesce. Its solution is not affected by ammonia, which proves the absence of aluminum and ferric oxide, or by hydrogen sulphide, which shows that neither copper nor lead is present.

After the whole of the barium has been precipitated by an excess of sulphuric acid, the supernatant liquid is shown to be free from lime by the non-action of sodium carbonate. If strontium be present, an alcoholic solution of the salt will burn with a red flame.

Medicinal Properties.—Rabuteau found that the intravenous injection of barium chloride produced in the dog a sudden cry, convulsions, and death, with remarkable fibrillary muscular contractions, continuing after death. Laborde (*B. A. M.*, July, 1891) has shown that when the chloride is very slowly injected, the heart beats become slower, the pupils dilate, the animal shrieks, and death occurs from centric arrest of the respiration, the blood and the muscles, after death, remaining of a bright red color. Given by the mouth, it produced in the dog vomiting, choleraic diarrhœa, paresis, collapse, and death. After small doses, barium has been found by Krahmer and by J. Neumann in the liver, kidney, spleen, lungs, and nerve centres, and especially abundant in the bones. (*A. G. P.*, Bd. xxxvi.) In a case reported by Ogier and Socquet (*Annales d'Hygiéne Publ.*, May, 1891) death followed in five hours the ingestion of three hundred grains (19.4 Gm.). Bardet (*S. M.*, Dec. 1891) reports recovery after sixty grains (3.9 Gm.). Barium chloride has been employed in *sclerosis* of the nerve centres, but is of no value. It may prove to be a useful heart stimulant, since it is asserted by Lauder Brunton, confirmed by H. A. Hare, that in small doses it is a rapidly acting stimulant to the heart, steadying its rhythm and increasing the volume and force of the blood thrown out by the systole. (*Pract.*, June, 1889.) *Liquor Barii Chloridi, U. S.* 1870 (a troyounce of barium chloride in three fluidounces of water) is given in five minim (0.3 Cc.) *doses*.

Barium Dioxide. *Barii Dioxidum. U. S.* 1890. *Barium Peroxide.* $BaO_2 = 168.16$.—"Commercial, anhydrous Barium Dioxide. It should be kept in well-closed vessels." *U. S.* 1890.

It is used solely for making hydrogen dioxide. Barium forms two oxides, BaO and BaO_2; the former is produced by the action of oxygen or dry air on barium. Barium dioxide, BaO_2, is made by heating barium oxide to about 450° C., when it takes up another atom of oxygen. It is "a heavy, grayish-white, or pale yellowish-white, amorphous, coarse powder, odorless and tasteless. When exposed to the air, it slowly attracts moisture and carbon dioxide, and is gradually decomposed. Almost insoluble in cold water, with which, however, it forms a definite hydrate, and to which it imparts a decidedly alkaline reaction. Hydrochloric, phosphoric, and most other mineral acids decompose it, producing the corresponding barium salts, and hydrogen dioxide, which remains in solution for a considerable time, if the reaction has taken place in the cold, and an excess of the acid is present. When heated to a bright red heat, Barium Dioxide fuses, loses oxygen, and is reduced to barium oxide. Barium Dioxide should be dissolved by diluted hydrochloric or phosphoric acid without leaving more than a trace of residue. If 2.11 Gm. of Barium Dioxide be dissolved, as completely as possible, in ice-cold water to the volume of 25 Cc., with the aid of 7.5 Cc. of phosphoric acid, and 5 Cc. of this solution (corresponding to 0.422 Gm. of the Dioxide) be measured off for assay, it should require not less than 40 Cc. of decinormal potassium permanganate volumetric solution to impart to the liquid a permanent pink tint, corresponding to not less than 80 per cent. of pure Barium Dioxide (each Cc. of the volumetric solution indicating 2 per cent. of the latter)." *U. S.* 1890.

Barium dioxide is not used medicinally.

Barium Iodide. *Barii Iodidum. Iodure de Baryum*, Fr. *Jodbarium*, G. BaI_2.—This compound may be formed by double decomposition, by adding native barium carbonate in powder to a boiling solution of ferrous iodide. M. Henry, Jr., obtained it by decomposing a solution of barium sulphide by a concentrated alcoholic solution of iodine. Sulphur is precipitated, which is separated by filtration, and barium iodide formed in solution, from which it is obtained in the solid state by rapid evaporation to dryness. Barium iodide crystallizes in small, colorless needles, which deliquesce slightly, and are very soluble in water. The solution promptly undergoes decomposition on exposure to the air, barium carbonate being precipitated, and iodine set free, which colors the solution. It has been used with advantage by Jahn and Lugol, as an alterative, in *scrofulous affections* and morbid growths. The *dose* is an eighth of a grain (0.008 Gm.) three times a day, gradually increased to three grains (0.2 Gm.).

Barium Sulphate. *Barii Sulphas.* $BaSO_4$. (See *Barium Chloride.*)—Barium sulphate is a heavy, lamellar, brittle mineral, varying in sp. gr. from 4.4 to 4.6. It is generally translucent, but sometimes transparent or opaque, and its usual color is white or flesh-red. When crystallized, it is usually in very flat rhombic prisms. Before the blowpipe it strongly decrepitates, and melts into a white enamel, which, in the course of ten or twelve hours, falls to powder. It is thus partially converted into barium sulphide, and, if applied to the tongue, will give a taste like that of putrid eggs, from the formation of hydrogen sulphide. This salt, on account of its great insolubility, is not poisonous. It is, however, soluble in a great excess of diluted hydrochloric acid. (*Chem. News*, 1871, 69.) Ground to fine powder it is often mixed with white lead, but impairs the quality of that pigment. The artificial barium sulphate, under the name of *permanent white* or *blanc fixé*, is much used in the arts as a water-color. It is made from both the native sulphate and carbonate. It forms a dazzling white color, unalterable by light, heat, air, or hydrogen sulphide.

Barringtonia. *Barringtonia speciosa.*—The large Indo-Malayan tree, *Barringtonia speciosa*, Forst., contains, according to Maresuw, 3.3 per cent. of *barringtonin*, a colorless, amorphous glucoside, having the formula $C_{18}H_{28}O_{10}$, and belonging to the saponin group. It is said to be an active cardiac poison. (*S. W. P.*, xli. 1903, pp. 423, 435.)

Bassora Galls are cultivated in Persia and Asia Minor, and are exported by way of Smyrna for tanning purposes. They come into commerce ground and pressed into the form of bricks. They contain, on an average, 27 per cent. of tannin.

Bassora Gum. *Caramania Gum. Hog Gum. False Tragacanth. Kutera Gum.*—This substance came into commerce originally from the neighborhood of Bassora, on the Gulf of Persia; but is often found mixed with gum brought from other countries, and is said to be the product of the almond and plum trees. It is in irregular pieces, of various sizes, never very large, brown or yellow, intermediate in the degree of its transparency between gum arabic and tragacanth, inodorous, tasteless, and possessed of the property of yielding a slight sound when broken under the teeth. But a small portion of it is soluble in water, whether hot or cold. The remainder swells up considerably, though less than tragacanth, and does not, like that substance, form a gelatinous mass, as it consists of independent granules which have little cohesion. The soluble portion is pure gum or *arabin*, and, according to Guérin, constitutes 11.2 per cent. The insoluble portion consists of *bassorin*, associated with a small proportion of saline substances, which yield, when the gum is burnt, 5.6 per cent. of ash. The gum is employed only to adulterate tragacanth, and for this purpose is sometimes whitened by means of white lead.

Batiator Root.—The root of the *Vernonia nigritiana*, Oliver and Hiern. (Fam. Compositæ), a widely distributed plant of West Africa, is said to be largely used in Senegal as a febrifuge, emetic, and anti-dysenteric, resembling ipecac somewhat in its therapeutic application. The plant is a composite which climbs to the height of a foot and a half, and yields a root composed of numerous fibres from twenty to thirty centimeters long, slender and grayish yellow externally, a number of which are united to form an irregular knotty rhizome, unequally spherical at the neck or crown, and covered at this point with silky hairs. The active constituent is a glucoside, *vernonin*, $C_{10}H_{24}O_7$. (Heckel and Schlagdenhauffen, *A. de P.*, Aug. 1888. See also *Zeit. An. Chem.*, 1893, p. 364.) This is a hygroscopic whitish powder, forming a pale yellow solution with water, and only slightly soluble in ether and in chloroform. By the absorption of 2 molecules of water it is split into a resinous body and glucose. Physiological experiments made upon frogs show vernonin to be a cardiac poison

comparable to digitalin, but about twenty-four times less active; it is also said to act as a paralyzant to the motor nerve trunks. (*P. J.*, June 30, 1888.)

Baume Tranquille. *Balsamum Tranquillans.* This is a preparation of some note, directed by the French Codex, and consisting essentially of olive oil holding in solution the active matters of certain narcotic and aromatic plants. According to the Codex the fresh plants (belladonna, henbane, etc.) are boiled with the oil in a copper kettle until all their water is driven off, and a gentle heat maintained until the oil acquires a fine green color; the oil is then expressed and the essential oils of thyme, rosemary, peppermint, and other plants are added. The preparation is used externally by friction as an anodyne in local pains, but especially to relieve *earache*, a few drops being placed in the ear on a pledget of cotton. For old formula see *J. P. C.*, August, 1862, 121. An improved process was proposed by W. C. Bakes. (*A. J. P.*, 1862, 22.) We have still further modified this, and the formula is as follows. Take of Alcoholic Extracts of Belladonna, Conium, Hyoscyamus, and Stramonium, each 30 grains; Aqueous Extract of Opium, 12 grains. Soften the extracts with one fluidounce of Boiling Water, and add four fluidounces of Olive Oil. Digest this mixture with a gentle heat until the water has been evaporated, and then strain or filter. To this add one minim of each of the following volatile oils: Sage, Wormwood, Lavender, Thyme, Peppermint, Rue. It should be used with care.

Baycuru Root.—This is the root of a Brazilian plant, probably the *Statice brasiliensis*, Boiss. (Fam. Plumbagineæ), which is used by the natives as a discutient in glandular swellings and as an astringent gargle. F. A. Dalpe (*A. J. P.*, xiv. 361) believes that he has found in it an alkaloid, *baycurine*, besides volatile oil, gum, glucose, etc. C. Symes found in it 12.5 per cent. of tannic acid. (*Newer Mat. Med.*, 51.)

Bdellium.—Under this name have been included various gum resins having little or nothing in common. The commercial Bdelliums are naturally divided into the Indian and the African, but E. M. Holmes, in an elaborate study (*P. J.*, lxi.), recognizes five commercial varieties of African Bdellium,—namely, 1. Perfumed Bdellium, which is believed to be collected in Northeastern Africa; 2. African Bdellium; 3. Opaque Bdellium; 4. Hotai Bdellium from the Somaliland, and 5. Non-aromatic acrid gum resin. *Perfumed Bdellium*, or *Habaghadi*, closely resembles in appearance *Somali myrrh*, but has a less bitter, more acrid and peculiar taste which distinguishes it at once from myrrh. *African Bdellium*, proper, occurs in hard, roundish pieces, of a pale to dark grayish-brown color with a resinous unstreaked fracture, dotted with glistening points. The odor is said to recall that of cedar pencils; the taste is slightly acrid but not bitter. *Opaque Bdellium* is of a pale brown color and has a bitter, slightly acrid taste and cedar-like odor; it occurs in tough, roundish pieces about an inch to an inch and a half in diameter. *Hotai Resin* resembles opaque bdellium, but is distinguished by its lack of odor, its slightly soapy taste, and its brittleness. These four bdelliums of Holmes are for the most part collected in Somaliland. They are the product of different species of Commiphora, small trees or large shrubs which suggest in appearance the English hawthorn. The species are by Holmes divided into four groups. (See *P. J.*, lxxii.) According to A. Engler, the resin of *Commiphora roxburghiana* (Stocks), Engl., is the commercial *Gugul*, or *India Bdellium*, which is employed in the East Indies as a remedy for *leprosy*, *rheumatism*, and *syphilis*. Bdellium sometimes comes mixed with gum arabic and gum senegal. It is either in small roundish pieces, of a reddish color, semi-transparent, and brittle, with a wax-like fracture, or in large irregular lumps, of a dark brownish-red color, less transparent, somewhat tenacious, and adhering to the teeth when chewed. It has an odor and taste like that of myrrh, but weaker. It is infusible and inflammable, diffusing while it burns a balsamic odor. According to Pelletier, it consists of 59 per cent. of resin, 9.2 of gum, 30.6 of bassorin, and 1.2 of volatile oil, including loss. In medicinal properties it is analogous to myrrh, and was formerly used for the same purposes. In Europe it is still occasionally employed in plasters. The *dose* is from ten to forty grains (0.65–2.6 Gm.).

Bebeeru Bark.—*Nectandræ Cortex*, Br. 1885, is the dried bark of *Nectandra Rodiæi*, Hook. (*N. Rodiei*, Schomb.) (Fam. Lauraceæ). The *bebeeru*, *bibiru* or *sipiri*, as it has been indifferently named, is a tree sixty feet or more in height, growing in Guiana and the neighboring regions of South America, and yielding the wood known as *greenheart*.

The bark occurs in large, flat, heavy pieces, from one to two feet long, from two to six inches broad, and three or four lines thick, with a rough and somewhat fibrous fracture, of a grayish-brown color on its outer surface and a dark cinnamon color on the inner. It has an intensely bitter, somewhat astringent taste. On microscopical examination it is seen to be composed chiefly of very thick-walled parenchymatous cells. The inner liber contains peculiar short, sharp-pointed, saw-shaped liber cells. Within the cells dark brown masses (colored greenish black by ferrous sulphate) may be seen. Analyzed by Maclagan of Edinburgh, it was found to contain tannic acid of the kind that precipitates the salts of iron green, resin, gum, sugar, albumen, fibrin, various salts, and two peculiar alkaloids, named respectively *bebeerine*, $C_{18}H_{21}NO_3$, and *sipirine*, the former soluble and the latter insoluble in ether. In the seeds, besides the foregoing principles, Maclagan found 53 per cent. of starch, and a peculiar white, crystalline, volatile acid, which he named *bebeeric acid*. The alkaloids are extracted together from the bark, in the form of impure sulphates, by a process similar to that for preparing quinine sulphate. This preparation is known as the *commercial bebeerine sulphate*. The official process of the Br. Pharmacopœia of 1885 also yielded an impure alkaloid. The alkaloid was obtained pure by Maclagan and Tilley by the following process: The impure sulphate is dissolved in water and precipitated by ammonia. The precipitate, mixed with an equal weight of recently precipitated lead oxide, and dried, is treated with absolute alcohol, which, being evaporated, leaves the two alkaloids in the form of a translucent resinoid mass. The bebeerine is separated by means of ether, which yields it by evaporation. Another process is to dissolve the precipitate obtained by ammonia, previously washed, in diluted acetic acid, add lead acetate, precipitate by *potassium hydroxide*, exhaust the precipitate by strong ether, evaporate the solution until syrupy, dissolve the residue in abso-

lute alcohol, and pour the solution gradually into water. A flocculent deposit is formed, which when washed and dried, is the alkaloid in question. Flückiger found the commercial article to yield a very trifling amount, less than 25 per cent. of the pure alkaloid. It is in dark brown translucent scales, yellow when reduced to powder, of a strongly bitter taste, and soluble in water and alcohol. According to Flückiger (*P. J.*, xi. 193, 1869), pure bebeerine is a white, amorphous powder, whose concentrated aqueous solution is not precipitated by tartar emetic, but affords abundant white precipitates with sodium phosphate, potassium nitrate, iodide, or iodohydrargyrate, mercuric chloride, potassium platino-cyanide, and nitric or iodic acid. Its acetate yields yellow amorphous precipitates with potassium ferrocyanide, or potassium ferricyanide, potassium chromate, potassium dichromate, and platinum dichloride. D. B. Dott has confirmed the results of Flückiger's examination, although he found a larger percentage of alkaloids than the latter did. Owing to the difficulty of obtaining the alkaloids in crystals, it was almost impossible to ascertain the quantity present. (*Y. B. P.*, 1881, 442; 1885, 420.) Bebeerine was asserted by Walz in 1860 to be identical with *buxine*, obtained from *Buxus sempervirens*. This statement was confirmed by Flückiger, who proved that *pelosine* was identical with both of the above principles. (*P. J.*, xi. 1870, 192.) The alkaloid dried at 100° C. (212° F.) has the formula $C_{18}H_{21}NO_3$. (Palen gives $C_{19}H_{21}NO_3$ as the formula.)

By treating the mixed alkaloids obtained from the wood with chloroform, Douglas Maclagan and Arthur Gamgee have separated an alkaloid, *nectandrine*. It is a white powder, amorphous, and intensely bitter. It differs from bebeerine in being much less soluble in ether, and, when treated with strong sulphuric acid and manganese dioxide, in giving rise to a magnificent green, slowly passing into a beautiful violet, and, lastly, in having a higher molecular weight, its formula being $C_{20}H_{23}NO_4$. After separating nectandrine from the mixed bases, the authors succeeded in extracting another alkaloid, different from bebeerine, much more soluble in water than nectandrine, but insoluble in chloroform. (*A. J. P.*, 1869, 453.)

Nectandra is tonic, somewhat astringent, and febrifuge, resembling cinchona in its virtues, though much inferior, at least in antiperiodic power. It has generally been employed in the form of the impure bebeerine sulphate, and sometimes with great asserted success, in the treatment of *intermittent* and *remittent fevers*. Rodie recommended it as early as 1834; but later experience shows that, though frequently successful, it often fails, and cannot be relied on as a substitute for quinine. From twenty grains to a drachm (1.3–3.9 Gm.) may be given between the paroxysms, in *doses* of two grains (0.13 Gm.). Bebeerine sulphate has been given in *dysmenorrhœa*, *menorrhagia*, and *leucorrhœa*, and in *blennorrhœal discharges*. The *dose* is from two to five grains (0.13–0.32 Gm.).

Bedeguar. *Fungus Rosarum.*—An excrescence upon the *sweetbrier* or *eglantine*, and other species of *Rosa*, produced by the puncture of insects, especially by one or more species of *Cynips*. It is of irregular shape, usually roundish, about an inch in diameter, with numerous cells containing larvæ. It is nearly odorless, of slightly astringent taste, and was formerly considered a diuretic and anthelmintic. *Dose*, from ten to forty grains (0.65–2.6 Gm.).

Benzacetin. *Acet-amido-ethyl Salicylic Acid.* $C_6H_3\begin{cases} OC_2H_5 \\ NH.COCH_3 \\ COOH \end{cases}$.—This occurs in colorless crystals, melting at 205° C. (401° F.), sparingly soluble in water. It has been recommended by Frank as an analgesic in *migraine* and other forms of *neuralgia*, and as a sedative in nervous excitement. It has been used with alleged excellent results in conjunction with caffeine, ten parts to one. *Dose*, from eight to fifteen grains (0.5–1.0 Gm.) two or three times a day, or repeated in an hour for relief.

Benzanilide. — *Phenylbenzamide*, $C_6H_5NH(C_7H_5O)$, is closely related to acetanilide, containing the benzoyl radical C_7H_5O instead of the acetyl radical C_2H_3O. White, crystalline, odorless powder melting at 163° C. (325.4° F.), practically insoluble in water but soluble in alcohol. This substance has been recommended by Cahn as an antipyretic in diseases of children in *doses* of from one and a half to three grains (0.096 to 0.2 Gm.) for children one to three years of age, and three to six grains (0.2 to 0.4 Gm.) when from four to eight years old. Forty-five grains (3 Gm.) can be given to the adult without injury. It has been little used.

Benzo-Iodo-Hydrine. — Prepared by mixing *benzoyl iodide* and *epichlorhydrin*. It forms a brown, fatty mass, soluble in ether, alcohol, and petroleum oils, insoluble in glycerin. It is decomposed at 100° C. (212° F.), with separation of iodine. For dispensing, it is usually mixed with powdered sugar, so that the mixture contains 3½ per cent. of benzo-iodo-hydrine, and a teaspoonful is about the equivalent of sixteen grains of potassium iodide. It is used as a substitute for potassium iodide, because of its freedom from irritating properties and from tendency to produce iodic poisoning.

Benzo-Naphthol. *Benzoyl-Naphthol. β-Naphthyl Benzoate.* $C_{10}H_7.O(C_7H_5O)$.—A compound of β-naphthol and benzoic acid, made by the action of benzoyl chloride upon β-naphthol. It is a whitish crystalline powder, without taste or odor, melting at 110° C. (230° F.). It occurs in microscopical crystals, almost odorless and tasteless, nearly insoluble in water at ordinary temperatures, more soluble in alcohol, with solubility rising rapidly with the temperature, but most soluble in chloroform. "A hot alcoholic solution should not give any cherry-red coloration when an equal volume of nitric acid and a few drops of mercuric nitrate solution are added, which would indicate the presence of free β-naphthol." This substance, which was proposed by Yvon and Berlioz (*Pract.*, Dec. 1891) as especially efficacious as an intestinal antiseptic, has been reported upon by Gilbert (*S. M.*, May, 1892), who affirms that it is of little value in *gastric fermentation*, but very valuable in *intestinal* fermentation. It is probably slowly broken up in the intestines into benzoic acid and naphthol, and the experiments made by Ewald (*B. K. W.*, 1892) indicate that it has a positive influence upon intestinal fermentation, a conclusion confirmed by various French clinicians. It appears to be free from irritant properties, and to be a very useful remedy in chronic *diarrhœa;* also in *senile pruritus* dependent upon intestinal indigestion. It is best administered in small *doses* of from four to eight grains (0.26–0.5 Gm.), re-

peated frequently, in capsule; as much as seventy-five grains (5 Gm.) daily may be given to an adult.

Benzo-Phenoneid. *Tetra-methyl-diapsido-benzo-phenoid.*—This substance, which is soluble in 100 parts of water, has been proposed by Galezowski as a non-irritant and efficient germicide, and as a local application in ulcerative diseases of mucous membranes or skin. (*L. L.*, Jan. 1891.)

Benzoin. *Benzoin Benzoin* (L.), Coulter. *Lindera Benzoin*, Blume. *Laurus Benzoin*, L. (Fam. Lauraceæ.) *Spicewood. Spice-bush. Fever-bush. Wild Allspice. Laurier Benzoin*, Fr. *Benzoelorbeer*, G.—An indigenous shrub, all parts of which have a spicy, agreeable flavor, strongest in the bark and berries. By warming and expression A. W. Miller obtained from the berries 50 per cent. of oily material, which, on distillation, yielded about 2 per cent. of volatile oil. The latter had a sp. gr. of 0.850, was thin, bright green, of a warm aromatic taste, and a fragrant odor. J. M. Jones found it to be of the cinnamyl series. (*Proc. A. Ph. A.*, xxvi. 772; also *A. J. P.*, xlv. 300; xlvii. 246.) The small branches are said to be employed in the form of infusion or decoction, by the country people, as a vermifuge, and an agreeable drink in *low fevers*, and the bark has been used in *intermittents*. The berries, dried and powdered, were sometimes substituted, during the Revolutionary War, for allspice. The oil is feebly aromatic. (*A. J. P.*, xlv. 300; *Ibid.*, xlvii. 246.)

Benzosol. *Benzoyl Guaiacol. Guaiacol Benzoate.*—A colorless crystalline powder, almost free from odor and taste. It melts at 59° C. (138.2° F.). It is prepared from guaiacol, $C_6H_4\begin{cases}OCH_3,\\OH\end{cases}$ and benzoyl chloride, or benzoic acid, and has the formula $C_6H_4\begin{cases}OCH_3\,(1)\\OCO.C_6H_5\,(2)\end{cases}$ The compound is insoluble in water, soluble with difficulty in hot glacial acetic acid, readily so in chloroform, ether, and hot alcohol. In the digestive tract, it soon splits up into guaiacol and benzoic acid; this decomposition occurs partially in the stomach, but chiefly in the small intestine. It is said to appear in the urine as guaiacol and benzoic acid, and their derivatives.

Benzosol was first made by Bougartz, and highly commended by Walzer and Hughes (*D. M. W.*, 1891) as a substitute for creosote in *phthisis*, and has been used to a considerable extent by clinicians as an intestinal antiseptic in *intestinal indigestion, diarrhœa, typhoid fever*, and other conditions. It has also been used successfully in *cystitis*, and is affirmed by Piatokowski, J. Blake White, and others to be valuable in the treatment of *diabetes*. Summerbrodt has given it continuously in *phthisis* with excellent results in *doses* of twenty-four grains (1.6 Gm.) a day, and it is probable that larger amounts may be safely administered.

Benzoyl-acetyl-peroxide. *Benzozone. Acetozone.* $C_6H_5CO.O.O.CH_3CO$.—The pure peroxide forms a white crystalline mass melting at 36.6° C. (98° F.). When gradually heated it slowly decomposes and evaporates; if suddenly heated it almost instantly decomposes and in a tightly-stoppered bottle an explosion will follow. Grinding, compressing, or pounding the undiluted substance will often bring about the same result. In crystalline form, the substance is soluble in oils to the extent of about 5 per cent., slightly soluble in alcohol, moderately soluble in ether, chloroform, and carbon tetrachloride, although gradually decomposed by all the solvents with the exception of neutral petroleum oils. It is decomposed by contact with alkaloids and organic matter of all kinds. It is slowly hydrolyzed and decomposed by water. Acetozone of the markets is benzoyl-acetyl-peroxide diluted with a neutral drying powder so that 50 per cent. of the pure article is represented. Benzoyl-acetyl-peroxide is moderately soluble in water so that fifteen grains of it may be dissolved in one-half gallon of boiled or distilled water, and the solution should be used within thirty-six hours after it is made. If the commercial drug be employed thirty grains may be used in the half gallon; the solution should be allowed to settle and be decanted without filtration.

Benzoyl-acetyl-peroxide is a very active germicide. Experiments in the laboratories of the United States government in the Philippines show that 1 part of the hydrolized substance to 177 of water, and containing only 0.05 per cent. of active oxygen, destroys all germs, including spores, almost instantly, and even at a dilution of 1 in 3000, vegetating germs, as a rule, are killed within one minute, but the spores require an appreciable time. On comparing these results with similar ones with hydrogen dioxide, 1 in 1000, and phenol 5 per cent., it was shown that hydrogen dioxide, although it contained ten times as much active oxygen as the solution of benzoyl-acetyl-dioxide, was by no means as effective, and the same may be said of phenol.

It was further shown that 1 part in 1000 absolutely destroys and that 1 in 30,000 distinctly inhibits the growth of the comma bacillus. In the experiments of Ferer and Novy (*Am. Chem. J.*, vol. xxvii., No. 3, March, 1902), one drachm (3.9 Gm.) of it a day, for weeks, given a dog weighing eight kilos, produced no sensible effect. Charles L. Bliss has shown that the peroxide is eliminated in the form of hippuric acid. In internal medicine benzoyl-acetyl-peroxide has been used in the United States hospitals with most excellent results in the treatment of *cholera*, given in double capsules in *doses* of from three to five grains (0.2–0.32 Gm.) every two to four hours. It was found that when the stomach was full at the time of administration vomiting frequently occurred, probably being due to the decomposition of the peroxide by the organic matter present, since no irritation was produced when the stomach was empty. Benzoyl-acetyl-peroxide has been employed primarily by Wasdin, and subsequently by Harris and others (*T. G.*, 1902–1903), in *typhoid fever* with alleged most extraordinary results in the reduction of the local and general symptoms, —one hundred and thirty to two hundred and ten grains (8.3–13.6 Gm.) being administered in the twenty-four hours. Acetozone has also been employed locally as a germicide with excellent results in *gonorrhœa, malignant œdema, tinea tonsurans, infected ulcers*, and similar affections. In surgical cases acetozone may be applied directly to the wound. When used as an intestinal antiseptic in typhoid fever or in conditions similar to those resulting from this disease, a 1 in 1000 solution should be freshly prepared each day, and administered almost *ad libitum*.

Benzoyl Ecgonine.—This substance is made by heating cocaine in aqueous solution to decomposition. For details, see Paul, *P. J.*, Oct. 17, 1885, March 27, 1886; also, Skraup, *Sitzungsb. Wiener Akad.*, 1885. The reaction consists in the substitution in cocaine $[C_{16}(CH_3)H_{18}NO_4]$ of an

atom of hydrogen (H) for the methyl group (CH_3). There results $C_{16}(H).H_{18}NO_4$ or $C_9H_{14}(C_7H_5O)NO_3$ = benzoyl ecgonine; while CH_3OH (methyl alcohol) is formed at the same time. M. R. Stockman (*J. A. P.*, vol. xxi.) finds that it acts like caffeine, but less powerfully. It does not paralyze the sensory nerves.

Benzoyl-Eugenol.—*Benzeugenol*, $C_{10}H_{11}(C_7H_5O)O_2$, occurs in colorless prisms or crystals, melting at 70.5° C. (158.9° F.), soluble in alcohol, ether, and chloroform, insoluble in water. It is similar in its properties and medicinal uses to *cinnamyl-eugenol*, $C_{19}H_{18}O_3$. Both are used as antiseptics and in the treatment of *tuberculosis*.

Benzoyl Tropeine, $C_{15}H_{19}NO_2 + 2H_2O$, is formed by heating tropine with benzoic and dilute hydrochloric acids to 100° C. (212° F.), when the benzoyl radical, C_7H_5O, derived from benzoic acid, $C_6H_5CO.OH$, replaces a hydrogen atom of the tropine, $C_8H_{15}NO$, and $C_8H_{14}(C_7H_5O)NO$ is produced. It forms silky needles, fusing at 58° C. (136.4° F.). When deprived of water, the anhydrous base fuses at from 41° to 42° C. (105.8° to 107.6° F.), and can be sublimed without decomposition. It has a strong basic reaction, and its salts are not very soluble.

Filehne (*B. K. W.*, vii. 1887) has found that benzoyl tropeine is a powerful local anæsthetic, also affecting the pupil and accommodation like other tropeines. He also found other benzoyl compounds to be local anæsthetics, *benzoyl methyl-triacetonalkamine* being the most powerful, *benzoyl quinine* next, *benzoyl morphine* the least.

Berberis.—This genus belonging to the natural order Berberidaceæ comprises various shrubs having a yellow inner bark and wood, probably most of which are more or less medicinal. The bark of the root of *B. vulgaris*, L., was formerly included in the secondary list of the U. S. Pharmacopœia, under the name of *Berberis*. *Berberis aquifolium* is official in U. S. P. 8th Revision (see page 236). *Berberis*, Br. Add., is the stem of *Berberis aristata*, DC., a plant of Northern India.

Lycium, or λύκιον of the ancients, highly valued as a local application in affections of the eye and eyelids, and used for various other purposes, is supposed to be the medicine still used in India for the same affections, under the name of *rusot* or *rusiwut*. According to Royle, extracts from various species of berberis enter into this substance, which, combined with opium and alum, is much used in *ophthalmia;* also in the treatment of *intermittent*, *remittent*, and *typhoid fevers*, *diarrhœa*, and *dyspepsia*. (*P. J.*, Dec. 1865.) *Concentrated solution of berberis* (*Liquor Berberidis Concentratus*, Br. Add.) may be given in *doses* of one-half to one fluidrachm (1.8–3.75 Cc.); the *tincture* (*Tinctura Berberidis*, Br. Add., 120 gr. in a pint of 60 per cent. alcohol), in *doses* of half to one fluidrachm (1.8–3.75 Cc.). *Fluid-extractum Berberidis* is official (see page 529).

Barberry. Berberis vulgaris. Epinevinette, Vinettier, Ecorce de Racine de Berbérides, Fr. *Fauerach, Gemeiner Sauerdorn, Berberitze, Berberitzen-* (*Saurach-*) *Wurzelrinde*, G. *Berbero*, It., Sp.—This is a native of Europe, but grows wild in waste grounds in the eastern parts of New England, and is sometimes cultivated in gardens on account of its berries. It is a spreading shrub, from four to six feet or more in height, with thorny branches, a light gray bark, and a fine yellow wood. Under the name of *Berberis canadensis*, Pursh described an American plant, which grows in hilly districts, from the borders of Canada to the Carolinas, and which is characterized, according to Gray, by its repandly-toothed leaves, with the teeth less bristly-pointed, by its few-flowered racemes, its petals notched at the apex, and its oval berries. By Hooker, however, it is considered a variety of *B. vulgaris*, from which it differs only in the points mentioned. By Regel it is referred to *B. sinensis*, Desf., of China. It is from one to three feet high.

The *berries* of *B. vulgaris*, which grow in loose bunches, are oblong and of a red color, have a grateful, sour, astringent taste, and contain malic and citric acids. They are refrigerant, astringent, and antiscorbutic, and are used in Europe, in the form of drink, in *febrile diseases* and *diarrhœas*. An agreeable syrup is prepared from the juice, and the berries are sometimes preserved for the table. Graeger found in the ripe fruit, freed from stalks, 15.58 per cent. of integuments and seeds, 17.20 of soluble solid constituents, and 67.22 of water. The constituents of the juice in 100 parts of fresh berries were 5.92 parts of malic acid, 4.67 of sugar, 6.61 of gum, 67.16 of water, and 0.06 of salts of potassium and calcium. (*A. J. P.*, Jan. 1, 1873, 14.) The *root* and *inner bark* have been used for dyeing yellow. The bark of the root is grayish on the outside, yellow within, very bitter, and stains the saliva when chewed. Brandes found in 100 parts of the root 6.63 of bitter, yellow extractive (impure berberine), 1.55 of brown coloring matter, 0.35 of gum, 0.20 of starch, 0.10 of cerin, 0.07 of stearin, 0.03 of chlorophyll, 0.55 of a sub-resin, 55.40 of lignin, and 35.00 of water.

Hesse found in berberis root four alkaloids besides *berberine;* the mother liquor from berberine hydrochloride when precipitated with sodium hydroxide yielded to ether three alkaloids, a fourth, which is amorphous, remaining undissolved. One of the alkaloids in the ethereal solution crystallized from alcohol in small tabular crystals, and is named by the author *berbamine*. It has the composition $C_{18}H_{19}NO_3 + 2H_2O$. (*Ber. d. Chem. Ges.*, 19, 3190). To a second alkaloid the name of *oxyacanthine* has been applied. It can be obtained from the mother liquor from which the berberine hydrochloride has been separated. The liquid is treated with sodium hydroxide, when a dark colored precipitate is thrown down, from which ether dissolves oxyacanthine, berbamine, and an unnamed alkaloid, while another brown colored amorphous base remains undissolved. The ethereal solution is treated with acetic acid, and the resultant acetate decomposed by sodium sulphate, when oxyacanthine sulphate is precipitated, berbamine remaining in solution. On decomposing the solution of oxyacanthine sulphate with ammonia the free alkaloid is precipitated in flocks, which, after drying at 100° C. (212° F.), melt at from 138° to 150° C. (280.4° to 302° F.), but when crystallized from alcohol or ether it forms anhydrous needles, melting at from 208° to 210° C. (406.4° to 410° F.). Its formula is given as $C_{19}H_{21}NO_3$. It is readily soluble in chloroform and benzene, but only sparingly in petroleum spirit. (Allen, *Com. Org. Anal.*, 2d ed., vol. iii., part 2, 466.) Schmidt and Schilbach have made some interesting studies upon the salts and decomposition products of berberine. (See *A. Pharm.*, 1887, 141; *J. Chem. S.*, 1892, 641.)

Barberry is in small doses tonic, in larger ones cathartic, and was formerly given in *jaundice*. It is a gentle tonic and laxative. It may be used in the form of decoction. For uses of *B. aquifolium*, see *Berberis*, page 236.

The alkaloid berberine is probably a simple bitter tonic, although antiperiodic properties have been attributed to it, and T. Lascarato (*La Grèce médicale*, 1899, No. 2) affirms that it has a specific action upon the spleen which renders it very valuable in the treatment of malarial *splenic enlargement*, and that it is so powerful in producing contraction that when the spleen is softened large doses may produce splenic rupture, with *fatal hemorrhage*. *Dose*, three to five grains (0.2–0.3 Gm.).

Beta-Naphtholsulphonic Acid. *Acidum Beta-naphtholinsulphonicum.* $C_{10}H_6(OH).SO_3H$.—*Beta-naphtholinsulphonic acid* occurs in white pearly scales, tinged with red. It is readily soluble in water and alcohol, and appears to be interesting to the physician only as a test for albumin in the urine. According to E. Riegler, the reaction is so delicate that it will make plainly visible the presence of one part of albumin in forty thousand of water. Albumoses and peptones are also thrown down, but such precipitates disappear on the application of heat, which does not occur with albumin. *Riegler's test* is best performed by adding to five or six cubic centimeters of the urine from twenty to thirty drops of a 5 per cent. aqueous solution of the reagent.

Betaine.—This is an alkaloid of weak basic properties which Scheibler discovered in the juice of the sugar beet. (*A. J. P.*, xli. 559.) Husemann showed it to be identical with *lycine*, and to have the composition $C_5H_{11}NO_2$. (*A. J. P.*, 1875, 209.) Liebreich also obtained it by the oxidation of choline, and called it *oxyneurine*. (*Ber. d. Chem. Ges.*, iv. 735.) It has been made synthetically, and its relation to choline and similar compounds established. It is now known to be *trimethyl glycocoll*, $\begin{matrix} CH_2.N(CH_3)_3 \\ | \quad / \\ COO \end{matrix}$.

Waller and Plimmer (*P. J.*, lxxi. 517) find that betaine is feebly but distinctly toxic. In dose of 0.1 Gm. per kilo it produced in rabbits fall of blood pressure with final paralysis of the heart. They assert that pure betaine is less poisonous than the commercial. They obtained 4.4 Gm. from 1000 Gm. of beet sugar.

Betel. *Br. Add.*—"The leaves of *Piper Betle*, L." *Betle.* (*Chavica Betle* (L.), Miq.)—The betel pepper is largely cultivated in the hotter parts of India, Ceylon, and the Malay Islands, with irrigation and training of the vine upon trees in a manner similar to the Italian cultivation of the grape. The leaves, which are about five inches long, are sometimes gathered green and ripened artificially, those which die upon the vines being of less value. They are described as broadly ovate, acuminate, obliquely cordate at the base, five- or seven-nerved; coriaceous and glossy on the upper surface; they have a warm aromatic bitter taste. As found in commerce they are frequently tied up or stitched together into packets. The warm aromatic taste of the betel leaves is due to an essential oil known as *betel oil*. This is of a color varying from clear yellow to dark brown and of aromatic, somewhat creosote-like, odor and burning sharp taste. The specific gravity ranges from 0.958 to 1.044, the lighter oil being that obtained from the fresh leaves. The alcoholic solution of the oil gives a greenish to bluish-green color with ferric chloride.

The betel oil from Siam contains *cadinene* and a characteristic phenol named *betelphenol*, isomeric with eugenol; the oil from Java contains in addition to the betelphenol, *chavicol* and a *sesquiterpene;* while the Manila oil contains betelphenol as the sole phenolic constituent (Gildemeister and Hoffmann, *Die Ætherische Oele*, Berlin, 1899).

The essential oil of betel is an active local stimulant and has been used in *doses* of one to two minims (0.06 to 0.12 Cc.) in the treatment of various respiratory *catarrhs*, and as a local application, either by gargle or inhalation, in *diphtheria*. It is said that the juice of four leaves is equivalent in power to one drop of the oil. In India betel leaves are used locally to a considerable extent for the purpose of counter-irritation and applied to the mammary glands for the suppression of the milk.

Betol. *Naphthol. Naphthosalol. Salinaphthol. Salicylic-naphthyl ester. Salicylate of β-naphthol.* $C_6H_4OH.COO.C_{10}H_7$.—Betol occurs in white, shining crystals, is odorless and tasteless, melts at 95° C. (203° F.), and is insoluble in cold or hot water, soluble in cold alcohol with difficulty, but readily dissolves in hot alcohol (1 in 3), in ether, and in benzene. It is not decomposed by acids or alkalies in the cold, but the alkaline pancreatic fluid has the power to decompose it into β-naphthol and salicylic acid.

Betol was proposed by Sahli as a substitute for salol, on the ground of its being less disagreeable and yielding in the intestines naphthol instead of the more poisonous phenol. It contains, however, 10 per cent. less salicylic acid than does salol, and, having a much higher melting point, splits up much less readily in the intestines; a fact which gains importance from the observation that frequently salicylic acid cannot be found in the urine after its ingestion. Sahli has given as much as one hundred and eighty grains (11.6 Gm.) in twenty-four hours. Betol may be used in *rheumatism*, and is especially commended by Kobert in ammoniacal *cystitis*. Butter of cacao will dissolve one-fourth of its weight of betol, so that suppositories or bougies are readily made. *Dose*, ten to twenty grains (0.65–1.3 Gm.).

The *salicylic ester of α-naphthol*, an isomer of betol, is known as *alphol*. It is said to resemble salol in therapeutic effect. The *dose* is from eight to thirty grains (0.5–2 Gm.).

Betonica. *Betonica officinalis*, L. *Wood Betony.*—A perennial European labiate herb, feebly aromatic and astringent. Its root has been considered emetic and purgative.

Betula. *Betula alba*, L. *Common European Birch. Bouleau*, Fr. *Birke*, G. (Fam. Cupuliferæ or Betulaceæ.)—Various parts of this tree have been applied to medicinal uses. The young shoots and leaves secrete a resinous substance, having acid properties, which, combined with alkalies, is said to produce the effects of a tonic laxative. (*J. P. C.*, xxvi. 208.) The *inner bark*, which is bitterish and astringent, has been employed in *intermittent fever*. The epidermis is separable into thin layers, which may be employed as a substitute for oiled paper, and applied to various economical uses. The bark contains *betulin*, or *betula camphor*, which Hausemann (*Ann. Ch. Ph.*, 182, 368) has shown to be a diatomic alcohol, as it forms a diacetate. Its formula is $C_{36}H_{60}O_3$, fusing point 258° C. (496.4° F.). When oxidized it yields *betulinic acid*, $C_{36}H_{54}O_6$, and *betulinamaric acid*, $C_{36}H_{52}O_{16}$. Submitted to dry distillation it yields an oily body of characteristic Russia leather odor. When the bark is distilled, it yields an

empyreumatic oil, called *Daggett, oleum Rusci, betulinum*, or *muscoviticum*, it is a thick, brownish-black liquid, sp. gr. 0.955, having the odor of Russia leather, in the preparation of which it is employed. This oil has been found very useful as a local application in *chronic eczema* and other *skin diseases*. Its medicinal properties closely resemble, if they be not identical with, those of oil of cade. Dutch and German oil of birch are quite different from the Russian oil. (See *P. J.*, xv. 769.) The *leaves* of birch, which have a peculiar aromatic, agreeable odor, and a bitter taste, have been employed, in the form of infusion, in *gout, rheumatism*, and *dropsy*. Active diuretic properties are claimed for birch leaves and attributed to the *betulorentinic acid* in them. An alcoholic extract has been used in daily *doses* of from twenty-five to fifty grains (1.6–3.2 Gm.). When the stem of the tree is wounded a saccharine *juice* flows out which is considered useful in complaints of the kidneys and bladder, and is susceptible, with yeast, of the vinous fermentation. A beer, wine, spirit, and vinegar are prepared from it in some parts of Europe. *Tinctura Rusci* is made, according to Hager, as follows: Ol. Rusci 10, Alcohol, Æther, of each 15, Ol. Lavandulæ, Ol. Rosmarini, Ol. Rutæ, of each 0.4 parts; filter. (*A. J. P.*, 1881.)

Bezoar.—This name has been given to concretions formed in the stomach or intestines of animals, which were formerly thought to possess extraordinary medicinal virtues. Many varieties have been noticed; but they were all arranged in two classes, the *oriental bezoar* (*lapis bezoar orientalis*), and the *western bezoar* (*lapis bezoar occidentalis*); the former was most esteemed.

Bichetia. *Bichetia officinalis. Mureré Juice* is extracted in Brazil from the incised bark of this plant; it is a thick reddish liquid, sp. gr. 1.100, and is said to contain an alkaloid and to be useful in *rheumatism* and *syphilis*. The *dose* of the juice is one fluidrachm (3.75 Cc.) in water; in large doses it is drastic.

Bicuculla. *Bicuculla canadensis* (Goldie), Millsp. *Corydalis formosa*, Pursh. (*Dicentra canadensis*, Walt.) *Turkey Corn. Turkey Pea. Squirrel Corn.* (Fam. Papaveraceæ.)—The tubers of this indigenous plant have a slight peculiar odor, and a bitterish somewhat pungent and persistent taste. It is said to yield its active properties to water and alcohol.

According to Merck (*Berichte über das Jahr*, 1892), there are in *Capnoides tuberosum* (DC.), Lyons (*Corydalis cava*, Schweig.), four alkaloids, two of which (*corydaline* and *corycavine*) are weak bases, and two (*bulbocapnine* and *corydine*) strong bases. *Corydaline*, $C_{22}H_{27}NO_4$, is a tertiary base and was obtained crystallized in large prisms, fusing at 135° C. (275° F.), and easily soluble in alcohol and ether. *Corycavine*, $C_{23}H_{23}NO_6$, is difficultly soluble in all solvents, crystallizes in small matted needles, and fuses at 218° C. (424.4° F.), with partial decomposition. *Bulbocapnine*, $C_{19}H_{19}NO_4$, is a crystallizable base, melting at 199° C. (390.2° F.), and soluble in excess of potassium hydroxide. This alkaloid is the one present in largest amount, and was first called corydaline; but Merck accepts the name bulbocapnine, proposed for it by Freund and Josephy. (*Ber. d. Chem. Ges.*, 25, 2411.) *Corydine* is obtained from the mother liquors of the bulbocapnine, and is also a strong base. It is insoluble in water, very readily soluble in alcohol and ether, but cannot be obtained in crystallized form. J. Gadamer made careful extractions from bicuculla bulbs and found about five per cent. of alkaloids. He found the following composition: I. Crystalline bases: 1, corydaline, 2, bulbocapnine, 3, corycavine, and 4, *corybulbine*. II. Amorphous mixture of bases consisting of the following, after fractional salt formation: *a*, crystallizable substances: 1, corydaline, 2, corybulbine, 3, isocorybulbine, 4, corycavamine, 5, corycavine, 6, corydine, 7, bulbocapnine, 8, a base melting at 135° C. (275° F.), not identical with corydaline; *b*, two amorphous bases, and *corytuberine*, an alkaloid not extracted by ether, but obtained from the syrupy extract by the addition of a little chloroform. *Capnoides tuberosum*, with its eleven distinct alkaloids, therefore may be compared to *Papaver somniferum* (L.). It is to be noted, however, that protopine, which is one of the principal alkaloids in the Papaveraceæ, has as yet not been found in *Corydalis cava*. It is possible, however, that *corycavamine*, which has a very similar constitution, takes the place of protopine in corydalis. The alkaloids of *Corydalis nobilis*, Pers., have been studied by Birsmann. (*A. J. P.*, 1893, 135.) Benzene extracts an amorphous white base of the composition $C_{21}H_{21}NO_6$, resembling the amorphous base (corydine?) of *C. tuberosum*. On making the mother liquor alkaline, a brown resinous mass is thrown down, from which benzene separates a base crystallizing from boiling water, with the formula $C_{23}H_{25}NO_5$, to which he gives the name *corydalnobiline*. Several other alkaloids were obtained, and indications of hydroberberine and berberine.

The tubers of *Bicuculla canadensis* (turkey corn) are asserted to be tonic, diuretic, and alterative, and are given in *syphilitic, scrofulous*, and *cutaneous affections*, in the *dose* of from ten to thirty grains (0.65–2.0 Gm.). They are also used in the form of tincture and decoction. *Corydalin* or *corydalia*, of the eclectics, is an impure resinous mixture. Fischer and Svell have found that the *Bicuculla cucularia* (L.), Millsp. (*Dicentra cucularia*, Torr.), a plant closely resembling *B. canadensis*, but producing no tubers, contains three alkaloids, one of which is *protopine*. (*Ph. Archiv*, No. 7, 1903.)

Bidens. *Bidens bipinnata*, L. *Spanish Needles.* An indigenous composite plant, of which the root and seeds are popularly used as emmenagogues, and by the eclectics in *laryngeal* and *bronchial* diseases as expectorants.

Bignonia.—From the various species of South American bignonias are produced coloring matters which are much used for various purposes by the South American Indians. The most important of these are *carajura, chica*, and *ula*. (See *P. J.*, xlvi.)

Biodal. *Monoiodo-dibismuthi-methylene-dicresotinate.*—A pink, odorless, insoluble powder, suggested as a substitute for iodoform.

Bird-Lime. *Bird-glue. Vogelleim*, G.—A viscid substance, existing in various plants, particularly in the bark of *Viscum album*, L., and *Ilex aquifolium*, L., or *European holly*, from the latter of which it is usually procured. The process for preparing it consists in boiling the middle bark for some hours in water, then separating it from the liquid, and placing it in proper vessels in a cool situation, where it is allowed to remain till it thickens, when it is washed to separate impurities. Bird-lime thus prepared is greenish, tenacious, glutinous, bitterish, and of an odor analogous to that of flaxseed oil. Ex-

posed to the air in thin layers it becomes dry, brown, and pulverizable, but re-acquires its viscidity upon the addition of water. It is a complex body, but is thought to owe its characteristic properties to a proximate principle, which is called *glu* by the French chemists. This principle is without odor or taste, extremely adhesive, fusible by heat, inflammable, insoluble in water, nearly insoluble in alcohol, but dissolved freely by ether and oil of turpentine. According to Macaire, it is insoluble in the fixed oils, either hot or cold, a property which distinguishes it from the resins. Macaire proposed for it the name of *viscin*. (*J. P. C.*, xx. 18.) Its analysis corresponds to the formula $C_{20}H_{48}O_8$ (or possibly $C_{20}H_{32} + 8H_2O$). After the extraction of the viscin by ether, Reinsch found a substance soluble in oil of turpentine which he called *viscaoutchin*, because of its elastic caoutchouc-like character. He gives it the formula $C_8H_{16}O$. Birdlime is so tenacious that it may be employed to catch small birds, which, when they alight on a stick thickly covered with it, are unable to escape.

Under the name of *viscum aucuparium verum*, or *viscin*, bird-lime has become a commercial substance which, when dissolved in benzene, gives a syrupy, intensely green solution capable of any degree of concentration, and possesses extraordinary adhesive powers, adapting it for use as the basis of plasters and also as a vehicle for various dermatological remedies. The ordinary base of *viscin plasters*, as proposed by Riehl, consists of a mixture of forty-eight troyounces (1500 Gm.) solution of viscin, three troyounces, one and one-half drachms (100 Gm.) powdered orris, thirteen troyounces (400 Gm.) starch, to which are added Venice turpentine, nine troyounces, three drachms (280 Gm.), and Damar gum, one troyounce (31 Gm.), the whole reduced to a paste by evaporation. In the preparation of salicylic viscin plasters the same formula is followed, excepting that the last two substances are replaced by 5 to 10 per cent. of salicylic acid. Various viscin plasters are made with mercury, iodoform, and other active substances. *Zincum viscosum* is a viscin solution of the consistency of linseed oil, containing 10 per cent. of zinc oxide.

Bismal.—The bismuth salt of methylene-digallic acid. A grayish-brown powder, insoluble in water or the gastric juice, but soluble in alkaline solutions. It is used as an astringent in *diarrhœa*. *Dose*, from one and one-half to five grains (0.096–0.32 Gm.).

Bismone. *Colloidal Bismuth Oxide.*—A substance said to be produced by the reaction between bismuth salts and alkaline solutions of sodium lysalbinate or protalbinate. It occurs as a translucent amorphous mass, containing 22.3 per cent. of bismuth oxide; freely soluble in warm or cold water, the solution up to 25 per cent. being a reddish-yellow and slightly opalescent tasteless fluid; when stronger, syrupy or gelatinous. It has been highly recommended in the treatment of *gastro-intestinal catarrh*, especially in infants. It cannot be used hypodermically on account of its tendency to produce local disturbances and nephritis. Eighty minims (5 Cc.) of a 10 per cent. aqueous solution may be given three or four times a day to young children, and *doses* of fifteen grains (1 Gm.) are said to be borne without difficulty by older children; always given in solution and not in powder.

Bismutan. *Isutan.*—A yellow, odorless powder, consisting of bismuth, resorcinol, and tannin. It is recommended for *intestinal catarrh* in *doses* for adults of from eight to fifteen grains (0.5–1.0 Gm.).

Bismuth Albuminate. *Bismuthi Albuminas. Bismuthum Albuminatum. Wismutalbuminat*, G. A compound of indefinite composition made by adding a solution of 75 parts of dried egg-albumin to 25 parts of bismuth and ammonium citrate dissolved in a small quantity of water and drying the product at a low temperature.

A pale gray or white powder, not wholly soluble in water, containing from 10 to 12 per cent. of bismuth. It is used in gastric and intestinal cramps in *doses* of from eight to fifteen grains (0.5 to 1.0 Gm.).

Bismuth Benzoate. *Bismuthi Benzoas.* $BiO.(C_7H_5O_2)$.—*Basic Bismuth Benzoate* is official in the French Codex. It is a white powder, insoluble in water, and was originally proposed by P. Vigier as a substitute for the bismuth salicylate; it may be made by double decomposition between bismuth nitrate and sodium benzoate; like the salicylate, it is decomposed in the alimentary canal, benzoic acid being set free. It contains about 65 per cent. of bismuth, and may be given as an intestinal antiseptic in *diarrhœas*, in *doses* of from eight to fifteen grains (0.5–1.0 Gm.) four to six times a day. The benzoate has been commended by Finger as a substitute for iodoform.

It may be made by adding a solution (prepared with heat) of 76 parts of sodium benzoate in 200 parts of distilled water to a solution of 100 parts of bismuth nitrate in 20 parts of glycerin and 60 parts of distilled water. It contains 27 per cent. of benzoic acid.

Bismuth Borate.—*Bismuthi Boras*, $BiBO_3$, is a grayish-white powder which has been used as an intestinal antiseptic in *doses* of from seven to fifteen grains (0.45–1.0 Gm.).

Bismuth Borophenate.—*Bismuthi Borophenas, Markasol*, has been recommended as a slightly astringent absorbent powder, to be used in the same way and for the same purposes as iodoform. It is free from odor, and is alleged to be locally antiseptic.

Bismuth-Cerium Salicylate is a reddish-white powder, insoluble in water and alcohol. This salt has been highly commended in *diarrhœa*, *enteritis*, and *dysentery* by Salaya. *Dose*, ten grains (0.65 Gm.).

Bismuth Chrysophanate. *Bismuthi Chrysophanas. Dermol. Bismuthum Chrysophanicum.* $Bi(C_{15}H_9O_4)_3.Bi_2O_3$.—This is a yellow, amorphous, insoluble powder, which has been used in the treatment of various diseases of the skin.

Bismuth Dithiosalicylate. *Bismuthi Dithiosalicylas. Thioform.* $(S.C_6H_3(OH)COO.BiO)_2 Bi_2O_3 + 2H_2O$.—This is a yellowish-gray, odorless and tasteless powder, insoluble in water, alcohol, or ether. It has been used externally as a dusting powder in skin diseases and in surgery, and probably acts precisely as does dermatol. It has been employed upon the eye to a considerable extent and is not irritant. Internally it has been given in *diarrhœa* as an intestinal antiseptic in *doses* of five grains (0.32 Gm.) three or four times a day in capsules.

Bismuth Iodo-oxyquinoline-sulphonate. *Bismuthi Loretinas. Loretin Bismuth.*—This compound has been used in the *dose* of four-fifths of a grain (0.05 Gm.) every four hours in the treatment of tubercular and other obstinate *diarrhœas*, and as a local application in powder form to *epithelioma*, *syphilitic* and other forms of infected

ulcers. The 10 per cent. ointment made with lanolin has been recommended in *eczema* and *psoriasis.*

Bismuth Lactate. *Bismuthi Lactas.*—This salt may be made as follows. Take of bismuth subnitrate, *sixty-one parts;* ammonia water, *fifty parts;* lactic acid, *fifty-five parts;* distilled water, a *sufficient quantity.* Mix the bismuth subnitrate, in a flask, with the ammonia water previously diluted with *seventy-five parts* of distilled water. Let the mixture stand for one hour, pour off the supernatant liquid, and wash the residue thoroughly with distilled water. To the moist residue add the lactic acid, and evaporate the mixture to dryness on the water bath. The product is a white powder, slowly soluble in water and insoluble in alcohol. It may be used in *diarrhœa* in *doses* of one to two grains (0.065–0.13 Gm.).

Bismuth Metacresolate. *Bismuthi metacresolas.*—A pale gray or white powder, odorless and tasteless, insoluble in water and alcohol. It is used as an internal antiseptic and also as an antiseptic dusting-powder, to take the place of iodoform.

Bismuth Naphtholate. *Naphthol Bismuth. Betanaphthol Bismuth. Orphol.* $(C_{10}H_7O)_3Bi + 3H_2O$. (Merck.)—This is a neutral, light brown, almost odorless and tasteless non-irritant powder, insoluble in water, which, according to its manufacturer, contains 80 per cent. of bismuth in combination with 20 per cent. of betanaphthol. According to F. A. Jasenski it is broken up both in the stomach and in the intestines into its constituents, which are to a slight extent absorbed, but to a much greater extent act locally as a gastro-intestinal antiseptic; useful in *acute* and *chronic enteritis,* in *fermentative diarrhœas,* in various forms of *dyspepsia,* and whenever an intestinal antiseptic is desired. The drug has also been used locally in *gonorrhœa,* external *ulcerations, impetigo,* etc. It is affirmed, however, to be harmless, and Chaumier states that he has frequently given seventy-five grains a day to young children with impunity. It is probable that only a small portion of these large doses is decomposed in the gastro-intestinal tract, the greater part passing out unchanged. The ordinary *dose* is from eight to fifteen grains (0.5–1.0 Gm.) in capsule or suspended in water.

Bismuth Oleate. *Bismuthi Oleas.* $Bi(C_{17}H_{33}CO_2)_3$.—A compound resulting from the reaction between sodium oleate and bismuth trinitrate. It forms an insoluble powder and is used as an emollient and astringent.

Bismuth Oxybromide. *Bismuthi Oxybromidum. Wismutoxybromid,* G. BiOBr.—This is an impalpable yellow powder, used internally in gastric affections.

Bismuth Oxychloride. *Bismuthi Oxychloridum seu Subchloridum. Bismuth Subchloride. Bismuthyl Chloride. Oxychlorure de bismuth,* Fr. *Wismutoxychlorid,* G. BiOCl.—Made by slowly pouring a solution of bismuth trinitrate, in diluted nitric acid, into a solution of sodium chloride, collecting the white precipitate, washing and drying. It is sometimes known as *pearl white,* and in France as *blanc de fard.* Bismuth oxychloride is insoluble in water, soluble in acids, and is used for the same purposes as bismuth subnitrate.

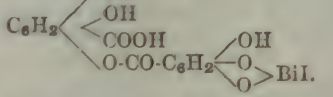
Bismuth Oxyiodide. *Bismuthi Oxyiodidum.* BiOI.—This compound, sometimes termed *Bismuthi Subiodidum,* may be made by F. X. Moerk's process, as follows: Take of iodine, 4.6 Gm.; bismuth subnitrate, 10 Gm.; nitric acid, sp. gr. 1.42, 10 Cc.; solution of sodium hydroxide, U. S. P., 150 Cc.; water, a sufficient quantity. The iodine is covered with 50 Cc. of water, and converted into hydriodic acid by passing hydrogen sulphide through the mixture, boiling to remove excess of hydrogen sulphide, and filtering. The subnitrate is dissolved in the nitric acid, diluted with 10 Cc. of water, and then enough water added to produce a slight permanent opalescence; this mixture is then slowly poured into the solution of sodium hydroxide with constant stirring. The precipitate is then washed by decantation until the washings cease to turn red litmus paper blue; 50 Cc. of water are added to it, and the hydriodic acid gradually poured in, until after stirring and allowing to settle the supernatant liquid has a yellow color. The oxyiodide is washed by decantation, removed to a filter, allowed to drain, and, finally, dried at a temperature not exceeding 100° C. (212° F.). The oxyiodide has a light yellowish-red color, and contains no water of crystallization, (*A. J. P.,* 1887, 273.) In 1877 the bismuth oxyiodide was recommended as a local antiseptic and substitute for iodoform, by A. Sidney Reynolds. It has been used to a considerable extent with success in the Philadelphia Hospital, but its high price interferes with its general adoption. It has also been given internally in *gastric ulcer* and other gastric affections for which bismuth is usually employed. The *dose* is from five to ten grains (0.32–0.65 Gm.).

Bismuth Oxyiodo-methyl-gallol. *Bismuthi Oxyiodo-methylgallolum. Iodo-gallicin.* $C_6H_2COOCH_3(OH)_2O.BiOH.I$.—Made by acting upon gallicin (methyl gallate) with bismuth oxyiodide. It is in the form of a light, amorphous, dark gray powder, insoluble in ordinary solvents and containing 23.6 per cent. of iodine and 38.4 per cent. of bismuth.

It is used as an antiseptic powder to replace iodoform.

Bismuth Oxyiodo-pyrogallate. *Bismuthi Oxyiodo-pyrogallas.* $C_6H_2(OH)_2.O.Bi(OH)I$.—Made by digesting bismuth oxyiodide with pyrogallic acid or by precipitating a solution of potassium iodide and pyrogallic acid with bismuth nitrate in acetic acid. A fine, amorphous, yellowish-red powder, permanent in light and air. It is recommended as a powerful surgical antiseptic powder.

Bismuth Oxyiodo-tannate. *Bismuthi Oxyiodo-tannas.*



Bismuth oxyiodo-tannate is a greenish-gray, odorless, tasteless powder, becoming brownish on exposure, insoluble in water, and has been suggested as a surgical substitute for iodol.

Bismuth Peptonate. *Bismuthi Peptonas.*—Prepared by adding a solution of 80 parts of dried peptone to 20 parts of bismuth and ammonium citrate, dissolved in a small quantity of water, and drying at a low temperature. A grayish-brown powder containing from 7 to 8 per cent. of bismuth.

It is used in *dyspepsia* and *gastralgia* in *doses* of from fifteen to sixty grains (1.0–3.9 Gm.).

Bismuth Phenolate. *Bismuthi Phenolas. Bismuth Carbolate. Phenol-Wismut,* G. $C_6H_5O.Bi$

$(OH)_2$.—Made by a reaction between solutions of bismuth trinitrate and sodium phenolate. A gray, insoluble, inodorous powder, used as an internal antiseptic, in *doses* of from eight to fifteen grains (0.5–1.0 Gm.), also as an antiseptic dusting-powder.

Bismuth Phosphate, Soluble.—*Bismuthi Phosphas Solubilis*, which is prepared by the melting together of bismuth, sodium hydroxide, and phosphoric acid, is a powder easily soluble in water, precipitated by alkalies, acids, or heat, and undergoing spontaneous decomposition when in concentrated solution. It contains 20 per cent. of bismuth, and has been used as an intestinal antiseptic in *choleraic* and other acute *diarrhœas* in the *dose* of from three to eight grains (0.2–0.5 Gm.) three times a day.

Bismuth Pyrogallate. *Bismuthi Pyrogallas. Helcosol.* $C_6H_3(OH)_2OBiO$.—It is a yellowish-green amorphous powder, insoluble in water and alcohol, soluble in acid and alkaline solutions and in the gastro-intestinal juices. According to von Heyden, it contains about 60 per cent. of bismuth. In very large doses it is said to be non-poisonous, and to be a valuable intestinal antiseptic; if, however, pyrogallic acid should be liberated in the alimentary canal, it might produce disagreeable effects, and the remedy seems to us dangerous.

Bismuth Resorcinate. *Bismuthi Resorcinas. Resorcin-Wismut*, G. $[(C_6H_4O_2)_3Bi_2]_3 + Bi_2O_3$. Prepared by adding a solution of bismuth trinitrate to a solution of resorcinol in an excess of alkali. A yellowish-brown powder containing about 40 per cent. of Bi_2O_3. It is used in chronic and acute catarrh of the stomach.

Bismuth Sulphite.—*Bismuthi Sulphis*, $Bi_2(SO_3)_3$, is made by reacting on normal bismuth nitrate with sodium sulphite. It is an antiseptic and antiferment with anthelmintic properties.

Bismuth Tannate. *Bismuthi Tannas.*—Bismuth tannate has been used as an astringent in *diarrhœas* in *doses* of from ten to thirty grains (0.65–2.0 Gm.).

Bismuth Valerate. *Bismuthi Valeras. Valérianate de Bismuth*, Fr. *Wismutvalerianat*, G. $Bi(C_5H_9O_2)_3$.—This salt is formed by double decomposition between solutions of bismuth trinitrate and sodium valerate. Bismuth valerate precipitates as a white powder, which is washed with water, and dried with a gentle heat. It has been recommended by Righini in *neuralgia*, and in *gastrodynia*. The *dose* is from half a grain to two grains (0.032–0.13 Gm.), repeated several times a day, and given in the form of pill.

Bismuthol. *Bismutal.*—This substance, which is probably a mere mixture of the bismuth phosphate and the sodium salicylate, is a white, crystalline, odorless powder, soluble in water, which has been commended by Radlauer as an antiseptic in the treatment of wounds and inflammations of the mucous membrane. It may be used with talc (from 1 to 2 to 1 to 5) as a powder, or in a 10 to 20 per cent. ointment with vaseline, or as a 1 to 4 per cent. aqueous solution, in the treatment of *infected wounds*, *syphilitic* and other *ulcers*, and as an injection in *gonorrhœa*, chronic *sinuses*, etc. It has been especially recommended for excessive *sweating of the feet*.

Bismutose.—This substance is said to be an albuminous compound containing 22 per cent. of bismuth, 66 per cent. of albumin and impurities. It is a tasteless white powder which gradually acquires under the influence of light a slaty-gray color. It is insoluble in water and other solvents, and dilute acids partly dissolve it when warmed. With dilute alkaline solution it forms rapidly, especially when heated, an opalescent fluid. It is affirmed to be non-poisonous. It has been highly praised by Laquer (*Ther. Geg.*, July, 1901) as a remedy specially for children in all those forms of *gastric* and *intestinal irritation* or *ulceration* for which bismuth has been employed. The *dose* for infants is 15 to 30 grains (1–2 Gm.), for children a drachm (3.9 Gm.), and for adults larger quantities. It is also employed as a dusting-powder in the treatment of *burns* and *intertrigo* as an absorbent.

Bistort. *Snakeweed. Bistorte, Couleuvrine*, Fr. *Weissenknöterich, Natterwurz*, G.—This is the root of *Polygonum Bistorta*, L. (Fam. Polygonaceæ), a perennial herbaceous plant, growing in Europe and the north of Asia. The root is cylindrical, somewhat flattened, about as thick as the little finger, marked with annular or transverse wrinkles, furnished with numerous fibres, and folded or bent upon itself, so as to give it the tortuous appearance from which its name was derived. When dried, it is solid, brittle, of a deep brown color externally, reddish within, inodorless, and of a rough, astringent taste. It contains much tannin, some gallic acid and gum, and a large proportion of starch. H. K. Bowman found 21 per cent. of tannin in bistort root. (*A. J. P.*, 1869, 193.) Its medicinal properties are like those of kino, but it is less efficient. It may be employed in powder, decoction, or extract. The *dose* of the powder is twenty or thirty grains (1.3–2.0 Gm.).

Besides the bistort, some other plants belonging to the genus Polygonum have been used as medicines. Among these are *P. aviculare*, L., or *knot grass*, a mild astringent, formerly employed as a vulnerary and styptic; *P. Persicaria*, L. (*Persicaria mitis*, Gilib.), of a feebly astringent saline taste, and at one time considered antiseptic; and *P. hydropiper*, L., or water-pepper (*Persicaria hydropiper*, Opiz.), the leaves of which have a burning and biting taste, inflame the skin when rubbed upon it, and are esteemed diuretic, and have been used with asserted success in *amenorrhœa* and other *uterine disorders*. Its irritant and also medicinal properties are due to an acid, *polygonic acid*, discovered by C. J. Rademaker. (*A. J. P.*, xliii. 490.) The *water-pepper* or *smartweed* of this country—*P. punctatum*, Ell.—which grows abundantly in moist places, possesses properties similar to those of the European water-pepper, and is occasionally used as a detergent in chronic *ulcers*, and internally in *gravel*. B. Woodward found that the dried plant contains 18 per cent. of tannin, and used a saturated tincture with great advantage in *diarrhœa* and *dysentery*, in *doses* of from twenty to sixty minims (1.3–3.75 Cc.). Aughey finds that *P. amphibium*, L., is readily cultivated, with a yield of from three to six tons to the acre, that the roots contain 21.75 per cent., the stems 17.1 per cent. of tannic acid, and urges the growth of it for tanning purposes. (*N. R.*, 1876, 75.) *P. Fagopyrum*, L., is common *buckwheat*. The leaves of this plant have been found by Ed. Schunck to contain a crystallizable coloring principle, identical with the *rutin* or *rutic acid* previously discovered by Weiss in the leaves of the common rue, and probably, with the *ilixanthin* of Moldenhaus, existing in the leaves of *Ilex aquifolium*, L., or the common holly.

Buckwheat leaves yielded to Schunck somewhat more than one part of rutin in a thousand.

(*Chem. Gaz.*, No. 399, 201.) From *P. cuspidatum*, L., has been separated a glucoside, *polygonin*, and also *emodin*. (*P. J.*, Feb. 1896.)

Various species of the genus Polygonum are used for the production of dye-stuffs; thus, indigo is obtained largely in China, Japan, and in some parts of Russia, from the leaves of *P. tinctorium*, Ait., and is said also to be yielded by those of *P. aviculare* and *P. barbatum*, L.; while in India, China, and Japan the roots of the *P. cuspidatum* are employed for making a yellow dye. (*J. Chem. S.*, Dec. 1895.)

Blennostasine.—W. F. Chappell (*N. Y. M. J.*, lxiv. 1896) asserted that this derivative of a cinchona bark alkaloid is a powerful sedative to the brain and spinal cord, and that in *doses* of from one to four grains (0.065–0.26 Gm.) every hour it is a valuable remedy in nasal and laryngeal hyperæsthesia.

Blepharis. *Blepharis capensis.*—This plant is said to be physiologically very active and useful in the treatment of *anthrax*. (*P. J.*, 60, p. 140.)

Blood of Bullocks.—As long ago as 1852 Samuel Jackson of Philadelphia, employed as a tonic the blood of bullocks carefully dried *in vacuo*, giving from five to ten grains (0.32–0.65 Gm.) of it as a *dose*. Recently it has been used considerably in Europe, and even drinking fresh bullock's blood was at one time in fashion. Under the name of *Sanguis Bovinus Exsiccatus*, F. E. Stewart introduced defibrinated dried bullock's blood, claiming for it that, by the simple addition of water, bullock's blood can be reproduced minus a small quantity of fibrin. There is no reason for believing that dried blood is more valuable than the more usual ferruginous tonics, if indeed it be of equal value.

Blumea. *Blumea lacera*, DC. (Fam. Compositæ.)—From this plant, which is used in India as an insect powder, Dymock has obtained a light yellow volatile oil. It has a sp. gr. of 0.9144 at 26.7° C. (80° F.), and an extraordinary rotating power, 1 Mm. turning the ray 66° to the left.

Bocconia.—It is probable that various species of this papaveraceous genus have active medicinal properties. *B. arborea*, Watson, of Mexico, has been found by Elliott to contain two alkaloids, one of which is probably *sanguinarine;* and the leaves of other species are used in South America as abortifacients, purgatives, etc. (See Rusby, *Bull. Pharm.*, 1891.)

Boldo. *Boldus.*—This plant is an evergreen shrub, frequenting the meadows of the Andes in Chili, where its yellowish-green fruit is eaten, its bark used in tanning, and its wood in charcoal making. It is the *Peumus Boldus* of Molina (1782); *Peumus fragrans*, Pers.; *Boldea fragrans*, C. Gay, also Juss.; *Ruizia fragrans*, Pav. (Fam. Monimiaceæ.) The *leaves*, which are the parts used in medicine, contain in special cells an aromatic volatile oil, of which they yield, on distillation, about 2 per cent. They are entire, reddish brown when dry, coriaceous, with a prominent midrib and very numerous small glands upon their surface. The oil boils between 175° and 250° C. (347° and 482° F.) and gives a green coloration with ferric chloride, it contains terpene and oxygenated bodies which have not as yet been investigated. A peculiar alkaloid, *boldine*, has been found in them by Bourgoin and Verne (*J. P. C.*, 4e sér., xvi. 191), and a glucoside, *boldoglucin*, $C_{30}H_{52}O_8$, by P. Chapoteaut. (*C. R. A. S.*, xcviii. 1052.) According to Sigismond Pascaletti (*Terapia Moderna*, 1891), boldine when injected hypodermically paralyzes both the motor and sensory nerves, and also attacks the muscle fibres. As a local anæsthetic he believed it to be superior to caffeine but inferior to cocaine. When given internally in toxic dose it produces great excitement, with exaggeration of the reflexes and of the respiratory movements, increased diuresis, cramps, disorder of coördination, convulsions, and finally death from centric respiratory paralysis, the heart continuing to beat long after the arrest of respiration, finally stopping in diastole. Boldoglucin is said to act on the lower animals as a narcotic, and has been given by Réne Juranviller, with asserted success, as a hypnotic and calmative remedy in *insanity*. Fifteen minims (0.9 Cc.) of the oil of boldo cause in man some warmth in the epigastrium; thirty minims (1.8 Cc.), much gastric irritation, with pain and vomiting, and passage of urine smelling strongly of the oil. Dujardin-Beaumetz finds the oil useful in *genito-urinary inflammations* in *doses* of five drops (0.25 Cc.) (*B. G. T.*, Mars, 1875), in diseases of which character the drug has long been employed in South America. (*Ibid.*, lxxxvi. 165.) In France boldo has been employed as a tonic in *chronic hepatic torpor* and in *hepatitis*. (*Etude sur le Boldo*, C. Verne, Paris, 1883.) Eight minims (0.5 Cc.) of a tincture (1:5) or four minims (0.25 Cc.) of a fluidextract may be considered as the commencing *dose*, increased *pro re nata*. Large doses are apt to vomit and purge.

According to A. T. De Rochebrune (*Toxicol. Africaine*, i. 1897), the tree *Monimia rotundifolia* of Australia, contains an abundant volatile oil, an alkaloid, and a glucoside, which are very similar to, if they be not identical with, those obtained from the *Boldo*, and may be substituted for the latter in therapeutics.

Bole Armenian. *Bolus Armeniæ. Bolus Rubra. Argilla Ferruginea.*—The term *bolus* or *bole* was formerly applied to various forms of argillaceous earth, differing in color or in place of origin. Such were the *Armenian*, *Lemnian*, and *French boles*, and the *red* and *white boles*. Some of these substances were so highly valued as to be formed into small masses and impressed with a seal, and hence received the name of *terræ sigillatæ*. They were all similar in effect, though the small proportion of oxide of iron contained in the colored boles may have given them greater activity. The only one at present kept in the shops is that called *bole Armenian*, from its resemblance to the substance originally brought from Armenia. It is prepared, by trituration and elutriation, from certain native earths existing in different parts of Europe. It is in pieces of various sizes, reddish, soft, and unctuous, adhesive to the tongue, and capable of forming a paste with water. It consists chiefly of a hydrated aluminum silicate with ferric hydrate. The boles were formerly employed as absorbents and astringents in *acidity of the stomach* and in *relaxed bowels*. Bole Armenian is used chiefly as a coloring ingredient in toothpowders.

Bonduc Seeds.—These are seeds derived from several species of the genus *Cæsalpinia*, called also *Guilandina* (Fam. Leguminosæ), which are used in India as febrifuges, tonics, and antiperiodics. Heckel and Schlagdenhauffen have discovered in them a bitter principle (*C. R. A. S.*, 103, 89), probably identical with that previously isolated by Flückiger. (*Pharmacographia*, 2d ed., 212.)

Bone. *Os*, Lat., Fr. *Knochen-Asche*, G. *Ossa*, It. *Huesos*, Sp.—Under the name of *Os Ustum*, or *Bone ash*, the Br. Pharmacopœia formerly recognized "the residue of Bones, which have been burned to a white ash in contact with air. Bone ash consists principally of phosphate of calcium, mixed with about 10 per cent. of carbonate of calcium and a little calcium fluoride, silica, and magnesium phosphate." When bones are subjected to destructive distillation, in *close* vessels, they are decomposed without alteration of shape, lose about three-sevenths of their weight, become brittle, and are converted into a black substance, containing the earthy salts of the bone, and constituting the species of animal charcoal called *bone black*. (See *Carbo Animalis*.) The portions which distil over consist of the usual ammoniacal products derived from animal matter, but are especially rich in nitrogenous bases of the pyridine and quinoline series. (See *Ammonii Chloridum*.) Before the distillation is performed, the bones are boiled with water, to separate the fat, which amounts to 5 or 6 per cent.; but gelatin is at the same time extracted, with the effect of rendering the bones less fitted to furnish a good bone black. In view of this fact, M. Deiss of Paris, has proposed to extract the fat by carbon disulphide, which gives a product of 10 or 12 per cent., without injuring the bones for subsequent conversion into bone black. (*A. J. P.*, 1856, 356.)

When calcined in open vessels, bones are converted into a white friable substance, consisting of the incombustible part, and commonly called *bone earth*, or *bone ash;* and a similar residue is obtained by calcining horns, and is termed *Cornu Ustum*. When bones are treated with boiling water, a small portion of the gelatinous matter is dissolved; but when acted on by water in a Papin's digester, the whole of it is taken up and the earthy salts, deprived of their cement, crumble into powder, and become diffused through the solution. When acted on by diluted hydrochloric acid, the earthy salts are dissolved, and the bone softens without losing its shape and becomes semi-transparent and flexible. The portion remaining unattacked by the acid is the gelatinous tissue, which may be converted into gelatin by long boiling. The hoof bones of the ox, boiled with water, furnish a peculiar oil, called neat's-foot oil.

The bones of different animals, and of the same animal at different ages, vary somewhat in composition. Dry ox bones consist of bone gelatin (cartilage of bone) 33.3, calcium bone phosphate with a little calcium fluoride 57.35, calcium carbonate 3.85, magnesium phosphate 2.05, and sodium hydroxide with a very little sodium chloride 3.45 = 100. Human bones differ somewhat in the proportions of their constituents, and in containing traces of iron and manganese. According to W. Heintz, however, bones exhausted by water, so as to remove the coloring matter of blood do not contain a trace of iron. Marchand found 1 per cent. of calcium fluoride in human bone. *Calcium bone phosphate* consists of the tribasic phosphate, $Ca_3(PO_4)_2$.

Borago. *Borago officinalis*, L. *Borage. Bourrache*, Fr. *Borasch, Boretsch*, G. (Fam. Boraginaceæ.)—This European annual abounds in mucilage, and the stems and leaves contain potassium nitrate with other salts. To these constituents the plant owes its feeble medicinal properties. An infusion of the leaves and flowers is employed as a demulcent, refrigerant, and gently diaphoretic drink. The expressed juice of the stems and leaves is also given in the *dose* of from two to four fluidounces (60–120 Cc.).

Boral.—*Aluminum boro-tartrate* is soluble in water, and is used in the form of a fine powder. *Aluminum boro-tannate* (*cutol*) contains 47 per cent. of tannin. Both salts are used as astringents by dermatologists.

Boricin.—A mixture of sodium borate and boric acid.

Bornyval.—This isovaleric ester of borneol, $C_{10}H_{17}O.C_5H_9O$, is a limpid fluid with an aromatic odor, suggesting valerian; soluble in alcohol and ether, insoluble in water; boiling under ordinary pressure, at 255° to 260° C. (491° to 500° F.); sp. gr. at 20° C. (68° F.) 0.951. Polariscopic rotation: $[a]D\ 20° = 27°\ 40'$. It has been urged as a substitute for valerian, given in *doses* of 4 to 8 grains (0.26–0.5 Gm.) several times a day.

Boro-Citric Acid.—A combination of the two acids, forming a white, very soluble powder. It is used in *doses* of from five to twenty grains (0.32 to 1.3 Gm.) as a solvent for the urates and phosphates in *urinary calculi* and *gout*.

Boro-Formol. *Boro-formalin.*—Made by dissolving aluminum hydroxide in a solution of 1 part of boric acid, and 2 parts of formic acid, evaporating and crystallizing. Used as a deodorant and antiseptic.

Boro-Phenol is a combination of borax and phenol. It has an agreeable odor, is completely soluble in water, and can be used for all the purposes for which carbolic acid disinfectants are used.

Boro-Salicylic Acid has been introduced by Cesaris and Carcano as an antiseptic; the solution contains 4 per cent. each of boric and salicylic acids.

Borogen.—This is the ethyl ester of boric acid, $B(O.C_2H_5)_3$. It is a liquid, boiling at 120° C. (248° F.), which is decomposed by water into boric acid and alcohol. It is inflammable, burning with a green flame. This substance has been suggested as a local remedy in diseases of the nasal and respiratory mucous membrane, under the belief that it is decomposed into its constituents in the throat and lungs. Borogen is used by inhalation.

Boroglyceride. *Boroglycerinum. Glyceryl-borate.*—This substance has been largely employed as a convenient form of obtaining boric acid in a soluble condition. It is made by heating boric acid and glycerin together so as to effect a combination without discoloring the product by overheating. (See *Glyceritum Boroglycerini*, page 592.) James Kennedy (*Nat. Drug.*, 1887, 46) maintained that it is a chemical compound, and not a mere mechanical mixture, as has been supposed; he gave it the formula $C_3H_5BO_3$, and expressed the reaction in its formation thus:

$$C_3H_5(OH)_3 + H_3BO_3 = C_3H_5BO_3 + 3H_2O$$

The metallic boroglycerides, such as sodium and calcium boroglyceride, are not explained, however, in this case. Aqueous solutions of boroglyceride are used for preserving milk, meat, fruit juices, etc. Under the name of *glacialin* a substance has been largely sold in England which is simply boroglyceride.

Borol.—This is a compound possessing the structural formula $SO_2{<}^{BO}_{KO}$ or $SO_2{<}^{BO}_{ONa}$, or as it may be written, $BKSO_4$ or $BNaSO_4$. It occurs in irregular, colorless, odorless, vitreous

fragments, soluble in five times its weight of water. According to H. Jäger, it is three times as powerful as phenol as an antiseptic, the 2 per cent. solution rapidly destroying most pathogenetic germs. It has been used internally in various germ diseases and externally in *diphtheria, gonorrhœa, ozœna, psoriasis,* and other surgical affections. *Dose,* from thirty to fifty minims (1.8 to 3.1 Cc.) of a 20 per cent. solution well diluted. Locally a 1 to 2 per cent. solution has been used. (*Ther. Woch.,* iv.)

Borsalicyl is made by Bernegau by triturating thirty-two parts of sodium salicylate with twenty-five parts of finely powdered boric acid with a little water; the hardened mass is dried and powdered. It is used as an antiseptic. (*Ap. Ztg.,* 1894, 876.)

Bowdichia. *Bowdichia virgilioides,* H. B. K. (*B. major,* Mart.) (Fam. Leguminosæ.)—Under the name of *Sucupira,* the hard, yellow, very bitter bark yielded by this tree is employed in Brazil in *fevers* and *rheumatism.* Petit has found in it a mydriatic alkaloid. (*P. J.,* June, 1885.)

Bragantia. *Bragantia Wallichii.* (Fam. Aristolochiaceæ.)—The roots of this shrub of India contain an alkaloid allied to *aristolochine,* a soft resin, a resinous acid, and a substance related to dulcite. (*P. J.,* 1894, 231.)

Brassica.—In China the oil of *Brassica sinensis,* or *petsai,* is used for lighting, and is said also to be purgative, and useful in *skin diseases,* while the Japanese employ the yellow oil of *B. campestris,* L., under the name of *aburana,* for culinary and lighting purposes. (*A. J. P.,* June, 1885.)

Brazil Nuts. *Cream Nuts. Para Nuts. Châtaigne du Brésil,* Fr. *Paranuss,* G.—These are edible nuts imported from Brazil, and sometimes employed in making cream syrups for giving flavor to carbonic acid water. In Brazil an expressed oil is obtained from them, which is said to be used for burning, making ointments, and adulterating copaiba. The nuts are the product of *Bertholletia excelsa* (Humboldt and Bonpland), a large and beautiful tree of the fam. Myrtaceæ, growing over extensive regions in South America. Corenwinder has found in the kernel of the nut 65.60 per cent. of oil, and 15.31 per cent. of nitrogenous matter. (*P. J.,* Aug. 1873.)

Brazil Wood.—A red dye-wood, the product of different species of Cæsalpinia, growing in the West Indies and South America. Two varieties are known in commerce,—1, the proper Brazil wood, said to be derived from *Cæsalpinia echinata,* Lam., and sometimes called *Pernambuco* or *Fernambuco wood,* from the province of Brazil, where it is collected; 2, the *brasiletto,* produced by *C. brasiliensis,* L., and *C. Crista,* L., which grow in Jamaica and other parts of the West Indies. The former is the most highly valued. The *Nicaragua* or *peach wood* is also analogous to the brasiletto, and is said by Bancroft to be derived from a species of Cæsalpinia. It is produced in the East Indies. Brazil wood is nearly inodorous, has a slightly sweetish taste, stains the saliva red, and imparts its coloring matter to water. It was formerly used in medicine, but has been abandoned as inert. In pharmacy it serves to color tinctures, etc., but its chief use is in dyeing. A red lake is prepared from it, and it is an ingredient in a red ink. Its dyeing properties are owing to a crystallizable coloring principle, named *brazilin* or *brasilin,* $C_{16}H_{14}O_5$. This, as usually obtained, is of a sulphur-yellow color, which it preserves in the dark, but soon loses in the sunlight, to which it is remarkably sensitive, changing to a reddish hue after a few minutes' exposure, and undergoing a similar alteration in diffused daylight, though more slowly. The principle should, therefore, be kept in perfectly opaque vessels. It is now stated that when absolutely pure it is colorless, and becomes red on exposure to the air. The change is due to the formation of *brasilein,* $C_{16}H_{12}O_5$, which can be prepared from the brasilin by a variety of methods, such as oxidation by nitrous acid, by alcoholic iodine solution, etc. Brasilin is sparingly soluble in water, yielding a sweet and almost colorless solution which is not changed by acids, but is deeply reddened by alkalies. In alcohol and ether it is somewhat more soluble than in water, giving a light yellow solution. Brasilin and hematoxylin (from logwood) are both now recognized as related, and as derived from the pyrone nucleus $C_5H_4O_2$, from which the two groups, the xanthone group and the flavone group, are also taken. The coloring principles of most dye-woods are now referred to this source. (Kupe, *Die Chemie der natürlichen Farbstoffe,* Braunschweig, 1900.)

Brea Gum.—This substance, which has been proposed as a substitute for gum arabic, is believed to be derived from *Cæsalpinia præcox,* a Brazilian tree. It occurs in stalactitic pieces or oval reddish-yellow tears, isolated or agglomerated. It forms with water a viscous pale reddish-yellow mucilage, of acid reaction, which may be partially decolorized by heating with a few drops of hydrochloric acid. It is said to contain 77 per cent. of arabin.

Bremen Blue or **Bremen Green.**—This substance, chemically, is *cupric hydroxide,* although sometimes *cupric carbonate* is sold under the same name. It is made by precipitating a copper salt with an alkali, and drying the precipitate below 40° C. (104° F.). When used as a water-color, it is blue, but when mixed with oil, a soap is formed which is of a green color.

Bromal. C_2HBr_3O.—This substance resembles chloral in its chemical properties, like it existing as an oily colorless liquid, or, when united with water or alcohol, as a crystalline hydrate or alcoholate. It boils at about 172° C. (341.6° F.), and distils without decomposition. It is prepared by adding, little by little, from 3 to 4 parts of bromine to refrigerated alcohol. After fifteen hours of contact the mixture is distilled. The excess of bromine and the other volatile products come over first, and afterwards, at a temperature of from 160° C. (320° F.) to 180° C. (356° F.), the bromal, with an oily substance insoluble in water. Water being added, *bromal hydrate,* $C_2HBr_3O.H_2O$, is formed in rhombic scales fusing at 53.5° C. (128° F.). By the action of an alkali, bromoform is produced from the bromal hydrate. According to S. Steinauer (*V. A. P. A.,* May 19, 1870), in frogs and mammals bromal produces at first great restlessness, followed by sleep of moderate intensity, accompanied by an almost complete analgesia. Dyspnœa was usually very marked, and death sometimes occurred in convulsions. The cardiac ventricles after death were relaxed or tetanized, according as the dose had been large or small. Steinauer believes that the succession of symptoms is due to the first action being that of the bromal, and the subsequent, that of bromoform and nascent bromides generated in the blood from the bromal hydrate. Steinauer administered the drug to several patients, in

doses of three grains (0.2 Gm.) at bedtime, with the effect of relieving pain or producing sleep. In *epilepsy* it seemed to avert the paroxysms.

Bromalin. *Bromethylformin.—Hexamethylenetetramine-bromethylate,* $(CH_2)_6N_4.C_2H_5Br.$, is formed by the action of ethyl bromide upon hexamethylenetetramine. It occurs in colorless scales or white powder, melting at 200° C. (392° F.) with decomposition; nearly tasteless, readily soluble in water. It has been used, especially by Bardet, as a sedative and substitute for the bromides. The *dose* is from thirty to sixty grains (2.0–3.9 Gm.).

Bromamide. *Tribromaniline Hydrobromide.* $C_6H_2Br_3NH_2HBr.$—This substance, which is said to contain 75 per cent. of bromine, and to be very stable, occurs in odorless, tasteless, colorless, needle-shaped crystals, insoluble in water, but soluble in sixteen parts of boiling alcohol, in chloroform, ether, and the fixed oils. It melts at 117.2° C. (243° F.), and volatilizes at 154.4° C. (310° F.) without change. It has been proposed by A Caillé (*N. Y. M. J.*, 1892) as an antipyretic, antirheumatic, and analgesic. *Dose,* from ten to fifteen grains (0.65–1.0 Gm.).

Bromine Chloride. *Bromi Chloridum.* BrCl. This chloride is prepared by passing chlorine gas through bromine, and condensing the vapors which form, by a freezing mixture. It is a reddish-yellow, very mobile and volatile liquid, emitting dark yellow fumes, which have a very powerful odor and cause a flow of tears. Its taste is hot and unpleasant. Bromine chloride is used by Landolfi of Naples, internally, in the treatment of *cancer* and as an ingredient in his caustic.

Bromipin.—*Brominized Sesame Oil* is probably a simple addition compound of bromine with the unsaturated oleins of sesame oil. The exact composition of this substance is not known, but it is asserted to be a stable combination of bromine and sesame oil. It is claimed for it that it has the sedative powers of potassium bromide and other alkaline bromides, but does not produce disturbances of the intestinal tract, skin, and general system which occur in bromism. It has been highly recommended by a number of clinicians for the relief of *epilepsy, insomnia, cardiac symptoms,* and other disturbances occurring in *neurasthenia.* It may be given hypodermically or dissolved in oil and rubbed into the skin; after either method of administration bromine soon appears in the urine. Bromipin is a clear, oily liquid, which was supplied by the manufacturer in two strengths,—one containing 10 per cent. and the other 33⅓ per cent. of bromine. It must be given in capsules or dissolved in cod liver oil. According to *Merck's Report,* 30 grains of the stronger bromipin are equivalent to 15 grains of potassium bromide. The 10 per cent. solution is now (1905) the only one quoted in Merck's Manual; the adult *dose* of this is one fluidrachm (3.75 Cc.); in *epilepsy* two fluidrachms to one fluidounce (7.5 to 30 Cc.) have been given. *Dose,* for children, about one-half the adult dose.

Bromochinal. *Quinine Bromsalicylate.*—Bromochinal occurs in yellow crystals, sparingly soluble in water, alcohol, or ether. According to von Noorden, in *doses* of nine to twelve grains (0.6–0.78 Gm.) given twice a day, it acts as a feeble antipyretic and is also soporific. (*Ther. Geg.*, v.)

Bromocoll. *Dibromtannin-gelatin.*—This is a yellow, tasteless, odorless powder, composed of 20 per cent. of bromine, 10 per cent. of water, 30 per cent. of gelatin, and 40 per cent. of tannic acid. According to the experiments of Brat (*Th. M.*, xv. 4, 1901), bromocoll is very resistant to gastric juice, but is readily dissolved with decomposition in the intestinal juices. It is claimed that it acts precisely like the older bromides, and produces the disagreeable symptoms of bromism, only in a very mild degree. Friedländer (*Th. M.*, 1901) determined by experiments that it depresses the irritability of the psychomotor centres. The *dose* is thirty to seventy-five grains (2–5 Gm.) a day.

Bromol. *Tribromophenol. Tribromphenol.* $C_6H_2Br_3OH.$—Bromol is obtained as a white flocculent and gradually crystallizing sediment when bromine water is added to an aqueous solution of phenol. Pure tribromophenol occurs as a white crystalline substance which melts at a temperature of 92° C. (197.6° F.), and is nearly insoluble in water, but readily so in alcohol, ether, chloroform, glycerin, and in fatty and ethereal oils; the odor is disagreeable, like that of bromine, but more penetrating; the taste is sweet and astringent. According to Grimm and Rademacher, tribromophenol is a powerful antiseptic and disinfectant, which, when in concentrated form, acts as a caustic, and is especially valuable in the treatment of *tuberculous ulcers* and *gangrene.* Grimm considered the remedy too caustic to be used upon the mucous membrane of the upper air-passages, but Rademacher has used it in the solution of olive oil (one to thirty) with asserted excellent results in *diphtheria.* It is said to be very slowly acted upon by the intestinal juices, and has been used as an intestinal disinfectant in *doses* of from three to eight grains (0.2–0.5 Gm.) a day. That it is absorbed in some form is shown by the fact of its excretion in the urine in the form of *tribromophenol-sulphonic acid.*

Bromolein is an addition product of bromine in which the unsaturated fatty oleins of the almond oil have taken up the bromine necessary for their saturation. This substance, introduced by Coronedi and Marchetti (*Settimana med.*, liii. 1899) is a yellow, clear, oily liquid, containing 20 per cent. of bromine combined with olein of the oil of sweet almonds. It is asserted that it may be used hypodermically or upon the skin, and affords an excellent means of using the bromides in nervous diseases, acting like the older bromides without causing bromism. It is said also not to be decomposed by the enzyme of the pancreas. Theoretically the *dose* of bromolein is about three times that of potassium bromide.

Bromopyrin. *Monobromantipyrin.* $C_{11}H_{11}BrN_2O.$—This occurs in white crystalline needles, almost insoluble in cold water, scarcely soluble in hot water, easily soluble in alcohol and chloroform. Its melting point is 114° C. (237.2° F.). Its influence upon the system seems not to have been investigated. A mixture of antipyrine, caffeine, and sodium bromide has been sold as bromopyrin.

Brunswick Green.—A color pigment, chemically either *copper oxycarbonate* or *oxychloride.*

Bryonia. *U. S.* 1890. *Bryonia.*—"The root of *Bryonia alba,* and of *Bryonia dioica* Linnê (nat. ord. *Cucurbitaceæ*)." *U. S.* 1890.

Bryonia alba, or *white bryony,* is a perennial, climbing, herbaceous plant with monœcious flowers, growing in thickets and hedges in different parts of Europe. Another species, *B. dioica,* with diœcious flowers and red berries, bears so close a resemblance in character and properties to the preceding that it is considered by some botanists merely a variety. The roots of both plants are gathered for use. When fresh they are spindle-

shaped, sometimes branched, a foot or two in length, as thick as the arm, or even thicker, externally yellowish gray and circularly wrinkled, within white, succulent, and fleshy, of a nauseous odor, which is lost in great measure by drying, and of a bitter, acrid, very disagreeable taste. The peasants are said sometimes to hollow out the top of the root, and to employ the juice which collects in the cavity, as a drastic purge. (Mérat and De Lens.) The berries are also purgative, and are used in dyeing. *B. americana*, Lam., and *B. africana*, Thunb., are respectively used in the West Indies and Africa as hydragogue cathartics in dropsy. The berries of the European *black byrony* (*Tamus communis*, L.), are said to be an irritant poison, and Coutagne has found that their tincture causes in animals paralysis and convulsions. (See *Rép. de Pharm.*, Nov. 1884; also *P. J.*, Jan. 1903.)

As kept in the shops bryonia occurs in transverse sections "about 5 Cm. in diameter, the bark gray-brown, rough, thin, the central portion whitish or grayish, with numerous small, projecting wood-bundles arranged in circles and radiating lines; fracture short; inodorous; taste disagreeably bitter." *U. S.* 1890. Besides a peculiar glucoside called *bryonin*, the root contains a resin, to which the name of *bryoresin* has been given. It yields its active properties to water. Bryonin, $C_{34}H_{50}O_9$, may be obtained by exhausting the coarsely pulverized root in the cold with water containing 3 per cent. of hydrochloric acid. This acid aqueous liquid is then treated with tannin until no further precipitate occurs, the precipitate treated first with water containing HCl and then with distilled water, dried, pulverized, and dissolved in 90 per cent. alcohol; the solution is filtered, decomposed with zinc oxide, and the resulting mass exhausted with cold distilled water. This on evaporation yields impure bryonin, which is purified by dissolving it in water containing hydrochloric acid and dialyzing it. It is white, amorphous, very bitter, soluble in water and alcohol, insoluble in ether and chloroform. It is dextrogyrate and precipitates tannin and ammoniacal lead acetate. The root thus exhausted with water and dried, when treated with 90 per cent. alcohol, yields the bryoresin. This is soft at 15° C. (59° F.), red, amorphous, soluble in alcohol, ether, chloroform, glacial acetic acid, and alkalies. Bryonin, boiled with dilute sulphuric acid, yields a glucose and a yellowish, amorphous resin, *bryogenin*. This latter is soluble in alcohol, insoluble in ether. (Masson, *J. P. C.*, 1893, 300; see also C. F. Heller, *A. J. P.*, 1887, 68.)

Bryonia is an active irritant hydragogue cathartic. In a number of cases it has produced serious or even fatal poisoning. Vomiting and purging have been commonly present, but in some cases there has been no diarrhœa. Giddiness, delirium, and dilated pupils, coupled with fall of the bodily temperature, imperceptible pulse, cold perspiration, and other manifestations of collapse, are the usual symptoms. Eighty minims (5 Cc.) of the homœopathic tincture caused very serious but not fatal poisoning. (For cases see *P. J.*, 1858, p. 542; *L. L.*, May 9, 1868; *B. M. J.*, 1883, ii. 1067; *T. G.*, ii. 35; also *Woodman and Tidy.*) The recent root is highly irritant, and is said, when bruised and applied to the skin, to be capable of producing vesication. The medicine was well known to the ancients, and has been employed as a hydragogue cathartic in *dropsy*. *Dose*, twenty grains to a drachm (1.3–3.9 Gm.).

Tinctura Bryoniæ. U. S. 1890. *Tincture of Bryonia.*—"Bryonia, recently dried, and in No. 40 powder, *one hundred grammes* [or 3 ounces av., 231 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *one hundred cubic centimeters* [or 3 fluidounces, 183 minims] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Tincture are obtained." *U. S.* 1890. *Dose*, from one to two fluidrachms (3.75–7.5 Cc.).

Burra Gookeroo.—Under this name, in India, the fruit and sometimes the whole plant of the *Tribulus lanuginosus* (Fam. Zygophyllaceæ) is used as a diuretic and aphrodisiac. The carpels have been commended in London as a remedy in *nocturnal emissions; dose* of fluidextract, from twenty minims to one fluidrachm (1.3–3.75 Cc.).

Butea Gum. *Buteæ Gummi. Br. Add. Bengal Kino.*—The inspissated juice obtained from incisions in the stem of *Butea frondosa*, Roxb. The *Sacred Tree* (*Butea frondosa*) enters largely into the religious rites of the Hindoos. Its red flowers are offered at the bloody sacrifice of the goddess Kali. Its leaf with three spreading leaflets is supposed to represent the Hindoo deity, and furnishes platters used when the Hindoo boy becomes of age. Butea gum occurs in small, irregular, shining, odorless fragments, which by exposure become dull and blackish. It is partially soluble in water and yields to hot 90 per cent. alcohol about 40 per cent., the solution being scarcely colored. It is said (Hanbury) to yield 1.8 per cent. of ash and 13.5 per cent. of water, and to be composed of about equal parts of a kinotannic acid and a soluble mucilaginous substance. On dry distillation it yields pyrocatechin, which, according to Eissfel, does not preëxist in it. The Br. Add. permits of its substitution for true kino in India and the eastern colonies, and its therapeutic properties are undoubtedly those of kino.

The Br. Add. recognizes under the name of Buteæ Semina the seeds of *Butea frondosa* and describes them as "flat and reniform, from one to one and one-half inches (25 to 38 Mm.) long, from three-quarters of an inch to one inch (16 to 25 Mm.) wide, and from one-sixteenth to one-twelfth of an inch (1½ to 2 Mm.) thick. The testa is thin, glossy, veined, wrinkled, and of a dark reddish-brown color. There is a large prominent hilum situated in the middle of the concave edge. The cotyledons are large, leafy, and of a yellow color." The butea seeds have been specially used by Tamil practitioners against the *tape worm* and *ascarides* and in *dose* of six fluidrachms twice daily (22.5 Cc.). (Ainslie.) According, however, to the authors of the *Pharmacographia Indica* the infusion of three seeds is distinctly aperient.

The Br. Add. directs that butea seeds shall be soaked in water, the integument carefully removed, and the dried kernels ground to powder (*Pulvis Buteæ Seminum*, Br. Add.); *dose*, ten to twenty grains (0.65–1.3 Gm.).

Butylchloral-Antipyrine. $C_{11}H_{12}N_2O.C_4H_5Cl_3O + H_2O$.—This compound results when antipyrine and butylchloral hydrate, in the proportion of 188 parts of the former to 193.5 parts of the latter, are triturated together; the resulting oily liquid dissolved in hot water, and the solution set aside to crystallize. It is in the form of colorless, needle-like crystals, melting at 70° C. (158° F.),

and soluble in about 30 parts of water. *Dose*, of butylchloral-antipyrine, from five to twenty grains (0.32 to 1.3 Gm.) as an analgesic and hypnotic.

Butyric Acid. *Acidum Butyricum.*—(See *Fruit Essences.*)

Buxus. *Buxus sempervirens*, L. *Box.* (Fam. Buxaceæ.)—This evergreen shrub is too well known to require description. Though much cultivated in this country as an ornamental plant, it is a native of Europe and Western Asia. The wood is considered diaphoretic in its native countries, and is used in decoction in *rheumatism, secondary syphilis*, etc. The leaves, which have a peculiar odor and a bitter and disagreeable taste, are said to be purgative in the *dose* of a drachm. A volatile oil distilled from the wood has been given in *epilepsy*. A tincture formerly enjoyed some reputation as an antiperiodic. (Mérat and De Lens.) In 1860 it was determined by Walz that *buxine*, an alkaloid which had been discovered in the leaves of this tree, is identical with the bebeerine of the bebeeru or nectandra bark. (See *Nectandra;* also *P. J.*, Oct. 1869, 194.) Pavia obtained a second alkaloid from *Buxus sempervirens*, which was investigated by Pavesi and Rotondi. (*Jahresberichte*, 1874, 903.) They named it *parabuxine*, and ascribed to it the formula $C_{24}H_{43}N_2O$. Barbaglia (*A. J. P.*, 1885, 145) described still another alkaloid, *parabuxinidine*. It crystallizes in thin, colorless prisms, is insoluble in water, soluble in ether, freely soluble in alcohol, and colors turmeric paper deep red.

Cabbage-Tree Bark. *Ecorce de Geoffree*, Fr. *Kohlbaumrinde, Wurmrinde*, G.—The bark of *Vouacapoua inermis* (Swz.), Lyons. (*Andira inermis*, H. B. K. *Geoffræa inermis*, Sw.) This is a leguminous tree, with a stem rising to a considerable height, branched towards the top, and covered with a smooth gray bark. The tree is a native of Jamaica, and other West India islands. The bark, which is the part used, is in long pieces, thick, fibrous, externally of a brownish-ash color, scaly, and covered with lichens, internally yellowish, of a resinous fracture, a disagreeable odor, and a sweetish, mucilaginous bitterish taste. Its power resembles that of jalap. Huttenschmidt obtained from it a crystallizable, very bitter substance, having the composition and neutralizing properties of the vegetable alkaloids, and named it *jamaicine*. Two grains (0.13 Gm.) of it produced violent purging in pigeons.

Theodore Peckoldt says of the wood of an allied species, *Andira anthelmintica*, Benth., that the workmen engaged in sawing it are prone to be affected with inflammation of the eyes, constriction of the throat, excessive thirst, a bitter, burning taste, a troublesome itching over the body, and sometimes eruptions on the skin. By treating a concentrated decoction of the wood with calcium hydroxide, then filtering after forty-eight hours, evaporating to the consistence of syrup, and exhausting the residue with alcohol, Peckoldt obtained a yellowish-brown coloring matter which he called *andirin*. (This name has also been given to a glucoside said to have been found in *Vouacapoua inermis*. See *A. J. P.*, 1885, 558.) Peckoldt also obtained a peculiar resin by treating the wood with alcohol, filtering, distilling off most of the alcohol, and then precipitating by water. The resin is inodorous, of a bitter, acrid taste, soluble in alcohol, and but partially soluble in ether. This resin, and especially the portion soluble in ether, gives its irritating properties to the sawdust. (*Chem. Cb.*, Nov. 17, 1858.)

Cabbage-tree bark is cathartic, and, in large doses, prone to occasion vomiting, fever, and delirium. It is said that these effects are more liable to result if cold water be drunk during its operation, and may be relieved by the use of warm water, castor oil, or a vegetable acid. In the West Indies it is esteemed a powerful vermifuge, and is much employed for expelling *lumbrici;* but it is dangerous if incautiously administered, and instances of death from its use have occurred. It is almost unknown in this country. The usual form of administration is that of decoction, though the medicine is also given in powder, syrup, and extract. The *dose* of the powder is from twenty to thirty grains (1.3–2.0 Gm.); of the extract three grains (0.2 Gm.).

On the continent of Europe the bark of *Vouacapoua retusa* (Poir), Lyons (*Andira retusa*, H. B. K., *Geoffræa surinamensis*, Bondt.), which grows in Surinam, has also been used. It is considered more powerfully vermifuge and less liable to produce injurious effects. It has a grayish epidermis, beneath which it is reddish brown, laminated, compact, and very tenacious, and when cut transversely, exhibits a shining and variegated surface. In the dried state it is inodorous, but has an austere bitter taste. The powder is of a pale cinnamon color.

Cacodylic Acid. *Acidum Cacodylicum.* $As(CH_3)_2OOH$.—Cacodylic acid is a deliquescent, crystalline, and odorless solid, which is, however, chemically quite stable. It is very soluble in water with an acid reaction. Cacodylic acid is *dimethyl-arsenic acid;* that is, arsenic acid in which two hydroxyl radicles have been replaced by two methyl radicles. In the metallic cacodylates the hydrogen in the remaining hydroxyl is replaced by the base; sodium cacodylate is, therefore, $As(CH_3)_2OONa$; potassium cacodylate, $As(CH_3)_2OOK$, etc. In recent times cacodylic acid has been very largely used as a substitute for the older preparations of arsenic in the treatment of *psoriasis, neurasthenia*, and other diseases of the skin or the nervous system, being employed in those cases in which Fowler's solution has been commonly used. It has been variously alleged that it is very active and that it is almost free from toxic properties, a divergence of statement which seems to be reconciled by the researches of John Marshall and Howard Green (*Am. Chem. J.*, May, 1886), who found that commercial cacodylic acid was quite active in rabbits, and then determined that this activity was due to the presence of free arsenic trioxide.

Chemically pure cacodylic acid had to be given in enormous doses to have any effect, but when administered to the rabbit in repeated doses of seven grains (0.45 Gm.) it produced vomiting, diarrhœa, profuse salivation, staggering gait, followed in one case by death. It would seem, therefore, to be a very feeble arsenical preparation. There is little reason for supposing that it is essentially different in its therapeutic action from the more ordinary preparations of arsenic, its remedial properties being in all probability directly proportionate to its toxic—that is, its physiological activity. This conclusion is sustained by two facts which the published clinical records make very clear,—namely, that in order to be at all effective in disease cacodylates must be given in extraordinary doses, and that occasionally the exhibition of comparatively small doses is followed by very violent symptoms of arsenical

poisoning. (See Murrell, *B. M. J.*, No. 2086.) It is most probable that in the latter cases the cacodylate has contained free arsenous acid. Pure cacodylic acid may be used itself internally in *doses* of one-half to two grains (0.032–0.13 Gm.), but is commonly administered in the form of a salt. The following preparations have been suggested:

Calcium Cacodylate. Calcii Cacodylas.

$$\left.\begin{matrix}(CH_3)_2\,As\,OO\\(CH_3)_2\,As\,OO\end{matrix}\right\rangle Ca + aq.$$

A white powder, soluble in water.

Iron Cacodylate. Ferri Cacodylas.—A grayish-yellow amorphous powder freely soluble in water, especially when heated, less soluble in alcohol. This salt has been specially recommended by Gilbert and Lereboullet (*R. T.*, 1900, No. 16) for hypodermic use in the treatment of *leucocythæmia, lymphadenoma*, and other serious anæmias. It is too irritant to be used in concentrated solution, but as much as one grain (0.065 Gm.) dissolved in half a fluidrachm (1.8 Cc.) of water may be injected daily.

Guaiacol Cacodylate.—A reddish-white crystalline mass, which dissolves in alcohol and parts with cacodylic acid in the presence of water. Dissolved in oil it has been employed hypodermically in *tuberculosis*.

Mercury Cacodylate. Hydrargyri Cacodylas. White crystals freely dissolving in water, but sparingly soluble in alcohol. We have no definite knowledge of the physiological action of this salt, but it is said to have been used by Dayas hypodermically in *doses* of half a grain (0.032 Gm.). One and a half grains (0.096 Gm.) is affirmed to be the fatal dose for the rabbit.

Lithium Cacodylate. Lithii Cacodylas.

$$\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\rangle As\,OOLi + aq.$$

A light white powder, soluble in water. *Dose*, one-half to two grains (0.32–0.13 Gm.).

Magnesium Cacodylate. Magnesii Cacodylas.

$$\left.\begin{matrix}(CH_3)_2\,As\,OO\\(CH_3)_2\,As\,OO\end{matrix}\right\rangle Mg + aq.$$

A white powder, soluble in water. *Dose*, one-half to two grains (0.032–0.13 Gm.).

Potassium Cacodylate. Potassii Cacodylas.

$$\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\rangle As\,OOK + aq.$$

Small white crystals, soluble in water, but sparingly soluble in alcohol and insoluble in ether.

Quinine Cacodylate. Quininæ Cacodylas. $C_{20}H_{24}N_2O_2(CH_3)_2AsOOH$.—A white powder, more freely soluble in cold than in hot water, but freely soluble in alcohol. *Dose*, one-half to two grains (0.032–0.13 Gm.).

Sodium Cacodylate. Sodii Cacodylas.

$$\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\rangle As\,OONa + aq.$$

Of all the preparations of cacodylic acid the sodium cacodylate is usually preferred. It especially lends itself to hypodermic use, and may be given in ten per cent. solution. One-fourth of a grain (0.016 Gm.) may be administered at first, and the dose rapidly increased until some evidences of physiological action are produced; or as much as two (0.13 Gm.) or even three grains (0.2 Gm.) of the salt are given in the day. Sodium cacodylate has also been administered to a considerable extent by the rectum. Various clinicians report daily *doses* of four grains (0.26 Gm.) without injury.

Cactus.—Cardiac stimulant properties have been attributed to two Cacti,—namely, *Cereus Bonplandii*, H. B. K., *Cereus grandiflorus* (L), Miller (*Cactus grandiflorus*, L. *Night-blooming Cereus. Cierge à grandes fleurs*, Fr. *Königin der Nacht*, G.) Of these the latter only is now used in practical medicine. It is a native of tropical America, often cultivated in hot houses for the sake of its very fragrant night-opening white flowers. F. W. Sultan (*A. J. P.*, 1891, 424) believed that he had found in it an alkaloid, *cactine*, but the existence of this alkaloid is extremely doubtful.

Cereus grandiflorus has long been used in tropical America in the treatment of *dropsy*. It was first brought into notice as a cardiac remedy by Rubini of Naples. According to O. M. Myers (*N. Y. M. J.*, June, 1891) it elevates the arterial tension by increasing the muscular energy of the heart, and by contracting the arterioles through the vasomotor centres. These conclusions have been partially confirmed by Boy-Teissier and Boinet (*Marseilles Méd.*, 1891). Considerable clinical testimony has been given to the value of cactus as a cardiac stimulant and as a partial substitute for digitalis in the functional disorders of the heart connected with *dyspepsia, neurasthenia, anæmia, Graves's disease, tobacco toxæmia, sexual exhaustion*, and allied affections. It is alleged that cactus does not prolong the diastolic pause, and is valuable in *aortic regurgitation*.

Notwithstanding the scientific and clinical evidence already spoken of, cactus is probably of little or no value in practical medicine. In careful therapeutic trials with it we have failed to get any results whatsoever. Sharp could only obtain from the drug resins which were inactive and concludes that it is inert. (*Pract.*, Sept. 1894.) Moreover, cactus, except in the fresh state as it is ordered by manufacturers from tropical countries, has disappeared entirely from the American drug market,—a sub-committee of the U. S. Pharmacopœial Committee of Revision, after a year's search, was not able to get a single specimen of it. According to P. W. Williams, the maximum *dose* of the tincture (four ounces of the fresh stems to a pint of strong alcohol) is thirty minims (1.8 Cc.) every four hours, and of the fluidextract twelve minims (0.7 Cc.).

From *Cereus pectene*, Heyl separated an alkaloid, *pectenine*, which, according to Heffter (*A. Pharm.*, ccxxxix. S. 462, 1901), produced both in cold and warm blooded animals tetanic convulsions with heightened reflexes. According to the experiments of Mogilewa, the alkaloid acts upon the isolated frog's heart as a depressant.

From *Cereus pilocereus*, Heyl separated the alkaloid *pilocerëine*, which Heffter found to produce in frogs central paralysis with great cardiac depression, and in warm blooded animals to kill by cardiac arrest. Mogilewa found this alkaloid to act upon the frog's heart as a direct depressant to the muscle structure.

Anthelmintic properties have been ascribed to *Cereus flagelliformis*, Miller, and to *C. divaricatus*, Lam., DC.

Cacur.—This is a small gourd which while still unripe is used by the Caffirs as an emetic, and which, according to Oliver, is yielded by the *Cucumis myriocarpus*, Nand. (Fam. Cucurbitaceæ.) G. A. Atkinson (*A. J. P.*, 1887) obtained from it a neutral resinous body, *myriocarpin*, and found that twenty grains (1.3 Gm.) of the fresh pulp produced in man nausea and slight purgation. (*Ed. M. J.*, July, 1886.)

Cadmium. *Kadmium*, G.—This metal is associated with zinc in its ores, occurring principally as *greenockite* (CdS), a yellowish incrustation upon *zinc blende* (ZnS), and, being more volatile than that metal, comes over with the first portions of the zinc in the process for obtaining it. (See *Zincum.*) The cadmium is separated by dissolving the alloy metals in diluted sulphuric acid, precipitating the sulphate by hydrogen sulphide, treating the precipitate with hydrochloric acid, and again precipitating with ammonium carbonate. The cadmium carbonate thus obtained, after being washed and dried, is mixed with charcoal, and exposed to a dull red heat in an earthen retort, when the reduced metal distils over.

Properties.—Cadmium is a white metal, resembling tin, but somewhat heavier and more tenacious. Like that metal, it crackles when bent. Its sp. gr. is 8.7, melting point from 316° to 320° C. (600.8°–608° F.). It begins to volatilize at a temperature slightly above this, but under the boiling point of mercury, while it boils only at 770° C. (1418° F.). It is little affected by the air, but, when heated, combines with an atom of oxygen, forming a reddish-brown or orange-colored oxide, CdO, which combines with the acids to form salts. From its saline solutions the oxide is precipitated by the alkalies in the form of a white hydroxide. Cadmium also combines with chlorine, iodine, bromine, and sulphur. It is distinguished by forming a colorless solution with nitric acid, from which hydrogen sulphide or ammonium sulphide precipitates a lemon-yellow sulphide insoluble in an excess of the reagent or in solution of potassium hydroxide or ammonia water, and not volatilized at a red heat. Potassium hydroxide produces a white precipitate insoluble in an excess, and ammonia a similar precipitate soluble in an excess of the precipitant. Zinc precipitates cadmium in the metallic state. "A neutral solution of the metal in nitric acid, after having been fully precipitated by carbonate of sodium in slight excess, yields a filtrate which is not affected by ammonium sulphide." *U. S.* 1870. This test was intended to prove the absence of arsenic.

Cadmium Iodide. Cadmii Iodidum. (CdI_2. Mol. wt. 363.4.) *Cadmium Iodatum, Iodidum Cadmicum. Iodure de Cadmium*, Fr. *Jodcadmium, Kadmiumjodür*, G.—Cadmium iodide may be prepared by mixing iodine and filings of cadmium in a moist state, or by dissolving the metal in hydriodic acid, or by double decomposition between potassium iodide and cadmium sulphate. It is soluble in water and alcohol, and may be crystallized from either solution, in large, white, transparent crystals, in the form of six-sided tables, of a pearly lustre. These are permanent in the air, melt at 404° C. (759.2° F.), forming an amber-colored liquid, and give off violet vapors at a dull red heat. The salt is freely soluble in water and in alcohol, and the solution has an acid reaction. The Br. Pharmacopœia of 1867 gives the following tests. The aqueous solution gives a yellow precipitate with hydrogen sulphide or ammonium sulphide, insoluble in excess of the sulphide, and a white gelatinous precipitate with excess of solution of potassium hydroxide, the filtrate from which is unaffected by ammonium sulphide. Ten grains dissolved in water give with an excess of silver nitrate a precipitate which, washed with water and afterwards with half an ounce of water of ammonia and dried, weighs 12.5 grains.

Cadmium Salicylate. Cadmii Salicylas. $Cd(C_5H_4OHCOO)_2$, is prepared by acting on cadmium oxide with salicylic acid. It is colorless and crystalline, soluble in 24 parts of boiling water, and in alcohol, ether, and glycerin. It is used as an antiseptic.

Cadmium Sulphate. Cadmii Sulphas. Cadmium Sulfuricum. Sulfas Cadmicus. Sulfate de Cadmium, Fr. *Schwefelsaures Cadmiumoxyd, Kadmiumsulfat*, G. $CdSO_4.4H_2O$.[1]—"Take of Cadmium, in small pieces, *a troyounce;* Nitric Acid *two troyounces;* Carbonate of Sodium *three troyounces;* Sulphuric Acid *four hundred and twenty grains;* Distilled Water *a sufficient quantity.* To the Cadmium and two fluidounces of Distilled Water, contained in a glass vessel, add by degrees the Nitric Acid, and, when the action slackens, apply a gentle heat until the metal is dissolved. Filter the solution, and, having dissolved the Carbonate of Sodium in six fluidounces of Distilled Water, mix the solutions thoroughly. Wash the precipitate obtained until the water passes tasteless, and dissolve it in the Sulphuric Acid, diluted with four fluidounces of Distilled Water. Then evaporate the solution to one-third, and set it aside to crystallize. Lastly, dry the crystals on bibulous paper." *U. S.* 1870.

Cadmium sulphate crystallizes in oblique prisms with rhomboidal bases, which are transparent and colorless, and resemble those of zinc sulphate. They have an astringent, slightly acidulous, and austere taste, effloresce on exposure to the air, and are very soluble in water. The solution, even though acidulated, gives with hydrogen sulphide a yellow precipitate, becoming orange-yellow, of cadmium sulphide, which is dissolved by strong hydrochloric acid, but is insoluble in solutions of potassium hydroxide or ammonia, and is thus readily distinguished from arsenic sulphide. With ammonium sulphide it gives a yellow precipitate insoluble in an excess of the sulphide. Ammonia produces a white precipitate, soluble in an excess of the precipitant; ammonium carbonate a white one insoluble in an excess; potassium ferrocyanide a white precipitate not dissolved by hydrochloric acid; and the ferricyanide a brownish-yellow one soluble in a large excess of that acid. (Brande and Taylor.) By these tests cadmium sulphate is distinguished as a salt of that metal. As a sulphate it is known by yielding a precipitate with barium chloride not soluble in nitric acid. Zinc precipitates cadmium in the metallic state from the solution. Cadmium suspended in a solution of copper sulphate precipitates that metal, leaving cadmium sulphate in solution, and this has been proposed as a method of obtaining the salt.

Medicinal Uses of Cadmium.—It is probable that the insoluble preparations of cadmium are not actively poisonous, but it is certain that the soluble preparations are corrosive poisons, causing in overdoses giddiness, vomiting, purging, slowing of the pulse and respiration, loss of consciousness, and spasm. In three cases in which the carbonate is said to have been inhaled, the chief symptoms were constriction of the throat, embarrassed respiration, vomiting and purging, giddiness, and painful spasms. (*Ann. Thér.*, 1859.) For a case of poisoning by the *bromide*, see *B. M. S. J.*, 1876.

[1] The ordinary crystals of cadmium sulphate have the formula $CdSO_4.8H_2O$, and, at very low temperature, $CdSO_4.7H_2O$.

It has been shown by Athanasius and Langlois (*C. R. S. B.*, ii. 1895) that the soluble salts of cadmium act very powerfully in arresting the lactic fermentation. When given hypodermically to the frog they produce symptoms similar to those caused by zinc salts, than which, however, they are less powerful; the symptoms are rapid loss of voluntary motion with persistence of the reflexes and pronounced cardiac depression. In the higher animals there is destruction of the red blood corpuscles.

Cadmium sulphate has been used to a considerable extent as a local astringent and stimulant in diseases of the eye and in *gonorrhœa*, and is believed by many oculists to have special power in relieving specks and *opacities of the cornea*. It is employed either in solution, from half a grain to four grains to the fluidounce of distilled water, or in ointment, twelve grains to the ounce of simple ointment.

Cadmium iodide was introduced by A. B. Garrod as an external remedy in the treatment of *scrofulous glands, nodes, chronic inflammation of joints*, and various *cutaneous diseases*. The ointment, which was formerly official in the British Pharmacopœia under the name of *Unguentum Cadmii Iodidi* (sixty-two grains to one ounce of simple ointment), is soft, white, and said to readily yield its iodine to absorption when applied by persistent gentle friction.

Cæsium.—The physiological effect of cæsium chloride has been investigated by S. Botkin (*In. Dis.*, St. Petersburg, 1888.) He finds that it increases the blood pressure and retards the heart movement to a slight extent. Laufenauer (*Th. M.*, 1889, and *Pester Med. Chirurg. Presse*, 1889) asserts that cæsium bromide theoretically ought to, and practically does, control *epilepsy* better than do the ordinary bromides. The physiological and medicinal properties of *rubidium* have also been studied by these investigators and found to resemble those of cæsium. This investigation has led to the putting upon the market, by Merck, of the following preparations:

Rubidium and Ammonium Bromide ($RbBr + 3NH_4Br$).—A white or slightly yellowish, crystalline powder, readily soluble in water. Its taste is somewhat cooling at first, and pungently saline afterwards. This salt, one hundred parts of which contain thirty-six parts of rubidium bromide and sixty-four of ammonium bromide (NH_4Br), was especially used by Laufenauer in *doses* of from one to two drachms (3.9–7.7 Gm.).

Cæsium and Ammonium Bromide ($CsBr + 3NH_4Br$).—A white, crystalline powder, readily soluble in water.

Cæsium Carbonate (Cs_2CO_3).—Sand-like, white; melting at red heat; very hygroscopic; very soluble in water; soluble also in alcohol.

Cæsium Hydroxide (CsOH.)—A grayish-white mass melting below red heat; rather deliquescent, behaving towards water or alcohol as potassium hydroxide does.

Cæsium Sulphate (Cs_2SO_4).—Anhydrous, colorless prisms, permanent in the atmosphere; extremely soluble in water; insoluble in alcohol.

The triple salt *Cæsium, Rubidium*, and *Ammonium Bromide* is also used.

Caffeine Hydrobromide. *Caffeinæ Hydrobromidum. Caffeinum hydrobromicum. Koffeinhydrobromat, Bromwasserstoffsaures Koffein*, G. $C_8H_{10}N_4O_2.HBr + 2H_2O$.—In the form of transparent crystals, readily decomposed but more stable than the hydrochloride. When heated to 110° C. (230° F.) the hydrobromic acid is driven off. Used for nervous headaches and as a diuretic, injected subcutaneously.

Caffeine Hydrochloride. *Caffeinæ Hydrochloridum, Caffeinum Hydrochloricum. Koffein-hydrochlorat, Salzsaures Koffein*, G. $C_8H_{10}N_4O_2HCl + 2H_2O$. Large, colorless, prismatic crystals, readily decomposed by washing with alcohol or water or by long exposure to the air, when water and chlorine are lost. If heated to 110° C. (230° F.) the chlorine is driven off. The normal salt contains about 73 per cent. of caffeine.

Caffeine Nitrate. *Caffeinæ Nitras. Caffeinum Nitricum. Koffeinnitrat, Salpetersaures Koffein*, G. $C_8H_{10}N_4O_2HNO_3 + H_2O$.—In the form of yellowish crystals, quickly decomposed by water and alcohol. The salt contains about 70 per cent. of caffeine and all the nitric acid is driven off at a temperature of 100° C. (212° F.).

Caffeine Phenylate. *Caffeinæ Phenylas. Caffeinum Phenylicum. Caffeine Phenol. Koffeinphenol, Coffeo-phenol*, G. $C_8H_{10}N_4O_2.C_6H_6O + H_2O$.—Made by dissolving 22.6 parts of caffeine in 10 parts of fused phenol. It is in the form of a white or pinkish crystalline mass, soluble in water.

Caffeine Sulphate. *Caffeinæ Sulphas. Caffeinum Sulfuricum. Koffeinsulphat, Schwefelsaures Koffein*, G. $C_8H_{10}N_4O_2H_2SO_4$.—The sulphate may be made by dissolving caffeine in alcohol, containing more sulphuric acid than is needed to make the salt, and setting the solution aside to crystallize. It is decomposed by alcohol or water alone. The salt contains about 66 per cent. of caffeine.

Cahinca. *David's Root. Radix Caincæ. Cainça*, Fr. *Kainkawurzel*, G.—This medicine attracted at one time considerable attention. The name of *cahinca* or *cainca* was adopted from the language of the Brazilian Indians. The Portuguese of Brazil call the medicine *raiz pretta*, or *black root*. When first noticed in Europe, it was supposed to be derived from the *Chiococca racemosa* of Linnæus, which was known to botanists as an inhabitant of the West Indies. But Martius, in his *Specimen Materiæ Medicæ Brasiliensis*, describes two other species of *Chiococca*, *C. anguifuga*, Mart., and *C. densifolia*, Mart., both of which are now known as *C. brachiata*, Ruiz and Pav., which afford roots having the properties of the root ascribed to *C. racemosa*. A. Richard, however, received from Brazil specimens of *C. racemosa* as the cahinca plant.

A specimen brought to Philadelphia consisted of cylindrical pieces, varying in size from the thickness of a straw to that of the little finger, somewhat bent or contorted, slightly wrinkled longitudinally, with occasional small asperities, internally ligneous, externally covered with a thin, brittle, reddish-brown bark, having a light brown or brownish ash-colored epidermis. The cortical portion, which was of a resinous character, had a bitter disagreeable taste, somewhat acrid and astringent; the ligneous part was quite tasteless. The virtues of the root reside almost exclusively in its bark. They are extracted by water and alcohol. Cahinca has been analyzed by several chemists. Four distinct principles were discovered in it by Pelletier and Caventou,—1, a crystallizable bitter substance, believed to be the active principle, and called *cahincic acid*, $C_{40}H_{64}O_{18}$; 2, a green fatty matter of a nauseous odor; 3, a yellow coloring matter; and 4, a colored viscid substance. Rochleder and Hlasiwetz found also caffetannic acid. By these chemists a tincture, obtained by boiling the bark in alcohol, was pre-

cipitated first with a spirituous solution of lead acetate, and afterwards, having been previously filtered, with the tribasic lead acetate. The first precipitate consisted chiefly of lead caffe-tannate and a portion of lead cahincate, the second of lead cahincate exclusively. Cahincic acid is white, without odor, of a taste at first scarcely perceptible, but afterwards extremely bitter and slightly astringent, slightly soluble in water, but readily soluble in alcohol, permanent in the air, and unaltered at 100° C. (212° F.). It reddens vegetable blues, and unites with the alkalies, but does not form crystallizable salts. It is thought to exist in the root as calcium subcahincate. When treated with diluted hydrochloric acid it is decomposed into glucose and other products, of which is obtained at first *chiococcaic acid*, $C_{28}H_{42}O_7$ (thought by some to be identical with *quinovic acid*), and later, by boiling with alcoholic hydrochloric acid, *caïncetin*, $C_{22}H_{34}O_3$.

Cahinca is tonic, diuretic, purgative, emetic, and is capable of producing serious gastro-intestinal irritation. In Brazil it has long been used by the natives as a remedy for the *bites of serpents*. Patrick Brown speaks of the root of *C. racemosa* as very useful in obstinate *rheumatism*. It is said to be largely used for *dropsy* in Brazil, and Achille Richard, François, and other practitioners have attested its value. *Dose*, of the powdered bark, from twenty grains to a drachm (1.3–3.9 Gm.); of the aqueous or spirituous extract, from ten to twenty grains (0.65–1.3 Cc.).

Calamine. *Calamina. Lapis Calaminaris.* Calamine is the old name of the native *zinc carbonate*, although in mineralogy the name *calamine* is now applied to *zinc silicate*, while the name *Smithsonite* is given to the carbonate. It is found in the United States, as well as in Belgium, Germany, and England. It occurs in compact or earthy masses, or concretions, of a dull appearance, readily scratched by the knife, and breaking with an earthy fracture, or it occurs crystallized in rhombic forms. Its color is very variable, being, in different specimens, grayish, grayish-yellow, reddish-yellow, and, when very impure, brown- or brownish-yellow. Its sp. gr. varies from 3.4 to 4.4. Before the blow pipe it does not melt, but becomes yellow and sublimes. When of good quality, it is almost entirely soluble in the dilute mineral acids, and, unless it has been previously calcined, emits a few bubbles of carbon dioxide. If soluble in sulphuric acid, it can contain but little calcium carbonate and no barium sulphate.

Prepared Calamine. Calamina Præparata.—Calamine must be impalpable before being used in medicine. The following is the U. S. formula of 1850. "Take of Calamine a convenient quantity. Heat it to redness, and afterwards reduce it to a very fine powder." *U. S.* 1850. Prepared calamine occurs as a pinkish or flesh-colored powder, of an earthy appearance. Sometimes it is made up into small masses. It is used only externally as a mild astringent and desiccant in *excoriations* and *superficial ulcerations*, either as a dry powder dusted on the part, or as a cerate.

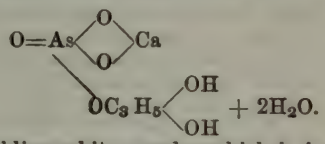
Calcium Acetate. *Calcii Acetas. Acétate de Chaux*, Fr. *Essigsaurer Kalk*, G. $Ca(C_2H_3O_2)_2 + H_2O$.—Made by neutralizing acetic acid with precipitated calcium carbonate, evaporating and crystallizing. Colorless needle-like crystals, soluble in water, less so in alcohol.

Calcium Benzoate. *Calcii Benzoas.* $Ca(C_7H_5O_2)_2 + 3H_2O$.—This salt may be made by adding calcium carbonate to a hot aqueous solution of benzoic acid, filtering, and evaporating the solution, and collecting and drying the crystals, which usually form in beautiful radiating tufts. It is soluble in 18 parts of cold water and 6 parts of boiling water. *Calcium hippurate*, $Ca(C_9H_8NO_3)_2 + 3H_2O$, is made in a similar manner, and is identical in appearance and uses. Poulet recommends the latter highly in the *uric acid diathesis*, for *scrofula*, incipient *cirrhosis of the liver*, and in *struma*. *Dose*, ten grains (0.65 Gm.).

Calcium Borate. *Calcii Boras.* $Ca_3(BO_3)_2$. Calcium borate is prepared by mixing solutions of sodium borate and calcium chloride. It is a white, inodorous, tasteless powder. It is given internally in *diarrhœa*, and used externally as a deodorant and antiseptic.

Calcium Dithiocarbonate. *Dithio-Calcium Carbonate.* $CaCOS_2$.—An orange-red, crystalline, hygroscopic powder, slightly soluble in water, less so in alcohol. It has been especially employed by Tommasoli and Vicini (*Monatssch. f. Prakt. Dermatol.*, 1892) as a local application in *eczema*, *psoriasis*, *lupus*, *purulent venereal* and other *skin diseases*, in the form of a 5 per cent. ointment or a somewhat stronger aqueous solution. A 20 per cent. solution produced distinct burning irritation and even pustulation. Sabbatini states that the 1 per cent. solution inhibits, but does not kill pyogenic micro-organisms. On exposure, its aqueous solution undergoes decomposition with the separation of sulphur and hydrogen sulphide.

Calcium Glycero-arsenate. *Calcii Glycero-arsenas.*



A crumbling white powder which is insoluble in water and alcohol but freely dissolves in mineral and organic acids, especially in a dilute solution of citric acid. According to Schlagdenhauffen and Pagel, the lethal subcutaneous dose of this compound is for frogs, 19 grains (1.23 Gm.) per kilo (2⅘ lbs.), and that of guinea pigs, 47 grains (3.10 Gm.) per kilo (2⅘ lbs.). The preparation is therefore only slightly poisonous and has been employed in daily *dose* of one-sixth grain (0.01 Gm.) internally in *phthisis* by Spillmann and in *diabetes* by Heinrich Stern, with alleged good results, in *doses* of 4 to 10 grains (0.26–0.65 Gm.) to be taken three or four times daily.

Calcium Iodate. *Calcii Iodas.* $Ca(IO_3)_2 + 6H_2O$.—This is a white crystalline powder dissolving in about 400 parts of water. It contains 51 per cent. of iodine and 16 per cent. of available oxygen, which substances are liberated slowly in the presence of putrescent organic matters. It is stated further that in alkaline solution, while the organic matter is being oxidized by the oxygen set free from the decomposing iodate, the iodine slowly reforms iodates by the decomposition of water. The iodate so reformed, in contact with another portion of putrescible matter, yields further proportions of free oxygen and iodine to act as before, and so on. This salt was brought forward by E. Sonstadt as a valuable antiseptic, to be used in the preservation of food. (*Chem. News*, xxviii. 297; confirmed in *Provincial Med. Journ.*, March, 1890.) It is strongly recommended by W. Mackie (*L. L.*, 1900, No. 4035) as a substitute in surgery for iodoform and in internal medicine as a gastro-

intestinal antiseptic. The internal *dose* is from three to five grains (0.2–0.32 Gm.) given in capsules after meals.

Calcium Iodide. *Calcii Iodidum. Calcium Iodatum. Iodure de Calcium*, Fr. *Jodcalcium, Calcium Jodid*, G. CaI_2.—According to Malem (*B. G. T.*, Avril 30, 1868) this salt is preferable to any other iodic compound in *phthisis*. Malem prepares it by treating a solution of ferrous iodide with milk of lime. This liquor thus obtained, being filtered and evaporated, yields crystals of calcium iodide. It may also be made by dissolving lime or its carbonate in hydriodic acid. Pure calcium iodide is white, and crystallizes in large plates of a pearly lustre. Procured as recommended, it is yellowish, probably in consequence of the presence of iodine in excess. It is deliquescent, and very soluble in water, and its solution is capable of dissolving iodine added to it. Calcium iodide is much more unstable than potassium iodide. When taken into the stomach, it is rapidly decomposed into hydriodic acid and salts of lime, which are almost immediately absorbed. Most patients bear it very well. From one to three or four grains (0.065–0.2–0.26 Gm.) may be given after meals. (*Ann. Thér.*, 1869, 194.) To make the syrup of calcium iodide the following formula has been proposed by O. Eberbach (*P. J.*, 3d ser., i. 364). Take of iodine 4 oz.; iron (in form of wire) 7½ dr.; distilled water q. s.; milk of lime (fresh) q. s.; sugar 28 oz.; simple syrup q. s.; mix 3 oz. of the iodine with the iron and 4 oz. of water, in a thin flask with long neck; shake occasionally until the reaction has ceased and the solution assumes a pale green color; filter the solution, and add the remainder of the iodine; heat to the boiling point, and add milk of lime until all of the iron is precipitated. Filter, and wash the precipitate with hot water until all the iodide is washed out, and then bring the whole to the measure of 20 fl. oz.; add the sugar, and dissolve by a gentle heat; to the solution add enough simple syrup to make it measure 40 fl. oz.; mix thoroughly, and fill into 2 oz. bottles, well corked.

Calcium Permanganate. *Calcii Permanganas.* $CaMn_2O_8$.—This salt probably has the same physiological and medicinal properties as the corresponding salt of potassium. It has been used in *gastro-enteritis* and *diarrhœa* in *doses* of from one-half to one and a half grains (0.032–0.096 Gm.), but has been especially urged for the purification of water. For spring water twenty milligrammes, for river water forty milligrammes, per liter are recommended. If the color of the water becomes red the permanganate is indicated to be in excess.

Calcium Peroxide. *Calcii Peroxidum.* $CaO_2 + 4H_2O$.—A yellow crystalline powder which dissolves but sparingly in water. The solution has an alkaline reaction and possesses a somewhat caustic and astringent taste. In the presence of water calcium peroxide splits up into calcium hydroxide and oxygen. It has been brought forward as a powerful oxidizing antizymotic and as an antidote to hydrocyanic acid. In Hornstein's experiments it failed as an antidote unless the cyanide was given in very small quantities and the antidote was administered immediately after the poison. Its germicidal powers appear to be feeble, and its proneness to decomposition is a practical difficulty in its use. It has, however, been highly recommended by Reszkowski (*Gazette Lekarska*, 1899) in the summer *diarrhœas* of children, in *doses* of three to ten grains (0.2–0.65 Gm.), administered in milk. It is advised to keep it in parchment capsules in well stoppered bottles. Under the name of *calcium superoxide* or *gorite* a probably identical oxide has been put on the market. The germicidal influence of gorite was determined by Hornstein (*A. J. P.*, 1901, viii.) to be distinctly weaker than that of hydrogen dioxide; it was also found that if a rabbit, to which twice the fatal dose of potassium cyanide had been administered by the mouth, six to eight minutes later be given fifteen grains (1 Gm.) of gorite, injected into the stomach, no toxic symptoms follow. The chief value of the substance, according to Hornstein, is as a tooth-powder.

Calcium Salicylate. *Calcii Salicylas.* $CaC_7H_4O_3 + H_2O$.—This compound is the basic calcium salt. It is a sandy, white powder, almost insoluble in water. The neutral salt is also known and is quite soluble in water. Calcium salicylate has been used in Austria in *doses* of from seven to twenty grains (0.45 to 1.3 Gm.) for *diarrhœa* and *gastro-enteritis*. For method of preparation, see *P. J.*, vol. xxii. 1891.

Calcium Santonate.—This is a white, tasteless, insoluble powder, obtained by saturating hot milk of lime with santonin, and has been brought forward by Bombelen as superior to santonin as a vermifuge on account of its tastelessness, and especially because of its insolubility, which causes it to be absorbed with great slowness. (*Ap. Ztg.*, March, 1899.) *Dose*, one grain (0.065 Gm.).

Calcium Sulphophenate. *Calcii Sulphophenas. Calcium Sulphocarbolate. Karbolsulfosaures Calcium*, G. $[C_6H_4(OH)SO_3]_2Ca + H_2O$.—Made by neutralizing paraphenolsulphonic acid with precipitated calcium carbonate. In the form of a colorless, almost odorless powder, astringent and bitter, readily soluble in water and alcohol. A 1 per cent. solution is recommended for internal administration as an antiseptic, disinfectant and astringent in *doses* of a fluidrachm (3.75 Cc.) every 3 hours.

Calcium Thiosulphate. *Calcii Thiosulphas. Calcium Sulpho-sulphate. Calcium Hyposulphite.* $CaS_2O_3.6H_2O$.—The following mode of preparing this salt is recommended by J. Laneau of Paris. Take 1000 parts of sulphur, 400 of lime, and 4000 of rain water; slake the lime with sufficient of the water, add the sulphur and the residue of the water, and boil for an hour and a half, adding water to keep up the measure; when cool filter the liquid through linen covered with filtering paper, and wash the residue with 1000 parts of water. A solution is thus obtained of calcium polysulphide of the sp. gr. 1.141. Into this pass a current of washed sulphurous acid gas until the solution becomes colorless; separate the precipitated sulphur (which may be used for the official precipitated sulphur); and evaporate the clear solution at a heat not exceeding 60° C. (140° F.), until it begins to crystallize, when it is to be set aside. The product is 700 parts of calcium thiosulphate. This is in six-sided crystals, which effloresce in a dry air. Laneau prepares a *syrup of calcium thiosulphate* by dissolving 10 parts of the crystallized salt in 20 parts of distilled water, and mixing with the solution 170 parts of syrup of orange flowers. (See *A. J. P.*, 1863, 223.) The *dose* of the salt is from ten to twenty grains (0.65–1.3 Gm.) three times a day, of the syrup from two to four fluidrachms (7.5–15 Cc.).

Of the *thiosulphates* (*hyposulphites*) generally, it may be said that they closely resemble the sulphites in medicinal properties, and may be employed as substitutes for those salts, over which they have the advantage of greater stability, passing less readily into sulphates on contact with the air. They may be prepared by boiling a sulphite or bisulphite for some time with sulphur. They are very soluble in water, and are recognized by the precipitation of sulphur when decomposed by an acid.

Cali Nuts.—These nuts, which come from the west coast of Africa, are the seeds of a papilionaceous plant, and have a more circular shape than Calabar beans, but otherwise agree with the latter in essential external characters. They contain an alkaloid which is said to be chemically and physiologically closely allied to physostigmine. (Merck, *Chem. Cb.*, 1887.)

Calotropis. *Br. Add. Mudar.*—The dried root-bark of *Calotropis procera*, R. Brown, and of *Calotropis gigantea*, R. Brown, freed from the outer corky layer. These asclepiadaceous plants are natives of Hindostan, but have become widely naturalized in various parts of the East and West Indies. Their milky juice is a violent local irritant, which, when taken internally, acts as an emetocathartic and may produce a fatal gastro-enteritis. In India it has long been used not only for suicidal purposes but to kill newly-born female infants, and is also applied to the womb to cause abortion.

The root-bark occurs in short more or less quilled pieces having a thickness of from one-tenth to one-fifth of an inch (two to five millimeters) and a width of not more than one and a half inches (thirty-seven millimeters). It is covered with a soft, grayish-buff, strongly furrowed and reticulated, easily separated periderm. The fracture is short and mealy; the taste bitter and acrid. According to C. J. H. Warden and L. A. Waddel, calotropis contains an acid resin, a crystalline colorless substance, *madaralban*, an amber-colored viscid body, *madarfluavil*, and caoutchouc. (*P. J.*, 1885, 165.)

Calotropis has been very largely used as a local remedy in Hindostan in *elephantiasis* and *leprosy*, and is asserted by John Morton (*Indian Medical Record*, viii. 1895) to act with extraordinary efficiency upon chronic *eczema*. It has also been employed internally as a remedy in *diarrhœa* and *dysentery;* also with less probability of usefulness in *syphilis* and *rheumatism*. *Dose*, of powder, from three to twelve grains (0.2–0.78 Gm.), three times a day, gradually increased until it affects the system.

Tincture of Calotropis. Tinctura Calotropis, Br. Add., two ounces to a pint (alcohol 6 per cent.), is given in *doses* of one-half to one fluidrachm (1.8–3.75 Cc.).

Calycanthus. *Calycanthus glaucus*, Willd. (*Butneria fertilis* (Walt.), Kearney, in Britton and Brown's *Flora.*)—This is a shrub of the fam. Calycanthaceæ, from six to eight feet high, which inhabits the low, shady woods along the mountains of Georgia and North Carolina, and also Tennessee, where it is known as *sweet shrub* or *bubby*. According to R. G. Eccles, the seeds contain a fixed oil, and an alkaloid, *calycanthine*, of unknown physiological properties. H. W. Wiley (*A. J. P.*, 1890, 96) found in the seeds over 47 per cent. of oil and notable quantities of sugars (dextrose, sucrose, and dextrin), also 4.25 per cent. of alkaloid. This latter crystallizes from ether in feathery crystals. The whole plant is aromatic, having, when crushed, the odor of strawberries.

Cam Wood.—A red dye-wood, procured from the *Baphia nitida*, Lodd, a leguminous tree, growing on the western coast of Africa. The wood is usually kept in the shops in the ground state. It yields its coloring matter scarcely at all to cold water, slightly to boiling water, and readily to alcohol and alkaline solutions. The coloring matter is thought to be identical with *santalin*, $C_{15}H_{14}O_5$.

Camphacollasis is the name given to the *camphoric acid ester of methylene diguaiacol.* It occurs in crystals, and is recommended as an antispasmodic, sedative and antiseptic in *doses* of 5 to 20 grains (0.32–1.3 Gm.).

Camphoroxol.—A compound of camphor with hydrogen dioxide. It forms a clear, colorless liquid with a fragrant odor of camphor.

Camphossil.—This is a crystalline, unctuous, deliquescent, tasteless mass, with a camphoraceous odor, insoluble in water. It is said to be a condensation product of camphor and salicylic acid, and as an antipyretic and antiseptic to be useful in *diarrhœas* in *doses* of eight grains (0.65 Gm.).

Canada Pitch. *Pix Canadensis. U. S.* 1880. *Hemlock Pitch.*—The *Tsuga canadensis* (L.), Carr (*Pinus canadensis*, L., *Abies canadensis*, Michx.), *Hemlock* or *Hemlock Spruce* of the United States and Canada, when of full growth, is often seventy or eighty feet high, with a trunk two or three feet in diameter, and of nearly uniform dimensions for two-thirds of its length. The branches are slender, and dependent at their extremities. The leaves are very numerous, six or eight lines long, flat, denticulate, and irregularly arranged in two rows. The strobiles are ovate, little longer than the leaves, terminal and pendulous.

The tree is abundant in Canada, Nova Scotia, and the more northern parts of New England, and is found in the elevated and mountainous regions of the Middle States. Its bark is much used for tanning, an extract being made for the purpose. The tree contains much less juice than some other of the Pinaceæ, and very little flows from incisions made into its trunk. But in the trees which have attained their full growth, and are about to or have begun to decay, the juice exudes spontaneously, and hardens upon the bark, in consequence of the partial evaporation or oxidation of its volatile oil. The bark thus incrusted is stripped from the tree, broken into pieces, and boiled in water. The pitch melts, rises to the surface, is skimmed off, and is still further purified by a second boiling in water. Hemlock pitch is hard, brittle, quite opaque, of a dark reddish-brown color, becoming still darker by exposure to the air, of a weak peculiar odor, and scarcely any taste. It softens and becomes adhesive with a moderate heat, and even at ordinary temperatures takes the form of the vessel containing it, and melts at 92.2° C. (198° F.).

The constituents of this pitch are resin and a minute proportion of volatile oil. It is sometimes known by the incorrect name of *hemlock gum*. Canada pitch is a gentle rubefacient, closely analogous to Burgundy pitch in its properties, and employed for precisely the same purposes. It is, however, more readily softened by heat, and is sometimes almost too soft for convenient application at the temperature of the body. A volatile oil obtained from *Tsuga canadensis*, and called *oil of spruce* or *oil of hemlock*, has been employed to produce

abortion, with the effect of endangering the life of the woman. (J. S. Paige, *N. Y. M. J.*, viii. 184.)

W. Zinn (*M. M. W.*, Oct. 1902) reports a case of stupor and involuntary evacuation of urine, and collapse with subsequent psychic disturbance, as produced by the inhalation for many hours of the emanations from branches of *Pseudotsuga taxifolia* (Lamb.), Britton (*P. Douglasii*, Car.).

The U. S. Pharmacopœia of 1880 gave the following directions for preparing the *Hemlock* or *Canada Pitch Plaster* (*Emplastrum Picis Canadensis, U. S.* 1880): "Canada Pitch, *ninety parts* [or nine ounces av.]; Yellow Wax, *ten parts* [or one ounce av.], to make *one hundred parts* [or ten ounces av.]. Melt them together, strain the mixture, and stir constantly until it thickens on cooling." *U. S.* 1880.

Canary Seed. *Fructus* (*Semen*) *Canariense. Semence de Canarie*, Fr. *Kanariensamen*, G.—The seeds of *Phalaris canariensis*, L., an annual grass originally from the Canary Islands, but now growing wild in Europe and the United States. The seeds are ovate, somewhat compressed, about two lines long, shining, and of a light yellowish-gray color externally and brownish within. Their chief constituent is starch, and they are now used chiefly as a bird seed.

Canchalagua.—This plant, *Erythræa venusta*, A. Gray (Fam. Gentianaceæ), found on our Pacific coast, is a valuable bitter tonic and stomachic. (*Ph. Rec.*, 1887, 363.) *Erythræa australis*, R. Br., is said to be similarly used in Australia. (*P. J.*, xix.)

Canella.—The bark of *Canella alba*, Murray, was formerly recognized by the U. S. and Br. Pharmacopœias. The tree is a native of Florida and the Bahama and West India Islands. The bark of the branches, which is the part employed in medicine, is loosened and deprived of its epidermis by beating. After removal from the tree it is dried in the shade. It enters commerce solely from the Bahamas, where it is known as *cinnamon bark*, or as *white wood bark*. It occurs in pieces partially or completely quilled, occasionally somewhat twisted, of various sizes, from a few inches to two feet in length, from half a line to two or even three lines in thickness, and, in the quill, from half an inch to an inch and a half in diameter.

Canella is of a pale orange-yellow color externally, yellowish-white on the inner surface, with an aromatic odor somewhat resembling that of cloves, and a warm, bitterish, very pungent taste. It is brittle, breaking with a short fracture, and yielding, when pulverized, a yellowish-white powder. Boiling water extracts nearly one-fourth of its weight; but the infusion, though bitter, has comparatively little of the warmth and pungency of the bark. It yields all its virtues to alcohol, forming a bright yellow tincture, which is rendered milky by the addition of water. By distillation with water it affords a large proportion of a yellow or reddish, fragrant and very acrid volatile oil. It contains, moreover, according to the analysis of Petroz and Robinet, mannite, a peculiar very bitter extractive, resin, gum, starch, albumen, and various saline substances. Meyers and Reiche obtained twelve drachms of the volatile oil from ten pounds of the bark. They found it to consist of four different oils, the first being identical with the eugenol or eugenic acid of oil of cloves; the second is closely allied to the chief constituent of cajuput oil; the other oils require further examination. The bark yielded to Flückiger 0.74 per cent. of oil. Meyers and Reiche also obtained 8 per cent. of mannite and 6 per cent. of ash, chiefly calcium carbonate. Canella has been sometimes confounded with Winter's bark, from which, however, it differs widely. (See *Wintera.*) According to John P. Frey, it contains volatile oil, 1.28 per cent.; resin, 8.2 per cent.; mannite, 8 per cent.; ash, 8.9 per cent.; also starch, bitter principle, albumen, and cellulose. (*A. J. P.*, 1884, 1.) It is a mild, aromatic tonic, very acceptable to the stomach, and especially as an addition to tonic or purgative medicines. It is scarcely ever prescribed except in combination. In the West Indies it is employed by the negroes as a condiment and as an antiscorbutic. *Dose*, ten to forty grains (0.65 to 2.6 Gm.).

Cangoura.—An evergreen creeper, from the seeds of which the natives of Salvador are said to produce a paste which is a violent nerve poison, producing in some cases delirium lasting as long as eight days. (*Nouv. Rem.*, Avril, 1892.)

Caoutchouc, Artificial.—Within recent years many attempts have been made to make artificial rubber by the vulcanization of fatty oils with either sulphur or sulphur chloride. Linseed oil, cotton seed oil, and the fish oils have all been used for this purpose with varying success. Latterly it is asserted that very successful results have been attained by the vulcanization of maize oil. These products, known in Germany as *Factis*, may be white or dark colored, the latter color being obtained by the prolonged action of the sulphur. Oxidized or blown oils and sulphated oils are also used for the vulcanization. In 1894 Nobel patented solutions of nitrocellulose in heavy oil solvents as rubber substitutes for rubber varnishes and coatings. Much reclaimed rubber from old rubber articles is revulcanized and incorporated with pure rubber in the manufacture of new rubber articles.

Capparis. *Capparis spinosa*, L. *Caper-bush.* (Fam. Capparidaceæ.)—A low, trailing shrub, growing in the south of Europe and north of Africa. The buds or unexpanded flowers, treated with salt and vinegar, form a highly esteemed pickle, which has an acrid, burning taste, and is considered useful in *scurvy*. The dried bark of the root was formerly official. It is in pieces partially or wholly quilled, about one-third of an inch in mean diameter, transversely wrinkled, grayish externally, whitish within, inodorous, and of a bitterish, somewhat acrid, and aromatic taste. It contains *rutic acid* and a volatile substance of garlic-like odor. It is considered diuretic, and was formerly used in *amenorrhœa* and *chronic rheumatism*.

Capsella. *Capsella Bursa-pastoris*, Medic. *Shepherd's purse. Thlaspi Bursa-pastoris*, L. *Bursa-pastoris*, Weber. *Bursa Bursa-pastoris* (L.), Britt. *Bourse à Pasteur, Molette*, Fr. *Hirtentäschlein*, G. (Fam. Cruciferæ.)—This very common weed is bitter and pungent, yields on distillation a volatile oil identical with oil of mustard, and, according to E. Bombelon, contains an alkaloid, *bursine*. (See *A. J. P.*, 1888; also *Provincial Med. Journ.*, 1858.) It has been used as an antiscorbutic, also in *hæmaturia* and in other *hemorrhages, amenorrhœa* and *dropsy*. From two to four fluidounces (60–120 Cc.) of the fresh expressed juice may be given at a *dose;* or from one-fourth to one-half fluidrachm (0.9–1.8 Cc.) of the fluidextract of the dried plant.

Captol.—This proprietary preparation is said to be an impure condensation product of tannin

and hydrated chloral. It is a brown hygroscopic powder, slightly soluble in cold water, very soluble in hot water and alcohol, not altered by acids but decomposed by alkalies, striking an olive-green color with ferric salts. According to Eichhoff in *seborrhœa capitis* washing the head morning and evening with a 1 to 2 per cent. alcoholic solution of captol is very successful.

Capulincullo.—This drug, derived from the *Rhamnus humboldtianus* of Mexico, is said to be a violent poison, acting like curare. A non-toxic, non-drying fixed oil, tasteless and odorless, is obtained in considerable quantities from the fruit of the tree.

Carana. *Gum Carana.*—A resinous substance, in pieces of a blackish-gray color, externally dark brown, internally somewhat shining and translucent, brittle and pulverizable when dry, but, in the recent state, soft and adhesive, like pitch, easily fusible, of an agreeable balsamic odor when heated, and a bitterish resinous taste. (Geiger.) It is said to be derived from *Protium Carana* (H. B. K.), March (*Amyris Carana*, Humb.), a tree growing in Mexico and South America. Geiger refers it also to *Bursera Simaruba* (L.), Sarg. (*Bursera gummifera*, L.), of the West India Islands; but the resin of this tree is *resine de Gomari* or *resine de chibou* or *cachibou* of French writers, and is said to bear a close resemblance to the resin *tacamahac*. It is probable that in South America the name Carana is applied to different products. (*A. J. P.*, xli. 233.)

Cardamine. *Cardamine pratensis*, L. *Cuckoo-flower.*—This is a perennial herbaceous plant, of the fam. Cruciferæ, with a simple, smooth, erect stem, about a foot in height. The plant grows in Northern Europe and America. Its bitterish and slightly pungent leaves are supposed to be antiscorbutic. The seeds are said to contain *myronic acid*, and to yield on decomposition by hydrolysis an oil analogous to oil of mustard. In Europe they are sometimes added to salads. The flowers have the same taste as the leaves, and, when fresh, a somewhat pungent odor. When dried they become inodorous and nearly insipid. They formerly possessed the reputation of being diuretic, and of being useful in *chorea* and *asthma*.

Carissin.—This is a glucoside which has been isolated from the bark of *Carissa* (*Carandas*) *ovata*, R. Br. (Fam. Apocynaceæ), by J. H. Maiden and H. G. Smith. It is stated to be exceedingly bitter and very poisonous, and in its chemical relations to resemble strophanthin, from which it differs, however, in being precipitated by basic acetate of lead and by tannic acid. Its most characteristic reaction is the production of a beautiful emerald-green color on the addition of a minute fragment of potassium dichromate to its solution in concentrated sulphuric acid. (*P. J.*, 1896.)

Carnallite.—This mineral, found in Stassfurt, Prussia, is very extensively used in the preparation of potassium salts. It is a double magnesium and potassium chloride, associated with rock salt. (See *P. J.*, March, 1872, 787.) The amount of carnallite mined is nearly two million tons annually. In 1904 the quantity of potash salts other than kainite was given as 2,179,471 tons, valued at about five million dollars.

Carnauba Root.—This root, the product of *Copernicia cerifera* (Ar.), Mart. (*Corypha cerifera*), the Brazilian wax palm, is several feet in length, about three-eighths of an inch thick, with a thick friable cortex of a mixed gray-ish and reddish-brown color. (*A. J. P.*, 1875, 349.) E. L. Cleaver found in it tannic acid, an acrid resinous body, a red coloring matter, and a minute portion of volatile oil and of an alkaloid. (*P. J.*, 1875, 965.) It is said to act like sarsaparilla. *Carnauba Wax*, with which the young leaves of the palm are coated, is used in church candles to prevent guttering, for the manufacture of phonograph records, in the composition of sealing wax and for other purposes in the arts.

Carota. *U. S.* 1870. *Carotte*, Fr. *Mohre, Gelbe Rübe*, G. *Daucus Carota*, L.—The *wild carrot* (Fam. Umbelliferæ) is widely distributed, growing along fences, and in neglected fields. It grows wild also in Europe. The well-known garden carrot is the same plant altered by cultivation. The seeds or fruits are very light, of a brownish color, an oval shape, flat on one side and convex on the other, and on their convex surface present four longitudinal ridges, to which stiff, whitish hairs or bristles are attached. They have an aromatic odor, and a warm, pungent, and bitterish taste. By distillation they yield a pale yellow volatile oil, upon which their virtues chiefly depend. The root of the wild plant may be substituted for the seeds. The *root* of the wild carrot is whitish, hard, coriaceous, branched, of a strong odor and an acrid, disagreeable taste; that of the cultivated is reddish-orange, fleshy, thick, conical, rarely branched, of a pleasant odor, and a peculiar, sweet, mucilaginous taste. The constituents of the root are crystallizable and uncrystallizable sugar, a little starch, extractive, albumen, volatile oil, vegetable jelly or pectin, malic acid, saline matters, lignin, and a peculiar crystallizable, ruby red, neutral principle, without odor or taste, called *carotin*. According to Husemann, its formula is $C_{18}H_{24}O$. It forms reddish-brown, golden-green, lustrous quadratic crystals, fusing at 167.8° C. (334° F.), easily soluble in carbon disulphide, difficultly soluble in alcohol and ether, dissolving in concentrated sulphuric acid with violet or blue color, colored blue by sulphur dioxide. Husemann has also described a colorless compound, *hydrocarotin*, $C_{18}H_{30}O$, which exists with carotin in the juice of the carrot, and is probably changed into the latter by oxidation as the plant develops in growth. According to Frorde and Sœauer, carotin, as well as the modification which has been named hydrocarotin, is in fact cholesterin colored by a red pigment (*A. J. P.*, 1866, 505), but Husemann seems to have disproved this assertion. Arnaud (*C. R. A. S.*, cii. 1319), however, isolated cholesterin from carrots; this after repeated purifying with alcohol, was obtained crystallized in leaflets with 1 molecule of water. It melts at 136.5° C. (278° F.), losing the 1 molecule of water. It seems to be identical with the cholesterin obtained by Hesse from Calabar beans and from peas, and differs only very slightly from animal cholesterin. The substance called *vegetable jelly* was by some considered a modification of gum or mucilage, combined with a vegetable acid. Braconnot found it to be a peculiar principle, and named it *pectin*, from the Greek (*πηκτός*), expressive of its characteristic property of gelatinizing. It exists more or less in all vegetables, and is abundant in certain fruits and roots from which jellies are prepared. It may be separated from the juice of fruits by alcohol, which precipitates it in the form of a jelly. This, being washed with weak alcohol and dried, yields a semi-transparent substance bearing some re-

semblance to ichthyocolla. Immersed in 100 parts of cold water, it swells like bassorin, and ultimately forms a homogeneous jelly. With a larger proportion of water it exhibits a mucilaginous consistence. It is less acted on by boiling than by cold water. When perfectly pure it is tasteless, and has no effect on vegetable blues. A striking peculiarity is that, by the agency of a fixed alkali or alkaline earthy base, it is instantly converted into pectic acid, which unites with the base to form a pectate. This may be decomposed by the addition of an acid, which unites with the base, and separates the pectic acid. *Pectic acid* thus obtained is in the form of a colorless jelly, slightly acidulous, with the property of reddening litmus paper, scarcely soluble in cold water, more soluble in boiling water, and forming with the latter a solution, which, though it does not become solid on cooling, is coagulated by alcohol, lime water, acids, or salts, and even by sugar if allowed to stand for some time. With the alkalies it forms salts, capable of gelatinizing; with the earths and metallic oxides, insoluble salts. Braconnot thinks that pectic acid exists in many plants already formed. Frémy found that pectin results, in fruits, from the reaction of acids upon a peculiar insoluble substance they contain when immature, called by him *pectose*, and that pectin is changed into pectic acid not only by alkalies, but also by vegetable albumen. Carrot *seeds* are slightly aromatic, moderately excitant and diuretic, and have been employed as a diuretic in chronic *renal diseases* and in *dropsy*. An ounce of them may be given in infusion, in a day. The flowers are sometimes substituted for the seeds, and the scraped root has been used as a local stimulant to sloughing or *indolent ulcers*.

Carthamus. *Carthamus tinctorius*, L. *Safflower.*—The *African, false, American*, or *dyers' saffron* is an annual composite, with a smooth, erect stem, somewhat branched at top, and a foot or two in height. The plant is a native of India, the Levant, and Egypt, and is cultivated in those countries, as well as in various parts of Europe and America. The florets are brought to us chiefly from the ports of the Mediterranean. *Safflower* (*Flores Carthami; Fleurs de carthame, Safran bâtard*, Fr.; *Saflor*, G.; *Cartamo*, It., Sp.) in mass is of a red color, diversified by the yellow of the styles contained within the floret. It has a peculiar slightly aromatic odor, and a scarcely perceptible bitterness. It contains a fixed oil; also two coloring substances.—one red, insoluble in alkaline liquids, and called *carthamin* or *carthamic acid* by Döbereiner, who found it to possess weak acid properties; the other yellow, and soluble in water. Carthamin, $C_{14}H_{16}O_7$, exists to the amount of from 0.3 to 0.6 per cent. only in the safflower, while the safflower-yellow, to which Malin gives the formula $C_{24}H_{30}O_{15}$, is present to the amount of from 24 to 30 per cent. It is the former which renders safflower useful as a dye stuff. These flowers are sometimes fraudulently mixed with saffron, which they resemble in color, but from which they may be distinguished by their tubular form, and the yellowish style and filaments which they enclose. In large doses carthamus is said to be laxative, and, administered in warm infusion, diaphoretic. It is used in domestic practice, as a substitute for saffron, in *measles, scarlatina*, and other *exanthematous diseases*, to promote the eruption. An infusion, two drachms to a pint of boiling water, is usually employed *pro re nata*.

Carubadi Guiden.—Under this name are largely used, for the relief of *asthma*, certain gall-like bodies, formed on various species of *Pistacia*, especially *P. Terebinthus*, L. (*P. Terebinthina*, St. Lag.), as the result of the stings of a hemipterous insect. According to Ignaz Hoffman, they are used by smoking and fumigation. For this purpose they are coarsely pulverized and burned in the bowl of a pipe, or in a dish, using a small funnel attached to a rubber tube for inhaling the fumes. Preparations should be made beforehand, so that the smoke may be inhaled at the commencement of the attack. They appear to act by exciting free secretion, probably through the turpentine with which they are saturated. They are said to be useful in *chronic bronchitis*. (*S. Jb.*, Bd. clii.)

Carvacrol. *Isopropyl-o-cresol.* $C_{10}H_{13}OH$.—A phenol-like body existing in the essential oils of species of Origanum and some other labiate plants and made artificially from either carvone or camphor. It forms a thick oil which does not solidify at 25° C. (77° F.), boils at from 233° to 235° C. (451.4°–455° F.), and possesses powerful antiseptic properties.

Carvacrol Iodide.—*Iodocorol*, $C_{10}H_{13}OI$, is a bulky, grayish-yellow or buff-colored amorphous powder having a faint aromatic odor. It is insoluble in water, slightly soluble in alcohol, soluble in ether, chloroform, petroleum benzin, carbon disulphide, volatile and fixed oils. From its solution in ether and chloroform it is precipitated on the addition of alcohol, becoming paler in color. This purified product does not show signs of shrinkage until above 170° C. (338° F.), and at 200° C. (392° F.) becomes tarry and black. It is alleged that it combines the antiseptic properties of carvacrol with those of iodine, and possesses the advantage over iodoform in being odorless or nearly so, and in being five times as bulky. It has been used in surgical dressings in *eczema, pruritus, chancres*, and *chancroids*.

Carya. *Hicoria. Hickory.*—Several species of the genus *Hicoria*, Raf. (*Carya*, Nuttall), grow in the United States, of which *H. Pecan* (Marsh.), Brit. (*H. olivæformis*, Raf. *C. olivæformis*, Nutt.), bears the *pecan-nut* of the Southwest, *H. ovata* (Mill.), Brit. (*C. alba*, Nutt.), the *shell-bark nut*, *H. laciniosa* (Michaux f.), Sarg. (*C. sulcata*, Nutt.), another variety of shell-bark and *H. alba* (L.) Brit., *Juglans alba*, L. (*C. tomentosa*, Nutt.), the common thick-shelled hickory nut. Other indigenous species are *H. minima* (Marsh.), Brit. (*C. amara*, Nutt.), *H. glabra* (Mill.), Brit. (*C. porcina*, Nutt.), and *H. microcarpa* (Nutt.), Raf. (*C. microcarpa*, Nutt.). The leaves of most if not all of these trees are somewhat aromatic and astringent, and the bark astringent and bitter. In the bark of *H. alba* F. R. Smith found a crystalline principle, *caryin*, which he believed to be *quercitrin*.

Cascara. *Cascara Amarga. Honduras bark.* The bark of an unidentified species of *Tariri* (*Picramnia*) (Fam. Simarubaceæ). It is a bitter tonic credited with specific alterative properties. For an elaborate discussion of the microscopic and chemical characters of the bark and its alkaloid *picramnine*, by Thompson, see *A. J. P.*, June, 1884.

Casearia. *Casearia esculenta.*—This Indian plant (Fam. Lamydaceæ) is said to be a valuable remedy in *hepatic torpor*, and to contain an organic acid allied to cathartic acid. (*P. J.*, xx.)

Casein.—This substance is one of the important constituents of milk and cheese. It is now

made on a large scale in the United States from the "skim-milk" obtained from creameries; this is conducted into tanks and heated by steam to 120° F., then coagulated by hydrochloric acid and thoroughly agitated; the casein separates into a mass, and the remaining liquid is used in the manufacture of sugar of milk. See *Saccharum Lactis* and a paper by C. H. LaWall in the *Alumni Report of the Philadelphia College of Pharmacy*, April, 1902. Also an excellent paper by J. W. England on the manufacture and uses of casein in the *Proc. A. Ph. A.*, 1902, p. 357. It has been proposed by Seger as an emulsifying agent in pharmacy. One gallon of milk is treated with two and a half fluidounces of water of ammonia for twenty-four hours, and, after removing the saponaceous matter from the surface of the mixture, the serum is precipitated with acetic acid. The magma of casein, strongly pressed, is treated with sodium bicarbonate, and with a sufficient quantity of sugar to make the dried product contain one-tenth of its weight of casein. The powdered substance dissolves easily in water, and, mixed with its weight of gum, may be used for almost all of the emulsions. Resinous matters and balsams previously dissolved in alcohol, essences, and oils, may be mixed with it in the bottle itself without using the mortar. The only defect in this casein saccharate is its slight odor. (*L'Union Pharm.*, May, 1887.)

Casimiroa. *Casimiroa edulis.* Llav. and Lex. *Zapote blanco. Cochilsapote. White Sapota.*—This is a large tree belonging to the family of Aurantiaceæ, a native of Mexico, the leaves are employed in *diarrhœa* and as an anthelmintic. The seeds are said to be narcotic. In them José Sanchez (*Breve estudio Zabote blanco, Thesis*, Mexico, 1893) has found a resin and a crystalline alkaloidal body. Bikorn (*A. Pharm.*, 241, p. 166) asserts that the base, for which he suggests the name *casimirose*, is glucosidal in nature and assigns the formula $C_{30}H_{32}N_2O_8$.

Cassia. *Cassia marylandica*, L. *Séné Américain*, Fr. *Amerikanische Senna*, G. (Fam. Leguminosæ.)—*American senna* is an indigenous perennial plant of vigorous growth, sending up annually numerous round, erect, nearly smooth stems, which are usually simple, and rise from three to six feet in height. The leaves are alternate, and composed of from eight to ten pairs of oblong-lanceolate, smooth, mucronate leaflets, green on their upper surface, pale beneath, and connected by short petioles with the common footstalk, which is compressed, channelled above, and furnished near its base with an ovate, stipitate gland. The flowers, which are of a beautiful golden-yellow color, grow in short axillary racemes at the upper part of the stem. The calyx is composed of five oval, obtuse, unequal yellow sepals; the corolla of the same number of spatulate, concave petals, of which three are ascending, and two descending and larger than the others. The stamens are ten, with yellow filaments and brown anthers, which open by a terminal pore. The three upper stamens bear short abortive anthers; the three lowermost are long, curved, and tapering into a beak. The ovary bears an erect style terminating in a hairy stigma. The fruit is a pendulous legume, from two to four inches long, linear, curved, swelling at the seeds, somewhat hairy, and of a blackish color. The *American senna*, or *wild senna*, is very common in all parts of the Eastern United States south of New York. The leaves, which should be collected in August or the beginning of September, are sometimes brought into the market, compressed into oblong cakes, like those prepared by the Shakers from most herbaceous medicinal plants. The leaflets are from an inch and a half to two inches long, from one-fourth to half an inch in breadth, thin, pliable, and of a pale green color. They have a feeble odor, and a nauseous taste, somewhat analogous to that of senna. Water and alcohol extract their virtues. Hermann J. M. Schroeter (*A. J. P.*, 1888, 231) found in them a yellow coloring matter identical with *chrysophanic acid;* also an active principle corresponding in all respects with *cathartic acid.* For earlier analysis by Martin, see *A. J. P.*, i. 22. American senna is an efficient and safe cathartic, acting like senna but more feebly.

Cassia nictitans, L., was investigated by Gallaher (*A. J. P.*, 1888, 280), who failed to find any glucoside or alkaloid. The amount of volatile oil found was very small, and cathartic acid could not be prepared from it, although the powder produced griping. The leaves of *Cassia alata*, L., are recommended by Conillebault in *ringworm;* they are moistened and the parts affected rubbed with them. (*A. J. P.*, 1887, 266.)

Under the names of *Cheshmat, Chashmizok, Schischen*, the seeds of *C. absus*, L., are said to be used in India and Africa in the treatment of inflammations of the eye, either in the form of a fine powder or an infusion made from the coarsely ground seeds to which several medicinal substances are added.

The root of the *Cassia beareana* is said to be very useful in the so-called *black-water fever* of Africa. (See *P. J.*, vols. xlvii., xlviii.)

Castanea. *U. S.* 1890. *Chestnut.*—Under this name the U. S. Pharmacopœia formerly recognized the leaves of *Castanea dentata* (Marshall), Borkh., collected in September or October while still green. Of the few species included in the genus Castanea, two are natives of North America. Of these *C. dentata* has been considered by many botanists as identical with *C. sativa*, Mill. (*C. vesca*, Gaertn.), of Europe and was described by Michaux as a variety of that species under the name of *americana*. Botanists at present, however, generally consider the two species as distinct. The fruit of the *European chestnut*, or, as it is commonly called in the United States, *Spanish chestnut*, differs greatly from the *American chestnut* both in size and shape. Further, the European tree when planted in America does not lose its distinctive characteristics. The leaves of the European chestnut are more erect and less deeply serrate than those of the American, and usually have a rounded or heart-shaped base, whereas the base of the American leaf is commonly somewhat pointed. Again, the European leaf is commonly stellately tomentose on the under surface, at least when young. Castanea leaves are from four to ten inches long by about two inches in breadth, oblong-elliptical, sharp at the ends, strongly and somewhat unequally serrated with prominent parallel nerves beneath, of a bright color, and so flexible and tenacious as to be powdered with difficulty. It is almost impossible to exhaust them by percolation. Their odor is feeble and their taste slightly astringent. They yield their virtues freely to water, and probably less so to alcohol. John B. Turner found in chestnut leaves chlorophyll, tannin, gallic acid, gum, and albumen. (*A. J. P.*, 1879, p. 542.) In addition to these constituents, L. J. Steltzer found

potassium, calcium, magnesium, and iron carbonates, chlorides, and phosphates, and a trace of resin and fat. (*A. J. P.*, 1880, p. 294.)

Castanea leaves, as proposed by J. C. Close in 1862, have been used to some extent in *whooping cough*, but the possession by them of any physiological or medicinal power is extremely doubtful and they have passed out of use. They are best administered in the form of a *fluidextract*.

Extractum Castaneæ Fluidum. U. S. 1890. *Fluid Extract of Castanea.*—"Castanea, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Glycerin, *one hundred cubic centimeters* [or 3 fluidounces, 183 minims]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Pour *five thousand cubic centimeters* [or 169 fluidounces, 33 minims] of boiling Water upon the powder, allow it to macerate for two hours, then express the liquid, transfer the residue to a percolator, and pour Water upon it until the powder is exhausted. Evaporate the united liquids, on a water-bath, to *two thousand cubic centimeters* [or 67 fluidounces, 5 fluidrachms], allow this to cool, and add *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol. When the insoluble matter has subsided, separate the clear liquid, filter the remainder, evaporate the united liquids to *seven hundred cubic centimeters* [or 23 fluidounces, 321 minims], allow this to cool, add the Glycerin, and enough Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890. The preparation is an aqueous fluidextract with only sufficient alcohol to preserve it. It is a thick reddish-brown liquid, having an astringent taste. *Dose*, from one to two fluidrachms (3.75 to 7.5 Cc.).

Castanea pumila (L.), Mill., *Chinquapin* of the Southern United States, is a bush or small tree usually eight or ten feet in height, but in the Gulf States reaches sometimes thirty feet. The oblong, acute, mucronately serrated leaves are readily distinguished from those of the ordinary chestnut by being whitish and downy underneath. The bark has been used as an astringent tonic. (For analysis, see *A. J. P.*, 1899.)

Castela. *Castela Nicholsonii*, Hook. (Fam. Simarubaceæ.)—This plant is reputed to have antiseptic properties, probably due to a resinous principle discovered by J. L. Putegnat and named by him *amargosin*. (See *N. R.*, April, 1883.)

Castor. *Castoreum. Castoréum*, Fr. *Bibergeil, G. Castoro*, It. *Castoreo*, Sp.—In the beaver, *Castor fiber*, L., between the anus and external genitals of both sexes, are two pairs of membranous follicles, of which the lower and larger are pear shaped, and contain an oily, viscid, highly odorous substance, secreted by glands which lie externally to the sac. After death, the follicles containing castor are removed, and dried either by smoke or in the sun.

This drug is derived either from the northern and northwestern parts of America, or from Russia, and is called in commerce, according to its source, Canadian or American and Russian castor. It is supposed by some that the American and Russian beavers are distinct species, the former being a building, the latter a burrowing animal, and additional ground for the supposition is afforded by the fact that the products of the two differ considerably. Of the Russian castor only a very small portion is imported into this country.

Castor comes to us in the form of solid unctuous masses, contained in sacs about two inches in length, larger at one end than at the other, much flattened and wrinkled, of a brown or blackish color externally, and united in pairs by the excretory ducts which connect them in the living animal. In each pair one sac is generally larger than the other. They are divided internally into numerous cells, containing the castor, which, when the sacs are cut or torn open, is exhibited of a brown or reddish-brown color, intermingled more or less with the whitish membrane forming the cells. Those brought from Russia are larger, fuller, heavier, and less tenacious than the American; and their contents, which are of a rusty or liver color, have a stronger taste and odor, and are considered more valuable as a medicine. A variety of Russian castor, described by Pereira under the name of *chalky Russian castor*, is in smaller and rounder sacs than the American, has a peculiar empyreumatic odor very different from that of the other varieties, breaks like starch under the teeth, and is characterized by effervescing with diluted hydrochloric acid. Müller found 40.646 per cent. of calcium carbonate. According to Kohli, Canadian castor, treated with distilled water and ammonia, affords an orange precipitate, while the precipitate thrown down from the Russian under similar treatment is white.

Good castor has a strong, fetid, peculiar odor; a bitter, acrid, and nauseous taste, and a color more or less tinged with red. It is of a softer or harder consistence according as it is more or less thoroughly dried. When perfectly desiccated, though still slightly unctuous, it is hard, brittle, and has a resinous fracture. Its chemical constituents, according to Brandes, are volatile oil; a resinous matter; albumin; a substance resembling *osmazome;* mucus; calcium urate, carbonate, benzoate, phosphate, and sulphate; sodium acetate and chloride; potassium chloride, sulphate, and benzoate; ammonium carbonate; membranous matter, and a peculiar proximate principle discovered by Bizio, an Italian chemist, and called by him *castorin*. This principle crystallizes in long, diaphanous, fasciculated prisms, has the odor of castor, and a copperish taste. It is insoluble in cold water and cold alcohol, but is dissolved in 100 parts of the latter liquid at the boiling temperature, and by the essential oils. It possesses neither alkaline nor acid properties, and is considered as belonging to the cholesterin group of bodies. It may be obtained by treating castor, minutely divided, with six times its weight of boiling alcohol, filtering the liquor while hot, and allowing it to cool. The *castorin* is slowly deposited, and may be purified by means of cold alcohol.

Valenciennes, who could not obtain the crystals white and pure by simple treatment with alcohol, succeeded by first boiling together a mixture of equal parts of castor and lime water, and acting upon the residue, separated and dried, with boiling alcohol of the sp. gr. 0.823. Canadian castor is said to yield 1.98 per cent., and Russian castor 4.60 per cent., of castorin. This, together with the volatile oil and the peculiar resin, are said to constitute the medicinal principles. (Pennetier, *Matières Premières Organiques*, 783.) The *volatile oil* may be obtained by repeated distillation with the same portion of water. It is pale yellow, and has the odor and taste of castor.

F. Wöhler ascertained the existence of salicin and of phenol in a specimen of castor; Pereira detected *salicylic aldehyde* (*oil of Spiræa ulmaria*) in castor, and concluded that the oil of castor had been converted into that principle. (*P. J.*, xi. 200.) The salicin of the castor, however, probably proceeds from the willow and poplar on which the beaver feeds.

Alcohol and ether extract the virtues of castor. An infusion made with boiling water has its sensible properties in a slight degree, but the odorous principle of the drug is dissipated by decoction. The virtues of castor are impaired by age. Warmth, and especially moisture, promote its decomposition. In a dry cool place it may be kept for a long time without material deterioration. When quite black, with little taste or odor, it is unfit for use. The castor follicles are sometimes partly deprived of the castor, and its place supplied with sawdust. A factitious preparation has been sold, consisting of a mixture of various drugs, scented with genuine castor, intermingled with membrane, and stuffed into the scrotum of a goat. The fraud may be detected by the comparatively feeble odor, the absence of other characteristic, sensible properties, and the want of the smaller follicles containing fatty matter, often attached to the bags of castor.

Castor was at one time much used as a stimulant antispasmodic, also as an emmenagogue, but has passed almost entirely out of vogue. It may be given in *hysterical affections* in doses of ten to thirty grains (0.65–2.0 Gm.), in capsules or emulsion.

A substance allied to castor is the secrétion of the anal glands, used for the purpose of defence by the *Mephitis mephitica*, or *common skunk* of North America. According to T. B. Aldrich, this is a neutral, golden-colored liquid, having an extremely penetrating and not altogether agreeable odor, containing mercaptan, allyl-sulphide, and traces of butyl-mercaptan. (*C. D.*, 1897.)

Catalpa. *Catalpa bignonioides*, Walt. *Bignonia Catalpa*, L. *Catalpa Catalpa*, (L.), Karst. *Catalpa-tree*, or *Catawba-tree*.—This is a beautiful indigenous, flowering tree, of the fam. Bignoniaceæ, the seeds of which have been employed in *asthma*. Eugene O. Rau obtained from them tannin and a bitter crystalline principle. (*A. J. P.*, xlii. 204.) F. K. Brown obtained from the seeds resin, fixed oil, tannin, sugar, and two crystalline bodies, their exact nature not being determined. (*A. J. P.*, 1887, 230.) I. Schneck states that large doses cause nausea, vomiting, and slow, weak, intermittent pulse. He gave two fluidrachms (7.5 Cc.) of tincture (1 oz. troy to 1 pint) every one to three hours.

Cataplasms. *Cataplasmata. Poultices. Cataplasmes*, Fr. *Umschläge, Breiumschläge*, G.—Cataplasms, or poultices, are moist substances intended for external application, of such a consistence as to accommodate themselves accurately to the surface to which they are applied, without being so liquid as to spread over the neighboring parts, or so tenacious as to adhere firmly to the skin. As they are in this country seldom made by the apothecary, with the exception of cataplasm of kaolin, they were not deemed by the compilers of the U. S. Pharmacopœia proper objects for official direction.

Cataria. *Nepeta Cataria*, L. *Catnep* or *catmint. Cataire*, Fr. *Katzenmünze*, G. *Cattara*, It. *Gatera*, Sp.—Catnep is a perennial labiate plant which is abundant in the United States, but is supposed to have been introduced from Europe. The whole herb is used; it has a strong, peculiar, rather disagreeable odor, and a pungent, aromatic, bitterish, camphorous taste. The active constituents are volatile oil, and tannin of the kind which produces a greenish color with the salts of iron. Therapeutically it is a very feeble mint.

Catechu. *U. S.* 1890. *Catechu Nigrum*, Br. Add. *Cutch, Cachou*, Fr. *Pegu Katechu*, G. *Caticu, Catto*, It. *Catecu*, Sp. *Cutt*, Hindostanee.

The U. S. P. (8th Rev.) dismissed catechu and introduced gambir because of the greater uniformity in quality of the latter. See *Gambir*, p. 574.

The U. S. P. 1890 defined catechu as "an extract prepared from the wood of *Acacia Catechu* (Linné fil.) Willdenow (nat. ord. *Leguminosæ*)."

Acacia Catechu. Willd., *Sp. Plant.*, iv. 1079. According to Kerr, whose description has been followed by most subsequent writers, *Acacia Catechu* is a small tree, seldom more than twelve feet in height, with a trunk one foot in diameter, dividing towards the top into many close branches, and covered with a thick, rough, brown bark. This species of Acacia is a native of the East Indies, growing abundantly in various provinces of Hindostan, and in the Burmese Empire. Pereira says that it is common in Jamaica.

This drug had been long known before its source was discovered. It was at first called *Terra japonica*, under the erroneous impression that it was an earthy substance derived from Japan. When ascertained by analysis to be of vegetable origin, it was generally considered by writers on the Materia Medica to be an extract of the *betel nut*. Its true origin was made known by Kerr, assistant surgeon of the civil hospital in Bengal. According to Kerr, the manufacturer, having cut off the exterior white part of the wood, reduces the interior brown or reddish-colored portion into chips, which he then boils in water in unglazed earthen vessels until all the soluble matter is dissolved. The decoction thus obtained is evaporated first by artificial heat, and afterward in the sun, until it has assumed a thick consistence, when it is spread out to dry upon a mat or cloth, being, while yet soft, divided by means of a string into square or quadrangular pieces. The account subsequently given by Royle, of the preparation of the extract in Northern India, is essentially the same. The process, as he observed it, was completed by the pouring of the extract into quadrangular earthen moulds. It is said that the unripe fruit and leaves are also sometimes submitted to decoction. Three colors of catechu are prepared; the light red or red, which is considered best and is especially employed in Burmah and India to chew with the betel nut; the dark red and black, which are made especially for European and American markets, and which are apt to suffer adulteration *en route* in China.

The name *catechu* in the native language signifies the *juice of a tree*, and appears to have been applied to astringent extracts obtained from various plants. Commerce is chiefly supplied with catechu from Bahar, Northern India, and Nepaul through Calcutta, from Canara through Bombay, and from the Burmese dominions. It is frequently called *cutch* by the English traders, a name derived from the Hindostanee word *cutt*. The following varieties are or have been found in the Philadelphia markets.

Plano-convex Catechu. Cake Catechu.—This is in the form of circular cakes, flat on one side, con-

vex on the other, and usually somewhat rounded at the edge, as if the soft extract had been placed in saucers, or vessels of a similar shape, to harden. As found in the retail shops, it is generally in fragments, most of which, however, exhibit some evidences of the original form. The cakes are of various sizes, from two or three to six inches or more in diameter and weighing from a few ounces to nearly two pounds. Their exterior is usually smooth and dark brown, but we have seen a specimen in which the flat surface exhibited impressions as if produced by coarse matting. The color internally is always brown, sometimes of a light yellowish-brown or chocolate color, but more frequently dark reddish-brown, and sometimes almost black. The cakes are almost always more or less cellular in their interior; but in this respect great diversity exists. Sometimes they are very porous, so as almost to present a spongy appearance, sometimes compact and nearly uniform, and this difference may be observed even in the same piece. The fracture is sometimes rough and dull, but in the more compact parts is usually smooth and somewhat shining, and occasionally a piece split in one direction will exhibit a spongy fracture, while in another it will be shining and resinous, indicating the consolidation of the extract in layers. This variety of catechu is often of good quality.

Pegu Catechu.—This is the product derived from the Burmese dominions, and named from that section of the country whence it is exported. It enters commerce, probably in general through Calcutta, in large masses, sometimes of one cwt., consisting of layers of flat cakes, each wrapped in leaves, said to be those of the *Mitragyua parvifolia*, Korth. (*Stephegyua diversifolia*, Benth. and Hook. *Nauclea brunonis*, Wall. Cat.) In this form, however, we do not see it in the shops, but almost always in angular, irregular fragments, in which portions of two layers sometimes cohere with leaves between them, indicating their origin. It is characterized by its compactness, shining fracture, and blackish-brown or dark port-wine color, so that when finally broken it bears considerable resemblance to kino. This is an excellent variety of catechu.

Catechu in Quadrangular Cakes.—This is scarcely ever found in commerce in its complete form, and the fragments are often such that it would be impossible to infer from them the original shape of the cake. This is usually between two and three inches in length and breadth, and somewhat less in thickness, of a rusty-brown color externally, and dark brown or brownish gray within with a somewhat rough and dull fracture, but, when broken across the layers in which it is sometimes disposed, exhibiting a smoother and more shining surface. Guibourt speaks of the layers as being blackish externally and grayish within, and bearing some resemblance to the bark of a tree, a resemblance, however, which has not struck us in the specimens which have fallen under our notice. There is little doubt that this variety comes from the provinces of Bahar and Northern India, where the preparation of the drug was witnessed by Kerr and Royle, each of whom speak of it as being brought, when drying, into the quadrangular form. It has been called *Bengal catechu.*

Pale catechu, so far as the term is not applied to *gambir*, may be considered as belonging to this variety. A specimen with this name, which was sent from India to the London exhibition of 1862, and which G. B. Wood had an opportunity of examining, was in oblong rectangular pieces, or fragments of such pieces, about three and a half inches long by an inch and a half in breadth, of a dirty yellowish color within, and an earthy fracture, quite free from gloss, and bearing a very much stronger resemblance to gambir than to catechu.

Catechu in Balls.—We have seen this in two forms—one consisting of globular balls about as large as an orange, very hard and heavy, of a ferruginous aspect externally, very rough when broken, and so full of sand as to be gritty under the teeth; the other in cakes, originally, in all probability, globular, and of about the same dimensions, but flattened and otherwise pressed out of shape before being perfectly dried, sometimes two adhering together, and closely resembling in external and internal color, and in the character of their fracture, the quadrangular variety last described. The former kind is rare, and the specimens we have seen had been twenty years in the shop, and had very much the appearance of a factitious product. The latter is in all probability the kind known formerly as the *Bombay catechu*, as Hamilton, and, more recently Mackintosh, in describing the mode of preparing catechu on the Malabar coast, of which Bombay is the entrepôt, say that, while the extract is soft, it is shaped into balls about the size of an orange.

Guibourt and Pereira describe other varieties, which we have not met with, and which are probably rare. One of these is the *Siam catechu*, in conical masses shaped like a betel nut and weighing about a pound and a half. Its fracture is shining and liver-colored, like that of hepatic aloes; in other respects it resembles Pegu catechu. Another is the *black mucilaginous catechu* of Guibourt, in parallelopipeds an inch and a half in length by an inch in breadth. Internally it is black and shining, and its taste is mucilaginous and feebly astringent. A third is the *dull reddish catechu* of Guibourt, in somewhat flattened balls, weighing three or four ounces, of a dull reddish, wavy, and often marbled fracture. Many years since, an extract like this was brought to Philadelphia upon speculation by a merchant from Calcutta, but it is not now in the market. Lastly, there is a *pale* or *whitish* catechu, in small roundish or oval lumps, with an irregular surface, dark or blackish brown externally, very pale and dull internally, and of a bitter, astringent and sweetish taste, with a smoky flavor. It is unknown in commerce.

Areca Catechu.—This is obtained from the Areca Nut Palm. (See *Areca Nut*, page 1395.) It is prepared by boiling the nuts in water and evaporating the decoction. There are two varieties; one of a black color, very astringent, mixed with paddy husks and other impurities, and obtained by evaporating the first decoction, the other, yellowish-brown, of an earthy fracture, and pure, resulting from the evaporation of a decoction of the nuts which had been submitted to the previous boiling. The first is called *kassu*, the other *coury*. (Heyne, *Tracts, etc., on India.*) They are prepared in Mysore, and Ainslie states that both varieties are sold in the bazaars of Lower India, and used for the same purpose as the official catechu. They are also much used for chewing by the natives. But they are seldom exported, and it is uncertain whether they find their way into European or American commerce. Pereira thought he had identified the *kassu* with a variety of catechu derived from Ceylon, where

he had been informed that an extract of the areca nut is prepared. It was in circular flat cakes, from two to three inches in diameter, scarcely an inch thick, covered on one side with paddy husks, and internally blackish-brown and shining.

Catechu is inodorous, with an astringent and bitter taste, followed by a sense of sweetness. It is brittle, and breaks with a fracture which is rough in some specimens, in others uniform, resinous, and shining. That which is preferred in our market is of a dark color, easily broken into small angular fragments, with a smooth glossy surface, bearing some resemblance to kino. Catechu is often mixed with sand, sticks, and other impurities. The U. S. P. 1890 gave the following tests of purity. "In irregular masses, containing fragments of leaves, dark brown, brittle, somewhat porous and glossy when freshly broken. It is nearly inodorous, and has a strongly astringent and sweetish taste. If a portion of Catechu be digested with 10 times its weight of alcohol, and the liquid filtered, the undissolved matter, after being dried at 100° C. (212° F.), should not exceed 15 per cent. of the original weight. The tincture, diluted with 100 parts of water, acquires a green color on the addition of ferric chloride test-solution. If two parts of Catechu be boiled with 20 parts of water, a brownish-red, turbid liquid will be obtained which turns blue litmus paper red. Upon incineration, Catechu should not leave more than 6 per cent. of ash." *U. S.* 1890.

The proportion of tannic acid, which may be considered the efficient principle, varies from about 45 to 55 per cent. in catechu or cutch, and from 36 to 40 per cent. in gambir. The portion designated by Davy as extractive is said to contain, if it does not chiefly consist, of a principle discovered by Buchner, and now called *catechin*, *catechuin*, or *catechuic acid*, to which Etti gives the formula $C_{18}H_{18}O_8$. To prepare pure catechin, Etti recommends the following process: Catechu is dissolved in eight times its weight of boiling water, and the liquid, after being strained through a cloth, is left for some days until the insoluble catechin has subsided. The crude catechin is collected in a linen cloth and submitted to the action of a screw press, then dissolved in a sufficient amount of diluted alcohol, and the filtered solution is shaken up with ether as long as any catechin is thereby dissolved, and after the ether has been removed by distillation the residue is taken up with distilled water, and the solution is left for a few days, when the catechin crystallizes out in an almost colorless state. After pressure in a cloth it is again dissolved in boiling water, when a yellowish-white body remains behind, which appears to be *quercetin*. The deep red liquid remaining behind after the catechin has been dissolved out with ether contains *catechu red*, $C_{36}H_{34}O_{15}$, which is evidently the first anhydride of catechin. The *tannic acid* is of the variety which precipitates iron of a greenish-black color, and differs from most of the other varieties in not yielding grape sugar when digested with diluted sulphuric acid. It is not, therefore, a glucoside. It precipitates gelatin, but not tartar emetic (Kane), and is not, like the tannic acid exposure of galls, converted into gallic acid by the access of the air. It may be distinguished by the name of *catechu-tannic acid*. Catechu is almost wholly soluble in a large quantity of water, to which it imparts a brown color. The extractive or catechuic acid is much less soluble than the astringent principle, which may be almost entirely separated from it by the frequent application of small quantities of cold water. Boiling water dissolves it much more readily than cold, and deposits it of a reddish-brown color upon cooling. Both principles are readily dissolved by alcohol or proof spirit, and also by ether.

The importations of *cutch* or catechu and Terra japonica or gambir for purposes of tanning and calico printing are quite large, being in 1905, for cutch 3,986,886 lbs., valued at $163,359, and for gambir 32,192,891 lbs., valued at $1,112,660. De Meyer affirms that the best method of detecting adulteration of catechu is to treat the suspected drug with ether. Catechu of good quality, after repeated treatment with ether, loses 53 per cent. of its weight, and the dried residue weighs only 47 per cent. of the catechu employed. If this be exceeded, the drug must be proportionately impure. (*J. P. C.*, Juin, 1870, 479.) A. Jossart (*J. P. A.*, 1881, 41) examined a catechu which was adulterated with from 60 to 65 per cent. of ferrous carbonate. For methods of assaying catechu and gambir, see Trimble's *The Tannins*, 43; also *Ph. Rev.*, 1897, 27. (See also *Gambir*, p. 574.)

Catha. *Catha edulis.*—Under various Arabic names, such as *Kât*, *Khât*, *Chaat*, *Kus es Salahin*, *Tchaad*, *Tschut*, *Tohat*, *Tohai*, *Gât*, the leaves of *Catha edulis*, Forsk. (Fam. Celastraceæ) (*Abyssinian* or *African tea*), are very largely used as a stimulant in Northern Africa, the plant being extensively cultivated. According to Collin, from 1400 to 1500 camel loads are yearly sold in Aden. The plant is a shrub, reaching the height of 9 to 12 feet, with thin coriaceous leaves whose margin is bluntly serrate. The rounded, grayish-green twigs are, for commercial purposes, dried with the leaves and tied together in bundles containing about forty twigs; the bundles are commonly from twelve to fourteen inches in length and three to four inches in diameter, but sometimes much smaller. The leaves are chewed both green and fresh, and are in some places made into a tea. Their taste is said to resemble that of coca, and the inebriation which they produce in the Arabs is described as similar to that caused by coca in the South American natives.

So far as known *Catha* is not used as a medicine in Africa, but it has been employed to some extent as a stimulant in Europe in *neurasthenia*, *migraine*, and allied conditions. Bernon concluded that there is no alkaloid in it. Flückiger and Gerock isolated a volatile liquid, which they believe to be an alkaloid, and to which they gave the name of *katine*. In 1897 T. Shennan (*Royal Coll. Phys. Lab. Rep.*, vi. 1897) obtained evidences of the existence of a non-volatile alkaloid in the leaves, different from caffeine. He found that catha, both in cold blooded and warm blooded animals, produces drowsiness, followed by excessive reflex activity, and, if the dose has been large enough, violent tetanus. Catha evidently belongs among the domestic stimulants, such as tea and coffee, and probably contains an active alkaloid belonging to the caffeine group.

Caulophyllum. *U. S.* 1890. *Pappoose Root. Squaw Root. Blue Cohosh. Caulophyllum thalictroides* (L.), Michaux (*Leontice thalictroides*, L.), nat. ord. Berberidaceæ.—This is an indigenous, perennial, herbaceous plant, with matted, knotty rhizomes, from which rises a single smooth stem, about two feet high. It was officially described (U. S. P. 1890) as follows: "Rhizome of horizontal growth, about 10 Cm. long, and about 6 to 10 Mm. thick, bent; on the upper side with broad, concave

stem-scars and short, knotty branches; externally grayish-brown, internally whitish, tough and woody. Roots numerous, matted, about 10 Cm. long, and 1 Mm. thick, rather tough; nearly inodorous; taste sweetish, slightly bitter and somewhat acrid." *U. S.* 1890.

Mayer found caulophyllum to contain *saponin* and a colorless alkaloid (*A. J. P.*, 1863, 99), while A. E. Ebert subsequently obtained from it albumen, gum, starch, phosphoric acid, extractive, two resins, coloring matter, and a body analogous to saponin. The *caulophyllin* of the eclectics is made by pouring a concentrated alcoholic tincture into water and collecting the precipitate, washing with ether, and drying. J. U. Lloyd purified the substance which Ebert described as analogous to saponin, and for distinction terms it *leontin*. (See *Drugs and Medicines of North America*, vol. ii. 152.) He also obtained *caulophylline*, the alkaloid first announced by Mayer in 1863. Lloyd describes it as colorless, odorless, possessed of little taste, and dissolving freely in water, alcohol, ether, and chloroform. It crystallizes with difficulty. The hydrochloride has been obtained, however, in crystals. It has not been tested physiologically. (*Proc. A. Ph. A.*, 1893, 115.)

Caulophyllum has been used by so-called eclectic and homœopathic practitioners. It is said to be sedative, antispasmodic, and oxytocic, and to have the power when *uterine inertia* occurs during labor to cause the contractions to become very severe, without altering their general character as does ergot. It is also alleged to be capable of arresting threatened *abortion*, to be very efficacious in *hysteria, amenorrhœa, dysmenorrhœa, menorrhagia, uterine subinvolution*, etc.; also to be capable of originating uterine contractions and of producing abortion. For a detailed description of the various contradictory powers ascribed to it, the reader is referred to Lloyd's *Drugs and Medicines of North America*, vol. ii. p. 155. It is given in decoction, infusion, or tincture, the first two being made in the proportion of an ounce to a pint of water, the last of four ounces to a pint of spirit. *Dose*, of decoction or infusion, one or two fluidounces (30 or 60 Cc.); of tincture, one or two fluidrachms (3.75 or 7.5 Cc.). *Leontin* has been used in doses of one fluidrachm (3.75 Cc.) of the one per cent. solution.

Cayaponia. *Cayaponia globosa. Silva Manso.* This is a cucurbitaceous plant of Brazil, from which Gubler has extracted the alkaloid *cayaponine*, said to purge without griping. *Dose*, one grain (0.065 Gm.). (*Rép. de Pharm.*, 1879, 193.)

Ceanothus. *Ceanothus americanus*, L. *New Jersey Tea. Red-root. Céanothe*, Fr. *Seckelblumen-wurzel*, G.—A small indigenous shrub, of the fam. Rhamnaceæ, growing throughout the Eastern United States. The *root* is astringent, and imparts a red color to water. H. K. Bowman found in it 9.21 per cent. of tannin. (*A. J. P.*, 1869, 195.) F. C. Gerlach has again examined the root. (*A. J. P.*, 1891, 332.) He finds 6.48 per cent. of tannin and 0.52 per cent. of an alkaloid to which he gives the name *ceanothine*. J. H. M. Clinch has found in the leaves a resin and a volatile oil. (*A. J. P.*, xiv. 1884.) J. A. Buckner (*A. J. P.*, 1891, 428) found 9.45 per cent. of tannin in the leaves. Ceanothus is said to be useful in *syphilis*. Schoepf states that it is purgative. The leaves were used during the Revolutionary War as a substitute for tea. The Mexican *C. cœruleus*, Lagasca (*C. azureus*, Desf.), is used as a febrifuge.

Cearin.—An ointment vehicle capable of taking up a large proportion of water. Issleib makes it from a mixture of one part of carnauba wax and three parts of paraffin or ceresin (bleached by exposure to sunlight only); this is fused and mixed with four times its weight of liquid petrolatum and stirred until cold.

Cedron.—The seeds of the *Simaba Cedron* (R. Br.), Planch., a tree growing in Colombia and Central America, belonging to the Simarubaceæ. The fruit is a large solitary drupe, containing a single seed. A specimen of the dried fruit, sent to George B. Wood from Cartago, in Costa Rica, by Guier, formerly of Philadelphia, was light, of a yellowish-ash color, flattish-ovate, with one edge convex and the other nearly straight, the convex outline terminating at each end in an obtuse point, of which that at the apex was most prominent. It was about two inches long and sixteen lines in its greatest breadth. Within, the seed was loose and movable. Cedron seed is about an inch and a half long, ten lines broad, and half an inch thick, convex on one side, flat or slightly concave on the other, and presenting an oval scar near one extremity of the flat surface. It is often yellowish, hard and compact, but readily cut with a knife, is inodorous, but of a pure and intensely bitter taste, not unlike that of quassia. It yields its virtues to water and alcohol. Lowry obtained from it a crystalline substance, intensely bitter, freely soluble in boiling water, and neutral to test paper, which he supposes to be the active principle, and named *cedrin*. He first exhausted the cedron with ether, then treated it with alcohol, and crystallized from the tincture. (*J. P. C.*, xix. 335.) Cedrin is now an article of commerce in the form of yellowish transparent crystals, easily soluble in water, less so in alcohol.

This medicine has long had great reputation in Central America as a remedy for the *bite of serpents*. S. S. Purple recommends it as a valuable antiperiodic, with a tendency to purge in large doses. *Dose*, ten to thirty grains (0.65 to 2.0 Gm.) every four hours. (*N. Y. M. J.*, N. S., xiii.)

Celastrus.—Various species of the Celastraceæ have medicinal properties. In the East Indies the oil obtained from the seeds of *Celastrus paniculata*, Willd., is used as a powerful stimulant and diaphoretic in *rheumatism, gout*, and various *fevers*. The oil is said to be deep reddish-yellow, and to become thick and honey-like on keeping. It is sometimes known as *oleum nigrum*. In Abyssinia, according to Dragendorff, the leaves of *C. serratus*, Hochst. (*C. obscurus*, A. Rich.), are used as an antiperiodic under the name of *Add-add*. Dragendorff found in them tannic acid, a volatile oil, and a bitter principle, *celastrine*. (*A. J. P.*, xxvi.) In North America the bark of *Celastrus scandens*, L. (*climbing staff tree, false bittersweet, fever twig*), has been used in chronic affections of the *liver* and in *secondary syphilis*, and is said to be emetic, diaphoretic, and alterative. C. H. Bernhard found in the bark acid and neutral resin, starch, glucose, gum, a caoutchouc-like body, coloring matter, and volatile oil. It yields its virtues best to alcohol of 80 per cent. (*A. J. P.*, 1882, 1.) Wayne stated that he had isolated from *C. scandens* white minute crystals, to which he gave the name of *celastrine*. According to Ugolino Mosso (*Rivista Clinica*, 1891) celastrine arrests the frog's heart in systole; does not affect markedly the blood pressure in mammals, and influences the respiration only through its action on the vagus.

The stimulant action is especially manifest on the brain and is not followed by a secondary depression. There is marked, persistent elevation of the temperature.

Celluloid. *Zylonite.*—This material, which has been manufactured into so many useful forms, furnishes an excellent substitute for ivory, tortoise shell, amber, and vulcanite. It is a nitrocellulose, which is made capable of moulding into any desired form by the admixture of a small amount of camphor. At the temperature at which the camphor melts, it acts as a solvent for the nitro-cellulose and forms a uniform plastic mass with it. This mass may be used directly in the manufacture of various articles, or it may be admixed with mineral coloring matters so as to imitate the various natural stones. The stratified appearance of ivory and the mottled appearance of tortoise shell and amber are obtained by passing between heated rolls plain and colored or clouded celluloid in alternating layers. The material is combustible when ignited, and in thin pieces burns rapidly with a bright light.

Within recent years celluloid varnishes have come into extensive use for lacquering on metal; these are nothing but pyroxylin solutions in which methyl alcohol, petroleum naphtha, and amyl acetate are used as a mixed solvent.

Celtis. *Celtis cinnamomea,* Lindl. *C. reticulosa,* Miq.—W. R. Dunstan has isolated *skatol,* the substance to which the odor of the human fæces is due, from the wood of this East Indian tree. (*P. J.,* June, 1889.)

Centaurea. *Centaurea benedicta,* L. *Blessed Thistle. Carduus benedictus,* L. *Cnicus benedictus,* L. *Chardon bénit,* Fr. *Herba Cardui Benedicti,* P. G. *Benedicten Distel,* G.—This is an annual herbaceous composite common in Europe and occasionally seen in the United States. The leaves were formerly official. They should be gathered when the plant is in flower, quickly dried, and kept in a dry place. The herb has a feeble, unpleasant odor and an intensely bitter taste, more disagreeable in the fresh than in the dried plant.

Water and alcohol extract its virtues. The infusion with cold water is a grateful bitter; the decoction is nauseous, and offensive to the stomach. The active constituents are volatile oil and *cnicin.* This is crystallizable, inodorous, very bitter, neutral, scarcely soluble in cold water, more soluble in boiling water, and soluble in all proportions in alcohol. Its formula is $C_{42}H_{56}O_{15}$, and it is analogous to salicin in composition. In the *dose* of five grains (0.32 Gm.) it is said to cause vomiting, while eight grains (0.5 Gm.) given in divided doses, is useful in *intermittent fevers.* (*Ann. Thér.,* 1843, 206.) In cold infusion this drug is tonic; when taken in hot infusion in large quantities it is diaphoretic, or in larger quantities, emetic. Tonic *dose,* of the infusion (ounce to a pint), two fluidounces (60 Cc.); of the powder, from half a drachm to one drachm (2.0–3.9 Gm.).

Silybum Marianum, Gaertn. (*Mariana Mariana* (L.), Hill, *Carduus Marianus,* L.), was of old used for the same purpose as *C. benedictus.* Rademacher attributed great value to the seeds in *hemorrhages,* particularly when connected with diseased liver or spleen. Lobach found the decoction (two ounces to the pint of water), in *doses* of four fluidrachms (15 Cc.) every hour, useful in *amenorrhœa* and *menorrhagia.* (*Am. J. M. S.,* April, 1859.)

Centaury. *Common European Centaury. Centaurium. Herba Centaurii,* P. G. *Erythræa Centaurium* (L.), Pers. (*Gentiana Centaurium,* L., *Chironia Centaurium,* Schmidt) (Willd. *Sp. Pl.* i. 1068).—This is a small, annual herbaceous plant which grows wild in most parts of Europe. The fresh, bitter, odorless herb yields an odorous, pungent distillate (Geiger, ii. 482), in which Méhu has found valeric acid, also a peculiar colorless, crystallizable, non-nitrogenous substance, *erythrocentaurin,* $C_{27}H_{34}O_8$, which he obtained by exhausting the tops with water, evaporating a portion of the water, allowing the residue to stand, separating the precipitated matter or apotheme, adding alcohol to the remaining liquid, which now deposited a bitter substance, and, after the separation of this by decantation, evaporating the liquid to the consistence of syrup, and treating the residue with ether. The ethereal solution, upon evaporation, yielded the erythrocentaurin in crystals. These are needle-shaped, fusing at 136° C. (276.8° F.), and crystallizing easily on cooling again. They are strongly reddened by exposure to solar light, and reacquire their colorless character upon being again dissolved and crystallized, or by mere heating to 130° C. (266° F.). They are almost insoluble in cold water, more readily soluble in boiling water, alcohol, ether, and chloroform. Carbon disulphide, benzene, volatile and fatty oils dissolve them easily. J. F. Huneker believes that erythrocentaurin exists also in American centaury. (See *Sabbatia.*) Besides these principles, Méhu found also in centaury a *wax-like substance* and saline matter. (*J. P. C.,* xliii. 38.) Leuderich assigns to *erythrocentaurin* the formula $C_9H_{14}O_5$ and states that in its decomposition a dextro-rotatory carbohydrate is produced. (*A. J. P.,* 1892, 311.) The common centuary of Europe has tonic properties very closely resembling those of gentian.

A species of *Erythræa, E. chilensis,* Pers., is employed to a considerable extent in Chili as a mild tonic. (For details, see *J. P. C.,* 3e sér., xxv. 434.) *E. acaulis,* which grows in great abundance in the territory of French Algiers bordering on the Sahara, yields a root which, under the name of *rejagnou,* is much employed by the natives for dyeing yellow. (*Ibid.,* 4e sér., v. 87.)

Cephalanthus. *Cephalanthus occidentalis,* L. *Button Bush. Button Wood. Crane Willow. Swamp Dogwood.* (Fam. Rubiaceæ.)—A common indigenous shrub which grows in moist places, as along streams or on the borders of swamps. Its bark is bitter, is said to be laxative as well as tonic, and has been given in periodical fevers, in decoction or infusion. E. M. Hattan found in it a crystallizable fluorescent acid, a bitter uncrystallizable principle, a principle resembling saponin, tannin, two resins, fatty matter, gum, glucose, and starch. (*A. J. P.,* xlvi. 314.) According to Claassen (*Ph. Rund.,* Bd. vii. 1889), the fluorescent acid of Hattan is composed of two substances, *cephalin* and *cephaletin.* Carl Mohrberg has separated from the bark a substance which he knows as *cephalanthin,* and also a toxic saponin-like principle which, like its allied poisons, has the power of dissolving the blood corpuscles. Cephalanthin he finds to be a distinct poison to both cold and warm blooded animals, causing destruction of blood corpuscles with conversion of oxyhæmoglobin into methæmoglobin), violent vomiting, convulsions, and paralysis. (See *Kobert's Arbeiten,* viii. 1892.)

Ceratopetalum.—The New South Wales species of this genus yields considerable quantities of a kino-like gum. (See *P. J.*, xxi. 742.)

Cercis. *Cercis canadensis*, L. *Judas Tree. Red-bud.*—The bark of this beautiful leguminous tree, indigenous and well known throughout the Eastern and Central United States on account of its brilliant red-purple flowers, which appear before the leaves, has been highly recommended by Wm. R. Smith as a mild but very active astringent in the treatment of *chronic diarrhœa* and *dysentery*. *Dose*, of the fluidextract, from half to one fluidrachm (1.8 to 3.75 Cc.).

Ceresin.—Under this name there has been introduced into commerce, as a substitute for wax, a substance which closely resembles white wax, but which is a natural mineral product. It is found most abundantly in Galicia, on the slopes of the Carpathian Mountains, and also on the Wallachian side of the range, under the name of *ozokerite* (*earth-wax*), but occurs in smaller deposits along the Caspian under the name *neft-gil*. A valuable deposit has also been discovered in Southern Utah. It consists of a mixture of solid paraffin with some oxygenated bodies. The crude ozokerite is melted to allow earthy impurities to settle out, is treated with sulphuric acid and alkali, as in the treatment of paraffin, and is clarified by bone black, or, better, the black from the manufacture of yellow prussiate of potash. The refined ozokerite or ceresin melts between 61° and 78° C. (142° and 172° F.), is quite odorless and colorless, and has the appearance of beeswax. It may be distinguished from the latter by its lower specific gravity (0.753 at 98° C. (208.4° F.) against 0.822) and its absolute resistance to alcoholic potassium hydroxide, no trace of saponifiable matter being present. The production of Galician ozokerite in 1886 amounted to 13,925 tons, but had fallen in 1896 to 7925 tons. The production of Utah ozokerite in 1890 amounted to 350,000 pounds. The Galician product is worked chiefly in Vienna and in London, where ozokerite candles are manufactured. (See *A. J. P.*, xlv. 11.) In this country ceresin bottles have largely replaced the gutta-percha bottles formerly used to contain hydrofluoric acid.

Cerium Bromide. Ce_2Br_6.—This salt was prepared by Charles Bullock by calcining cerium oxalate in a porcelain capsule until it became converted into the yellowish-brown sesquioxide, dissolving this in hydrochloric acid, precipitating with sodium carbonate, and dissolving in hydrobromic acid, then evaporating at a low temperature to dryness. The salt is of a light chocolate color, and of a very styptic sweetish taste, soluble in 95 per cent. alcohol, partially soluble in water. (*A. J. P.*, xliii. 345.)

Cetraria. *U. S.* 1890. *Iceland Moss. Iceland Lichen.*—Under this name the U. S. P. formerly recognized the dried plant of *Cetraria islandica*, Acharius, *Lichen islandicus*, L. This plant, although known as a moss, is not a moss, but a lichen which grows in most northern latitudes and on elevated mountains further south, including the Northern United States.

The dried moss is of diversified color, grayish white, brown, and red, in different parts, with less of the green tint than in the recent state. It was officially characterized as follows. "From 5 to 10 Cm. long, foliaceous, irregularly branched into fringed and channelled lobes, brownish above, whitish beneath, and marked with small, depressed spots; brittle and inodorous; when softened in water, cartilaginous, and having a slight odor; its taste is mucilaginous and bitter." *U. S.* 1890. Macerated in water, it absorbs rather more than its own weight of the fluid, and, if the water be warm, renders it bitter. Boiling water extracts all its soluble principles. The decoction thickens upon cooling, and acquires a gelatinous consistence without viscidity. After some time the dissolved matter separates, and when dried forms semi-transparent masses, insoluble in cold water, alcohol, or ether, but soluble in boiling water, and in solution forming a blue compound with iodine. *Lichenin*, or *lichen starch*, $C_{12}H_{20}O_{10}$, resembles starch in its general characters, but differs from it in some respects. Lichenin has been found to consist of two distinct proximate principles, for one of which the name lichenin may be retained, while for the other no particular designation has been chosen, but which we may call *lichenoid*. According to Th. Berg (*Thèse de Dorpat*, 1872), cetraria yields 35.15 per cent. of the mixed principles, of which 20 per cent. is of lichenin, and 15.15 of the so-called lichenoid. To separate them, a decoction of the moss, concentrated to a small bulk, and still hot, is treated by alcohol. The lichenoid is deposited in flocculi, which gradually unite in a viscid mass. This, being washed by alcohol until it ceases to be bitter, and then dried, yields a light friable matter partly soluble in cold water, with which it forms a yellow, limpid solution. To deprive it of mineral and coloring substances, it is dissolved in a little water, and precipitated afresh by alcohol. Lichenin is insoluble in cold water, but swells up and easily dissolves in hot water. It is insoluble in alcohol and in ether. It is only tinged by iodine. Lichenoid is, on the contrary, colored blue by that reagent. It is, in part, dissolved in cold water, and the undissolved part is equally colored blue by iodine. It is, like lichenin, insoluble in alcohol and ether. Both substances have strong analogies with starch, yet are distinct. For a further account, see *J. P. C.*, 1873.

The name *cetrarin* has been conferred on the bitter principle. Herberger's process for extracting it may be found in the 18th ed., U. S. D. By it one pound of moss yielded to Herberger 133 grains of cetrarin. This principle is white, not crystalline, light, unalterable in the air, inodorous, and exceedingly bitter, especially in alcoholic solution. Its best solvent is absolute alcohol, of which 100 parts dissolve 1.7 of cetrarin at the boiling temperature. Ether also dissolves it, and it is slightly soluble in water. Its solutions are quite neutral to test paper. It is precipitated by the acids, and rendered much more soluble by the alkalies. Concentrated hydrochloric acid changes its color to a bright blue. It precipitates the salts of iron, copper, lead, and silver. In the *dose* of two grains (0.13 Gm.) every two hours, it has been used successfully in intermittent fever. (*J. P. C.*, xxiii. 505.) Schnedermann and Knop have ascertained that the cetrarin above referred to consists of three distinct substances: 1, *cetraric acid*, $C_{18}H_{16}O_8$, which is the true bitter principle, crystallizable, and intensely bitter; 2, a substance resembling the fatty acids, called *lichen-stearic acid*, $C_{14}H_{34}O_2$, the crystals of which melt at 120° C. (248° F.); and, 3, a green coloring substance, which they name *thallochlor*. These principles are obtained perfectly pure with great difficulty. (*Ann. Ch. Ph.*, lv. 144.) Hilger and Buchner (*Ber. d. Chem. Ges.*, 1890, p. 461) have extracted both lichen-stearic

and cetraric acids and studied them more fully. They give to the former the formula $C_{43}H_{76}O_{13}$, and to the latter the composition $C_{30}H_{30}O_{12}$, and both are shown to be dibasic acids.

The gum and starch contained in the moss render it sufficiently nutritive to serve as food for the Lapps and Icelanders, who employ it powdered and made into bread, or boiled with milk, after having partially freed it from the bitter principle by repeated maceration in water. As suggested by Berzelius, the bitterness may be entirely extracted by macerating the powdered moss, for 24 hours, in twenty-four times its weight of a solution formed with 1 part of an alkaline carbonate and 375 parts of water, then decanting the liquid, and repeating the process with an equal quantity of the solution. The powder, being now dried, is perfectly sweet, and has been used to some extent in pharmacy as a substitute for acacia, although lacking in adhesiveness. (See also *Gelatina Lichenis Islandici Saccharata Sicca* (Germ. Unoff. Formulary), *Proc. A. Ph. A.*, 1892, 455.)

Iceland Moss has been much used in chronic *catarrhs*, especially of the pulmonary mucous membrane and even in *phthisis*. It acts chiefly as a mucilaginous drink, but as Kobert has found that *cetrarin* is a stimulant to the gastro-intestinal mucous membrane and to peristalsis, cetraria probably is feebly tonic. A 20 per cent. tincture has been recommended by Deying and Brice-Moret as an anti-emetic (*P. J.*, Oct. 30, 1897).

Decoctum Cetrariæ. U. S. 1890. *Decoction of Cetraria. Decoction of Iceland Moss.*

"Cetraria, *fifty grammes* [or 1 ounce av., 334 grains]; Water, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Cover the Cetraria, in a suitable vessel, with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of cold Water, express after half an hour, and throw the liquid away. Then boil the Cetraria with *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms] of Water for half an hour, strain, and add enough cold Water, through the strainer, to make the product, when cold, measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

As the bitter principle is dissolved along with the starch-like matter of the moss, this decoction has an unpleasant flavor; but the plan which has been proposed of first extracting the bitterness by maceration in water or a very weak solution of an alkaline carbonate, and afterwards preparing the decoction, is inadmissible, as the peculiar virtues which distinguish the medicine from the ordinary demulcents are thus entirely lost. A pint (473 Cc.) of the decoction may be taken during the day. Other species of Cetraria appear to be more active than *C. islandica*.

The *Cetraria juniperina* (probably *Cetraria vulpina*) of Europe is said to be sometimes used as a poison for wolves and foxes, while the *wolf's moss* (*Ulfmossa*) of the north of Europe contains *vulpinic acid*, $C_{19}H_{14}O_5$, which has been found by Kobert to be an active protoplasmic poison; in frogs it produces tetanus, convulsions, and paralysis of central origin; in mammals it causes dyspnœa, vomiting, trembling, and a slowing of the pulse, with rise of the blood pressure due to stimulation of the respective nerve centres. After death the blood is not coagulable, and the secreting kidney cells are found covered with a crystalline or amorphous mass of a vulpinate. The acid is found also in species of Calycium, Culveraria, Parmelia, and Cyphelium. (Schmidt, *Ph. Chemie*, St. 1319.) No difference of action exists between vulpinic acid derived from wolf's moss and that synthetically produced. From *Cetraria pinastrin* Zopf has separated *pinastrinic acid*, which seems to be very closely allied to vulpinic acid. (*Sitzungsb. der Dorpat. Naturforsch.-Gesellschaft*, 1892.)

Cetyl Alcohol. *Alcohol Cetylicum.* $C_{16}H_{33}OH$.—*Cetylic alcohol, ethal, primary hexadecyl alcohol*, is a tasteless, odorless, waxy powder, which fuses at 49.5° C. (121° F.) and boils at 344° C. (651° F.). It is soluble in alcohol and ether. According to Grimm (*Derm. Zeit.*, 1899, vol. vi.), cetyl alcohol is absorbed and obstinately retained by the epidermis, producing a peculiar velvety condition of the skin. It has been found useful in the treatment of *chapped hands*, weeping *eczema*, and *prurigo*. Mixtures of it with boric acid or the borates have been put upon the market as cosmetics under the name of *Borsyl*. Grimm especially recommends equal parts of cetyl alcohol with boric acid or one part with five of powdered talc.

Chamælirium. *Chamælirium luteum* (L.), A. Gray. *C. carolinianum*, Willd. *Veratrum luteum*, L. *Helonias lutea*, Ker-Gawl in *Bot. Mag. Helonias dioica*, Pursh. *Starwort. False Unicorn Root. Devil's Bit. Blazing Star.*—This plant is indigenous to the United States. The *rhizome* is the part employed in medicine. It is commonly known by the erroneous name *Helonias*. F. V. Greene obtained from it in 1878 a bitter principle, *chamælirin*. He states that it is a cardiac poison. *Helonin* is a term used by the eclectics to define the alcoholic extract found in commerce. Chamælirium, or starwort, is said to be diuretic, tonic, and anthelmintic. It is usually given in aqueous infusion, 1 in 16, in the *dose* of a wineglassful.

Champaca-Camphor. *Champacol.* $C_{17}H_{30}O$. This camphor was first separated by Merck from *champaca-wood*. (See *Merck's Annual*, 1893, also *Schim. Rep.*, 1897, 11.)

Cheiranthus. *Cheiranthus Cheiri*, L.—From the leaves of this cruciferous European plant Moritz Reeb (*A. E. P. P.*, 1899, vol. xliii.) has obtained a glucoside, belonging to the digitalis group, of such power that 0.0005 Gm. will produce systolic cardiac arrest in the frog; also a crystalline alkaloid, *cheirinin*, $C_{18}H_{35}N_3O_{17}$, which acts upon nerve centres and also upon muscles.

Chelidonium. *U. S.* 1890. *Chelidonium majus*, L. (nat. ord. Papaveraceæ.) *Celandine.*—Celandine is a perennial herbaceous plant growing wild in both Europe and America, recognized readily by its pinnate leaves, small peduncled yellow flowers and yellow opaque juice. The plant was formerly official and was described as follows: "Root several-headed, branching, reddish-brown; stem about 50 Cm. long, light green, hairy; leaves about 15 Cm. long, thin, petiolate, the upper ones smaller and sessile, light green, on the lower side glaucous, lyrate-pinnatifid, the pinnæ ovate-oblong, obtuse, coarsely crenate or incised and the terminal one often three-lobed; flowers in small, long-peduncled umbels with two sepals and four yellow petals; capsule linear, two-valved and many-seeded. The fresh plant contains a saffron-colored milk-juice, and has an unpleasant odor and acrid taste." *U. S.* 1890.

Probst of Heidelberg, found in it a peculiar acid denominated *chelidonic acid;* two alkaline principles, one of which forms neutral salts with

the acids, and is called *chelerythrine* in consequence of the intense redness of its salts; the other unites with but does not neutralize the acids, and is named *chelidonine;* and lastly a neutral crystallizable, bitter principle, which from its yellow color he calls *chelidoxanthin.* Orlow believes, however, that the latter is an alkaloid, and gives a process for its preparation in *Ph. Z. R.,* 1893, No. 21. Chelerythrine appears to be an acrid narcotic poison. (*Ann. Ch. Ph.,* xxix. 113.) For color tests for chelidonine, see *Proc. A. Ph. A.,* 1895, 992. *Chelidonine phosphate, chelidonine sulphate,* and *chelidonine tannate* have been used medicinally. (See *Proc. A. Ph. A.,* 1897, 721.)

In 1889 Schmidt announced the presence of twelve different bases in chelidonium, four of which he has studied: *chelidonine,* $C_{20}H_{19}NO_5 + H_2O$; *methylchelidonine; alpha-methylchelidonine* and *beta-methylchelidonine,* represented by the formula $C_{21}H_{21}NO_5$. These bases were ascertained to possess physiologically an action resembling that of morphine. (*Ph. Ztg.,* 1889, p. 582.) Schmidt (*A. J. P.,* 1890, p. 13) also found *protopine,* and showed the identity of *stylophorine,* from *Stylophorum diphyllum* (Michx.), Nutt. (*Chelidonium diphyllum,* Nutt.), with chelidonine. This last result was confirmed by Selle. (*A. J. P.,* 1890, p. 176.) Selle later (*A. Pharm.,* 1890, 441–462) sums up the composition of *Chelidonium majus* as follows: it contains, besides chelidonine and chelerythrine, three other alkaloids, called *alpha-homochelidonine,* $C_{21}H_{21}NO_5$, *beta-homochelidonine,* $C_{21}H_{21}NO_5$, and *protopine,* $C_{20}H_{17}O_5$. These results practically agree with those before obtained by Schmidt. The identity of chelerythrine and sanguinarine is not conceded by G. König. (*Chem. Cb.,* 1891, p. 321.) He gives the composition $C_{21}H_{17}NO_4$ to the former and $C_{20}H_{15}NO_4$ to the latter, making one the methyl derivative of the other and with this conclusion Schmidt also agrees. In 1902 J. O. Schlotterbeck showed that the *chelidoxanthine* of Probst is really *berberine.* Schlotterbeck has also established the identity of the most abundant of the alkaloids of sanguinaria with chelerythrine.

Celandine is an irritant purgative to which toxic properties have been ascribed with doubtful correctness; in the fatal case of poisoning reported in the *Zeitsch. f. Medizinalbeamte,* 1898, it was not the cause of death. The irritant juice has long been used locally upon *corns, warts, eczema,* and other diseases of the skin, and even in *cancer.* The *dose* of the dried root or herb is from thirty grains to a drachm (2.0–3.9 Gm.), that of the fresh root one or two drachms (3.9–7.7 Gm.), and the same quantity may be given in infusion. The *dose* of the aqueous *extract* is from five to ten grains (0.32–0.65 Gm.), of the expressed juice from ten to twenty minims (0.6–1.3 Cc.), to be gradually increased. The allegation of Peronin that *chelidonine sulphate,* in doses of from one-twentieth to one-third grain (0.003–0.021 Gm.), is an active analgesic and somnifacient has not been confirmed by subsequent observers.

Chelone. *Chelone glabra,* L. *Snake-head. Turtle-head. Balmony. Shellflower. Chelone,* Fr., G.—The leaves of this very common indigenous, perennial, herbaceous plant, of the fam. Scrophulariaceæ, have a bitter taste, and are said to be tonic and aperient, with a supposed peculiar action on the liver. The decoction (two ounces of the fresh herb to the pint) may be given in the *dose* of one or two fluidounces (30–60 Cc.).

Cheltenham Salt, Artificial.—Several artificial mixtures have been prepared as imitations of the salts of the chalybeate Cheltenham water. One frequently used is equal parts of magnesium sulphate, sodium sulphate, and common salt; other formulas contain some iron. These combinations are used as laxatives in *glandular obstructions,* especially of the *liver,* and in *scrofulous affections,* attended with feeble digestion, sluggish bowels, and pallidness of skin; also in *habitual costiveness* and *hemorrhoids.*

Chenopodium. *Chenopodium. American Wormseed.*—The fruit of *C. Neuopodium* (*anthelminticum*), Linné (nat. ord. Chenopodiaceæ).

This species of Chenopodium, known commonly by the names of *wormseed* and *Jerusalem oak,* grows in almost all parts of the Eastern United States. The whole herb has a strong, peculiar, offensive, yet somewhat aromatic odor, which it retains when dry. All parts of the plant are occasionally employed, but the fruit alone was official in the U. S. P. 1890. This should be collected in October.

Wormseed, as found in commerce, is in small grains, not larger than the head of a pin, irregularly spherical, very light, of a dull greenish-yellow or brownish color, a bitterish, somewhat aromatic, pungent taste, and possessed in a high degree of the peculiar odor of the plant. These grains, when deprived, by rubbing them in the hand, of a capsular covering which invests the proper seed, exhibit the shining, blackish surface of the obtusely-edged seed. They abound in a volatile oil, upon which their sensible properties and medicinal virtues depend and which is obtained by distillation. (See *Oleum Chenopodii,* p. 841.) The same oil impregnates to a greater or less extent the whole plant.

Of the activity of the wormseed as an anthelmintic there can be no question. Given in *doses* of from 20 to 40 grains (1.3–2.6 Gm.) with calomel and followed by a purgative it is very effective. In practical medicine it has been entirely replaced by the official volatile oil.

China Morada.—Under this name there appear to be used in Bolivia several barks. One of these has been ascertained by Arati and Canzoneri (*L'Orosi,* Feb. 1889) to be the product of a rubiaceous tree, *Pogonopus* (*Chrysoxylum*) *febrifugus,* and to contain an alkaloid, *moradeine,* besides a fluorescent substance, *moradin,* allied to scolopetin. (See *P. J.,* xix.)

Chinaphenine. $CO\begin{cases} NH.C_6H_4OC_2H_5 \\ OC_{20}H_{23}N_2O \end{cases}$. *Quinine Carbophenetidide.*—Chinaphenine occurs as a white, tasteless powder, slightly soluble in water, easily in alcohol, ether, and chloroform and benzene, forming salts which are soluble in water. Chinaphenine has been recommended by von Noorden as a mild antipyretic, producing a fall of temperature which is at its lowest point four or five hours after the ingestion of the remedy; also as an analgesic in *diabetic* and other forms of *neuralgias;* also in *whooping cough.* The analgesic *dose* is twenty to thirty grains (1.3–2.0 Gm.) given in two portions. To children under a year old, von Noorden gave two to three grains (0.13–0.20 Gm.) and older children three to five grains (0.21–0.32 Gm.) three times a day. (*Ther. Geg.,* Jan. 1903.)

Chinaphthol. *Quinaphthol. Quinine-β-naphthol-α-mono-sulphonate.* $C_{20}H_{24}N_2O_2(C_{10}H_6OHSO_3H)_2$.—This substance is a yellow crystalline powder fusing at 185° C. (365° F.), of a bitter

taste, insoluble in cold water, moderately soluble in hot water and alcohol; it has been proposed by E. Riegler (*W. M. Bl.*, xix. 1896) as an antipyretic and intestinal antiseptic. He states that it is decomposed by the alkalies of the intestinal juices into its constituents,—namely, quinine and β-naphthol sulphuric acid, and that he has used it up to 75 grains (5 Gm.) a day with satisfaction in acute *rheumatism* as well as in *typhoid fever*. It contains about 42 per cent. of quinine.

Chinoidinum. *U. S.* 1880. *Chinoidine. Quinoidine. Chinoidin. Quinoidin. Precipitated Extract of bark. Amorphous Quinine. Quinine brute ou amorphe*, Fr.—The term chinoidine was first applied to all of the amorphous alkaloids existing naturally in cinchona bark, but it is now used to define a complex body consisting not only of the natural amorphous alkaloids, but those which are artificial and accidental in the derivative products resulting from the application of heat. Upon the evaporation of the mother liquor left after the crystallization of the quinine sulphate in the preparation of that salt, a dark colored substance is obtained, having the appearance of an extract. Sertürner supposed that he had discovered a new alkaline principle in this product, but his conclusions were invalidated by the experiments of Henry and Delondre, which went to prove that the alkaline matter contained in it consisted of quinine and cinchonine, obscured by admixture with a yellowish substance that interfered with their crystallization. Nevertheless, under the name of *quinoidine* or *chinoidine*, given to the supposed new alkaloid by Sertürner, there has been long employed in Europe a substance precipitated from the mother liquor of quinine sulphate by means of an alkaline carbonate, having a yellowish-white or brownish color, and when moderately heated, agglutinating into a mass of resinous appearance. By the conjoint labors of the chemists, Winckler, Liebig, and Pasteur, it was proved that ordinary quinoidine, or amorphous quinine, consisted of two alkaloids, derivatives from quinine and cinchonine, with which they are respectively isomeric, though differing in being uncrystallizable, and named, in view of their origin, *quinicine* and *cinchonicine*. The pure amorphous quinine of Liebig is the former of these alkaloids. The *amorphous quinine*, as Liebig calls it, is entirely soluble in diluted sulphuric acid and in alcohol, and, if its solution in a diluted acid yields upon the addition of ammonia exactly as much precipitate as there was of the original substance dissolved, it may be considered pure. (*A. J. P.*, xviii. 181.) The U. S. P. of 1880 described chinoidine as "a brownish-black or almost black solid, breaking, when cold, with a resinous, shining fracture, becoming plastic when warmed; odorless, having a bitter taste and an alkaline reaction. Almost insoluble in water, freely soluble in alcohol, chloroform, and diluted acids; partially soluble in ether and in benzol. The solutions have a very bitter taste. If Chinoidin be triturated with boiling water, the liquid, after filtration, should be clear and colorless, and should remain so on the addition of an alkali (abs. of alkaloidal salts). On ignition, Chinoidin should not leave more than 0.7 per cent. of ash." *U. S.* 1880.

A simple method of purification consists in dissolving the chinoidine in diluted hydrochloric acid, adding water, filtering and precipitating with an alkali and washing and drying the precipitate.

Tinctura Chinoidini was formerly made, by the German Pharmacopœia, by simply dissolving 3 parts of chinoidine in one of hydrochloric acid and 17 of alcohol, sp. gr. 0.894.

Chinoidine hydrochloride is made by heating 1 part of the purified chinoidine with 4 parts of distilled water, adding sufficient diluted hydrochloric acid to complete the solution, filtering, evaporating, and powdering the residue. Zimmer furnishes the German market with the purified hydrochloride, under the name of *Chininum amorphum muriaticum purum*. It has been largely used medicinally. For formulas for various salts of chinoidine, see *N. R.*, 1882, 11, or *Proc. A. Ph. A.*, 1882, 417.

As an antiperiodic, chinoidine is inferior to the cinchona alkaloids and more nauseating. From thirty grains to a drachm (2.0–3.9 Gm.) may be given in the interparoxysmal periods of an *intermittent*, and its action closely watched.

Chinol. *Quinoline mono-hypochlorite.* $C_9H_6N.ClO$.—A white crystalline powder, odorless, having a pungent but not disagreeable taste. It is almost insoluble in cold and hot water, but quite soluble in alcohol. This substance is said to be actively antipyretic and analgesic, useful for the purposes for which antipyrin is employed. *Dose*, from three to five grains (0.2–0.32 Gm.).

Chinoline. *Quinoline. Leucoline. Chinoline*, Fr. *Chinolin*, G. (C_9H_7N.)—This is an artificial alkaloid prepared by the destructive distillation of quinine or cinchonine with potassium hydroxide, and also synthetically by König's and Skraup's processes by the action of sulphuric acid and glycerin upon nitrobenzene and aniline, or a mixture of these two latter substances. Chinoline is a colorless, strongly refractive, oily liquid, having a specific gravity of 1.081 at 10° C. (50° F.) (Hoffmann), boiling at 235.6° C. (456.8° F.) without decomposition, the oily stain left on bibulous paper disappearing readily on exposure. Its odor is aromatic, resembling that of oil of bitter almond. It is sparingly soluble in cold water, more so in hot water, soluble in alcohol, and mixes in all proportions with ether, carbon disulphide, methyl alcohol, etc. It easily dissolves camphor and resin. It gradually turns reddish-brown in color on exposure to the air. It forms readily crystallizable salts with acids, the tartrate now being a commercial article; these salts are decomposed by contact with fixed alkalies and the peculiar odor of chinoline developed. Ekin (*P. J.*, Feb. 11, 1882) found a sample of commercial German chinoline to consist largely of a mixture of aniline and nitrobenzene, although labelled pure. *Quinoline tartrate* is in the form of a whitish, micaceous, crystalline powder, melting at 125° C. It dissolves in 80 parts of cold water, in about 150 parts of alcohol, and in 300 parts of ether, having a peculiar pungent odor and a rather sharp though not unpleasant taste. *Quinoline hydrochloride* melts at 94° C. (201.2° F.) and sublimes unchanged. It dissolves in water, alcohol, and chloroform. *Quinoline salicylate* is a white crystalline powder, soluble in water and in glycerin, very soluble in alcohol, ether, vaseline, and fatty oils.

Quinoline was first brought forward as a substitute for quinine by Julius Donath of Hungary. (*Ber. d. Chem. Ges.*, xiv. 1769.) It appears to be a powerful antipyretic and a stronger antiseptic even than phenol and to act as a powerful depressant upon the central nervous system. A one per cent. solution completely destroys the coagula-

bility of the blood. Quinoline was at first used by various Continental physicians with alleged excellent results in *malarial fevers*, but subsequent experience showed that the drug is only feebly, if at all, antiperiodic, and very apt to disagree with the stomach. The tartrate was given in doses of fifteen grains (1 Gm.). It has been highly commended as a preservative for anatomical specimens. The formula adopted in the Erlangen Physiological Institute is: quinoline, 5 grammes; sodium chloride, 6 grammes; glycerin, 100 grammes; water, 900 grammes. The ordinary tar quinoline can be used. The liquid is said to have the advantage of preserving all the tissues in their natural condition, except that it removes from them all coloring matter.

For physiological activities of chinoline derivatives, see *Trans. College of Physicians*, Edinburgh (Laboratory), 1893.

Chinosol. *Quinosol.* $C_9H_6ON.SO_3K + Aq$. *Potassium Oxyquinoline Sulphonate.*—This is a neutral compound of oxyquinoline from which the latter is readily liberated in a nascent condition.

It is a crystalline yellow powder, very soluble in water, insoluble in alcohol and ether, having a feeble aromatic odor. Its aqueous solution when very dilute strikes with ferric chloride a lively green color.

Chinosol does not precipitate albumin, is affirmed to be very slightly toxic, unirritating, and possessed of an extraordinary power of penetrating tissues. It has been commended by a large number of German and English clinicians as a very advantageous antiseptic, which even exceeds in power corrosive sublimate; but Giovanni asserts that in regard to the chancre poison it is inferior to phenol. Moor found the bacillus of the plague to be killed by it in ten minutes in a dilution of 1 in 500. It has been very highly recommended by Gilles and others in the treatment of *vaginitis* and other affections of the female genital organs, in the form of douches of 1 in 1000 to 1 in 8000; also as a local application in *leprosy*, in *lung* and *bone tuberculosis*, and, mixed with from 5 to 10 per cent. of boric acid, as a powder to be used as a substitute for iodoform. Schifferdecker states that the irrigation of cadavers through their arteries with a 5 per cent. solution is an effective means of preservation.

As a disinfectant to the hands, skin, and suture threads, according to F. Hobday, chinosol may be used in as strong solution as 1 in 60, without the production of irritation of skin or wound. On the other hand, it rapidly attacks surgical instruments, taking off their edge and causing greenish-black spots upon them. Internally it has been especially used by A. G. Cipriani in the treatment of *tuberculosis*, both by mouth and injected locally. (*Allgemeine Medicin Central-Zeitung*, Bd. lxvi.) It is probably more toxic than has been generally supposed, since in Hobday's experiments a dose of one-sixteenth of a grain for each pound of body weight was found to be the extreme limit that could be given to cats without serious danger. As a local application the strength most generally useful is probably one-half grain in a fluidounce; although to a very badly infected wound a solution of 1 in 500 may be often applied once, twice, or three times a day with great advantage.

Chinotoxine. *Dichinolindimethylsulphate.*—This synthetic compound is said to possess properties similar to those of curare.

Chionanthus. *Chionanthus virginica*, L. *Fringe Tree.* (Fam. Oleaceæ.)—In the bark of this indigenous plant saponin was found by R. S. Justice (*A. J. P.*, xlvii. 195), but not by W. von Schulz, who, however, (*Ph. Z. R.*, 1893, 579), detected a glucoside. The fluidextract has been recommended in *doses* of from one-half to one fluidrachm (1.8–3.75 Cc.) two or three times a day, as an aperient and a diuretic.

Chione. *Chione glabra. Violette.*—The bark of this West Indian rubiaceous plant is said to be largely used as an aphrodisiac and tonic. According to B. H. Paul and A. J. Cownley, it yields 1.5 per cent. of a pale yellow volatile oil composed largely of phenol. (*P. J.*, vol. lx.)

Chloral Ammonium. $CCl_3.CH(NH_2)OH$. *Trichloramido-ethylic Alcohol.*—This substance is said by W. B. Nesbit to act like hydrated chloral, but to be a stimulant to the circulation in *doses* of from five to twenty grains (0.32–1.3 Gm.). For method of preparation, see *T. G.*, 1888.

Chloral Amylene Hydrate. *Amylene-chloral. Dormiol.* $CCl_3CHOHOC_5H_{11}$.—Made by mixing 10 parts of anhydrous chloral with 6 parts of amylene hydrate. It is a colorless, oily liquid having a pungent, mint-and camphor-like odor and a cooling pungent taste. It is not miscible with cold water and is decomposed by boiling water, but is freely soluble in alcohol, ether, acetone, and the fixed oils. Used as a hypnotic in *doses* of one-half to one fluidrachm (1.8–3.75 Cc.) of a 10 per cent. solution.

Chloral Caffeine.—Made by mixing 10 parts of caffeine and 7.8 parts of hydrated chloral, in a small amount of water or alcohol, and evaporating at a low temperature.

The resulting product is soluble in water and alcohol.

Chloral Camphor. *Camphorated Chloral.*—This is a thick, oily liquid, made by rubbing up equal parts of camphor and hydrated chloral. It distils slowly without change, and dissolves in 60 per cent. alcohol, from which it is precipitated by the addition of water. (*A. J. P.*, 1886, 282.) Chloral camphor is used in *neuralgia* as a counter-irritant and local anæsthetic. Conflicting opinions have been expressed about the character of this liquid, the fact that both substances could be obtained unchanged by precipitating its alcoholic solution with water being regarded as proof of its being simply a mechanical mixture. Cazeneuve and Joubert believe, however, that chemical combination has been effected, and point to its optical behavior as proof.

Chloral Carbamide.—When 165.5 parts of trichloraldehyde hydrate are mixed in a porcelain mortar with 60 parts of carbamide (urea), the mixture liquefies. On dissolving this substance in three times its quantity of water warmed to 60° C. (140° F.) and then allowing the mixture to cool, a crystalline mass, chloral carbamide, is obtained. This substance dissolves readily in warm water and in alcohol, and less readily in warm alcohol. According to Kobert, it acts like hydrated chloral, but is too slow and uncertain to be of practical value.

Chloral Carbol. *Carbolated Chloral.*—According to Boureiz, when hydrated chloral and phenol are rubbed up in the proportion of 10 parts of the former to 14 parts of the latter, a liquid is obtained which has the sp. gr. of about 1.5, and is soluble in all proportions in water, alcohol, and ether. Applied locally it is a counter-irritant and local anæsthetic. See *Chloral Phenol*, page 1445.

Chloral Cyanhydrate.—This is a compound first prepared by Pinner and Bischoff, and recom-

mended by Hermes (*Ph. Centralh.*, Aug. 1887) as a substitute for hydrocyanic acid, whose physiological action it is stated to share. Chloral cyanhydrate is represented by the formula $CCl_3—CH—\begin{cases} OH \\ CN \end{cases}$, and is described as a crystalline powder, consisting partly of colorless prisms and partly of rhombic tables, fusing at 61° C. (141.8° F.), easily soluble in water, alcohol, and ether. With the vapor of water it volatilizes in small quantity, and breaks up into its components, chloral and hydrocyanic acid. It is also decomposed by alkalies, with the formation of alkaline cyanides. Its aqueous solutions remain unaltered for a long time. Six and a half parts by weight of chloral cyanhydrate correspond with one part of anhydrous hydrocyanic acid.

Chloral Menthol. *Mentholated Chloral.*—This is obtained by triturating equal weights of hydrated chloral and menthol, and heating gently in a water bath until liquefied. It is an oily, colorless liquid, with a distinct mint-like odor and warm taste, having a specific gravity of 1.1984. It is freely soluble in alcohol, chloroform, and petroleum benzin. (*A. J. P.*, 1886, 283.) Chloral menthol has been used as a counter-irritant and local anæsthetic in facial and other *neuralgias*.

Chloral Phenol. *Phenolated Chloral. Chloral Carbol.*—Made by mixing equal weights of hydrated chloral and phenol, by trituration. In the form of a colorless viscid liquid, having the odor of hydrated chloral, a sweet caustic taste and producing a blister when placed on the skin. It mixes with alcohol, acetic acid, chloroform, carbon disulphide and ether. It has been used to relieve toothache by saturating a piece of cotton and inserting it in the cavity in the tooth.

Chloral Urethane. *Uraline.—Uralium*, $CCl_3.CH\begin{cases} OH \\ NHCO_2C_2H_5 \end{cases}$, is a compound of chloral and urethane. It is insoluble in cold water, and is decomposed by boiling water; it is soluble in alcohol and ether, and melts at 103° C. (217.4° F.). According to G. Poppi (*Rif. M.*, 1889), this substance as a hypnotic is equal to hydrated chloral, and has the superiority of not acting on the heart and of being tolerated better. J. Schmitt, however (*R. M. Est*, May, 1890), finds that it does act upon the heart, arresting it in diastole, and resembling very closely chloral in its physiological action, and having the inconvenience of great insolubility. J. Schmitt and P. Parisot (*R. M. Est*, Dec. 1890) found that unless given in *doses* of fifteen and a half grains (1.032 Gm.) it was very uncertain in its action as a medicine, and was likely to disagree with the stomach, being on the whole inferior to hydrated chloral.

Chloralose. $C_8H_{11}Cl_3O_6$. *Anhydro-gluco-chloral.* When equal parts of anhydrous chloral and glucose are heated together for an hour at the temperature at which chloral boils, two isomeric substances—*chloralose*, which is soluble, and *parachloralose*, which is insoluble—are formed. Chloralose occurs in small crystals having a very bitter and disagreeable but not acrid taste. It is freely soluble in alcohol and in hot water, slightly so in cold water, a little less than five grammes to the litre. Its melting point is 185° C. (365° F.). Chloralose was first brought forward as a remedial agent by Hanriot and Richet (*C. R. S. B.*, 1893), who state that five grammes of it will produce in a dog of ten kilogrammes' weight symptoms of intoxication, followed by a most profound sleep, in which all sensibility is lost, although the reflex activities are greater than normal. Upon the circulation the drug has but little power, the arterial pressure, even when there is profound anæsthesia, being scarcely affected. During the anæsthesia not only was the spinal motor side of the cord more active than normal, but the motor cerebral cortex was found to be excessively excitable, the animals experimented upon offering a strong contrast with chloralized dogs, in which the psychomotor cortex was almost devoid of responding power.

As a practical hypnotic, the action of chloralose is very variable and is often attended by disagreeable results, ten grains frequently failing to cause sleep, although the same amount has produced complete unconsciousness with alarming symptoms. Partial general paralysis, tremors, great slowing of the pulse, and marked evidences of enfeebled heart action have not rarely followed the use of the drug, while involuntary discharges of urine, delirious intoxication, excessive vomiting, and other disagreeable symptoms have been noted. The *dose* is from five to ten grains (0.32–0.65 Gm.), given in capsules.

M. H. Rendu (*Bull. et Mém. de la Soc. Méd. de l'Hôp. de Paris*, xx. 1895), has reported violent collapse, excessively rapid feeble pulse, pronounced disturbance of respiration, epileptiform convulsions, and collapse as produced by four grains (0.26 Gm.) of chloralose.

Chloraloximes.—A series of compounds, whose strong physiological activities are asserted to be due to their splitting up in the system into hydrated chloral and their respective oximes. They are *chloralacetoxime* (melting point, 72° C., 161.6° F.); *chloralcamphoroxime* (melting point, 98° C., 208.4° F.); *chloralnitroso β-naphthol* (melting-point, 100° C., 212° F.); *chloralacetaldoxime* (melting point, 74° C., 165.2° F.); *chloralbenzaldoxime* (melting point, 62° C., 143.6° F.). The compounds are easily soluble in alcohol and ether, and are readily recrystallized from petroleum benzin. Water dissolves them with difficulty, and when applied hot is likely to cause decomposition and the re-formation of hydrated chloral. (*Deut. Chem. Zeit.*, 1892.)

Chloretone. *Trichlorbutyl Alcohol. Acetone-chloroform.* $CCl_3.(CH_3)_2.COH + \frac{1}{2}H_2O$.—It forms colorless crystals fusing at 80° to 81° C. (176°–177.8° F.), difficultly soluble in water, more readily soluble in alcohol and glycerin. Chloretone, in 1894, was introduced to the medical profession as an anæsthetic and hypnotic by J. A. Abel. When given in proper doses it produces in the lower animals a profound sleep with complete anæsthesia without the respiration or blood pressure being seriously affected, although the period of sleep may last some hours or even days. If the dose be sufficient, however, death occurs from asphyxia. Chloretone has no influence upon the blood, very little upon blood pressure, although when brought locally in contact with the heart it acts as a depressant. The bodily temperature is distinctly lowered during anæsthesia. The results of Abel in regard to the toxicity of chloretone have been challenged by E. Impens, who finds that chloretone restricts the combustion of oxygen more than 50 per cent. and that it is more dangerous than hydrated chloral. Certainly, as a hypnotic and general anæsthetic, chloretone has failed to fulfil earlier expectations. This failure may in part be the result of timidity in the use of the drug, the *dose* having been given as from two to ten grains (0.13–0.65 Gm.), but we have

given thirty grains (2 Gm.) in twelve hours without producing any perceptible symptoms, and a case is reported of one hundred and twenty grains (7.7 Gm.) taken during twenty-four hours, causing sleep for six days, without evil results. As a local anæsthetic chloretone seems to be of distinct value. It has been much used in 1 to 2 per cent. solution as an antiseptic and analgesic application to painful *ulcerations;* also for *vomiting* and *gastralgia.* Ten grains (0.65 Gm.) given before anæsthetization, according to Lewis Hirschmann, reduces the amount of ether required to half, and also lessens the after nausea. The *dose* of chloretone is five to fifteen grains (0.32 to 1 Gm.). In the physiological laboratory chloretone is a useful anæsthetic, 0.2 Gm. per kilo bodyweight being given intravenously when it is desired to keep the animal alive.

Chlorinated Anæsthetic Compounds. ETHYLENE DICHLORIDE. *Bichloride of Ethylene. Dutch Liquid. Æthyleni Bichloridum. Æthylenum Chloratum. Elaylum Chloratum. Liquor Hollandicus. Æthylenchlorid, Elaylchlorid,* G. $C_2H_4Cl_2$. By the mutual action of chlorine and olefiant gas an oily liquid is obtained, discovered by four associated Dutch chemists, and called *Dutch liquid.* This Dutch liquid was tried as an anæsthetic by Simpson and by Nunneley. Two forms of the Dutch liquid have been experimented with by Aran of Paris, and one of them furnished very satisfactory clinical results. The liquid which gave the favorable results has been ascertained by Mialhe and Flourens to be the monochlorinated Dutch liquid (*monochlorethylene chloride,* $CH_2Cl,CHCl_2$), but its cost proved to be too high to allow of its general use at that time as a therapeutic agent. In consequence of this objection to the monochlorinated liquid, Mialhe and Flourens were induced to search for a substitute in the corresponding compound of a parallel series of ethers, formed by the action of successive portions of chlorine on hydrochloric ether, C_2H_5Cl; under these circumstances the hydrogen is replaced by the chlorine, atom for atom, and there are formed the five following compounds: $C_2H_4Cl_2$; $C_2H_3Cl_3$; $C_2H_2Cl_4$; C_2HCl_5; C_2Cl_6. Of this series, the first member is isomeric with the Dutch liquid; the second, third, and fourth with the mono-, bi-, and trichlorinated Dutch liquid, and the fifth is a chloride of carbon, frequently called *carbon sesquichloride.* The first member, though identical with the Dutch liquid in elementary composition and having a vapor of the same density, has, nevertheless, a lower boiling point, *i.e.* 60° to 64° C. (140°-147.2° F.), while the Dutch liquid boils at 84.9° C. (185° F.); it is also different in chemical properties. Thus, it is not decomposed by an alcoholic solution of potassium hydroxide, as the Dutch liquid is, and is not acted on by potassium, while the Dutch liquid is immediately attacked by it. The explanation of these facts is that the two compounds, while isomeric, or having the same empiric formula, are differently constituted molecularly. Thus, Dutch liquid is known chemically as *ethene dichloride,* CH_2Cl,CH_2Cl, while the chlorinated ethyl chloride is known as *ethylidene chloride,* CH_3CHCl_2. This difference of molecular structure, of course, runs all through their derivatives until the final product C_2Cl_6 is reached in both cases, and here there is identity of product.

The conclusion arrived at by Mialhe and Flourens appears to be that the four chlorinated hydrochloric ethers all possess anæsthetic properties; and, as it would be difficult to separate them, they propose the use of the mixed ethers, consisting principally of the tri- and quadrichlorinated compounds, as an anæsthetic, under the indefinite name of *chlorinated muriatic ether.* Since the time of Mialhe and Flourens's experiments, the matter has been taken up again, and Taube (*A. J. P.*, 1880, 603, and 1881, 119) proved the availability as anæsthetics of monochlorethylidene chloride, CH_3,CCl_3, and of monochlorethylene chloride, $CH_2Cl,CHCl_2$.

The precise action of the various ethers upon the organism is at present unknown. The committee of the British Association found (*B. M. J.*, i. 1879) the *ethene dichloride* ("formerly named *ethylene dichloride,* or Dutch liquid, $C_2H_4Cl_2$") to cause convulsions in the lower animals, while E. T. Reichert (*P. M. T.*, xi. 518) found that the "ethylene dichloride" produces anæsthesia with the usual stages, and that, like chloroform, it depresses the heart and steadily lowers the arterial pressure. His experiments seem to show, however, that its action upon the heart is much less powerful than that of chloroform, and in all of his trials the animal died of centric respiratory paralysis while the heart was still maintaining some degree of circulation. He believes, therefore, that it is a much safer agent than chloroform, ranking it between the latter and ether. It is evident that Reichert was not using the same agent as the English committee were, but exactly what he did have is uncertain.

The above bodies are produced sometimes on a considerable scale in the manufacture of chloral. A very variable mixture of the middle members of the series has been sent into commerce under the name of *liquor anæstheticus.* Another similar mixture containing the less chlorinated bodies is the *æther anæstheticus aranii,* boiling between 84° C. (183.2° F.) and 103° C. (217.4° F.). The *æther anæstheticus, Wiggers,* contains the more highly chlorinated products.

ETHYLIDENE CHLORIDE, *chlorinated muriatic ether, ethydene chloride* ($CH_3,CHCl_2$), is a colorless, very mobile, neutral liquid, having an aromatic ethereal odor, and a hot, saccharine taste. It is sparingly soluble in water, but readily soluble in alcohol, ether, and most of the fixed and volatile oils. It is not inflammable, in which respect it agrees with chloroform. When purified it is a liquid somewhat resembling chloroform, of sp. gr. 1.174 at 17° C. (62.6° F.), boiling at 60° C. (140° F.), and not miscible with water. It can be distinguished from chloroform in that it combines with chlorine even in the dark, liberating hydrochloric acid. According to Flourens, its action is similar to that of chloroform. The British Association Committee (*B. M. J.*, 1879, i.) believed it to be a valuable anæsthetic, exerting little or no depressing effect upon the heart, but the work of the committee was not sufficiently thorough to be conclusive. Many years ago Snow used it on man, and gave judgment in its favor, and Binz has produced human anæsthesia, and thinks it increases the force of the circulation (*M. T. G.*, 1879, i.); but Reeve finds (*N. R.*, 1880, 334) that in animals it lowers the arterial pressure, but does not suddenly paralyze the heart, as does chloroform. It is extremely probable that the liquid used by Reichert was this substance, and not the ethylene dichloride, as he thought. (See *Ethylene Dichloride.*)

METHYLENE DICHLORIDE. *Dichloro-methane. Bichloride of Methylene.* CH_2Cl_2.—This was in-

troduced by B. W. Richardson of London. It may be prepared by exposing to sunshine, in a glass globe, pure chlorine and gaseous methyl chloride. The globe has two lateral apertures for the admission of the gases, and below an open neck, which communicates with one of the tubulures of a Woulfe's bottle, of which the other tubulure communicates by a bent tube with a second Woulfe's bottle, and this by another bent tube with a flask. The second bottle is surrounded with ice, and the flask immersed in a freezing mixture, to condense the volatile products. The dichloride condenses in the flask in a pure state, while the contents of the two Woulfe's bottles consist chiefly of chloroform. (Gmelin, vii. 288.)

The *methyl chloride* may be made for this purpose by heating together 1 part of wood spirit, 2 parts of sodium chloride, and 3 of sulphuric acid, and collecting the evolved gas over water, which retains the impurities. Methyl chloride is a colorless gas, having an ethereal odor and a sweetish taste. (Gmelin.) Richardson found it to possess anæsthetic properties, but to be less manageable than the methylene dichloride. It has been since made more practically by reducing chloroform (trichlormethane) in alcoholic solution by zinc and hydrochloric acid, the product being mixed with water; the specifically heavier liquid separates and is purified by successive treatment with sodium hydroxide solution, sulphuric acid, water, calcium chloride, and finally by fractional distillation.

Methylene dichloride is a colorless liquid, of an odor analogous to that of chloroform, of the sp. gr. 1.344, and the boiling point 40° C. (104° F.). The density of its vapor is 3.012 (Gmelin), 2.937 (Richardson). In its preparation the chlorine replaces one atom of hydrogen in the methyl chloride, thus converting the CH_3Cl (methyl chloride) into CH_2Cl_2 (methylene dichloride). The vapor of the dichloride does not, like that of chloroform, extinguish the flame of a taper, but itself takes fire, burning with a brilliant flame, and yielding, as the result of combustion, carbon dioxide and hydrochloric acid. Methylene dichloride mixes readily with absolute ether, and, as the boiling points of the two approach nearly, they volatilize evenly and equably. It is neutral to test paper and an acid reaction in any specimen would be an evidence of the presence of hydrochloric acid, and should preclude its use as a respiratory anæsthetic. To prevent the generation of the acid, the liquid should be kept carefully secluded from the sunlight, and the addition of a small quantity of absolute alcohol is recommended.

In his experiments upon the lower animals, Richardson found that methylene dichloride was a powerful and advantageous anæsthetic, narcotism being produced more rapidly and continuing longer than when caused by other anæsthetics, passing off, however, with great suddenness. (*M. T. G.*, 1867.) As the result of the paper of Richardson, the dichloride was used as an anæsthetic by various English surgeons, also in Germany and America.

Judging from its chemical constitution, methylene dichloride, containing less chlorine than chloroform, should be the safer of the two agents. It may very well be that the deaths which have occurred from it (*B. M. J.*, Oct. 1869; *Dublin Quarterly Journ.*, Aug. 1870; *P. J.*, 1871, 875) have been due to the commercial drug being something else than it purported to be. Some years ago H. C. Wood had examined in the chemical laboratories of the University of Pennsylvania methylene dichloride, supplied by one of the most reputable of the English manufacturing chemical firms, and sold as first quality. It contained, however, little or none of the methylene dichloride, and was largely chloroform. Gutzart states, as the result of examination of German specimens of the drug, that they are mixtures of alcohol, methylene dichloride, and chloroform in varying proportions. It seems even probable that Richardson did not have the pure article. The experiments of Geuther and Eichholz, and of Heymanns and Debuck (*Arch. de Pharmacod.*, i.) show that the dichloride acts upon guinea pigs and rabbits similarly to chloroform, but that chloroform is twice as poisonous to the heart. It is possible that methylene dichloride has advantages over chloroform, but the high price of the pure drug must interfere with its use. Any commercial article offered below price may be relied upon as impure. The quantity used by Richardson averaged a fluidrachm (3.75 Cc.) every five minutes. As yet methylene dichloride cannot be regarded as a safe anæsthetic. Even the mixture of methylene dichloride and absolute ether, which Richardson introduced under the name of *methylene ether* (*M. T. G.*, ii. 1872; i. 1873), has caused death. (*P. M. T.*, iii. 718; *M. T. G.*, July, 1873.)

The methylene dichloride may be given internally in the *dose* of from ten to thirty minims (0.6–1.8 Cc.), which may be dissolved in dilute spirit.

Carbon Tetrachloride. *Tetrachlor-methane. Carbonei Tetrachloridum. Carboneum Chloratum. Chlorocarbon. Tétrachlorure de Carbone, Formène Perchloré*, Fr. *Chlorkohlenstoff*, G. CCl_4.—This substance, though discovered by Regnault so early as 1839, did not come into general notice until December, 1865, when it was suggested as an anæsthetic by Simpson of Edinburgh. (*M. T. G.*, Dec. 1865.) It had, however, been previously used as an anæsthetic by A. E. Sansom and John Harley, who experimented with it in 1864, and recorded their experience in Sansom's work on Chloroform, published in May, 1865. (*B. and F. Med.-Chir. Rev.*, 1867, 551.) To procure it, dry chlorine is passed first through a bottle containing carbon disulphide, and then through a porcelain tube filled with pieces of porcelain and kept at a bright red heat. The vapors are condensed in a well cooled receiver, forming a yellowish-red liquid, which is a mixture of carbon tetrachloride and sulphur chloride. The sulphur chloride is removed by slowly adding the liquid to an excess of potash lye or milk of lime, the moisture being set aside, and agitated from time to time until the sulphur compound is decomposed, and then distilled. Chloroform is made to yield it by the substitution of an atom of chlorine for one of hydrogen; thus $CHCl_3$ (chloroform) becomes CCl_4 (carbon tetrachloride).

Carbon tetrachloride is a transparent colorless liquid, of the sp. gr. 1.599 (Regnault), boiling at 77° C. (170.6° F.), with a vapor density of 5.33, and an agreeable aromatic flavor. At 30° C. (86° F.) it solidifies to a crystalline mass. It has already found an extensive use in organic laboratories as a solvent for fats, replacing petroleum benzin to advantage because of its non-inflammability. As a solvent for alkaloids in assay work and in manufacturing processes it takes the place of chloroform. Mixtures of 40 per cent. light petroleum benzin with 60 per cent. carbon tetrachloride, or 50 per cent. benzene with 50 per cent. carbon tetrachloride, are also uninflammable.

P. Smith describes its effects as follows. About half a fluidrachm (1.8 Cc.) on a handkerchief was inhaled. The vapors had a quince-like odor, and produced a sense of coolness in the fauces, followed by a feeling of calmness and comfort. A very rapid and fugacious anæsthesia was produced by a larger dose. Small doses of the carbon tetrachloride caused in animals entire loss of power and consciousness, from which they soon recovered entirely; but larger doses occasioned death. These results were confirmed by John Harley. Trials on human beings led to the conclusion that the carbon tetrachloride may be usefully employed, by inhalation, for the relief of pain, especially *headache, tic douloureux, toothache, dysmenorrhœa*, etc.

J. Y. Simpson concluded, however, that it depresses the heart much more than does chloroform, and it has failed to come into use. See also *L. L.*, June, 1867. Its vapor, applied to the eye by sprinkling a few drops on the hand, is asserted to be an effectual means of relieving some forms of *conjunctivitis, ulceration of the cornea, photophobia*, etc. Injected subcutaneously, in the dose of from ten to twenty minims (0.5–1.0 Cc.) it relieved pains in the walls of the chest and abdomen without subsequent nausea. Internally, Simpson tried it only in small doses in *gastrodynia*, in which it had the same effects as chloroform. (*M. T. G.*, 1865, 651.)

Chloroiodolipol.—This is stated to be a chlorine substitution product of phenol, creosote, and guaiacol. It is used in chronic affections of the respiratory tract by inhalation.

Chlorol.—A liquid disinfectant containing mercuric chloride, sodium chloride, hydrochloric acid and copper sulphate, dissolved in water. It should be used with caution.

Chlorolin.—This is a liquid disinfectant said to contain about twenty per cent. of monochlorphenol and trichlorphenol. It is applied to wounds in solutions varying in strength from one-half to three per cent. Pills containing one thirtieth of a grain of chlorolin have been used in the treatment of tuberculosis.

Chlorphenols.—By the action of chlorine upon phenol is produced a mixture of ortho- and parachlorphenol ($C_6H_4Cl.OH.$) and by continued action trichlorphenol ($C_6H_2Cl_3.OH.$). *Orthochlorphenol* is a liquid boiling at 175° C. (347° F.) and solidifying at 7° C. (44.6° F.); the *parachlorphenol* forms crystals melting at 37° C. (98.6° F.) and boiling at 217° C. (422.6° F.). Both have an unpleasant, penetrating odor. *Trichlorphenol*, which was discovered by Laurent, crystallizes in needles, which melt at 68° C. (154.4° F.) and boil at 244° C. (471.2° F.). It is easily soluble in alcohol and ether.

Cech (*Prakt. Ch.*, Bd. xxii.) was the first to show that a mixture of three isomers of monochlor- and trichlorphenols was an extremely active antiseptic, more powerful than phenol itself; but it is chiefly to Karpow, working in the laboratory of Nencki, that we are indebted for our knowledge of these subjects. This investigator found that metachlorphenol is poisonous to the rabbit, the minimum fatal dose being 1.08 Gm. per kilogramme, and the chief symptom violent clonic convulsions. He experimentally demonstrated that both orthochlor- and parachlorphenol escape with the urine, in combination with sulphuric acid, and probably also with glycouronic acid, the urine becoming rapidly blackish on exposure to air, and confirmed the observations of Külz (*A. G. P.*, Bd. xxx.) that the urine of dogs poisoned with the chlorphenols polarizes to the left. It would appear almost certain that the chlorphenols undergo at least partial decomposition in the organism, giving origin to hydroquinone, pyrocatechin, and other educts found after poisoning with phenol. The action of these chlorphenols upon the general system is probably practically that of phenol. As germicides these compounds were found by Nencki to be very active, the 2 per cent. solution being stronger than the 5 per cent. phenol solution, and only a little weaker than the one-thousandth sublimate solution.

In practical medicine chlorphenols have been used by Simanoffski, by Girard, and by others. According to Girard, the 2 per cent. solution is irritant to the surface of wounds, but Simanoffski asserts that even the 20 per cent. solution in glycerin is not irritant to mucous membranes. A. Spengler (*Arch. des Sci. Biolog.*, vol. iv. 1895–96) states that the parachlorphenol acts very energetically upon the tubercle bacillus, and that its 10 per cent. glycerin solution, applied locally to the larynx, causes no irritation but an anæsthesia which lasts some days and is very advantageous in the treatment of *tubercular laryngitis*. These statements have been confirmed by Simanoffski. The chlorphenols have been used in *ozæna, gonorrhœa, ulceration*, and various other surgical affections, and Girard affirms that a 1 per cent. solution affects wounds favorably, and that a 2 per cent. solution affords an excellent method of sterilizing the instruments and hands of surgeons.

The *chlorsalols*, the *salicylic esters of chlorphenols*, were also studied by Nencki and found to undergo decomposition in the intestines or system, the salicylic acid or its derivatives appearing in the urine. The antiseptic properties of these chlorsalols were found to be much greater than that of salol. Girard has used them in *doses* of from sixty to ninety grains (3.9–5.8 Gm.) a day in *cystitis* and *diarrhœa* with excellent results. Passerini has employed them in *phthisis* and in *bronchitis* by means of an inhaling apparatus, in which fifteen minims (0.9 Cc.) are placed on a piece of cotton, the patient inhaling with slow and deep inhalations from five to ten minutes daily. Usually at first some pulmonic irritation, and even for a day or two temporary exacerbation, occur, but the final results are said to be remarkable.

Menthorol, so called, is a moderately thick liquid, with an agreeable taste and the odor of parachlorphenol, which is said to be a mixture of menthol and parachlorphenol. It may be used as a local remedy in a 5 to 15 per cent. solution in the treatment of *ulcerations* of the *throat* and *lungs*.

Chroatol.—*Terpin-iodo-hydrate*, $C_{10}H_{16}.2HI$, occurs in greenish-yellow crystals, having an aromatic odor; it is insoluble in water, soluble in alcohol and glycerin, slightly soluble in ether and chloroform. It has been used externally in the treatment of *psoriasis* and other skin diseases as a dusting powder or 10 per cent. ointment.

Chrome Yellow. *Chromate of Lead. Lemon Yellow. Leipsic Yellow. Paris Yellow.* $PbCrO_4$. This is the *neutral lead chromate* prepared by precipitating a solution of lead nitrate with potassium chromate. It is of a beautiful lemon-yellow color. The basic lead chromate ($PbO,PbCrO_4$) possesses a red color, and is sometimes used as a pigment. *Chrome green* is either *chromium sesquioxide* or a mixture of chrome yellow and

Prussian blue. The chromates are often adulterated with lead sulphate. Duviller (*J. P. C.*, Août, 1873, 114) detects this by heating one part of the suspected pigment with a mixture of from two to three parts of nitric acid, sp. gr. 1.420, one to two parts of water, and one-fourth part of alcohol. The chromate is all dissolved, but any sulphate present remains unaffected. Lead chromate has been used by bakers for giving a rich yellow coloring to buns, and there can be no doubt of its having produced fatal poisoning in a number of cases. John Marshall has shown that its exhibition in animals is followed by an absorption, which takes place very slowly.

Chromium.—Chromium was discovered by Vauquelin in 1797. Its most common ore is *chrome iron*, consisting of ferrous oxide and chromium sesquioxide. This is not an abundant mineral, the principal source of supply being at present Asia Minor. Chromium is obtained by igniting its oxide in contact with charcoal with the aid of the electric arc; or by the more recent methods of reduction of its oxide by finely divided metallic aluminum (Goldschmidt), or by metallic silicon (Green and Wahl). It is a brittle metal, of a grayish-white color like platinum, with some lustre, and very hard, so that it scratches glass. Its sp. gr. is 6.8, atomic weight 51.7, and symbol Cr. It does not change by exposure to the air, and is with difficulty attacked by the acids. It forms with oxygen five compounds: 1, the monoxide (CrO), 2, the sesquioxide (Cr_2O_3), 3, the trioxide or chromic acid (CrO_3). Of the two others, one may be considered as a compound of the monoxide and sesquioxide ($CrO.Cr_2O_3$), and the other, called *perchromic oxide*, consists of two atoms of chromium and seven of oxygen (Cr_2O_7). Chromium combines with chlorine in two proportions, forming the *dichloride* and *sesquichloride*. The chief value of chromium in the arts is as the source of potassium dichromate and of pigments, although recently it has come into extensive use as an alloy, called *ferro-chromium*, for the manufacture of chrome steel and nickel-chrome steel.

Chrysarobin Oxide.—*Chrysarobini Oxidum.* A brownish-black powder, obtained by boiling chrysarobin in water with sodium peroxide; its 5 to 10 per cent. ointment has been highly recommended by Unna in the treatment of facial, genital, and other forms of *eczema* for which chrysarobin is too irritating. It has no influence in dry eruptions.

Cichorium. *Cichorium Intybus*, L. *Chicory. Succory.*—A perennial herbaceous composite plant, indigenous in Europe, but naturalized in this country, where it grows in fields, and in roads along the fences. The whole plant has a bitter taste, without acrimony or any very peculiar flavor. The taste is strongest in the root and weakest in the flowers. The leaves, when young and tender, are eaten as salad. Chicory is a feeble, non-irritating tonic.

The root is much used as a substitute for or adulterant of coffee. In preparing it, Dausse recommends that the dried root should be cut into rather large and equal pieces, which are to be roasted until they lose 140 out of 500 parts. The pieces are then easily ground in a mill, and afford a yellowish-brown powder. (*Ph. Cb.*, 1850, 688.) In France alone the annual consumption of chicory root amounted in 1860 to sixteen million pounds. For methods of detection in ground coffee, see *P. J.*, 1867, 141; also Allen (*Com. Org. Anal.*, 2d ed., vol. iii., part 2, 540), and J. R. Leebody (*Chem. News*, 1874, 243). A glucoside has been obtained from the blossoms of *Cichorium Intybus* by Nietzki (*A. Pharm.*, (3) 8, 327), to which the formula $C_{32}H_{34}O_{19}$ is assigned. On boiling with dilute acids it yields glucose and a compound, $C_{20}H_{14}O_9$. This decomposition product seems to exist in the blossoms ready formed along with the glucoside. The *garden endive* is also a species of Cichorium, *C. Endivia*, L.

Cicuta. *Cicuta virosa*, L. *Water Hemlock. Cowbane. Ciguë vireuse*, Fr. *Wasserschierling*, G.—A perennial, umbelliferous European plant, growing on the borders of pools and streams. It is very poisonous to most animals which feed upon it, though said to be eaten with impunity by goats and sheep. According to Wikszemski, it acts upon frogs similarly to picrotoxin, at first stimulating the convulsive centres in the medulla and producing violent general spasms, and later causing general centric paralysis. (Dragendorff, *Jahresb.*, 1875, 494.) Upon man it operates as an acrid narcotic, producing vertigo, intoxication, and convulsions, followed by general paralysis and death. (*Ibid.*) Infusion of galls is recommended as an antidote, but should not be relied on to the exclusion of emetics. When the plant causes vomiting, as it frequently does, fatal effects are less prone to ensue. It is said to be less poisonous dried than fresh; Van Ankum (*J. P. C.*, 1868, 105, 151) has shown that the active principle is a resinous, chemically indifferent substance, to which the name *cicutoxin* has been given. Böhm (*A. E. P. P.*, v. 281) has since obtained this principle pure, as a thick, tenacious, amorphous substance, of acid reaction, of slight odor but disagreeable taste. The dry root yielded about 3.5 per cent., the fresh 0.2 per cent. of cicutoxin. The presence of a volatile alkaloid resembling *coniine*, and termed *cicutine*, has been observed by Wittstein and Buignet. The volatile oil, obtained by distillation, was found by Simon not to be poisonous. According to Julius Trapp, it is identical with the aromatic oil of cumin seeds. (*Chem. Cb.*, 1858, 414.) On the other hand, the alcoholic extract of the dried root operated as a violent poison upon animals. (*Ann. Ch. Ph.*, xxxi. 258.) At present the plant is never used internally, and rarely externally as an anodyne poultice in local pains.

Cicuta maculata, L., *American water hemlock, Musquash root, Beaver poison, Spotted cowbane.* This grows in meadows and on the borders of streams throughout the United States, and is closely analogous, in botanical character and in effects, to the European species. In several instances children have been fatally poisoned by eating its root. This consists of several oblong, fleshy tubers, sometimes as long as the finger, spreading out from the base of the stem, and having an odor and taste not unlike those of parsnip. For microscopic examination of plant, see *A. J. P.*, July, 1891. Cicuta has been highly lauded as a specific in nervous and sick *headache* (*Proc. A. Ph. A.*, 1858, 253), but is rarely if ever used. J. E. Young found in the seeds an alkaloid supposed to be identical with *coniine*. (*A. J. P.*, xxvii. 294, confirmed by R. Glenk, *A. J. P.*, 1891, 328.)

In poisoning by either of these species of Cicuta, free vomiting should be induced as speedily as possible, and symptoms met as they arise.

Cinchonidine Salicylate. *Cinchonidinæ Salicylas.* $C_{19}H_{22}N_2O.C_7H_6O_3$.—This salt occurs in needles soluble at 18° C. (64.4° F.) in 766 parts of water. It is capable of producing physiologically

the action of the quinine salts, and no doubt is a powerful antiperiodic, inferior, however, to the ordinary preparations of that alkaloid. It has been recommended and considerably used as a specific in *chronic* and *subacute rheumatism*, in *doses* of from fifteen to twenty grains (1–1.3 Gm.) a day, best given in pill or capsule.

Cinnamic Acid. *Acidum Cinnamicum.* $C_6H_5CH=CH.COOH$.—This acid occurs naturally in Peru and Tolu balsams, and is made synthetically by the reaction of acetyl chloride upon benzaldehyde, or by the action of a mixture of acetic anhydride and fused sodium acetate upon benzaldehyde. It forms colorless, lustrous plates, melting at 133° C. (271° F.), and is insoluble in cold water, but quite soluble in boiling water and in alcohol. Cinnamic acid is used in medicine solely in the treatment of *tuberculosis*, especially in the form of *sodium cinnamate* (*hetol*). As originally suggested by A. Landerer (*M. M. W.*, xxxv. Nos. 40, 41), this salt is to be given intravenously, and, according to Tobias, the same vein may be injected from fifty to sixty times in succession. Most extraordinary results have been claimed for the method, Landerer affirming that in the early stages of uncomplicated tuberculosis 85 per cent. of the cases can be cured. The heated controversy to which Landerer's paper gave rise has been well reviewed by W. J. Robinson (*M. A.*, 1902). It does not appear probable that the Landerer treatment will accomplish what is claimed for it, and the conclusion of Robinson that sodium cinnamate is not a direct curative agent in tuberculosis and is of no more value symptomatically than is creosote, is probably correct. The sodium cinnamate may be given by the mouth in *doses* of from two to three grains (0.13–0.2 Gm.). The initial intravenous *dose* of the intravenous treatment should not exceed one-fiftieth of a grain (0.0013 Gm.); the injection may be made every third day and the amount increased until one-third of a grain (0.021 Gm.) has been reached. A 10 per cent. solution in glycerin affords an excellent method of administration.

Citarin. *Sodium Anhydromethylenecitrate.* $(NaO.COCH_2)_2.CO\langle\begin{matrix}CH_2\\CO\end{matrix}\rangle O$.—A readily soluble compound which is said to liberate formaldehyde in the blood. It is asserted to be a useful remedy in cases of *uric acid gravel*, and in *gout* and *chronic rheumatism*, in *doses* of 30 to 45 grains (2–3 Gm.) four times a day.

Citrophen. $C_3H_4(OH)(CONH.C_6H_4OC_2H_5)_3$. This compound of citric acid and *p*-phenetidin originated with Roos. It is a white crystalline powder, soluble in forty parts of water; its melting point is 181° C. (358° F.) and its ready solubility in water adapts it for hypodermic use. It is used as an antipyretic, also in *migraine* and *neuralgia*. *Dose*, ten to fifteen grains (0.65–1.0 Gm.).

Civet. *Zibethum. Civette*, Fr. *Zibeth*, G. This is an odorous substance, obtained from two animals of the genus Viverra; the *V. Civetta* or *civet cat* of Africa, and the *V. Zibetha*, which inhabits the East Indies. It is secreted in a cavity opening between the anus and external genitals, and is collected from animals confined for the purpose. It is semi-liquid, unctuous, yellowish, becoming brown and thicker by exposure to the air, of a very strong, peculiar odor, similar to that of musk, though less agreeable and less diffusible, and of a bitterish, subacrid, disagreeable, fatty taste. When heated it becomes quite fluid, and at a higher temperature takes fire and burns with a clear flame, leaving little residue. It is insoluble in water, and only slightly soluble in ether and cold alcohol, but heated alcohol dissolves it almost entirely, depositing it again upon cooling. It contains, among other ingredients, a volatile oil, fat, and free ammonia. In medicine it was formerly employed in lieu of castor and musk; it is now used exclusively as a perfume. For analyses of commercial samples, see *P. J.*, 1897, 101.

Clematis. *Clematis recta*, L. (*C. erecta*, L.) *Upright Virgin's Bower. Clématite*, Fr. *Waldrebe*, G.—A perennial European plant. The leaves and flowers have an acrid, burning taste. When bruised in a mortar they irritate the eyes and throat, giving rise to a flow of tears and to coughing, and applied to the skin they produce inflammation and vesication; hence their old name of *flammula Jovis*. The acrimony is greatly diminished by drying. Störck found this clematis to be diuretic and diaphoretic, in *doses* of from one to two grains (0.065–0.13 Gm.) of the extract a day, or from thirty to forty grains (2–2.6 Gm.) of the leaves given in infusion three times a day, and to be useful, locally and internally, in *syphilitic, cancerous*, and other *foul ulcers*.

Other species of Clematis have the same acrid properties; among these *C. flammula*, L., or *sweet-scented virgin's bower*, which, though a native of Europe, is cultivated in our gardens, *C. vitalba*, L., or *traveller's joy*, also a native of Europe, and several indigenous species, of which *C. virginiana*, L., or *common virgin's bower*, *C. viorna*, L., or *leather flower*, and *C. crispa*, L., have been used as substitutes for *C. recta*, L. All these are climbing plants. Rochebrune (*Toxicol. Africaine*, i.) affirms that he has found in *C. flammula*, L., an alkaloid, *clematine*, two milligrammes of which will produce in the guinea pig copious and frequent urination, general tremors, great disturbance of respiration, feebleness and intermittency of the heart beat, followed in seven minutes by convulsions ending in coma and death.

From the bruised roots and stems of *C. vitalba*, L., boiled for a few moments in water to diminish their acrimony, and then digested in sweet oil for a little while, is made a preparation used locally in Europe for the *itch*. Twelve or fifteen applications are said to be usually sufficient. Gaube has found in this species an alkaloid, also named *clematine*, which forms with sulphuric acid a salt crystallizable in six-sided needles; also an acrid volatile oil analogous to mezereon in its properties, tannic acid, mucilage, and earthy salts. (*J. P. C.*, Août, 1869.)

Clove Bark. *Cortex Caryophyllatus. Cassia Caryophyllata.*—Under these names two barks occur in the market. Of these the most abundant comes from the West Indies, and is derived from a tree, *Dicypellium caryophyllatum*, Nees (*Licaria guaianensis*, Aublet, *Persea caryophyllacea*, Mart.), Fam. Myrtaceæ. It is usually in cylinders, from one to two feet long by an inch in diameter, composed of numerous separate pieces rolled around one another and having a dark brown color, a pungent taste, and an odor similar to that of cloves. The second variety of clove bark occurs in fragments, resembling the other form in odor and color but softer and lighter, and supposed to be derived from *Myrtus caryophyllata* (L.) (*Eugenia caryophyllæa*, Wight), which grows in Ceylon. This clove bark has aromatic properties not unlike those of the spice from

which it derived its name, but it is much inferior and is not used in this country. Some authors have confounded with it a different bark, produced in the Moluccas, and known by the Indian name of culilawan. (See *Culilawan.*) For description of a false clove bark, see *A. J. P.*, vol. xv.

Cnicus. *Cnicus arvensis,* Hoffm. (*Carduus arvensis* (L.), Robs. *Cirsium arvense,* Scop.) *Canada Thistle.*—This European composite plant, to which have been attributed diaphoretic, emetic, and tonic properties, according to Herman J. Pierce (*A. J. P.*, lxviii. 1896) contains a volatile alkaloid.

Coal Tar.—When bituminous coal is subjected to dry distillation, besides the incondensible gases which serve for lighting, and the charcoal left behind as coke, which is a valuable fuel, there are formed numerous other pyrogenic products, necessarily more or less varying in character and amount, not only according to the kind of coal used, but also with the varying circumstances of the decomposing process. Most of these newly formed bodies, all of which are volatile, are condensed into a dark thick liquid or semi-liquid substance called coal tar. Formerly this was considered as refuse matter, but from it are now prepared substances of great value in the arts and in medicine. Our purpose is to give a condensed view of these substances. For greater details, see Lunge, *Coal-Tar and Ammonia,* 2d ed., London, 1887, and Sadtler's *Industrial Organic Chemistry,* 3d ed., Philadelphia, 1901, chap. xi. The composition of coal tar varies considerably with the temperature at which the distillation of the coal is effected, the yield of solid bodies and of gases being larger when the temperature is higher, while at a lower temperature the liquid portion of the tar is in increased amount. When coal tar is submitted to distillation and rectification, it yields the following products, solids, liquids, and gases, in variable proportion:

1. *Solids.*—Naphthalene, $C_{10}H_8$, methyl-naphthalene, $C_{11}H_{10}$, naphtha-ethylene and diphenyl, $C_{12}H_{10}$, fluorene, $C_{13}H_{10}$, anthracene and phenanthrene, $C_{14}H_{10}$, fluoranthene, $C_{15}H_{10}$, methyl-anthracene, $C_{15}H_{12}$, retene, $C_{16}H_{12}$, chrysene, $C_{18}H_{12}$, pyrene, $C_{16}H_{10}$, picene, $C_{22}H_{14}$, and carbazol, $C_{16}H_{11}N$.

2. *Liquids.*—These may be neutral hydrocarbons, acids, and ethers of the same, or bases. The *neutral hydrocarbons* are benzene, C_6H_6, toluene, C_7H_8, methyl-toluene, and iso-xylene, C_8H_{10}, pseudocumene, and mesitylene, C_9H_{12}, cymene, $C_{10}H_{14}$. The *acid constituents* are phenol, C_6H_6O, orthocresol, paracresol, and metacresol, C_7H_8O, phlorol, $C_8H_{10}O$, rosolic acid, $C_{20}H_{16}O_3$, pyrocatechin, $C_6H_6O_2$, and creosote, consisting of the methyl ethers of pyrocatechin and its homologues, $C_7H_8O_2$, $C_8H_{10}O_2$, and $C_9H_{12}O_2$. There are also present, probably in combination with the ammonia of the ammoniacal liquor, acetic, butyric, carbonic, hydrocyanic, sulphocyanic, and hydrosulphuric acids. The *bases* are ammonia, NH_3, methylamine, CH_3NH_2, ethylamine, $C_2H_5NH_2$, phenylamine, $C_6H_5NH_2$, pyridine, C_5H_5N, picoline, C_6H_8N, lutidine, C_7H_9N, collidine, $C_8H_{11}N$, leucoline, C_9H_7N, iridoline, $C_{10}H_9N$, cryptidine, $C_{11}H_{11}N$, acridine, $C_{12}H_9N$, coridine, $C_{10}H_{15}N$, rubidine, $C_{11}H_{17}N$, and viridine, $C_{12}H_{19}N$.

3. *Gases.* (1) *Illuminating gases.*—Acetylene, C_2H_2, ethylene, C_2H_4, propylene, C_3H_6, butylene, C_4H_8, allylene, C_3H_4, crotonylene, C_4H_6, terene, C_5H_8, and vapors of benzene, C_6H_6, styrolene, C_8H_8, naphthalene, $C_{10}H_8$, methyl-naphthalene, $C_{11}H_{10}$, fluorene, $C_{13}H_{10}$, fluoranthene, $C_{15}H_{10}$, hexane, C_6H_{14}, heptane, C_7H_{16}, and octane, C_8H_{18}.

(2) *Heating and diluting gases.*—Hydrogen, H_2, marsh-gas (methane), CH_4, carbon monoxide, CO.

(3) *Impurities.*—*Carbon dioxide,* CO_2, ammonia, NH_3, cyanogen, $(CN)_2$, methyl cyanide, CH_3CN, sulphocyanic acid, CN,SH, hydrogen sulphide, H_2S, carbon disulphide, CS_2, carbon oxysulphide, COS, and nitrogen, N_2.

Cobalt. (Co = 58.56.)—This not very abundant metal is usually found associated with arsenic, and is rarely used in its pure condition in medicine or pharmacy. It occurs as *smaltine* or *tin-white cobalt, cobalt glance,* or *sulpharsenide; cobalt bloom, erythrine,* or *arsenate; earthy cobalt* or *wad,* a mixture of cobaltous oxide and black manganese oxide, and *spiess cobalt,* (Co,Ni,Fe)As_2.

Spiess cobalt is frequently employed as the source of cobalt salts, and the substance called in commerce *zaffre* is an impure cobalt arsenate, made by simply roasting the crude cobalt ores or calcining them, with access of air, and is used to give a blue color to glass, enamels, and pottery glaze. The native ore is frequently found in commerce under the name of *flystone,* and is used for poisoning flies, by roughly grinding it and putting a small quantity in a saucer with sweetened water. *Smalt* is the common name used for glass colored by fusing with oxide of cobalt, producing a blue pigment, for coloring glass, etc. The soluble salts of cobalt, particularly the *chloride* and *sulphocyanate,* have been used to impregnate paper, etc., giving it ordinarily a pink tint, indicative of the presence of moisture, while on elevation of temperature and drying the color changes to blue. Advantage has been taken of this fact to produce the so-called *barometer paper.*

A cobalt oxide, prepared by precipitating the chloride with potassium hydroxide, has been employed in *rheumatism.* It is emetic in the *dose* of 10 or 20 grains (0.65–1.3 Gm.). The salts of the metal are irritant poisons. The statement that the cobalt salts and hydrocyanic acid will form in the animal system a potassium or sodium-cobalt-cyanide and are antagonistic poisons and may be used as antidotes one for the other, is probably not correct. (See Hübner, *A. I. P.*, vol. ix.)

Cobalt Blue.—This beautiful pigment is a compound of cobalt oxide and aluminum oxide, obtained by precipitating the mixed solutions of a salt of aluminum and one of cobalt by means of an alkali, and washing, drying, and strongly calcining the precipitate. (Berzelius.) The cobalt blue of Thénard is made by heating together the hydrated cobalt subphosphate and aluminum hydroxide. It is used in painting.

Cobweb. *Spiders' Web. Tela Araneæ.* Spiders' webs were formerly much used in *headache, hectic fever, asthma, hysteria,* and *nervous irritation,* but probably acted solely through the imagination. *Dose,* from ten to twenty grains (0.65–1.3 Gm.) *pro re nata.* (See *L. L.*, 1867.) Spiders' web is useful as a styptic, especially after extraction of teeth, the cavity being stuffed full of the web.

Cocculus. *Cocculus Indicus. Coque du Levant,* Fr. *Kokkelskörner, Fischkörner, Tollkörner,* G. *Indian Berries. Oriental Berries. Fish Berries. Menispermum Cocculus,* L. *Anamirta Cocculus,* Wight and Arn. *Cocculus suberosus,* DC. (Fam. Menispermaceæ.)—This is a climbing shrub, with a suberose or corky bark, which grows along the Malabar Coast, and in Eastern

Insular and Continental India. By Roxburgh it was proved to be one source of Cocculus, which is, however, probably derived also from other plants, notably from the *Cocculus Plukenetii*, DC. (now *Pachygone ovata*, Miers.), of Malabar, and *C. lacunosus*, DC. (now *Anamirta paniculata*, Colebr.), of Celebes and the Moluccas. It was known to the Arabian physicians, and was imported into Europe from the Levant, from which circumstance it was called *Cocculus levanticus*. It is now brought exclusively from the East Indies.

Cocculus Indicus, as found in commerce, is roundish, somewhat kidney-shaped, about as large as a pea; having a thin, dry, blackish, wrinkled exterior coat, within which is a ligneous bivalvular shell, enclosing a whitish, oily, very bitter kernel. It is without odor, but has an intensely and permanently bitter taste. It bears some resemblance to the bayberry, but is not quite so large, and may be distinguished by the fact that in the Cocculus Indicus the kernel never wholly fills the shell. When the fruit is kept long, the shell is sometimes almost empty. The Edinburgh College directed that "the kernels should fill at least two-thirds of the fruit." Boullay discovered in the kernel *picrotoxin*.

A *tincture of Cocculus Indicus* is sometimes used made by macerating the ground fruit in diluted alcohol two weeks, in the proportion of four ounces in a pint. For Procter's formula for preparing a fluidextract, see *U. S. D.*, 17th ed., or *A. J. P.*, 1863.

Cocculus Indicus is used in India and elsewhere to stupefy fishes. Its powder, mixed with oil, is locally employed in the East Indies in *obstinate cutaneous affections*. An ointment of it has been used in *tinea capitis*, and to destroy vermin in the hair. Death in a child six years old, preceded by tetanic spasms and extremely contracted pupil, resulted from the application of a strong tincture of the fruit to the scalp. (*Med. Exam.*, N. S., viii. 227.) It should be used with great caution when the surface is abraded. For cases of poisoning, see Sozinsky, *Phila. Med. News*, Nov. 3, 1886; Mitchell, *Therapeutics*, Philadelphia, 1850; T. F. Haynes, *P. M. T.*, vol. xiv. 748. Moderate doses produce vertigo, weakness and headache; after large doses there are violent headache, vomiting, and epileptiform convulsions.

Cochlearia. *Cochlearia officinalis*, L. *Common Scurvy-grass. Herbe au Scorbut*, Fr. *Herba Cochleariæ*, P. G. *Löffelkraut*, G. *Spoonwort.*—This annual or biennial cruciferous plant, is a native of the northern countries of Europe as well as the United States. The whole herb is active. It has, when fresh, a pungent, unpleasant odor if bruised, and a warm, acrid, bitter taste. These properties are lost by drying. They are imparted to water and alcohol by maceration, are retained by the expressed juice, and probably depend on a peculiar volatile oil, which is separable in very small quantity by distillation with water, and is probably produced by reaction between a fixed principle in the plant and water, under the influence of myrosin acting as a ferment. (*Chem. Cb.*, 1856, 124.) The oil was at first supposed to be identical with the oil of mustard, and, later, Geiseler gave its formula $(C_3H_5)_2CS$. (See *A. J. P.*, 1859, 416.) The boiling point, according to A. W. Hofmann, is about 160° C. (320° F.), while that of mustard oil is 147° C. (296.6° F.). (*Chem. News*, 1869, 286.) According to Hofmann, the oil is a mustard oil of the butylic series, having the formula $C_5H_9NS = C_4H_9CSN$. Hofmann has made it synthetically.

Common scurvy-grass has been much used in *scurvy*, and even in *chronic rheumatism*. The fresh plant may be eaten as a salad, or used in infusion; the expressed juice has also been used.

Cocillana Bark.—The bark of a number of species of Guarea (Fam. Meliaceæ) has in former times attracted attention on account of its asserted purgative and emetic properties. *G. Rusbyi* (Brit.), Rusby (*Sycocarpus Rusbyi*, Brit.), a species related to *Guarea trichiloides*, L., is supposed to yield cocillana. (*A. J. P.*, 1890, 178; *Bull. Pharm.*, 1893, 350.) The bark of this large Bolivian tree, which was discovered by H. Rusby, is believed by him (*T. G.*, 1888) to contain an alkaloid; but by John W. Eckfeldt (*Med. Bull.*, 1891) its active principle is thought to be a glucoside. In *doses* of from twenty to fifty grains (1.3–3.2 Gm.) the bark causes vomiting, with prostration and some purging; also, it is said, much sneezing, dull frontal headache, and discharge from the nasal mucous membrane. The therapeutic action of the drug resembles that of ipecac, although as an expectorant it is somewhat more stimulant. (See *N. Y. M. J.*, Dec. 1889, and April, 1890.) It has been used in *acute* and *subacute bronchitis, bronchial pneumonia, phthisis*, etc., with asserted success. *Dose* of the fluidextract, from eight to twenty minims (0.5–1.3 Cc.) every three or four hours.

Cœlocline. *Cœlocline polycarpa*, A. DC. *Xylopicrum polycarpum*, O. Kze. *Unona polycarpa*, DC. *Xylopia polycarpa*, Oliver. *Berberin Tree. Yellow-dye Tree of Soudan.*—This small tree, of the fam. Anonaceæ, growing in Soudan, Sierra Leone, and certain parts of Western Africa, was described by William F. Daniell. (*P. J.*, Feb. 1857.) When wounded, the tree exudes a juice which produces a yellow stain upon linen that cannot be washed out. The epidermis of the bark is greenish-gray, interrupted by occasional blackish patches; the inner layers are of a golden yellow, and very fibrous, so that they can be separated in ribbon-like bands. The bark is moderately but disagreeably bitter, and stains the saliva yellow. Water extracts its color and bitterness. Stenhouse has ascertained that it contains *berberine*. The bark is much used in Africa for dyeing yellow. In Sierra Leone it is employed topically, in powder or decoction, for *obstinate ulcers*.

Coffee. *Caffea. Semen Caffeæ. Café*, Fr. *Kaffee*, G. *Caffe*, It. *Cafe*, Sp. *Bun*, Ar. *Copi Cotta*, Cingalese. *Kaeva*, Malay.—*Coffea arabica*, Linn., is a small evergreen tree from fifteen to thirty feet in height. The genus Coffea contains a number of species which probably produce the alkaloid caffeine, but only two of which yield commercial coffee,—namely, *Coffea arabica* and *Coffea liberica*. The two species closely resemble one another, but are at once distinguished by the fact that the corolla is 4 to 5 cleft in *C. arabica* and 9 cleft in *C. liberica*. The seeds of the Liberian plant are also much larger than are those of the Arabian, are not greenish, and have the groove deeply wrinkled along its edges. The fruit of the coffee plant is a roundish berry, umbilicate at top, at first green, then red, and ultimately dark purple. It is about as large as a cherry, and contains two seeds surrounded by a paper-like membrane, and enclosed in a yellowish-purple matter. These seeds, divested of their coverings, constitute coffee.

This tree is a native of Southern Arabia and Abyssinia, and probably pervades Africa about the

same parallel of latitude as it is found growing wild in Liberia, on the western coast of the continent. About the year 1690 it was introduced by the Dutch into Java, and in 1718 into their colony of Surinam. Soon after this latter period the French succeeded in introducing it into their West India Islands, Cayenne, and the Isles of France and Bourbon.

The tree is raised from the seeds, which are sown in a soil properly prepared, and, germinating in less than a month, produce plants which, at the end of the year, are large enough to be transplanted. These are then set out in rows at suitable distances, and in three or four years begin to bear fruit. It is said that they continue productive for from thirty to forty years. Though almost always covered with flowers and fruit, they yield most largely at two seasons, and thus afford two harvests during the year. Various methods are employed for freeing the seeds from their coverings; but that considered the best is, by means of machinery, to remove the fleshy portion of the fruit, leaving the seeds surrounded only by their papyraceous envelope, from which they are separated by peeling and winnowing mills.

The annual production of coffee for the world is about one million tons, of which the American countries produce in the neighborhood of nine-tenths, Brazil giving to commerce three-fourths of the world's supply. After South America, the chief producer of coffee is Java, that island sending into commerce nearly twice as much as the remaining Asiatic countries. The amount of coffee entering commerce from Africa is small. The character of coffee varies greatly, not only with the climate in which it is grown but with the circumstances of its cultivation and the character of the stock which produces it. The most esteemed varieties are those which are known as *Mocha* and *Java*, but probably the bulk of the berry retailed as Mocha or Java is of South American origin.[1] Coffee improves by age, losing a portion of its strength and acquiring a more agreeable flavor. It is said to be much better when allowed to ripen perfectly on the tree than as usually collected. The grains should be hard, and should readily sink in water. When soft, light, black or dark colored, or musty, they are inferior.

Mussaenda coffee, so called, is not a true coffee, but, according to Lapeyrère, is the seeds of the *Mussaenda borbonica*, or "*wild orange*" of the Island of Réunion, and contains from 0.3 to 0.5 per cent. of caffeine. Dunstan, however, found no alkaloid in the seeds of *M. borbonica*, while according to the botanists of Kew Gardens, the seeds which Lapeyrère examined were really derived from *Gaertnera vaginata*. (*P. J.*, Nov. 1889.) *Senoussi coffee*, which is said to have a fine flavor, is obtained in the Soudan from the *Caffea excelsa*, which reaches the size of a tree.

[1] Julian E. Walter gives the following results of the analyses of several kinds of unroasted coffee; Java, 0.89 per cent. caffeine; Liberian Java, 1.08 per cent. caffeine; Costa Rica, 1.24 per cent. caffeine; Mocha, 0.54 per cent. caffeine; Pea-berry or Fenroll, 0.77 per cent. caffeine; Rio, 1.12 per cent. caffeine. (*Ph. Rec.*, May 5, 1890, 176.) Bertrand (*Bull. des Sci. Pharm.*, iv.) gives the following results of studies of the percentage of caffeine in various coffee berries: In *Coffea arabica* the percentage varied from 0.69 to 1.60. Of species other than the *C. arabica*, *C. canephora* was found to be the richest in alkaloid, the berries yielding 1.97 per cent., while those of the *C. humboldtiana*, Baill., were remarkable by reason of their containing a bitter principle, *cafamarin*, but no caffeine at all, the berries of *C. mauritiana* contained only 0.07 per cent.

Coffee has a faint, peculiar odor, and a slightly sweetish, somewhat austere taste. An analysis by Payen gives for its constituents, in 100 parts, 34 of cellulose, 12 of hygroscopic water, from 10 to 13 of fatty matter, 15.5 of glucose, with dextrin and a vegetable acid, 10 of legumin, 3.5 of *potassium and caffeine chlorogenate*, 3 of a nitrogenous body, 0.8 of free caffeine (see *Caffeina*, p. 252), 0.001 of concrete volatile oil, 0.002 of fluid volatile oil, and 6.697 of mineral substances. (*J. P. C.*, 3e sér., x. 266.) Pfaff recognized, in the precipitate produced by lead acetate with the decoction of coffee, two peculiar principles, one resembling tannin, called *caffe-tannic acid*, and the other an acid, called by him *caffeic acid*. The latter is thought to be identical with the *chlorogenic acid* of Payen. When strongly heated, it emits the odor of roasted coffee, and it is supposed to be the principle to which the flavor of coffee as a drink is owing. A remarkable property of caffeic acid is that, when acted on by sulphuric acid and manganese dioxide, it is converted into quinone, being in this respect analogous to quinic acid. The *sugar* of coffee is a reducing sugar, but is almost completely caramelized in the roasting process, being reduced thereby from 8.5 per cent. to 0.5 per cent. Caffe-tannic acid has been ascertained by Hlasiwetz to be a glucoside with the formula $C_{14}H_8O_7$ and resolvable into glucose and a peculiar crystallizable acid, $C_8H_8O_4$, named by him *caffeic acid* (*J. P. C.*, 1867, 307), and which may be obtained from coffee by boiling a solution of the extract with potassium hydroxide, treating the resulting liquid with sulphuric acid in excess, and extracting the caffeic acid with ether, which yields it somewhat impure by evaporation. (*Ibid.*, January, 1868, 75.) Caffeic acid has the constitution of a dihydroxy-cinnamic acid, and on fusion with potassium hydroxide yields protocatechuic and acetic acids. The *coffee fat*, which ranges in different varieties from 14 to 21 per cent., is, when purified, white, without odor, of a buttery consistence, melting at 37.5° C. (100° F.), and becomes rancid on exposure. According to Rochleder (*Wien. Akad. Ber.*, xxiv. 40), it contains glycerides of palmitic acid and of an acid of the composition $C_{12}H_{24}O_2$.

During the roasting process coffee swells to almost double its original volume, losing from 15 to 23 per cent. of its weight (*Ph. Cb.*, 1850, 687), and acquires a new, peculiar odor and a bitter taste. An active empyreumatic oil (*caffeol*, $C_8H_{10}O_2$) is developed during the process, probably at the expense of a portion of the caffeine. Much of the alkaloid, however, escapes change, and a portion of it is volatilized. The excellence of the flavor of roasted coffee depends much upon the manner in which the process is conducted, and the extent to which it is carried. It should be performed in a covered vessel, over a moderate fire, and the grains should be kept in constant motion. When they have acquired a chestnut-brown color, the process should cease. If too long continued, it renders the coffee bitter and acrid, or, by reducing it to charcoal, deprives it entirely of flavor. During a severe roasting the coffee loses a portion of caffeine, which sublimes, while in a slight roasting it loses none; yet ordinary coffee for drinking, prepared by percolation, contains rather more caffeine when prepared from strongly roasted than from slightly roasted coffee, because the caffeine is more easily extracted from the former. (Herman Aubert. See *A. J. P.*, 1873, 121.) The coffee should not be roasted long before it is used,

and should not be kept in the ground state. Paul and Cownley found in preparing "low and medium roasted" coffee no perceptible loss of alkaloid, while in "over-roasted" coffee the loss amounted to one-third. The average of caffeine in roasted coffee they fix at 1.3 per cent. (*P. J.*, 1887, 822.)

The *leaves* of the coffee plant possess properties analogous to those of the fruit, and are extensively used by the Malays. Stenhouse found them to contain caffeine in larger proportion than the coffee bean, and also caffeic acid. The leaves are prepared for use by drying over a clear fire and then powdering by rubbing in the hands. The powder is made into an infusion like common tea. The taste is like that of tea and coffee combined. (*P. J.*, xii. 443, xiii. 207 and 382, and xvi. 1067.)

According to Paul and Cownley, a cup of coffee (3 fl. oz.), prepared by percolation through half an ounce of coffee, contains a little less than two and a half grains of caffeine. (*P. J.*, April, 1887.) The beverage, coffee, has a tendency to derange digestion and to act upon the bowels, so that in chronic or acute diarrhœa its use frequently has to be forbidden. Its habitual excessive use may give rise to troublesome dyspepsia, to cardiac irritability, or to headache, and even to vertigo. It differs so in its effects from tea, and it is said from the drink made from green coffee, as to indicate that its action depends at least in part on some substance formed during the process of roasting. In 1853 J. Lehmann found that the empyreumatic oil of coffee, *caffeone*, is active, but more recent investigations have yielded contradictory results. Hare and Marshall (*M. News*, Phila., lii.) believed that they proved the empyreumatic oil to be active. E. T. Reichert (*Ibid.*, 1890, lvi.), however, found it in dogs inactive, excepting in so far that when given intravenously it mechanically interfered with the circulation. Binz (*Cb. I. M.*, 1900, xxi.) was only able to produce with it in man a feeble nervous excitement, with restlessness, and increase in the rate and depth of respirations. Caffeone is apparently the same as the empyreumatic volatile oil, *caffeol*, which in 1880 Bernheimer (*M. Chem.*, 1) obtained from roasted coffee and believed to be a methyl derivative of saligenin; besides it and caffeine, Bernheimer obtained from the roasted coffee hydroquinone, methylamine, pyrrol, and acetone. Coffee roasters often add water and a little lard to the hot roasted coffee to increase the weight and gloss the grains. Jaeckle (*Zeitsch. f. Unters. d. Nahrungs. u. Genuss.*, 1898) failed to get caffeol, but in a later investigation Erdman (*A. E. P. P.*, 1902, Bd. 48) secured it as a brown oily substance with a strong odor of coffee and an acid reaction having a specific gravity of 1.0844. From this oil Erdman separates valeric acid, *furane-alcohol*, a peculiar nitrogenous substance having strongly the aroma of coffee, and various phenols; the chief constituent was furane-alcohol, there being at least 50 per cent. of it. Erdmann found that in doses of between 0.5 and 0.6 gramme per kilo of weight, furane-alcohol kills a rabbit by respiratory paralysis, and that the symptoms of poisoning are a short primary excitement, salivation, diarrhœa, respiratory depression, continuous fall of the bodily temperature, and death from collapse with respiratory failure. In man, doses of from 0.6 to 1 gramme of furane-alcohol increased respiratory activity without producing other symptoms. Coffee has been used in times past in various diseases, but as a medicine it has been replaced by caffeine. Roasted coffee, especially in the form of powder, has long been known to have some disinfecting and deodorizing power. Leuderitz has found that this is based upon a feeble influence exerted upon bacteria.

Syrup of coffee is prepared by Dorvault in the following manner: Treat a pound of ground roasted coffee by percolation with boiling water until two pints have passed. Evaporate eight pounds of simple syrup to six, add the infusion, and strain. Two tablespoonfuls of this syrup may be added to a cup of hot water or milk. It is also used with carbonic acid water.

Collinsonia. *Collinsonia canadensis*, L. *Horseweed. Horse-balm. Richweed. Heal-all. Stoneroot. Knot-root. Knob-weed. Guérit-tout, Baume de Cheval*, Fr. *Collinsonie*, G.—A labiate plant, which grows in woods from Canada to the Carolinas. The whole plant has a strong disagreeable odor, and a warm pungent taste. C. N. Lochman (*A. J. P.*, 1885, 228) found in the root a resin, tannin, starch, mucilage, and wax; in the leaves resin, tannin, wax, and volatile oil. The alkaloid discovered by H. J. Lohmann in the root of the *Collinsonia canadensis* appears to have been a magnesium salt. (See *D. C.*, 1902.) It is tonic, astringent, diaphoretic, and diuretic. Collinsonia is said to be locally irritant. A decoction of the fresh root has been used in *catarrh of the bladder, leucorrhœa, gravel*, and *dropsy*.

Cologne. *Spiritus Odoratus. U. S.* 1880. *Perfumed Spirit. Eau de Cologne*, Fr. *Kölnerwasser*, G.—"Oil of Bergamot, *sixteen parts* [or two fluidounces]; Oil of Lemon, *eight parts* [or one fluidounce]; Oil of Rosemary, *eight parts* [or one fluidounce]; Oil of Lavender Flowers, *four parts* [or half a fluidounce]; Oil of Orange Flowers, *four parts* [or half a fluidounce]; Acetic Ether, *two parts* [or two fluidrachms]; Water, *one hundred and fifty-eight parts* [or eighteen fluidounces]; Alcohol, *eight hundred parts* [or six and a half pints], to make *one thousand parts* [or about eight pints]. Dissolve the Oils and the Acetic Ether in the Alcohol, and add the Water. Set the mixture aside, in a well-closed bottle, for eight days, then filter through paper, in a well-covered funnel." *U. S.* 1880.

Cologne water was introduced into the Pharmacopœia of 1880, but was dropped at the 1890 revision. In our opinion a more fragrant spirit, and one more closely resembling the original, would be made if the quantity of oil of orange flowers or *neroli* were doubled.

Colubrina.—*Mabee bark*, yielded by the *Colubrina reclinata*, Brongn. (*Marcorella reclinata*, O.Kze. Fam. Rhamnaceæ) (*Ceanothus reclinatus*, L'Herit.), of South America, has been analyzed by Elborne and Wilson, who find in it a glucoside. It is used in the West Indies as a stomachic. (See *P. J.*, April 11, 1885.)

Colutea. *Colutea arborescens*, L. *Bladder Senna. Baguenaudier, Séné Indigène*, Fr. *Falsche Senna*, G.—A leguminous shrub growing spontaneously in the southern and eastern parts of Europe, and cultivated in gardens. The leaflets are purgative, and in some parts of Europe are used as a substitute for senna, which is said to be sometimes adulterated with them. Barbey (*P. J.*, 1895, 261) isolated *coluteic acid*, which occurs in white crystals, insoluble in water, soluble in alcohol, chloroform, and carbon disulphide. Bladder senna is comparatively very feeble. It is administered in infusion or decoction, of which the *dose* is about half a pint, containing the virtues of from one to three ounces of the leaves.

Commelina.—Under the name of *Yerba del Pollo, Commelina tuberosa*, L., is said to be very largely used in Mexico in the treatment of *internal hemorrhage*, especially from the womb. From thirty to sixty grains (2.0–3.9 Gm.) of the extract may be taken in the course of one day. (See *A. J. P.*, 1897, 290.) The North American species, *Commelina communis*, L., has also had hæmostatic properties attributed to it. For chemical and microscopical study, see *A. J. P.*, July, 1898.

Commiphora. *Commiphora Berryi*, Engl. *Balsamodendron Berryi*, Arn. (Fam. Burseraceæ.) *Mulu Kilivary.*—This Indian thorn yields an abundant gum resin. (*P. J.*, Aug. 1899.)

Comptonia. *Comptonia peregrina* (L.), Coulter (*C. asplenifolia*, Gaertn.). *Sweet Fern. Fern-gale. Meadow-fern.* (Fam. Myricaceæ.)—A shrubby indigenous plant, named from the resemblance of its leaves to the spleenwort fern. It grows in thin sandy or stony woods, from Nova Scotia to North Carolina and Michigan. All parts of it possess a resinous, spicy odor. R. T. Chiles has found in it tannic and gallic acids, volatile oil, extractive, gum, resin, and a substance resembling saponin. (*A. J. P.*, xlv. 306.) H. K. Bowman found it to contain 8.20 per cent. of tannin. (*A. J. P.*, 1869, 193.) It is said to be tonic and astringent; its decoction is used in *diarrhœa*.

Condurango. *Cundurango. Cortex Condurango*, P.G.—This drug some years ago attracted a great deal of attention as a reputed remedy in *cancerous disease*, but further experience has demonstrated its uselessness. It appears, however, to be used largely in South America as an alterative in *chronic syphilis*, has been recognized by the German Pharmacopœia, and so merits a brief notice here. According to an official investigation (*A Report on the Origin and Therapeutic Properties of Cundurango*, by Ruschenberger, Washington, 1873) made by Passed Assistant Surgeon Joseph G. Ayers, U. S. N., there are at least ten different plants known in the republic of Colombia as condurango. The variety which has been used in *cancer*, and which may be considered as genuine condurango, is the *condurango blanco*, the product of an asclepiadaceous vine from ten to thirty feet in length and from one to two inches in diameter. The plant, which has been named *Pseusmagenuetus equatoriensis*, Rusch., is the *Gonolobus Cundurango* of Triana and the *Marsdenia Condurango* of G. H. Reichenbach. The bark is prepared by pounding the stem with a mallet, to separate it, and then drying it in the sun. It is from one-sixteenth to one-sixth of an inch thick, with a smooth external surface of an ash-gray color, diversified with greenish and blackish lichens. When dried on the stem the bark has a darker color. Thomas Antisell (*A. J. P.*, xliii. 289) found in it tannin, extractive matter, and a yellow resin, to which he attributes whatever of virtue the plant may possess. Vulpius (*P. J.*, 1885, 1066) found in it *condurangin*, a substance very closely allied to vincetoxin of Tanret, and, like it, converted by warming when in concentrated solution into a tolerably stiff jelly. For Barthe's method of isolating it, see *A. J. P.*, 1892, 640. Carrara (*A. J. P.*, 1892) obtained from the so-called condurangin of commerce two principles: one insoluble in water, soluble in benzene, a light, almost white, powder, melting at from 60°–61° C. (140°–141.8° F.), and of the composition $C_{20}H_{32}O_6$. Both compounds are decomposed by acids, yielding a brown pitchy substance, insoluble in water. According to Firbas, condurangin in solution can be recognized by freeing from alcohol with gentle warmth, precipitating with a saturated solution of sodium chloride, dissolving the precipitate in chloroform, and adding a liquid composed of equal parts of sulphuric and hydrochloric acids and alcohol. On warming, the mixture assumes a green color, which turns a beautiful greenish-blue on the addition of a trace of ferric chloride. This *Lafon reaction* is given also by adonidin, oleandrin, sapotoxin and digitoxin. *Condurango blanco* seems to have little or no positive physiological action. Gianuzzi and Bufalini, indeed, affirm that it is a convulsant, like strychnine, but Lauder Brunton has shown (*J. P.*, vol. v.) that it has no action upon frogs or rabbits unless the unfiltered solution be injected into the jugular vein, and it would seem probable that the convulsions seen by the Italian observers were the result of cerebral embolisms. Nevertheless, Kobert found condurangin to be a violent poison, causing convulsions followed by paralysis; he believes it to be a mixture of several principles. (*S. Jb.*, 1889, No. 9.) H. Chiriboga states that three drachms of the drug taken by himself in the form of decoction produced considerable activity of the circulation, copious diaphoresis, increased secretion of urine, and even some vertigo and disturbance of vision. Under the name of *Guayaquil condurango* a drug has appeared in the European markets composed of pieces of bark and fragments of woody branches, believed to be derived from an asclepiadaceous plant closely related to the genus Gonolobus. *Mexican condurango* is composed of split stems or thin adherent bark, and is thought to be yielded by an Aristolochia. For full description, see *Ph. Rund.*, May, 1888.

Condy's Fluid.—A solution made by dissolving 53 parts of potassium permanganate and 333 parts of crystallized aluminum sulphate in 777 parts of hot water.

The potassium alum, which crystallizes out when the liquid cools, is separated. The liquid is therefore a solution of the permanganate of aluminum with some aluminum sulphate. It is used as a disinfectant.

Condy asserted that in this disinfecting solution all of the available oxygen in the permanganate is utilized, whereas only 60 per cent. of the oxygen is utilized in the simple alkaline permanganate.

Connarus. *Connarus guianensis*, Lamb. *C. africanus*, G. F. W. Mey. *Seribéle.*—The seeds and root bark of this plant (Fam. Connaraceæ), from French Guinea, are used as tænifuges; two ounces of the seeds in decoction, without straining. (Maclaud, *P. J.*, 1896, 243.)

Contrayerva. *Contrayerba. Contrayerve*, Fr. *Bezoarwurzel, Giftwurzel*, G.—The root of *Dorstenia Contrayerva*, L., of the fam. Artocarpaceæ, a native of Mexico, the West Indies, and Peru. According to Pereira and Martius, the contrayerva of the shops is the product of *D. brasiliensis*, Lam., and is brought from Brazil. The term contrayerba, in the language of the Spanish Americans, signifies *counterpoison* or *antidote*, and was applied to this root under the impression that it had the property of counteracting all kinds of poison. The probability is that the root sold as *contrayerva* is derived from several species of Dorstenia, among which, besides *D. Contrayerva*, two others are mentioned by Houston,

D. Houstoni, L. (not now regarded as distinct from *D. Contrayerva*, L.), and *D. drakena*, L., the former growing near Campeachy, the latter near Vera Cruz.

The root, as found in commerce, is oblong, an inch or two in length, of varying thickness, very hard, rough, and solid, of a reddish-brown color externally, and pale within; and has numerous, long, slender, yellowish fibres attached to its inferior part. The odor is aromatic; the taste warm, slightly bitterish, and pungent. The fibres have less taste and odor than the tuberous portion. The sensible properties are extracted by alcohol and boiling water. The decoction is highly mucilaginous. The tincture reddens infusion of litmus, and lets fall a precipitate on the addition of water. Mussi (*L'Orosi*, 1894, 259) investigated this plant and found two substances, which he called provisionally *cajapine* and *contrayerbine*. Contrayerva is a stimulant tonic and diaphoretic, and has been given in *low fevers, typhoid dysentery*, and *diarrhœa*, and other diseases requiring gentle stimulation.

Dose, of powdered root, half a drachm (2 Gm.). In the root of the *Gaboon ivy* (*Dorstenia klaineans*) Heckel and Schlagdenhauffen have found a coumarin-like body, *pseudocoumarin*. (*Ph. Cb.*, xliii.)

Convallaria Polygonatum, L. (*Polygonatum uniflorum*, Gilib.; now *P. officinale* (L.), All.). *Sealwort. Solomon's Seal. Sceau de Salomon, Genouillet*, Fr. *Weisswurzel, Salomon's Siegel*, G. (Fam. Liliaceæ.)—A perennial, herbaceous European plant, whose root is inodorous. It is said to be emetic. In former times it was used externally in *bruises*, especially those about the eyes, in *tumors, wounds*, and *cutaneous eruptions*, and was highly esteemed as a cosmetic. At present it is not employed. The berries and flowers are said to be acrid and poisonous. *Polygonatum multiflorum*, L. (All.) (*C. multiflora*, L.), which grows both in this country and in Europe, is analogous to the preceding in properties. (See John H. Rauch, *In. Dis.*, 1849.)

Convolvulus. *Convolvulus Panduratus*, L. (Now *Ipomœa pandurata* (L.), Meyer.) *Wild Potato. Man-root. Man of the Earth. Wild Jalap.* The wild potato plant has a perennial root, and a round, purplish, procumbent or climbing stem, which twines around neighboring objects, and grows sometimes twelve feet in height. The leaves, which stand alternately on long petioles, are broad, heart-shaped at the base, entire or occasionally lobed on the sides like a guitar or violin, somewhat acuminate, deep green on the upper surface, and paler beneath. The flowers are in fascicles, upon long axillary peduncles. The calyx is smooth and awnless; the corolla tubular, campanulate, very large, white at the border, but purplish red at the base. The plant is indigenous, growing in the Eastern United States in sandy fields and along fences, and flowering from May to September. A variety with double flowers is cultivated in the gardens for the sake of ornament. The root, which was the official part, is very large, two or three feet in length, about three inches thick, branched at the bottom, externally of a brownish-yellow color, and full of longitudinal fissures, internally whitish and milky, and of a somewhat acrid taste. The wild potato is feebly cathartic and diuretic (*N. Y. Journ. of Med.*, x. 375), useful in *strangury* and *calculous diseases*. Forty grains (2.6 Gm.) of the dried root are said to purge gently.

Copal.—A resinous substance brought from the East Indies, South America, and the eastern and western coasts of Africa, but most abundantly from the first mentioned source. It is the concrete juice of different trees, and is furnished by exudation. The East India copal has been ascribed to the *Vateria indica*, L. (Fam. Dipterocarpaceæ), (*Elæocarpus copalliferus*, Retz., *Vateria acuminata*, Hayne), and the Brazilian, by Martius and Hayne, probably with reason, to different species of Hymenæa (Fam. Leguminosæ). There are some grounds for believing that the East India copal is also the product of a Hymenæa; at least a specimen of this resin was collected by Perottet from the *Hymenæa verrucosa*, Hornem. (*Trachylobium hornemannianum*, Hayne), which he found growing in the Isle of Bourbon. This tree is a native of Madagascar, and probably of the neighboring parts of Africa, and Perottet was informed that the copal of India is taken thither by the Arabs of Muscat, who obtain it from the east coast of Africa. (*J. P. C.*, 3e sér., i. 406.) It is stated by James Vaughan, who was stationed as army surgeon at Aden in Arabia, that copal is taken to that port from the African coast, opposite the island of Zanzibar, where it is said to be dug up from the earth. (*P. J.*, xii. 385.) Playfair, British consul at Zanzibar, has sent to the Kew Museum specimens of the bark of a tree, with the resin *in situ*, and specimens of the collected resin, and of the fruit of the tree, which leave little doubt that the Zanzibar copal is obtained from *Hymenæa mozambicensis* (*Trachylobium mossambicense*, Klotzsch; now *T. hornemannianum*, Hayne). In a communication from John Kirk, dated Zanzibar, March 20, 1865, it is stated that the smooth copal exported from that region is obtained from *Trachylobium mossambicense*, Klotzsch, a small tree or bush, distinguished by its rounded head of glossy leaves, with groups of white flowers at the ends of the branches. The trunk and limbs are covered with a clear resinous exudation, portions of which, after solidifying, drop to the ground and are collected, while other portions are broken from the tree. This kind of resin is always smooth, and is exported to India. Another variety, with an indented goose-flesh surface, known in the English market as *animé*, is dug from the earth, and though the product of forests now extinct, originated probably from the same tree. (*P. J.*, 1869, 654.) W. F. Daniell (*P. J.*, xvi. 369 and 423) has given an account of several varieties of copal produced on the coast and interior parts of Western Africa, from Sierra Leone to Angola and Benguela. Those from Sierra Leone, which are most highly valued for their superior hardness and transparency, are said by Daniell to be derived from the *Guibourtia copallifera* of Bennett (*Copaifera guibourtiana*, Benth.), a large leguminous tree, growing preferably in mountainous regions, and very nearly related, botanically, to the *Hymenæas* which produce copal in other regions. The drug is mostly collected, not from the tree itself, but from the beds and borders of streams, into which it is washed down, during the rains, from the hillsides, in the soil of which it had been deposited.

The commercial product known as *Manila copal*, according to Tschirch and Koch, is derived from *Agathis Dammara*, Rich. (*Dammara orientalis*, Lamb.), a conifer. It consists chiefly of free amorphous resin acids, namely, *alpha-* and *beta-mancophalolic acid*, $C_{10}H_{18}O_2$ (about eighty per

cent.), and contains besides about 12 per cent. of a resin, $C_{20}H_{32}O_2$, and about five per cent. of essential oil. The latter, when fresh, forms a liquid as clear as water, very mobile, having a pleasant odor, and the sp. gr. 0.840; it boils at from 165° to 170° C. (329°–338° F.), and mixes in all proportions with alcohol, ether, chloroform and fatty oils.

Copal varies in appearance and properties as procured from different sources. It is in roundish, irregular, or flattish pieces, often rough over the surface, probably from the impression of sand in its soft state, colorless, yellowish, or brownish yellow, more or less transparent, very hard, with a shining, conchoidal fracture, inodorous and tasteless, of a sp. gr. varying from 1.045 to 1.139, insoluble in alcohol, partially soluble in ether, and slightly so in oil of turpentine. Some varieties unite with alcohol, if suspended in its vapor while boiling. By heat it melts and emits gases, loses from 15 to 20 per cent. of weight, and is altered so as to become more soluble in ether, alcohol, and oil of turpentine, and in this way copal varnishes are usually made. It is not a proximate principle, but consists of various resins united in different proportions. According to Unverdorben and Filhol, some five different resins can be obtained by the successive action of solvents. On the distillation of copal, an oil is obtained of the composition $C_{10}H_{16}$, boiling at from 160° to 165° C., and sp. gr. 0.965, together with an oxygenated oil, showing it to have arisen from the oxidation of various terpenes, $C_{10}H_{16}$. (For an account of the present views on the nature of copal resins see Tschirch, *Die Harze und die Harzbehälter*, Leipzig, 1900.) The East India or African copal is described by Schindler as of a globular form, softer and more transparent than the other varieties, with a surface always clear, and having an agreeable odor when heated. It is readily and freely dissolved by the oils of turpentine and rosemary when pure, but not by these fluids when rendered resinous by age. It is more readily fusible than the others, and makes the best varnish. The West India copal is in flat pieces, seldom weighing more than three ounces, rarely containing insects, very hard, of a rough appearance, of a yellowish color, and without odor or taste. It is much less readily dissolved by oil of turpentine than the East India variety, swells but does not dissolve in oil of rosemary, and is slightly soluble in absolute alcohol. A third kind, probably also American, is in convex or concave pieces, about a pound in weight, often containing insects and other impurities. In solubility it resembles the last mentioned variety, in fusibility is intermediate between it and the East Indian, and is altogether inferior. (*P. J.*, 1850.) The African or Sierra Leone copal is described by Daniell as occurring "in small round tears, or irregular conical and smooth nodulated masses, seldom exceeding in size an ordinary duck egg. They are covered, to a greater or less extent, by a peculiar white efflorescence, which increases by age. Their color graduates from a pale green to a lemon or dull yellow." (*Ibid.*, xvi. 369.) Welwitsch states that this drug is mostly found in sandy soil, in the hilly districts, along the whole coast of Angola, where its prevalence coincides with that of *Adansonia digitata*, L. (Fam. Malvaceæ.) It is dug from the earth, or found in spots where it has been collected by the washing of the rains, or laid bare by earth-falls, and the quantity annually collected in this region, and exported from Benguela, was at one time very large. The surface, like that described by Daniell, is covered with a whitish earthy crust, sometimes exhibiting veins or network, probably produced by attrition in their conveyance by floods. (*A. J. P.*, 1866.)

Inhabane copal has been shown to be the product of *Copaifera gorskiana*, Benth. (Fam. Leguminosæ), and seeds sent to Kew Gardens in 1886 germinated, and the plant has been widely introduced into both the East and West Indies, and into Australia. (*P. J.*, xix. 508.)

Crude and *scraped* copal are known in the market; the former of a dull opaque appearance externally, the latter much clearer and more transparent, in consequence of being deprived of its outer coat. The process of *scraping* is said to consist in the removal of the exterior portion by means of an alkaline solution, which readily dissolves copal. This resin is used chiefly in making varnishes. H. Violette states (*A. J. P.*, 1863, 140) that certain varieties of copal used for varnish, which are not naturally soluble in ether, oil of turpentine, benzin, petroleum, etc., become soluble in these menstrua, whether cold or hot, by being heated in close vessels to the temperature of from 176.7° to 204.4° C. (350° to 400° F.), and thus yield excellent varnishes without loss of matter; and the same resin, heated as above with one-third of linseed oil and three-fourths of oil of turpentine, gives directly a clear, limpid, slightly yellowish varnish, fit for the most delicate uses. (*J. P. C.*, 4e sér., iv. 284.) Edison found aniline oil a good solvent for copal.

Copper Acetate. *Cupri Acetas. U. S.* 1880. $Cu(C_2H_3O_2)_2.H_2O = 198.14$. *Crystallized verdigris. Crystals of Venus. Verdet, Cristaux de Vénus*, Fr. *Essigsaures Kupfer, Aerugo crystallisata, Crystallisirter Grünspan*, G.—This salt may be prepared by dissolving verdigris in acetic acid, or by precipitating a concentrated solution of lead acetate with copper sulphate. It is the normal cupric acetate, as distinguished from the basic salt. "Deep-green, prismatic crystals, yielding a bright green powder, efflorescent on exposure to air, odorless, having a nauseating, metallic taste and an acid reaction. Soluble in 15 parts of water and in 135 parts of alcohol at 15° C. (59° F.), in 5 parts of boiling water and in 14 parts of boiling alcohol. When heated above 100° C. (212° F.), the salt loses its water of crystallization, and at a temperature above 200° C. (392° F.), it is gradually decomposed. The aqueous solution of the salt has a bluish-green color, which is rendered deep blue by an excess of ammonia. On heating the salt with sulphuric acid, acetous vapors are evolved. If the aqueous solution of the salt be treated with hydrogen sulphide until all the copper is precipitated, the filtrate should leave no residue on evaporation (alkalies, alkaline earths, and iron). If the aqueous solution be heated to boiling with solution of soda in excess, it will yield a filtrate which should not be clouded by hydrogen sulphide (absence of lead, zinc)." *U. S.* 1880.

Verdigris. Impure Subacetate of Copper, U. S. 1870. *Copper Subacetate. Viride Æris, Ærugo*, Lat.; *Acétate de Cuivre brut, Sous-acétate de Cuivre, Vert-de-gris, Acétate basique de Cuivre, Verdet gris*, Fr. *Grünspan, Spangrün, Basisches Essigsaures Kupfer, Kupferoxyd*, G.; *Verde Rame*, It.; *Cardenillo*, Sp.—This basic salt is prepared in the south of France, more particularly in the neighborhood of Montpellier. It is also manufac-

tured in Great Britain and Sweden. In France the process is conducted in the following manner. Sheets of copper are stratified with the residue of the grape after the expression of the juice in making wine, and are allowed to remain in this state for a month or six weeks. At the end of this time the plates are found coated with a considerable quantity of verdigris. This is scraped off, and the plates are then replaced as at first, to be further acted on. The scrapings thus obtained form a paste, which is afterwards well beaten with wooden mallets, and packed in oblong leathern sacks, about ten inches in length by eight in breadth, in which it is dried in the sun, until the loaf of verdigris, as it is called, attains the proper degree of hardness. The rationale of the process is easily understood. The juice of the grape refuse undergoes the acetous fermentation, and the acetic acid attacking the copper forms the subacetate. In England a purer verdigris is prepared by alternating copper plates with pieces of woollen cloth steeped in pyroligneous acid. Verdigris comes to this country exclusively from France, being imported principally from Bordeaux and Marseilles. The importation for 1904 amounted to 59,843 lbs., valued at $7,750. It occurs in masses of a pale green color, and composed of a multitude of minute silky crystals. Sometimes, however, it occurs of a bright blue color. Its taste is coppery. It is insoluble in alcohol, and, by the action of water, a portion of it is resolved into the neutral acetate which dissolves, and the tribasic acetate which remains behind in the form of a dark green powder, gradually becoming black. It is hence evident that, when verdigris is prepared by levigation with water, it is altered in its nature. When verdigris is acted on by sulphuric acid, it is decomposed, vapors of acetic acid being evolved, easily recognizable by their vinegar odor. It is almost entirely soluble in ammonia, and dissolves in hydrochloric and diluted sulphuric acids, with the exception of impurities, which should not exceed 5 per cent. When of good quality, it has a lively green color, is free from black or white spots, and is dry and difficult to break. The green rust, called in popular language verdigris, with which copper vessels are very frequently coated, when not kept clean, is a copper carbonate, and should not be confounded with true verdigris. Verdigris, apart from its impurities, is a variable mixture of the basic copper acetates.

The *blue* variety has approximately the composition $(C_2H_3O_2)_2Cu,Cu(OH)_2 + 5H_2O$. When treated with water it is gradually decomposed into two parts, according to the reaction:

$$3(Cu(C_2H_3O_2)_2.Cu(OH)_2) = Cu(C_2H_3O_2)_2. 2Cu(OH)_2 + 2Cu(C_2H_3O_2)_2.Cu(OH)_2$$

The latter of these products constitutes the *green* variety of verdigris. (Flückiger, *Pharm. Chem.*, 758.) The local and general action of verdigris upon the animal economy and the treatment of its poisoning are the same as those of copper sulphate. It is not used internally.[1]

Copper Ammonio-sulphate. *Cuprum Ammoniatum. Ammoniated Copper. Cuprum Sulfuricum Ammoniatum. Sulfate de Cuivre ammoniacal, Cuivre ammoniacal,* Fr. *Schwefelsaures Kupferoxyd-Ammoniak, Ammoniakalisches Kupfersulfat, G.*—"Take of Copper Sulphate *half a troyounce;* Ammonium Carbonate *three hundred and sixty grains.* Rub them together in a glass mortar until effervescence ceases. Then wrap the Ammoniated Copper in bibulous paper, dry it with a gentle heat, and keep it in a well-stopped glass bottle." *U. S.* 1870.

When the two salts above mentioned are rubbed together, a reaction takes place between them, attended with the elimination of the water of crystallization of the copper sulphate, which renders the mass moist, and with the simultaneous escape of carbon dioxide gas from the ammonium carbonate (sesquicarbonate), which occasions an effervescence. The color is at the same time altered, passing from the light blue of the powdered copper sulphate to a beautiful deep azure. The nature of the chemical changes which take place in the formation of what is commonly called "ammoniated copper" depends somewhat upon the conditions of action. When anhydrous cupric sulphate is exposed to the action of dry ammonia gas, the mass becomes heated, and a deep blue powder, $CuSO_4 + 5NH_3$, results, which on exposure to the air is capable of exchanging the 5 molecules of ammonia for a corresponding amount of water. If, however, one part of powdered cupric sulphate be added to three parts of ammonia solution (sp. gr. 0.960), and after the subsidence of any ferric hydroxide present as impurity, six parts of alcohol be added to the clear liquid, crystals will be formed of the composition $Cu(NH_3)_4SO_4 + H_2O$. If this preparation be allowed to remain exposed to the air, it will lose ammonia and water, and be changed into a mixture of basic sulphates. Ammoniated copper sulphate loses two molecules of NH_3 and the one molecule of water at 150° C. (302° F.), and at 260° C. (500° F.), only anhydrous sulphate remains, which frequently, however, contains cuprous oxide.

This salt has a beautiful deep azure-blue color, a strong ammoniacal odor, and a styptic, metallic taste. It is soluble in water, and the solution has an alkaline reaction on vegetable colors; but, unless there is excess of ammonium sesquicarbonate, the solution deposits copper subsulphate if much diluted. When exposed to the air it parts with ammonia, and is said to be ultimately converted into ammonium sulphate and copper carbonate. This change is apt to occur, to a greater or less extent, while it is drying. It should not, therefore, be prepared in large quantities at a time, and should be kept in well-closed bottles. By heat the whole of it is dissipated, except the copper oxide. Arsenic trioxide precipitates a green copper arse-

[1] *Linimentum Æruginis, Mel Ægyptiacum, Unguentum Ægyptiacum.*—This is an old preparation, formerly official in Great Britain. The following is the process for it given in the old London Pharmacopœia: "Take of Verdigris (Subacetate of Copper), in powder, *an ounce;* Vinegar *seven fluidounces;* Honey *fourteen ounces.* Dissolve the Verdigris in the Vinegar, and strain through linen; then gradually add the Honey and boil down to a proper consistence." The ounces used here are troyounces. It sometimes happens, during the boiling of the acetic solution of the verdigris, that a red deposit rapidly forms, consisting of the red or suboxide of copper (cuprous oxide); and that at the end of the process little or none of the metallic salt remains. This happens especially when granular or old honey is employed. (Harley, *P. J.*, xi. 357.) The change is owing to the decomposition of the cupric oxide by the grape sugar of the honey, converting it into cuprous oxide. The inference is that, in making the preparation, so as to fulfil the objects of the original prescription, simple syrup should be used. It was formerly employed, either undiluted or mixed with some mild ointment, to destroy *fungous granulations* or to repress their growth. In the latter state it acts as a stimulant to *flabby, indolent,* and *ill-conditioned ulcers;* and, largely diluted with water, it has been used as a gargle in *venereal ulcerations* of the mouth and throat. It is sometimes also applied undiluted, by means of a camel's-hair brush.

nite from its solution. Solutions of potassium and sodium hydroxides, lime water, and the acids are incompatible with it. Ammoniated copper was formerly much employed in *epilepsy, chorea, hysteria,* etc. It is at present very seldom exhibited. In overdoses it produces vomiting, and the poisonous effects which result from the other preparations of copper. *Dose,* in pill or solution, a quarter or half a grain (0.016–0.032 Gm.), twice a day, and gradually increased to four or five grains (0.26 or 0.32 Gm.).

Copper Arsenite. *Cupri Arsenis. Scheele's Green.*—This salt was brought forward for the purpose of treating *diarrhœa* on the homœopathic principle, in the *Symptomen-Codex* of Jahn, in 1865, and has been greatly lauded by John Aulde and other regular practitioners in the treatment of *diarrhœa, enterocolitis, cholera morbus,* and *dysentery.* It is to be given in doses of from one-three-thousandth to one-two-thousandth of a grain (0.000022–0.000033 Gm.), at intervals of from ten to twenty minutes, until some effect is produced. It does not seem to be sustaining its first reputation. According to H. A. Hare copper arsenite is a valuable remedy in *anœmia; dose,* one-twentieth grain (0.003 Gm.).

Copper Iodide. *Cupri Iodidum. Cuprous Iodide. Kupferjodür,* G.—A white powder, insoluble in diluted acids and in water; soluble in ammonia water and solution of potassium iodide. Made by adding a solution of potassium iodide to a solution of copper and iron sulphates.

Copper Nitrate. *Cupri Nitras. Br.* 1885. *Cupric Nitrate.* $Cu(NO_3)_3,3H_2O$.—"May be obtained by dissolving copper in diluted nitric acid and evaporating the solution until crystallization takes place on cooling to a temperature not lower than 70° F. (21.1° C.)." *Br.* 1885. This salt was introduced in the 1885 revision of the British Pharmacopœia, to be dropped in 1898. As obtained by the above process, the crystals are prismatic and of a deep blue color, and very deliquescent and corrosive. At a temperature below 70° F. (21.1° C.), with one-third of its weight of water it forms tabular crystals which have the composition $Cu(NO_3)_2,6H_2O$. The addition of a very little more water causes the crystals to form a styptic and caustic fluid. The diluted aqueous solution should show only a faintly acid reaction to litmus-paper. This salt has the physiological and medicinal properties of copper sulphate, and may be used in the same dose.

Copper Nucleinate. *Cuprol.*—This salt is a greenish powder and is said to contain 6 per cent. of the metal and to be readily soluble in hot water and not to be thrown out of its solution by alkalies and not to precipitate with albuminous liquids. It is used in 10 per cent. solution with one-half per cent. of chloretone as a preservative. It has been highly recommended in the treatment of *trachoma* and other conditions of the conjunctiva. The assertion is made that it has greater penetrating powers and produces less irritation than ordinary salts of copper. (Von Sicherer, *Die Ophthal. Kl.,* 1901.)

Copper Oxide, Black. *Cupri Oxidum Nigrum. Cuprum Oxydatum. Oxyde noir de Cuivre, Safran de Vénus,* Fr. *Kupferoxyd,* G.—*Cupric oxide,* CuO, is obtained most conveniently by heating to redness the nitrate. This oxide, in the form of ointment, made by mixing four parts with thirty of lard, has been locally used twice a day to remove *chronic indurations of the glands.* (Hoppe, *Ann. Thér.,* 1855.) It is also asserted to be an active *tænicide* of very feeble toxic power. It is given by Dörr in *doses* of one and a half grains (0.096 Gm.) four times a day for several days, the last dose followed by castor oil. (See *Ther. Geg.,* 1901.)

Copper Phenolsulphonate. *Cupri Phenolsulphonas. Copper Sulphocarbolate. Paraphenolsulfosaures Kupfer,* G. $(C_6H_4(OH)SO_3)_2Cu + 5H_2O$.—Green prismatic crystals soluble in water and alcohol. Made by reaction between copper sulphate and barium phenolsulphonate. Used externally as an antiseptic (1 to 100 or 200) solution in *gonorrhœa* and *blennorrhœa.*

Coptis. *Goldthread. Coptide,* Fr. *Gelbe (Kleinste) Niesswurz,* G.—The slender, bright yellow root of the ranunculaceous plant *Coptis trifolia* (L.), Salisb., was formerly official in the U. S. Pharmacopœia. It inhabits the northern region of this continent and of Asia, and is found in Greenland and Iceland. It delights in the dark shady swamps and cold morasses of northern latitudes and alpine regions, and abounds in Canada and in the hilly districts of the Northern United States.

Dried goldthread, as brought into the market, is in loosely matted masses, consisting of the long, thread-like, orange-yellow roots, frequently interlaced, and mingled with the leaves and stems of the plant. It is without odor, and has a purely bitter taste, unattended with aroma or astringency. It imparts a bitterness and yellow color to water and alcohol, but most perfectly to the latter, with which it forms a bright yellow tincture. The infusion is precipitated by silver nitrate and lead acetate. (Bigelow.) It affords no evidence of containing either resin, gum, or tannin. The plant undoubtedly contains *berberine,* which, according to F. F. Mayer (*A. J. P.,* 1863) and E. Z. Gross (*Ibid.,* 1873), is associated with another alkaloid. Gross states that *coptine* differs from berberine in its colorless crystals, and by forming with *mercuric potassium iodide (Mayer's reagent)* a crystalline instead of flocculent precipitate. See also John J. Schulz (*A. J. P.,* 1884, 261). C. W. Burr detected starch in *Coptis trifolia.* (*A. J. P.,* 1884, 31.) Goldthread is a simple tonic bitter, bearing a close resemblance to quassia in its mode of action, and applicable to all cases in which that medicine is prescribed, though, from its higher price, not likely to come into general use as a substitute. In New England it is employed as a local application in *aphthous ulcerations* of the mouth, but it probably has no other virtues in this complaint than such as are common to the simple bitters. It may be given in substance, infusion, or tincture. The *dose* of the powder is from ten to thirty grains (0.65–2.0 Gm.), or of a tincture made with an ounce of the root to a pint of diluted alcohol, one fluidrachm (3.75 Cc.).

The *Coptis Teeta* of Wallich, which grows in the mountainous regions bordering on Assam, is much used as a tonic by the natives and by the Chinese. It is analogous in properties to *C. trifolia,* and is said to contain 8½ per cent. of berberine. It has been brought into use in British India. It is highly commended by Twining as a stomachic tonic. (*P. J.,* 1870, 161.) *Coptis anemonifolia,* Lieb. and Zucc., is said to contain berberine, and has been used in Japan in *intestinal catarrh.* (*Sei-i-Kwai,* 1892.)

Coral. *Corail,* Fr. *Koralle,* G.—The solid mesodermal calcareous skeletons of the coral polyps, *anthozoa,* were formerly used in medicine, but

have passed out of vogue. Their chief constituent is calcium carbonate, colored by ferric oxide, and united with more or less animal matter.

Corallin. *Pœonin.*—A coloring or dyeing material, derived from *rosolic acid* or *aurin* ($C_{19}H_{14}O_3$), which is itself derived from *phenol* or *carbolic acid* by the joint action of sulphuric and oxalic acids upon it. It is formed by exposing together rosolic acid and alcoholic ammonia to a heat of 149° C. (300.2° F.), and is considered to be an intermediate product between pararosaniline and pararosolic acid. A solid substance is thus obtained, in scales of a peony redness, with reflected green or dull yellow rays, almost insoluble in water, soluble in alcohol and the fixed oils. Ambrose Tardieu, having met with some extraordinary cases of a severe vesicular eruption upon the feet, attended with violent inflammation and swelling, and with general febrile symptoms, attributed to the wearing of red socks, found that these socks yielded nothing to water, cold or hot, feebly acidulated or alkaline, but did give up their red coloring matter to boiling alcohol of 85°. By evaporating the alcoholic solution thus made, an extract was obtained, whose alcoholic solution given hypodermically caused death in various lower animals. An alcoholic solution of pure corallin was then injected. A dog was killed by twenty centigrammes (about three grains), a rabbit by half the quantity, and a frog by five centigrammes, or less than a grain. In the dog and rabbit there was violent purgation, with intense fever and progressive prostration, and the leg of the side in which the injection had been made was very painful. After death the neighborhood of the wound was found suppurating, the stomach sound, and the intestines distended, with signs of violent inflammation of the mucous membrane; the liver presented evidences of fatty degeneration and the lungs appeared as if dyed by the scarlet coloring matter. Roussin succeeded in extracting a portion of the coloring matter from the lungs and liver, and dyeing with it a skein of silk. These experiments are very interesting from a medico-legal point of view, as corallin might be readily detected in this way, if at any time, accidentally or otherwise, the cause of fatal results. Hitherto the effects on the human subject have been confined to the painful cutaneous affection, which has been so satisfactorily traced to contact of the skin with the silk fabrics dyed with it; but even in these cases there were serious constitutional symptoms, as fever, headache, giddiness, and nausea. (*J. P. C.*, 1859, 262.)

Local poisoning may be caused by aniline red as well as by corallin. The two colors may be distinguished in tissues. *Aniline red* disappears very rapidly by contact with ammonia; but the color reappears by the addition of an acid, or by the evaporation of the alkali. *Corallin red* is not dissolved by cold water, yields a slight color to boiling water, but rapidly disappears from the tissue under the action of boiling alcohol. Alkalies brighten the color without changing it: acids precipitate the coloring matter in yellow flakes. (*Ibid.*, 1869, 371.) Some observers later than Tardieu believe that pure corallin is not poisonous, and that the symptoms have been produced by arsenic or other contaminating substances. (See *M. T. G.*, 1869, 421; *P. J.*, 2d ser., xi. 360; also *N. Y. M. J.*, 1870, 599; *N. R.*, i. 288.)

Corallorhiza. *Corallorhiza odontorhiza* (Willd.), Nutt. *Coral-root.* (Fam. Orchidaceæ.)—This is a parasitic leafless herb, sending up from a coral-like rhizome a simple scape or flower stem, from six to sixteen inches high, furnished with sheaths instead of leaves, of a light brown or purplish color, and bearing small, greenish-brown flowers in a long spike. The plant grows throughout the United States east of the Mississippi. The rhizome is the part used. It is much branched and toothed, and of a brown color, and from its resemblance to coral gave name to the plant. It has a strong peculiar odor, and an astringent bitterish taste. It is much valued by the eclectics as an energetic diaphoretic, destitute of general stimulant properties. It is given in *fevers; dose* of powder, thirty grains (2 Gm.) every two hours.

Cordol. *Tribromsalol.* $C_6H_4.OHCOO.C_6H_2Br_3$. A white, tasteless, and odorless powder, insoluble in water, ether, and alcohol, freely soluble in chloroform and glacial acetic acid. *Cordyl* or *acetyl tribromsalol* is insoluble in water, and occurs in the form of fine white needles. *Cordeine* or *methyl tribromsalol* occurs in small white crystals, which are insoluble in water, but soluble in alcohol and chloroform. Cordol, cordyl, and cordeine are said to be hypnotics which have the advantage of being almost tasteless. The *dose* of either is from eight to fifteen grains (0.5–1.0 Gm.).

Coriaria. *Coriaria myrtifolia*, L. *Currier's Sumach. Redoul, Sumach des Corroyeurs*, Fr. *Gerberstrauch*, G. (Fam. Coriariaceæ).—This is a shrub growing wild in Southern Europe, which is sometimes cultivated in gardens on account of its handsome foliage. The leaves, which are used for dyeing black, were at one time employed to a considerable extent in France in the adulteration of senna. The fruit, resembling berries in form, are black, and about the size of a pea. Both these and the leaves are poisonous in large doses, and several instances of death are on record from eating the fruit. (Mérat and De Lens.) Riban has discovered in the fruit *coriamyrtin*. This is in the form of white crystals, inodorous, excessively bitter, and extremely poisonous. It fuses at 220° C. (428° F.), and crystallizes again on cooling. It is but slightly soluble in water, hot or cold, but freely so in alcohol, ether, chloroform, and benzol. Its composition is represented by the formula $C_{30}H_{36}O_{10}$. It ranks with the glucosides, as when boiled with diluted hydrochloric acid at least three decomposition products are formed, of which one separates in yellow flocks, while the solution reduces alkaline copper solutions. About three grains caused in a dog vomiting, severe convulsions, and death in an hour and a quarter. Riban obtained it by treating the juice of the fresh or an infusion of the dried fruit and leaves at first with lead acetate, then with hydrogen sulphide to throw down the lead, concentrating the filtered liquid to a syrupy consistence, and agitating this with ether, which extracted the poison, and yielded it on evaporation. (*J. P. C.*, 1864, 487.)

Tlolocopetale, a Mexican drug, is said to be the product of a Coriaria, probably *C. myrtifolia*, containing *coriarin* and *coriamyrtin*, and to be actively poisonous.

Toot-poison. Tu-tu.—In New Zealand a poisonous plant, known as the *toot-plant*, has proved very destructive to the domestic animals. W. Lauder Lindsay found it to be the *Coriaria ruscifolia* of Linnæus (*C. sarmentosa*, Forst.), and in its action on the system to be an irritant narcotic. For an elaborate account of the *toot-plant*, and its poisonous effects, see *Brit. and For. Med.-Chir. Rev.*, 1865, 153, and 1868, 465. From these it appears that more than one species of Coriaria

inhabit New Zealand, *C. thymifolia*, Humb. et Bonpl., and *C. angustissima*, Hook. f., besides the *ruscifolia;* though Lindsay appears to think that the two former may be merely varieties of the third. It is not only cattle that are poisoned by the plant, but not infrequently also children, and occasionally even an adult. The cattle are probably, in general, poisoned by eating the young shoots. W. S. Key attributes poisonous qualities to an oil (*Chem. News*, 1890, xxii.), but it has been shown by T. Hill Easterfield and B. C. Aston that the three New Zealand species of coriaria contain a glucoside, *tutin*, $C_{17}H_{20}O_7$, which is not identical with coriamyrtin, and which, according to Marshall, is toxic especially to the medulla oblongata and the basal ganglia of the brain. (*Proc. Chem. Soc.*, xvi. 213.) It is affirmed by T. H. Hustwick (*P. J.*, vol. xv. 22) that goats are not poisoned by the tu-tu, and have even been used to eradicate the plant by browsing, also that the berries when ripe are not only not poisonous to man, but, if care is taken to reject the seeds, are a grateful and refreshing fruit. The prominent symptoms of the poisoning in man are giddiness, stupor, and coma, with or without delirium or convulsions. Occasionally the delirium resembles that of alcoholic intoxication, in other instances approaches that of acute mania, and is attended with violent muscular action. Loss of memory is characteristic of the convalescence.

Cork. *Suber. Liége*, Fr. *Kork*, G.—The great use made of this substance in pharmacy and the arts justifies a brief notice of it. It is chiefly produced by *Quercus Suber*, L. (Fam. Cupuliferæ), but is obtained also from the *Q. occidentalis*, F. Gay, and from *Q. pseudosuber*, Santi. It consists of the exterior layers of the bark beneath the epidermis, which acquire in these species an extraordinary development, becoming thick, and of that peculiar spongy consistence which characterizes cork. The tree begins to yield cork when fifteen or sixteen years old, and every six or eight years furnishes a fresh supply, even for a century and a half, before it perishes, that interval of time being required for the renewal of the suberose layers by the living portions of the bark beneath. There are four constituent layers of the bark: the epidermis, within this the cork, next the cellular envelope, and lastly the liber which lies upon the wood. Each of these increases year by year; but the cork thus naturally produced is not valued. The commercial product is obtained by an artificial process. The exterior layers are removed, and the liber exposed. In the interior of this, at a variable distance from the surface, a layer of the proper cork is now formed, apparently by a change in the substance of the liber, the outer portions of which perish, while annually a new layer is added to the cork already existing, until it acquires a thickness which will justify its removal. Incisions are made in such a way that the cork is removed in large concave plates, which are then flattened under pressure, and dried. At present cork comes into commerce from Portugal, Spain, France, Italy, Tunis, Algeria, and Morocco. About one million of quartels of it are said to be produced annually.

A cork has recently come into the United States commerce from Nicaragua. It has been found by E. F. D. Baker to be obtained from the roots of the *Anona*, a tree closely resembling in appearance the ordinary cottonwood of the United States.

In selecting cork for use, those parts should be preferred which are soft and of uniform consistence, and in the choice of the larger plates those should be selected which are thick, flexible, elastic, finely porous, and of a reddish color. Boiling hot alcohol extracts from rasped cork tissue some 10 per cent. of soluble principles. From the hot alcohol solution a substance crystallizes which was first noticed by Chevreul under the name of *cerin*. According to Kugler (*Dissertation on Suberin*, Halle, 1884), besides cellulose and lignocellulose, cork contains two constituents, *cerin*, to which he gives the formula $C_{20}H_{32}O$, and *suberin*, which is a fat, and contains stearic acid and *phellonic acid*, $C_{22}H_{42}O_3$. This constituent, suberin, prevents the penetration of liquid into the cork, and is only extracted by alcoholic alkali solutions. When treated with nitric acid, cork yields a peculiar acid, which has been denominated *suberic acid*. This is a dibasic acid homologous with oxalic acid, and has the formula $C_8H_{14}O_4$. It is formed by the oxidation of many other substances, such as the oils from linseed, castor bean, cocoa nut, almond, spermaceti, etc.

Stanislaus Martin has called attention in France to the use of refuse corks in Paris, where they are collected by the scavengers, and sold to persons whose business it is to revive them, recutting such as are of unsuitable shape, filling up the interstices with mastic, and covering them over with some powder which may give them a fresh and proper appearance. In consequence of the high price of cork, those which are thus prepared over again are said to be used in the bottling of beverages. Corks are sometimes bleached with sulphurous acid, and the odor of hydrogen sulphide has been noticed in prescriptions which have been compounded, when such corks have been used in the dispensing bottle. (*P. J.*, 1881, 1080.) Mohr has found that old corks may be regenerated by allowing them to soak for twenty-four hours in hot water, washing well several times, allowing to stand for a few hours in a mixture of one part of hydrochloric acid and fifteen parts of hot water, and finally washing well in pure water. (See also *A. J. P.*, 1875, 467.) It is easy to conceive that a cork at one time used to enclose arsenical or other deadly solution may become saturated with the poison, and afterwards impart enough of it to another liquid, if not to produce dangerous effects on the health, at least to give to tests evidence of its presence, and thus lead to serious suspicions. No cork, therefore, which has been used in a bottle containing a poisonous substance should be employed a second time.

Cornus. *Dogwood. Ecorce de Cornouiller à grandes fleurs*, Fr. *Grossblüthige Cornelrinde*, G.—Under the name of Cornus, the U. S. Pharmacopœia formerly recognized the bark of the root of *Cornus florida*, L. (Fam. Cornaceæ), the only American species of the genus which attains the size of a tree.

The barks of two other indigenous dogwoods are sometimes substituted for that of *C. florida*, L. Each of these is a shrub with opposite leaves, the flowers in flat spreading cymes, and the fruit globular and blue. *C. circinata*, L'Her., is further distinguished by its branches being greenish and warty; its leaves round-oval, abruptly pointed, and woolly underneath. *C. Amomum*, Mill. (*C. sericea*, L.), is to be recognized by its purplish branches, and by the fact that the branchlets, stalks, and lower surface of the elliptical pointed leaves are silky and downy.

These dogwoods are found in all portions of the United States east of the Mississippi.

Dogwood bark was used many years ago as an antiperiodic in *intermittent fever*, but it is only a feeble, astringent tonic. Formerly from one to two ounces of the powder were given in the interval between the paroxysms of intermittent fever, and the U. S. Pharmacopœia recognized the fluidextract, and gave in the edition of 1880 the following formula for its production: "Cornus, in No. 60 powder, *one hundred grammes* [or fifty ounces av.]; Glycerin, *twenty grammes* [or seven and a half fluidounces]; Diluted Alcohol, *a sufficient quantity*, to make *one hundred cubic centimeters* [or three pints]. Mix the Glycerin with *eighty grammes* [or forty-one fluidounces] of Diluted Alcohol. Moisten the powder with *thirty grammes* [or fifteen fluidounces] of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Cornus is exhausted. Reserve the first *eighty-five cubic centimeters* [or forty fluidounces] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or three pints]." *U. S.* 1880. The *dose* of this fluidextract was from half a fluidrachm to a fluidrachm (1.8–3.75 Cc.).

Cornutine Citrate. *Cornutinæ Citras.—Cornutine citrate* of commerce is a blackish-brown powder. According to Kobert, Lewitzky, Krohl, and others, the alkaloid cornutine is the active principle of ergot. For practical purposes the citrate is preferable on account of the difficulty of solution of cornutine. Lewitzky affirms that, in doses of from one-twelfth to one-sixth grain (0.005–0.01 Gm.) cornutine administered by the mouth is very active and certain in its influence upon *uterine contraction* and in congestive and hemorrhagic *metritis*. This is confirmed by Thompson and Krohl. Meisel alleges that it is a powerful remedy in *hemorrhage* and paralytic *spermatorrhœa*. The citrate may be given hypodermically.

Coronilla. *Coronilla scorpioides*, Koch.—In 1886 (*Nancy Thesis*) Cardot announced that the *Coronilla scorpioides* (Medic.), Koch, a papilionaceous plant of Southern France, is an active cardiac poison. In 1889 Schlagdenhauffen and Reeb (*R. G. Clin. Thérap.*, July, 1889) isolated a glucoside, *coronillin*, to which they assigned the formula $C_{11}H_{12}O_5$. It was a yellowish powder, soluble in water, acetone, and amyl alcohol; slightly soluble in chloroform and ether. Heated with diluted hydrochloric acid an amorphous resin was separated, *coronillein*. This also occurs as a yellow powder, but is not bitter to taste. It is insoluble in water, but dissolves in alcohol, acetone, and chloroform. The physiological studies by Gley, by Schlagdenhauffen and Reeb, and by Prevost, some years since, led to the conclusion that coronillein acts upon the heart in a manner similar to digitalis, and to the practical trials of the drug as a succedaneum for digitalis. The most recent researches are those of Luigi Maramaldi (*R. T.*, cxxxvi.), who finds as the result of elaborate experiments that coronillin in small dose lowers the rate and increases the energy of the cardiac beats; while in larger doses it increases the systolic contraction up to the point of permanent ventricular spasm, these results being due to a direct influence upon the cardiac muscular fibre, which increases gradually its tonicity so that it becomes less extensible during diastole, contracts with more than the normal force, and finally fixes itself in systolic arrest. This action upon the heart is accompanied by increase in the arterial pressure, followed after a time by lowering of the pressure, which apparently is the result of failure of diastole, causing the amount of blood forced out of the heart at each systole to be insufficient to fill the arteries. The inhibitory intracardiac ganglia are said to be at first stimulated, afterwards paralyzed. The drug also depresses the spinal cord, and lowers the respiratory movements by an action which is believed by Maramaldi to be partly centric and partly peripheral. Death is produced by cardiac arrest. The toxic lethal *dose* for the frog weighing about 30 Gm. was found by Maramaldi to be from 0.0004 to 0.0005 Gm.; for the dog to be 0.0005 Gm. per kilo (1 to 2,000,000) of the animal's weight.

Locally, coronillin appears to be actively irritant. In Maramaldi's experiments it failed to assert its physiological action when administered to the dog by the mouth, a result believed by the investigator to be due to its decomposition by the acid in the stomach. It is claimed for it that it is an excellent cardiac tonic, superior to digitalis in that it is very rapidly eliminated. As it has been found by various clinicians to be active in man when given by the mouth, it is probable that the comparative feebleness of human gastric juice permits of its absorption unchanged. The *dose* given by various clinicians has varied greatly, from three to five grains (0.2–0.32 Gm.)—Spillemann—downward. These differences probably depend upon differences in purity of the various samples used; of the commercial coronillin the *dose* is commonly stated at present to be one and one-half grains (0.096 Gm.) from four to six times a day, but it must be noted that Schlagdenhauffen affirms that three-fourths of a grain (0.048 Gm.) is a toxic dose. *Coronilla varia* of Europe also probably contains coronillin. (V. Poulet, *B. G. T.*, 1891.)

Coryl is a mixture of methyl chloride and ethyl chloride. It has been used in dentistry and minor surgery as an anæsthetic.

Corylus. *Corylus rostrata*, Ait. *Beaked Hazel.* This is a small indigenous shrub of the fam. Betulaceæ, growing especially in mountainous districts. The nut is invested with a scaly involucre, projecting beyond it like a beak, and thickly covered with short spicules like those of *Mucuna pruriens*, DC. (Fam. Leguminosæ.) These spicules have been employed by Huebener as an anthelmintic. They operate in the same way as cowhage, and may be administered in the same manner and dose. (See *A. J. P.*, xiv. 280.)

Cosaprin, $C_6H_4\begin{cases}SO_3Na\,(1)\\NH-CO.CH_3\,(4)\end{cases}$, is the acetyl derivative of sodium parasulphanilate, and is obtained by the reaction of acetic anhydride upon the sodium salt of *parasulphanilic acid.* Cosaprin forms a greenish-white finely crystalline tasteless powder of a mild saline taste, freely soluble in water, difficultly soluble in alcohol, and almost insoluble in ether, forming a colorless solution with a weak acid reaction. It has been studied by V. Vámossy and Fenyvessy (*Th. M.*, 1897), who find that it resembles phenacetin very closely in its action, but is characterized by the promptness and shortness of its influence.

Coscinium. *Br. Add.*—The dried stem of *Coscinium fenestratum* (Gaertn.), Colebr. (*Menispermum fenestratum*, Gaertn.), The stem of this menispermaceous plant has long been used in Ceylon and Southern India as a yellow dye and bitter tonic, and has found its way into Europe under the names of *false columba* and *tree turmeric.* It almost certainly contains berberine and is an efficient stomachic. The Br. Add. recognizes an *infusion* (*Infusum Coscinii*, Br. Add.), *dose*, one-half to one fluidounce (15–30 Cc.); a *concentrated solution* (*Liquor Coscinii Concentratus*, Br. Add.), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.); and a *tincture* (*Tinctura Coscinii*, Br. Add.), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Cotarnine Hydrochloride. *Stypticin.* $C_{12}H_{15}NO_4.HCl$.—This salt occurs in commerce in yellow crystals, readily soluble in water and alcohol. It is made by oxidizing narcotine. The fact that the only chemical difference between hydrastinine and cotarnine is that in the latter OCH_3 is substituted for one atom of hydrogen led Freund to suggest the substitution of cotarnine in *dysmenorrhœa* and *menorrhagia* for hydrastinine, and on trial Gottschalk found that it was powerfully hæmostatic and also analgesic. Falk (*Th. M.*, vol. x. 1896) found that cotarnine produces in frogs paralysis by depression of the spinal cord, and in warm blooded animals a slightly narcotic condition followed by paralysis, results of an influence respectively upon the cerebral cortex and the spinal cord. On the circulation it has no direct influence. On the respiratory centres it so acts as to produce a primary stimulation, soon followed after the large dose by lessened respiratory movements, and finally central asphyxia and death.

There is a great mass of clinical evidence that cotarnine is a valuable remedy in the arrest of *excessive menstruation* and also that it is very effective in pulmonic and other internal *hemorrhages* and as a local hæmostatic. Cotarnine gauze and purified cotton saturated with cotarnine have been greatly praised by dentists and surgeons. In excessive menstruation one-half grain (0.032 Gm.) may be given three or four times a day for four days before the expected discharge, the dose being increased to one grain (0.065 Gm.) when the menstruation appears. In *hæmoptysis* three grains (0.2 Gm.) may be given at once subcutaneously, and repeated in half an hour, if required.

Coto Bark.—In the years 1873 and 1874 a bark bearing this name appeared in the London drug market, coming from Bolivia. Its botanical origin still remains unknown. Under the name of *coto-coto*, the bark of a rubiaceous plant (*Palicourea densiflora*) is employed in Brazil in *rheumatism.* Whether this be the Bolivian plant or not is very uncertain.

Coto bark occurs in pieces a foot or more long, from three to four inches wide, and from one-half to three-quarters of an inch thick. The outer surface is irregular, often looking as though it had been shaved or split off, and in other parts covered with a fine adherent epidermis free from lichens; the inner surface also is irregular, with numerous rather closely placed, longitudinal projecting bark bundles.

The general color approaches cinnamon-brown; upon fresh cross section the bark is seen to be filled with yellowish spots, except in the outer portions. The odor is aromatic, and much more apparent if bruised; the taste hot, and somewhat aromatic; the powder is very pungent to the nostrils. The microscope shows the outer bark to be composed of thin-walled, colorless, parenchymatous cells, containing starch granules, with numerous yellowish sclerenchymatous cells joined into groups. The inner bark contains numerous yellow bark cells, mostly joined into bundles of from twenty to fifty. For microscopic structure, see *P. J.*, vi. 301, also *Ph. Era*, May, 1888. The coto bark which we have seen in the American market conforms with the original description, but other barks are said to pass under the name. The most important of these is the so-called *Paracoto bark*, which is stated to differ from the true coto bark chiefly in its having a less pungent but more agreeably spicy taste, and being marked with deep whitish furrows upon its surface. Wittstein found in coto bark a volatile alkaloid, a pungent aromatic volatile oil, yellowish-brown soft resin, brown hard resin, starch, gum, sugar, calcium oxalate, tannin, and formic, butyric, and acetic acids. (*A. Pharm.*, iii. 4, 219.) Jobst and Hesse obtained a crystallizable body, *cotoin*, from true coto bark, by making an ethereal extract from the powdered bark, treating this with warm petroleum benzin, and allowing the mixture to stand until clear. The clear liquid yields cotoin in crystals on spontaneous evaporation. The oily resinous residue contains considerable cotoin, which may be obtained by boiling with milk of lime and adding to the solution hydrochloric acid. After twenty-four hours the clear liquid will be found studded with large, glistening, laminated crystals of cotoin, of a pale yellow color. Cotoin, $C_{14}H_{12}O_4$, is sparingly soluble in cold water, more soluble in hot water, insoluble in petroleum benzin, very soluble in alcohol, chloroform, benzol, acetone, and carbon disulphide. Nitric acid becomes blood-red in contact with cotoin, sulphuric acid is colored brownish-yellow, and ferric chloride blackens a dilute solution of cotoin.

Paracotoin, $C_{19}H_{12}O_8$, is extracted from paracoto bark, in which it exists associated with *oxyleucotin*, $C_{34}H_{32}O_{12}$, *leucotin*, $C_{34}H_{32}O_{10}$, *hydrocotin*, $C_{15}H_{14}O_4$, and *dibenzoylhydrocotin*, $C_{32}H_{32}O_8$. Paracotoin may be distinguished from cotoin by giving no reaction with ferric chloride. *Piperonylic* acid (*methyleneprotocatechuic* acid), $C_8H_6O_4$, is present in both barks. Coto bark is decidedly irritating; its powder, rubbed upon the skin, is said to produce heat and redness, and, according to Burkart, fifteen grains (1.0 Gm.) taken into the stomach produce persistent burning pain, followed by repeated vomiting. The remedy was first introduced as serviceable in *diarrhœa*, and seems to have established its reputation. Although observers are not explicit upon this point, it is evident that when there is a tendency to acute inflammation it must be used with great caution. The *paracoto bark* is said to resemble it in its action, but to be much less powerful. The fluid-extract and tincture are very eligible preparations, the former made with alcohol in the usual way, and the tincture 1 part in 10 of alcohol, which may be given in from five- to fifteen-minim (0.3–0.9 Cc.) *doses* every two or three hours.

The active principle, cotoin, is given by Dr. Burkart in *doses* of three-quarters of a grain (0.048 Gm.) every two or three hours. He states that he could detect it in the urine from four to six hours after the ingestion of the dose. Balz (Tokio, Japan) is said to have treated *cholera* successfully by hypodermic injections of three grains (0.2 Gm.) of paracotoin. Oxyleucotin, leucotin, and hydro-

cotin are very feeble. The value of cotoin in the treatment of *diarrhœa* has been confirmed by various clinicians. It has been used in catarrhal diarrhœas and the *diarrhœas* of *tubercular ulceration*, of *typhoid fever*, and of other conditions. (See *B. G. T.*, vol. xi. 167.) It does appear to have some special effect upon the alimentary canal, as, according to Pribram (*Prager Med. Wochens.*, 1880) and Albertoni (*A. E. P. P.*, xvii. 293), it markedly lessens the excretion of indican. Albertoni also believes that it actively dilates the abdominal vessels and thereby hastens absorption, and Bibrana, that it is an antiseptic. It is not probable that cotoin has any general action upon the system, and Jobst found that even fifteen grains (1.0 Gm.) injected hypodermically into the rabbit produced no other than local symptoms. *Dose*, of cotoin, from one to three grains (0.065–0.2 Gm.); of fluidextract of coto, from five to twenty minims (0.3–1.3 Cc.), four to six times a day.

Cotula. *U. S.* 1870. *Mayweed. Wild Chamomile. Dog Chamomile. Camomille puante, Maroute, Herbe de camomille puante, Herbe de maroute*, Fr. *Hunds-Kamille, Hunds-Kamillenkraut, Stinkende Kamille*, G. *Camomilla fetida, Cotula*, It. *Manzanilla loca*, Sp. *Herba Chamomillæ Fœtidæ. Anthemis Cotula*, L. *Maruta Cotula*, De Cand.—The mayweed is an annual composite plant, which grows abundantly both in the United States and in Europe. In this country it is found in the vicinity of inhabited places, growing among rubbish, along the sides of roads, and in waste grounds. W. H. Warner found in the flowers volatile oil, oxalic, valeric, and tannic acids, coloring matter, acrid fatty matter, bitter extractive, and salts of potassium, calcium, magnesium, and iron. (*A. J. P.*, 1858, 390.) Pattone (1859) claimed to have found an alkaloid, *anthemidine*, and a crystallizable bitter acid, *anthemidic acid*, but his results have not been confirmed. The whole plant has a strong, disagreeable odor, and a warm, bitter taste, and imparts these properties to water.

The medicinal properties of this species of Anthemis are essentially the same as those of chamomile, for which it may be substituted, but its disagreeable odor is an obstacle to its general use. On the continent of Europe it has been given in *hysteria* as an antispasmodic. It has also been thought to be emmenagogue. It is said to have the property of vesicating, if applied to the surface fresh and bruised. The whole plant is active, but the flowers, being less disagreeable than the leaves, are preferred for internal use. The remedy is best administered in the state of infusion.

Cotyledon Umbilicus, L. *Navelwort. Pennywort. Cotylet, Nombril de Vénus*, Fr. *Nabelkraut*, G.—This is a perennial, herbaceous, succulent plant, of the fam. Crassulaceæ. The plant is a native of England, where it grows upon old walls and rocks, and dry sandy banks.

According to Flétet, it contains *trimethylamine*, combined with an unknown acid. When the powder of the plant is exposed to the air, it attracts moisture, and exhales a disagreeable odor strikingly analogous to that of fish, and an extract treated with a fixed alkali disengages, even in the cold, an odor which, at first ammoniacal, soon acquires the fishy character referred to. The plant contains cellulose, starch, glucose, mucilage, chlorophyll, yellow coloring matter, a volatile oil smelling like sandarac, tannin, iron, and salts of potassium, sodium, calcium, and iron, with 0.9 per cent. of nitre, and 95 per cent. of water. (*Ann. Thér.*, 1865, 125.) It has been highly lauded in *epilepsy* (for references, see 16th edition *U. S. D.*), but it has very feeble and uncertain therapeutic properties. *Dose*, of fresh juice, from one-half to one fluidounce (15–30 Cc.), two or three times a day; of fluidextract, one fluidrachm (3.75 Cc.); of dry extract, five grains (0.32 Gm.); to be increased and given steadily for months.

Cow Tree. *Palo de Vaca. Palo de Leche.*—The milky juice of the *Brosimum galactodendron*, D. Don (Fam. Urticaceæ), is much used in South America instead of cream in tea and coffee, etc. It is obtained by making incisions in the tree, is white and viscous, turns sour on exposure to the air, and deposits a caseous substance. According to the analysis of Boussingault, its composition varies very much, but it always contains a large percentage of fatty matters (32.2 per cent.), and much less casein, albumen, sugar, and phosphates. (*P. J.*, ix. 679.)

Crab Orchard Salt.—A mild, saline purgative, obtained by evaporating the waters of springs at Crab Orchard, Lincoln County, Kentucky. Its principal active ingredients are the magnesium, sodium, and potassium sulphates; it contains also a little iron and lithium. In its crude form it is not wholly soluble, and sometimes it is purified by dissolving and straining through flannel, and evaporating. As thus prepared, it is white, and as a purgative is about 20 per cent. stronger than the crude salt. It, however, lacks the tonic properties of the latter. According to R. Peter, the composition of the dry salt is: magnesium sulphate, 63.19 per cent.; sodium chloride, 4.77; sodium sulphate, 4.20; potassium sulphate, 1.80; calcium sulphate, 2.54; calcium, magnesium, and iron carbonates, and silica, 0.89; water of crystallization and loss, 22.61; total, 100.00. *Dose* from one to two teaspoonfuls. (See *A. J. P.*, 1874, 5.)

Crabs' Claws. *Chelæ Cancrorum.*—These, finely powdered, were formerly official. In the 100 parts are 60 parts of calcium carbonate and 14 of calcium phosphate, with 26 of animal matter.

Crabstones. *Lapilli Cancrorum. Crabs' Eyes. Oculi* (*Calculi*) *Cancrorum. Yeux* (*Pierres*) *d'Ecrevisses*, Fr. *Krebsaugen, Krebssteine*, G. Concretions found in the stomach, one on each side, of the European crawfish, at the time the animal is about to change its shell; chiefly procured in the province of Astrakhan, in European Russia. The crawfish are bruised with wooden mallets and laid up in heaps to putrefy. The animal remains are then washed away, and the stones picked out. They are inodorous, insipid bodies, somewhat hemispherical in shape, of a whitish or reddish color, hard and stony consistence, and laminated texture. They are very variable in size, weighing from one to twelve grains each. They effervesce with acids, and, without dissolving, become converted, owing to the animal matter which they contain, into a soft transparent mass, retaining the original shape of the stone. By this character they are distinguished from counterfeit stones, which are sometimes fabricated of chalk mixed with mucilaginous substances. They consist of calcium carbonate and phosphate, cemented together by animal matter. Crabstones have been used as an absorbent and antacid, given in the same dose as prepared chalk.

Cranberries. Fruit of *Oxycoccus macrocarpus* (Ait.), Pers. (*Vaccinium macrocarpon*, Aiton.) (Fam. Vacciniaceæ.)—These familiar berries, so well known as an article of diet, have come into

notice as a source of citric acid. For method, see *J. P. C.*, 4e sér., xviii. 439. The leaves of the *Vaccinium Vitis-idœa* (L.) have been studied by Edo Claassen (*A. J. P.*, 1886) and A. M. Karger (*P. J.*, vol. lxx.). They contain *arbutin, hydroquinone,* and *tannin. Benzoic acid* has also been recognized as normally present in small amounts. In the cranberry Edo Claassen found an uncrystallizable glucoside, *oxycoccin.*

Creosote Albuminate. *Creosotum Albuminatum. Nutrincreosote.*—A yellow-gray powder, which is said to contain 40 per cent. of pure creosote and to be free from irritant action.

Creosote Carbonate. *Creosotum Carbonicum. Cresotal.*—This is a mixture of the phenol-carbonates of the several constituents of creosote, and is obtained by the action of carbon oxychloride upon the phenol-sodium compounds of creosote. It is a thick, oleaginous, pale yellow, almost tasteless liquid, soluble in ethyl and methyl alcohol, chloroform, in benzene, and in fatty oils; insoluble in water; having an oleaginous taste, which after a time suggests that of creosote. Its specific gravity is from 1.165 to 1.168. It contains 92 per cent. of pure creosote and is analogous to guaiacol carbonate.

It is stated that this substance is free from the poisonous activity of creosote and is well tolerated by the digestive apparatus, and that it has the activity of creosote in *phthisis* and other forms of *tuberculosis,* in chronic *bronchitis* and *enteritis, ulcerations, intestinal indigestion,* and in various other derangements of the alimentary canal. It is decomposed in the system, as the odor of creosote is imparted to the breath and the urine becomes blackish from the appearance in it of the educts from creosote. In phthisis and in *chronic bronchitis* creosote carbonate is much used in *doses* of fifteen to thirty minims (0.9–1.8 Cc.) up to two to four fluidrachms (7.5–15.0 Cc.) a day, administered in capsule, emulsion, or preferably in milk, sometimes added to cod liver oil. Fifteen fluidrachms (56 Cc.) a day are asserted to have been given without any unpleasant symptoms. It has been used to a considerable extent hypodermically. Before the administration it should be warmed, so as to obtain complete fluidity.

Creosote Iodide. *Creosotide.*—A product obtained by causing iodine to enter into combination with the cresol constituents of beechwood creosote. It contains approximately 25 per cent. of its weight of iodine. It is an amorphous brownish powder, practically insoluble in water and having a faint characteristic odor and taste. It is prescribed in incipient *tuberculosis* with alleged good results; also in *asthma* and as a gastric and intestinal antiseptic. *Dose,* one-fourth to one-half grain (0.016–0.032 Gm.) three or four times a day.

Creosote Oleate. *Creosoti Oleas. Oelsaures Kreosot, Oleokreosot,* G.—An oily liquid, light yellowish in color, almost odorless, but with slight creosote taste, insoluble in water and almost so in 90 per cent. alcohol, freely soluble in absolute alcohol, ether, chloroform, benzene and fixed and volatile oils.

It is used for the same purposes as creosote in *doses* of from one to three fluidrachms (3.75 to 11.25 Cc.).

Creosote Phosphate. *Creosoti Phosphas. Phosote.*—A combination of creosote and phosphoric acid, in the form of a syrupy, colorless liquid, with almost no odor or taste of creosote. It contains about 80 per cent. of creosote and 20 per cent. of phosphoric anhydride.

The *dose* is two fluidrachms (7.5 Cc.) given in 24 hours, and it is said to be one of the best forms in which to administer creosote. *Creosote Phosphate* and *Creosote Tannophosphate* (*Taphosote*) have also been introduced as antiseptics.

Creosote Tannate. *Creosotum Tannicum. Creosal. Tannosal.*—The tannic acid ester of creosote. It is obtained by heating equal quantities of beechwood creosote and pure tannin to 80° C. (176° F.) and adding gradually phosphorus oxychloride and purifying the product. It is soluble in water, alcohol, glycerin, and acetone and occurs as a dark brown hygroscopic powder. It is astringent and antiseptic, and may be given in daily *doses* of forty-five grains (3 Gm.), representing 26 grains (1.8 Gm.) of creosote.

Creosote Valerate. *Creosotum Valeras.* (*Eosote.*)—A mixture of the valeric esters of the phenols contained in creosote. It forms a rather mobile oily liquid, boiling at about 240° C. (464° F.), and soluble in alcohol and ether. This substance as an internal medicine is practically identical with the creosote carbonate. *Dose,* three grains (0.2 Gm.).

Crescentia. *Crescentia Cujete,* L.—The fruit of this South American plant (Fam. Bignoniaceæ) has been found by Gustav Peckoldt to contain *crescentinic acid* and a blue coloring matter allied to indigo. (*Ph. Rund.*, Aug. 1884.)

Cresin. *Cresaprol.*—Made by dissolving 25 per cent. of cresol in 75 per cent. of a solution of sodium cresoxyl-acetate. A brown, clear liquid soluble in alcohol and water. It is said to be less toxic than phenol. Cresin is used in ½ to 1 per cent. solution as a disinfectant for wounds.

Cresol Iodide. *Iodocresol. Traumatol.* $C_6H_3I.(CH_3)OH$.—This is formed by the action of potassium iodide solution upon an emulsion of cresol and water. It contains but one atom of iodine, while losophan or cresol triiodide contains three atoms, and, consequently, a higher percentage of iodine. It is a violet-red, odorless, amorphous powder; insoluble in water, acids, and alcohol; dissolving with difficulty in ether, readily in alkaline solutions, and freely in chloroform. It contains 55 per cent. of iodine, and has been commended as powerfully antiseptic, non-irritant, and having local anæsthetic properties. It is used locally in *syphilitic* and other *ulcers, eczema,* especially when attended with much discharge, *intertrigo,* and various other skin diseases. Also as a substitute for iodoform in surgery. In *herpes* a 10 per cent. traumatol collodium has been found very useful, and a 5 to 10 per cent. traumatol zinc ointment has been highly commended. Pure traumatol may also be used as a dusting powder.

Cresol Naphthol.—A brown, viscous, tar-like liquid, insoluble in but emulsifying with water. Guinard states that it is a very active germicide, and that it is impossible to produce poisoning in the lower animals by giving by the mouth, largely on account of its inducing vomiting at once. Its aqueous solution, like that of other creolin products, has the disadvantage of depositing in wounds.

Cresol Preparations.—On account of the insolubility of cresol, various compounds were some time since put upon the market. The most important of these are *bacillol, creolin, lysol, solveol, paracresol,* and *tricresol.* These compounds are not essentially different from the *Liquor Cresolis Compositus,* U. S.

Creolin is said to be an emulsion of cresol, obtained by means of rosin soap. There are in the market at least two sets of preparations, the one

of German the other of English origin. An analysis of Creolin-Pearson, published by Pfrenger (*A. Pharm.*, 1890, 701), gives: phenols, 2.67; hydrocarbons, 44.94; organic bases, 2.76; sodium, 1.45; resin, 32.45; sulphur, 0.248; chlorine, 0.14; water (by difference), 5.34. The phenols consisted of ortho- and meta-cresol, with traces of phenol and the oxyleucols; the hydrocarbons, of the higher homologues of benzene, with naphthalene and anthracene; the bases belonged to the quinoline group. Creolin forms a milky emulsion or mixture with water; with chloroform, ether, and absolute alcohol it mixes in all proportions. It is sometimes called *cresoline* or *sanatol*.

Medicinal Properties.—According to Jessner, the first report upon creolin was that of F. von Esmarch (*Cb. B.*, Bd. ii., Nos. 10 and 11), who stated, as the result of experiments made with creolin and phenol upon putrefactive bacteria and upon the bacteria of *cholera*, *typhoid fever*, and *anthrax*, that it was much more powerful than phenol as a germicide, except in the case of the anthrax bacillus. It is claimed for creolin that it is not poisonous. Jessner (*L. M. R.*, Aug. 1889) gave eight ounces (249 Gm.) to a cow without any effect; and daily doses of one hundred and twenty grains (7.7 Gm.) were given to a man without any bad general symptoms, or any noticeable effect except decrease of intestinal gases and limitation of the putrefactive processes in the intestine. The urine also required longer than usual for ammoniacal fermentation. In a case reported by Kortüm, nine hundred grains (60 Gm.) are said to have been taken without bad effects, while in a case reported by S. Korach (*D. M. W.*, xxi. 1895), seventy-five grammes of creolin were taken for suicidal purposes. Although both coma and collapse, with complete loss of corneal reflexes, and tracheal râles, also vomiting and diarrhœa, occurred, the patient finally recovered without permanent injury. It is true that Neudörfer (*Internat. Klinisch. Rundsch.*, April, 1888) has shown that injection of creolin into the venous circulation of dogs produces a marked effect, but this may be mechanical, connected with the insolubility of the remedy. Fatal human poisoning by creolin has, however, occurred. Bitter (*B. M. J.*, 1890) has seen restlessness, anxiety, nausea, amblyopia, and a tendency to syncope, with a peculiar strong taste of tea or smoke, produced by the drug. The urine in some of these cases was dark and strongly albuminous, evidently acute nephritis having set in. Fliesburg (*Northwestern Lancet*, Dec. 1891) details a case of a three-weeks-old babe who was killed by thirty drops of undiluted creolin, the chief symptoms being those of violent irritation of the mouth and upper respiratory and digestive tracts.

Compared with other antiseptics, creolin seems to be innocuous. Externally, according to Neudörfer, the solution of 1 to 5 per 1000 is non-poisonous and very antiseptic. He claims that it does not affect the hands or instruments of the surgeon, and is the best of the antiseptics for practical purposes. *Creolin gauze*, as usually sold, contains from 5 to 10 per cent. of the creolin; Neudörfer believes that the 1 per cent. is sufficiently strong. He recommends, especially for local use, the creolin in a powder combined with asbestos, in the proportion of 5 to 100, and for the disinfection of catheters and other instruments, a 33 per cent. solution with olive oil.

Internally, creolin is probably a very important remedy when it is desired to check fermentation in the alimentary canal. Locally applied, it has been largely used with great success in the treatment of *scabies*, in the form of a 5 per cent. ointment with vaseline. In *ammoniacal cystitis*, washing out the bladder with a half per cent. solution of creolin has yielded excellent results. It also seems to be a very effective local application in the treatment of *acute* and *chronic dysentery*, and also in the *cholera morbus* of children. In the case of adults, large enemas of a one-half of one per cent. solution may be used; in the case of infants the strength should be about one-half of this. As a local application in *gonorrhœa*, creolin has been used with alleged most excellent results, both in the form of bougies containing half a grain of creolin, and the injection of creolin dissolved in olive oil (1 in 3). For washing out the uterus after *labor*, the strength of the creolin solution should be 1 per cent.

Creolin is recommended by Jaksch as a deodorant to iodoform; a mixture of from 1 to 2 per cent. of creolin with iodoform produces a compound *creolin-iodoform* of a faint aromatic odor, soluble in alcohol and ether, and believed to possess the therapeutic properties of iodoform. Water removes from it the creolin and leaves the iodoform.

Ethylenediaminetricresol or *kresamin* is a mixture of tricresol with ethylenediamine. It is a colorless aqueous liquid, having a phenol-like odor, and after standing in the air becomes of a light yellow color without losing disinfecting power. According to H. Eckstein, it is an exceedingly powerful antiseptic, especially adapted to the preserving of specimens for microscopic use. As a local application the same author has found it very valuable in those cases of *eczema* in which there was a pronounced secondary infection of the skin, and also in *sycosis* and similar parasitic diseases. Bandages of it wet with a solution of from 1: 4000 to 1: 400 were kept applied to the part. In *lupus* and some similar conditions local protracted baths of from three to twelve hours' duration, with a concentration of 1: 4000, were found efficacious. From 10 to 15 per cent. ointments of it were also employed.

Lysol is made by dissolving the fraction of tar oil which boils between 190° and 200° C. (374°–392° F.) in fat, and subsequently saponifying by the addition of alkali, in the presence of alcohol; it is a brown, oily looking, clear liquid, with a feebly aromatic, creosote-like odor. It is described as containing 50 per cent. of cresols, miscible with water (forming a clear, saponaceous, frothing liquid), also with alcohol, petroleum spirit or petroleum benzin, chloroform, carbon disulphide, and glycerin. To the aqueous solution of the saponified cresols and fat may be added any desired quantity of the higher phenols.

Lysol was introduced as a disinfectant by V. Gerlach (*Zeit. für Hygiene*, June, 1891), who, as the result of an elaborate research, found that both in pure cultures and in mixed masses of pathogenetic bacteria it is more powerful as a germicide than is phenol or creolin; that its 1 per cent. solution has a soapy feeling, and can be used for the purpose of disinfecting the hands without the use of soap; that for the purposes of disinfecting sputa and stools it is by far the most powerful of the germicides; that it is free from irritating properties, unless in strong solution, so that wounds may be sprayed with a 3

per cent. solution and absolutely disinfected; and that comparatively it is much less poisonous than phenol, corrosive sublimate, or even creolin; 1 or 2 per cent. solutions were said to produce some slight transient burning when brought in contact with the mucous membrane. According to Lemke and Straube, a 0.3 per cent. solution will, in fifteen minutes, completely arrest the development of pus organisms, and a 0.5 per cent. solution even remove the odor of putrefying flesh. The value of lysol as an antiseptic has been confirmed by Vulpius, by Michelsen, and other surgeons, and there can be little doubt as to its applicability to the needs of antisepsis, although various surgeons seem to find it a little more irritating than at first stated, and some condemn it as not superior to the older antiseptics. Szuman (*Nowiny Lekarskie*, June, 1891) affirms that a solution stronger than 1 per cent. produces irritation, and that even two parts to a thousand are irritating to the bladder. It does not injure metallic instruments to an appreciable extent or those made of rubber, but celluloid articles are said to become friable and useless under its action. A large number of cases are on record in which lysol has caused severe and sometimes fatal poisoning. The symptoms have been similar to those of phenol poisoning, with marked fall of temperature, and in many cases hemorrhagic nephritis. Indeed, lysol is probably, in proportion to its remedial activity, as toxic as is phenol. H. Cramer has reported death from its vaginal use. (*Centralb. f. Gynækol.*, Oct. 1898.)

Paracresol is a patented disinfectant, to which the formula $C_6H_4\begin{cases}CH_3(1)\\OH(4)\end{cases}$ is ascribed. It is said to give with water in every proportion a pure, neutral, non-caustic, almost odorless solution, similar to that of phenol, but more active and safer. It is evidently not paracresol, before described, as that has odor and is soluble in water with difficulty.

Solveol and *solutol* are said to be respectively solutions of sodium cresolate in excess of cresol, and of cresol in excess of sodium cresolate. They are affirmed to be about as poisonous as phenol. Solveol has been especially praised, it being affirmed to be distinctly more powerful than phenol as a germicide, and in a one-half to five per cent. solution a very valuable antiseptic, especially in major gynæcological operations. (See *D. M. W.*, Sept. 1892; *Journ. Méd. de Paris*, 1892.)

Tricresol is a clear, colorless liquid, of a creosote-like odor, a specific gravity of from 1.042 to 1.049, and boiling between 185° and 205° C. (365°–401° F.). It is soluble in cold water to the extent of from 2.2 to 2.5 per cent., and forms a clear solution, thus showing it to be free from neutral oil, naphthalene, etc. It is said to be composed of orthocresol, 35 per cent.; metacresol, 40 per cent.; paracresol, 25 per cent.

The concurrent testimony of Grüber (*Archiv für Hygiene*, 1893), of Walter Reed, U. S. A. (*St. L. M. S. J.*, 1894), of Charteris (*L. L.*, 1894), and other investigators and surgeons, show that tricresol is a very active germicide, which is probably three times as powerful as pure phenol. Its 1 per cent. solution even in the presence of albuminous fluids readily destroys pathogenetic bacteria. It may be used for all purposes for which phenol is employed. It is said to affect the skin of the operator much less than does phenol, and to be much less irritating to wounds than either phenol or bichloride of mercury solutions. It does not act on surgical instruments. For the ordinary purposes of surgery the 1 per cent. solution may be employed. It is probably less toxic than phenol. Charteris, indeed, affirms that it is only one-third as active a poison as is phenol.

Cresol Salicylates. *Cresalols. Cresol Salols.* $C_6H_4\begin{cases}OH\\COC_6H_4CH_3\end{cases}$. Salicylates may be prepared from ortho-, meta-, or para-cresol by a process similar to that used in the making of salol. They are insoluble in water, slightly soluble in cold alcohol, and are easily crystallized. The *meta-cresol salicylate* is the cresalol generally referred to by that name. It fuses at 74° C. (165.2° F.), and is easily soluble in alcohol and ether. Nencki states that the cresalols decompose in the alimentary canal, and are efficient substitutes for phenyl salicylate, and less poisonous. (*C. R. A. S.*, Feb. 1889.)

Cresol Triiodide. *Meta-cresol Tri-iodide.* (*Losophan.*) $C_6HI_3(CH_3)OH$.—A fine, yellowish powder, with a rather strong, not altogether disagreeable odor; insoluble in water, soluble in alcohol, ether, and chloroform, exceedingly so in oil. Merck (*Jahresbericht*, 1892, 77) describes it as obtained in colorless needles, fusing at 121.5° C. (251° F.). It contains 78.39 per cent. of iodine. A specimen prepared by Friedrich Baeyer & Co. was found by Petersen (*M. M. W.*, July, 1891) to yield its iodine with difficulty, passing through the alimentary canal almost without absorption; applied to the mucous membrane of the nose in *acute inflammation*, it was found to act very well in checking secretion and lessening inflammatory action.

Cresotinic Acid.—*Cresotic acid, homosalicylic acid, oxytoluic acid,* $C_6H_3\begin{cases}CH_3\\OH\\COOH\end{cases}$, may exist as ortho, meta, or para modification, and is the homologue of salicylic acid, bearing the same relation to cresol that salicylic acid does to phenol. The cresotic acids may be made artificially from the cresols by a reaction analogous to that used in making salicylic acid.

Only the para compound is used in medicine. It crystallizes in white needles, melting at 151° C. (303.8° F.). As long ago as 1876 *sodium cresotate* was proposed as an antipyretic, but the commercial drug furnished was proved to be a mixture of varying composition, and has been replaced by the pure sodium paracresotate, a white, finely crystallized powder, having a somewhat bitter taste, forming a permanent solution in twenty-four parts of hot water. It is made as stated by the Kolbe process of heating the sodium paracresol with carbon dioxide under pressure. Charteris (*B. M. J.*, March, 1891) found that ortho- and para-cresotic acids act upon rabbits as poisons, the lethal dose being less than half a grain (0.032 Gm.) of the ortho, and one grain (0.065 Gm.) of the para, acid per pound. According to the experiments of Demme (*W. M. Bl.*, Feb. 1870), sixty grains (3.9 Gm.) of the sodium paracresotate may be taken by man without producing very distinct symptoms, except an antipyretic action in cases of fever. The same authority used the drug with asserted good results in *acute articular rheumatism*. In some of the cases marked collapse occurred, in others there was erythematous eruption.

Crurin. *Quinoline-bismuth sulphocyanide.* $(C_9H_7HSCN)_2Bi(SCN)_3$.—*Quinoline-bismuth rhoda-*

nate, a reddish-yellow powder with weak odor of quinoline, insoluble in water, alcohol, and ether. Crurin of the markets is a preparation containing 25 per cent. of active ingredients with starch. According to the researches of Müller it is bacteriologically active, and it has been especially recommended in the treatment of ulcers of the leg, by dusting them at intervals in full strength or diluted, *pro re nata*. It has also been highly recommended by E. Jacobi in *gonorrhœa*, according to the following formula: Rub fifteen grains (1.0 Gm.) of crurin with seventy-five minims (4.6 Cc.) each of distilled water and glycerin and gradually add sufficient distilled water to make six and one-half troyounces (201.5 Gm.).

Cryptocarya. *Cryptocarya australis*, Bentham. (Fam. Lauraceæ.)—From the bark of this Queensland tree, T. L. Bancroft (*Austral. Journ. Pharm.*, March, 1887) has separated an alkaloid which is said to be a powerful respiratory poison.

Cucurbita. *Cucurbita Citrullus*, L. (*Citrullus vulgaris*, Schrad. *Citrullus Citrullus* (L.), Karst.) *Watermelon.*—The seeds of the watermelon are employed, to a considerable extent, as a domestic remedy in *strangury* and other affections of the urinary passages. They have properties similar to those of the seeds of the other Cucurbitaceæ, of which four different kinds were formerly official under the name of the *greater cold seeds*,—viz., those of *Cucurbita Pepo*, L., or *pumpkin*, of *Lagenaria vulgaris*, Ser. (*L. Lagenaria* (L.), Cockerell; *Cucurbita Lagenaria*, L.), or *gourd*, of *Cucumis Melo*, L., or *muskmelon*, and *Cucumis sativus*, L., or *cucumber*. These, when bruised and rubbed up with water, form an emulsion, which was formerly thought to possess considerable virtue, and was much used in *catarrhal affections* and *disorders of the bowels* and *urinary passages*. Watermelon seeds are also esteemed by some as a diuretic. The infusion of two ounces of the bruised seeds to a pint may be taken *ad libitum*. In the form of *Arbooznyi miod*, or *watermelon honey*, or as a freshly expressed juice, the Russian peasants are said to employ watermelon in the treatment of *dropsy*, *urino-genital affections*, *chronic hepatic congestion*, and *chronic intestinal catarrh*. Manassein (*Vrach*, Nov. 1881), found that the melon honey acts upon the lower animals as a very powerful diuretic, and causes when in sufficient dose fall of the arterial pressure, rapid pulse, and death from cardiac paralysis.

The pulp of the root of *Lagenaria vulgaris*, or *gourd*, is said by Chapin to be a powerful and even drastic purgative, and to be used by the natives of the Sandwich Islands successfully in the treatment of *dropsy*. (See *N. Y. Journ. of Med.*, 1855, 203.)

Culilawan. *Cortex Culilaban.*—An aromatic bark, produced by *Cinnamomum Culilawan*, Blume (*Laurus Culilaban*, L.), (Fam. Lauraceæ), a tree of considerable size, growing in the Molucca Islands, Cochin-China, and other parts of the East. It is usually in flat or slightly rolled pieces, several inches long, an inch or more in breadth, and one or two lines thick. Sometimes the bark is thinner and more quilled, bearing considerable resemblance to cinnamon. The epidermis is for the most part removed, but when present is of a light brownish-gray color, soft to the touch, and somewhat spongy. The color of the bark itself is a dull, dark, cinnamon brown, the odor highly fragrant, the taste agreeably aromatic, and not unlike that of cloves. The active constituent is a volatile oil, smelling like a mixture of the oils of cajuput and cloves. Culilawan has the medicinal properties of the aromatics, but is rarely used. (See *Cortex Caryophyllata.*)

Cumin. *Cyminum*, Lond. *Cuminum*, Ed. *Cumin*, Fr. *Kreuzkümmel*, *Mutterkümmel*, *Römischer* (*langer*, *scharfer*) *Kümmel*, G.—The so-called cumin seeds are the fruit of the *Cuminum Cyminum*, L., an annual umbelliferous plant, which is a native of Egypt, but is cultivated for its fruit in Sicily, Malta, and other parts of Europe.

The cumin fruits (*seeds*) are elliptical, flat on one side, convex, furrowed, and rough on the other, about one-sixth of an inch in length, and of a light brown color. Each has seven longitudinal ridges. Two fruits are sometimes seen united. Their odor is peculiar, strong, and heavy; their taste warm, bitterish, aromatic, and disagreeable. They contain much essential oil, which is lighter than water, yellowish, and has the sensible properties of the seeds. It consists of three distinct oils, one a hydrocarbon, *cymene*, $C_{10}H_{14}$, recognized now as *isopropyl-p-methyl-benzene*, another *cuminol*, $C_{10}H_{12}O$, which may be regarded as *cumin aldehyde*, $C_{10}H_{11}OH$, and the third a terpene, $C_{10}H_{16}$. Dumas, a long time since, obtained a cymene identical with that of oil of cumin seeds, by dehydrating camphor, and Paternò prepared it in a similar way from oil of turpentine. (*J. P. C.*, 4e sér., xx. 409.) In his discovery Paternò seems, however, to have been preceded by several chemists, C. R. A. Wright apparently having the priority. (*A. J. P.*, xlvi. 117; see especially *A. J. P.*, xliv. 452.) Cumin aldehyde has also, together with cymene, been obtained from the seeds of *Cicuta virosa*, L. (Trapp, *Ann. Ch. Ph.*, cviii. 386.) In medicinal properties cumin seeds resemble the other aromatic umbelliferous fruits. *Dose*, fifteen to thirty grains (1–2 Gm.).

Cumol. *Pseudocumol.* $C_6H_3(CH_3)_3$ (1 : 3 : 4). An oily fluid derived from coal tar, boiling at 168° to 178° C. (334.4°–352.4° F.). Cumol has been especially recommended by Krönig (*Centralbl. f. Gyn.*, 1894) for the purpose of sterilizing catgut, which is placed in the cumol and slowly heated up to 160° C. (320° F.). After two hours it is removed and freed from the adhering cumol by petroleum benzin.

Cunila. *Cunila origanoides* (L.), Britt. *C. Mariana*, L. *American Dittany. Sweet Horsemint. Stonemint.*—A small indigenous perennial herb, growing on dry, shady hills, from New England to Georgia, and flowering in June and July. The whole herb has a warm pungent taste and a fragrant odor, dependent on an essential oil. This, according to Philip Milleman of Chicago, is of reddish-amber color, becoming light yellow by exposure to light, of a delicate, fragrant odor, very similar to that of oil of monarda, of a warm, pungent taste, and of the sp. gr. 0.920. It is readily soluble in alcohol, ether, and chloroform. On spontaneous evaporation, it leaves a small crystalline residue. Iodine decomposes it, producing white vapors; by sulphuric acid it is reddened and decomposed, by nitric acid resinified, and by hydrochloric acid decolorized, though its color returns on exposure. It is slightly rubefacient; in the *dose* of five or ten minims (0.3–0.6 Cc.) it is carminative, and of from fifteen to twenty minims (0.9–1.3 Cc.) diaphoretic. The same author found in the dried herb tannic acid, a trace of glucose, gum, bitter extractive, resin, and salts of potassium, calcium, magnesium, and iron. (*A. J. P.*, Nov. 1866, 495.) American dittany is a gently stimulant aromatic, analogous to mints.

Cuprargol.—Cuprargol is a dull, grayish-white powder, which is slowly soluble in water, and has been used as an astringent in ophthalmology in 20 per cent. solutions.

Curcuma. *U. S.* 1870. *Turmeric. Curcuma longa*, L., *Amomum Curcuma*, Jacq., includes *C. rotunda*, L. (Fam. Marantaceæ.)—The rhizome of this plant is perennial, tuberous palmate, and internally of a deep yellow or orange color. The plant is a native of the East Indies and Cochin-China, and is cultivated in various parts of Southern Asia, particularly in China, Bengal, and Java, whence the root is exported. The best is said to come from China.

The dried root (*Safran des Indes, Souchet des Indes*, Fr.; *Kurkuma, Gelbwurzel*, G.; *Curcuma*, It., Sp.; *Zirsood*, Arab.; *Huldie*, Hindoo) is in cylindrical or oblong pieces (*Curcuma longa*), about as thick but not as long as the finger, tuberculated, somewhat contorted, externally yellowish brown or greenish yellow, internally deep orange yellow, hard, compact, breaking with a fracture like that of wax, and yielding a yellow or orange-yellow powder. Another variety (*Curcuma rotunda*), comparatively rare, is round or oval, about the size of a pigeon's egg, and marked externally with numerous annular wrinkles. Sometimes it comes cut into two transverse segments. The two varieties have a close resemblance in sensible properties, and are thought to be derived from the same plant, though formerly ascribed to different species. The odor of turmeric is peculiar; the taste warm, bitterish, and feebly aromatic. It tinges the saliva yellow. Analyzed by Pelletier and Vogel, it was found to contain lignin, starch, a peculiar yellow coloring matter called *curcumin*, a brown coloring matter, gum, an odorous and very acrid volatile oil, and a small quantity of calcium chloride. Curcumin was obtained, mixed with a little volatile oil (about 1 per cent.), by digesting the alcoholic extract of turmeric in ether, and evaporating the ethereal tincture. It has been obtained, by F. A. Daube, in deep yellow crystals, of a diamond lustre, by a process which may be found in the *A. J. P.* (1871, 308). C. L. Jackson and Menke have submitted turmeric root to a thorough examination, and give the following results: The turmeric oil was first removed from the ground root by treatment with ligroine, then the curcumin mixed with a large quantity of resin is extracted with ether, and finally purified by crystallization from alcohol. The oil extracted by ligroine was dark yellow, and amounted to 11 per cent. of the root. The purified curcumin amounted to 0.3 per cent., and melted at 178° C. (352.4° F.). Analyses of the pure curcumin, of several of its salts, and of derivatives, show its formula to be $C_{14}H_{14}O_4$. (*Am. Chem. J.*, iv. 77.) It is brown in mass, but yellow in the state of powder, without odor or taste, insoluble in benzin, scarcely soluble in water, but very soluble in alcohol, ether, and the oils. It is a diatomic monobasic acid. When treated with weak oxidizing agents it yields vanillin. The alkalies rapidly change its color to a reddish brown, and paper tinged with tincture of turmeric is employed as a test of their presence. The paper is rendered brown also by boric acid, which it thus serves to detect. When treated with a mixture of sulphuric and boric acids it yields a product called *rosocyanin*, because it dissolves in alcohol with a fine red color, and is turned blue by alkalies. Its alcoholic solution produces colored precipitates with lead acetate, silver nitrate, and other salts. Turmeric is used for dyeing yellow, but the color is not permanent. James Cook has found in turmeric an alkaloid, which forms crystallizable salts with sulphuric and nitric acids, and, separated from these acids by ammonia, yields a semi-crystalline precipitate. He observed also indications of a second base. (*P. J.*, Nov. 1870.) Ivanow Gajewsky also states that there is an alkaloid in the root. (*Pharmacographia*, 641.)

This root is a stimulant aromatic, bearing some resemblance to ginger in its operation, and is much used in India as a condiment. It is a constant ingredient in the curries so generally employed in the East. In former times it had some reputation in Europe as a remedy in *jaundice*, but its medicinal action was purely imaginary, based on the old doctrine of signatures, and at present it is employed only to impart color to ointments and other preparations.

Turmeric, when used as an adulterant, may be detected by means of a mixture of boric and sulphuric acids, but according to A. E. Bell, a much better test is afforded by the use of the reagent made by dissolving 1 gramme of diphenylamine in 20 Cc. of 90 per cent. alcohol, carefully adding 25 Cc. of pure sulphuric acid. To a little of the suspected powder, placed on a slide, a drop of the reagent is added with a glass rod. Spots of a fine purple color immediately develop, which may be readily recognized with the microscope.

Turmeric paper, used as a test, is prepared by tingeing white unsized paper with a tincture or decoction of turmeric. The tincture may be made with one part of turmeric to six parts of proof spirit; the decoction, with one part of the root to ten or twelve of water. The access of acid or alkaline vapors should be carefully avoided.

Curry Leaves. *Currie.*—The leaves of the *Murraya* (*Bergera*) *Kœnigii*, Spreng. (Fam. Aurantiaceæ), a tree of India, are very largely used in that country as an aromatic, stomachic stimulant; when powdered and mixed with spices and other substances it forms *curry powder*, which is much used for seasoning food, rice, cooked dishes, etc.; it is also employed in *dyspepsia, diarrhœa*, and even *dysentery*. According to J. G. Prebble (*Pharmacographia Indica*, vol. i.), curry leaves yield to distillation a small quantity of volatile oil, and also contain a greenish-black resin, and a glucoside, *kœnigin*. The clear oil extracted from the seeds is known as *simabolee oil*.

Cuttlefish Bone. *Os Sepiæ, Os de Sèche* (*Seiche*), Fr. *Sepie, Weisses Fischbein*, G.—This is a calcareous body, situated underneath the skin, in the back of the *Sepia officinalis*, L., or *cuttlefish*, of European seas. It is oblong-oval, from five to ten inches long, and from one and a half to three inches broad, somewhat convex on both sides, with thin edges, of a rather firm consistence upon the upper surface, very friable beneath, and composed of numerous layers, loosely connected, so as to give to the mass a porous consistence. It is lighter than water, of a white color, a feeble sea odor, and a saline taste. It contains, according to John, from 80 to 85 per cent. of calcium carbonate, besides animal matter, a little common salt, and traces of magnesia. Its fine powder may be given as an antacid, and it is sometimes used as an ingredient of tooth-powders. Small pieces of it are often put into bird cages that the birds may rub their bills against them, and the powder is employed for

polishing. Another product of the cuttlefish is a blackish-brown liquor, secreted by a small gland in an oval pouch, communicating externally near the rectum by a long excretory duct, through which the animal is said to have the power of ejecting it at will. This, when taken from the fish, is dried, and used in making the water-colors *sepia* and *India ink*.

Cyclamen. *Cyclamen europæum*, L. *Pain de Porceau, Arthanite*, Fr. *Erdscheibe, Erdbrod, Schweinbrod*, G. *Sowbread.*—This is an herbaceous, perennial, stemless plant, of the south of Europe. The root is globular, with many branched fibres, almost black without, and white within, inodorous, and, when fresh, of a bitter, acrid, burning taste. By drying it loses much of its acrimony, and is said to be rendered edible by roasting. Hogs are said to root it up from the ground and to eat it with impunity, and hence its common French name. The root is a drastic cathartic, and is used to cause abortion, but has in such cases produced fatal gastro-enteritis. Its active principle appears to be *arthanitin* of Saladin, the *cyclamin* of S. De Luca. This is a poisonous glucoside, which, when boiled with diluted acids, splits into *cyclamiretin*, $C_{18}H_{22}O_2$, and glucose. It is white, amorphous, inodorous, and, when held a short time in the mouth, intensely acrid, extending its action even to the throat. With cold water it swells and becomes gelatinous, but is readily dissolved, and forms a solution which froths like soap and water, and is coagulated by a heat of about 65.5° C. (150° F.). Alcohol dissolves it with difficulty when cold, but freely when hot; it is soluble in glycerin with the aid of heat; and is insoluble in ether, chloroform, carbon disulphide, and the essential oils. Its formula, according to an analysis by Klinger, is $C_{20}H_{34}O_{10}$, although Kobert (*Chem. Cb.*, 1893, i. 32) makes it one of the class of saponins, and gives it the formula $C_{20}H_{32}O_{10}$, which is the same as that of sarsaparilsaponin and smilacin. T. W. C. Martius recommends the following method of preparing it. The tubers, collected in the autumn, dried and powdered, are mixed with animal charcoal, and exhausted at a boiling heat by alcohol of 0.825; the tincture is filtered, concentrated, and set aside for six or eight weeks, when the cyclamin is deposited. This should be washed on a filter with alcohol till it passes colorless, and if the filtrate be concentrated, and set aside, it will deposit a further quantity in a few weeks. The whole is then mixed with animal charcoal and treated with boiling alcohol, which will slowly deposit the pure cyclamin on cooling. *Dose*, of powdered root is said to be from twenty to forty grains (1.3–2.6 Gm.).

Cydonium. *U. S.* 1880. *Quince Seed. Semen Cydoniæ. Semences (Pépins) de Coing*, Fr. *Quittenkerne, Quittensamen*, G. *Semi di Cotogno*, It. *Simiente de Membrillo*, Sp.—The *Pyrus Cydonia*, L. (*Cydonia vulgaris*, Pers.), or common quince tree, is characterized as a species by its downy, deciduous leaves. It is supposed to be a native of Crete, but grows wild in Austria, on the banks of the Danube. The fruit is yellow, downy, of an agreeable odor, and a rough, astringent, acidulous taste, and in each of its five cells contains from eight to fourteen seeds. Though not eaten raw, it forms a very pleasant confection, and a syrup prepared from it may be used as a grateful addition to drinks in sickness, especially in looseness of the bowels, which it is supposed to restrain by its astringency. The seeds, which were formerly official, are ovate, angled, reddish-brown externally, white within, inodorous, and nearly insipid, being slightly bitter when long chewed. Their coriaceous envelope abounds in mucilage, which is extracted by boiling water. "About a quarter of an inch (6 Mm.) long, oval or oblong, triangularly compressed, brown, covered with a whitish, mucilaginous epithelium, causing the seeds of each cell to adhere. With water the seeds swell up, and form a mucilaginous mass. The unbroken seeds have an insipid taste." *U. S.* 1880. Two drachms of the seeds will render a pint of water thick and ropy. (*A. J. P.*, 1876, 35.) It has been proposed to evaporate the decoction to dryness, and powder the residue. Three grains of this powder form a sufficiently consistent mucilage with an ounce of water. According to Garot, one part communicates to a thousand parts of water a semi-syrupy consistence. (*J. P. C.*, 3e sér., iii. 298.) Pereira considers the mucilage as peculiar, and proposes to call it *cydonin*. It differs from arabin in not yielding a precipitate with potassium silicate, and from bassorin and cerasin in being soluble in water both hot and cold. Tollens and Kirchner (*Ann. Ch. Phys.*, clxxv. 205–226) assign to it the formula $C_{18}H_{28}O_{14}$, regarding it as a compound of gum, $C_{12}H_{20}O_{10}$, and cellulose, $C_6H_{10}O_5$, less one molecule of water. Quince mucilage is very bland, and may be used for the same purposes as other mucilaginous liquids. The U. S. P. 1880 gave the following formula for its preparation. "Cydonium, *two parts* [or thirty-six grains]; Distilled Water, *one hundred parts* [or four fluidounces]. Macerate the Cydonium for half an hour, in a covered vessel, with Distilled Water, frequently agitating. Then drain the liquid through muslin, without pressure. This preparation should be freshly made, when required for use." *U. S.* 1880.

Cynara. *Cynara Cardunculus*, L. (*C. Scolymus*, L.) *Artichoke.*—This is a composite plant, indigenous in the south of Europe, and cultivated as a culinary vegetable. The receptacle and the lower portion of the fleshy leaflets of the flower-heads are eaten. When young, the heads are cut up raw and eaten as salad; when older, they are boiled, and dressed variously. The flowers are said to curdle milk, and the plant to yield a good yellow dye. The leaves and their expressed juice are very bitter, and have been thought to be actively diuretic. Artichoke leaves have been used in *dropsies* and *rheumatic affections*.

Cynoglossum. *Cynoglossum officinale*, L. *Hound's-tongue. Langue de Chien*, Fr. *Hundszunge*, G.—A biennial plant of the fam. Boraginaceæ, common both in Europe and in this country. The leaves and root have been employed, but the latter has been generally preferred. The fresh plant has a disagreeable narcotic odor, resembling that of mice, which is dissipated by drying. The taste is nauseous, bitterish, and mucilaginous. Although hound's-tongue has been believed by some to be nearly inert, there can be little doubt that it is a dangerous poison. The experiments of Diedülin (*M. S. Rep.*, 1868) many years ago demonstrated that the extract paralyzes motor nerves in vertebrate animals, and K. Greimer has found in it a poisonous alkaloid, *cynoglossine*, which acts upon the animal organism similarly to curare; also a toxic glucoside, *consolidin*, and a notable amount of *choline* (*P. J.*, vol. lxv.). *Consolicin*, a derivative of consolidin, like consolidin, paralyzes the central nervous system. Cynoglossum has been used as a demulcent and

sedative in *coughs, catarrh, spitting of blood, dysentery,* and *diarrhœa.* The *pilulæ de cynoglosso* owe their properties chiefly to opium.

Cytisus. *Cytisus Laburnum,* L. *Laburnum vulgare,* Grisebach. *L. anagyroides,* Medic. (Fam. Leguminosæ.)—Laburnum is a small tree, indigenous in the higher mountains of Europe and cultivated throughout the civilized world, for its flowers, which appear early in the spring in rich pendant yellow clusters. All parts of the plants are probably poisonous. In fifty-eight boys poisoned simultaneously by the roots, the symptoms were intense sleepiness, vomiting, convulsive movements, coma, slight frothing at the mouth, and unequally dilated pupils. (*M. T. G.,* vol. ii. 875.) In some cases the diarrhœa has been severe. The convulsions have at times been markedly tetanic; wide-spread anæsthesia has been noted, and also excessive mydriasis, with loss of the pupillary reflex, elevation of temperature, delirium, and cyanosis. After death there have been found erosion of the colonic mucous membrane, extreme hyperæmia of the brain, and nephritis. (*D. M. W.,* xxi. 1895.) For cases, see also previous editions of the *U. S. D.; Arbeiten Pharm. Instit. Dorpat,* ii. 1888; *Le Mouvement Méd.,* 1875, No. 28; *Dublin Q. J.,* 1863, 248; *M. T. G.,* Sept. 1862; *L. L.,* Aug. 1870. Chevallier and Lassaigne discovered in the seeds of *laburnum* a white, amorphous, deliquescent, non-nitrogenous substance, of a bitter nauseous taste, soluble in water and weak alcohol, and insoluble in ether. In small doses it produced, in animals, vomiting, convulsions, and death. (Mérat and De Lens.) Husemann and Marmé isolated in 1864 an alkaloid, *cytisine,* a white, crystalline solid, of a bitter, somewhat caustic taste, soluble in water and alcohol, but scarcely at all soluble in ether, chloroform, benzene, or carbon disulphide. A second alkaloid, *laburnine,* was also announced by them. (*Chem. News,* July 16, 1869, 36.) Partheil (*A. Pharm.,* 1892, 448) has since studied cytisine, and gives it the formula $C_{11}H_{14}N_2O$, which has been adopted by other authorities. He considers it to be identical with the *ulexine* of the *Ulex europœus,* L. (Fam. Leguminosæ). Ferric chloride colors cytisine and its salts blood-red, which color, however, disappears on diluting with water or on addition of hydrogen dioxide. If after the addition of this latter reagent the mixture is heated gently in the water bath an intense blue color is developed. When cytisine is distilled with soda lime, pyrrol is obtained, besides a base, $C_9H_{13}N$, which is possibly a hydroquinoline. A. Rannerda purified crude cytisine, obtained from the seeds of *Cytisus Laburnum,* L., by the well known shaking out process with chloroform, by distilling it in a partial vacuum. Under a pressure of 2 Mm. and a temperature of 228° C., the alkaloid distils over as a colorless liquid and congeals in the receiver in the form of fine crystalline needles. It separates from absolute alcohol in the form of small transparent rhombic crystals, which have the sp. gr. 1.0046. (*Ap. Ztg.,* July, 1900, 486.) Cytisine is stated to be found also in arnica flowers.

According to the researches of P. C. Plugge (*A. Pharm.,* 1895), cytisine is a very widely distributed alkaloid. He has found it in eight species of the genus Cytisus, two of the genus Genista, two of the genus Sophora, two of the genus Baptisia, and in other plants. He asserts that *ulexine* of Gerrard, from *Ulex europœus,* L.; *sophorine* of H. C. Wood, from *Sophora secundiflora* (Cav.), DC. (*S. speciosa,* Benth.), and *baptitoxine* of von Schroeder, from *Baptisia tinctoria,* R. Br., are identical with cytisine. Plugge also believes that the alkaloid of *Euchestra Horsfieldii,* Benn. (Fam. Leguminosæ), a Javanese pea, whose seeds are used as a contra-poison by the natives, is identical with cytisine. Kobert and Radziwillowicz (*loc. cit.*) find that in the lower animals the symptoms of poisoning by cytisine resemble somewhat those of strychnine poisoning, but are attended by much vomiting of centric origin; that the alkaloid depresses even in the living organism the ozonizing properties of the red corpuscles; that it first excites and afterwards paralyzes the centre of respiration, and probably in this way causes death; that it also powerfully stimulates the vasomotor centres, producing a marked elevation of blood pressure which is independent of the heart and is followed, if the dose has been large enough, by a gradual fall of pressure, due to paralysis of the vasomotor centres. The motor side of the spinal cord is also strongly excited by small, and finally paralyzed by large, doses. The peripheral ends of the motor nerves are paralyzed in a curare-like method. The alkaloid also seems to have a distinct action upon the uterus, and has frequently produced abortion. Therapeutic trials were made with the alkaloid in hypodermic doses of one-twelfth grain (0.005 Gm.), or by the mouth in from one- to three-minim (0.06–0.2 Cc.) doses of the 1 per cent. solution, in conditions of *depression,* without much effect. Gray (*J. P. C.,* 1862) found laburnum to produce in man narcotic effects, and commends it in *vomiting, bronchitis, whooping cough,* and *asthma.*

Damiana.—Under this name have been sold in the American market as aphrodisiacs several distinct Mexican drugs. According to Wellcome, there were on the market in 1875 (*A. J. P.,* xlvii.) at least three of these, each claiming to be genuine.

Of these various drugs, one had a smooth, dark green, broadly lanceolate, dentate leaf, usually having six teeth on each side, heavy midrib, and ribs extending to the point of the teeth, from two to five lines in width and from six to twelve in length; the stem was red and woody, and the leaves gave a minty flavor when chewed. The second variety had a light green, obovate, deeply toothed leaf, having three and occasionally four teeth on each side, with a heavy midrib, and branching ribs extending to the edge. The surface was rough, and both sides were covered with short hairs. It was from two to five lines in width and five to eight in length. The stem was very woody, and near the apex it was quite hairy; on chewing it yielded a sage-like flavor. In the third variety the leaf was light green, lanceolate, having three teeth on each side, which terminated in hard, sharp points; it had a distinct midrib, and was rather indistinctly veined; was from one and a half to three lines in width and four to ten in length. It was quite thick and had a rough surface, with occasional black dots. To the naked eye the leaf appeared to be covered with shining scales, which, under the glass, appeared as minute resin-like globules. This was the only specimen accompanied by flowers. They were compound, with yellow florets and white pappus; the stem was woody, with green epidermis, and covered with resinous secretion. In 1882 there were two damianas in the Philadelphia market. One was chiefly composed of pieces of stems and branches, but

contained enough of floral heads and leaves to show that it was the third variety of Wellcome, and was the product of one of the Compositæ, *Bigelowia veneta*, Gray (*Aplopappus discoideus*, DC.). (*M. S. Rep.*, xxxiv. 180.) The second variety was that considered by the introducers as *genuine damiana*. It was the leaves and terminal twigs of a Turnera (Fam. Turneraceæ), supposed by some to be a new species, *T. aphrodisiaca*, L. F. Ward, now recognized as identical with *T. diffusa*, Willd., and probably only a variety of *T. microphylla*, DC. It is this drug which constitutes the damiana of commerce. The leaves are from three to eight lines long, one to three lines broad, obovate to lanceolate, eight to ten sharp-toothed, smooth or with a few hairs on ribs below, midrib marked with, in some cases, strong, straight veins running to the edge between the teeth; in other cases veins branched and sending a final vein into the tooth; stems fine, woody, reddish, ends of branches hairy. F. W. Rantzer (*A. J. P.*, 1887, 69) obtained from the leaves of this species about one-half per cent. of an amber-colored volatile oil, with a heavy aromatic odor, and a warm, camphoraceous, and bitter taste; also tannin, two tasteless resins, and extractive.

The published reports as to the value of the drug vary greatly, some having had great success with it in *sexual atony*, most others finding it useless; it is probably nothing more than a feeble tonic. *Dose*, an ounce (31 Gm.) of the leaves, either in the form of infusion or fluidextract, may be given daily.

Danais. *Danais fragrans*, Gaertn. f. (Fam. Rubiaceæ.)—In this Madagascar plant, the root of which is said to be tonic and antiperiodic, Heckel and Schlagdenhauffen found a glucoside, *danain*. (*A. J. P.*, 1886.)

Daphnandra.—The bark of several species of Australian trees belonging to the genus Daphnandra (Fam. Monimiaceæ) is asserted to be rich in poisonous alkaloid. (*P. J.*, Oct. 1887.) Bancroft states that the active alkaloid is soluble in water, and to some extent is antagonistic to strychnine.

Delphinium.—It is probable that most if not all of the species of this genus of Ranunculaceæ are actively poisonous. Thomas C. Hopkins of Baltimore, found in the seeds of *D. consolida*, L., or *Larkspur* (*Lark's claw, Knight's spur*), *delphinine* ($C_{24}H_{35}NO_2$), volatile oil, fixed oil, gum, resin, chlorophyll, gallic acid, and salts of potassium, calcium, and iron. (*A. J. P.*, xi.) Rochebrune (*Toxicol. Africaine*, i.) has separated alkaloids believed by him to be identical with *delphinine* from *D. peregrinum*, L., and *D. mauritanicum*, Coss. From the expressed juice of the larkspur *aconitic acid* was obtained by W. Wicke. (*J. P. C.*, 1854.) Moreover, the seeds of the indigenous *D. urceolatum*, Jacq. (*D. exaltatum*, Ait.), are stated to have a physiological action similar to that of the larkspur. The common larkspur (*D. consolida*) is a showy annual, which has been introduced from Europe into the United States, where it has become naturalized, growing in the woods and fields, and flowering in June and July. The flowers are bitter and acrid. In large doses the seeds produce violent vomiting and purging, and are said to be diuretic. They were formerly in the Secondary List of the U. S. Pharmacopœia, and a tincture (1 fl. oz. to 1 pint diluted alcohol) has been used in spasmodic *asthma* and *dropsy*. *Dose*, ten minims (0.6 Cc.), gradually increased. Brett has found that *D. peregrinum*, L., when growing, is very effective in the destruction of grasshoppers. (*P. J.*, vol. xxi. 1891. See *Staphisagria* in PART I.)

Dextroform is a combination of formaldehyde and dextrin, soluble in water and glycerin, but insoluble in alcohol, ether or chloroform; it occurs as a white almost odorless and tasteless powder; it should be used with caution. It affords, according to Bongartz, in from 10 to 20 per cent. solution, a useful injection in *gonorrhœa* and other toxic diseases, or is used for irrigation in half strength.

Dialiopsus. *Dialiopsus africana.*—In the seeds of this plant Beitter has found a poisonous glucoside belonging to the saponins. (*B. P. G.*, 1902.)

Diamine (*Hydrazin*), $\left.\begin{matrix}H_2N\\H_2N\end{matrix}\right\}$, is a strong base crystallizing in white crystals at 1.4° C. (34.5° F.) and boiling at 113° C. (235.4° F.); it forms salts with the common acids. The free base mixes with water in all proportions and has a strong alkaline character and powerful reducing action. This substance has been proved by Julius Pohl to be actively poisonous. (*A. E. P. P.*, xli. 1898.)

Dianthus. *Dianthus Caryophyllus. Clove Pink.* (Fam. Caryophyllaceæ.)—Of the ordinary garden pink those specimens should be selected for medicinal use which have the deepest red color and the most aromatic odor. The petals should not be collected until the flower is fully blown, and should be employed in the recent state. They have a fragrant odor, thought to resemble that of the clove. Their taste is sweetish, slightly bitter, and somewhat astringent. Both water and alcohol extract their sensible properties, and they yield a fragrant essential oil by distillation. In Europe they are employed to impart color and flavor to a *syrup*, used as a vehicle. The Edinburgh Pharmacopœia directed this to be made by macerating one part of the flowers, without their claws, in four parts of boiling water for twelve hours, then filtering, and adding seven parts of sugar.

Diaphthol. *Quinaseptol. Ortho-oxyquinoline-metasulphonic Acid.* $C_9H_5N.OH.SO_3H$.—Occurs in yellowish-white crystals fusing at 295° C. (563° F.), slowly soluble in cold water. It is an antiferment said to be without toxicity and introduced by Guignard as a urinary disinfectant to replace salol.

Diastin.—A form of diastase introduced for use in certain forms of amylaceous dyspepsia. It is given in the *dose* of five grains (0.32 Gm.).

Diathesin. *Ortho-oxybenzylalcohol. Salicyl alcohol.* $C_6H_4(OH)CH_2OH$.—This phenol-alcohol may be prepared from salicin by the action of dilute acids or emulsin. It forms colorless crystals melting at 86° C. (186.8° F.) and soluble in fifteen parts of water at 22° C. (71.6° F.). It gives a blue color with ferric chloride. This substance has been proposed by L. Lederer (*M. M. W.*, No. 7, 1899) as an antirheumatic and antiseptic. It exists in salicin in combination with glucose, and it is believed by Lederer that the activity of salicin depends not upon the conversion of the ortho-oxybenzylalcohol into salicylic acid, but upon the direct influence of the diathesin. In *rheumatism* it may be given in seven-grain (0.45 Gm.) *doses* every two hours.

Dichloral Antipyrine. $C_{11}H_{12}N_2O.[CCl_3CH(OH)_2]_2$.—Made by triturating 94 parts of antipyrine with 165.5 parts of hydrated chloral and crystallizing from hot water. It differs from hypnal in containing one molecule more of the hydrated chloral. Its uses and dose are the same as hypnal, viz., from five to twenty grains (0.32 to 1.3 Gm.), as an analgesic and hypnotic.

Didymium is now recognized generally as a mixture of *neodymium* and *praseodymium*, the salts of the former being in general rose-colored while those of the latter are of a greenish-yellow. The by-products obtained in the manufacture of gas mantles and certain other chemical manufactures have been utilized in making the salts.

Didymium Chloride, Didymii Chloridum.—This salt has been used in the form of a rose-red, odorless and non-irritant solution containing 25 per cent. to 30 per cent. of the salts. It has been affirmed that the chloride is superior to phenol as a germicide, but the experiments of I. Schmidt and of Pflücker (*M. R.*, 1898, 1900) show that it is much inferior, a 5 per cent. solution being required to destroy ordinary germs.

Didymium nitrate, Didymii Nitras, $Di_2(NO_3)_6.12H_2O$, occurs in rose-colored crystals soluble in water and alcohol. Antiseptic in solution of the strength of 1 in 2000. (*Cb. B.*, xxi.)

Didymium Salicylate. Dymol.—A very fine white powder free from odor. It has been specially recommended by Kopp, Roth, and others as an innocuous, non-irritant, desiccant, and antiseptic dusting powder in various skin diseases, especially in weeping *eczema*, and also *hidrosis*, and *burns* of the first and second degree. In *erysipelas* and drier forms of skin disease it failed to be of service.

Didymium Sulphate, Didymii Sulphas.—This salt has been marketed in the form of a pale rose-red powder to be used for disinfecting closets, etc.

Diervilla. *Diervilla trifida*, Moench. *D. canadensis*, Muhl. *D. Diervilla* (L.), MacM. *Bush Honeysuckle.*—A low, erect indigenous shrub, growing especially in rocky places throughout the Northern States. The whole plant is supposed to be possessed of diuretic and astringent properties, and is given in infusion by the eclectics in diseases of the urinary passages.

Diethylketone.—*Propione*, $C_2H_5.CO.C_2H_5$, is obtained by the dry distillation of *calcium propionate* $(C_3H_5O_2)_2Ca$. A transparent liquid, soluble in twenty-four parts of water, mixing with water, alcohol, and ether, boiling at 101° C.; (213.8° F.); recommended by Albanese and Barabini in 1892, as inducing sleep in animals. It has been used by Giovanni in the treatment of *maniacal* and *hysterical excitement* in *doses* of from eight to twenty grains (0.5–1.3 Gm.). It should be administered in dilute solution.

Diiodacetylene, C_2I_2, is made simultaneously with *tetraiodoethylene*, C_2I_4, by the action of a solution of iodine in potassium iodide upon calcium carbide. The two are separated by reason of their different solubilities. It occurs in small crystalline needles, insoluble in water but dissolving in oil of sweet almond. It has been found by E. Mebert (*A. E. P. P.*, xli. 1898) to be very actively poisonous. This fact, together with its penetrating odor, makes it improbable that it will be of practical value in medicine.

Diiodoform. *Tetraiodoethylene. Ethylene Periodide.* C_2I_4.—Obtained by the action of iodine on a solution of acetylene iodide in carbon disulphide. In the form of bright yellow, odorless, needle-like crystals, insoluble in water, only slightly soluble in alcohol but readily soluble in chloroform. It contains 95.5 per cent. of iodine and is recommended in the place of iodoform. It is decomposed by exposure to light.

Diiodosalol. *Phenyl Diiodosalicylate.* $C_6H_2I_2(OH)CO_2C_6H_5$.—Made by the condensation of diiodosalicylic acid with phenol. An odorless and tasteless crystalline powder melting at 135° C. (275° F.). Used as an antiseptic in the treatment of *skin diseases.*

Dimethyl Sulphate, $(CH_3)_2SO_4$, is a liquid boiling at 188° C. (370.4° F.), soluble in alcohol and ether. This substance has recently come into importance with toxicologists on account of the number of fatal cases of poisoning occurring from it, due to its extended use in chemical factories. It acts locally as a strong caustic and also influences the central nervous system, producing nystagmus, convulsions, and respiratory death during coma. (See S. Weber, *A. E. P. P.*, Bd. xlvii.)

Dinitrocresol. $C_6H_2(NO_2)_2\left\{\begin{matrix}CH_3\\OH\end{matrix}\right.$.—Commercial *Saffron Substitute* is a mixture of the potassium salts of dinitro-ortho- and para-cresols. It is said to have been sold for saffron in Berlin, with fatal results. (*Ph. Rund.*, Prague, 1887.)

Dionine. *Ethyl-morphine Hydrochloride.*—This substance is a white, somewhat bitter, microcrystalline powder fusing at 123° to 125° C. (253.4° to 257° F.), soluble in seven parts of water, one and a half parts of alcohol, and twenty parts of syrup; insoluble in ether and chloroform; precipitated from its solutions by most of the alkaloidal reagents. First brought forward by Ludwig Hesse (*Ph. Cb.*, xl.). It has been reported upon by numerous practitioners. It shares the analgesic and hypnotic powers of morphine, but does not produce the nausea, constipation, and other disagreeable after effects of that alkaloid. Upon the respiratory centres it acts even more powerfully than does morphine. It is at the same time an active antihidrotic, so that it is a most valuable remedy in the treatment of advanced *tuberculosis* of the *respiratory tract.* It has been especially praised as a sedative in cases of *nymphomania, masturbation*, and other forms of *sexual excitement* and irritability. It may be employed in *asthma* and all cases in which there is excessive cough, in all forms of pain, including *dysmenorrhœa*, and indeed in any case in which opium has formerly been used, except when it is desired to check secretion in the intestines. It also has the advantage in not lessening the secretion from the lungs. It is, however, less decisive in its action than is morphine, so that in cases of severe pain morphine will bring relief after the failure of dionine. *Dose*, one-fourth to one-half of a grain (0.016 to 0.032 Gm.), in powder, pills, or solution.

As a local remedy a five per cent. solution of dionine has been considerably employed by ophthalmologists. It produces immediate irritation and great swelling of the conjunctiva, followed in a short time by rapid subsidence of the swelling and a condition of analgesia and anæsthesia. The swelling is produced by the lymphatic inundation, and during the period of subsidence interstitial deposits are likely to be softened and removed. (See H. C. Wood's *Treatise on Therapeutics.*)

Dioscorea. *Dioscorea villosa*, L. *Wild Yam-root. Colic-root. Rheumatism-root.* (Fam. Dioscoreaceæ.)—An indigenous perennial creeper, with long, branching, contorted, ligneous roots. It grows from Ontario to Wisconsin, and south to Florida and Texas. The roots are used by the eclectics, who consider them efficacious in *bilious colic*, and by the Southern negroes in *rheumatism.* W. C. Kalteyer found abundant saponin in the roots. (*A. J. P.*, 1888.) A substance, improperly called

dioscorein, obtained by precipitating the tincture with water, is used in the *dose* of from one to four grains (0.065–0.26 Gm.). *Dose*, of decoction (1 oz. in 1 pint), four to eight fluidounces (120 to 240 Cc.); ten minims to one fluidrachm (0.6–3.75 Cc.) of fluidextract.

Dioscorea hirsuta, Bl., grows in the island of Java, where it is known as *Gadoeng*. In 1894 W. G. Boorsma (*Mededeelingen uit's Lands Plantentuin*, xiii.) separated from it an alkaloid to which he gave the name of *dioscorine*. This alkaloid has been elaborately studied chemically and physiologically by Plugge and Schutte (*A. J. P.*, iv. 1897), who obtained it in crystals having the formula $C_{13}H_{19}NO_3$, and found it to be a convulsant poison, resembling closely in its action picrotoxin, but much more feeble. *Dioscorea bulbifera*, L., grows in the Gaboon country of tropical Africa. Heckel and Schlagdenhauffen found in the tuber a glucoside, together with wax, chlorophyll, saccharose, and resin.

The root of *Dioscorea rhipogonoides*, Oliver, under the names of *Cunao*, *Shu-lang*, *faux gambier*, is exported in enormous quantities from Indo-China to Southern China for use as a dye-stuff.

Diospyros. *Persimmon. Date-plum. Fruits de Plaqueminier de Virginie*, Fr. *Persimmonfrüchte, Dattelpflaumen*, G.—The *Diospyros virginiana*, L., or persimmon (Fam. Ebenaceæ), is a small indigenous tree. The fruit is a globular berry, dark yellow when ripe, and containing numerous seeds in a soft yellow pulp. The seeds, dried, roasted, and ground, are used in some parts of Georgia as a substitute for coffee. (*M. S. Rep.*, 1873, 437.)

This tree, common in the Middle and Southern States, does not flourish beyond the forty-second degree north. The flowers appear in May or June, but the fruit is not ripe until the middle of autumn. While green, the fruit is excessively astringent, and in this form was formerly included in the U. S. Secondary List; but, when perfectly mature, and after being touched by the frost, it is sweet and palatable. The unripe fruit, according to B. R. Smith of Philadelphia, contains tannic acid, pectin, sugar, malic acid, coloring matter, and lignin. (*A. J. P.*, xviii. 167.) The tannic acid was considered by John E. Bryan not to be of the kind existing in galls and oak bark. (*Ibid.*, xxxii. 215.) Charropin (*Pharmacographia*, 403), however, believes the tannic acid to be identical with that of nutgalls, and finds besides an abundance of pectin, glucose, and a yellow coloring matter insoluble in water, but dissolving freely in ether. Wm. Schleif. Jr. (*A. J. P.*, 1890, 390), extracted from persimmon bark a resinoid principle, in the form of crystalline masses, soft and waxy when freshly crystallized from alcohol or ether, drying to a brownish mass of peculiar odor and slightly astringent taste, soluble in alcohol, ether, chloroform, very slightly in water. Heated to 258° C. (496.4° F.) it darkens considerably, and is decomposed at 262° C. (503.6° F.). The persimmon has been used by Mettauer in *diarrhœa*, *chronic dysentery*, and *uterine hemorrhage*. The *dose* of the vinous tincture (an ounce of the fresh green fruit to two fluidounces of dilute alcohol) is a fluidrachm (3.75 Cc.) or more for infants, and half a fluidounce (15 Cc.) or more for adults. The bark is astringent and very bitter.

Dioxynaphthalene, $C_{10}H_8O_2$, may exist in several modifications, the best known being the *α*- and *β-hydronaphthoquinones*. They are diatomic phenols in character. **Lépine** (*S. M.*, No. 31, 1887) finds that dioxynaphthalene produces in dogs and guinea pigs violent convulsions, alteration in the color of the blood, due to the formation of methæmoglobin, and blackening of the urine. He asserts that in asthenic persons *doses* of three grains (0.2 Gm.) a day increase power.

Dippel's Animal Oil. *Oleum Cornu Cervi.* This oil was formerly produced in the process of obtaining ammoniacal products from bone or horn, and is distinguished by the presence of pyridine and quinoline, to which bases its odor is largely due. (See early editions of *U. S. D.*)

Dirca. *Dirca palustris*, L. *Leather Wood.* Fam. Thymelaceæ.—A shrub growing widely in the Northeastern United States. The berries, which are small, oval, and of an orange color, are said to be narcotic and poisonous. The tough bark, in the fresh state, has a peculiar rather nauseous odor, and an unpleasant acrid taste, and when chewed excites a flow of saliva. It yields its acrimony completely to alcohol, but imperfectly to water even by decoction. Six or eight grains of the fresh bark produce violent vomiting, preceded by a sense of heat in the stomach, and often followed by purging. Applied to the skin it slowly excites redness and ultimately vesicates. It is analogous to mezereon in its medicinal as well as botanical characters.

Dithio-Salicylic Acid. $\begin{matrix} C_6H_3(OH)COOH.S \\ C_6H_3(OH)COOH.S \end{matrix}$\>. According to *O. Z.* (1889, 298) dithio-salicylic acid, a proposed substitute for salicylic acid, is made by heating equal molecules of *sulphur chloride* and salicylic acid to from 120° to 150° C. (248°–302° F.), dissolving the light yellow residue in sodium hydroxide, and precipitating the acid, by addition of HCl, as a resinous straw-colored mass, forming, after pulverization, a light yellow powder, easily soluble in alcohol, benzene, and glacial acetic acid. The sodium salt of the acid, *sodium dithio-salicylate*, called also *dithion*, is said by Lindenborn (*Rép. de Pharm.*, Sept. 1889) to be preferable in the treatment of *rheumatism* to salicylic acid, because more energetic and less apt to disturb the digestion. It is asserted that, as an antiseptic, it is fully equal to *sodium salicylate*. *Dose*, three grains (0.2 Gm.), repeated according to circumstances. Ten grains (0.65 Gm.) are said to produce nausea, tinnitus aurium, and sweating.

Doundaké. *Dundaki, Quinquina Africaine. Kina du Rio Nunez.—Sarcocephalus esculentus*, Afzel (Fam. Rubiaceæ), of Africa yields a bark which is said to be an astringent and tonic febrifuge. For a description of the bark and its chemical characteristics, see *P. J.*, vol. xvi. 49. Heckel and Schlagdenhauffen do not believe that doundaké contains an alkaloid, but attribute its power to three distinct principles of a resinous nature, the first of which is of an orange-yellow color and very bitter, soluble in water, alcohol, and potassium hydroxide; the second light yellow in color, soluble in potassium hydroxide but not in water; the third soluble in potassium hydroxide, insoluble in water and in alcohol. (*J. Soc. Chem. Ind.*, 1886, 435.)

Dracontium. *Spathyema fœtida* (L.), Raf. *Skunk Cabbage. Skunk Weed. Polecat Weed. Racine de Pothos fétide*, Fr. *Stinkende Drachenwurzel*, G. *Dracontium fœtidum*, L. *Ictodes fœtidus*, Bigelow.—This plant is abundant in wet places throughout the Northern and Middle United States. All parts of it have a fetid odor, de-

pendent upon an extremely volatile principle, which is rapidly dissipated by heat. The rhizome should be collected in the autumn, or in the early spring.

The rhizome occurs either whole or in transverse slices. When entire, it is cylindrical or in the shape of a truncated cone, two or three inches long by about an inch in thickness, externally dark brown and very rough from the insertion of the radicles, internally white and amylaceous. The rootlets are of various lengths, about as thick as a hen's quill, very much flattened and wrinkled, white within, and covered by a yellowish or reddish-brown epidermis, considerably lighter colored than the body of the rhizome. The odor is fetid, the taste acrid; both are lessened by drying and progressively diminish with time, so that the dried rhizome should not be kept longer than a single season. This acrimony is entirely absent in the decoction. The seeds are very acrid, and, though inodorous when whole, give out, when bruised, the peculiar odor of the plant.

The rhizome is affirmed to be antispasmodic and narcotic; occasioning nausea and vomiting, with headache, vertigo, and dimness of vision. It has been used with alleged success in *asthma, chronic catarrh, chronic rheumatism, chorea, hysteria,* and *dropsy. Dose,* of powder, from ten to twenty grains (0.65–1.3 Gm.), increased *pro re nata.*

Dragon's Blood. *Sanguis Draconis. Sang-dragon,* Fr. *Drachenblut,* G. *Sangre de drago,* Sp.—This is a resinous substance obtained from the fruit of several species of *Dæmonorops,* especially *D. Draco* (L.), Blume (*Calamus Draco,* L.) (Fam. Palmaceæ), small palms, growing in Siam, the Molucca Islands, and other parts of the East Indies. On the surface of the fruit, when ripe, is an exudation, which is separated by rubbing, or shaking in a bag, or by exposure to the vapor of boiling water, or finally by decoction. The finest resin is procured by the two former methods. It comes in two forms: sometimes in small oval masses (*tear dragon's blood*) of a size varying from that of a hazelnut to that of a walnut, covered with the leaves of the plant, and connected in a row like beads in a necklace; sometimes in cylindrical sticks, eighteen inches long and from a quarter to half an inch in diameter, thickly covered with palm leaves, and bound round with slender strips of cane. In both these forms it is of a dark reddish-brown color, opaque, and readily pulverizable, affording a fine scarlet powder. It sometimes comes also in the form of a reddish powder. An inferior kind, said to be obtained by boiling the fruit in water, is in flat circular cakes (*cake dragon's blood*), two or three inches in diameter and half an inch thick. This also yields a fine red powder. A fourth variety, much inferior even to the last mentioned, is in large disks, from six to twelve inches in diameter by an inch in thickness, mixed with various impurities, as pieces of the shell, stem, etc., and supposed to be derived from the fruit.

According to the British Resident at Pontianak (1891), dragon's blood is sent into commerce from Pontianak, first, in flat cakes of various dimensions; second, in small cakes from three to seven inches long and an inch wide; third, in long pipes, while the regular cakes of dragon's blood, three inches wide, three inches long, and a quarter-inch thick, are manufactured at Singapore. One substance known by the name of dragon's blood is derived by exudation from the trunk of *Dracæna Draco,* L. (Fam. Liliaceæ), a large tree inhabiting the Canary Islands and the East Indies, and another from *Pterocarpus Draco,* L. (Fam. Leguminosæ), a tree of the West Indies and South America, by incision into the bark; these, however, are little known in commerce. *Drop dragon's blood* is the product of the *Dracæna schizantha,* Baker (Fam. Liliaceæ), of Socotra. It is occasionally seen in the London market. It is in small tears and fragments, seldom exceeding an inch in length, has a clean glassy fracture, and in thin pieces is transparent and of a splendid ruby color. It may be distinguished from true dragon's blood by the absence of shell-like scales, and by not evolving the irritating fumes of benzoic acid when heated.

Dragon's blood is inodorous and tasteless, insoluble in water, but soluble in alcohol, ether, and the volatile and fixed oils, with which it forms red solutions. According to Herberger, it consists of 90.7 parts of a red resin, which he calls *draconin,* 2.0 of fixed oil, 3.0 of benzoic acid, 1.6 of calcium oxalate, and 3.7 of calcium phosphate. Tschirch (*Harze und Harzbehälter,* 1900, p. 189) has made an elaborate study of dragon's blood, and finds 2.5 per cent. of *draco-alban,* $C_{20}H_4O_4$, a white substance melting with decomposition at about 200° C.; 13.58 per cent. of *draco resen,* a yellow resinous substance of the formula $C_{26}H_{44}O_2$, and 56.86 per cent. of *draco resin,* a resin ester or mixture of esters, *benzoic dracoresinotannol ester* and *benzoylaceticdracoresinotannol ester,* and 18.4 per cent. of insoluble substances. It was formerly employed in medicine as an astringent, but is nearly or quite inert, and is now never given internally. It is sometimes used to impart color to plasters.

Drosera. *Sundew. Herba Rorellæ. Rossolis. Rosée du Soleil,* Fr. *Sonnenthau,* G.—*Drosera rotundifolia,* L., and *D. longifolia,* L. (Fam. Droseraceæ), are said to be useful in *phthisis,* but they are probably of no value. (See *Proc. A. Ph. A.,* xxvii. 225.)

Duboisia.—*D. myoporoides,* R. Br. (Fam. Solanaceæ), is a tall, glabrous shrub or small tree, which is a native of Australia, New South Wales, New Caledonia, and Queensland. The medicinal properties of this plant were made known by Baron von Mueller, who received the leaves from J. Bancroft. The alkaloid *duboisine* was discovered in the leaves by A. W. Gerrard (*P. J.,* viii. 787). For his method, see 16th ed. *U. S. D.;* also, for an account of the chemical and medicinal properties of this alkaloid, and its relations to atropine, see *Belladonna,* page 227.

According to the researches of Jos. Lanterer (*L. L.,* 1896), the old leaves and twigs of *Duboisia myoporoides,* R. Br., contain hyoscyamine, the fresh young leaves scopolamine, the dried leaves being stronger than are belladonna leaves, and yielding 0.97 per cent. of alkaloid. *Duboisia Leichhardtii,* F. Muell., is said to be still richer in alkaloid, which is chiefly amorphous scopolamine; while the leaves of *Datura arborea,* L. (*Brugmansia arborea,* Steud.), and of *D. cornigera,* Hooker (*Brugmansia Knightii,* Hort.), natives of South America acclimatized in Queensland, contain a mixture of hyoscyamine and atropine.

D. Hopwoodii, F. Muell., is the source of *pituri,* a narcotic stimulant largely used by the natives of Central Australia. The drug itself is a fine powder, composed of the leaves and twigs which are gathered during the month of August, while the flower is in bloom, and are put up in various forms of circular mats about six inches in diameter.

The natives smoke and chew pituri, and it is alleged to have a powerfully stimulating effect, assuaging hunger, and enabling those who are its devotees to perform much labor and go long journeys with but little food. Pituri yielded to A. W. Gerrard minute quantities of an alkaloid which he believed to be identical with nicotine, but Liversidge has shown that the liquid, acrid alkaloid, *piturine*, $C_{12}H_{16}N_2$, is distinct from nicotine. (*Proc. Roy. Soc. N. S. W.*, 1880.) Pituri contains from 1 to 2½ per cent. of the alkaloid.

Echinacea. *Brauneria pallida* (Nutt.), Britton (*Echinacea angustifolia*, DC., *Rudbeckia pallida*, Nutt.). *Nigger-head, Sampson-root, Pale Purple Cone-flower.*—This composite plant, a native of the prairie region of America west of Ohio, has been introduced by the so-called eclectic physicians as a remedy in divers dissimilar diseases. The root occurs in irregular cylindric pieces with shrunken epiderm wrinkled longitudinally or spirally, of a thickness ranging from one-quarter to one-half of an inch; the taste is at first sweetish and subsequently acrid and tingling. C. G. Lloyd believes that he has found in it minute quantities of an inactive alkaloid but that the active substance is a resinous body. (*Eclec. Med. Journ.*, 1897.) Echinacea is said by eclectic physicians to be an effective alterative in all septic diseases, also useful in *fermentative dyspepsia*, and in *intestinal indigestion*. It is also used by these practitioners locally in *mastitis, cancers, boils, abscesses*, and all forms of *infective wounds*. Lloyd states that the best preparation is the fluidextract, or tincture made with a menstruum of alcohol and water, four parts to one. The fluidextract is recommended in *doses* of from two to thirty minims (0.12 to 1.8 Cc.). J. C. Stinson (*T. G.*, 1900) recommended the local application of the undiluted fluidextract to the glans and its corona as an aphrodisiac, and E. Hale (*Lancet Clinic*, March, 1901) injects from two to six drachms (7.7 to 23.5 Gm.) of the extract into the rectum for the cure of *hemorrhoids*.

Brauneria purpurea (L.), Britton (*Rudbeckia purpurea*, L., *Echinacea purpurea*, Moench), *Black Sampson, Purple Cone-flower* (Virginia to Illinois and southward to Louisiana), has similar properties to *B. pallida*, and is similarly used.

Eggs.—The egg of the ordinary hen consists of an exterior covering, the shell; a white, semi-opaque membrane; the white; and the yolk.

The shell—*testa ovi* or *putamen ovi*—consists, according to Vauquelin, chiefly of calcium carbonate, with animal matter, and a minute proportion of calcium phosphate, magnesium carbonate, ferric oxide, and sulphur. When exposed to a high degree of heat in the open air, the carbon dioxide is driven off, the animal matter consumed, and the lime left nearly pure. The membrane lining the shell appears to be of an albuminous nature. The white—*albumin* or *albumen*, Br. 1898—is a glairy viscid liquid, contained in very delicate membranes, without odor or taste, readily soluble in water, coagulable by the stronger acids, by alcohol, and by a heat of 56° C. (132.8° F.). Exposed in thin layers to a current of air, it becomes solid, retaining its transparency and solubility in water. By coagulation it is rendered white, opaque, and insoluble. At a temperature of 100° C. (212° F.), one part of it renders opaque one thousand parts of water in which it has been dissolved. It contains, according to Bostock, in 100 parts, 85 of water, 12 of pure albumin, 2.7 of mucus or uncoagulable matter, and 0.3 of salts, including sodium hydroxide and traces of sulphur. The white of eggs is precipitated by stannous chloride, gold chloride, lead subacetate, copper sulphate, corrosive sublimate, and tannin. When kept in the fluid state it soon putrefies; but if carefully dried without coagulation it may be preserved unaltered a long time, and may be readily redissolved in water.

The yolk—*vitellus*, U. S. 1890—is inodorous, of a bland oily taste, and forms an opaque emulsion when agitated with water. By heat it is coagulated into a granular solid, which yields a fixed oil by expression. The researches by Gobley and others have established the constitution of the yolk about as follows: water, 51.8 per cent.; vitellin, 15.8 per cent.; nuclein, 1.5 per cent.; palmitin, stearin, and olein, 20.3 per cent.; cholesterin, 0.4 per cent.; phosphoglyceric acid, 1.2 per cent.; lecithin, 7.2 per cent.; cerebrin, 0.3 per cent.; coloring matter, 0.5 per cent.; salts, 1.0 per cent. (König, *Nahrungs- und Genussmittel*, 180.) Vitellin belongs to the class of globulins, and, while not precipitated from its solution by sodium chloride, is precipitated completely on saturation of its solution with ammonium sulphate. Chevreul states that there are two coloring principles, one reddish containing iron, the other yellow and similar to the coloring matter of bile. The former is more difficultly soluble in ether than the latter. (*N. R. Pharm.*, 1867, xvi. 697.) It is said that the yolk may be kept for a considerable time without observable change by adding to it 5 per cent. of sodium sulphate, in powder or concentrated solution. Granules have been found, with the aid of the microscope, in the yellow of the egg, which are rendered blue by iodine, and have all the other properties of the starch granules. (*J. P. C.*, Oct. 1868, 261.) See *Glyceritum Vitelli*, page 860.

The *white* of egg is used chiefly for the clarification of liquids, which it effects by involving, during its coagulation, the undissolved particles, and rising with them to the surface, or subsiding. It is highly recommended as an antidote for corrosive sublimate and copper sulphate, with which it forms insoluble and comparatively inert compounds. It is sometimes also used for the suspension of insoluble substances in water, but is inferior for this purpose to the yolk, and even to mucilage of gum arabic. Agitated briskly with a lump of alum, it coagulates, at the same time dissolving a portion of the alum, and thus forming the so-called *alum curd*, which is used between folds of gauze over the eye, in some states of *ophthalmia*. It is also used in the official pepsin valuation.

The *yolk* in its raw state is thought to be laxative. In pharmacy, the yolk is highly useful as an intermedium between water and insoluble substances, and is to be preferred to the white in preparing emulsions.

Egols.—This name has been applied by E. Gautrelet (*C. R. A. S.*, 1899, 11) to a large series of substances introduced by him. They are *o-nitro-parasulphonates* of phenol, cresol, and thymol, in chemical combination with mercury and potassium. The egols are permanent compounds which crystallize with difficulty in rhombohedra, but which occur in commerce as reddish-brown powders, soluble in any proportion of water, forming odorless and tasteless solutions, neutral in reaction, and free from caustic or irritant character. In solutions of 0.4 per cent. they are said to be actively inhibitory to the growth of germs, and

in stronger solutions powerfully bactericidal. It is claimed for them also that they are not poisonous to man, although when given in overdoses they sometimes act as an emetic.

Eigones.—This name has been given to certain albuminous compounds of iodine and bromine which, when taken into the alimentary canal or brought in contact with wounds or ulcerated surfaces, undergo decomposition with liberation of their active substances.

Bromeigone is a white, almost odorless, and tasteless powder, insoluble in water, and contains on an average 11 per cent. of bromine in organic combination.

Iodine eigones: Alpha-eigone is a compound of iodine and albumin and appears as a light brown powder without odor or taste; contains about 20 per cent. of iodine. *Alpha eigone-sodium* is a light colored, almost white, powder, containing about 15 per cent. of iodine. It is moderately soluble in cold and more readily in hot water. *Beta-eigone* is a *peptonized iodized iodoeigone*, readily soluble in water; eigone soap contains 5 per cent. of *iodoeigone*. Internally the iodine eigones have been used in *doses* of from six to nine grains (0.4–0.6 Gm.), best given in the form of pill, in *syphilis, rheumatism, bronchitis, asthma*, and other conditions in which potassium iodide is employed. They produce the ordinary symptoms of iodism when given in sufficient amount, but are said to have the great advantage over the older iodides of not irritating the stomach. As a local application they are employed in all forms of external infective wounds, in *nasal catarrh, tuberculosis, ulcers, abscesses*, and in the class of cases in which iodoform has been hitherto employed. It is claimed for them that they are innocuous, but it is certain that if they do undergo decomposition in the wound with the liberation of iodine they must be capable of producing symptoms similar to those which have so often followed the surgical use of iodoform.

Peptoneigone is a peptonized bromine albumin compound which is comparatively readily soluble in water. It also contains about 11 per cent. of combined bromine. It is odorless and tasteless. Traces of hydrogen bromide are sometimes present as an impurity. The bromeigones are supplied commercially in the form of *bromeigone, brompeptone* or *peptonebromeigone*, and are odorless, tasteless powders. Bromeigone is insoluble, peptonebromeigone is soluble in water. The bromeigones have been given internally as substitutes for the bromides in various diseases. The *dose* of each of them varies from two grains (0.13 Gm.) up to a daily dose of a drachm (3.9 Gm.) in *epilepsy*.

Ektogan is the name given to *zinc peroxide*, ZnO_2, which has been recommended for external application; it liberates hydrogen dioxide. It is a yellow, odorless, and tasteless powder.

Embelia. *Br. Add.*—"The fruit of *Embelia Ribes*, Burmann, and of *Embelia robusta*, Roxb." This berry-like fruit grows in large bunches; it is of a dull red color, is about one-sixth of an inch in diameter and contains a reddish, horny seed dotted with whitish spots. C. H. Warden separated from it (*P. J.*, Jan. 1888) the brilliant golden spangles of embelic acid, and L. Scott has determined the presence in the fruit of a volatile oil and an alkaloid *christembine*. Under the names of *viranga, vayvirang, birang-i-kabuli* it has long been employed in India as an anthelmintic and has found its way into European commerce. It is sometimes used to adulterate cubeb and black pepper. It has but slight laxative properties, so that it is better to follow it by a purgative. It is especially tænicidal, the *tape worm* being expelled dead. One to four drachms (3.9–15.5 Gm.) of the powder may be given in milk early in the morning. Warden has found that *ammonium embelate* is an effective *tænicide* in *doses* of three grains (0.2 Gm.) for children and six grains (0.4 Gm.) or more for adults. As it is nearly tasteless and soluble it may be readily administered in syrup.

Emery. *Lapis Smiridis, s. Smiris. Emeri, Corindon granuleux ferrifère*, Fr. *Smirgel, Schmirgel*, G.—A very hard mineral, the powder of which is capable of wearing down all other substances except the diamond. It was formerly derived almost solely from the island of Naxos, in the Grecian Archipelago. According to Landerer, it has been found in Asia Minor and the Morea, and it occurs in Chester, Hampden County, Mass. (See J. Lawrence Smith, *Am. J. Sci.*, 1866, xlii.) Emery is pulverized by grinding it in a steel mill, and the powder is kept in commerce of different degrees of fineness. It is used for polishing metals and hard stones. Compact corundum is now ground extensively for the manufacture of emery wheels, etc. Corundum is found abundantly in Northern Georgia, in North Carolina, and in Chester County, Pennsylvania, U. S. Emery is being steadily replaced in use by the new product of the electric furnace, *carborundum*.

Emodin.—This compound, now recognized as *trioxymethylanthraquinone*, $C_{14}H_4(CH_3)(OH)_3O_2$, (see *Rheum*, 1059), as prepared from aloes, forms orange-red needles, melting at 216° C. (420.8° F.). It may be prepared from barbaloin by extraction with ether, in which the emodin is soluble, while the aloin is left undissolved. This ethereal extract turns red on the addition of ammonia (Borntraeger's reaction for oxymethylanthraquinones).

According to Tschirch, aloe-emodin is a certain, moderate purge in man, in *doses* of one and three-tenths grains (0.085 Gm.), frangula emodin having about the same purgative strength. In view of the fact that in Barbados aloes there is only 2 per cent. of aloe-emodin, that in rhubarb there is only 2 per cent. of rhubarb-emodin with 4 or 5 per cent. of chrysophanic acid, and that in senna the percentage of emodin is much less than these figures, the belief of Tschirch that emodin is the active principle of these drugs seems highly improbable. It constitutes only a fraction of aloin, but has to be given in four or five times the dose of aloin to have purgative effect. In Tschirch's estimation, the superior activity of crude drugs is due to the presence in them of educts produced by oxidation or hydrolysis from the oxymethylanthraquinone. The experiments of Asher, upon which Tschirch bases his belief that in the emodin group the purgation is caused by local stimulation of the nerve endings in the intestinal mucous membranes and reflexly excited peristalsis, were certainly not sufficient in number or thoroughness to establish the correctness of the theory.

Endermol is a compound ointment vehicle containing hydrocarbons of the paraffin series and stearic acid amide. (Coblentz, *M. News*, Sept. 3, 1904.)

Eosin. $C_{20}H_8Br_4O_5$.—A dye obtained by the action of phthalic anhydride upon phenols and introduction of bromine into the product. When phthalic anhydride acts upon resorcinol, C_6H_4

$(OH)_2$, in the presence of a dehydrating agent like sulphuric acid or stannic chloride, at a temperature of 120° C. (248° F.), there is formed a compound *resorcinphthalein*, $C_{20}H_{12}O_5$, better known as *fluorescein*. By the action of bromine upon this is formed *tetrabrom-fluorescein* or *eosin*, $C_{20}H_8Br_4O_5$. Soluble eosin is the potassium salt of this compound, $C_{20}H_6Br_4O_5K_2$. It forms a bronze-colored crystalline powder having a strong green reflection. Its solution in water is a red liquid having a fine green fluorescence. On the addition of hydrochloric acid the fluorescence is destroyed, the liquid becoming yellow. Eosin is largely used at present as a dye; to make a brilliant *red ink*, dissolve 5 grains of eosin and 10 grains of gum arabic in a fluidounce of water.

Ephedra. *Ephedra vulgaris*, L. (Fam. Gnetaceæ.)—Nagai has extracted from this Japanese plant an alkaloid, *ephedrine*, which, according to Kinnossuke, produces in the lower animals acceleration of the pulse, with lowering of the blood pressure, elevation of the rectal temperature, dilatation of the pupils, convulsions, and death by arrest of the heart and respiration. (*B. K. W.*, No. 38, 1887.) Scriba found that a 10 per cent. solution dilates the pupil with certainty, in from forty to sixty minutes, without irritation, the dilatation not being complete, and the accommodation not at all or only slightly affected, and the pupils returning to normal in from five to twenty hours. An alkaloid has also been discovered in *Ephedra distachya*, L., a shrub whose branches and root are used in Siberia as a powerful remedy in *gout* and *syphilis*. According to Kobert, this alkaloid is essentially different from *ephedrine*, in not being mydriatic or poisonous. P. Spehr (*A. J. P.*, 1892, 234) considers that *E. vulgaris* contains two alkaloids, *ephedrine* and *pseudo-ephedrine*, isomeric and of the formula $C_{10}H_{15}NO$, while *E. monostachya* contains a crystalline base melting at 112° C. (233.6° F.) and having the formula $C_{13}H_{19}NO$. This latter, as stated by Kobert, is not mydriatic or poisonous. According to Günsberg, pseudoephedrine is a powerful mydriatic, its 10 per cent. solution causing in fifteen minutes dilatation of the eye through excitement of the sympathetic nerve.

Ephedra nevadensis, S. Wats., and *E. antisyphilitica*, C. A. Meyer, which grow abundantly in the extreme Western United States, are much used under the names of *cayuote*, *canutillo*, *whorehouse tea* as a remedy in *gonorrhœa*. Loew thinks that their virtues reside in a peculiar tannin. *Dose*, of fluidextract, from one to two fluidrachms (3.75–7.5 Cc.). In Texas *E. trifurca*, Torr., is similarly employed.

Epicarin.—A condensation product of *creosotinic acid* and naphthol which, according to Eichengrün, is *β-oxynaphthyl-o-oxy-meta-toluylic acid* thus: $C_6H_3\begin{cases}COOH\\OH\\CH_2—C_{10}H_6OH\end{cases}$. Epicarin forms slightly yellowish crystals or powder, with a faint odor, melting at 199° C. (390.2° F.), difficultly soluble in water but freely soluble in alcohol and ether as well as in soaps. It is said to be slightly poisonous, and was primarily introduced into veterinary medicine especially for the treatment of *mange*, but has been used by Kaposi, Monti, and other dermatologists in *scabies*, *ring-worm*, *prurigo*, and allied skin diseases as a substitute for naphthol. Its application is sometimes followed by irritation, which, though usually slight, may lead to papular and eczematous eruptions. It is claimed that the remedy is less poisonous than naphthol. In Kaposi's clinic no toxic symptoms followed covering the entire body of children with 10 per cent. ointment. Five to twenty per cent. ointment is used *pro re nata*.

Epidermin.—A surgical dressing made by fusing 15 Gm. of white wax, and triturating in a warm mortar with 15 Gm. of powdered acacia until uniform, and adding a boiling mixture of 15 Gm. each of water and glycerin, and stirring until cold. Valentine and Schwarz have given the name epidermin to an ointment vehicle said to be composed of fluorxylol and difluordiphenyl.

Epigæa. *Epigæa repens*, L. *Trailing Arbutus. Ground Laurel. Mayflower. Gravel plant.*—This is a small trailing ericaceous plant, with woody stems from six to eighteen inches long, entire, cordate-ovate leaves, and small, very fragrant flowers, which appear early in the spring. It is found in the woods, and grows on the sides of hills with a northern exposure. Darlington states that the plant has been supposed to be injurious to cattle, when eaten by them. (*Flora Cestrica*, 259.) Jefferson Oxley has found in this plant *arbutin*, $C_{12}H_{16}O_7$, *urson*, $C_{20}H_{32}O_2$, *ericolin*, $C_{34}H_{56}O_{21}$ (the same constituents as are in uva ursi), tannic and formic acids, and a principle allied to gallic acid. (*A. J. P.*, xliv. 253.) Thal gives the simpler formula $C_{26}H_{30}O_3$ to ericolin. Eli Ives of New Haven, Connecticut, in 1849, highly commended epigæa as a substitute for uva ursi, and we now know that the two drugs contain the same active principles. The decoction of the leaves and stem may be used freely.

Epilobium. *Epilobium angustifolium*, L. *Chamænerion angustifolium* (L.), Scop. *Willow-herb. Herbe de St. Antoine*, Fr. *Weidenröschen, Antonskraut*, G. (Fam. Onagraceæ.)—There are several indigenous species of Epilobium, which have the common name of willow-herb from the resemblance of their leaves to the willow, and probably have nearly identical properties. The *E. angustifolium*, L., is the largest of them. Its leaves and roots are said to be demulcent, tonic, and astringent, and yield their virtues to water and alcohol. They are used by the eclectics, generally and locally, in decoction, infusion, or cataplasm, as astringents. Oliver reports (*B. M. J.*, ii. 1897) violent poisoning with epileptiform convulsions caused by *E. hirsutum*, L. Under the name of *Kaporie tea* the leaves of *E. angustifolium* and of *E. hirsutum* are largely used in Russia as a beverage.

Epiosin, $C_{16}H_{12}N_2$, crystallizes in glassy prisms melting at 195° C. (383° F.), readily soluble in alcohol and chloroform. It is a synthetic compound, produced by E. Vahlen, who claims for it the anodyne action of morphine without its objectionable after results. Chemically it is a *methyl-diphenylenamido-azol*. (*A. E. P. P.*, 47 to 368.)

Epithol.—*Epithol gold* and *epithol silver* are finely powdered copper and tin, which have been used in veterinary medicine by L. Hoffmann as a local application to *wounds*. (*B. Thier. W.*, 1902.)

Equisetum. *Equisetum hyemale*, L. *Horsetail. Scouring Rush. Préle*, Fr. *Schachtelhalm*, G. (Fam. Equisetaceæ.)—An indigenous plant, with slender annual stems from a foot and a half to three feet high, growing abundantly in the Northern States, and preferring wet places, as the banks of streams, etc. The plant derives its name of scouring rush from its use in scouring, for which it is fitted by the silicious character of the stems. Examined by F. J. Young (*A. J. P.*, 1886, 419), it yielded to petroleum benzin as a solvent 1.4 per

cent. of a brownish-green, semi-liquid, fixed oil, which was readily saponified. It also contained a green semi-solid resin, sugar, and mucilage. The infusion of the whole plant has the reputation of being diuretic, and is used sometimes in *dropsical* and *renal diseases*.

Erechthites. *Erechthites hieracifolia* (L.), Raf. *Fire-weed.*—An annual indigenous composite plant, growing in moist woods and recent clearings, and having a rank somewhat aromatic odor. Its taste is bitterish, slightly acrid, and disagreeable. It yields its virtues to water. It has been especially recommended in *dysentery*. It is prone to infest the peppermint fields of Michigan, and its oil is said sometimes to deteriorate the oil of peppermint from that region. It has been shown, however, that *Leptilon canadense* (L.), Brit., is far more injurious.

Ergotinol.—*Liquor Ammonii Ergotinatis*, a preparation of ergot made by Vosswinkel, sixteen minims (1 Cc.) corresponding to eight grains (0.5 Gm.) of extract of ergot. The *dose* for subcutaneous injection is sixteen minims (1 Cc.). It is recommended in excessive *menorrhagia*.

Erigeron. *Fleabane. Scabious. Sweet Scabious. Daisy Fleabane. Herbe d'érigeron, Herbe de Vergerette*, Fr. *Berufkraut*, G.—Under this name the U. S. Pharmacopœia of 1870 recognized the herbal portions of *Erigeron annuus* (L.), Pers. (*E. heterophyllus*, Muhl.) and *E. philadelphicus*, L. (Fam. Compositæ.)

E. annuus is a biennial herbaceous plant, belonging both to North America and to Europe. The lower leaves are ovate, acute, deeply toothed, with long winged footstalks; the upper are lanceolate, acute, deeply serrate in the middle, and sessile; the floral leaves are lanceolate and entire; all, except the radical, are ciliate at the base.

Erigeron ramosus (Walt.), B. S. P. (*E. strigosus*, Muhl.) grows with *E. annuus*, and is frequently collected with it. It is distinguished by its leaves being nearly entire, and by both stems and leaves being almost smooth or furnished only with minute appressed hairs.

Erigeron philadelphicus, L. *Philadelphia fleabane* is perennial and herbaceous, with a branching yellowish root, and from one to five erect stems. The whole plant is pubescent. The lower leaves are ovate-lanceolate, nearly obtuse, ciliate on the margin, entire or marked with a few serratures, and supported on very long footstalks; the upper are narrow, oblong, somewhat wedge-shaped, obtuse, entire, sessile, and slightly embrace the stem; the floral leaves are small and lanceolate.

The three species are abundant in the middle portions of the United States, grow in open fields, and are probably of identical medicinal value. They are popularly known as *scabious*. The whole herb is used, and should be collected while the plants are in flower. It has a feebly aromatic odor and bitterish taste, and imparts its properties to boiling water. F. L. John of Philadelphia, obtained from *E. philadelphicus* a volatile oil by distillation, but in exceedingly small proportion, forty-five pounds of the herb having yielded only half a drachm of the oil. As described by Procter, this is of a greenish-yellow color, a powerful, penetrating, aromatic odor, and a bitterish, pungent, disagreeable taste. It is more viscid than the oil of *Leptilon canadense*, has a higher sp. gr. (0.946), and contains more oxygen. (*A. J. P.*, xxvii. 105.) Fleabane is diuretic and stomachic, and has been used in *gravel* and in *dropsy*.

The U. S. Pharmacopœia also formerly recognized, as *Erigeron canadense*, the plant known to botanists as *Leptilon canadense* (L.), Britt. (*Erigeron canadense*, L.) *Horseweed. Mare's tail. Fire-weed. Butter-weed. Colt's-tail. Canada fleabane* is an indigenous annual plant; an allied species, *L. divaricatum* (Michx.), Raf. (*Erigeron divaricatum*, Michx.), is not more than from three to twelve inches high, and has an erect smooth stem, less branched than the preceding, with all its leaves entire, and scabrous on the margin. The panicle is simple, and the peduncles filiform, nearly naked, divaricate, each bearing two or three flowers.

Canada fleabane is very common throughout the northern and middle sections of the United States, and has become naturalized in many parts of Europe. It abounds in neglected fields, and is reported to be a very troublesome weed on the peppermint plantations of the West. It blooms in July and August. The plant, all parts of which are medicinal, should be collected while in flower. The leaves and flowers are said to be the most active parts. It has a characteristic odor, and a bitterish, acrid, somewhat astringent taste. Among its constituents, according to De Puy, are bitter extractive, tannin, gallic acid, and volatile oil. Both alcohol and water extract its virtues. Its acrimony is diminished by decoction, in consequence, probably, of the escape of the oil, upon which its virtues in part depend. (See *Oleum Erigerontis Canadensis*.) According to De Puy, Canada fleabane is diuretic, tonic, and astringent; and useful in *dropsical complaints* and *diarrhœa*. It has been given in substance (*dose*, a drachm, or 3.9 Gm.), infusion, tincture, or extract (*dose*, ten grains, or 0.65 Gm.), but the oil is the only proper preparation. The oil is of value in *uterine, pulmonary*, and other *internal hemorrhages*, in *doses* of from five to fifteen minims (0.3–0.9 Cc.), every two hours.

Eriobotrya. *Eriobotrya japonica*, Lindl. *Loquat.* (Fam. Rosaceæ.)—The seeds and leaves of this tree are said to contain amygdalin and emulsin, and to yield hydrocyanic acid in poisonous quantities. (*P. J.*, Aug. 1885.)

Erodium. *Erodium Cicutarium* (L.), L'Herit. *Storks-bill.*—An annual hairy plant belonging to the Geraniaceæ. It is highly recommended by W. Abbotts Smith in *dropsy*. (See *Am. J. M. S.*, 1865.)

Eryngium. *Eryngium aquaticum*, L. *Button Snakeroot. Corn Snakeroot. Rattlesnake's Master.*—The *button snakeroot* or *water eryngo* is an indigenous umbelliferous plant which grows in low wet places, as far south as Florida and Texas. The root, which is the medicinal portion, has a bitter, pungent aromatic taste, provoking, when chewed, a flow of saliva. It is said to be diaphoretic, expectorant, in large *doses* emetic, and the plant has been used as a substitute for senega. (Bigelow.)

Erythrina.—The bark of the Australian species of this genus, *Erythrina Broteroi*, is said to contain an alkaloid, *erythrinine*, while the Mexican species, *Erythrina coralloides*, DC., bears poisonous seeds in which Altamirano has found *erythroidine*, a powerful paralyzant of the motor system, *erythroresin*, an emetic, *coralin* and *erythric acid*. The *extract* has been suggested as a substitute for curare. (*B. S. Ph. Br.*, 1900.)

Erythrina Lithosperma, Blume. (*Hypaphorus subumbrans*, Hasskl.)—From the seeds of this beautiful leguminous tree, largely grown for

shade in the coffee gardens of Java, P. C. Plugge has obtained *hypaphorine*, a tetanizing alkaloid. (*A. E. P. P.*, xxxii.)

Erythrol Tetranitrate. $C_4H_6(NO_3)_4$.—Erythrol tetranitrate is solid and crystalline, and melts at 61° C. (142° F.). When pure it is colorless, and if kept in a dark and moderately cool place is fairly stable. If exposed to warmth, and especially sunlight, it rapidly undergoes decomposition, turning yellow and giving off nitrous fumes. It is also capable of rapid decomposition, and death has been caused by the explosion following its trituration in a mortar with glucose. (*B. M. J.*, i. 1896.) Its solubility in water is slight, but it dissolves readily in alcohol and in ether. It is a vaso-dilator, and belongs to the group of which glyceryl trinitrate (glonoin) or nitroglycerin is the representative. Blood pressure experiments show that the nitrates of erythrol and mannitol have a less marked but more prolonged action than those of glycerol and glycol. In man the effects of the remedy are said not to be apparent in less than half an hour and to last for over an hour. It may be used in all cases for which glyceryl trinitrate is employed, and has been especially commended in *angina*. Its alcoholic solution is explosive, so that it should always be used in tablets, in preparing which great care is necessary. *Dose*, from a half to one grain (0.032–0.065 Gm.).

Erythronium. *Erythronium americanum*, Ker. (*E. lanceolatum*, Pursh.)—This is an indigenous, perennial, liliaceous plant, sometimes called, after the European species, *dog's-tooth violet*. It grows in woods and other shady places from Nova Scotia to Florida and west to Minnesota and Arkansas. It flowers in the latter part of April or early in May. All parts of it are active. In the *dose* of twenty or thirty grains (1.3 or 2.0 Gm.) the recent bulb is emetic. The leaves are said to be more powerful. The activity of the plant is diminished by drying.

Eschscholzia. *Eschscholzia californica, Chamisso.*—Attention has been brought to this Californian member of the Papaveraceæ, as a powerful soporific and analgesic, which is free from the disadvantages of opium. Bardet and Adrain (*G. H. M. C.*, Nov. 1888) assert that they have obtained a glucoside, an alkaloid, and morphine in the proportion of from five to six grains in two pounds of the dried product. According to Fischer and Tweeden, there are seven alkaloids in *Eschscholzia californica; protopine*, *β-* and *γ-homochelidonine*, "alkaloid *a*," "alkaloid *b*," *sanguinarine* and *chelerythrine*. As far as could be determined from the small quantities obtained, the alkaloids designated as *a* and *b* differ from any other alkaloids thus far known. (*Ph. Archiv.*, 1902, No. 7.) The narcotic power of the drug seems to be very weak, since, according to Bardet, three drachms were necessary to kill a rabbit. Ter-Zakariant (*G. M. P.*, Feb. 1889) states that the alcoholic extract acts as a respiratory depressant and narcotic, affecting in toxic dose also the spinal cord. Dujardin-Beaumetz has used the extract in commencing *doses* of twelve grains (0.78 Gm.), increasing to one hundred and eighty-five grains (12 Gm.) a day, and affirms that it is a harmless soporific and analgesic.

Ethoxycaffeine, $C_{10}H_{14}N_4O_3$, is prepared by boiling 3 parts of bromcaffeine with 2 parts of potassium hydroxide and 10 parts of alcohol. It forms crystals fusing at 140° C. (284° F.); is difficultly soluble in water and ether, easily soluble in hot alcohol, insoluble in alkalies, soluble without decomposition in cold diluted hydrochloric acid; on warming it is decomposed. Filehne (*A. Phys.*, 1886) finds that ethoxycaffeine has upon frogs and rabbits a narcotic effect. From seven to ten grains of it produced in man vertigo, intellectual torpor, and sometimes pain in the head. Dujardin-Beaumetz (*B. G. T.*, March, 1886) finds that it acts in the guinea pig as a narcotic and diuretic, and has given it for *headache* in *doses* of from three to fifteen grains (0.2–1.0 Gm.) a day, in capsules or dissolved in water by means of sodium salicylate. Cases of painful *zona*, *migraine*, and *nervous headaches* were relieved. The larger doses produced gastric irritation.

Ethyl Bromide. *Bromide of Ethyl. Hydrobromic Ether. Æther Bromatus. Bromure d'éthyle*, Fr. *Bromäthyl*, G. C_2H_5Br.—This ether was discovered by Sérullas in 1827, who prepared it by acting on alcohol with bromine in the presence of phosphorus. (*Ann. Ch. Phys.*, xxxiv. 99.) Personne suggested the use of amorphous phosphorus, as less dangerous than ordinary phosphorus and more convenient to manipulate. (*C. R. A. S.*, iii. 468.) A process was also recommended by Remington, based upon Personne's suggestion. (*Proc. A. Ph. A.*, 1877.) De Vrij proposed to decompose potassium bromide with sulphuric acid in the presence of alcohol, and a modification of his method is now generally employed. We have obtained good results from the following:

Take of potassium bromide (not powdered) 58 parts; sulphuric acid, sp. gr. 1.838, 44 parts; alcohol (clean), 95 per cent., 44 parts; water, 28 parts. Pour the water into a flask having double the capacity of the liquid ingredients above, and gradually add the acid; when the liquid has become cool, add the potassium bromide, and having placed the flask in a sand bath, adjust a thermometer, and with a bent glass tube connect the flask with a well cooled condenser; insert a narrow glass tube in the cork of the flask, and by means of a short rubber tube connect it with a narrow glass tube which is terminated by a siphon: the shorter limb of this siphon is inserted in the bottle containing the alcohol, which is elevated three feet or more above the flask. Heat the contents of the flask to 116° C. (240.8° F.), and having attached a screw pinch-cock to the short rubber tube of the siphon, allow the alcohol to drop or flow in a small stream into the flask, carefully regulating the rate of flow so that the temperature shall not fall below 100° C. (212° F.), nor rise above 116° C. (240.8° F.). When all the alcohol has passed into the flask, continue the distillation until the temperature rises to 116° C. (240.8° F.), and then disconnect the receiving flask. Agitate the distillate with an equal bulk of distilled water, to which has been added five parts of solution of sodium hydroxide (or sufficient to render the liquid slightly alkaline), and when the mixture has clearly separated into two layers, pour off the uppermost layer, and, having introduced the heavier liquid into a clean flask containing a few fragments of calcium chloride, redistil it. For other methods of manufacture, see *N. R.*, 1877, 200; 1879, 8; *A. J. P.*, 1879, 292; 1880, 248, 280, 298; also *Ph. Centralh.*, xxviii. 1887, 122. For L. Wolff's process for making it economically, see *A. J. P.*, 1880.

Ethyl bromide is a colorless, very volatile liquid, not inflammable, having an agreeable odor, and a hot, saccharine taste. Its sp. gr. is 1.450. It

boils at from 38°–39° C. (100.4°–102.2° F.). It is very sparingly soluble in water, freely soluble in strong alcohol and ether. When a small portion is evaporated from a porcelain plate by causing it to flow to and fro over the surface, little or no foreign odor is yielded as the last portions pass off, and the plate is covered with a slight deposit of moisture.

The ethyl bromide prepared from alcohol and bromine in the presence of amorphous phosphorus should not be used in medicine because of the possible presence of organic compounds of sulphur and arsenic. Shaken with distilled water, ethyl bromide should not show any acid reaction from hydrobromic acid, nor should it cause any appreciable turbidity with silver nitrate. Shaken with an equal volume of pure concentrated sulphuric acid, no color should develop even after an hour's time; otherwise ethylene bromide may be present. Dropped slowly into potassium iodide solution, the drops of the ethyl bromide should settle to the bottom of the vessel without developing any appearance of violet color, which would indicate free bromine. Ethyl bromide should be kept in amber-colored glass bottles, completely filled and well stoppered. (Fischer, *Die Neueren Arzneimittel*, 6te Aufl., 74.)

Some years ago ethyl bromide was proposed and largely used as an anæsthetic. In a series of experiments made with it at that time, H. C. Wood found that its action upon the heart is the same as that of chloroform, and that injected into the jugular vein it causes cardiac arrest. The occurrence of two deaths from it, one of them distinctly syncopal, partly arrested its successful career, although it certainly acts very promptly and agreeably, and its influence passes off with extraordinary rapidity. Recently, professional attention has been strongly redirected to the bromide, and it is asserted that the evil effects produced in its early use were due to the presence of impurities, especially of ethylene bromide. Hamecker (*Internat. Klin.*, Dec. 20, 1891) affirms that in experiments upon the lower animals, made with pure ethyl bromide, death always occurred through arrest of the respiration, the heart continuing to beat from fifteen to nineteen minutes after cessation of the breathing.

In accordance with this, Gilles asserted in 1892 that in twenty thousand successive administrations with the ethyl bromide in Germany there had been no fatal results when a chemically pure bromide has been used. Since this assertion a number of deaths (five or six) have been reported, in which it has been distinctly proved that a pure ethyl bromide was given. Gurlt (*Arch. f. Klin. Chir.*, lv.) puts the mortality rate at 1 in 5396 inhalations, and the studies of Wood and Cerna indicate that it is about as dangerous as chloroform. Moreover, it has been shown by Hennicke that the ethyl bromide undergoes decomposition with the liberation of bromine compounds in the system. We have at present no definite knowledge as to the action of these bromine compounds, but it is probable that they are capable of producing secondary changes in the organic structure, especially since cases have been reported by Reich and by Hatten of death from acute fatty degeneration after its inhalation. It has been largely used as a practical anæsthetic. (*S. Jb.*, Bd. cclvii. 234; Bd. cclx. 18.) The narcosis is said to be produced almost abruptly, with practically no stage of preliminary excitation and to be accompanied by little tendency to muscular relaxation. Its effects pass off so suddenly as to endanger their continuance during the operation. On account of its loss by evaporation it is a very expensive anæsthetic. Ethyl bromide has been especially recommended for use in *parturition*, it being stated that it suspends the pain of the uterine contractions without influencing their force, and it has been employed to a considerable extent in cases when a brief anæsthetic is required. In using it, from two to four fluidrachms (7.5–15 Cc.) may be put upon an Allis inhaler or upon a napkin.

Ethyl Cyanide. *Hydrocyanic Ether. Propionitrile.* C_3H_5N, or C_2H_5CN.—This ether was discovered by Pelouze. It is formed by distilling a mixture of barium sulphovinate and potassium cyanide, or better, by the action of ethyl iodide on potassium cyanide in closed tubes at a temperature of 180° C. (356° F.). It is a colorless liquid, of an agreeable ethereal odor, soluble in alcohol, ether, and water, boiling at 98° C. (208.4° F.), and having the sp. gr. 0.78. *Ethyl cyanide* is very poisonous, but less so than hydrocyanic acid, with which it agrees in therapeutic action and dose.

Ethyl Fluoride.—*Fluoride of Ethyl*, C_2H_5F, is said to cause in animals violent excitement, followed quickly by death. For properties and method of preparation, see *Chem. News*, Jan. 1889, also *B. A. M.*, Mars, 1890.

Ethyl Formate. *Formic Ether. Ethyl-formic ester.*—A liquid with a peach-kernel odor, sp. gr. 0.937, soluble in ten parts of water. This compound is reputed to be useful in the treatment of infectious diseases of the respiratory organs.

Ethyl Iodide. *Hydriodic Ether. Ethyl-hydriodic ester. Iodure d'éthyle, Ether hydriodique*, Fr. *Jodäthyl, Jodwasserstoffäther*, G. C_2H_5I. This liquid may be obtained by gradually and cautiously mixing five parts of alcohol, ten of iodine, and one of phosphorus, and distilling. The residue of the distillation, as ascertained by D. K. Tuttle, is *ethylphosphoric acid.* Personne (*C. R. A. S.*, 51, 468) proposed to use amorphous phosphorus instead of the ordinary kind, thus avoiding danger. Five parts of amorphous phosphorus are added to 60 parts of 95 per cent. alcohol and 40 parts of iodine are added in small portions to the mixture poured into a retort. The whole is allowed to stand for twenty-four hours; attachment is made to a Liebig condenser, and the liquid distilled at a temperature not exceeding 80° C. (176° F.). The yellowish distillate is shaken with solution of acid sodium sulphite, and the layer of ethyl iodide washed repeatedly with water. It is then rectified after removing traces of water by shaking the ethyl iodide with dry calcium chloride. De Vrij recommends the following method for procuring ethyl iodide on a large scale. Absolute alcohol is to be saturated with dry hydrochloric acid gas, the liquid being kept well cooled, and the amount of the acid is to be determined in a sample. The liquid thus saturated is to be put into a retort, with as much potassium iodide as may be necessary to form potassium chloride; the mixture is to stand for a day, and is then to be submitted to distillation. Finally, the ether which comes over is to be washed and rectified. (See *A. J. P.*, 1859, 170.) Ethyl iodide is a colorless non-inflammable liquid, insoluble in water, with a penetrating ethereal odor and pungent taste. Its density is 1.92, and boiling point from 71°–72° C. (159.8°–161.6° F.). Exposed to the air it becomes red from the liberation of

iodine; the change in color is prevented by adding to the bottle containing it a globule of mercury. Huette has proposed this ether, placed under a layer of water, as a medicine, to be used by inhalation. Fifteen or twenty inspirations suffice to impregnate the system with iodine. It acts as a powerful anæsthetic, when inhaled for a sufficient time. It is said to increase the appetite, render the pulse fuller, and give vivacity to the feelings and activity to the intellect. (See *A. J. P.*, xxiii. 156.) James Turnbull of Liverpool, and Henry Fisher of New York, have used this ether by inhalation with satisfactory results in *chronic bronchitis* and *phthisis*. The *dose* is fifteen drops (0.75 Cc.), three or four times a day, inhaled from a handkerchief. Ethyl iodide often has an unpleasant odor from the presence of foreign substances which renders it offensive to patients. Phosphorus is a common and injurious impurity.

According to Linosier and Lannois (*S. M.*, 1897), ethyl iodide affords an excellent method of affecting the general system by external application. Absorption of the iodine is rapid; the liquid should be applied with a brush and then covered with paraffined paper; after applying two fluidrachms they recovered thirteen grains of iodine from the urine.

Ethylene Bromide. *Brom-ethylene. Æthylenum Bromatum.* $C_2H_4Br_2$.—This is a colorless oily liquid smelling like chloroform, with a sweet burning taste. It boils at 131.6° C. (269° F.), and solidifies at 0° C. (32° F.) to a crystalline mass; sp. gr. at 20° C. (68° F.) 2.178. It is insoluble in water, miscible with alcohol in all proportions. In experiments made by Scherbatscheff (*A. E. P. P.*, 1902, vol. xlvii.) ethylene bromide was found not to act as a true anæsthetic in the lower animals, but to produce serious symptoms, usually ending in death. The chief medicinal importance of this agent grows out of its liability to be confounded with the ethyl bromide, death in this way having been produced. Ten fluidrachms of it were inhaled without the production of anæsthesia, followed by uncontrollable vomiting and complete suppression of urine. On account of its containing over 85 per cent. of bromine, Donath has used it in *epilepsy*. He gives it in an emulsion with oil, or mixed with almond oil in capsules. Children from eight to ten years begin with from ten to twenty drops (0.5–1.0 Cc.) of a 5 per cent. solution; the adult *dose* is six drops (0.3 Cc.) of ethylene bromide, three times a day. (See also *P. J.*, xxi. 1068.)

Eucaine. *Eucaine Hydrochloride. Alpha-Eucaine, Beta-Eucaine.*—Under the name of Eucaine Hydrochlorate, manufacturers have introduced into practical medicine two distinctly different substances, distinguishing them as Eucaine Hydrochlorate A, or *Alpha-Eucaine*, and Eucaine Hydrochlorate B, or *Beta-Eucaine*, producing much confusion in clinical reports.

Alpha-Eucaine, or the present *Eucaine*, is free from irritant properties, while *Beta-Eucaine*, which was formerly sold as eucaine, is so irritant that its use has been abandoned.

Eucaine Hydrochloride A, or *Alpha-Eucaine*, was first described. It is *n-methyl-benzoyltetramethyl-γ-oxypiperidincarboxylicmethylester*. Eucaine Hydrochloride B, or *Beta-Eucaine*, is *benzoylvinyldiacetonalkamine*. The first of these has the formula $C_{19}H_{27}NO_4HCl + H_2O$, and is a triacetonamine derivative. Triacetonamine by treatment with hydrocyanic acid, followed by boiling with water, is converted into oxymethyl piperidincarbonic acid, and this by the introduction of the benzoyl and methyl groups into the base eucaine, which is then crystallized out as the hydrochloride. Eucaine B, on the other hand, is the benzoyl derivative of *vinyl-diaceton alkamine*. Its formula is $C_{15}H_{21}NO_2.HCl$.

Eucaine Hydrochloride A. $C_{19}H_{27}NO_4.HCl + H_2O$.—It is a white, neutral, crystalline powder, soluble in ten parts of cold water,—*i.e.*, about 9 per cent.

Eucaine Hydrochloride B ($C_{15}H_{21}NO_2.HCl$) is a white, neutral, crystalline powder, soluble in from 27 to 28 parts of cold water,—*i.e.*, to the amount of from 3 to 4 per cent. at the ordinary temperature of the room. To make more concentrated solutions it must be slightly warmed. Such concentrated solutions remain perfectly clear quite long enough for the completion of an operation. If precipitation occurs after prolonged standing the solution may be clarified by heat.

Eucaine is affirmed to be in toxic dose a spinal cord depressant and a direct muscle poison, killing by its action upon the cardiac muscle. It is used solely as a local anæsthetic, less powerful than cocaine, but also much less toxic and not causing a primary constriction or a secondary dilatation of the local blood vessels, as does cocaine.

The 3 to 5 per cent. solution will rapidly and completely anæsthetize the cornea without dilating the pupil or paralyzing the pupillary reflexes. The concentrations and dosage of the solutions generally recommended are as follows.

In ophthalmology, 2 per cent., applied by instillation.

In the urethra and bladder, 2 per cent. up to 60 Cc. (2 ounces) in amount.

In the nose, throat, and pharynx, 5 to 10 per cent., by spray or brush.

On mucosæ and wounds, 5 to 10 per cent., as much as required.

In dentistry, 2 to 5 per cent., amount 1 Cc. (15 minims).

For infiltration-anæsthesia:

(*a*) After Schleich, 1:1000 to 1 per cent., as much as required.

(*b*) After Réclus, 2 per cent., as much as required.

(*c*) After Braun, 1:1000 up to 0.3 gramme (4½ grains).

For regional analgesia after Braun, 1 per cent. up to 0.15 gramme (2½ grains).

The influence of eucaine upon the general system is so slight that fifteen grains (1 Gm.) of it have been injected hypodermically (G. W. Spencer) without the production of any marked symptoms. It may prove of value in *gastrodynia* or *vomiting*. The maximum *dose* is said to be three grains (0.2 Gm.).

Eucalyptus Manna. *Australian Manna.*—This substance exudes during the summer months from punctures made in the bark and leaves of the Australian tree *Eucalyptus mannifera*, (*E. viminalis*, Labill.). It occurs in small round opaque masses, and is said medicinally to resemble ordinary manna.

Eucasin. *Ammonium Caseinate, Casein-ammonium.*—This compound is obtained by passing ammonia gas over casein. It is a grayish-white powder, having an odor somewhat like buttermilk, readily soluble in hot water. It has been brought forward by Salkowski as a very easily digested food. It may be given in broths or with cocoa, and, according to Feustell (*D. M. W.*, xxii. 1896),

is a valuable food in cases of great failure of digestion. From thirty to forty grains of eucasin correspond to twenty-four to thirty-two grains of albumin.

Eudrenine.—A local anæsthetic in the form of capsules each containing one-twelfth of a grain of eucaine and one four-thousandth of a grain of adrenalin hydrochloride. Used especially in dentistry.

Eugallol. *Pyrogallol-mono-acetate.* $C_6H_3(OH)_3CH_3CO_2$.—A thick transparent mass, brownish yellow in color, soluble in water and in its own weight of acetone. A 33 per cent. acetone solution is used externally as a substitute for pyrogallol in the treatment of psoriasis.

Eugenia Chequen, Molina. (*Myrtus Cheken,* Spreng.) *Cheken. Chekan. Chequen. Arrayan.* (Fam. Myrtaceæ.)—The leaves of this Chilian plant have entered commerce under the name of *Chekan leaves.* Weiss (*P. J.*, 188, 246) has found in them,—1, *chekenon,* $C_{40}H_{44}O_8$, a crystalline body; 2, *chekenin,* $C_{12}H_{11}O_3$, in yellowish rhombic tables; 3, *chekenetin,* $C_{11}H_7O_6 + H_2O$, in olive-colored crystals; 4, *cheken-bitter,* an amorphous, very soluble bitter substance. (See also *P. J.*, 1889, 782.) Chekan leaves are reported by W. Murrell to be useful in chronic *bronchitis.* For an additional account of them and their properties, see *P. J.*, ix. 653; and *Newer Materia Medica.* The leaves are used in their native country as a remedy in *chronic respiratory catarrh,* and have been strongly recommended by Murrell and others in *chronic bronchitis.* Their virtues appear to reside in the tannin, and especially in the volatile oil that they contain. Fritz Wein (*A. Pharm.*, 1888, 665) examined cheken leaves proximately; he found a volatile oil and three crystalline bodies, *chekenon, chekenin,* and *chekenetin,* and an amorphous bitter principle. The *dose* of the fluid-extract is from one to three fluidrachms (3.9–11.6 Cc.).

Eugenia Jambolana, Lam. *Jambul. Jamboo. Rose Apple. Java Plum.*—This is a large tree belonging to the Myrtaceæ, growing in East India and also in Queensland; well known on account of its popular edible fruit. Jambul bark is a dense, hard bark, of a pinkish-brown or reddish-brown color, with a whitish-gray mottled epidermis adherent to portions of its outer surface; the inner surface is of a somewhat silky lustre, frequently coarsely marked by waving lines or ridges; the fresh fracture varies from pinkish or purplish to fawn color, sometimes distinctly but shortly fibrous, more commonly absolutely abrupt; the thickness of the bark varies from a quarter of an inch to nearly one inch. The taste is somewhat bitter, astringent, after a time distinctly pungent. The seeds are grayish black or blackish gray, being abruptly truncated at the base, above rounded or dome-shaped. They are about a third of an inch in diameter and three-eighths of an inch long; so hard and dense that they cannot be chewed, and are almost tasteless. The analysis of the seeds by Thomas Christy yields the following results. Essential oil, a trace; chlorophyll and fat, 0.37; resin soluble in alcohol and ether, 0.30; gallic acid, 1.65; albumen, 1.25; colored extractive soluble in water, 2.70; moisture, 10.00; insoluble resin, 83.73.

In the experiments made by Thomas Christy of London (*P. J.*, 1888), it was found that when sufficient of diastasic matter was mixed with fifty grains of starch to convert 45 per cent. of the latter in fifty minutes into sugar, the addition of twenty-five grains of powdered jambul seeds reduced the conversion of the starch to 12 per cent. We have no knowledge of the effect of jambul or its active properties upon the general organization, but Binz (*Verhandl. der Kongr. für Innere Med.*, Wiesbaden, 1886) found that when dogs were made diabetic by the administration of phlorizin, according to the method of von Mering, the exhibition of jambul reduced the excretion of sugar from 50 to 90 per cent. without the production of any evidences of poisoning by the jambul. In India, jambul has long been used as a stomachic astringent and carminative in *diarrhœa,* and also in the treatment of *diabetes.* The first therapeutic trials in Europe appear to have been made by Clacius, who found that the drug notably reduced the excretion of sugar in diabetic patients. The practice has been largely followed, and there would seem to be no doubt that in occasional cases of glycosuria jambul does good. H. C. Wood has seen the sugar of the urine entirely disappear under its use. No cases of poisoning or of disagreeable results from it have been reported.

Nevertheless jambul has failed to establish itself as a practical medicament. It may be that this has been due to the use of too small doses. The fluidextract is the best preparation and the beginning dose of it, recommended in previous editions of the *U. S. D.*, was ten minims (0.6 Cc.); but according to von Noorden (*Deutsche Praxis,* 1901) half a fluidounce (15 Cc.) of the fluidextract should be taken in eight fluidounces (240 Cc.) of hot water, one hour before breakfast and late in the evening.

Eugenoform, *Eugenol carbinol sodium,* forms colorless crystals fusing at 160° C. (320° F.), readily soluble in water, difficultly soluble in alcohol. Is used as a bactericide for disinfection of the intestines in cases of *typhoid fever, cholera,* etc.

Eugenol Acetamide. $C_{10}H_{11}O_2.(CO.CH_2NH_2)$. This substance occurs in shining scales or needles, soluble in alcohol and water, melting at 110° C. (230° F.). According to Merck, it is a local anæsthetic and at the same time antiseptic.

Eugenol Iodide. *Iodo-eugenol.* $C_6H_2I(C_3H_5)(OCH_3)OH$.—A yellowish, inodorous, insoluble powder obtained by acting on eugenol-sodium with iodine. It is used as an antiseptic, and said to resemble aristol.

Euguform.—*Acetylized methylene diguaiacol* is obtained by the action of formaldehyde upon guaiacol and subsequent acetylization. It is a white, almost odorless, dust-like and amorphous powder, insoluble in water. It has been recommended by Ciesielski as a cheap substitute for orthoform, as a dusting powder or in the form of a 2 to 10 per cent. ointment. (*Derm. Cb.*, 1901, No. 6.)

Eumenol is a liquid preparation of the Chinese root *Tang-kui,* one of the Araliaceæ. It has been recommended for the relief of *dysmenorrhœa* by Langes (*Th. M.*, 1901, 363) and others.

Euphorbia. *Wild Ipecac. Wild Hippo. Euphorbe,* Fr. *Wolfsmilch,* G.—The genus Euphorbia (Fam. Euphorbiaceæ) contains numerous species, having the common property of yielding a milky juice. They are herbaceous or shrubby, with or without leaves, and the leafless species, which are chiefly confined to the African deserts, have fleshy, naked, or spiny stems, like those of the cactus. They nearly all afford products which act powerfully as emetics and cathartics, and in

overdoses occasion dangerous if not fatal prostration, with symptoms of inflammation of the gastro-intestinal mucous membrane. Their milky juice, which concretes on exposure, usually possesses these properties in a high degree, and, in addition, that of powerfully irritating the skin when applied to it. The U. S. Pharmacopœia formerly recognized the indigenous species *E. corollata*, L., and *E. Ipecacuanha*, L. In a full dose the root of *E. corollata*, L., operates actively and with sufficient certainty as an emetic, producing ordinarily several discharges from the stomach, and sometimes acting with considerable energy upon the bowels. In quantities insufficient to cause vomiting, it excites nausea, almost always followed by brisk purging. In still smaller doses it is diaphoretic and expectorant. It is, however, too harsh and uncertain in its action for practical use, and has passed entirely out of vogue. The *dose* of the dried root as an emetic is from ten to twenty grains (0.65–1.3 Gm.), as a cathartic from three to ten grains (0.2–0.65 Gm.). The recent root, bruised and applied to the skin, produces vesication. C. Petzolt found in the root of *E. Ipecacuanha* fixed oil, resin, starch, glucose, and various salts. The resinous matter was a dark mass, of a taste slight at first but after a time nauseous and pungent, readily dissolved by alcohol, but insoluble in ether and petroleum benzin, and, when swallowed, producing in half grain (0.032 Gm.) doses watery stools, and in one and a half or two grain (0.096 or 0.13 Gm.) doses nausea and vomiting. It gave no evidence of the presence of an alkaloid. (*A. J. P.*, 1873, 255.) The medicinal properties of *E. Ipecacuanha* resemble those of *E. corollata*, though the former is said to be somewhat milder. The indigenous *E. Preslii*, Guss. (*E. hypericifolia*, A. Gray), and *E. maculata*, L., are said by Zollickoffer to be a valuable remedy in *dysentery*, *diarrhœa*, *menorrhagia*, and *leucorrhœa*. (See 16th ed. *U. S. D.*, also *A. J. M. S.*, xi.) B. J. D. Irwin, U. S. A., states that, under the name of *gollindrinera*, the native Mexican uses the *Euphorbia prostrata*, Ait., in New Mexico and Arizona as a remedy for *snake bites*. (*Am. J. M. S.*, 1861.) In Chili the juice of *Euphorbia portulacoides*, L. (*E. chilensis*, C. Gay), is said to be used as a drastic purgative. (*A. J. P.*, 1866, 102.) The juice of *Euphorbia Drummondii*, Boiss., is said in Australia to kill annually a great many sheep and cattle, and in 1886 John Reid (*Australasian Med. Gaz.*, No. 61) announced the discovery in it of a new anæsthetic alkaloid, *drummine*, which he obtained in colorless crystals almost insoluble in ether, but freely soluble in chloroform and in water. The report of Alexander Ogsden (*B. M. J.*, Feb. 1887) throws, however, very grave doubts upon the anæsthetic power of this new alkaloid. The *E. ocellata*, Durand and Hilgard, of the Pacific coast is used as an antidote for *snake bites*, and is said to contain 2.82 per cent. of resin, besides gallo-tannic acid, while *Euphorbia cremocarpus*, Auct., of the same region is employed for the purpose of catching fish in still pools and streams, and is said to contain a volatile oil, besides acid and resins. (See *Proc. California Coll. Pharm.*, 1885.) The oil of *E. Lathyris*, L., is stated to physiologically resemble croton oil. (*Proc. A. Ph. A.*, xxvi. 305.)

The *E. heterodoxa*, Muell.-Arg., *alveloz* or *aveloz*, a Brazilian species, has been used with asserted extraordinary advantage against *cancerous* and *syphilitic ulcers*. It is a powerful irritant, and even mild caustic. The milky juice, preserved with salicylic acid, or a resin obtained by precipitating with water is employed. The ointment of the resin may be made 3 parts in 100 with vaseline.

Euphorbia pilulifera, L.—A prostrate or ascending branched annual, found in almost all tropical countries; it is furnished with leaves which are opposite, shortly stalked, ovate to ovate-lanceolate or oblong, from three-quarter inch to one and a half inches long, denticulate, very oblique and narrow below, or with a semi-cordate base. Stipules minute, linear, inserted on a transverse raised line. The flower-heads are minute, numerous, crowded in head-like cymes, globular, and are borne on a short stalk in one axil only of each pair of opposite leaves. The involucre is about one-third of a line long, small, entire, and without petal-like appendages. According to De Candolle, the seeds are reddish, acutely oblong, four-sided, and transversely wrinkled, the ridges uniting irregularly. It is to be distinguished from *E. parviflora* (L.?), which is sometimes substituted for it, by the flower-head of the latter having but few flowers, by the glands of the involucre being furnished with a white, obovate-orbicular appendage, and seeds which are minutely papillose. Levison found in it (*A. J. P.*, 1885, 147) several glucoside resins, wax, and volatile matter.

A physiological study of *Euphorbia pilulifera* led A. Marsset (*T. G.*, 1885) to the conclusion that the active principle acts directly upon the heart and respiration; that it is not an irritant to the skin, but in large dose it is to the gastric mucous membrane. It has been used by Dujardin-Beaumetz and a number of other clinicians with asserted excellent results in the treatment of *asthma* and *asthmatic bronchitis*, also in *chronic bronchitis*, and in *advanced* or *subacute bronchitis*. The best preparation is the fluidextract, the *dose* of which is from a half to one fluidrachm (1.8–3.75 Cc.) three or four times a day.

Euphorbium. *Euphorbium*, P. G. *Euphorbe*, *Gomme-résine d'Euphorbe*, Fr. *Euphorbiumharz*, G.—The concrete resinous juice of one or more species of Euphorbia (Fam. Euphorbiaceæ); but its precise source is uncertain. It has been ascribed to *E. resinifera*, Berg. (*E. officinalis*, Jack.), growing in the north of Africa and at the Cape of Good Hope, *E. canariensis*, L., a native of the Canary Islands and Western Africa, and *E. antiquorum* (L.?), inhabiting Egypt, Arabia, and the East Indies, and supposed to be the plant from which the ancients derived this resinous product. These species of Euphorbia bear some resemblance in form to a cactus, having leafless, jointed, angular stems, divided into branches of a similar structure, and furnished with double prickles at the angles. When wounded they yield an acrid milky juice, which concretes on the surface, and constitutes the euphorbium of commerce.

Euphorbium occurs in the shape of tears, or in oblong or roundish masses, about the size of a pea or larger, often forked, and perforated with one or two small conical holes, produced by the prickles of the plant, around which the juice has concreted, and which sometimes remain in the holes. The masses are occasionally large and mixed with impurities. The surface is dull and smooth, bearing some resemblance to that of tragacanth; the consistence somewhat friable, the color light yellowish or reddish; the odor scarcely perceptible; the

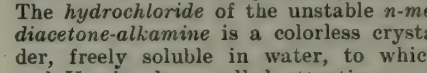
taste at first slight, but afterwards excessively acrid and burning. The color of the powder is yellowish. The sp. gr. of euphorbium is 1.124. Triturated with water it renders the liquid milky and is partially dissolved. Alcohol dissolves a larger portion, forming a yellowish tincture, which becomes milky on the addition of water. Its constituents, according to Pelletier, are resin, wax, calcium malate, potassium malate, lignin, bassorin, volatile oil, and water. It contains no soluble gum. The most abundant constituent is resin, and the remainder consists chiefly of wax and calcium malate. The resin is excessively acrid, is soluble in alcohol, and, when exposed to heat, melts, takes fire, and burns with a brilliant flame, diffusing an agreeable odor. According to Flückiger, it has the formula $C_{10}H_{16}O_2$. Flückiger also found a substance analogous to lactucon, which he names *euphorbon*. It is neutral, fusible above 106° C. (222.8° F.), readily dissolved by boiling alcohol, and soluble in ether, petroleum benzin, amyl alcohol, chloroform, acetone, and glacial acetic acid. From its solution in ether and petroleum benzin it separates on spontaneous evaporation, in feathery needles. Its solution in sulphuric acid, spread on a plate, is colored violet by nitric acid. Its composition is $C_{13}H_{22}O$. While the acrid resin constitutes 38 per cent. of euphorbium, 22 per cent. of euphorbon is found in it (*A. J. P.*, 1868, 393; from *S. W. P.*). Hesse (*Ann. Ch. Ph.*, cxcii. 182) has prepared pure euphorbon, and gives it the formula $C_{15}H_{24}O$, fusing point from 113°–114° C. (235.4° to 237.2° F.), making it isomeric with lactucon. It is lævorotatory.

Euphorbium taken internally is a very irritant emetic and cathartic, and in large doses acts as a violent gastro-intestinal irritant poison. In consequence of the severity of its action, its internal use has been entirely abandoned. Applied to the mucous membrane of the nostrils, it excites violent irritation, attended by incessant sneezing and sometimes bloody discharges. Persons who powder it are under the necessity of guarding their eyes, nostrils, and mouth against the fine dust which rises. Largely diluted with wheat flour or starch, it has been used as an errhine in *amaurosis* and *deafness*. Externally applied, it inflames the skin, often producing vesication. It enters into some epispastic preparations, and is especially employed in veterinary practice as a vesicant.

Euphrasia. *E. officinalis*, L. *Eyebright. Euphraise*, Fr. *Augentrost*, G. (Fam. Scrophulariaceæ.)—A small annual plant, native of Europe, without odor, and of a bitterish, astringent taste. Enz (*Viertelj. f. Prakt. Pharm.*, viii. 175) obtained a little volatile oil, an acrid and bitter principle, mannite and glucose, and a tannic acid, the lead salt of which showed on analysis the formula $C_{32}H_{20}O_{17}.3PbO$ and had a bright green color. It was formerly used in *toothache*. G. M. Garland (*A. J. P.*, 1890) states that ten minims (0.6 Cc.) of a concentrated tincture every two hours is a specific in acute *nasal catarrh*.

Euphthalmine Hydrochloride.—This is the mandelic acid derivative of Eucaine B, just as homatropine is the mandelic acid derivative of the base tropine. A permanent snow-white crystalline powder, very soluble in water and soluble in about two parts of boiling absolute alcohol, separating again on addition of ether in crystalline aggregates. The salt is anhydrous; it melts at from 183°–184° C. (361.4°–363.2° F.) and begins to run together at 181° C. (357.8° F.). The salicylate, $C_{17}H_{25}O_3N,C_6H_4(OH)COOH$, prepared by mixing ether solutions of the base and of salicylic acid, and recrystallizing from absolute alcohol and ether, melts at from 115°–116° C. (239°–240.8° F.), and is very readily soluble in water. The *hydrochloride* of the unstable *n-methyl-vinyl-diacetone-alkamine* is a colorless crystalline powder, freely soluble in water, to which Treutler and Vossius have called attention as a powerful local mydriatic. From two to three drops of a 2 per cent. solution will produce in from twenty to thirty minutes pronounced mydriasis, which disappears after two or three hours (seven hours, Winselmann) and is not accompanied by pain or other unpleasant secondary effects. There is no irritation of the cornea, or local anæsthesia, and accommodation is said to be less affected than with the mydriatics in common use. (*Ther. Woch.*, 1897; *Ber. d. Chem. Ges.*, xxxi. 665.)

Eupyrine. *Para-phenetidine-vanillin-ethyl-carbonate.*



This substance occurs in pale greenish-yellow, tasteless needles, with a vanillin odor, melting at 87° to 88° C. (188.6°–190.4° F.), sparingly soluble in water, freely so in alcohol, ether, and chloroform. It forms salts by combination with a few acids. It has been brought forward by Overlach (*Cb. I. M.*, xxi. 1900) as an antipyretic, who found that half an ounce of it causes no serious symptoms in dogs. He claims that it produces a gradual but marked fall of the temperature, accompanied by a sense of euphoria rather than of depression. In neuralgia he found that it was without influence. Porges has confirmed the statements of Overlach. The remedy is stated to be of special value in the young and the aged. *Dose*, twenty to thirty grains (1.3–2.0 Gm.).

Euquinine. *Quinine Ethyl Carbonic Ether.* $CO<^{O.C_2H_5}_{O.C_{20}H_{23}N_2O}$. Euquinine is made by the action of chloro-carbonic ethyl-ether on quinine. It occurs in the form of fine needle-like white crystals, melts at 95° C. (203° F.), is scarcely soluble in water, but easily so in alcohol, ether, and chloroform. It forms crystalline salts. A solution in sulphuric or nitric acid fluoresces with a blue color like quinine. The thalleioquin reaction of euquinine is the same as that of quinine, but there is no herapathite reaction. The euquinine hydrochloride dissolves readily in water, the sulphate much less easily, while the tannate is almost insoluble.

It has been alleged that it is possible by the use of euquinine to obtain the beneficial effects of quinine without unpleasant accompaniments of cerebral congestion and irritation, although tinnitus aurium is produced. It is absorbed rapidly, and according to Panegrosso and Gammarelli its elimination by the kidneys can be demonstrated within half an hour after its ingestion, and is completed in about forty-eight hours. It has been suggested, but not demonstrated, that within the body it is decomposed, quinine being re-formed from it. Euquinine has been employed with asserted satisfactory results by C. von Noorden (*Cb. I. M.*, 1896) in *pneumonia*, *pleurisy*, and various other acute diseases, as a substitute for quinine, and the results have been confirmed by Goliner (*Allge. Med. Central-Zeitung*, 1897) and by Overlach (*D. M. Ztg.*, 1897), while, following Panegrosso (*Gaz. degli ospedali*, Oct. 1897),

numerous physicians have tried it in *malaria;* A. Celli and A. Mori, experimenting in the Pontine marshes and other malarial districts of Middle Italy, have found that in *doses* of ten grains (0.65 Gm.) a day it is very effective in preventing the contraction of disease. (*Cb. B.*, vol. xxix.) In *doses* of twenty to thirty grains (1.3–2.0 Gm.) it has been found effective in *intermittent fevers.* As a tonic Overlach found it useful in small doses in *chlorosis* and *anæmia,* and this has been confirmed by other observers. Von Noorden, Castle, Niedermayer, and others commend it in *whooping cough.* It is so far tasteless that it may be administered in milk or syrup and is usually very well borne by the stomach, so that it is especially useful in the treatment of children. The necessary doses are larger than those of quinine; in ordinary acute diseases thirty grains (2 Gm.) may be given daily; in malaria forty grains (2.6 Gm.).

Euresol is *monoacetyl resorcinol,* $C_6H_4(OH)OCOCH_3$. A viscid honey-like liquid, boiling at 283° C. (541.4° F.). It is made by heating resorcinol with glacial acetic acid.

Eurobin.—*Triacetyl chrysarobin* is used as a substitute for chrysarobin; it is soluble in chloroform, acetone, and ether, insoluble in water. *Lenirobin,* the tetracetyl derivative, is similarly used.

Europhen. *Di-isobutyl-ortho-cresol-iodide.* $\left(\begin{matrix}C_4H_9\\CH_3\end{matrix}\right\}C_6H_3O\Big)$ HI.—This is a yellow amorphous powder, of a specific aromatic odor, which has been proposed as a substitute for iodoform. It is asserted that it is five times lighter than iodoform, and can be used in much larger bulk; that it is equally efficacious with iodoform; also that it is decomposed more slowly than iodoform, and is, therefore, less poisonous. (See *Ph. Ztg.*, July, 1891; also *Th. M.*, July, 1891.) Europhen is made by the action of iodine upon isobutylortho-cresol in alkaline solution. It occurs as a fine, soft, amorphous powder, light yellow, tasteless, and having but a faint odor. It is soluble in ether, chloroform, collodion, alcohol, and fixed oils; insoluble in water and glycerin; melting at 110° C. (230° F.). Its solution undergoes decomposition when exposed to light or heat.

Europhen contains about 28.1 per cent. of iodine, which element is slowly liberated from its alcoholic and ethereal solutions. It is incompatible with metallic oxides and mercurial salts, and undergoes slight change in the presence of organic matter. Taken internally it is said to pass out in great part from the alimentary canal with the fæces unchanged, though some absorption takes place. It is asserted that it is non-toxic, two or three drachms (7.7–11.6 Gm.) having been given to dogs and fifteen grains (1 Gm.) to human beings without effect. As a microbicide it is affirmed to be about equivalent to iodoform. (*Revue Méd. de l'Est*, Feb. 1892.)

It has been used by a number of clinicians with asserted good results as a local application in *chancres, syphilitic ulcers, burns, psoriasis, eczema, lupus,* and various *skin diseases.* It is usually applied in an ointment varying in strength, according to the individual cases, from 1 to 10 per cent. It has also been employed in *rhinitis, laryngeal tuberculosis,* and other inflammatory disorders of the preliminary air-passages. Internally it has been used, especially hypodermically, dissolved in oil, in *constitutional syphilis,* with not very encouraging results. *Dose,* one-half to one and one-half grains (0.032–0.096 Gm.).

Under the name of *europhen-aristol* a mixture of europhen and aristol has been marketed.

Eurybin.—A glucoside obtained from a New Zealand plant, *Eurybia moschata.* (*Merck's Bericht*, 1893, 12.)

Evodia.—Several species of this rutaceous genus are stated to have medicinal properties. *E. febrifuga* of Brazil is astringent and tonic, *E. glauca* of Japan contains berberine, while *E. longifolia* of the Feejee Islands is used to prevent abortion.

Exalgine. *Methylacetanilide.* $C_6H_5N(CH_3)COCH_3$ or $C_9H_{11}NO$.—This substance, which was discovered by Brigonnet, is one of the three isomeric methyl derivatives of acetanilide (*C. R. A. S.*, cviii. 571), and is made by warming together monomethylaniline and acetylchloride. It occurs in needles, or in long tablet-like crystals, according as it is obtained by crystallization or from the mass after fusion. It is sparingly soluble in cold water, quite soluble in hot water, and readily soluble in very dilute alcohol, or in water to which a small amount of alcohol has been added; it fuses at 101° C., and boils between 240° and 250° C. without decomposition. The hot aqueous solution is said by Upton to retain most of its exalgine on cooling.

According to Brigonnet, hypodermic injections of exalgine produce in the lower animals violent epileptiform convulsions, profuse salivation, cyanosis, disturbance of breathing, fall of temperature, and alteration of the blood, which becomes dark prune-colored and contains an abundance of methæmoglobin. The muscles at the seat of the injection are said to be locally paralyzed, and although small doses increase slightly the blood pressure, after the toxic dose the pressure suddenly falls. The urine does not become albuminous or bloody. When given to man in full, non-poisonous doses, it produces some slight amblyopia, vertigo accompanied in some patients by vomiting, tinnitus aurium, headache, drowsiness, and vasomotor disturbances, such as sweating. After large doses, cyanosis is pronounced, but no eruption upon the surface of the skin seems as yet to have been noticed. After toxic doses dyspnœa, cyanosis, dilated pupils, paresis, heart failure and convulsions have been noted, but no fatal result has been recorded; in a boy fourteen years old two doses of 3 grains each produced most alarming symptoms.

Therapeutically, exalgine seems to be an antipyretic, but it has been used almost exclusively as an analgesic and antispasmodic. According to Moncorvo, it is very well borne in children; he has used it extensively in *chorea, polyuria,* and for the relief of *pain.* He believes that its analgesic effect is at least five times as strong as that of antipyrine; his dose, to a child five years old, is one and a half grains (0.096 Gm.). *Dose,* for an adult, three to five grains (0.2 to 0.32 Gm.), not more than twelve grains to be given in twenty-four hours.

Fabiana. *Fabiana imbricata,* Ruiz and Pavon. *Pichi.* (Fam. Solanaceæ.)—This is a shrub growing in Chili and the Argentine Republic, attaining the height of about six feet. The appearance of the plant is almost that of a conifer, but it has white flowers. The wood is uniformly yellowish, hard, heavy, and very fine grained. The thin bark is light gray, minutely roughened by small, sharp, longitudinal ridges, and minute gland-like protuberances, which exhibit under the lens a peculiar resinous lustre. For microscopic structure, see *Proc. A. Ph. A.*, 1889.

A. B. Lyons first obtained a fluorescent body resembling æsculin, a neutral crystalline principle, some volatile oil, resin, and apparently traces of an alkaloid. (*A. J. P.*, 1886, 65.) Henry Trimble and J. M. Schroeter (*A. J. P.*, 1889, 407) considered the crystalline principle to be a resin, and gave it the formula $(C_{18}H_{31}O_2)x$. H. Kunz-Krause (*A. J. P.*, 1900, p. 80) more recently made a full study of pichi and found a tannin which he named *fabiana-tannoid*, a fluorescent substance proven to be *chrysatropic acid* (*β-methyl æsculetin*), $C_9H_5(CH_3)O_4$, while no alkaloids are present, the sole basic principle being choline. The volatile oil he names *fabianol* and gives it the formula $C_{54}H_{90}O_2$. The resin he calls *fabiana-resin* and gives to it the formula $(C_{18}H_{30}O_2)_3$. The resin appears in microscopical crystals, melting at 280° C. The tannin proved to be like caffetannic acid, which Kunz-Krause had previously shown to be *glycosyl-dioxycinnamic acid*.

Pichi appears to be a terebinthinate diuretic, to which also are attributed tonic and cholagogue properties. It has been used to a considerable extent in the treatment of *acute* and *chronic vesical catarrh*, giving especially favorable results in cases in which the urinary irritation is kept up by *gravel*. It is said even to calm the irritability and aid in the expulsion of *renal*, *urethral*, or *cystic calculi*. It has been further recommended in the treatment of *jaundice* and *dyspepsia*, with lack of biliary secretion. It is somewhat irritating, and is usually said to be contra-indicated by the existence of organic disease of the kidneys; but cases have been reported in which *renal hemorrhage* connected with Bright's disease has been greatly benefited by the remedy. It has also been employed in *gonorrhœa* and in *gonorrhœal prostatitis*. The solid extract may be used in the *dose* of from two to ten grains (0.13–0.65 Gm.); the fluidextract, in the *dose* of from ten to forty minims (0.6–2.5 Cc.). It is probable that the resinoid precipitate, made from a strong tincture by means of water, would be the best preparation of the drug. The fluidextract does not mix with water unless the solution be made alkaline. It may be administered in capsules.

Fanghi di Sclofani.—This is a light yellowish fine powder of volcanic origin, consisting chiefly of sulphur and small quantities of iron, manganese, calcium, etc., the sulphur being in an exceedingly fine powder. It is highly praised by Otto v. Fleischl as a remedy in *acne rosacea*. Two or three grains (0.13 or 0.2 Gm.) of the powder are mixed with a teaspoonful (4 Cc.) of water and the opaque mixture applied with the finger on going to bed and allowed to dry on the part.

Ferissol.—This is a substance said to be derived from cinnamic acid and guaiacol which occurs as a very soluble powder and has been used in *tuberculous diseases* intermuscularly in 10 per cent. solutions, fifteen minims (0.9 Cc.) per *dose*, increased to forty-five minims (2.8 Cc.). The internal *dose* is fifteen grains (1 Gm.).

Ferralbumose.—This is made by treating finely cut meat, freed from fat, with an artificial gastric juice, freeing the solution from albumin, neutralizing it with sodium carbonate, filtering and evaporating to dryness, *in vacuo*. A 10 per cent. solution of this *albumose* is precipitated by the addition of a 10 per cent. solution of ferric chloride and the precipitate dried, powdered and sifted.

Ferratin.—This is a light brown powder containing from 6 to 8 per cent. of iron in a form soluble in alkaline liquids. It is an albuminous compound, originally prepared by Schmiedeberg from the liver of the hog, and believed to be the natural compound of iron as it exists in the system, and therefore of especial value in therapeutics. It is now made by the reaction of the albumin with a double tartrate of iron and an alkali. It is almost insoluble in water, soluble in alkalies, and contains 7 per cent. of iron in organic compounds. A solution of ferratin has also been put upon the market under the name of *ferratose*.

Ferratin may be given in *doses* of from three to five grains (0.2–0.32 Gm.) three times a day. It appears to be capable of acting as a chalybeate, but there is no sufficient reason for believing it to be superior to the older preparations of iron.

Ferratogen. *Ferric Nucleine.*—This substance is obtained by the cultivation of yeast on a ferruginous nutritive medium and subsequently extracted. It occurs as a grayish-white or yellow powder, insoluble in water and gastric juice, but believed to be dissolved by pancreatic fluid. It has been recommended by Cloetta in *chlorosis* when the stomach is delicate. *Dose*, five to ten grains (0.32–0.65 Gm.).

Ferric Albuminate. *Ferri Albuminas.*—This preparation has come into some prominence, more particularly in Europe, on account of its asserted advantages over various other compounds of iron, Démarquay, Chrisnard, and others recommending its employment in *chlorosis* and *anæmia*, as being very readily absorbed. Friese, Kobligk, Bernbeck, Biel, Holdermann, Nierck, Donitz, and Hager have each proposed methods for preparing either the solution or dry salt. C. L. Diehl, however, after a careful review of the processes of these investigators, offers the following: 4 troyounces of white of eggs are diluted with 8 fluidounces of water; 65 minims of official solution of ferric chloride diluted with 4 fluidounces of water are added, and the solution filtered. The filtrate is now mixed with 10 fluidounces of a saturated solution of sodium chloride, the precipitate collected on a wet muslin strainer, washed with a mixture of 1 volume of the saturated solution of sodium chloride and 3 volumes of water, until the washings give but a faint reaction for iron. The washed ferric albuminate is, after draining, powerfully pressed to get it as dry as possible, and then exposed to a dry atmosphere, and finally powdered. This salt contains the equivalent of 5 per cent. of ferric oxide, or 10 per cent. of ferric chloride. For other processes, see *A. J. P.*, 1880, 177. As thus obtained, ferric albuminate is a cinnamon-brown powder, having a slight taste of common salt (due to the presence of a small quantity), soluble in water, particularly if slightly acidulated with hydrochloric acid. It is best administered in *doses* of from twenty to thirty grains (1.3–2.0 Gm.) in simple aqueous solution, which should be freshly prepared. It may also be given in the form of a pill, either alone or combined with strychnine, quinine, etc. For method of preparing *iron and potassium albuminate*, and *iron and sodium albuminate*, see 16th ed. *U. S. D.*

Ferric Arsenio-Citrate (Ammoniated).—This compound under the name of Ferr-Arsenio-Citras Ammoniatus has been highly commended by Valvassori and Peroni (see *M. R.*, 1900) for the hypodermic treatment of *malaria*, especially in children. It is given in *doses* of three-fifths of a grain (0.036 Gm.) in sterilized water, injected at intervals of two or three days.

Ferric Benzoate. *Ferri Benzoas. Ferrum Benzoicum. Eisenbenzoat, Ferribenzoat*, G. Fe_2

$(C_7H_5O_2)_3(OH)_3 + 6H_2O$.—This is made by precipitating a solution of ammonium benzoate with a diluted solution of ferric chloride. The precipitate, after being washed, is dried at a temperature not above 30° C. (86° F.), protected from light. A brownish-red, odorless, tasteless, powder insoluble in water. When freshly prepared it is soluble in cod liver oil.

Ferric Glycerophosphate. *Ferri Glycerophosphas. Ferrum Glycerinophosphoricum. Iron Glycerophosphate. Glycerinphosphorsaures Eisen*, G. $Fe_2[C_3H_5(OH)_2PO_4]_3$.—This is made by dissolving freshly precipitated ferric hydroxide in glycerophosphoric acid, evaporating the solution *in vacuo* and scaling it upon glass plates. It is in the form of yellow scales, soluble in water and diluted alcohol. The salt is used as a tonic and nervine in *doses* of from five to ten grains (0.32 to 0.65 Gm.).

Ferric Iodate. *Ferri Iodas. Basic Ferric Iodate.* $2Fe_2(IO_3)_6Fe_2O_3.24H_2O$. — This has been proposed as a substitute for the iodide by Cameron. (*Dublin Q. J.*, 1869, 354.) It is prepared by precipitating five fluidrachms of the strong solution of iron perchloride (B. Ph.) in four fluidounces of water with a solution of one ounce of potassium iodate in ten ounces of water. It is said to be nearly tasteless, and not to injure the teeth. *Dose*, from two to five grains (0.13–0.32 Gm.).

Ferric Oxide, Magnetic. *Ferri Oxidum Magneticum. Magnetic Iron Oxide. Martial Ethiops. Ferrum Oxydatum Magneticum. Oxydum Ferroso-Ferricum. Black Iron Oxide. Oxyde de Fer noir (magnétique), Oxyde ferroso-ferrique*, Fr. *Magneteisen, Eisenoxyd-Oxydul*, G.

"Take of Solution of Persulphate of Iron *five and a half fluid ounces* [Imperial measure]; Sulphate of Iron *two ounces* [avoirdupois]; Solution of Soda *four pints* [Imp. meas.]; Distilled Water *a sufficiency*. Dissolve the Sulphate of Iron in *two pints* [Imp. meas.] of the Water, and add to it the Solution of Persulphate of Iron, then mix this with the Solution of Soda, stirring them well together. Boil the mixture, let it stand for two hours, stirring it occasionally, then put it on a calico filter, and, when the liquid has drained away, wash the precipitate with Distilled Water, until what passes through the filter ceases to give a precipitate with chloride of barium. Lastly, dry the precipita at a temperature not exceeding 120°." *Br.* 1867.

Though the object of this formula is the same as that of the Br. Pharmacopœia of 1864, the proceeding is different. The point aimed at is to get an iron oxide containing one molecule of ferrous oxide and one of ferric oxide.

Properties.—The artificial magnetic iron oxide is a brownish-black powder, without taste, and strongly magnetic. According to the former Br. Pharmacopœia, it consists of a 3–4 iron oxide, Fe_3O_4, with about 20 per cent. of water of hydration, and a portion of iron peroxide (sesquioxide). It dissolves without effervescence in hydrochloric acid diluted with half its bulk of water, and the solution gives a blue precipitate both with the potassium ferrocyanide and the potassium ferricyanide, showing the presence of ferrous and ferric oxide. *Dose*, from five to twenty grains (0.32–1.3 Gm.).

Scales of iron (*ferri squamæ*) were formerly official with the Dublin College under the name of black oxide. They were prepared from the scales found at the blacksmith's anvil, by washing them with water, separating them from impurities by means of a magnet, and reducing them to a fine powder. They are of variable composition, being mixtures of the two oxides of iron with metallic iron.

Ferric Saccharate. *Saccharate de Fer, Saccharure d'Oxyde de Fer soluble*, Fr. *Eisenzucker, Lösliches Eisenoxyd*, G.—The *Ferrum Oxydatum Saccharatum* of the German Pharmacopœia is of importance as an antidote to arsenic. The process is as follows: Dilute 30 parts of solution of ferric chloride with 150 parts of water; add to this, little by little, a solution of 26 parts of crystallized sodium carbonate in 150 parts of water; wash the precipitate thoroughly with distilled water on a muslin strainer and press out the excess of water; add 5 parts of sugar and 15 parts of solution of sodium hydroxide, U. S. P. (8th Rev.); heat on a water bath until a clear solution is obtained. This is evaporated to dryness and enough sugar added to make 100 parts. (See *Arseni Trioxidum*, p. 197; *A. J. P.*, xlvi. 559.)

Ferric Salicylate. *Ferri Salicylas. Ferrum Salicylicum. Ferrisalicylat*, G.—Made by adding sodium salicylate to a concentrated solution of ferric chloride. The violet colored precipitate, when washed and dried forms a brown mass or powder insoluble in water. It is sometimes used as a tonic and antirheumatic in *doses* of from three to ten grains (0.2 to 0.65 Gm.).

Ferric Succinate. *Ferri Succinas. Succinate of Iron.*—The precipitate obtained by adding ferric chloride to a solution of a succinate is a basic salt $(C_4H_4O_4)_2Fe_2(OH)_2$. This is yellowish in color, becoming darker on standing. Ferric succinate has been introduced as a remedy for *jaundice* resulting from obstruction of the biliary duct; also as a chalybeate. *Dose*, five grains (0.32 Gm.).

Ferric Tannate. *Ferri Tannas.*—This salt is prepared by dissolving 44 parts of precipitated ferric subcarbonate, moderately dried, in a boiling solution of 9 parts of pure tannic acid, evaporating the solution at the temperature of 80° C. (176° F.), in a porcelain vessel, until it becomes thick, pouring it out on a glass or porcelain plate, and drying it with a gentle heat. As thus obtained, ferric tannate is in flat pieces, of a crimson color, without taste, and insoluble in water. It is not a definite chemical compound. It acts as an astringent and tonic, and may be given in *chlorosis*. *Ink* is an aqueous solution of the ferric gallotannate, and probably possesses similar medicinal properties. It is a popular application for *ringworm*. *Dose* of ferric tannate, from eight to thirty grains (0.5–2.0 Gm.), in the course of the day.

Ferric Valerate. *Ferri Valerianas. U. S.* 1890. *Ferric Valerianate.* $Fe(C_5H_9O_2)_3$.—"Ferric Valerianate should be kept in small, well-stoppered bottles, in a cool and dark place." *U. S.* 1890.

This preparation, which was official in the old Dublin Pharmacopœia, was introduced into the United States Pharmacopœia, but was dismissed from the 8th Revision. It is rarely used, because of its insolubility. It may be made by precipitating a diluted solution of ferric sulphate with a solution of sodium valerate, and collecting and washing the precipitate.

It was officially described as "a dark brick-red, amorphous powder of somewhat varying chemical composition, having the odor of valerianic acid, and a mildly styptic taste; permanent in dry air. Insoluble in cold water, but readily soluble in alcohol. Boiling water decomposes it, setting free the vale-

rianic acid, and leaving ferric hydrate. When slowly heated, the salt parts with its acid, without fusing, but, when rapidly heated, it fuses and gives off inflammable vapors having the odor of butyric acid, and, on complete ignition, leaves a residue of ferric oxide. The stronger acids decompose the salt with the liberation of valerianic acid. If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 2 Cc. of hydrochloric acid and 15 Cc. of water, and after the addition of 1 Gm. of potassium iodide the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled and mixed with a few drops of starch test-solution, it should require not less than 15 nor more than 20 Cc. of decinormal sodium hyposulphite volumetric solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)." *U. S.* 1890.

Uses.—Ferric valerate is a chalybeate tonic, which has been especially used by some practitioners in *anæmia* associated with *nervous exhaustion* and hysteroidal states. It has also been alleged to have almost specific properties in *diabetes insipidus*. *Dose*, from two to five grains (0.13 to 0.32 Gm.).

Ferripyrine. *Ferropyrine.*—This compound is prepared by adding 5 parts of crystallized ferric chloride, dissolved in 10 parts of 96 per cent. alcohol, to a solution of 5 parts of antipyrine in 10 parts of alcohol and 50 parts of ether. It is in the form of a fine, orange-red powder, containing about 64 parts of antipyrine and 36 parts of anhydrous ferric chloride. Soluble in 5 parts of water at 15° C., less soluble (9 parts) in boiling water, very soluble in alcohol but insoluble in ether. Alkalies or alkaline carbonates added to an aqueous solution precipitate ferric hydroxide. It combines the properties of both antipyrine and ferric chloride and is given in *anæmic conditions* accompanied by *headache*. It has been used in *chlorosis* as a chalybeate; is strongly astringent, and affirmed to be often useful in chronic *diarrhœas*. In strong solution (1 to 5) it is said to be a powerful non-irritant styptic. *Dose*, from three to six grains (0.2 to 0.4 Gm.).

Ferrosol.—A double saccharate of ferrous oxide and sodium chloride. It contains 0.77 per cent. of iron, and is employed in *anæmia* and *chlorosis*.

Ferrostyptin.—A. Eichengrün has introduced this antiseptic hæmostatic. It is a double salt of hexamethylene-tetramine hydrochloride and ferric chloride and forms dark yellow crystals, soluble in water. Its solution is coagulated by heat. *Dose*, five to eight grains (0.3–0.5 Gm.).

Ferrous Bromide. *Ferri Bromidum. Ferrum Bromatum. Bromure ferreux, Bromure de fer*, Fr. *Eisenbromid, Ferrobromid*, G. $FeBr_2$.—This bromide is obtained by heating gently, in thirty parts of water, two parts of bromine and one of iron filings. When the liquid has become greenish, it is filtered and evaporated to dryness in an iron vessel, and the dry mass, again dissolved and evaporated to dryness, furnishes the bromide. Ferrous bromide is a yellowish, deliquescent salt, very soluble, and extremely styptic. For medicinal employment it should be in aqueous solution, protected by sugar. Dillwyn Parrish has proposed the following formula. Take of bromine two hundred grains; iron filings eighty-five grains; distilled water four and a half fluidounces; sugar three ounces. Make a solution in the manner directed for preparing solution of ferrous iodide. (See *Ferrous Iodide.*) For other formulas, see *P. J.*, 3d ser., v. 67, 162. This solution has been used with alleged success as an alterative tonic in *chorea*, and in various *scrofulous* and *erysipelatous affections*. (See 16th ed. *U. S. D.*) The *dose* of ferrous bromide is from one to three grains (0.065–0.2 Gm.), three times a day, gradually increased until its effects are manifested.

Ferrous Iodide. *Ferri Iodidum. Iodide of Iron. Iodure de Fer*, Fr. *Ferrum Jodatum. Eisenjodür, Jodeisen*, G.

"Take of Fine Iron Wire *one ounce and a half* [avoirdupois]; Iodine *three ounces* [avoir.]; Distilled Water *fifteen fluid ounces*. Put the Iodine, Iron, and twelve [fluid] ounces of the Water into a flask, and, having heated the mixture gently for about ten minutes, raise the heat and boil until the froth becomes white. Pass the solution as quickly as possible through a wetted calico filter into a dish of polished iron, washing the filter with the remainder of the Water, and boil down until a drop of the solution taken out on the end of an iron wire solidifies on cooling. The liquid should now be poured out on a porcelain dish, and, as soon as it has solidified, should be broken into fragments, and enclosed in a well-stoppered bottle." *Br.* 1867.[1]

The solid ferrous iodide in its unprotected state is omitted in the present editions of the U. S. and Br. Pharmacopœias. The former directs it in pills and syrup prepared immediately from the materials. The iodide is extremely liable to spontaneous change.

In the Br. process of 1867, which is a modification of that of the old Dublin Pharmacopœia, iron is made to unite with iodine by the intervention of water, and the combination takes place readily and quickly. The liquid at first is red or orange colored, from the circumstance that all the iodine has not united with the iron; but, after the application of heat, it becomes fully saturated and limpid, and assumes a greenish color. It is now a solution of ferrous iodide, and yields the solid salt by evaporation. The proportion of the iron taken is half the weight of the iodine. Fine iron wire, recently cleaned, is directed on account of its purity; but iron filings dissolve more readily, and, if carefully selected, will be sufficiently pure. It is exceedingly difficult to obtain the salt in the solid state perfectly pure, so great is the proneness of its solution to absorb oxygen, whereby the iodide becomes, in part, converted into sesquioxide. This change is prevented to a certain extent by evaporating in an *iron* vessel.

T. and H. Smith of Edinburgh, recommend the following improved process, which more effectually excludes atmospheric air. Boil, in a Florence flask, six drachms of pure iron filings with two ounces and a quarter of iodine, in four and a half ounces of distilled water, until the liquid loses its dark color. Then filter the liquid rapidly into another flask, and evaporate it, at a boiling heat, until its green shade passes into black.

[1] *Tasteless Iron Iodide* is prepared in the following manner: 126.3 grains of iodine are combined with iron in the usual way to obtain the solution of ferrous iodide; this is filtered and 63 grains of iodine are dissolved in it; a solution of 201 grains of citric acid is exactly saturated with potassium hydroxide and then added to the first solution. When the apple-green color has been developed, the solution is evaporated, with gentle stirring, to dryness, when cauliflower-like masses of acicular crystals will be obtained. These are stable except in direct sunlight.

After this period, the heat is kept up as long as the evaporation of moisture continues, which may be ascertained by its condensation on a cold piece of glass, placed, from time to time, over the mouth of the flask. When this ceases, the flask contains pure, anhydrous, spongy ferrous iodide, which, when cold, is to be removed by breaking the flask, bruised coarsely in a warm dry mortar, and enclosed immediately in small well-corked bottles. If it be wished to obtain the iodine as a crystallized hydrate, the heat is to be withdrawn as soon as the liquid is sufficiently concentrated to congeal, in a dry and hard crust, on the end of an iron wire dipped into it. For a modification of this process, see *A. J. P.*, 1859, 52.

Ferrous iodide is a crystalline substance, exceedingly deliquescent, of a greenish-black color, and styptic, chalybeate taste. Its solution, by evaporation with as little contact of air as possible, affords transparent, green, tabular crystals. When heated moderately it fuses, and, on cooling, becomes an opaque crystalline mass, having an iron-gray color and metallic lustre. At a higher temperature it emits violet colored vapors, and the iron is left in the state of sesquioxide. It is very soluble both in water and in alcohol. When recently prepared it is wholly soluble in water, forming a pale green solution; but, if made for some time, it almost unavoidably contains some ferric oxide, from a partial decomposition, and will not entirely dissolve. Lecocq of Saint-Quentin, has proposed to preserve it in a wide-mouthed, ground-stoppered bottle, covered with a layer of reduced iron, which cannot decompose it, and protects it from the action of the air. When the iodide is wanted, the iron is removed with a bone spatula or a little brush. The aqueous solution is very liable to spontaneous decomposition, becoming at last orange-red from the generation of free iodine, and depositing ferric oxide. According to Richard Phillips, Jr., the first step in this change is the formation of ferrous oxide and hydriodic acid, from the decomposition of water. As the ferrous oxide immediately begins to be converted into ferric oxide by absorbing oxygen from the air, and in this state is precipitated, the hydriodic acid is set free, and hence is explained the acidity of the solution from the first moment the ferric oxide is deposited. Afterwards, the hydriodic acid is decomposed by the air, and iodine liberated. When the solution is prevented from generating free iodine, by placing in it a coil of iron wire, according to the plan of Squire, the iron acts by combining with the iodine of nascent hydriodic acid, and not with nascent iodine. (*P. J.*, iv. 19.) The plan of Squire does not prevent the deposition of ferric oxide, and has, therefore, been superseded by the use of saccharine matter, which affords a better protection to the solution. (See *Syrupus Ferri Iodidi.*) Ferrous iodide is incompatible with alkalies and their carbonates, with lime water, and with all other substances by which ferrous sulphate is decomposed. When crystallized, it has the composition $FeI_2.5H_2O$.

Ferrous iodide was first employed in medicine by Pierquin in 1824. It was first used in the United States in 1832 by Samuel Jackson. Its properties are those of a tonic, alterative, and diuretic. It acts more like the preparations of iron than like those of iodine. It sometimes sharpens the appetite and promotes digestion, and occasionally proves laxative. When it does not operate on the bowels, it generally augments the urine. Its use blackens the stools and lessens their fetor. It is chiefly employed in *scrofulous complaints, swellings of the cervical glands, chlorosis, atonic amenorrhœa*, and *leucorrhœa*. In *secondary syphilis*, occurring in debilitated and scrofulous subjects, Ricord has found it a valuable remedy. The *dose* is a grain (0.065 Gm.), gradually increased to eight grains (0.5 Gm.).

This salt, on account of its deliquescent property and proneness to decomposition, should not be given in pill, unless protected from change by saccharine matter or other means. (See *Pilulæ Ferri Iodidi* and *Ferri Iodidum Saccharatum*, p. 1225.) The most convenient form of exhibition is that of syrup, or glycerite.[1] *Iron Iodates* have been used to some extent as therapeutic agents in Dublin. For formulas, see *P. J.*, i. 624.

Ferrous Lactate. *Ferri Lactas. U. S.* 1890. $Fe(C_3H_5O_3)_2.3H_2O = 285.88$. *Lactate of Iron. Ferrum Lacticum*, P. G. *Lactas Ferrosus. Lactate de Fer*, Fr. *Milchsaures Eisenoxydul, Eisenlactat*, G.

A formula for this salt was omitted in the 1880 U. S. P. revision. In the process of the U. S. P. 1870 the lactic acid unites with the iron, forming ferrous lactate, a part of which crystallizes when the solution cools, and the remainder is obtained by evaporation and crystallization. It may be more cheaply prepared, on the large scale, by digesting the impure acid first obtained in Louradour's process, with iron filings, or by reaction between ferrous sulphate and the calcium lactate prepared as a step in obtaining lactic acid. The following is Gobley's process for making calcium lactate preparatory to its conversion into ferrous lactate. Add to 2 pints of skim milk, diluted with twice its bulk of water and contained in an earthen dish, 64 drachms of powdered lactose and 51 drachms of powdered chalk. Allow the whole to ferment for eleven or twelve days, at a temperature of from 26.6° to 32.2° C. (80°–90° F.), supplying fresh water as it evaporates. Transfer the liquor to a capsule, heat it gradually to boiling and stir it constantly. Boil for a quarter of an hour to coagulate casein, allow the insoluble matters to subside, and strain the liquid through flannel. The clear liquid is a solution of calcium lactate. In this process the casein of the milk, acting as a ferment, converts not only the lactose of the milk, but the lactose added, into lactic acid, a result which would not take place were it not for the presence of the chalk, which saturates the lactic acid as it is formed, and prevents it from uniting with the casein, whereby the power of the latter as a ferment would be destroyed. (*J. P. C.*, 3e sér., vi. 54.) See also other methods under *Acidum Lacticum.*) Calcium lactate may be expeditiously converted into iron lactate by the following process of Lepage. Dissolve 100 parts of calcium lactate, obtained by Gobley's process, in 500 parts of boiling water; dissolve also 68 parts of pure crystallized ferrous sulphate in 500 parts of cold distilled water. Mix the fil-

[1] *Glycerite of Ferrous Iodide.*—Glycerin has the property at once of dissolving and preserving ferrous iodide, and therefore makes an excellent solvent. Veza proposes the following formula: "Take of iodine 70 parts, iron, in powder, 35 parts, and glycerin 400 parts. Mix them." The color of the solution is an emerald-green; its taste is bitter and astringent; and tests do not detect in it the presence of free iodine. It may be used for preparing the syrup or pills. Five grains of it contain one of ferrous iodide.

tered solutions in a flask, acidulate slightly with lactic acid, and heat in a water bath, stirring frequently until the double decomposition is completed. Then filter to separate the calcium sulphate, and evaporate rapidly to one-half, either in an iron vessel, or in a porcelain capsule containing a few turnings of iron. Filter again, and set aside to crystallize, and, having washed the crystals in a funnel with a little alcohol, dry them on bibulous paper. (*J. P. C.*, 3e sér., ix. 272.) In relation to the precautions to be observed in preparing this lactate so as to prevent the partial oxidation of the iron, see *A. J. P.*, 1853, p. 556.

Ferrous lactate is in "pale greenish-white crusts, consisting of small, needle-shaped crystals, having a slight, peculiar odor, and a mild, sweetish, ferruginous taste. Slowly but completely soluble in 40 parts of water at 15° C. (59° F.), and in 12 parts of boiling water; freely soluble in a solution of an alkali citrate, yielding a green solution; almost insoluble in alcohol. When strongly heated, the salt froths up, gives out dense, white, acrid fumes, chars, and finally leaves a brownish-red residue. The aqueous solution of the salt has a greenish-yellow color, a slightly acid reaction, and gives with potassium ferricyanide test-solution a deep blue, and with potassium ferrocyanide test-solution a light blue, precipitate. A 2-per-cent. aqueous solution of the salt should not afford with lead acetate test-solution, nor, after acidulation with hydrochloric acid, with hydrogen sulphide test-solution, more than a whitish opalescence (limit or absence of *sulphate, chloride, citrate, tartrate, malate*, etc., and of *foreign metals*). The aqueous solution, acidulated with nitric acid, should not afford more than a slight opalescence with barium chloride test-solution, or with silver nitrate test-solution (limit of *sulphate* or *chloride*). If 25 Cc. of the aqueous solution (1 in 50), mixed with 5 Cc. of diluted sulphuric acid, be boiled for a few minutes, then precipitated by an excess of potassium or sodium hydrate test-solution, the filtrate, mixed with a few drops of alkaline cupric tartrate volumetric solution, and heated to boiling, should not afford a red precipitate (absence of *sugar*). If a portion of the salt be triturated with strong sulphuric acid, no offensive odor should be developed (absence of *butyric acid*), nor should any gas be evolved (absence of *carbonate*), and the mixture, after standing for some time, should not assume a brown color (absence of *sugar, gum*, or other *readily carbonizable impurities*). If 1 Gm. of the salt, contained in a porcelain crucible, be moistened with nitric acid, and carefully ignited, it should leave a residue of ferric oxide weighing not less than 0.270 nor more than 0.278 Gm. This residue should not have an alkaline reaction upon litmus paper, nor yield anything soluble to water (absence of *foreign salts*)." *U. S.* 1890. Ferrous lactate has an acid reaction. The aqueous solution quickly becomes yellow, in consequence of the iron passing to a higher state of oxidation. Louradour has seen several samples of this lactate variously adulterated, as with effloresced ferrous sulphate, starch, and lactin, the sophistication being concealed by the sale of the salt in powder. These impurities may be detected by appropriate reagents, but Louradour recommends the rejection of the salt when it is not in crystalline form.

Medicinal Properties.—Ferrous lactate has the general medicinal properties of the ferruginous preparations, and has been especially used in *chlorosis* by Andral, Fouquier, Bouillaud, and other Parisian doctors. As much as twelve or even twenty grains (0.78–1.3 Gm.) may be given in the course of a day. It may be administered in lozenge, pill, or syrup. The *lozenge* may be made of one grain (0.065 Gm.) of the lactate to twelve grains (0.78 Gm.) of sugar; the *pill*, of one grain (0.065 Gm.) of the salt, with an equal weight of some inert powder free from astringent matter, and sufficient honey. The following is the formula for a *syrup* proposed by Cap: Take of ferrous lactate a drachm; white sugar twelve ounces and a half; boiling distilled water six fluidounces and a half. Rub the salt to powder with half an ounce of the sugar, and dissolve the mixture quickly in the boiling water. Pour the solution into a flask placed on a sand bath, and add to it the rest of the sugar in small pieces. When the sugar is dissolved, filter the syrup, and, as soon as it is cold, transfer it to bottles, which must be well stoppered. This syrup has a very light amber color, and contains about four grains of the salt to the fluidounce. The *dose* is from two to four fluidrachms (7.5–15 Cc.). Bread, called *chalybeate bread*, containing ferrous lactate in the proportion of about a grain (0.065 Gm.) to the ounce (31 Gm.), has been used with advantage in cases of chlorotic patients in Paris.

Ferrous Malate. *Ferri Malas Crudus.*—This substance in an impure form has been long used and has been official in several European pharmacopœias under the name of *Extractum Ferri Pomatum.* It is made by digesting the juice of sour apples with iron filings until the reaction ceases, filtering and evaporating. Of a dark green color, containing varying amounts of iron.

Ferrous Oxalate. *Ferri Oxalas. U. S.* 1880. *Oxalate of Iron.* $FeC_2O_4.H_2O$. *Ferrum Oxalicum. Oxalas Ferrosus. Oxalate de Fer*, Fr. *Oxalsaures Eisenoxydul*, G.

"Take of Sulphate of Iron *two troyounces;* Oxalic Acid *four hundred and thirty-six grains;* Distilled Water *a sufficient quantity.* Dissolve the Sulphate of Iron in thirty fluidounces, and the Oxalic Acid in fifteen fluidounces of Distilled Water, filter the solutions, and, having mixed them with agitation, set aside the mixture until the precipitate is deposited. Decant the clear liquid, wash the precipitate until the washings cease to redden litmus, and dry it with a gentle heat." *U. S.* 1870.

This salt was official in 1870 and 1880 and was properly dropped in 1890, as it is a very feeble, inefficient chalybeate. "A pale yellow or lemon-yellow, crystalline powder, permanent in the air, odorless and nearly tasteless, very slightly soluble in cold or hot water, but soluble in cold, concentrated hydrochloric acid, and in hot diluted sulphuric acid. When heated in contact with air, it decomposes with a faint combustion, and, on ignition, leaves a residue, amounting to not less than 49.3 per cent. of the original weight. On heating the salt with excess of test-solution of carbonate of sodium, it is decomposed, yielding a precipitate which, when dissolved in diluted hydrochloric acid, affords a blue precipitate with test-solution of ferricyanide of potassium, and a filtrate which, when supersaturated with acetic acid, yields, with test-solution of chloride of calcium, a white precipitate soluble in hydrochloric acid." *U. S.* 1880. *Dose*, from two to three grains (0.13–0.20 Gm.).

Fersan is stated to be a preparation of the iron compound contained in the erythrocytes of the fresh blood of cattle, which is chemically a *ferruginous paranucleo-proteid.* It is soluble in water; the solution does not coagulate when boiled, and is not completely absorbed until it reaches the intestine. According to experiments made upon the lower animals, it remarkably increases the hæmoglobin of the blood and it has been used by various clinicians in the treatment of *anæmias. Dose,* a small teaspoonful after meals.

Filmogen. *Liquor Adhesivus.*—A vehicle for the application of medicinal substances to the skin. It is said to be a solution of pyroxylin in acetone containing a trace of fixed oil. It forms an elastic coating impervious to water.

Flindersia. *Flindersia maculosa* (Lindl.), F. Muell. *Leopard Tree.*—This is a tree of New South Wales, belonging to the Meliaceæ. During the summer it yields large masses of a clear amber-colored gum, which has a pleasant taste and is eaten by the aborigines; it is used as a remedy for *diarrhœa. Leopard tree gum* occurs in pieces as large as pigeons' eggs; dissolves rapidly in cold water, and has been found by J. H. Maiden to contain eighty per cent. of arabin but no metarabin. (*P. J.*, vol. xxi. 1890.)

Flour.—Under name of *Farina Tritici* the Br. Pharmacopœia formerly recognized ordinary wheat flour. *Bran* is the husk separated from the wheat during the process of grinding, and constitutes from 25 to 33 per cent. of the whole yield.

Flour is white, inodorous, and nearly insipid. Its chief constituents are starch, gluten, albumen, saccharine matter, and gum, the proportions of which are not constant. Clifford Richardson (*Bulletin No. 9, U. S. Department of Agriculture,* 1886) gives as the average of 27 analyses of wheat the following composition: moisture, 9.25; ash, 1.84; oil, 2.30; sugar, 3.50; dextrin and soluble starch, 2.30; starch, 67.88; albuminoids soluble in 80 per cent. alcohol, 3.58; albuminoids insoluble in 80 per cent. alcohol, 7.45; fibre, 1.90; total, 100. The gummy substance found in wheat flour is not precisely identical with ordinary gum, as it contains nitrogen, and does not yield mucic acid by the action of nitric acid. The starch, which is by far the most abundant ingredient, is much employed in a separate state. (See *Amylum.*) The gluten, however, is not less important, as it is to the large proportion of this principle in wheat flour that it owes its superiority over that from other grains for the preparation of bread. The gluten here referred to is the substance first noticed as a distinct principle by Beccaria. It is the soft, viscid, fibrous mass which remains when wheat flour enclosed in a linen bag is exposed to the action of a stream of water and at the same time pressed with the fingers till the liquor comes away colorless. But this has been ascertained to consist, in fact, of two different substances. When boiled in alcohol, one portion of it is dissolved, while another remains unaffected. Einhof ascertained that the part of the glutinous mass left behind by alcohol is identical with *vegetable albumen,* while the dissolved portion only is strictly entitled to the name of *gluten,* which had been previously applied to the whole mass. These two principles are contained in numerous vegetable products. They both contain nitrogen, and both, when left to themselves in a moist state, undergo putrefaction. From these circumstances, and from their close resemblance to certain proximate animal principles in chemical habitudes and relations, they were sometimes called, in old works on chemistry, *vegeto-animal substances.* They are separated from each other by boiling the gluten of Beccaria, above referred to, with successive portions of alcohol, until the liquid, filtered while yet hot, ceases to become turbid on cooling. The proper gluten dissolves, and may be obtained by adding water to the solution and distilling off the alcohol. Large cohering flakes float in the liquor, which, when removed, form a viscid, elastic mass, consisting of the substance in question with slight impurity. The part left behind by the alcohol is coagulated albumen.

Pure *gluten,* sometimes called *vegetable fibrin,* is a pale yellow, adhesive, elastic substance, which by drying becomes more deeply yellow and translucent. It is almost insoluble in water, and quite insoluble in ether and in the oils, both fixed and volatile. Hot alcohol dissolves it much more readily than cold, and from its solution in boiling alcohol it separates unchanged when the liquor cools. It is soluble in dilute acids, and in caustic alkaline solutions, in consequence of forming soluble compounds with the acids and alkalies. With the earths and metallic oxides it forms nearly insoluble compounds, which are precipitated when earthy or metallic salts are added to the solution of gluten in solution of potassium hydroxide. Corrosive sublimate precipitates it from its acid as well as alkaline solutions, and, added in solution to moist gluten, forms a compound with it, which, when dry, is hard, opaque, and incorruptible. Gluten is precipitated by infusion of galls. Its name originated in its adhesive property. It exists in most farinaceous grains and in the seeds of some leguminous plants.

Vegetable albumen is destitute of adhesiveness, and, when dried, is opaque and of a white, gray, or brown color. Before coagulation, it is soluble in water, but insoluble in alcohol. By heat it coagulates and becomes insoluble in water. It is dissolved by solutions of the caustic alkalies. Most of the acids, if added to its solution in excess, precipitate the albumen, which, though soluble in pure water, is insoluble in that liquid when acidulated. It is not, however, precipitated by an excess of phosphoric or acetic acid. Corrosive sublimate precipitates it from its solutions, except from those in phosphoric and acetic acids, and, when added in a state of solution to moist albumen, forms with it a hard, opaque compound. It is also precipitated by infusion of galls. This principle derived its name from its very close resemblance to animal albumin. It is associated with gluten in most of the farinaceous grains, is a constituent of all the seeds which form a milky emulsion with water, and exists in all the vegetable juices which coagulate by heat.

Vegetable albumen and *vegetable fibrin* (or gluten) both belong to the great class of *proteid* bodies, which class includes albumens, globulins, compound proteids, modified proteids, albuminoids, enzymes, and toxalbumins. *Proteids* consist of nitrogen, carbon, hydrogen, oxygen, and sulphur, and their average composition may be expressed by the empirical formula $C_{72}H_{112}N_{18}O_{22}S$.

It is scarcely necessary to state that *bread* is formed by making flour into a paste with water, with the addition of yeast, setting it aside to ferment, and then exposing it to the heat of an oven. The fermentation excited by the yeast is accompanied by the extrication of carbon dioxide, which, being retained by the tenacity of the gluten, forms innumerable little cells throughout the mass,

and thus renders the bread light.[1] Alcohol is also generated during the fermentation, most of which is driven off from the bread in baking; but a small portion remains, averaging, according to Thos. Polas, 0.314 per cent. (*Chem. News*, May 30, 1873.)

Wheat flour in its unaltered state is seldom used in medicine. It is sometimes sprinkled on the skin in *erysipelatous* inflammation, and in various itching or burning *eruptions*, particularly the *nettle-rash*; though rye flour is generally preferred for this purpose.

Bread is more employed; an infusion of toasted bread in water is a nutritive drink well adapted to febrile complaints. Boiled with milk, bread forms a good emollient poultice, which may be improved by the addition of a little perfectly fresh lard. Slices of it steeped in lead water, and the crumb mixed with the fluid and confined within gauze, afford a convenient mode of applying this preparation to local inflammations. The crumb (*mica panis*) is, moreover, frequently used to give bulk to minute doses of very active medicines administered in the form of pill. It should be recollected that it always contains common salt, which is incompatible with various substances.

Bran is sometimes used in decoction, as demulcent in catarrhal affections and complaints of the bowels. When taken in substance, it is laxative, and may be used with advantage to prevent *costiveness*. Bran bread, made from the unsifted flour, is an excellent laxative article of diet in some dyspeptic cases. The action of the bran is probably mechanical, consisting in the irritation produced upon the mucous membrane of the bowels by its coarse particles. Bran also forms an excellent demulcent bath.

Fluorescence.—It has been proposed to use this property of various drugs to detect adulterations. (See *P. J.*, 1875; *A. J. P.*, 1875; *P. M. T.*, 1875.)

Fluorescin. *Fluorescein.* $C_{20}H_{12}O_5$.—This may be prepared by heating phthalic anhydride (5 parts) with resorcinol (7 parts) to 200° C. (392° F.). It is a yellowish-red or dark red powder, soluble in alcohol with yellow-red color and green fluorescence. The sodium salt *uranin* (*sodio-fluorescein*), $C_{20}H_{10}O_5Na_2$, and the potassium salt (*potassio-fluorescein*) are marketed. They differ in that the first is a brownish-yellow and the second a yellowish-red powder; both of them yield aqueous solutions which exhibit an intense yellow-green fluorescence. These drugs were recommended by Straub in 1888 for the purpose of staining the eye and its secretions, under various circumstances, to facilitate diagnosis. The test solutions should contain fluorescin, 2 parts; sodium bicarbonate, 3 parts; distilled water, 100 parts. It is necessary to cocainize the eye before the application of the fluorescin.

Fluorides.—*Hydrofluoric acid* is a pungent, fuming, acid gas, very corrosive, attacking glass and porcelain and etching its surface. It is very soluble in water, the specific gravity of the solution rising to 1.25. The concentrated aqueous acid becomes weaker on boiling until, when boiling at 120° C. (248° F.), it attains a constant composition of from 36 to 38 per cent. of the anhydrous acid. Concentrated hydrofluoric acid is a powerful corrosive, having the peculiar property of hardening the skin or tissue with which it comes in contact and continuing its action underneath the hardened tissue, with an extraordinary amount and persistency of pain. For case, see *B. M. S. J.*, Jan. 1882; also *B. M. J.*, vol. i. 1880. According to L. A. Waddell (*Indian Med. Gaz.*, 1883), the dilute 8 per cent. acid applied to the skin causes stinging sensation and pallor, followed by redness and desquamation. From 15 to 20 per cent. acid destroys the epithelium and produces severe burning and aching pain. The vapor of the acid is exceedingly irritant to the lungs, causing, even when very dilute, spasm of the glottis and other symptoms of irritation. According to Husemann, death has been produced by it. Nevertheless, L. Olivieri and F. Mergoni affirmed that in solution of 33 per cent. the daily inhalation of hydrofluoric acid from half an hour to an hour is a valuable adjuvant to quinine in chronic *malaria*.

Alkaline Fluorides.—Waddell states that the alkaline fluorides are not pronounced irritants, and when taken internally in *doses* of from a grain to a grain and a half (0.065–0.096 Gm.) continuously, they reduce the force and the frequency of the pulse, at the same time depressing the temperature and increasing somewhat the flow of urine, but not distinctly affecting either the respiratory or the cutaneous functions. This accords with the physiological studies of Tappeiner, who found in animals the soda salt to powerfully depress blood pressure by acting on the vasomotor centres. Death, after profound collapse, was produced by centric failure of respiration. (*A. E. P. P.*, xxvii.) Waddell also affirms that there is an enormous decrease in the number of the red blood corpuscles, which he believes, but does not prove, to be the result of a direct action upon the spleen. According to the experiments of Brandl and Tappeiner, when solid fluorides are given in minute quantities with the food, they become separated in the body, especially in the bones, where they form a crystalline combination. (*Z. B.*, x. 1892.) Maumené has asserted that when the alkaline fluorides are given to dogs for five months goitrous enlargement of the thyroid gland is developed. On the other hand, Rabuteau failed in a series of experiments to obtain any such results, and Woakes has employed the remedy in goitrous enlargement of the thyroid with asserted good results. The remedy has also been used by Da Costa in rheumatism, but in the clinical studies of Waddell the fluorides failed to do any good

[1] *Adulteration of bread.*—Among the adulterations of bread practised by the bakers, alum, employed to cause whiteness and thus cover defects in the flour, is perhaps the one which has most attracted notice, and which, being sometimes noxious, it is most important to be able to test. One of the means of detection recommended is that of incineration, by which the bread is consumed, while the alum, if there be any, is left behind. But this method is somewhat tedious, and logwood has been recommended as being at once most convenient and, according to John Horsley, "*perfectly reliable*," if applied as he directs. The following is Horsley's method, by which in the county of Gloucester, England, alone, in the course of two surveys, he succeeded in obtaining two hundred convictions out of some thousands of cases examined by him. He first makes a tincture of logwood by digesting, for eight hours, two drachms of freshly cut chips in five ounces of methylated spirit and filtering; next makes a saturated solution of ammonium carbonate in distilled water; then mixes a teaspoonful of each solution with a wineglass of water in a white-ware dish, thus forming a pink-colored liquid, and lastly immerses a portion of the suspected bread, "for five minutes or so," in the mixed fluids. If alum be present, the bread, placed on a plate to drain, will in the course of an hour or two assume a blue color; if not present, the pink color will fade away. The appearance of a greenish color on drying will indicate the presence of copper. (*Chem. News*, May 17, 1872.) For some modifications of this method by Herz, see *A. Pharm.*, 1886, 676.

either in *rheumatism* or in *epilepsy*, although they did seem to accomplish something in *goitre*. *Dose* of the alkaline fluorides, one grain (0.065 Gm.). These fluorides are stated to be active antiseptics, and as such to be used in distilleries. Under the name of *fluorol*, Duclos has proposed the use of the *sodium fluoride* as being equally powerful and less toxic than the ordinary antiseptics. He reports that a 2 per cent. solution may be used upon the skin, mucous membranes, and wounds without irritation, and has used a half per cent. solution in diseases of the eye. According to Bokorny, it is much less powerful as a germicide than is the *potassium fluoride*. It is sometimes used as an insecticide, but is distinctly toxic, 150 grains having caused death. (*J. Am. C. S.*, xxi.)

Silver Fluoride, AgF. *Tachiol.*—This salt, which occurs in deliquescent crystals acquiring a yellow color in the air and finally being converted into a black crystalline mass, making stable solutions in water, has been brought forward by Durante and Perez as a valuable antiseptic for surgical use. It is a feeble coagulant of albumin, and great penetrating power is claimed for its solution. It is employed in the proportion of one to a thousand; the one per cent. solution is said not to be distinctly irritant to the skin. It blackens linen and other organic substances. Zappuli has destroyed *malignant pustules* by injecting into them silver fluoride solution.

Organic Fluorides.—A number of organic fluoric compounds have been proposed and put upon the market. According to Tischer and Beddies (*Aerzt. Rund.*, 1898), they are antispasmodic, bactericidal, and are primarily stimulant, secondarily depressant to the motor nerve. *Antitussin* is a five per cent. ointment of *di-fluordiphenyl*, $\begin{matrix} C_6H_4\text{–}F \\ | \\ C_6H_4\text{–}F \end{matrix}$, which has been lauded as a local application to the throat and chest in the treatment of *whooping cough*, one to one and a half drachms (3.9–5.8 Gm.) being applied at a time. *Di-fluordiphenyl* itself, a white aromatic powder, insoluble in water, freely soluble in alcohol, ether, and chloroform, was originally recommended by J. Thimm as a local remedy in the treatment of *syphilitic ulcers* or *wounds*, applied either as a ten per cent. dusting powder or a ten per cent. ointment. (*Derm. Zeit.*, iv. No. 15.)

Fluorphenetol has been introduced, in the form of a five per cent. ointment, under the name of *fluor-rheumin*, as a local application in *sciatica* and other acute affections.

Fluor-pseudocumol.—Under the name of *neodermin*, the five per cent. ointment of this substance has been put upon the market. It is alleged to have local properties similar to those of difluordiphenyl and especially to give relief to painful ulcers.

Fluoroform. CHF_3.—This gas was originally suggested by Stepp (*M. M. W.*, 1899, No. 29) in *tuberculosis*. Afterwards studied by Binz (*Verhandl. des Kongresses inn. Med.*, Berlin, 1891, vol. ii. Sec. iv.), who found it to have properties somewhat similar to those of chloroform. Under the name of *fluoroformol*, a two and eight-tenths per cent. aqueous solution has been introduced. It is almost odorless and tasteless, and is said to be non-toxic and non-irritant, so that four ounces a day may be given without the production of symptoms. Usually one fluidrachm (3.75 Cc.) has been administered in water four or five times a day. According to Stepp, it produces, when given internally, remarkable effects in *tuberculosis*. Gorl (*M. M. W.*, 1899, No. 50) found it, however, to be of very little value.

Forman. — *Chlormethylmenthyl-ether*, $C_{10}H_{19}$—$O.CH_2Cl$, a product formed by the action of formaldehyde upon menthol in the presence of hydrochloric acid. It is a colorless oil, emitting dense fumes and boiling at 160° to 162° C. (320°–323.6° F.) under a pressure of 16 Mm. In the presence of water or merely moist air the ether splits up into its original constituents, formaldehyde, menthol, and hydrochloric acid, according to the equation:

$$C_{10}H_{19}\text{—}O.CH_2Cl + H_2O = CH_2O + C_{10}H_{19}OH + HCl$$

therefore it is possible that when it is locally applied forman may act as nascent menthol and formaldehyde. It has been used in the treatment of various conditions of the nasal and even bronchial mucous membrane. It is applied either by inserting tufts of cotton impregnated with the compound loosely into the nostrils so that air may be aspirated through the nose, or by having the patient breathe the vapor arising from four to six drops of forman in warm water through a closed inhaler with nasal tips.

Formanilide. *Formanilidum. Phenylformamide.* $C_6H_5NH.COH$.—This substance, which is made by heating aniline with formic acid, or by distilling equal molecules of aniline and oxalic acid, occurs in long, colorless, prismatic needles, melting at 46° C. (114.8° F.), soluble in water, alcohol, glycerin, and oil. It has been used as an antipyretic and analgesic, but is said frequently to produce cyanosis and cardiac depression. Externally, mixed with equal parts of chalk, it has been used in diseases especially of the nasal passages by Preisach, and in 2 per cent. solution by Meisel in *genito-urinary inflammations*. It is said to produce burning pain, lasting about a quarter of an hour, and followed by a mild analgesia continuing from eight to twelve hours. *Dose*, two to five grains (0.13–0.32 Gm.).

Formic Acid. *Acidum Formicum*, P. G. *Ameisensaure*, G.—This acid, although deriving its name from having first been obtained from the ant (*Formica rufa*), is remarkable for the number of sources of its production. It can be made from some species of caterpillars, from the blood, urine, fluid of the spleen, and perspiration of human beings; it is found in the products of decomposition of a number of vegetable substances, in common oil of turpentine, as a decomposition product of tartaric acid contained in various fruits and in the juice of the stinging nettle. It may be produced artificially in many ways: by the oxidation of methyl alcohol, the saponification of chloroform, and the hydrolysis of hydrocyanic acid; the following process yields good results: 50 Gm. of glycerin and 50 Gm. of crystallized oxalic acid are placed in a suitable retort attached to a condenser and the mixture carefully heated until the temperature rises to 105° C. (221° F.), it is then allowed to cool to about 50° C. (122° F.) and 50 Gm. more of oxalic acid are added and the mixture heated very slowly to 115° C. (239° F.). The condensed liquid may be drawn off and another addition of oxalic acid made and the distillation continued almost indefinitely. When oxalic acid and glycerin are distilled together, chemical reaction occurs, glyceryl formate being produced; this is saponified by the water which is separated, formic acid distils over and glycerin is reproduced. Formic acid, in its most concentrated state, is a colorless liquid,

sp. gr. 1.235 (medicinal acid, sp. gr. 1.063), fuming slightly upon exposure to the air, having a pungent sour taste, and, when applied to the soft skin, producing violent pain, and often ulceration. Diluted solutions are alone suitable for medicinal applications; equal parts of the strong acid and water have been used. *Spiritus Formicarum*, P. G., *Spirit of Ants*, *Ameisengeist*, G., is made as follows: "Alcohol (90–91 per cent. vol.), *seventy parts;* Water, *twenty-six parts;* Formic Acid (24–25 per cent.), *four parts*. Mix them. A clear, colorless liquid of an acid reaction. Specific gravity from 0.894 to 0.898." *P. G.*

When formic acid is mixed with solution of lead subacetate, it throws down a white, crystalline precipitate. "When the Acid is mixed with five parts of water and saturated by yellow mercuric oxide, a clear solution results, which, on heating, evolves a gas and deposits a white precipitate, which rapidly turns gray and afterwards changes into shining, metallic, coalescing globules. When neutralized with solution of potassium hydroxide, it should have no pungent or empyreumatic odor. 10 Gm. of the Acid should neutralize 56 to 58 Cc. of volumetric solution of soda, corresponding to 24 to 25 per cent. of soluble Formic Acid. When diluted with five parts of water, the Acid should not be affected by silver nitrate, nor, after neutralization with ammonia, by chloride of calcium nor by hydrosulphuric acid. On diluting 1.5 Gm. of the Acid with 5 Gm. of water and heating on the water bath as long as gas is given off with 1 Gm. of yellow oxide of mercury, it should yield a neutral filtrate." *P. G.*

Formic acid, diluted with an equal measure of water, is sometimes used to excite the circulation in paralyzed limbs. It is rarely used internally; *dose*, five minims (0.3 Cc.).

Among the salts of formic acid, *ammonium formate* (NH_4CHO_2) has been used medicinally. Ramskill, at the Hospital for the Epileptic and Paralytic, in London, considers it useful in *chronic paralytic disease* associated with general tremor. It is contraindicated by any remaining active irritation or inflammation of the nervous centres or about them, which may have been the original seat of the lesion. Grêhaut and Quinquaud have found that the formates are eliminated by the kidneys unchanged. *Dose*, five grains (0.32 Gm.); a larger quantity than this is apt to cause vomiting.

Formic Ether.—A paper on the physiological action of this substance may be found in the *J. P. C.*, Juin, 1872, 453.

Formopyrine.—*Methylenediantipyrine* ($C_{11}H_{11}N_2O_2 = CH_2$) is formed by heating five parts of antipyrine with four parts of formaldehyde solution for several hours to 120° C. (248° F.); crystals melting at 156° C. (312.8° F.), or when anhydrous at 176° to 177° C. (348.8°–350.6° F.); almost insoluble in water, readily soluble in alcohol. It unites the action of the two components.

Fortoin is obtained by the action of formaldehyde upon *cotoin*, the active principle of the true coto-bark. Its composition is $CH_2 \begin{matrix} C_{14}H_{11}O_4 \\ C_{14}H_{11}O_4 \end{matrix}$ and it is therefore to be viewed in the light of a *methylenedicotoin*. Fortoin forms yellow needles or a yellow powder emitting a feeble cinnamon-like odor; it is freely soluble in chloroform, acetone, glacial acetic acid, and dilute alkalies, but dissolves sparingly in alcohol and ether, while in water it is absolutely insoluble; melting point, 211° to 213° C. (411.8°–415.4° F.). It is claimed for *fortoin* that it has the peculiar action of cotoin upon the intestinal mucous membrane, united with the antiseptic and disinfecting properties of formaldehyde. It is used in those cases of *chronic intestinal catarrh* in which there is no active inflammatory process. It has been also recommended by Overlach as a local application in badly *ulcerated sore throats* and in *gonorrhœa*. In making local applications 10 per cent. of alcohol should be employed with water, and the strength may vary from one to six grains to the fluidounce. *Dose*, four to seven grains (0.26–0.45 Gm.) three to five times a day.

Frankenia. *Frankenia grandifolia*, Cham. and Schlecht. *Yerba Reuma.* (Fam. Frankeniaceæ.) This California herb, which contains about 6 per cent. of tannin, is employed as a topical remedy in *catarrhal affections*, especially of the nose and genito-urinary tract; also internally in *doses* of from ten to twenty minims (0.6 to 1.3 Cc.) of the fluidextract. For local application the fluidextract may be diluted with from two to five times its volume of water.

Frasera. *Radix Fraseræ. Radix Colombo Americanæ. Racine de Colombo de Mariette (d'Amérique)*, Fr. *Frazerawurzel, Amerikanische Colombowurzel*, G.

American Columbo (*Frasera carolinensis*, Walt.; *F. Walteri*, Michx.) flourishes in the southern and middle western region of the United States. It prefers rich woodlands and moist meadows. The period of flowering is from May to July; but the stems and flowers are produced only in the third year, the radical leaves being the only part of the plant which previously appears above ground. From this manner of growth, it is inferred that the roots, which were formerly included in the Secondary List U. S. P., should be collected in the autumn of the second or the spring of the third year. Before being dried, they should be cut into transverse slices.

As formerly in the market, frasera was in pieces irregularly circular, an eighth of an inch or more in thickness, about an inch in diameter, somewhat shrunk in the middle, consisting of a central medullary matter and an exterior cortical portion, of a yellowish color on the cut surfaces, with a light reddish-brown epidermis. In appearance these pieces somewhat resembled calumba, but were easily distinguishable by the greater uniformity of their internal structure, the absence of concentric and radiating lines, and their purer yellow color, without a greenish tinge. The root sliced longitudinally, so as to imitate gentian, has been offered in the market as *American gentian*. The taste of frasera is bitterish and sweetish. Water and diluted alcohol extract its virtues, and the tincture lets fall a precipitate upon the addition of water, but is not disturbed by tincture of galls. The hot infusion is not precipitated by solution of gelatin, and gives with iodine no signs of starch. These reactions afford additional means of distinguishing the root from calumba. Higinbothom of Bermuda, found in it gum, pectin, glucose, wax, resin, fatty matter, yellow coloring matter, bitter extractive, and an acid which was probably peculiar. (*A. J. P.*, Jan. 1862, 23.) Frank W. Thomas has determined the entire absence of berberine. (*Ibid.*, July, 1868, 310.) G. W. Kennedy obtained *gentisic acid*, $C_{14}H_{10}O_5$, and *gentiopicrin*, $C_{20}H_{30}O_{12}$. (*Proc. A. Ph. A.*, 1873, 635.) Patch points out (*Ibid.*, 1881, 467) that the yellow coloring matter differs from gentisic acid in being less soluble in cold alcohol, more soluble in hot alco-

hol and in ether, in having a lower melting point, 86.1° C. (187° F.), and in behaving differently with nitric and sulphuric acids.

Frasera, or *American Columbo*, is a feeble, simple bitter, *Dose*, of powder, one drachm (3.9 Gm.); of infusion (1 fl. oz. to 1 pint boiling water), two fluidounces (60 Cc.) a day. The fresh root is said to be emetic and cathartic.

Fraxinus. *Fraxinus americana*, L. *White Ash.* (Fam. Oleaceæ.)—The bark has been used in *dysmenorrhœa* by Charles P. Turner and others. The wine may be made (Thomas S. Wiegand, *A. J. P.*, 1882) by macerating eight troyounces of powdered bark for three days in one pint of sherry wine, then transferring to a percolator, and pouring on sufficient menstruum to obtain two pints of percolate. *Dose*, one fluidrachm (3.75 Cc.).

Fraxinus excelsior, L. *Frêne*, Fr. *Esche*, G. *Fresco*, Sp. (Fam. Oleaceæ.)—The bark of the *Common European Ash* is bitter and astringent, and at one time was employed in the treatment of intermittent fever. Keller believed that he had found in the bark a peculiar crystallizable principle which Buchner denominated *fraxinin;* but Rochleder and Schwartz proved that the crystals, formed along with the bitter substance obtained by the process of Keller, were nothing but mannite. (*Ph. Cb.*, 1853, 312.) *Fraxin* or *paviin*, the crystallizable bitter principle discovered by Salm-Horstmar, is obtained by precipitating the decoction with lead acetate, washing the precipitate, decomposing it by hydrogen sulphide, and concentrating the solution, which deposits the fraxin in needle-shaped crystals. These are four-sided prisms, shining, white with a tinge of yellow, feebly bitter and astringent, inodorous, soluble with difficulty in cold but readily in hot water. They have the formula $C_{16}H_{18}O_{10}$. Fraxin is a glucoside, dilute acids decomposing it into *fraxetin*, $C_{10}H_8O_5$, and *glucose*, $C_6H_{12}O_6$. The concentrated warm solution has an acid reaction. When much diluted, it exhibits a clear blue fluorescence by daylight, especially if a trace of ammonia be present. Alkalies, alkaline earths, and the carbonates color it yellow; ferric chloride first colors it green, and then throws down a yellow precipitate. (*Chem. Cb.*, 1857, 452.) The leaves have long been used in *rheumatic affections* and *gout*. Garot has shown that they contain 16 per cent. of *calcium malate*. (See *J. P. C.*, 3e sér., xxiv. 311; also 4e sér., xii. 60.) *Dose*, an ounce (31 Gm.), infused in half a pint (236 Cc.) of boiling water, three times a day. (See *Am. J. M. S.*, N. S., xxv. 492.)

French Chalk.—A compact, unctuous, indurated talc, of a greenish color, glossy, somewhat translucent, soft and easily scratched, and leaving a silvery line on paper; used chiefly for marking cloth and for extracting grease spots. (See *Talcum.*)

Fruit Essences, Artificial.—Several of the compound esters have been found to possess the odor and flavor of certain fruits, a property which has led to their employment as flavoring materials for confectionery and desserts, under the name of fruit essences. The simple ethers present in these compounds, so far as they have become of commercial importance, are common ether or ethyl oxide, and amyl oxide or amylic ether. Each of these ethers possesses basic properties, and has its alcohol, common or ethylic ether corresponding to common or ethyl alcohol, and amyl ether to amyl alcohol or fusel oil. These alcohols are hydroxides of ethyl and amyl respectively. (See *Amyl Alcohol*, and *Alcohol*, page 103.) Colored artificial essences are to be distinguished from the real by the following tests, founded upon the presence of aniline dyes. Fuchsine dyes a woollen or silken thread a permanent rose color, the tint imparted by natural fruit juice washes out (C. Puscher, *J. P. C.*, 4e sér., xlv. 395); dilute mineral acids redden natural fruit essences, turning yellow those containing an aniline dye; half a volume of nitric acid *instantly* turns an artificial syrup yellow; potassium carbonate reddens artificial syrups, but has no effect on natural syrups; lead subacetate precipitates red with fuchsine, green with natural fruit. (M. Vandeyvere, *J. P. C.*, 4e sér., x. 457; Hagar, *A. J. P.*, xlv. 395.)

Ethyl Butyrate. Butyric Ether. Ethyl-butyric Ester. $C_4H_7(C_2H_5)O_2$.—This ester is readily prepared by dissolving eight parts of normal butyric acid in five parts of ethyl alcohol and mixing this solution with ten parts of concentrated sulphuric acid. After warming the mixture for some time to about 80° C. (176° F.), and then allowing it to stand for some hours, it is poured into cold water, when the ether separates. It forms a layer on the surface, and may be purified by washing it with water and subjecting it to the action of calcium chloride. Butyric ether is sparingly soluble in water, but very soluble in alcohol, and boils at 121° C. (249.8° F.). It is said to be much used to communicate a pineapple flavor to rum. Dissolved in 8 to 10 parts of alcohol, it forms the *pineapple essence*. From twenty to twenty-five drops of this essence, added to a pound of sugar containing a little citric acid, imparts to the mixture a strong taste resembling that of pineapple. *Butyric acid*, $C_4H_8O_2$, is formed during what is called the butyric fermentation, which usually consumes two or three months before it is completed, and which is preceded by the lactic fermentation. To prepare it, a solution of grape sugar is mixed with half its weight of chalk, and with about one-tenth of its weight of cheese to act as a ferment, and the whole is kept at the temperature of 32.2° C. (90° F.). The sugar is first transformed into a viscous substance, and afterwards into lactic acid, which is gradually converted into butyric acid, with the disengagement of hydrogen and carbon dioxide. At the end of the fermentation the liquid contains principally a mixture of calcium butyrate and lactate, from which the butyric acid may be obtained by precipitating the lime as a carbonate by sodium carbonate, and decomposing the resulting sodium butyrate with sulphuric acid. Butyric acid is a colorless liquid, of disagreeable odor and rancid taste. It dissolves in all proportions in water and alcohol, boils at 163° C. (325.4° F.); density, 0.973.

Ethyl Pelargonate. Pelargonic Ether. Ethyl-pelargonic Ester. Œnanthic Ether. $C_2H_5,C_9H_{17}O_2$.—A preliminary step in forming this ether is to prepare the *pelargonic acid*. This is obtained, according to R. Wagner, by the action of nitric acid on oil of rue. Treat the oil with double its weight of very dilute nitric acid, and heat the mixture until it begins to boil. Two layers are formed in the liquid, the upper one being brownish, and the lower consisting of the products of the oxidation of the oil, with the excess of nitric acid. The lower layer, having been separated, is freed from the greater part of the nitric acid by evaporation in a zinc chloride bath, and then filtered. This filtrate is a solution of pelargonic acid, and may be converted into pelargonic ether by a pro-

longed digestion, at a gentle heat, with alcohol. The ether as thus prepared has the agreeable odor of quince, and when dissolved in alcohol in due proportion, forms the *quince essence.* It is also obtained from wine lees, by adding sulphuric acid and water, and distilling in a current of steam. Pure pelargonic ether (œnanthic ether) is a colorless liquid, having a peculiar, vinous, stupefying odor, and a taste at first slight but afterwards acrid. Its sp. gr. is 0.8635 at 17.5° C. (63.5° F.) and its boiling point from 227° to 228° C. (440.6°–442.4° F.). It is insoluble in water, but dissolves readily in alcohol and ether. Pelargonic acid, first obtained from *Pelargonium capitatum* (L.), Ait., or *rose geranium*, belongs to the fatty acid series and has the formula $C_9H_{18}O_2$. Delffs's analysis of *œnanthic acid* gives it the same composition, and he considers the two acids identical.

Amyl Acetate. Amyl-acetic Ester. Pentyl Acetate. $C_5H_{11}.C_2H_3O_2$.—A cooled mixture of 100 parts of pure amyl alcohol and 130 parts of concentrated sulphuric acid is poured over 100 parts of anhydrous sodium acetate placed in a retort connected with condensing apparatus; after 12 hours' standing the ether is distilled off by the aid of a sand bath. The distilled liquid is purified from free acid by washing with a weak alkaline solution, and from water by distillation from calcium chloride. It is a colorless, limpid liquid, lighter than water, boiling at 137° C. (278.6° F.), insoluble in water, but soluble in alcohol. It possesses the odor, in a remarkable degree, of the Jargonelle pear, and is manufactured on a large scale for flavoring syrups and confectionery. An alcoholic solution of this ether forms the *Jargonelle pear essence.* Fifteen parts of amyl acetate, with half a part of acetic ether, dissolved in 100 parts of alcohol, form what may be called the *bergamot pear essence*, which, when employed to flavor sugar acidulated with a little citric acid, imparts the odor of the bergamot pear, and a fruity taste. Amyl acetate mixed with ethyl butyrate forms another fruity compound, which recalls the odor of the banana, and forms, in alcoholic solution, the *banana essence.*

Amyl Valerate. $C_5H_{11}.C_5H_9O_2$. *Amyl Valerianate. Amyl-valeric Ester. Apple Oil.*—This is made by carefully mixing four parts of pure amyl alcohol (fusel oil) with four of sulphuric acid, and adding the mixture, when cold, to five parts of valeric acid. The whole is warmed for a few minutes in a water bath, and then mixed with a little water, which causes the ether to separate. Lastly, it is purified by washing it with water and a weak solution of sodium carbonate. It boils at 188° C. (370.4° F.), and has a sp. gr. of 0.879 at 0° C. (32° F.). An alcoholic solution of this ether, in the proportion of one part to six or eight of alcohol, forms a flavoring liquid under the name of *apple essence.* (See *Valeric Acid.*)

Besides the essences here described, there are found in commerce the strawberry, raspberry, apricot, greengage, mulberry, and black currant essences, all of which may be viewed as various mixtures of the esters of the ethyl and amyl series, modified by the addition of pure nitrous ether, tincture of orris, vanilla, volatile oils, etc., to bring about a resemblance to the fruit the odor and taste of which it is the object to imitate. In making these essences it is important that the materials should be pure, especially the fusel oil and alcohol. The alcohol used as a solvent should be rectified and deodorized.

The fruit essences are extensively employed for flavoring ices, jellies, lozenges, and drops, and for making fruit syrups and effervescent beverages. They are, however, vastly inferior to the concentrated juices and extracts from the real fruits, and if used at all should be free from injurious coloring agents.

Kletzinsky prepared a table giving the ingredients, and their proportions, of a large number of fruit essences. This table[1] has been carefully revised, as several important errors occurred in it. They are alcoholic solutions of different ethers, to which are sometimes added certain acid and natural essences. Glycerin is present in nearly all, being useful in blending and harmonizing the different flavors. The alcohol and other ingredients must be chemically pure. See a paper by George R. Pancoast and Willard Graham (*Proc. Penn. Phar. Assoc.*, June, 1906).

Fuchsine.—This product, one of the older coal tar colors, is either *rosaniline hydrochloride* or *acetate*, a complex body, the formula being $C_{20}H_{19}N_3.HCl$ or $C_{20}H_{19}N_3.C_2H_4O_2$. Both compounds

[1] Names of the Essences.	Alcohol.	Chloroform.	Nitrous Ether.	Aldehyde.	Acetic Ether.	Formic Ether.	Butyric Ether.	Valeric Ether.	Benzoic Ether.	Œnanthylic Ether.	Oil of Persicot.	Sebacic Ether.	Methyl-Salicylic Ether.	Amyl Alcohol.	Amyl-Acetic Ether.	Amyl-Butyric Ether.	Amyl-Valeric Ether.	Oil of Lemon.	Oil of Orange.	Alcoholic Solutions saturated in the cold of: Tartaric Acid.	Oxalic Acid.	Succinic Acid.	Benzoic Acid.	Glycerin.
Pineapple	100	1	....	1	....	....	5	..	....	....	....	....	....	....	....	10	....	....	....	....	....	....	....	3
Melon	100	....	....	2	...	1	4	5	....	....	...	10	....	....	....	....	....	....	....	....	....	....	....	3
Strawberry	100	....	1	....	5	1	5	....	....	....	....	....	1	....	3	2	....	....	....	....	....	....	....	2
Raspberry	100	....	1	1	5	1	1	....	1	1	....	1	1	....	1	1	....	....	....	5	....	1	....	4
Gooseberry	100	....	....	1	5	....	....	....	1	1	....	....	....	....	....	....	....	....	....	5	....	1	1	....
Grape	100	2	....	2	....	2	....	....	....	10	....	....	1	....	....	....	....	....	....	5	....	3	....	10
Apple	100	1	1	2	1	....	....	....	....	....	....	....	....	....	....	....	10	....	....	....	1	....	....	4
Orange	100	2	....	2	5	1	1	....	1	....	....	....	1	....	1	....	....	....	10	1	....	....	....	10
Pear	100	....	....	....	5	....	....	....	....	....	....	....	....	....	10	....	....	....	....	....	....	....	....	10
Lemon	100	1	1	2	10	....	....	....	....	....	....	....	....	....	....	....	....	10	....	10	....	1	...	5
Blackberry	100	....	....	....	10	....	....	....	5	....	2	....	....	....	....	....	....	....	....	....	1	....	2	....
Cherry	100	....	....	....	5	....	....	....	5	....	1	....	....	....	....	....	....	....	....	....	....	....	1	3
Plum	100	....	....	5	5	1	2	....	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	8
Apricot	100	1	....	....	....	....	10	5	....	....	1	....	....	2	....	1	....	....	....	1	....	....	....	4
Peach	100	....	....	2	5	5	5	5	....	....	5	1	....	2	....	....	....	....	....	....	....	....	....	5
Currant	100	....	....	1	5	....	....	....	1	1	...	....	....	....	....	....	....	....	....	5	....	1	1	....

form large crystals of a greenish lustre, which dissolve in water (the acetate more easily in cold water) with carmine-red color. They stain animal tissue directly violet-red, while vegetable fibre must first be mordanted. Reiss (*G. H. M. C.*, 1888) recommends fuchsine as a specific in *acute* and *chronic Bright's disease*. Fuchsine and *safranine*, $C_{21}H_{20}N_4$, are said to be largely employed in France for coloring wines red. In the experiments of Cazeneuve and Lépine (*G. H. M. C.*, Nov. 1885) fuchsine was found to be free from toxic properties, but safranine proved itself a violent poison, causing marked dyspnœa, acceleration of the heart's beat, violent diarrhœa and albuminuria, and death from respiratory paralysis. *Dose* of rosaniline, one-tenth to one-sixth grain (0.006–0.010 Gm.).

Fucus vesiculosus. L. *Sea-wrack. Bladder-wrack. Kelp-ware. Black-tang. Cutweed. Quercus Marina. Fucus (Varech) vésiculeux*, Fr. *Blasentang, Seetang, Meereiche*, G. (Fam. Fucaceæ.) This sea weed is perennial, with the frond or leaf flat, smooth and glossy, from one to four feet long, from half an inch to an inch and a half broad, furnished with a midrib throughout its length, dichotomous, entire upon the margin, and of a dark olive-green color. Small spherical vesicles, filled with a mixture of nitrogen and oxygen but no CO_2, are immersed in the frond near the midrib. The air in these vesicles has not the exact composition of the atmosphere, consisting, according to the analysis of Ernest Baudrimont, in one instance of 28.4 per cent. of oxygen and 71.6 of nitrogen, in another of 26.5 of the former and 73.5 of the latter. (*J. P. C.*, 4e sér., ii. 446.) The fruit consists of roundish, compressed conceptacles, at the ends of the branches, filled with a clear tasteless mucus and containing oogonia and antheridia on distinct plants. The plant grows upon the shores of Europe and of this continent, attaching itself to the rocks by its expanded woody root. On the coasts of Scotland and France it is much used in the preparation of *kelp*. It is also employed as a manure, and is mixed with the fodder of cattle. It has a peculiar odor, and a nauseous saline taste. Several chemists have undertaken its analysis, but the results are not satisfactory. It contains much sodium in saline combination, and iodine, according to Gaultier de Claubry, in the state of potassium iodide. Convoy has found in it 0.21 per cent. of iodine. (*P. J.*, x. 434.) These ingredients remain in its ashes, and in the charcoal resulting from its exposure to heat in close vessels. On the coast of France about a dozen species of sea weed have been used in making kelp. According to Eugene Marchand, *Fucus vesiculosus* is one of those poorest in iodine, the different species of Laminaria containing far larger amounts of iodine than the Fucaceæ. (See *P. J.*, 1884, 1011.) *Laminaria digitata* (L.), Lamx., and *L. stenophylla* contain ten times as much iodine as the Fuci, and are practically now the only kelps used in making iodine. (See *P. J.*, 1884, 1026.)

The charcoal, which is sometimes called *Æthiops vegetabilis* or *vegetable ethiops*, has long had the reputation of a deobstruent, and been given in *goitre* and *scrofulous swellings*. The mucus contained in the vesicles was applied externally, with advantage, by Russell, as a resolvent in scrofulous tumors. Duchesne Duparc has obtained from it very good results in the treatment of morbid *obesity*. (*J. P. C.*, 1862, 65.) A. T. Carson affirms, however, that the *Fucus vesiculosus* is largely used in Ireland for fattening pigs, and it is doubtful whether its preparations are capable of reducing human obesity unless given in such doses as to interfere with digestion and injure the health. Dannecy prepares the extract from the plant, collected at the period of fructification and rapidly dried in the sun. The coarse powder he treats for three days, with four times its weight of alcohol of 86°, expresses at the end of this time, and subjects the residue twice successively to a similar treatment with alcohol of 54°. The tinctures are then mixed, the alcohol distilled off, and the remainder evaporated to the consistence of an extract. Of this extract, which is one-fifteenth of the plant, three pills, each containing 0.25 Gm. (3.75 grains), may be taken daily in the beginning, and increased gradually to twenty-four pills. (*J. P. C.*, 1862, 434.) From the tincture a syrup may be prepared.

Other species of Fucus are in all probability possessed of similar properties. Many of them contain a gelatinous matter and a sweet principle analogous to mannite, and some are used as food in times of scarcity. Large quantities of a sea weed, *agar-agar*, are gathered on the rocky coasts of the East India islands, and sent to China, where it is valued for making jellies and as a size for stiffening silks. The varieties are classified by Fristedt as follows.

1.—*Ceylon Agar-agar*, consisting chiefly of *Sphærococcus lichenoides*, Ag., the alga used by the *Hirundo esculenta* in the formation of its edible nest.

2.—*Macassar Agar-agar*, coming from the straits between Borneo and Celebes, consisting of impure *Eucheuma spinosum*, Ag., incrusted with salt.

3.—*Japanese Agar-agar*, known as Japanese isinglass, derived from several algæ, especially *Sphærococcus compressus*, Ag., *Gloiopeltis tenax*, J. Ag., *Gelidium corneum*, Lam., and *G. cartilagineum*, Gaill. It occurs in European commerce either in transparent pieces, two feet long and as thick as a straw, prepared in Singapore by putting the algæ named in hot water, or, more frequently, in yellowish-white masses, a foot long and upward of a inch in width. It is the latter kind of agar-agar that is suitable for the culture of bacteria, according to Koch's method. (*P. J.*, 1885, 188.)

Morin has investigated the *gelose* of Payen, contained in the agar-agar. When a solution of gelose is cooled, even that of 1 in 500 parts of water, a colorless, transparent, and stiff jelly is obtained, which, when heated with moderately strong nitric acid, yields *mucic* and oxalic acids. It dissolves on heating with acidulated water without yielding a jelly on cooling.

Gelose leaves 3.88 per cent. of ash, and when air-dried contains 22.85 per cent. of moisture. When dissolved there also separates out a flocculent mass amounting to 1.9 per cent. Alcohol precipitates gelose, but it cannot be obtained pure in this manner, as the precipitate contains some ash. (*C. R. A. S.*, No. 90, 924–926.)

Under the name of *gelosine* a mucilaginous substance, extracted from a Japanese alga, has entered commerce in the form of dry, whitish leaves. Gelosine is soluble in alcohol and water, and is said when wet to gradually contract and expel water and the medicinal substances which it may contain. It has been proposed as a pharmaceutical basis for various preparations for local use. (See *B. M. J.*, vol. ii. 1886.) Glycerin suppositories have been made with agar-agar as a vehicle, but

they can contain but 70 per cent. of glycerin. The official suppositories, made with sodium stearate, contain 90 per cent. of glycerin.

The *Ceylon moss* is a delicate fucus (*Fucus amylaceus*) growing on the coast of Ceylon. It abounds in starch and vegetable jelly, and is used like carrageen or Irish moss. (*P. J.*, xiii. 355.) (*Fucus Helminthochorton*, L., *Gigartina Helminthochorton*, Grev.) *Sphærococcus Helminthochorton* (L.), Ag., has some reputation in Europe as an anthelmintic and febrifuge. It is an ingredient in the mixture of marine plants sold in Europe under the name of *Corsican moss* or *helminthochorton*. This is used in decoction, from four to six drachms to the pint; *dose*, a wineglassful three times a day.

Attention has been called by Sloan of Ayr, Scotland, to the *Laminaria digitata* (L.), Lamx., *L. Cloustoni*, Edmonst., commonly called sea-girdles or *tangles*, of Scotland, as supplying an admirable material for bougies. The stem is from two to twelve feet long and an inch or more in breadth, is of great strength and tenacity, with the property of drying readily, and, in doing so, of shrinking much, and acquiring an elastic firmness, with a consistence, if the desiccation be arrested at the proper point, somewhat softer than horn. In this state the plant may be kept for years, and is capable of absorbing moisture at any time and swelling to the original size, so that it has been used for the making of dilating bougies and tents.

Fuligokali.—This preparation, proposed by Deschamps, is formed by boiling for an hour 20 parts of potassium hydroxide and 100 of shining soot, in powder, in a sufficient quantity of water. The solution, when cold, is diluted, filtered, and evaporated to dryness. Fuligokali is in the form of a black powder, or of scales, very soluble in water, and having an empyreumatic odor and mild alkaline taste. It is used in the same affections as *anthrakokali*. The *dose* is two or three grains (0.13–0.2 Gm.), repeated several times a day. An ointment, containing from sixteen to thirty-two grains (1.04–2.13 Gm.) to the ounce (31 Gm.) of lard, was found by Gibert of Paris, to be detergent, resolvent, and gently stimulant. (*A. J. P.*, xiv. 284.)

Fumaria. *Fumaria officinalis*, L. *Fumitory. Beggary. Fumeterre*, Fr. *Erdrauch, Feldraute*, G. (Fam. Papaveraceæ.)—A small annual European plant, naturalized in this country, growing in cultivated grounds, and flowering from May to August. It was formerly considerably employed as a medicine, and is still used in Europe. The leaves are the official part. They are inodorous, have a bitter, saline taste, and are very succulent, yielding by expression a juice which has the sensible and medicinal properties of the plant. An extract, prepared by evaporating the expressed juice or a decoction of the leaves, throws out upon its surface a copious saline efflorescence. *Fumaric acid*, $C_4H_4O_4$, was early identified as present, and its isomerism with *maleic acid*, the acid obtained from malic acid by heat, was established later. The alkaloid *fumarine*, which was observed by Peschier, has been believed by some chemists to be identical with corydaline, but according to Reichwald (*P. J.*, xix. 990) its formula, $C_{21}H_{19}N.O_4$, is different from that of corydaline, from which it further differs in striking immediately an intense violet with concentrated sulphuric acid and an intense golden color with strong nitric acid. It occurs in colorless, tasteless crystals, freely soluble in chloroform, less so in benzene, still less so in alcohol and ether, sparingly soluble in water. He obtained it by treating the pulp of the leaves with concentrated acetic acid, with the aid of heat, filtering, evaporating the liquid, treating the extract with boiling alcohol, filtering the alcoholic solution, and, finally, decolorizing, and evaporating so that crystals might form. The acetate thus procured was decomposed by the alkalies, and yielded the fumarine. (See Adermann, *A. J. P.*, 1890, 396.) Fumitory has been considered gently tonic, alterative, and, in large doses, laxative and diuretic. Hannon has found fumarine, in the *dose* of about one-third or one-fourth of a grain (0.021–0.016 Gm.) to be moderately excitant; in that of three grains (0.2 Gm.) to be at first irritant and afterwards sedative. (*Ann. Thér.*, 1854, 78.) Both in ancient and modern times fumitory has been esteemed a valuable remedy in visceral obstructions, particularly those of the liver, in scorbutic affections, and in various troublesome eruptive diseases. Cullen gave two fluidounces (60 Cc.) of the expressed juice twice a day. Others have prescribed it in much larger quantities. The leaves, either fresh or dried, may be used in decoction or extract, in almost indefinite dose. The inspissated juice has also been employed.

Furfurol. *Furol.—Pyromucicaldehyde*, $C_4H_3(CHO)O$, a decomposition product of certain proteids, occurs in beer and brandy and is produced in the distillation of bran, pentoses, etc., with diluted sulphuric acid. It is a limpid, colorless liquid, soluble in 11 parts of water and freely in alcohol and ether.

According to Brunton and Tunnicliffe (*L. L.*, 4032), this toxic aldehyde is present in all raw spirits and is the cause of their toxic properties. The *dose* of one and a half grains (0.096 Gm.) of furfurol produces in man a persistent headache. Ammonia is said to be antidotal to furfurol, hence its value in "pick-me-ups."

Fustic.—A yellow dye-wood, obtained from *Chlorophora tinctoria* (L.), Gaud. (*Morus tinctoria*, L., *Maclura tinctoria*, D. Don, *Broussonetia tinctoria*, H. B. K.), a tree of the fam. Moraceæ, growing in the West Indies and South America. It is not used in medicine or pharmacy. According to Bancroft, two different woods bear in England the name of fustic, one the product of the tree just mentioned, distinguished as *old fustic*, probably from the greater magnitude of the billets in which it is imported; the other derived from the *Rhus cotinus*, L., or *Venice sumach*, and called *young fustic*, or sometimes *Hungarian fustic*. The wood of *C. tinctoria* owes its coloring properties to two principles, which have been isolated by R. Wagner; one denominated *morin*, or *morindon*, $C_{15}H_{10}O_5$, and the other *moritannic acid*, $C_{13}H_8O_8$, from its resemblance to tannin. The former, when distilled with zinc dust, yields methyl-anthracene, whence the conclusion has been drawn that it is a *trioxymethylanthraquinone*, $C_{15}H_7O_2(OH)_3$. (See *Chem. Gaz.*, ix. 1, 21, and 241.) From the fustic of *Rhus cotinus*, L. (Fam. Anacardiaceæ), or Hungarian fustic, Chevreul extracted a yellow coloring matter, in small crystalline needles when pure, which he called *fisetin*. J. Schmidt (*Ber. d. Chem. Ges.*, 19, 1734–1749) has made a thorough study of fisetin, and prepared a number of derivatives of it. He states that it occurs in the wood as a tannic acid compound of the glucoside of fisetin, which he calls *fustin*. This latter body crystallizes from hot water in fine silvery needles, easily soluble in alcohol and dilute alkalies, sparingly in ether. It melts at from 218°–219° C. (424.4°–426.2° F.)

with decomposition. By warming with dilute H_2SO_4 it is split up into fisetin and a glucose (probably *isodulcite*). The *fisetin* has the formula $C_{15}H_{10}O_6$, and as it contains four hydroxyl groups, it is probably a *tetroxymethylanthraquinone*, $C_{15}H_6O_2(OH)_4$. It is obtained by recrystallization from dilute alcohol or acetic acid; it forms fine yellow needles or yellow prisms. It is very slightly soluble in hot water, easily soluble in alcohol and acetic ether, sparingly in ether and benzene.

Gabianol is a substance prepared from a natural shale. It is described as a dark brown, oily liquid, with a greenish reflection, and as being a valuable remedy in various diseases of the lungs and throat, administered in capsules, each containing 4 grains (0.26 Gm.).

Gaiacyl.—C. André describes gaïacyl as being the calcium derivative of *guaiacol-sulphonic acid*, $(C_7H_7O_2SO_3)_2Ca$. It occurs as a bluish-gray powder very soluble in water and alcohol, but not in oil. It has been employed as a local anæsthetic in 5 to 10 per cent. solutions, but is probably of little value. (*J. P. C.*, Series 6, vol. vii.)

Galangal. *Galanga. China Root. India Root. Galanga*, Fr. *Rhizoma Galangæ*, P. G. *Galgant*, G.—Two varieties are described by authors, the *Galanga major* and *Galanga minor*, or *large* and *small galangal*. They are probably the roots of different plants. The large galangal is derived from *Alpinia Galanga*, Willd. (*Maranta Galanga*, L., *Galanga officinalis*, Salisb.). According to H. F. Hance of Canton, the smaller galangal is the product of a distinct but closely allied plant, *Alpinia officinarum*, Hance. (*A. J. P.*, xliii. 408.) Both forms are brought from the East Indies. The *larger variety* is cylindrical, three or four inches long, as thick as the thumb or thicker, often forked, reddish-brown externally, slightly striated longitudinally, marked with whitish circular rings, orange-brown internally, rather hard and fibrous, difficultly pulverizable, of an agreeable aromatic odor, and a pungent, hot, spicy, permanent taste. The *small galangal* resembles the preceding in shape, but is smaller, not exceeding the little finger in thickness, of a darker color, and of a stronger taste and odor. According to Morin, galangal contains a volatile oil, an acrid resin, extractive, gum, bassorin, and lignin. A. Vogel, Jr., found also starch and fixed oil. (*Ph. Cb.*, 1844, 158.) R. Brandes discovered a peculiar crystallizable substance called *kæmpferid*. (*Ann. Pharm.*, xxxii. 311; see also *A. Pharm.*, 1882, 161.) The active principles are the volatile oil and acrid resin. Thresh has described (*A. J. P.*, 1884, 553) an active pungent principle, which he has named *galangol*. Galangal is a stimulant aromatic. It was known to the ancient Greeks and Arabians, and formerly entered into numerous compounds. (*A. J. P.*, xliii.) *Dose*, from fifteen to thirty grains (1.0–2.0 Gm.) in substance, and twice as much in infusion.

Galega. *Galega officinalis*, L. *Goat's Rue. Herba Rutæ Capriariæ. Galega, Rue de Chèvre*, Fr. *Geisraute, Pestilenzkraut*, G.—A perennial leguminous herb, growing in the south of Europe, and sometimes cultivated in gardens. It is without odor unless bruised, when it emits a disagreeable odor. Its taste is unpleasantly bitter and somewhat rough, and when chewed it stains the saliva yellowish-brown. In former times it was much employed in *malignant fevers*, the *plague*, the *bites of serpents, worms*, etc. In 1873 Gillet-Damitte, in a communication to the French Academy, stated that this plant when fed to cows would increase the secretion of milk from 35 to 50 per cent.; since which time Cerisoli, Goubeaux, Masson d'Aury, Millbank, and Carron de la Carrière have affirmed that goat's rue is a powerful galactagogue. The best preparation appears to be an aqueous extract prepared from the fresh plant. This almost black extract has a pronounced odor, and may be given in *doses* of from eight to fifteen grains (0.5 to 1.0 Gm.), from three to five times a day.

The root of the indigenous *Cracca virginiana*, L. (*Galega virginiana*, L., *Tephrosia virginiana*, Pers.), is said to be diaphoretic and powerfully anthelmintic. It is given in decoction.

Galium. *Galium Aparine*, L. *Cleavers. Goose-grass. Grateron, Rièble*, Fr. *Klebkraut*, G.—This is an annual, succulent, rubiaceous plant, common to Europe and the United States, growing in cultivated grounds, and along fences and hedges. It is inodorous, and has a bitterish, herbaceous, somewhat acrid taste. Analyzed by Schwartz, it was found, besides chlorophyll, starch, and other principles common to all plants, to contain three distinct acids,—viz., a variety of tannic acid, which he names *galitannic acid*, citric acid, and a peculiar acid, previously discovered by Schwartz and Rochleder, and named *ribichloric acid*, $C_{14}H_8O_9$. (*P. J.*, xii. 190.) The expressed juice is said to be aperient, diuretic, and antiscorbutic, and has been used in *dropsy, congestion of the spleen, scrofula, scorbutic eruptions*, and *lepra*. Orwin (*T. G.*, vol. i. 767) commends it highly in *psoriasis*. Three ounces (90 Cc.) may be given twice a day.

Galium verum, L. *Yellow Ladies' Bedstraw. Cheese Rennet. Caille-lait jaune*, Fr. *Megerkraut, Liebfrauenstroh*, G.—This European Galium (Fam. Rubiaceæ) is inodorous, but has an astringent, acidulous, bitterish taste. The bruised plant is sometimes used to color cheese yellow, being introduced into milk before coagulation. It is also used for dyeing yellow. The roots of this and of most other species dye red, and the plant, eaten by animals, colors the bones like madder. Schwartz found the same principles in it as in *G. Aparine*. It was formerly highly esteemed as a remedy in *epilepsy* and *hysteria*, and was applied externally in *cutaneous eruptions*, in the form either of the recently expressed juice or of a decoction from the fresh plant. Of the American species, *G. tinctorium*, L., is closely allied in properties to *G. verum*. It is said to be useful in *cutaneous diseases*, and the root is employed by the Indians for staining their feathers and other ornaments red. *G. triflorum*, Michx., contains coumarin, as pointed out by L. von Cotzhausen. (*A. J. P.*, 1878, 405.)

Gallacetophenone. *Alizarine Yellow. C.*—$C_6H_2\begin{cases}(OH)_3\\CH_3CO\end{cases}$. This is a derivative of pyrogallol, containing an acetyl group replacing an H atom of the benzene nucleus. Forms a pale yellow powder, crystallizing from hot water, in which, as well as in alcohol and ether, it is readily soluble. It is also soluble in glycerin in all proportions. This substance has been proposed as a substitute for pyrogallic acid in the local treatment of *psoriasis*, it being claimed that it does not stain, and is not so poisonous as the acid.

Gallinol. *Gallanol. Gallanilide.* $C_6H_2\begin{cases}CO.NH.C_6H_5\\(OH)_3\end{cases} + 2H_2O$.—This anilide of gallic acid is formed by boiling tannin with aniline, and was brought forward by Cazeneuve and Rollet as a

local remedy to replace chrysarobin in the treatment of skin diseases. (*C. R. A. S.*, 1893.) It occurs in colorless crystals melting at 205° C. (401° F.), of a bitter taste, soluble in hot water, ether, and alcohol, insoluble in benzene and chloroform. It has been especially commended by Gonon, Bayet, Max Joseph, and others, not only in *psoriasis*, but also in chronic *eczema*, to be used in a 10 per cent. solution or ointment, or sometimes in very advanced cases as high as 20 per cent.; it is affirmed never to produce irritation. The removal of the hair is not necessary, provided the skin be thoroughly cleansed with alkaline soap solutions.

Gallobromol. *Dibromgallic Acid.* $C_6Br_2(OH)_3COOH$.—A colorless or pale grayish-red powder composed of fine needles melting at 205° C. (401° F.); soluble with difficulty in cold water, easily soluble in hot water, alcohol, and ether, and having a strong acid reaction and a slightly bitter taste. It has been used by Lépine in *neurasthenia* and *epilepsy* to replace potassium bromide, but it would seem to be a somewhat dangerous remedy, as in Lépine's experiments a dog weighing 11 kilogrammes was killed in two hours by 11 Gm., death having been preceded by slowing of the heart's action, depression of respiration, rise of temperature, convulsions, and methæmoglobinuria. According to Stein, it is to dogs more poisonous than the sodium bromide, less than the potassium bromide. In the dog small doses produce a primary moderate rise of the blood pressure, followed by fall of pressure, with cardiac arythmia. *Dose* (Lépine), as a sleeping potion, forty-five grains (3 Gm.); in epilepsy, from thirty to forty-five grains (2–3 Gm.) a day. (See *Cb. G. T.*, xiii. 1895.)

Gallols.—E. Kromayer (*Monatshefte für Prakt. Dermatologie*, vii.) has tested as remedies for diseases of the skin a number of chemical combinations of pyrogallol, chrysarobin, and resorcinol, with various acids. Of these a few give promise of therapeutic usefulness.

Lenigallol, pyrogallol triacetate, is described as a white insoluble powder, slowly soluble on warming with aqueous solutions of alkalies, with decomposition.

Eugallol, pyrogallol monoacetate, is a very thick, syrupy, transparent, dark yellow mass, readily soluble in water.

These substances are stated not to be affected by contact with healthy skin, but to be slowly decomposed by the diseased skin with the liberation of pyrogallol. Strong ointments of lenigallol are to be employed in *psoriasis*, 1 to 2 parts of lenigallol to 200 parts of zinc paste in *eczemas*. Even the most acute eczemas, as well as those with impetiginous crusty exudations, are reached by the ointment.

Eugallol produces great local excitement, and is only to be employed in the most obstinate cases of *psoriasis*. Under such circumstances, however, the direct local application as a paint, daily or every other day, produces a marked inflammation, under which the most stubborn patches are said to disappear. Dusting the painted parts with zinc oxide before drying makes the action more vigorous. The value of eugallol has been strongly confirmed by Paul Gruneberg (*Derm. Zeit.*, vi. 1899), who uses in *lupus* a zinc paste with from 11 to 12 per cent. of eugallol continuously applied after free curetting, and in *psoriasis* he uses a 33⅓ per cent. acetone solution followed by zinc oxide dressing.

Saligallol, pyrogallol disalicylate, is a resinous solid, useful in the preparation of skin varnishes, soluble in six parts of acetone or fifteen parts of chloroform. The deposit is very adhesive, but has no curative effect. It is useful as a means of applying eugallol.

Eurobin is *chrysarobin triacetate.*—It is insoluble in water, but is readily soluble in chloroform, acetic acid, acetone, or ether. It acts like chrysarobin on the skin, but is more powerful. Kromayer commends it applied as a paint, according to the following formula. Saligallol, 5 to 10 parts; eurobin, 1 to 20 parts; acetone, to make 100 parts.

Lenirobin, chrysarobin tetra-acetate, is less irritant than chrysarobin, and has the special advantage of not staining the linen.

Euresol, resorcinol monoacetate, is a viscid, rather fragrant, transparent, yellow mass, which is commended by Kromayer in *acne rosacea, seborrhœa*, and other conditions for which resorcinol is commonly used.

Gardenia. *Gardenia grandiflora*, Lour. (Fam. Rubiaceæ.)—A Chinese tree, the fruit of which is employed in dyeing the yellow robes of the mandarins, and, according to Lorenz Mayer, contains *crocin*, which in powder is of a bright red color, and soluble in water and alcohol. According to the researches of Kayser (*Ber. d. Chem. Ges.*, 1884, 2228), its formula is $C_{44}H_{70}O_{28}$. When heated with diluted hydrochloric or sulphuric acid, it is decomposed into *crocetin*, $C_{34}H_{46}O_9$, and a dextrorotatory sugar called *crocose*. Alkalies bring about the same decomposition almost instantly. Concentrated sulphuric acid dissolves both the crocin and crocetin with deep blue color. The fruit of another species, *G. campanulata*, Roxb., growing in the forests of Chittagong, in India, is said to be used by the natives as a cathartic and anthelmintic. (Lindley, *Flor. Med.*, 434.)

Garrya Fremontii, Torr. *California Fever Bush. Skunk Bush.*—The leaves of this California bush (Fam. Cornaceæ) have an intensely bitter taste, and are said to be largely used by Californians as a tonic and antiperiodic. D. W. Ross (*A. J. P.*, 1877) states that he has found in them a new alkaloid, *garryine*. The *dose* of the fluid-extract of the leaves is from ten to thirty minims (0.6–1.8 Cc.).

Gasu-Basu.—This is an amorphous, yellow, hygroscopic powder, easily soluble in water, less soluble in ether and alcohol, giving alkaloidal reactions, and is said to be the active principle of the Indian gasu-basu. It has been brought forward as a local anæsthetic in the form of hydrochloride under the name of *nervocidine*.

Gaultheria. *Wintergreen. Boxberry. Checkerberry. Feuilles de Gaulthérie couchée (de Paloninier), Thé du Canada, Thé de Terreneuve*, Fr. *Canadischer Thee, Bergthee*, G.—*Gaultheria procumbens*, L. (Fam. Ericaceæ), is a small indigenous, shrubby, evergreen plant. The leaves, which were formerly official in the U. S. Pharmacopœia, are short-petiolate, obovate or roundish-oval, about an inch and a half (4 centimeters) long, and three-quarters of an inch (2 centimeters) or more broad, acute, revolute at the edges with a few mucronate serratures, coriaceous, shining, bright green above, paler beneath, of unequal size, and supported irregularly on short red petioles.

The plant extends from Canada to Georgia, growing in large beds in mountainous tracts, or in dry barrens and sandy plains, beneath the shade of shrubs and trees, particularly of other

evergreens, as the Kalmiæ and Rhododendra. In different parts of the country it is variously called *partridge-berry*, *deer-berry*, *tea-berry*, *wintergreen*, and *mountain-tea*. The flowers appear from May to September, and the fruit ripens at corresponding periods. To the very peculiar aromatic odor and taste which belong to the whole plant the leaves add a marked astringency. The aromatic and medicinal properties of wintergreen reside exclusively in an official volatile oil. (See *Oleum Gaultheriæ*, page 846.)

Gelanth. *Gelanthum.*—Gelanth is a combination of equal weights of tragacanth and gelatin, prepared by Unna as a basis for various pastes for the skin. It is stated to be superior to the older pastes in drying more quickly and leaving a smoother coating upon the skin, as well as in holding more uniformly and in tighter suspense the drug used with it, and finally in not spoiling readily. It is made by allowing tragacanth to soften with twenty times its mass of water for four weeks, then warming the mass to fluidity with steam and pressing it through a mill. In the meanwhile gelatin has been softened in the water and then for some time exposed to a high pressure of steam in Unna's boiler, which exposure lessens its capability of gelatinization. The mixture of the two masses is allowed for two days to soften in the steam, then passed through a mill and mixed with 5 per cent. of glycerin, a little rose-water, and 2 per cent. of thymol. The finished gelanth contains about 2½ per cent. each of dry gelatin and tragacanth. In using it as a vehicle, fatty matters must first be emulsified and insoluble substances rubbed up with water to a soft paste before they are mixed with the gelanth.

Genista. *Genista tinctoria*, L. *Dyers' Broom. Dyers' Weed. Green Weed. Wood-Waxen. Genet des Teinturiers*, Fr. *Färberginster*, G. (Fam. Leguminosæ.)—A low shrub, growing wild in Europe, and sometimes cultivated in this country in gardens. The flowering tops of the plant are employed to dye yellow, whence its name was derived. Both these and the seeds have been used in medicine. They are said to be purgative and even emetic, especially the seeds, which were formerly given as a cathartic in the *dose* of a drachm and a half (5.8 Gm.). By some authors they are said to be diuretic and to be useful in *dropsy*.

Genoform.—This is stated to be a condensation product of acetyl-salicylic acid and formaldehyde. It occurs as a white powder having a slightly acid taste, which is sparingly soluble in cold water, but freely soluble in alcohol, ether and hot water. It is said to be split up in the intestines into salicylic acid, acetic acid, and formaldehyde. The *dose* is stated to be five to eight grains (0.32–0.5 Gm.).

Geranium. *Geranium robertianum*, L. *Herb Robert. Herbe à Robert*, Fr. *Ruprechtskraut*, G. (Fam. Geraniaceæ.)—This species of geranium grows wild both in Europe and the United States, and Pursh states that the American plant is destitute of the heavy odor by which the European is so well known, though the two agree in all other respects. The herb has a disagreeable, bitterish, astringent taste, and imparts its virtues to boiling water. It has been used internally in *intermittent fever*, *consumption*, *hemorrhage*, *nephritic complaints*, *jaundice*, etc., employed as a gargle in *throat affections*, and been applied externally as a resolvent to *swollen breasts* and other *tumors*.

Geum. *Water Avens. Radix Caryophyllatæ Aquaticæ. Radix Benedictæ Sylvestris. Racine de Benoîte aquatique* (*de Benoîte des Ruisseaux*), Fr. *Sumpfnelkenwurzel, Wasser-Benedikten-Wurzel*, G.—Several species belonging to this genus have been medicinally employed, but three or four are deserving of particular notice,—*Geum rivale*, L., which once had a place in the U. S. Secondary List, *G. urbanum*, L., formerly recognized by the Dublin College, *G. virginianum*, L., an indigenous species, the root of which has been recommended in *dysentery* by W. A. Gibson (*Med. Rec.*, 1868), and *G. canadense*, Jacq. (*G. album*, Gmel.), recommended by W. A. Spurgeon in *gastric irritation* and *headache*. (*A. J. P.*, 1883.)

Geum urbanum, or *avens*, is a native of Europe, where it grows wild in shady places. The root, which is the part used, consists of a short, oblong body, from a quarter to half an inch in thickness, externally brown, internally white towards the circumference and reddish at the centre, and furnished with numerous long descending fibres. When quite dry it is nearly inodorous, but in the recent state has an odor like that of cloves, whence it is sometimes called *radix caryophyllatæ*. The taste is bitterish and astringent. It imparts its virtues to water and alcohol, which it tinges red. Buchner obtained a yellow, amorphous, neutral, bitter-tasting mass, which he calls *geumbitter*. Distilled with water it yields 0.04 per cent. of a thick, greenish-yellow volatile oil, and gives a pleasant clove-like flavor to the liquid. It contains, besides, according to Trommsdorff, tannic acid, which is abundant, a tasteless resin, gum, bassorin, and lignin. It has been much used in Europe as a tonic and astringent, in chronic and passive *hemorrhages*, *chronic dysentery* and *diarrhœa*, *leucorrhœa*, *intermittent fever*, etc. The *dose* is from thirty grains to a drachm (2.0–3.9 Gm.) of the powder three or four times a day, or an equivalent quantity in decoction.

Geum rivale, L.—*Water avens* has a perennial, horizontal, jointed, scaly, tapering root, about six inches long, of a reddish-brown color externally, white internally, and furnished with numerous descending yellowish fibres. One or more stems rise from the same root, which also sends up numerous leaves. The stems are about a foot and a half high, simple, erect, pubescent, and of a purplish color. The radical leaves are interruptedly pinnate, with large terminal leaflets, and long, hairy footstalks; those of the stem are petiolate, and divided into three serrate, pointed segments. The flowers are few, solitary, nodding, yellowish purple, and supported on axillary and terminal peduncles. The color of the stems and flowers gives rise to the name of *purple avens*, sometimes applied to the plant. The calyx is inferior, with ten lanceolate, pointed segments, of which the five alternate are smaller than the others. The petals are five, and as long as the calyx. The achenes are oval, with plumose awns, minutely uncinate, and nearly naked at the summit. This species of Geum is common to Europe and the United States, though the plant of this country has smaller flowers, with petals more rounded on the top, and leaves more deeply incised than the European. It delights in wet, boggy meadows, and extends from Canada into New England, New York, and Pennsylvania. Its flowers appear in June and July. The dried root is hard, brittle, easily pulverized, reddish or purplish, without odor, and of an astringent, bitterish taste. Boiling water extracts its virtues.

Water avens is tonic and powerfully astringent. It may be used with advantage in *chronic* or *pas-*

sive hemorrhages, leucorrhœa, and *diarrhœa,* and is said to be beneficially employed in the Eastern States as a popular remedy in the debility of *phthisis* and in *simple dyspepsia.* In Europe it is sometimes substituted for the root of *common avens,* or *Geum urbanum,* but is less esteemed. The *dose* of the powdered root is from twenty grains to a drachm (1.3–3.9 Gm.), to be repeated three times a day. *Dose* of the decoction (ounce to the pint), one or two fluidounces (30–60 Cc.). A weak decoction is sometimes used by invalids in New England as a substitute for tea and coffee.

Gillenia. *Bowman's Root. Indian Physic. American Ipecac. Racine de Gillénie,* Fr. *Gillenienwurzel,* G.—Under this name the U. S. P. formerly included in its Secondary List the roots of two species of Porteranthus, at that time referred to the genus Gillenia. (Fam. Rosaceæ.)

P. trifoliatus (L.), Britt. (*Gillenia trifoliata,* Moench.), is an herbaceous plant with a perennial root, consisting of many long, slender, brown branches, proceeding from a thick, tuber-like head. It grows throughout the United States, east of the Alleghany ridge, and, in Pennsylvania, may also be found abundantly west of these mountains. The root should be gathered in September. (See *A. J. P.,* 1898, 501.)

P. stipulatus (Muhl.), Britt. (*G. stipulacea,* Nutt.), is herbaceous and perennial, though much taller and more bushy than the preceding. In the valley of the Mississippi this plant occupies the place of *P. trifoliatus,* which is not found beyond the Muskingum. It grows as far north as the State of New York, extends through Ohio, Indiana, Illinois, and Missouri, and probably into the States south of the Ohio, as it has been found in West Virginia. Its root is precisely similar to that of the Eastern species, and is reputed to possess the same properties.

The dried root of Gillenia is not thicker than a quill, wrinkled longitudinally with occasional transverse fissures, and, in the thicker pieces, presenting in some places an irregular, undulated, somewhat knotty appearance, arising from indentations on one side corresponding with prominences on the other. It is externally of a light brown color, and consists of a thick, somewhat reddish, brittle cortical portion, with an interior slender, tougher, whitish, ligneous cord. For microscopic characters, see G. L. Curry. (*Am. Pract. and News,* May, 1892.) The bark, which is easily separable, has a bitter, not disagreeable taste; the wood is nearly insipid and comparatively inert, and should be rejected. The powder is of a light brownish color, and possesses a feeble odor, which is scarcely perceptible in the root. The bitterness is extracted by boiling water, which acquires the red color of wine. The root yields its bitterness also to alcohol. By various experimenters it has been shown to contain gum, starch, gallotannic acid, fatty matter, wax, resin, coloring matter, albumen, and lignin, besides salts. (*A. J. P.,* xxvi. 490.) *Gillenin* of W. B. Stanhope was a whitish substance, very bitter, slightly odorous, permanent in the air, soluble in water, alcohol, ether, and the dilute acids, and neutral to test paper. Nitric acid rendered it blood-red, chromic acid green. Tannic acid produced no effect. It gave white precipitates with potassium hydroxide, lead subacetate, and tartar emetic. Half a grain (0.032 Gm.) of it produced nausea and retching. (*A. J. P.,* xxviii. 202.) G. L. Curry (*A. J. P.,* 1892, 513), has found two glucosides: the first, *gillein,* obtained from the ethereal extract, formed white feathery crystals, was colored red by sulphuric acid, yellow by nitric acid, and deepened the color of chromic acid; the second, *gilléenin,* obtained from the aqueous infusion, was amorphous, of yellowish color, of faint taste at first but becoming very bitter, and giving no color reactions with the acids.

Gillenia is a mild and efficient emetic, and, like most substances belonging to the same class, occasionally acts upon the bowels. In very small doses it has been thought to be tonic, and has been used as a substitute for ipecacuanha, which it is said to resemble in its mode of operation. It was employed by the Indians, and became known as an emetic to the colonists at an early period. Linnæus was aware of its reputed virtues. *Dose,* of the powdered root, from twenty to thirty grains (1.3–2.0 Gm.).

Glaucium. *Glaucium flavum,* Crantz. *Yellow Horned Poppy. Bruisewort. Pavot cornu,* Fr. *Hornmohn,* G. (*Glaucium Glaucium* (L.), Kars., *Chelidonium Glaucium,* L., *G. luteum,* Scop. (Fam. Papaveraceæ.)—Fisher separated from this plant two alkaloids, *protopine* and *glaucine* (*A. J. P.,* 1901, 489). Maepmann and Helt recommended the plant in the treatment of *diabetes* (*Med. Neuigkeiten d. Pharm-Post.,* 1899, 346).

Glechoma. *Glechoma hederacea,* L. *Herba Hederæ Terrestris. Lierre terrestre,* Fr. *Gundermann, Gundelrebe,* G. *Nepeta Glechoma,* Benth. *Ground-ivy.*—A small perennial, labiate herb, indigenous in Europe and widely naturalized in the United States, and growing in shady, grassy places, as in orchards and along fences and hedges. The herb was formerly official, and still enjoys some credit as a domestic remedy. It has a peculiar, disagreeable odor, and a bitterish, somewhat aromatic taste, and imparts its properties to boiling water. It is very prone to have galls developed on it, and to be infested with certain fungi. (*J. P. C.,* 1875, 127.) It is said to be gently stimulant and tonic, diuretic, and aperient; useful in chronic *pulmonary* and *urinary catarrhs.* From a half-drachm to a drachm (2–3.9 Gm.) was usually given in infusion as a *dose.* A fluidextract made with diluted alcohol would be useful.

Gleditschine.—In 1878 *Gleditschia triacanthos,* L., and *G. ferox,* Desf. (Fam. Leguminosæ), were chemically studied by B. F. Lautenbach (*P. M. T.,* 1878), who abstracted from them an alkaloid, which he found to produce in the frog stupor and loss of reflex activity, due to an action upon the spinal cord. To this alkaloid Lautenbach gave the name of *gleditschine.* In 1887 (*Med. Rec.,* July 31, 1887) Goodman, Seward, and Claiborne brought before the profession, as a local anæsthetic, an alkaloid under the name of *stenocarpine.* Subsequently Claiborne (*Med. Rec.,* Oct. 1, 1887) announced that the tree from which this alkaloid is obtained is the *Gleditschia triacanthos,* and suggested the name of gleditschine for it. The alleged alkaloid was placed upon the market in solution, and was largely used as a local anæsthetic and mydriatic by oculists. In October or November, 1888, however, F. W. Thompson of Detroit (*Med. Age*), and T. G. Novy (*Ph. Rund.*) and John Marshall of the University of Pennsylvania (*Phila. Med. News*), published analyses of this solution, showing that it contained 6 per cent. of cocaine, besides some atropine or other mydriatic alkaloid; this gleditschine was a fraud. (See also *A. J. P.,* 1887, 589.)

Globularia. *Globularia Alypum*, Delile. (*G. arabica*, Jaub. and Spach.) *Wild Senna* of Europe. (Fam. Globulariaceæ.)—This is a small shrub, growing on the European shores of the Mediterranean, the leaves of which have been occasionally used as a cathartic since the Middle Ages. Heckel and Schlagdenhauffen obtained from the leaves *globularin*, $C_{15}H_{20}O_8$, an amorphous glucoside which splits by treatment with mineral acids into glucose and *globularetin*. *Globularia vulgaris*, L., was found to contain the same substances. (*J. P. C.*, 1883, 361.) *Dose*, according to Planchon, one ounce (31 Gm.) in decoction.

Gloriosa. *Gloriosa superba*, L.—The roots, stalk, and leaves of this climbing liliaceous plant are said to be an acrid narcotic poison, and not infrequently used for suicidal purposes in India. C. J. H. Warden found in them two resins, and a very poisonous bitter principle, *superbine*. (*P. J.*, xi. 496.)

Glue.—An impure form of gelatin, obtained from various animal substances by boiling them in water, straining the solution, and evaporating it until upon cooling it assumes the consistence of jelly. The soft mass which results is then divided into thin slices, which are dried in the open air. Glue, when of good quality, is hard and brittle, of a color varying from light yellow to brown, and equally transparent throughout. It softens and swells very much in cold water, without dissolving, but is readily dissolved by hot water. It is soluble in a large proportion of glycerin, and with heat forms with it in smaller proportion a jelly. (Maisch, *A. J. P.*, xlii. 518.) It is employed chiefly for cementing wood.

An elastic and imputrescible preparation of glue may be made by dissolving glue in water by means of a water bath, concentrating the solution, then adding a weight of glycerin nearly equal to that of the glue employed, thoroughly mixing, evaporating the residue of the water, and finally pouring into moulds, or on a marble slab. It is especially applicable to the preparation of artificial anatomical specimens. (*J. P. C.*, 1857, 23.) The various *hectograph compositions* introduced within recent years for copying purposes are similar mixtures. One of the best copying masses is made by dissolving one part of glue or gelatin in a mixture of two parts of water and four parts of glycerin, with a few drops of phenol, heating, straining, and adding three parts of sifted whiting or terra alba. (See *N. R.*, 1879, 338, 364.) A good *liquid glue* may be made by rubbing up in two pints of rain water, with the heat of a water bath, sixteen ounces of the best white glue and four ounces of dry white lead, until thoroughly mixed, then adding four fluidounces of alcohol, and continuing the heat and the agitation for a few minutes. The mixture is to be poured into bottles while still hot. A liquid glue may also be prepared by mixing in a stoppered bottle 38 parts of glue, properly divided, and 100 parts of acetic acid of commerce, the latter of which dissolves the glue. On exposure the acid evaporates, leaving the glue unchanged. (*J. P. C.*, 3e sér., xlvi. 35.) Knaff prepares *strong liquid glue* by covering three parts of good glue, in small pieces, with eight parts of water, and, after it has stood for some hours, adding half a part of hydrochloric acid and three-fourths of a part of zinc sulphate, and exposing the whole for ten or twelve hours to a heat from 81.1° to 87.2° C. (178°–189° F.). This does not gelatinize, and keeps well. (*A. J. P.*, 1868, 330.) For a *water proof glue* add potassium dichromate to the solution of glue just before using, one part to fifty. (*A. J. P.*, xliii. 420.) *Chromatized gelatin*, obtained by the addition of one part of potassium dichromate to five parts of a solution (5 or 10 per cent.) of gelatin, forms an excellent cement for glass. The surfaces to be united, after being smeared with the cement, are placed upon each other and exposed to the sun. After a few hours the adhesion is perfect and almost invisible, and boiling water itself has no action on the cement. (*L. L.*, Nov. 11, 1876.) For other formulas for liquid glue, see *A. J. P.*, xliii. 421.

Glutoid Capsules.—Gelatin capsules which have been hardened by exposure to formaldehyde are recommended by Sahli in three grades, the weak capsule capable of withstanding the action of the gastric juices for from one and a half to seven hours, the strong for twelve hours. They appear to have great therapeutic value for the purpose of conveying intestinal antiseptics, medicinal substances which are destroyed by the peptic secretions, and irritating drugs through the stomach into the intestines. They have been used by Sahli (*D. A. K. M.*, lxi.) for diagnostic purposes. By their means he asserts that he is able to determine the condition of the pancreatic secretion and the closure of the pancreatic duct, the varieties of jaundice, etc.

Glutol (*Glutoform*) is made by the action of the solution of formaldehyde upon gelatin. It is a hard, clear, transparent mass, which may be pulverized.

Glybolid. *Glybrid.*—A preparation, of the consistence of a paste, made by combining 1 part of boric acid, 1 part of acetanilide and 2 parts of glycerin. Used as an antiseptic in *pustules, abscesses.*

Glycerinophosphoric Acid. *Acidum Glycerino-Phosphoricum.* $C_3H_5 = \begin{matrix} O.PO_3H_2 \\ (OH)_2 \end{matrix}$. This is an oily liquid whose salts have been commended as powerful nerve tonics in *neurasthenia* and allied conditions. The 25 per cent. sterilized solution of the sodium salt given hypodermically, in *dose* of fifteen minims (0.9 Cc.), increased to one fluidrachm (3.75 Cc.), has been especially used in *sciatica*. The iron salt has been used in *chlorosis*. (*K. T. W.*, 198.)

Glycogenal.—This substance, which is said to be closely allied to glycogen, is obtained from the animal system and occurs as a whitish, tasteless, odorless powder, freely soluble in alcohol and ether, and has been brought forward by Roerig as a specific remedy in *tuberculosis, puerperal fever, typhoid fever*, other infectious diseases, and also in *lupus*, and even in *cancer*. Applied hypodermically it is affirmed also to cure *Basedow's disease, migraine, catarrhs*, etc. It is said that although one and one-half ounces (46.5 Gm.) may be taken daily with safety, one-third of a grain (0.021 Gm.) given hypodermically acts powerfully and is a sufficient *dose* if administered every three hours in *typhoid fever*. The substance has probably little value. (*M. R.*, 1900 and 1901.)

Glycosal. *Monosalicylic Glycerinester.* $C_3H_5(OH)_2.C_7H_5O_2$.—This substance, originally prepared by E. Tauber, is a white crystalline powder, soluble (one per cent.) in cold water and freely in hot water, very soluble in alcohol, decomposed by alkalies and alkali carbonates, and also, it is said, by the intestinal juices with the separation of salicylic acid.

Glycosal has been especially recommended as affording means of treating *rheumatism* by external application. Zeigan (*B. K. W.*, 1903) found that from 50 to 100 grammes of its twenty per cent. alcoholic solution, to which a little glycerin had been added, placed upon the rheumatic part and covered with waterproof wadding, was sufficient to produce in four or five hours strong sweating lasting from a half to two hours, and in from six to eight hours a notable elimination of salicylic acid with the urine with the relief of the local symptoms. Ratz, however, has been unable to secure absorption either by means of the alcoholic solution or yet by inunctions made with an indifferent fatty basis; although when ether, oil of turpentine, or chloroform was added in the proportion of fifteen per cent. to the ointment, a notable proportion of salicylic acid appears in the urine after the local application. R. Block (*Th. M.*, Sept. 1903) found that the best method of using glycosal is a twenty per cent. collodion, which he applied every two to four hours to swollen rheumatic joints with asserted most extraordinary results. He claimed that if no relief is afforded the inflammation may be positively considered not to be of rheumatic origin.

Glycosal is also used internally as an antirheumatic in *doses* of one hundred and fifty to one hundred and eighty grains (9.8–11.6 Gm.) a day, usually without the production of salicylism; eight to ten grains (0.5 to 0.65 Gm.) may be given every half to three hours until sweating is induced. The remedy is probably very uncertain and feeble in its influence.

Glycozone.—A thick syrupy liquid, said to be a stable chemical compound, produced by treating chemically pure glycerin with ozone until it is saturated. It is claimed to be of benefit in relieving *catarrhal* and inflammatory conditions of the stomach when given in teaspoonful (3.75 Cc.) *doses*. It is also of value in stimulating healthy granulation in *ulcers*, when applied locally.

Gnaphalium. *Gnaphalium margaritaceum*, L. (More correctly *Anaphalis margaritacea* (L.), Benth. and Hook.) *Cudweed. Life-everlasting. Pied de Chat, Immortelle*, Fr. *Katzenpfötchen, Immerschön*, G. (Fam. Compositæ.)—An indigenous herbaceous perennial, which with *G. obtusifolium*, L. (*G. polycephalum*, Michx.), or *sweet-scented life-everlasting*, is sometimes used in the form of tea in intestinal and pulmonary *catarrhs*, and, externally, in the way of fomentation, in *bruises*, but it probably possesses little medicinal virtue. In Europe different species of Gnaphalium are occasionally employed for similar purposes.

Gold.—The chief preparations of gold which have been employed in medicine are metallic gold in a finely divided state, the oxide (trioxide, incorrectly called auric acid), the chloride (trichloride), the iodide, the double gold and sodium chloride, now official, the ammonium chloraurate (a compound of gold trichloride and ammonium chloride), and the gold cyanide (tricyanide). Aqueous solutions of gold in the *colloidal* state have been prepared by Bredig by forming an electric arc under water with gold wires. The sparking between gold electrodes liberates finely divided gold which dissolves with bluish-red color. The addition of acids and certain salts coagulates this colloidal gold solution; the addition of gelatine prevents this coagulation. *Gold in powder* may be obtained by rubbing up gold leaf with ten or twelve times its weight of potassium sulphate until brilliant particles are no longer visible, and then dissolving away the sulphate with boiling water. The *chloride* is obtained by dissolving pure gold in three times its weight of nitrohydrochloric acid, with the aid of moderate heat. The solution is evaporated by a gentle heat nearly to dryness, being at the same time stirred with a glass rod. It is in the form of a crystalline mass of a deep red color. Its solution has a fine yellow tint. Being deliquescent, it requires to be kept in ground-stoppered bottles. (See *Auri et Sodii Chloridum.*) The *iodide* may be made by precipitating a solution of gold trichloride by one of potassium iodide, and washing the precipitate with alcohol to remove the excess of iodine. It is of a greenish-yellow color, and, when heated in a porcelain crucible, is resolved into iodine vapors and a residue of pure gold. The *ammonium chloraurate* is formed by dissolving one part of the gold trichloride and two parts of ammonium chloride in distilled water, assisted by a few drops of nitrohydrochloric acid, and evaporating the solution to dryness by a gentle heat. The *cyanide* is best obtained, according to Oscar Figuier, as follows: Prepare the gold chloride as neutral as possible by repeated solutions and crystallizations; and to the solution of this salt add, very cautiously, avoiding any excess, a solution of *pure* potassium cyanide, so long as any precipitate falls. (See *Potassii Cyanidum.*) The precipitate, consisting of gold cyanide, is to be washed with pure water, and dried in the dark. Gold in powder, and the oxide, chloride, iodide, sodio-chloride, and cyanide, are official in the French Codex.

The preparations of gold are decidedly poisonous, though in different degrees. The chloride is most virulent, and, according to Chrestien, is even more active than corrosive sublimate. In an overdose, it produces pain, inflammation, and even ulceration of the stomach and bowels, and otherwise acts as a corrosive poison. It is said that these preparations, in moderate doses, produce increased fulness and frequency of the pulse, and augment the urine and insensible perspiration, without interfering with the appetite or the regular action of the bowels, but, if the dose be pushed too far, general irritation is apt to be produced, inflammation seizes upon some organ, according to the predisposition of the individual, and fever is developed.

Gold in powder, the oxide, chloride, and iodide are not as much used as the soluble gold and sodium chloride. The oxide may be given in the form of pill, containing the tenth of a grain (0.006 Gm.), in *scrofula* and *lymphatic swellings*, beginning with one pill daily, and afterwards gradually increasing to seven or eight in twenty-four hours. The chloride has been used with advantage as a caustic in *lupus*, and in *syphilitic tubercles* and *ulcers*, by Chavannes. The iodide may be given in the same cases with the other preparations. The *dose* is from the fifteenth to the tenth of a grain (0.004–0.006 Gm.).

In 1889 Goubert asserted before the French Academy that gold bromide, administered in a weak solution, is more efficacious and durable in its action in *epilepsy* than are any of the other bromides, and is also better tolerated. This statement led Shtcherbak to study the effect of the gold bromide upon the motor area of the cerebral cortex, according to the method of Albertoni. He found that in the dose of from one-half to three grains per kilogramme of weight it so depressed the cortical motor centres that even the strongest

electric stimulation failed to bring about any epileptic seizures. It is further asserted that the gold bromide never causes in man general depression, languor, emaciation, or other pronounced symptoms of bromism. The amount of bromine in the bromide, 55 per cent. by weight, would seem too small to make it probable that the bromine is the active ingredient of the salt. The *dose* of the bromide for the adult is from one-eighth to one-fifth grain (0.008–0.012 Gm.); for children, one-twentieth to one-tenth grain (0.003–0.006 Gm.). As a substitute for this preparation, E. Merck has proposed *gold* and *potassium bromide* (*Aurum-Kalium bromatum*, $AuBr_3.KBr + 2H_2O$), which has been tested by I. Jankura and Laufenauer (*Pest. Med. Chirurg. Presse*, 1892), and found to be a valuable anti-epileptic. It may be used hypodermically, by dissolving 2 parts of the salt in 100 parts of distilled water, and injecting of this eight minims (0.5 Cc.) and increasing the dose to thirty-two minims (2 Cc.). Solutions of gold pentabromide or pentachloride, recognized by their deep red color, are offered by several manufacturers under proprietary names, and advertised to produce remarkable effects in *anæmia*, *diabetes*, and in various dyscrasias.

Ammonium chloraurate has been recommended by Bouchardat in *amenorrhœa* and *dysmenorrhœa* in debilitated subjects, in the *dose* of about the tenth of a grain (0.006 Gm.). A grain may be dissolved in five teaspoonfuls of alcohol and five of water, and a teaspoonful given morning and evening, mixed with sweetened water.

Gold cyanide is employed, like the gold and sodium chloride, mixed with inert powders by friction, and in the form of pill. The fifteenth of a grain (0.004 Gm.) may be rubbed into the gums daily for fifteen days, next, the fourteenth of a grain for fourteen days, and so on, increasing until the dose amounts to the ninth or eighth of a grain (0.0075 or 0.008 Gm.). The *dose* for internal exhibition is the eighteenth of a grain, gradually increased to the eighth (0.0038–0.008 Gm.). Gold cyanide has been found useful in the treatment of *syphilis* and *scrofula* by Pourché, and is said to be less irritating than the double chloride.

The different medicinal compounds of gold should not be prepared in pill, powder, or otherwise until they are wanted for use, as they are liable to undergo decomposition when kept. They should be carefully secluded from the light.

Gold salts of various alkaloids have been prepared by H. A. D. Jowett (*Trans. Chem. Soc.*, 1897), but up to the present have not been tested physiologically.

Gomabrea.—This is an exudation from a Chilian tree, which has been offered in large quantities in France as a substitute for gum arabic, and is said to be of practical value.

Gratiola. *Gratiola officinalis*, L. *Hedge-hyssop. Gratiole.* Fr. *Gnadenkraut, Gottesgnadenkraut.* G. (Fam. Scrophulariaceæ.)—This is a perennial herb, indigenous in the south of Europe, in meadows and other moist grounds. The whole herb is used. It is nearly inodorous, but has a bitter nauseous taste. The indigenous *G. virginiana*, L. (*G. carolinensis*, Pers.), closely resembles the European plant and indeed was regarded by Michaux as identical with it. Both water and alcohol extract its active properties. F. G. Walz found in it the following constituents: 1, *gratiolin;* 2, *gratiosolin;* 3, *gratioloic acid;* 4, *gratiola fat;* and 5, a brown resin. (For chemistry see *P. J.*, vol. lxix. 295, and vol. lxx. 385.) The gratiolin is decomposed on prolonged boiling with diluted H_2SO_4 into *gratioletin*, *gratiolaretin*, and sugar; the gratiosolin is similarly decomposed by dilute acids or alkalies into *gratiosoletin* and sugar; the gratioloic acid is obtained in the form of pearly white scales of a fatty odor. Hedge hyssop is a drastic cathartic and emetic, possessing also diuretic properties, and has been used in Europe for the relief of *dropsy*, *jaundice*, *worms*, *chronic hepatic affections*, and *scrofula*. The *dose* of the powdered herb is from fifteen to thirty grains (1.0–2.0 Gm.); of the infusion (half an ounce to the pint of boiling water), half a fluidounce (15 Cc.).

Ground Nuts. *Peanuts. Goober-nuts.*—The fruit of *Arachis hypogæa*, L., a leguminous, annual plant, indigenous probably in Africa and South America, and abundantly cultivated in our Southern States, China, etc. Thirty thousand tons are said to be produced annually in Senegal, while the export from Madras in a single year amounts to one hundred thousand tons of the nuts (known there as *pistaches*), besides large quantities of the oil; the present annual product of Virginia and North Carolina is over two million bushels. A remarkable property of the plant is that its fruit ripens under the surface of the ground, into which the pods penetrate in the progress of their growth. The beans or seeds contain about 45 per cent. of a fixed oil.

Oleum Arachis, *Br. Add.*, *Peanut Oil*, consists of the glycerides of four different fatty acids. The chief of these is oleic acid, $C_{18}H_{34}O_2$, with which are associated *hypogœic acid*, $C_{16}H_{30}O_2$, *arachidic acid*, $C_{20}H_{40}O_2$, and *lignoceric acid*, $C_{24}H_{48}O_2$. It should be obtained by expression without heat. It is usually of a pale yellowish or green color with a faint odor, and a more distinct taste of the nuts, although on rectification a nearly colorless and tasteless oil may be obtained. Upon exposure to the air the oil slowly thickens and becomes rancid. It is soluble in all proportions in ether, chloroform, and petroleum benzin, but insoluble in alcohol. Its sp. gr. is 0.918 at 15.6° C. (60° F.). At 3.3° C. (38° F.) it thickens, solidifies at about —5° C. (+23° F.), and at 326.6° C. (620° F.) is decomposed, giving out spontaneously inflammable vapors. Winter made experiments to ascertain how far it might be employed with advantage in pharmacy, and found that it answered well in the preparation of cerates and ointments, but would not serve as a substitute for olive oil in the preparation of lead plaster. (See *Proc. A. Ph. A.*, 1897, 179, for later views on the subject.) It is a non-drying oil, and therefore will not answer for painting; but it is enormously used for adulteration (particularly of French olive oils) and for various purposes in the arts, as for lubricating machinery, and in the manufacture of woollen cloths; in lamps it burns with a bright light. It saponifies slowly, but yields an excellent firm, white, and odorless soap.

Guacamphol. *Camphoric Guaiacolester.* $C_8H_{14}(COO.C_6H_4OCH_3)_2$.—This is a white, tasteless powder, insoluble in water or gastric juice, easily soluble in hot alcohol and chloroform, and believed to be decomposed by the intestinal alkalies into camphoric acid and guaiacol. It was originally brought forward by Lasker as an antihidrotic, and has been used in *phthisis* by other clinicians for arresting the *night sweat* with asserted excellent results. *Dose*, three to fifteen grains (0.2–1 Gm.), taken immediately after supper in capsule.

Guaco.—This name is given in Central and South America and the West Indies to various

plants belonging to the genera Willughbæa (better known under the newer name, Mikania) and Aristolochia; but it is in its application to the different species of the former genus that the name is known in medicine. The species most used is *M. amara* (Willd.), O. Kze., *Mikania amara* (Willd.), *M. Guaco* (Humb. and Bonpl.). The plants are closely allied to the Eupatoria. *M. Houstonis* (Willd.), O. Kze., *M. gonoclada* (DC.), O. Kze. (of the Fam. Compositæ); *Aristolochia fragrantissima*, Ruiz, *A. grandiflora*, Sw., *A. pentandra*, Jacq. (of the Fam. Aristolochiaceæ); *Comocladia integrifolia*, Jacq. (Fam. Anacardiaceæ), are all known locally as guaco. *M. amara* is described as having twining stems, with round, sulcate, and hairy branches; ovate subacuminate, remotely dentate leaves, somewhat narrowed at the base, rough above and hairy beneath, and flowers in opposite axillary corymbs. The plant is a native of intertropical America, and has been introduced into the West India Islands from the continent. The leaves are the part used. The result of a long and close investigation into the natural history of guaco by the distinguished Guibourt is, that the guaco from this source, instead of possessing, as has been asserted, a strong, penetrating, and nauseous odor, is in fact inodorous, and destitute of all active properties, and that the strongly aromatic plants which have been employed under the name of guaco all belong to the genus Aristolochia, especially *A. cymbifera*, Mart. and Zucc., growing in Brazil, after this *A. maxima* (De Cand.), and in less degree *A. maxima*, Jacq. (*A. geminiflora*, H. B. K.). (*J. P. C.*, 1867, 99.)

Although the guacos of South America seem to be entirely distinct drugs, they appear to be indiscriminately used by the natives for the cure of the *bites of poisonous serpents*, as was first made known by Mutis, and afterwards confirmed by Humboldt and Bonpland. The medicine is also used in South America as a febrifuge and anthelmintic, and has been considered antisyphilitic. A few years ago it attracted on the continent of Europe considerable attention on account of its alleged power in *epidemic cholera* and *chronic diarrhœa*. The *Aristolochia cymbifera*, Mart. and Zucc., has been the subject of a careful study by L. Butte. The root of this plant as it occurs in commerce is cylindrical, from three to four centimeters in diameter, much broken up into long rootlets, yellowish, with a strong odor, especially in the bark. The plant itself is a vine, growing in great abundance in the province of Tabasco in Mexico. Butte was not able to find in it either an alkaloid or a glucoside, but he found a blackish resin which may be the active principle of the plant, though this does not seem probable, since Butte found the alcoholic extract much less active than the aqueous extract, which would hardly be the case if the resin were really the active principle. In the physiological experiments made with the aqueous extract it was found that in the guinea pig and rabbit massive doses produced cries and excitement, followed after a time by sleep, with muscular relaxation and diarrhœa. In the dog vomiting and diarrhœa were very marked. The muscular relaxation was probably centric, as the motor nerves and muscles were in a condition of activity. An apparent loss of function in the sensory nerve trunks Butte believed to be due not to paralysis of the nerve fibres, but of the centres of sensation. Although the muscle was not completely paralyzed, careful experimentation showed that its contractility was less than the norm after death from the poisoning. Death was produced by an arrest of the respiration. The heart continued to beat both in the reptile and the mammal after the cessation of respiration; nevertheless there was depression of the arterial pressure, apparently due to the action of the drug upon the heart. After death marked signs of gastro-intestinal irritation were found, the medicine having been given by the mouth. During life the urine was albuminous, and at the autopsy the kidneys were found congested. The temperature gradually rose during the poisoning, and less glucose than normal was found in the blood. Butte believes that guaco has valuable therapeutic properties in the treatment of skin affections, especially *eczema* and *pruriginous maladies*, in which he used it both locally and internally. He gives the *dose* of the aqueous extract of guaco as three grains (0.2 Gm.) three times a day. In the external application the following formula was used. Guaco (bruised), 30 parts; sodium bicarbonate, 5 parts; water, 1000 parts; boil for a quarter of an hour, allow to macerate one hour, decant, and use the liquid as a lotion. (*Annales de la Policlin. de Paris*, Sept. 1890.) Guaco is said to be largely used in South America as an antirheumatic, and E. W. Pritchard (*P. J.*, 1861) affirms that in the *gouty paroxysms* it is especially effective given in the *dose* of a fluidrachm (3.75 Cc.) of the tincture every four hours, and applied locally.

Guaiacol Compounds and Derivatives.—A very large number of these compounds have been produced by pharmaceutical chemists and put upon the market as substitutes for and improvements on ordinary guaiacol. Few of them have any more therapeutic value than guaiacol and most of them are less effective. In regard to their manufacture we refer the reader to elaborate papers by F. G. Ehlert (*Ph. Rev.*, 1901 and 1902).

Guacamphol.—This camphoric ester of guaiacol is a white, tasteless, insoluble powder, which is asserted to be broken up in the intestines into camphoric acid and guaiacol. It has been especially recommended as a remedy of great value in the treatment of the *night sweats of phthisis*. In some cases it is necessary to be administered for one or even two weeks for the desired effect. *Dose*, three to fifteen grains (0.2–1 Gm.) exhibited two hours before bed time.

Guaethol, a methyl derivative of guaiacol, soluble in ether and alcohol but very slightly so in water. It is said to be medicinally equivalent to guaiacol except that it acts more promptly. *Dose*, two to four grains (0.13–0.26 Gm.).

Guaiacol Benzyl Ether or *Pyrocain* occurs in colorless crystals, soluble in ether and melting at 62° C. It possesses the general therapeutic properties of guaiacol.

Guaiacol Biniodide, a reddish-brown powder, with something of the iodine odor, soluble in alcohol and fatty oils, has been proposed by Vicario as a local application in tuberculosis.

Guaiacol Bisulphonate of Quinine or *Guaiaquin*. $(C_6H_4O_2CH_3HSO_3)_2C_{20}H_{24}N_2O_2$.—Guaiaquin is an acid salt, occurring as a yellowish crystalline powder, very soluble in water, alcohol, and dilute acids, and of a bitter taste. It contains 44.26 per cent. of alkaloid quinine, combined with 55.74 per cent. of guaiacol sulphonic acid, the latter being equivalent to 33.38 per cent. of pure guaiacol. It has been brought forward as an anti-malarial remedy and a gastro-intestinal stimulant and antiseptic.

Dose, as a tonic, from three to six grains (0.2–0.4 Gm.); as an antiperiodic, ten grains (0.65 Gm.) three times a day.

Guaiacol Cinnamate or *Styracol* occurs in white, odorless, tasteless, stable needles, almost insoluble in water, readily soluble in alcohol, chloroform, acetone and benzene. It is said when taken internally to be broken up in the intestines into cinnamic acid and guaiacol and to be useful not only in *phthisis* but in various chronic *gastro-intestinal* and *genito-urinary catarrhs*. *Dose*, fifteen grains (1 Gm.), three or four times a day.

Guaiacol Ethyl is an oily liquid of an agreeable aromatic odor, soluble in water, which was brought forward as a remedy in *tuberculosis*, with the statement that it acts upon the human system like guaiacol, but more quickly and energetically. The researches of De Buck (*Belg. Méd.*, 1897) indicate, however, that it is not more effective than is guaiacol in tubercular diseases. It is affirmed, however, to be a pronounced analgesic, which when applied to the skin by means of a brush is rapidly absorbed, and in cases of *neuralgia* or *neuritis* produces great relief. It may also be used subcutaneously in 10 per cent. emulsions with sterilized glycerin, and has been so applied; this glycerin solution has also been used in *cystitis*.

Guaiacol Iodoform is a reddish-brown syrupy liquid, which is really a solution of iodoform in guaiacol. It has been used hypodermically for *tuberculosis* (one part diluted with sixteen parts of olive oil) in *doses* of fifty minims (3.1 Cc.).

Guaiacol Phosphate.—Phosphoric Guaiacol-ether has been shown by A. Gilbert (*S. M.*, 1897) to be split up in the intestines, with the liberation of its constituents, and to afford, therefore, a method of administering guaiacol, over which it has the advantage of being innocuous to the mucous membrane of the stomach. It would appear, however, much less active and much more uncertain in its influence than is guaiacol.

Guaiacol Phosphite. Phoso-Guaiacol. $P(OC_6H_4OCH_3)_3$. *Phospho-guaiacol.—Phosphite of Guaiacyl-ether* is a white crystalline powder, possessing a sharp taste and indifferent odor. It is soluble in water, dissolves very freely in alcohol, ether, chloroform, acetone, benzene, toluol, and the fatty oils, but it is sparingly soluble in oil of turpentine and in glycerin. Melting point, 77.5° C. It contains 92.25 per cent. of guaiacol, and was introduced in 1897 by Ballard. (*Rép. de Pharm.*, 1897.) It is but slightly poisonous, and probably is capable of acting as do other preparations of guaiacol.

Guaiacol Salol occurs in small odorless, tasteless, colorless crystals, readily soluble in alcohol, ether, chloroform or benzene, melting at 65° C. It is said to be split up into its constituents in the intestines and has been used in *phthisis* and as an *intestinal antiseptic*. *Dose*, ten to fifteen grains (0.65 to 1 Gm.) a day.

Guaiacol Succinate.—This drug occurs in fine, silky, white crystals insoluble in water, slightly so in alcohol and ether, very soluble in chloroform or acetone, and melting at 136° C. It is said to act medicinally like guaiacol.

Guaiacol Valerate. Geosote.—This occurs as a pale yellow, oily, mobile liquid, insoluble in water, freely soluble in alcohol, ether, and benzene. Sp. gr. 1.038, boiling point variously given from 240° to 260° C. Geosote is used in *phthisis* and as a gastro-intestinal antiseptic in fermentative *dyspepsia* and *diarrhœa*. *Dose*, five to ten grains (0.32–0.65 Gm.).

Guaiaform. Geoform. Methylenediguaiacol.—The drug is a tasteless yellow powder, odorless at first but acquiring a vanilla-like odor, soluble in alcohol or ether but insoluble in water. It is affirmed to contain 95.38 per cent. of guaiacol and to be non-irritating and non-toxic.

Pyrocain. Brenzcain.—The benzyl ester of guaiacol is a colorless, tasteless, odorless, stable body, which is affirmed to act like guaiacol and to be free from irritating, nauseating and toxic properties. Used in the same doses as guaiacol.

Guaiacyl. *Gajacyl. Calcium Ortho-guaiacol Sulphonate.* $(C_6H_3(OH).(OCH_3)SO_3)_2.Ca$.—This is a powder of a bluish-gray color, soluble in water and in alcohol. The aqueous five per cent. solution has a violet red color and may be used hypodermically in quantities of eight to twenty minims (0.5–1.3 Cc.).

Guaialin. *Methylene Diguaiacol Benzoic Ester.* This substance occurs in an amorphous powder, of a pea-green color, said to contain 60 per cent. of guaiacol, 30 per cent. of benzoic acid, and 7 per cent. of formaldehyde. It is reccommended as an antipyretic and alterative tonic in *tuberculosis*.

Guaiaperol. *Piperidin Guaiacolate.*—This salt occurs in colorless crystals, melting at 79°–80° C. (174.2°–176° F.), having a feeble creosote odor, soluble in water 1 to 30, freely soluble in alcohol, and has been used to a moderate extent. (*B. M. J.*, vol. ii. 1898.) In *doses* of from five to ten grains (0.32–0.65 Gm.) in capsules, three times a day, after meals, in *phthisis* it is said to lessen cough and cause general improvement.

Guaiaquin. *Quinine Guaiacol Bisulphonate.* $(C_6H_4O_2CH_3HSO_3)_2C_{20}H_{24}N_2O_2$.—This substance occurs as a yellowish crystalline bitter powder, very soluble in water, alcohol and diluted acids. It has been used to some extent in internal medicine as a tonic, but especially as an antiperiodic in various *malarial diseases* with asserted good results. It is stated that the sterilized 10 per cent. solution may be given hypodermically with the production of little pain. This solution has also been used locally with alleged good results in *gonorrhœa* and other infected conditions. *Dose*, three to ten grains (0.2–0.65 Gm.); sixty grains (3.9 Gm.) may be given in a day.

Guaiaquinol. *Guaiakinol. Quinine Dibromo-guaiacolate.*—This is a compound which combines the properties of quinine, guaiacol, and bromine. It is freely soluble in water and is used as an antipyretic and sedative in *tuberculosis*. *Dose*, eight to fifteen grains (0.5–1.0 Gm.).

Guaiasanol. *Diethyl-glycocollguaiacol Hydrochloride.* $C_6H_4\begin{cases}OCH_3\\O.CO.CH_2N.(C_2H_5)_2.HCl\end{cases}$. This substance occurs in very soluble white prisms fusing at 184° C. (363.2° F.), emitting an odor faintly suggestive of guaiacol and possessing an acrid taste. It was first produced by Einhorn and Hutz (*J. P. C.*, 174, 1903) through the union of aceticomonochlorguaiacol and diethylamine. In the presence of alkalies it breaks up, liberating guaiacol, which has been found in the urine of animals to which guaiasanol had been given. It has been given by A. Einhorn in *doses* of forty-five to one hundred and eighty-five grains (3–12 Gm.) daily as a substitute for guaiacol.

Guaisotol.—This is one of the numerous class of preparations having a name which suggests that of a chemical compound; it is stated to be a *syrup of guaiacol* containing 16 grains of guaiacol to the fluidounce. *Dose*, one to four fluidrachms (3.75–15.00 Cc.).

Guajamar. *Guaiacol-glycerinester.*—This is a white crystalline powder, $C_6H_4\begin{cases}OCH_3\\OC_3H_7O_2\end{cases}$, which possesses a bitter aromatic taste, melts at 75° C. (167° F.) and dissolves in alcohol, ether, glycerin and 20 parts of water at the ordinary temperature. According to G. Buttler it splits up in the intestines into guaiacol and glycerin and affords an excellent method of intestinal antisepsis in *typhoid fever, diarrhœa,* etc. Great relief has been obtained in *acute* and *articular rheumatism* by the local application of the remedy in the form of an ointment consisting of two parts of guajamar and one of lanolin. *Dose,* three to fifteen grains (0.2–1 Gm.).

Guano. *Bird-manure.*—This is a valuable manure, consisting of the decomposed excrement of countless aquatic birds, which has accumulated for ages on certain barren and uninhabited islets of the western coast of South America and in other localities throughout the world. Guano is a coarse dry powder of a brown color. Exposed to the air it absorbs moisture, and becomes somewhat sticky. Its odor is offensive and slightly ammoniacal. With the powder are intermingled friable lumps, which exhibit in their inside whitish specks, and which, when exposed to the air, fall to powder, exhaling an ammoniacal odor. It is soluble in great part in water, and the solution formed contains chiefly ammonium oxalate. When exposed to heat it blackens, burns with a slight flame, exhales the odor of ammonia, and leaves a whitish ash, varying in amount from 27 to 35 per cent. The value of guano as a fertilizer depends chiefly upon the proportion of the organic ingredients, the phosphates being of secondary importance. M. E. Baudrimont infers, from the analyses of seventeen samples of Peruvian guano, that the proportion of nitrogen may be obtained approximately by dividing the amount of the organic matters by five. The samples varied greatly in value. (*J. P. C.,* Oct. 1857.) Crystals of ammonium carbonate have frequently been observed in guano. C. Morfit of Baltimore found Colombian guano to be rich in phosphoric acid and lime. (*Chem. Gaz.,* Dec. 1, 1855.) Unger obtained from Peruvian guano, in 1845, a peculiar substance, called *guanine,* $C_5H_5N_5O$. (See *J. P. C.,* 4e sér., xvii. 328.) By the oxidation of guanine, as well as by other processes, chemists have prepared *guanidin,* CH_5N_3, and from this in turn a series of derivatives. For an elaborate investigation of the chemistry and physiological action of these substances, see *Arbeiten des Pharmak. Inst. zu Dorpat,* Bd. vii.–xii. By the action of nitrous acid upon guanine there is produced the base *xanthine,* $C_5H_4N_4O_2$, and Emil Fischer has shown that *theobromine* and *caffeine* are capable of being produced from xanthine, and are, in fact, dimethyl- and trimethyl-xanthine respectively. (*A. J. P.,* 1882, 218.) Guano is a powerful local irritant, which, when mixed with equal parts of potters' clay or other diluent, is capable of causing vesication. It has been used as a counter-irritant and also as a stimulant in certain *cutaneous diseases,* especially in *eczema, ecthyma,* and *tinea capitis.* For various preparations of guano, see 16th ed. *U. S. D.*

Guarea. *Guarea purgans. Gito.* (Fam. Meliaceæ.)—The root of *G. Rusbyi* (Brit.), Rusby (*Syncarpus Rusbyi,* Brit.), of Bolivia, has properties resembling those of ipecac. The root and bark of this Brazilian plant are said to be drastic purgatives.

Gum Cebil.—This gum is a product of the Brazilian leguminous tree *Piptadenia Cebil,* Griseb. (*Cebil colorado*). It occurs in reddish-yellow tears, or in dark-colored angular masses, and forms a reddish-yellow, odorless, viscous mucilage of acid reaction. It is said to contain 80.78 per cent. of arabin.

Gum, Cedar.—This, the product from *Cedrata australis,* F. Muell., or *Red Cedar* of Queensland (Fam. Meliaceæ), is a very pale yellow gum, occurring in tears about an inch long, feeling leathery between the teeth, swelling and, finally, almost dissolving in water. It contains about 68 per cent. of arabin, and 6 per cent. of metarabin, but no resin. (*P. J.,* vol. xx. 1890.)

Gum Elemi. *Elemi. Elemi,* Fr.—The botanical source of this concrete resinous exudation is not positively determined, and it is, indeed, probable that the drug usually known by the name of *elemi* is derived from several different trees. That known to the ancients is said to have been obtained from Ethiopia, and all the elemi of commerce was originally brought from the Levant. The tree which afforded it was not accurately known, but was supposed to be a species of Amyris. At present the drug is said to be derived from three sources,—namely, Brazil, Mexico, and Manila. According to Peckolt, *Brazilian elemi* (*Tacamahaca, Tacamaque terreuse,* Fr.) appears to be the product of *Protium heptaphyllum* (Aubl.), March (*Icica heptaphylla,* Aubl.), *P. Icicariba* (DC.), March (*Icica Icicariba,* DC.) (Fam. Burseraceæ), and other species of the genus. It seems not to occur to any extent in general commerce, and to be used locally as a substitute for incense. It occurs in brown almost odorless pieces, internally white, about the size of a bean. *Manila elemi* occurs in two forms, one soft and one hard, and is believed to be the product of *Canarium commune,* L., of the same family. It is erroneously stated in some works to be a native of Carolina. The elemi is obtained by incisions into the trees, through which the juice flows and concretes upon the bark. The *Mexico elemi* is said by Royle to be obtained from a species of Elaphrium which that author has described from dried specimens and proposes to name *E. elemiferum.* (*Mat. Med.,* Am. ed., 339.)

Carana-elemi.—The product of *Protium Carana,* (H. B. K.), March, produced on the confines of Venezuela and Colombia, occurs in masses of a greenish-yellow color, externally hard, internally soft, with a peculiar fennel-like aromatic odor. It is insoluble in water, soluble in sulphuric ether, chloroform, and benzene. According to Tschirch and Saal, carana-elemi contains 20 per cent. of exceedingly acrid resin. (*A. Pharm.,* Bd. 241, 1903.)

Elemi is in masses of various consistence, sometimes solid and heavy like wax, sometimes light and porous; unctuous to the touch; diaphanous; of diversified colors, generally greenish with intermingled points of white or yellow, sometimes greenish white with brown stains, sometimes yellow like sulphur; fragile and friable when cold; softening by the heat of the hand; of a terebinthinate somewhat aromatic odor, diminishing with age, and resembling to some extent that of lemon and fennel; of a warm, slightly bitter, disagreeable taste; entirely soluble, with the exception of impurities, in boiling alcohol; and affording a volatile oil by distillation. "Moistened with rectified spirit, it breaks up into small particles, which, when examined by the microscope, are seen

partly to consist of acicular crystals." *Br.* 1885. Elemi is sometimes adulterated with rosin and turpentine.

The two varieties of elemi that have been investigated chemically are the Manila, or soft elemi, and the Brazilian, or hard elemi. The Manila elemi contains 10 per cent. of an *ethereal oil* (made up of phellandrene and dipentene), *amyrin*, $C_{30}H_{50}O$, of which, according to Vesterberg, the isomeric varieties *a* and *b-amyrin* are present, an *amorphous resin*, small amounts of *elemic acid*, $C_{35}H_{46}O_4$, *bryoidin*, $C_{20}H_{38}O_3$, and a bitter principle. The Brazilian elemi (*protium elemi*) contained *protomyrin*, 30 per cent.; *protolaminic acid*, 25 per cent.; and *protolaresine*, 37.5 per cent. The protomyrin has the same melting point and formula as the amyrin from Manila elemi.

Elemi has properties analogous to those of the turpentines, but is exclusively applied to external use. In the United States it is rarely employed even in this way. In the pharmacy of Europe it enters into the composition of numerous plasters and ointments. We are told that it is occasionally brought to this country in small fragments mixed with the coarser kinds of gum arabic from the Levant and India. *Unguentum Elemi*, Br. Ph. 1885, was of the strength of about 20 per cent.

Gum, Grass-Tree.—An Australian product, said to be obtained by exudation from different species of Xanthorrhœa, especially *X. hastilis*, R. Br. (Fam. Liliaceæ.) It is of a resinous character, usually as found in the markets in the state of small fragments or coarse powder, resulting from the breaking up of the larger brittle masses in which it first occurs. It is of a deep reddish-yellow color in mass, but greenish yellow in powder. It does not dissolve in the mouth when chewed, nor adhere to the teeth, but has a slightly astringent and aromatic flavor. It melts with heat, and at a higher temperature takes fire in the air, burning with a smoky flame, and emitting a fragrant odor not unlike that of balsam of Tolu. It yields picric acid largely under the action of nitric acid. The natives and early settlers employed it as a medicine in *diarrhœa*. It is said to be used extensively, instead of shellac, in cabinet work, but to be distinctly inferior. For much interesting information concerning it and other resinous products of the genus Xanthorrhœa, see paper by J. H. Maiden, *P. J.*, vol. xxi. 1891. It is obtainable in inexhaustible quantities, as the plants producing it are abundant throughout almost the whole of Australia. (*A. J. P.*, 1866, 465.) Three hundred tons of the resin of *X. hastilis* have been exported in one year, and at one time the price rose to £65 per ton for the best quality, but for ordinary quality it is from £7 to £10. (*A. J. P.*, 1885, 405.) (See article on *Xanthorrhœa Resins.*)

Gum Hogg. *Hog-Gum. Kuteeragum.*—Under the name of Gum-Hogg a peculiar gum is much used in marbling paper. A full discussion of it may be found in the 14th edition of the *U. S. D.*, but, as it appears to be only a variety of Bassora gum, and rarely found in commerce, we omit any further account of it.

Gum, Indian. *Gummi Indicum. Ghati Gum.* A gummy exudation from the wood of *Anogeissus latifolia*. (Fam. Combretaceæ.) The forests of India produce large quantities of gums, a number of which have found their way into commerce and are used to a considerable extent as substitutes for gum arabic.

Of these gums,[1] that yielded by *Prosopis spicigera* occurs in small angular yellowish fragments, or sometimes in large ovoid tears two inches long, of an amber color, frosted externally with cracks. It forms with water a dark-colored tasteless mucilage and resembles in its behavior to reagents the *Mezquite gum*. The gum of *Feronia elephantum* is in small irregular tears varying from reddish-brown to pale yellow and forms a thick, tasteless, colorless mucilage which resembles gum arabic, but is precipitated by neutralized lead acetate and gelatinized by ferric chloride, although unaffected by borax. The most important of the Indian gums is that which has been recognized in the Br. Add., and which in its solubility and relation to reagents closely resembles gum arabic. It has double the power of viscosity of gum arabic and forms with water a colorless mucilage having a faint characteristic odor. It is well suited for pharmaceutical use, and is said to be specially valuable in the making of emulsions. It is insoluble in 90 per cent. alcohol. It occurs "in vermiform or rounded tears of varying size, pale amber or yellowish-white in color, translucent, with a somewhat dull surface and breaking with a bright glassy fracture. The aqueous solution is gelatinized by the addition of alcohol (90 per cent.), solution of borax, or solution of lead subacetate; but it is unaffected by the addition of test-solution of ferric chloride (distinction from Amrad and certain other gums) or of solution of lead acetate. It is not colored blue or brown by a small quantity of solution of iodine (absence of starch or commercial 'dextrin'). On incineration Indian Gum should not yield more than 4 per cent. of ash." *Br. Add.*

The Br. Add. allows of the substitution of Indian gum in official preparations in place of gum acacia, with the statement that one part of it should be substituted for two of the acacia. The *mucilage of Indian gum* (*Mucilago Gummi Indici*, Br. Add.) is made with two avoirdupois ounces of gum to six fluidounces of distilled water.

Gum Kauri.—This is an amber-like substance, varying from a soft cream-white to an amber color, dug in large quantities from the soil of New Zealand. It is a resinous exudation from *Agathis australis* (Lamb.), Steud. (*Dammaris australis*, Lamb.), of the fam. Coniferæ, but, as it first exudes and is found on the surface of the ground, it is not esteemed. According to Tschirch and Niederstadt, it contains *kaurinic acid*, $C_{10}H_{16}O_2$, 1.5 per cent.; *a-* and *β-kaurolic acids*, $C_{12}H_{20}O_2$, 48 to 50 per cent.; *kaurinolic acid*, $C_{17}H_{34}O_2$, and *kauronolic acid*, $C_{12}H_{24}O_2$, together, 20 to 22 per cent. All these resin acids are soluble in solution of sodium hydroxide. *Baume Calédonien* consists of a solution of kauri gum in an equal weight of 90 per cent. alcohol. It has been used with alleged great success in the treatment of *wounds* and *ulcers*, of *eczema* and other skin affections, and as a substitute for collodion and the soluble sodium silicate. When applied to a well cleansed and dried wound it leaves a slight deposit of resin as a varnish, which is not affected by friction or contact with water.

[1] There appears to be considerable confusion as to the proper use of the names of Indian gums. *Amrad gum* of the *Br. Add.* is probably the gum of *Feronia elephantum* (Fam. Rutaceæ), but, according to the editors of the *Indian Pharmacographia*, the term Amrad is unknown in India and is of African origin applied to dark brown acacia gums. The *ghatt gum* of the Indian bazaars is usually a mixed product.

Gum Mango.—This gum, which is obtained from the mango tree, *Mangifera indica*, L., occurs in the Indian bazaars in amber-colored or reddish-yellow lumps, almost transparent, with a brilliant conchoidal fracture, 39.4 per cent. of which is soluble in water. (See *J. P. C.*, 19, 584.)

Gum Mesquite. *Mesquite Gum. Gum Mezquite.*—This is the product of *Prosopis juliflora* (Swz.), DC., *P. glandulosa*, Torr., and perhaps other species of the same genus. Mesquite is a small thorny acacia-like tree or shrub belonging to the fam. Leguminosæ, and growing in New Mexico, Texas, and other neighboring regions, where it covers vast extents of country. The fruit is a long, compressed pod, filled with a sweet pulp, which is said to contain 30 per cent. of grape sugar, and to be used by the Indians as food. A gum exudes from the stem and branches. It occurs in irregular, roundish pieces, of various sizes and usually of a dark amber-brown color, though sometimes, especially when gathered from young trees, it is nearly colorless. Procter found it to resemble gum arabic in its solubilities, but to differ essentially in not being precipitated by lead subacetate, and in its strong solution not being coagulated by borax. (*A. J. P.*, xxvii. 224.) Campbell Morfit found in it a very little bassorin (0.206 per cent.), which did not exist in the specimens examined by Procter. (*Am. J. Sci.*, March, 1855, 264.) See also *A. J. P.*, 1855, 542, for a brief description of the gum and its character.

The saccharine pods of *Prosopis odorata*, Torr. and Frem. (*P. pubescens*, Benth.), are largely employed as food by the Indians, and those of all the species form valuable fodder for cattle.

Gum Sassa. *Sassa Gum.*—This name has been applied by Guibourt to a gum, occasionally brought into commerce from the East, and answering to Bruce's description of the product of a tree which he calls *sassa*. According to Guibourt's description, it is in mammillary masses, or in convoluted pieces resembling an ammonite, of a reddish color and somewhat shining surface, and more transparent than tragacanth. Its taste is like that of tragacanth, but slightly acrid. When introduced into water it becomes white, softens, and swells to four or five times its original bulk; but it preserves its shape, neither, like tragacanth, forming a mucilage, nor, like Bassora gum, separating into distinct flocculi. It is rendered blue by iodine.

Gum Sonora. *Sonora Gum.*—According to Krewson the exudation from *Covillea tridentata* (DC.), Vaill. (*Larrea mexicana*, Moric.), contains 17.27 per cent. of resin, and 11.71 per cent. of mucilage and allied substances. (For details see *P. J.*, xvi. 128; also *A. J. P.*, May, 1898.)

Gum Sterculia. *Sterculia Gum.*—A number of trees belonging to the genus Sterculia in India, Africa, and Australia yield gums in considerable quantity, most of which resemble in their appearance tragacanth, and some of which have remarkable adhesive properties. These gums have not, however, become important articles of commerce. (See *P. J.*, Nov. 1889; *A. J. P.*, Jan. 1900.)

Gutta-Percha. *Guetah* or *gueutta-pertcha*, Malay (meaning *gueutta*, gum; *pertcha*, rags or scraps). *Gummi plasticum.*—This is a hydrocarbon like India rubber obtained from the juice of certain tropical plants. It is less elastic than India rubber, so that when changed in form by mechanical force it preserves its new shape. At a temperature of boiling water it becomes highly plastic and capable on cooling of preserving the shapes in which it has been moulded, while India rubber, treated by heat, preserves its elasticity until the temperature becomes excessive, when it changes in its physical and chemical properties. Perhaps the most important difference between the two substances is in their reaction with sulphur, rubber readily vulcanizing, gutta-percha being practically incapable of so doing.

The plants which are capable of yielding gutta-percha are quite numerous, but those yielding the commercial substance inhabit the limited region of South America between the third degree of south and the fifth degree of north latitude, and the limited portion of Asia between longitude 102° and 112°. It is probable that other equatorial or sub-equatorial regions do, however, produce gutta-percha.

Of the true gutta-percha trees, three are or have been especially important, namely, 1. *Palaquium Gutta* (Hook. f.), Burck, *Dichopsis Gutta* (Th. Lobb.), B. and H., *Isonandra Gutta* (Serrulaz), *Dichopsis oblongifolium*, Beauvisage (*Palaquium oblongifolium*, Burck), *Isonandra oblongifolia*, Teysmann. 2. *Palaquium borneense*, Teysmann. 3. *Palaquium Treubii* and its variety, *parvifolium*, Burck.

Of these trees the *Palaquium Gutta* has been practically exterminated. The *P. oblongifolium* is said to yield the best of all the gutta-perchas, and to be cultivated in Sumatra. Other sapotaceous species of trees yield gutta-percha of inferior quality or in small quantities, and it is stated that *P. pustulatum* is cultivated in Ceylon and *Payena Leerii* is cultivated in its native Sumatra.

Gutta-percha is obtained in considerable quantity in the Philippine Islands, whence it is sent to Singapore. In obtaining gutta-percha, after the tree has been cut down, incisions are made through the bark into the latex, and the milk, after having been collected in gourds, is coagulated by heat, the resulting masses washed by kneading with water, increased in weight by additions of wood, dirt, pebbles, etc., and finally sent into trade worked into masses with a fair exterior.

It has been proven by the researches of Jungfleisch that the leaves of the gutta-percha trees contain, even after drying, nine per cent. of gutta-percha, as extracted by toluene. Hitherto the leaves have been simply lost in the forest. It is further stated that the year's product of leaves of the thirty year old tree will yield as much gutta-percha as does the tree when cut down, and efforts are being made to induce the Malays to collect the leaves instead of destroying the trees. Patents have been taken out for at least four different processes, in which carbon disulphide, toluene, rosin oil, and light petroleum are used as solvents.

In Singapore the gutta-perchas of various sources are mixed, and three commercial articles are sold,—viz. (1) first quality, (2) medium quality, (3) white gutta-percha.

Small quantities of commercial gutta-percha may be freed from impurities and obtained perfectly white by dissolving one part of gutta-percha in twenty of boiling benzene, shaking the solution frequently with calcium sulphate, which upon standing two or three days carries down with it the coloring matter, then decanting the clear liquid, and adding it, in small portions at a time, to alcohol, agitating continually. The deposited gutta-percha is then dried by exposure to the air.

Gutta-percha is of a dull white or whitish color, often with reddish-brown streaks, of a feeble odor, tasteless, at ordinary temperatures hard and almost horny, somewhat flexible in thin pieces, having an unctuous feel under the fingers, and very tenacious. Its sp. gr. is 0.9791. (Soubeiran.) At about 49° C. (120.2° F.) it becomes softer and more flexible, but is still elastic, resisting, and tenacious. At from 66° to 71° C. (150.8° to 159.8° F.) it is soft, very plastic, and capable of being welded and moulded into any form; "plastic above 120° F. (48.8° C.)." *Br.* It can be softened either by means of hot water or by dry heat. On cooling, it reassumes its former state, and retains any form which may have been given to it. In the softened state it is readily cut with a knife, though with some difficulty when cold. Exposed to a heat of 166° C. (330.8° F.), it loses a portion of water, and on hardening becomes translucent and gray; but it recovers its original characters if immersed in water. Subjected to igneous distillation, it yields volatile products resembling closely the volatile oil obtained from caoutchouc by the same process. Heated in an open vessel, it melts, foams up, and takes fire, burning with a brilliant flame and much smoke. A portion thus melted retains the state of a viscid fluid on cooling. Gutta-percha is a non-conductor of electricity. It is insoluble in water, alcohol, alkaline solutions, and the weak acids. Ether and the volatile oils soften it in the cold, and imperfectly dissolve it with the aid of heat. Oil of turpentine dissolves it perfectly, forming a clear, colorless solution, which yields it unchanged by evaporation. It is also dissolved by carbon disulphide, chloroform, benzene, and petroleum benzin. It has an ultimate composition closely analogous to if not identical with that of caoutchouc. According to Baumhauer, pure gutta-percha, as it issues from the tree, is a hydrocarbon, with the formula $(C_{10}H_{16})_2$, which he calls *gutta*, and by the oxidation of which, in various degrees, the different bodies constituting gutta-percha are produced. This hydrocarbon can be separated by treating gutta-percha with diluted hydrochloric acid, and boiling the residue with ether, which deposits the gutta on cooling, but the ethereal treatment must be frequently repeated to obtain it quite pure. (*J. Pr. Chem.*, lxxviii. 279.) Arpe considers gutta-percha as a mixture of six different resins, which may have been formed from a hydrocarbon, $C_{10}H_{16}$. (See *Chem. Gaz.*, ix. 471.) Oudemans (*Jahresb.*, 1859, 517) finds two resinous products in gutta-percha: *fluavil*, fusing at 42° C. (107.6° F.), with the formula $C_{20}H_{32}O$, and soluble in cold alcohol, and *albane*, fusing at 140° C. (284° F.), with the formula $C_{10}H_{16}O$, and soluble in chloroform, carbon disulphide, and ether, from which last it crystallizes out on cooling. Payen has shown that three proximate principles exist in the natural gutta-percha,—viz., *gutta* (insoluble in cold alcohol and in boiling alcohol), 78 to 82 per cent.; *fluavile* (insoluble in cold alcohol), 4 to 6 per cent.; *albane* (soluble in boiling alcohol), 14 to 16 per cent. Gutta-percha resists putrefaction strongly; but in certain situations, as when employed to protect underground telegraph wires passing near the roots of the oak, it has been observed to undergo speedy decomposition, in consequence, it is supposed, of the action of fungi. (*P. J.*, xvii. 193.)

Gutta-percha is employed very largely in the arts for various purposes, especially as a protection to electrical wires. In medicine it is used simply for mechanical purposes, as in the formation of splints and the manufacture of surgical instruments. For details of its use the reader is referred to works on surgery.

Gymnema. *Gymnema silvestris*, R. Br.—This is a woody climber, belonging to the Asclepiadaceæ, which grows in India and also in Africa. The root has for a long time been employed by the natives as a remedy in *snake bite*, and it is affirmed by T. Dyer (*Nature*, 1887) that directly after the eating of one or two leaves it is impossible to taste sugar, though other tastes are not obscured. Thus, pungency alone is detected in gingerbread, and a sweet orange tastes like a lime. The active principle, *gymnemic acid*, was discovered by Hooper, and has been used with considerable success as a remedy for *parageusia* and *hallucinations of taste*. The 1 per cent. aqueous solution is to be applied with a brush to the inside of the mouth, or a hot infusion (15 per cent.) of the crude drug may be used. (See *Th. M.*, Bd. ix.)

Gymnocladus. *Gymnocladus canadensis*, Lam. (*G. dioica* (L.), Koch). *Coffee-tree. Kentucky Mahogany.* (Fam. Leguminosæ.)—According to Bartholow, the aqueous extract of the seeds is toxic. (*Am. Drug.*, April, 1886.) Samuel S. Mell (*A. J. P.*, 1887, 230) obtained from them by petroleum benzin about 10 per cent. of fixed oil which is yellowish, saponifiable, and of sp. gr. 0.919. Ether extracted a little wax, fat, and resin. A little tannin and a small quantity of glucoside were also obtained. This latter had a peculiar odor and an acid burning taste. James H. Martin (*A. J. P.*, 1892, 558) obtained a yellow saponifiable oil from the bean and the bark and a glucoside from the pulp.

Hæmoglobin. *Hemoglobin.*—A constituent of venous blood, passing in the arterial blood into *oxyhæmoglobin*. Its molecular formula is extraordinarily complex, the hæmoglobin from the blood of swine having, according to some writers, the formula $C_{609}H_{1005}N_{156}S_3FeO_{179}$, while that from dogs' blood is given as $C_{636}H_{1025}N_{164}S_3FeO_{189}$. Various preparations of *desiccated blood* containing hæmoglobin have been put upon the market. Crystals of hæmoglobin may be obtained from the blood of certain animals (guinea pigs, rats, etc.) with ease by simply adding water to the blood. The hæmoglobin dissolves in the water, the corpuscles separating, and the crystals form in a few minutes. Another method consists in adding to defibrinated blood 6 per cent. of its volume of ether, or a mixture of alcohol and ether; on shaking the mixture, the corpuscles dissolve, and a thick magma of crystals forms sooner or later; these may be purified by washing with 25 per cent. alcohol and by recrystallization. Freezing has been resorted to for the purpose of separating the crystals.

Ferrohemol is a brown, almost tasteless, powder containing 3 per cent. of iron, which is made by the precipitation of blood by a dilute solution of iron and neutralization with soda. *Fer cremol* is a similar substance.

Hemol, *Hemogallol*, are made, as suggested by Kobert, by the action of reducing agents upon the blood coloring matter. (See *E. Merck's Jahresber.*, 1891.) With the hemol, zinc dust is used as the reducing agent; with the hemogallol, pyrogallol is used. The former is a dark brown, the latter a reddish-brown, tasteless powder.

Either of these blood derivatives may be employed instead of the older preparations of iron. There is sufficient clinical evidence to show that they are effective ferruginous tonics which may

be, as is claimed for them, less constipating and less disagreeable to the stomach than are the older preparations of iron; but there is no sufficient reason for believing that they have any real superiority. *Dose*, five to ten grains (0.32–0.65 Gm.).

A number of hemol preparations have also been recommended by Kobert and prepared by Merck & Co., such as *arsenhemol, bromhemol, iodohemol, iodomercuryhemol*, and *copperhemol*.

Hartshorn. *Cornu.* Lond., Ed. Ph.—The horn of the *Cervus Elaphus*, or *stag*. (See 16th ed. *U. S. D.*)

Hedera. *Hedera Helix*, L. *Ivy.* (Fam. Araliaceæ.)—This well-known evergreen creeper is a native of Europe. The fresh *leaves* have a balsamic odor, especially when rubbed, and a bitterish, harsh, unpleasant taste. They are used for dressing issues, and, in the form of decoction, have been recommended in *sanious ulcers* and *cutaneous eruptions*, particularly *tetter* and the *itch*. The *berries*, which have an acidulous, resinous, somewhat pungent taste, are said to be purgative and even emetic. Vandamme and Chevallier discovered in ivy seeds a peculiar very bitter alkaline principle, *hederine*. It is obtained by treating the seeds with calcium hydroxide, dissolving the precipitated alkaloid in boiling alcohol, and evaporating the alcoholic solution. (*A. J. P.*, xiii. 172.) Posselt has discovered two acids in the seeds, one of which has their taste in a high degree, and was named by him *hederic acid*, the other he did not obtain quite pure. (See *Chem. Gaz.*, 1849, 93.) The seeds were also found to contain a variety of tannic acid, turning ferric salts dark green, to which Posselt gave the name of *hedera-tannic acid*. (*Ann. Ch. Ph.*, 69, p. 62.) F. A. Hartsen has found in the leaves a crystalline glucoside allied to saponin. (*A. J. P.*, 1875, xlvii. 268.) Davies and Hutchinson confirmed the existence of Posselt's hederic acid, and gave it the formula $C_{16}H_{26}O_4$. Kingzett believes that it is not an acid, but a glucoside. J. Vernet (*Ber. d. Chem. Ges.*, xiv. 685) obtained a glucoside, which separated from solution in boiling acetone, in silky needles, melting at 233° C. (451.4° F.), insoluble in water, chloroform, and ligroine, slightly soluble in cold acetone, benzene, and ether, more soluble in hot alcohol and hot alkalies. Its formula he gives as $C_{32}H_{54}O_{11}$, and states that it decomposes on heating with diluted sulphuric acid into a body, $C_{26}H_{44}O_6$, which fuses at from 278°–280° C. (532.4°–536° F.), and a non-fermentable sugar which reduces Fehling's solution. (*Y. B. P.*, 1877, 508.) From the trunks of old ivy plants, growing in the south of Europe and the north of Africa, a resinous substance exudes through incisions in the bark, which has been employed in medicine under the name of *ivy gum*. It is in pieces of various sizes, of a dark yellowish-brown color internally, of a vitreous fracture, pulverizable, yielding a lively orange-yellow powder, of a peculiar not disagreeable odor when heated or inflamed, and of a bitterish resinous taste. Its chief constituent is resin, though some pieces contain a considerable proportion of bassorin, and other large quantities of ligneous matter. It was formerly used as a stimulant and emmenagogue, but is now scarcely employed. Placed in the cavities of carious teeth, it is said to relieve *toothache*. The light and porous wood of the ivy is sometimes used for making *issue-peas*.

Hedonal. *Methyl-propyl-carbinol-urethane*, $CO\langle^{NH_2}_{O(CH_3.CH.C_3H_7)}$. This is a white crystalline powder of weak aromatic odor, fusing at 76° C. (168.8° F.), sparingly soluble in cold water, somewhat more so in boiling water, soluble in alcohol, ether, and other organic solvents. Decomposed by boiling with alkalies. It forms colorless crystals melting at 76° C. (168.8° F.). The solutions have a powerful menthol-like taste. Hedonal is believed to split up in the system into carbon dioxide, ammonia, and urea. Probably owing to the presence of the urea, it sometimes acts as a diuretic, but more usually it has no other effect than that of an hypnotic. It is claimed by de Moor that its diuretic action is much increased by its administration in solution. According to Dreser, in the dog it acts very feebly upon respiration and blood pressure. As an hypnotic it is mild in its action and but rarely produces disagreeable after effects. In severe cases of *insomnia*, or when the patient is kept awake by pain, it is of little service. No cases of poisoning by it have been reported, and so far its prolonged use has not been followed by disagreeable symptoms. It resembles trional in its action, and when the continuous use of an hypnotic is required, may well be alternated with that drug. The *dose* is fifteen to forty-five grains (1.0–3.0 Gm.), given preferably in capsules half an hour before the desired effect.

Hedychium. *Hedychium spicatum*, Ham. (Fam. Zingiberaceæ.)—The root of this plant, which is used in India as incense, has been found by J. C. Thresh to contain *ethylmethyl paracoumarate*. (*P. J.*, Nov. 8, 1884.)

Helenium. *Helenium autumnale*, L. *False Sunflower. Sneezewort. Sneezeweed.*—An indigenous perennial, bitter, somewhat acrid composite herb. The leaves and flowers snuffed up in the state of powder produce violent sneezing, and have been used as an errhine. F. J. Koch (*A. J. P.*, 1874, 221) found in the plant a bitter principle believed to be a glucoside, malic acid, traces of tannic acid, albumen, volatile oil, etc. *Helenium nudiflorum*, Nutt., has similar properties; *H. tenuifolium*, Nutt., a common roadside weed of Mississippi and Louisiana, is stated by Galloway to produce in animals muscular twitchings, passing into violent convulsions, terminating in death. In four negroes helenium caused spasms with delirium and loss of consciousness. (*A. J. P.*, 1872, 309.)

Helianthemum. *Herbe de Hélianthème de Canada*, Fr. *Canadisches Sonnenröschen*, G. *Helianthemum canadense* (L.), Michx.—*Frostwort, frost-weed*, or *rock-rose*, grows in all parts of the Eastern United States, preferring dry sandy soils. William Crutcher (*A. J. P.*, 1888, 390) found in it volatile oil, wax, fatty oil, tannin, and apparently a glucoside crystallizing in white needles. Fred. J. Kruell found in *H. corymbosum*, Michx., tannin in large proportion, resin, glucose, gum, extractive, chlorophyll, and inorganic salts. (*A. J. P.*, 1874, 358.) Frostwort has an astringent, slightly aromatic, and bitterish taste, and appears to possess tonic and astringent properties; it was formerly employed in *scrofulous diseases*. (See *U. S. D.*, 14th ed.) According to D. A. Tyler (Pamphlet, New Haven, 1846), *H. corymbosum* possesses similar properties, and may be indiscriminately employed with *H. canadense* in *scrofula, diarrhœa*, and *secondary syphilis*, and locally as a gargle in *scarlatina*, and a wash in *prurigo*. Tyler, however, has known the strong decoction and the extract to produce vomiting. He considers two grains (0.13 Gm.) of the latter a full dose for an adult.

Helianthus. *Helianthus annuus*, L. *Common Sunflower. Hélianthe, Grand Soleil*, Fr. *Sonnenblume*, G.—This very large composite is cultivated in this country, in Europe, and especially in China, chiefly for the sake of the fixed oil yielded by the seed. The oil has a sp. gr. of from 0.924 to 0.926, solidifies at —15° C. (5° F.), is colorless or yellowish, limpid, nearly tasteless and odorless, and dries slowly. It is said to make an excellent salad dressing, and to be one of the best burning oils known. The increase in cultivation is stated to be nearly a thousandfold, 275 pounds of oil being a fair yield per acre. For particulars as to cultivation, see *A. J. P.*, 1875, 460; also *N. R.*, 1876, 165. Ludwig and Kromayer (*A. Pharm.* (2), 99, 1 and 285) obtained a tannin which they called *helianthitannic* acid, and gave it the formula $C_{14}H_9O_8$. On boiling with moderately diluted hydrochloric acid they obtained a fermentable sugar and a violet coloring matter. E. Diek (*In. Dis.*, Göttingen, 1878) found only small quantities of inulin, large amounts of levulin, and a dextro-rotatory sugar. Chardon has obtained a peculiar oleoresin from sunflowers grown in Algeria. (*P. J.*, 1873, 323.) The stalk, when treated as is flax, yields a long, fine fibre, which is said to be used in China for the adulteration of silk. The sunflower also enjoys the reputation of protecting against marsh miasmata. (See *N. Y. M. R.*, 1868, 353.) Kazatchkoff states (*B. G. T.*, Oct. 1889) that in the Caucasus the inhabitants employ the sunflower in *malarial fevers*. The leaves are spread upon a bed covered with a cloth, moistened with warm milk, and then the patient is wrapped up in the spread. Perspiration is produced, and the patient is kept in this condition for an hour or two. The same process is repeated every day until the access of the fever has ceased. The Pah Ute Indians are said to use very freely as food the seeds of two indigenous sunflowers, *H. petiolaris*, Nutt., and *H. lenticularis*. (*Proc. A. Ph. A.*, xxvii. 178.)

Helleborus. *Helleborus niger*, L. *Black Hellebore. Hellébore noir*, Fr. *Schwarze Nieswurzel, Weihnachtswurzel, Winterrose*, G. *Elleboro nero*, It. *Eléboro negro*, Sp.—*Hellebore* is a native of the mountainous regions of Southern and temperate Europe, and is sometimes cultivated on account of the early opening and beauty of its flowers, whose expansion in midwinter has given to the plant the name of *Christmas rose*. Black hellebore is sometimes called *melampodium*, in honor of Melampus, an ancient shepherd or physician, who is said to have cured the daughters of King Prætus by giving them the milk of goats fed on hellebore.

The formerly official rhizome is knotted, blackish on the outside, white within, and sends off numerous long, simple, depending fibres which are brownish-yellow when fresh, but become dark brown upon drying. (For a history of the use of hellebore by the ancients, see 15th edition, *U. S. D.*) The roots of various other plants, not belonging to the same genus, are said to be frequently substituted for the black hellebore. They may usually be readily distinguished by comparing them with the genuine root.[1]

Though the whole root is found in commerce, the fibres are the portion usually recommended. They are about as thick as a straw, when not broken, from four inches to a foot in length, smooth, brittle, externally black or deep brown, internally white or yellowish-white, with little odor, and a bitterish, nauseous, acrid taste. In their recent state they are extremely acrimonious, producing on the tongue a burning and benumbing impression, like that which results from taking hot liquids into the mouth. This acrimony is diminished by drying, and still further impaired by age. Feneulle and Capron obtained from black hellebore a volatile oil, an acrid fixed oil, a resinous substance, wax, a volatile acid, bitter extractive, gum, albumen, potassium gallate, acid calcium gallate, a salt of ammonia, and woody fibre. William Bastick discovered *helleborin*, which he obtained in white, translucent crystals, of a bitter taste with a tingling effect on the tongue, not volatilizable, slightly soluble in water, more so in ether and alcohol, and more readily in these liquids hot than cold. (*P. J.*, xii. 274.) Water and alcohol extract the virtues of the root, which are impaired by long boiling.

Marmé and Husemann obtained from black and green hellebore a glucoside, *helleborein*, $C_{36}H_{44}O_{15}$, by precipitating a solution of an extract of the root with solution of lead subacetate, freeing from lead by hydrogen sulphide, and again precipitating with phospho-molybdic acid; by boiling with acid it separated into glucose and *helleboretin*, $C_{14}H_{20}O_3$, a compound of a fine violet color. The helleborein exists both in the root and leaves. It has a taste at once sweet and bitter, is soluble in water and weak alcohol, much less so in ether and absolute alcohol, and is crystallizable in rhomboidal prisms. It is precipitable by tannic acid and mercurous acetate (*J. P. C.*, 4e sér., ii. 258). Husemann and Marmé (*Ann. Chem.*, 135, 61) also examined more thoroughly the *hellcborin* of Bastick. They ascribe to it the formula $C_{36}H_{42}O_6$, and find that when boiled with diluted sulphuric acid, or, better, zinc chloride, it is converted into sugar and *helleboresin*, $C_{30}H_{36}O_4$. They obtain this glucoside by treating with hot water the green fatty matter which is dissolved out of the root by boiling alcohol. Though both the principles referred to by the German chemists mentioned are poisonous, the products of their decomposition are said to be harmless. Neither of them is volatile.

Helleborein is strongly irritant to the mucous membranes, causing, when applied to the conjunctiva, redness, swelling, and increased secretion, with indirect enlargement of the pupil, and when applied to the nasal membrane, sneezing, though less than veratrine. Small doses produce little effect on the stomach; but, repeated and accumulated, they cause anorexia, nausea even to vomiting, pain, increased secretion, and inflammation both of the stomach and bowels. It is claimed for helleborein that it acts upon the heart in a manner similar

[1] The rhizomes of various plants which are sometimes substituted for true hellebore have been examined by Tschirch and Neuber, who state their results as follows: The rhizome of *H. niger* exhibits a small pith and comparatively large acutely wedge-shaped, radially-elongated wood-bundles. The root is often flattened and possesses a stellate wood with blunt points. The rhizome of *H. viridis*, L., has a large pith and tangentially extended, bluntly wedge-shaped or almost square wood-bundles; older roots exhibit a wood with from five to seven-pointed rays. In both rhizome and root of *H. fœtidus*, L., the wood is more strongly developed and radiate in appearance; it contains abundance of wood-fibres and encloses little or no pith. The rhizome of *Actæa spicata*, L., is flattened and bears cushion-like protuberances, due to the remains of the aerial stems. The wood-bundles are thickened at either extremity and rounded by wood-fibres, so that in transverse section the wood-ring has a scalariform appearance. The root exhibits a regular three to five-rayed wood, the rays being broader toward the outside. (*S. W. P.*, xi. 410.)

to digitalis, in small repeated doses slowing the pulse and increasing the force, in toxic doses increasing the rapidity of the pulse, and in most cases causing a sudden cardiac arrest in systole. The blood pressure in the earlier stages of the poisoning is always increased. Respiration continues after the arrest of the heart. It is affirmed also to increase secretion, especially of the saliva and the urine, and probably to have an action upon the uterus. In very large doses it acts upon the nervous system so as to produce partial paralysis with tremors, which if the dose has been sufficiently large are replaced by violent convulsions. The pupil is variously affected; usually it is dilated before death. There are no characteristic post mortem lesions. As yet the glucoside has not been found in the secretions, and it may be destroyed in the system. The *helleborin* of Marmé and Husemann is a more active poison, though less irritant to the mucous membrane. It acts on the tongue like aconite. Its influence appears to be directed especially to the nervous system. In the lower animals it causes quickened breathing, restlessness, tension and trembling of the muscles, uncertainty of movement; then retardation of the breathing and pulse, irritability of the peripheral nerves, dilatation of the pupil, loss of hearing, and finally almost complete anæsthesia, with cerebral and spinal congestion, even to apoplexy.

Black hellebore is a drastic hydragogue cathartic, formerly supposed to be possessed of emmenagogue powers. In overdoses it produces inflammation of the gastric and intestinal mucous membrane, with violent vomiting, hypercatharsis, vertigo, cramp, and convulsions, which sometimes end in death. The fresh root applied to the skin produces inflammation and even vesication. The medicine was very highly esteemed by the ancients in *mania*, *melancholy*, *amenorrhœa*, *dropsy*, and *epilepsy*. *Bacher's pills*, celebrated for the cure of *dropsy*, consisted chiefly of black hellebore. S. B. Botkin and N. Ischistowitsch (*Cb. M. W.*, July 9, 1887), as the result of experiments made with the extract of the root of a green hellebore, conclude that in moderate doses it lessens the rapidity and increases the force of the cardiac contractions, producing a rise in the arterial pressure, the slowing of the beat being the result, at least in part, of stimulation of the inhibitory nerves, since it is prevented by severing of the vagi or by injections of atropine. The cause of the rise of the arterial pressure is believed by the experimenters to be in part due to increased work of the heart, and in part to contraction of the capillaries by an action of the remedy directly upon their coats. Usually the pulse has been increased in force and diminished in frequency and the secretion of urine notably augmented. The results obtained by Botkin have been largely confirmed by Christovich. (*D. M. Ztg.*, Jan. 1888.) Ischistowitsch has seen fifteen drops of a solution of 1 to 100 of the aqueous extract every two hours produce in six cases of cardiac diseases a diminution in the frequency and an augmentation of the force of the cardiac pulsations, an increase in the quantity of urine, and a prompt disappearance of the symptoms of non-compensation. Venturini and Gaspairini (*B. G. T.*, June, 1888) state that helleborein is a local anæsthetic, which, in affections of the eye, is preferable to cocaine, because of the great permanency of the anæsthesia, and because neither the pupil nor the intraocular pressure is affected. They use from three to four drops of the solution, each drop of it representing 1-164th grain (0.0004 Gm.). Hypodermically injected, helleborein is stated also to act as a local anæsthetic, but its powerful influence upon the heart forbids this method of use. The *dose* of the powdered root is from ten to twenty grains (0.65–1.3 Gm.) as a drastic purge, two or three grains (0.13–0.2 Gm.) as an alterative.

Dose, of the decoction (two drachms to a pint), a fluidounce (30 Cc.) every four hours till it operates.

Helmitol. *Citramine.*—This substance is a white acidulous, odorless powder, soluble in water, but almost insoluble in alcohol, and is said to be a compound of *anhydromethylene-citric acid* and *hexamethylene-tetramine*, 2 Gm. representing 0.85 Gm. of the latter constituent. Theoretically, hexamethylene-tetramine should undergo decomposition in the human system with the formation and subsequent elimination of formaldehyde, and S. Goldschmidt (*Th. M.*, Jan. 1903) states that after the administration of helmitol the formaldehyde is present in the urine when freshly voided. Helmitol has been highly recommended by P. Rosenthal (*Ther. Geg.*, Dec. 1902) in chronic *gonorrhœa* and other infective diseases of the genito-urinary tract. Its value has been confirmed by S. Goldschmidt. It may be given in *doses* of fifteen to twenty-three grains (1.0–1.5 Gm.) up to forty-five to sixty grains (3–3.9 Gm.) a day.

Helonias. *Chamælirium luteum* (L.), A. Gray (*C. carolinianum*, Willd., *Helonias dioica*, Pursh). *False Unicorn Root. Starwort.* (See 18th ed. *U. S. D.*)

Heracleum. *Heracleum lanatum*, Michaux. *Masterwort. Cow-parsnip.*—This is one of our largest indigenous umbelliferous plants. The root, which is the part used, bears some resemblance to that of common parsley. It has a strong disagreeable odor and a very acrid taste. Both the leaves and root excite redness and inflammation when applied to the skin. Bigelow considers the plant poisonous. It appears to be somewhat stimulant and carminative, and has been used in *epilepsy*. (See 16th ed. *U. S. D.*)

Hermodactyls. *Hermodactyli.* — Under this name are sold in European commerce the roots or bulbs of an uncertain plant, growing in the countries about the eastern extremity of the Mediterranean. By some botanists the plant is thought to be a *Colchicum*, and *C. variegatum*, L., a native of the south of Europe and the Levant, is particularly indicated by Fée, Geiger, and others, while by authors no less eminent the roots are confidently referred to *Iris tuberosa*, L. They certainly bear a considerable resemblance to the corm of *Colchicum autumnale*, L., being heart-shaped, channelled on one side, convex on the other, and from half an inch to an inch in length by nearly as much in breadth. As found in commerce, they are destitute of the outer coat, are of a dirty yellowish or brownish color externally, white and amylaceous within, inodorous and nearly tasteless, though sometimes slightly acrid. They are often worm eaten. Their chief constituent is starch, and they contain no veratrine or colchicine. From this latter circumstance, and from their insipidity, it has been inferred that they are probably not derived from a species of Colchicum. They are in fact almost without action upon the system. It is doubted whether they are the *hermodactyli* of the ancients, which acted like colchicum and were useful

in *gout* and *rheumatism*. Pereira describes a bitter variety of hermodactyls, which was brought from India by Royle. The bulbs are smaller and darker than the others, and have externally a striped or reticulated appearance.

Hermophenyl. *Mercurio-sodic phenol-disulphonate.*—This substance, which contains 40 per cent. of metallic mercury, occurs as a white amorphous powder, freely dissolving in cold water (up to 22 per cent.). According to Lumiere and Chevrotier (*B. M.*, 1901, 690) it possesses very feeble toxic properties, while it is actively bactericidal. Its hypodermic injections are said to cause but little pain. Reynes recommends in *syphilis* the intramuscular injection of a solution of 0.05 Gm. (4-5th gr.) of hermophenyl per 10 Cc. (160 minims) of water, of which he injects 4 Cc. (64 minims) at intervals of two or three days,—*i.e.*, an equivalent of 0.02 Gm. (⅓ gr.) hermophenyl or 8 Mgm. (⅛ gr.) of metallic mercury. Bernard claims that it may be made into a 1 per cent. soap without decomposition, affording an excellent preparation for rendering the hands aseptic. The 2 per cent. aqueous solution may be used for surgical purposes.

Herniaria. *Herniaria glabra*, L. (Fam. Illecebraceæ.)—Goblez has obtained from this plant a crystalline principle, *herniarine* (*J. P. C.*, 4e sér., xx. 270), which proved to be *methyl-umbelliferone*, $C_{10}H_8O_3$. Schneegans has also discovered an alkaloid, *paronychine*. (*A. J. P.*, 1890, 488.) This plant is recommended by Zeissl in *catarrh of the bladder*.

Heroine Hydrochloride.—The hydrochloride of the diacetic ester of morphine $(CH_3COO)_2C_{17}H_{17}.ON.HCl$, a white odorless bitter powder, melting at 230° C. (446° F.). It is quite soluble in water with neutral reaction. The free base *heroine* is a white crystalline powder melting at 171°–172° C. and possessing an alkaline reaction. It is practically insoluble in water, difficultly soluble in cold alcohol, more readily in hot alcohol, easily soluble in chloroform and benzene.

Heroine hydrochloride is thrown out of solution by the action of caustic alkalies, ammonia, and alkaline carbonates. Heating with mineral acids causes the splitting off of acetic acid, this reaction distinguishing it from codeine. Heroine hydrochloride does not possess the analgesic properties of morphine to any extent. It is, however, an extremely useful cough sedative in *bronchitis* and similar conditions. In *phthisis* especial virtue is claimed for it,—that it diminishes the sweating as well as the cough. *Dose*, one-sixteenth to one-eighth grain (0.004 to 0.008 Gm.).

Heteromeles. *Heteromeles arbutifolia* (Poir.), Roem. (*Photinia arbutifolia*, Lindl.) (Fam. Pomaceæ.)—D. D. Lustig has found in this Californian plant (*toyon* of the Indians) tannic, gallic, and hydrocyanic acids. (*A. J. P.*, April, 1882.)

Hetocresol. *Metacresol Cinnamate* ($C_6H_5CH{=}CH.COOC_6H_4CH_3$).—Forms crystals melting at 65° C. (149° F.), insoluble in water, but soluble in alcohol, ether, benzene, chloroform, and glacial acetic acid. It is claimed that this substance is especially valuable as a local remedy in external *tuberculosis*. In tuberculosis of the bladder Landerer uses, after cocainization, 1.4 per cent. solutions containing 0.7 per cent. of common salt. Fistulous tracts he injected with hetocresol, 1 part; iodoform, 2 parts; water, 1 to 8 parts. In *scrophuloderma*, after scraping, hetocresol has been found to be very useful.

Hetralin. *Dioxybenzenehexamethylenetetramine.* Soluble in four parts of hot water and in fourteen of cold water. Contains 60 per cent. of *hexamethylene-tetramine*. It is used in the *dose* of twenty-three to thirty grains (1.5–2.0 Gm.) a day, in divided doses. Highly commended in specific inflammation of the genital organs. (Lederman.)

Hetol.—Sodium cinnamate, $C_6H_5.CH{=}CH.CO\,ONa$) is a white powder soluble in water.

Heuchera. *Heuchera americana*, L. (*H. cortusa*, Michaux. *H. viscida*, Pursh.) *Racine d'Heuchère d'Amérique*, Fr. *Amerikanische Sanikelwurzel*, G.—The *alum-root* or *American sanicle* is a perennial, herbaceous plant, belonging to the Saxifragaceæ, which grows in shady, rocky situations from New England to Carolina. The root, which was formerly official, is horizontal, somewhat compressed, knotty, irregular, yellowish, and of a strongly styptic taste. Alum-root is powerfully astringent, and may be employed in similar cases with other medicines belonging to the same class. H. K. Bowman (1869) obtained from it 18 to 20 per cent. of tannin. It has hitherto, however, been little used. J. Peacock (*A. J. P.*, 1891, 174) found a percentage of tannin ranging from 9.33 to 19.66 reckoned on the dry drug, according to the season of the year when collected; also a percentage of starch, calculated the same way, ranging from 5.17 to 16.32. Frederick Stearns (*Proc. A. Ph. A.*, 1858, 263) speaks of two other indigenous species, *H. villosa*, Michx. (*H. caulescens*, Pursh), and *H. pubescens*, Pursh, as having similar properties; and F. W. Anderson reports (*Botan. Gaz.*, 1887, 65) that the roots of *H. hispida*, Pursh, *H. cylindrica*, Douglas, and *H. parvifolia*, Nuttall, are much used by hunters of Montana and others as astringents, particularly in *diarrhœa* caused by the drinking of alkali water.

Hibiscus. *Hibiscus Abelmoschus*, L. (*Abelmoschus moschatus*, Medic.) (Fam. Malvaceæ.) An evergreen shrub, growing in Egypt, and in the East and West Indies, and yielding the seeds known under the names of *semen Abelmoschi vel alceæ Ægyptiacæ*, and *grana moschata*. These are of about the same size as flaxseed, kidney-shaped, striated, of a grayish-brown color, of an odor like that of musk, and of a warm somewhat spicy taste. They were formerly considered stimulant and antispasmodic, but are now used only in perfumery. The Arabs flavor their coffee with them. They are said to be employed in the adulteration of musk. Another species, *Hibiscus esculentus*, L., or *Abelmoschus esculentus*, Moench., is cultivated under the name of *okra*, *bendee*, or *gombo* in various parts of the world, for the sake of its fruit, which abounds in mucilage (*gombine*), and is used for thickening soup. The leaves are sometimes employed for preparing emollient poultices. The roots, which are a foot or two long, are said also to abound in mucilage free from any unpleasant odor. Their powder is perfectly white, and superior to the marshmallow. The plant is largely cultivated near Constantinople, where it is much used as a demulcent. (*A. J. P.*, 1860, 224.) The bark is also used in making paper and cordage.

Hieracium. *Hieracium venosum*, L. (Fam. Compositæ.) *Rattlesnake Weed. Epervière*, Fr. *Habichtskraut*, G.—The plant is common, growing in dry places and open woods, in most of the eastern and northern parts of the United States and in Canada. The leaves and root are thought to

possess medicinal virtues, and, being deemed astringent, have been used in *hemorrhagic diseases*. The juice is supposed by some to have the power of removing *warts*. *Dose* of infusion (two ounces to the pint), a wineglassful (60 Cc.).

Hippuric Acid. ($C_9H_9NO_3$). *Benzoylglycocoll*, $CH_2\begin{cases}NH.C_7H_5O\\COOH\end{cases}$. This occurs in considerable amount in the urine of herbivorous animals, sometimes in that of man. Benzoic and cinnamic acids, toluol, and other aromatic substances, when taken internally, are eliminated as hippuric acid. It crystallizes in rhombic prisms, melting at 187° C. (368.6° F.), and at about 240° C. (464° F.) decomposes into benzoic acid, benzonitrile, and prussic acid. Boiling acids or alkalies decompose it into benzoic acid and glycocoll. According to the experiments of Meissner and Shepard, hippuric acid injected into the blood of animals acts as a very decided poison, but the hippurates have been suggested by Garrod as a remedy in the *uric acid diathesis*. He affirms that if outside of the body the sodium hippurate be added to blood serum that shows the presence of a urate, the latter is soon removed. *Sodium hippurate* may be combined with lithium or potassium salts; the *dose* is ten grains (0.65 Gm.) three times a day.

Histogenol.—Monneyrat (*Prog. M.*, April, 1902), finding that *sodium methylarsenate* (OAs $CH_3O_2Na_2$) was not poisonous, has combined it with nucleinic acid to form this preparation, which he claims to be of great value in the treatment of *tuberculosis*.

Hoang-Nan.—This is the bark of *Strychnos malaccensis*, Benth. (Fam. Loganiaceæ), a climbing plant, which grows in Malacca and surrounding countries. Brucine and strychnine are stated to have been found in it (*Newer Mat. Med.*), brucine being the more abundant of the two. It has been found to produce in animals general tetanic spasms similar to those caused by strychnine. It probably has the same range of medicinal application as has nux vomica, although special virtues have been claimed for it in the treatment of *chronic skin diseases*. *Dose* of powdered bark, three grains (0.2 Gm.).

Holigarna. *Holigarna longifolia*, Roxb. (Fam. Anacardiaceæ.)—According to David Hooper (*P. J.*, xxv. 1895), the black juice of this tree, which is used in India as the basis of a varnish, is actively vesicant, and contains a body closely allied to, if not identical with, cardol.

Holocaine, *p-Diethoxyethenyl diphenylamidine*, $C_6H_4\begin{cases}OC_2H_5\\NH.C.(CH_3)=N.C_6H_4(OC_2H_5)\end{cases}$, formed by the condensation of molecular amounts of phenacetin and paraphenetidine. The free base crystallizes well, is insoluble in water, and melts at 121° C. (249.8° F.).

Holocaine Hydrochloride forms colorless, lustrous, odorless crystals, melting at 189° C. (372.2° F.). It is soluble in 45 parts of water and readily in alcohol, with neutral reaction. The salt commonly used of the base is the hydrochloride, which readily dissolves in boiling water, leaving on cooling a saturated solution containing about 2½ per cent. of the hydrochloride. This solution is slightly bitter, neutral in reaction, and keeps many months without change. In boiling, a porcelain vessel should always be used, as the solution at 212° C. attacks glass.

It has been brought forward as a local anæsthetic in the treatment of diseases of the eye. The anæsthesia, which is said to develop in from fifteen seconds to a minute after the instillation of the solution, lasts from ten to fifteen minutes. The amount of burning produced is about the same as with cocaine. The advantages which are claimed for it over the latter alkaloid are that it does not change the pupil, the accommodation, or the intraocular pressure, and is antiseptic. It does not contract the blood vessels. The objections to it are that the instillation has to be renewed in from ten to fifteen minutes, and that it is about five times as toxic as is cocaine, so that it cannot be used hypodermically. According to the experiments of Heinz and Schlosser (*Klin. Monat. f. Augen.*, xxxv. 1897), the ½ of 1 per cent. solution affects bacteria, while the 1 per cent. solution is a powerful germicide, rapidly killing the lower organisms, including infusoria. Even in small doses it causes in frogs and in mammals violent convulsions which appear to be of cerebral origin, since after division of the spinal cord in the mouse the convulsions were confined to the anterior portion of the body. Holocaine is an active muscle poison, the 1 per cent. solution rapidly killing voluntary and cardiac muscles in the frog, and it exerts also a curare-like influence upon the motor nerves. According to Winselmann, its 1 per cent. solution exceeds in anæsthetic power the 3 per cent. solution of cocaine.

Honthin.—This is a grayish-brown odorless and tasteless powder, insoluble in water but yielding a light-brown solution in alcohol and in aqueous alkali, in which it is partly soluble. It is said to be chemically a *keratinized albumin tannate*. It is given in *doses* of from ten to twenty grains (0.65–1.3 Gm.) three to five times daily, as an astringent, in all forms of *diarrhœa*, without great irritation.

Hoochinoo.—This is an alcoholic drink which is clandestinely distilled by the Alaskan Indians, and has been supposed, on account of the frenzy which it produces in them, to contain some poisonous substance other than alcohol. John Marshall found it, however, to be simply an alcoholic liquor of about the strength of sherry.

Hordeum.—Several species of the graminaceous genus Hordeum are cultivated in different parts of the world. The most common are *H. vulgare*, L., and *H. distichon*, L., both of which have been introduced into the United States. The original country of the cultivated barley is unknown. The plant has been found growing wild in Sicily and in various parts of the interior of Asia. *H. vulgare* is said by Pursh to grow in some parts of the United States, apparently in a wild state. The fruits or grains are used in various forms.

1.—In their natural state they are oval, oblong, pointed at one end, obtuse at the other, marked with a longitudinal furrow, of a yellowish color externally, white within, having a faint odor when in mass, and a mild sweetish taste. Careful analyses of barley have been made, which agree in the main, though differing in some details, especially as to whether any sugar exists in the barley before malting.

Pillitz found (*Zeit. An. Chem.*, 1872) in the dry barley 14.3 per cent. of insoluble albuminoids, 2.1 per cent. of soluble albuminoids, 62.6 per cent. of starch, 1.9 per cent. of dextrin, 2.7 per cent. of sugar, 1.7 per cent. of extractive material, 3.1 per cent. of fat, 1.4 per cent. of soluble ash, 1.2 per cent. of insoluble ash, and 8.9 per cent. of lignin. The presence of sugar seems to have been shown by Kühnemann (*Ber. d. Chem. Ges.*, 1875

and 1876), who found a crystallized dextrogyrate sugar which did not reduce alkaline copper solution, and an amorphous lævogyrate mucilaginous substance called *sinistrin*. According to Kühnemann, barley does not contain dextrin.

Clifford Richardson (*Bulletin No. 9, Department of Agriculture*, 1886) gives the following as the average composition of American barley: water, 6.47 per cent.; ash, 2.87; oil, 2.67; sugar, etc., 7.02; dextrin and soluble starch, 3.55; starch, 62.09; albuminoids soluble in 80 per cent. alcohol, 3.66; albuminoids insoluble in 80 per cent. alcohol, 7.86; fibre, 3.81; total, 100.00. He finds, moreover, that on an average the grain makes up 84.78 per cent. and the hull 15.22 per cent. of the barley.

2.—*Malt* consists of the seeds made to germinate by warmth and moisture, and then baked so as to deprive them of vitality. It is in the form of malt that barley is so largely consumed in the manufacture of malt liquors. (See *Maltum.*) *Diastase* was first discovered by Payen and Persoz in the seeds of barley, oats, and wheat, and in the potato. It is found, however, only after germination, in which process the production of it appears to be the first step. Germinated barley seldom contains it in larger proportion than two parts in a thousand. It is obtained by bruising freshly germinated barley, adding about half its weight of water, expressing strongly, treating the viscid liquid thus obtained with sufficient alcohol to destroy its viscidity, then separating the coagulated albumen, and adding a fresh portion of alcohol, which precipitates the diastase in an impure state. To render it pure, it must be redissolved as often as three times in water, and precipitated by alcohol. It is solid, white, tasteless, soluble in water and weak alcohol, but insoluble in the latter fluid when concentrated. Though without action upon gum and sugar, it has the property, when mixed, in the proportion of only 1 part to 2000, with starch suspended in water, and maintained at a temperature of about 71.1° C. (160° F.), of converting that principle into dextrin and *maltose*.

This latter is a variety of sugar and was first recognized by Dubrunfaut, but has been more thoroughly studied by O'Sullivan and by Schulze. Its formula is $C_{12}H_{22}O_{11} + H_2O$; the molecule of water of crystallization it loses at from 100° to 110° C. (212°–230° F.) (or, as Richter proposes, it may have the formula $C_{18}H_{34}O_{17}$). O'Sullivan (*J. Chem. S.*, 10. 597) explains the action of diastase upon starch by the following reactions:

At 63° C. (145.4° F.):

$$C_{18}H_{30}O_{15} + H_2O = C_{12}H_{22}O_{11} + C_6H_{10}O_5$$

At from 64°–70° C. (147.2°–158° F.):

$$2(C_{18}H_{30}O_{15}) + H_2O = C_{12}H_{22}O_{11} + 4(C_6H_{10}O_5)$$

At 70° C. (158° F.):

$$4(C_{18}H_{30}O_{15}) + H_2O = C_{12}H_{22}O_{11} + 10(C_6H_{10}O_5)$$

The crystals of maltose, $C_{12}H_{22}O_{11} + H_2O$, are soluble in water and alcohol, they reduce Fehling's solution, and, according to O'Sullivan, are equal to from 63.9–65.5 per cent. of dextrose, but, according to Schulze, they are equal to from 66–67 per cent. of dextrose, and show a specific rotatory power of $[\alpha]_D = 150°$ to the right. The whole of the starch undergoes this change, except the teguments of the granules, amounting to about 4 parts in 1000. The change which barley undergoes during germination, and in malting, is of a similar character. The purity of diastase may be tested by mixing 0.05 part of it with 200 parts of paste containing 10 parts of starch; after standing, the resulting liquid should filter rapidly, and decolorize five times its volume of Fehling's solution. The diastases are now recognized as a class of enzymes and known specially as amylolytic or saccharifying ferments, as their special function is the transforming of starch into sugars. We include in this class *plant diastase* and *animal diastases* such as the *amylopsin* of the pancreas and the *ptyalin* of the saliva.

Besides the diastase a second soluble ferment is formed during the malting process, the so-called *peptase*, which in the mashing process changes the proteids of the malt into peptones and parapeptones, which give nutritive value to the beer obtained from malt. For a fuller account of the composition and functions of malt, see Sadtler's *Industrial Organic Chemistry*, 179 *et seq.*

3.—*Hulled barley* is merely the grain deprived of its husk, which, according to Einhoff, amounts to 18.75 parts in the hundred.

4.—*Barley meal* is formed by grinding the seeds, previously deprived of their husk. It has a grayish-white color, and contains, according to Fourcroy and Vauquelin, an oleaginous substance, sugar, starch, nitrogenous matter, acetic acid, calcium and magnesium phosphates, silica, and iron. It may be made into a coarse, heavy, hard bread, which in some countries is much used for food.

5.—*Pearl barley* (*Hordeum decorticatum*, Br. 1885) is the seed deprived of all its investments and afterwards rounded and polished in a mill. It is in small round or oval grains, having the remains of the longitudinal furrow of the seeds, and of a pearly whiteness. It is wholly destitute of hordein, and abounds in starch, with some gluten, sugar, and gum. This is the proper form of barley for medicinal use.

Barley is one of the mildest and least irritating of farinaceous substances, and forms, by decoction with water, a mucilaginous drink much employed from the time of Hippocrates to the present. Pearl barley is the form usually preferred for the preparation of the decoction, made by pouring four pints of boiling water on two troyounces of pearl barley and boiling away to two pints, and straining. Malt affords a liquor more demulcent and nutritious, and the decoction of malt may be prepared by boiling from two to four ounces in a quart of water, and straining. When hops are added, the decoction takes the name of *wort*, and acquires tonic properties, which render it useful in debility.

Houttuynia. *Houttuynia californica*, B. and H. (*Anemopsis californica*, Hook. et Arn.). *Yerba Mansa.*—The root of this piperaceous Californian plant is employed by the natives in *chronic malaria*, and also in *diarrhœa* and *dysentery*, and has been used with asserted good results in *gonorrhœa* and *rheumatism*. For elaborate histological study, see *D. C.*, May, 1897. *Dose* of the fluidextract, from fifteen to sixty minims (0.9–3.75 Cc.).

Huamanripa.—This is a Chilian drug, the plant growing on the slope of the Cordilleras at considerable heights. Lapater found it to be stimulating, emetic, sialagogue, and diaphoretic. (*West. Drug.*, 1886, 410.)

Hura. *Hura crepitans*, L. (*H. brasiliensis*, Willd.) *Assacou. Sablier*, Fr. *Sandbüchsenbaum*, G.—This is a Brazilian tree belonging to the family of Euphorbiaceæ. It is characterized by the tendency of its fruit when ripe to break with violence into several pieces, and thus scatter the seeds. It is an acrid emeto-cathartic; in large

doses acting as a violent poison. The fresh juice, the seeds, and a decoction of the bark all have these properties; an oil expressed from the seeds is actively purgative. The juice of *Hura crepitans*, which, according to J. J. Surie (*Nederl. Tijdscg. voor Pharm.*, 1900, 107), contains a volatile, colorless liquid, *hurin*, closely allied to cardol and is stated by Martius to be used to intoxicate fish, it has been employed to a considerable extent with alleged favorable results in the treatment of the *elephantiasis*, or *leprosy*, of Brazil. The juice is extremely acrid, producing on the skin, when applied to it, an erysipelatous redness and a pustular eruption; the natives are said to employ it in the preparation of a poison. A grain (0.065 Gm.) of the juice made into a pill, or twenty grains (1.3 Gm.) of the bark infused in a pint of water, is given every day, and gradually increased as the stomach and bowels will bear it. Every week an emetic preparation is administered, made by boiling half an ounce (15.5 Gm.) of the bark in a pint of water to half a pint, to which twelve drops of the juice are added. Every second or third day the patient takes a bath in a saturated infusion of the bark. (*J. P. C.*, xiv. 424.)

Hydracetin. *Pyrodine.*—The hydracetin of commerce is stated to be a varying compound, whose active principle is *acetylphenylhydrazin* ($C_6H_5.NH-NH.C_2H_3O$). It is soluble in alcohol and in water in proportion of 1 to 50. According to Guttmann (*Ph. Centralh.*, May 16, 1889, 311), hydracetin is a powerful antipyretic and antirheumatic remedy. It occurs as a white, odorless, almost tasteless crystalline powder, melting at from 128°–129° C. (262.4°–264.2° F.). It is stated that it cannot be continuously used without danger. Externally, hydracetin is used in place of chrysarobin in *psoriasis* and similar disorders, in an ointment of from 5 to 15 per cent. *Dose*, three-quarters of a grain (0.048 Gm.) two or three times a day.

Hydrangea. *Hydrangea arborescens*, L. *Common Hydrangea. Seven Barks.* (Fam. Saxifragaceæ.)—The root of our indigenous Hydrangea, which is the only part used, consists of a caudex, from which proceed numerous radicles, from the thickness of a quill to that of a finger or more. For use it should be cut into transverse pieces when fresh, and then dried. The taste is aromatic, pungent, and not unpleasant. Bondurant (*A. J. P.*, 1887, 122) has isolated a characteristic glucoside, *hydrangin*, crystallizing in stellate clusters, melting at 235° C. (455° F.), and subliming without decomposition. It is decomposed by dilute acids into a resin-like body and glucose. Its aqueous solution fluoresces strongly on addition of an alkali, resembling æsculin, but distinctly different in several particulars. Bondurant also obtained a fixed oil and a volatile oil, the latter containing sulphur. Two resins seemed also to be present, together with saponin and sugar. He found no tannin, however. Its decoction is said to have been used with great advantage among the Cherokee Indians, and subsequently by settlers, in *calculous diseases.* (See *N. J. Med. Rep.*, 1850, 1854, and 1885.) In overdoses it occasions vertigo, oppression of the chest, etc.

Hydrargyrol. $(C_6H_4.OH.SO_3)_2Hg$. *Mercury Paraphenolsulphonate.*—This salt occurs in brownish-red scales, having a gingerbread-like odor, neutral reaction, and sp. gr. 1.85. It dissolves in water and glycerin, with a ruby-red color. It is said to contain over 53 per cent. of quicksilver, and not to precipitate albumin. It has been proposed by Gautrelet as a substitute for corrosive sublimate in antiseptic surgery. A solution of 4 to 1000 is not irritant to the mucous membrane or skin, but very active as an antiseptic, sterilizing bouillons at once. When taken in large doses it is toxic, thirty and a half grammes of it having caused death; but, according to its introducer, as a poison it is seventy-five times less active than is corrosive sublimate.

Hydrocotyle. *Hydrocotyle asiatica*, L. *Centella asiatica* (L.), Urban, *H. repanda*, Pers. *Thick-leaved Pennywort. Indian Pennywort. Bevilacqua*, Fr. *Wassernabel*, G.—This is a small umbelliferous plant growing in Southern Africa and in India, where it has long been used as an alterative; it is apparently indigenous also in the Southern United States. Jules Lépine discovered in it a peculiar oleaginous substance, *vellarine*, having a strong odor recalling that of the plant, and a bitter, pungent, and persistent taste. (*J. P. C.*, 1885, 49.) It is said to be diuretic, and has been given in *fever* and *bowel complaints;* also in *syphilitic* and *scrofulous affections.* (*P. J.*, 1860.)

C. Daruty de Grandpré (*Nouv. Rem.*, April 8, 1888) finds that in small doses it is an energetic stimulant, and that in large doses it is narcotic, producing stupor, headache, and in some persons vertigo with a tendency to coma.

Hydrofluoric Acid. *Acidum Hydrofluoricum.* (See *Fluorides.*)

Hydrogen Sulphide. *Hydrosulphuric Acid. Sulphuretted Hydrogen.* H_2S.—A colorless gas of unpleasant odor, soluble in water, to which it imparts an acid reaction. 3.23 volumes of gas are absorbed by one volume of water at 15° C. (59° F.). Also soluble in alcohol. Has been liquefied at ordinary temperatures under a pressure of 17 atmospheres, or at ordinary pressures by a cold of —74° C. (—101.2° F.), and at —85° C. (—121° F.) becomes an ice-like solid.

The symptoms of poisoning by hydrogen sulphide vary with the amount taken. Its inhalation in a concentrated form is followed by giddiness, nausea, excessive weakness, and rapid or immediate loss of consciousness. The very diluted gas produces nausea, pain in the head, and great general weakness; followed, if sufficient be taken, by coma, or stupor with delirium, and in some cases by general convulsions. The blood becomes of a brownish-black color, and after death remains fluid. The general appearances at the autopsy are not to be distinguished from those produced by the absorption of carbon dioxide, but the diagnosis is readily made by the odor which pervades the whole corpse.

Bruère (*J. A. P.*, Oct. 1891) finds that bright red diluted blood under the influence of the sulphide becomes of an olive-green color, and that out of the oxyhæmoglobin a new compound is formed, *sulphmethæmoglobin* or *sulphæmoglobin*, probably by a union of hydrogen sulphide with hæmatin. It has been shown by Paul Binet (*Rev. Méd. de la Suisse Rom.*, xvi. 1896) that this sulpho-methæmoglobin is produced in the blood during life, especially when the gas is in very large amount. It is worthy of remark that Bruère found *hydrogen selenide* and *hydrogen telluride* to act the same as the hydrogen sulphide.

In 1886 Bergeon proposed to the French Academy a method of treating *tuberculosis* by injecting hydrogen sulphide, diluted with pure carbon dioxide, into the large intestine, the method being founded upon the supposed power of hydro-

gen sulphide to destroy the tubercule bacillus. The method of Bergeon had an extraordinary run, and then fell rapidly into desuetude, but there can be no doubt that the hydrogen sulphide has a distinct influence upon mucous membrane. It is a useful remedy in *pulmonary catarrh*, chronic or acute, as well as in *chronic rheumatism* and in *gout*. It is for this reason that sulphur springs are so frequently resorted to. Water saturated with hydrogen sulphide and carbon dioxide is usually not objected to by patients after the first day or two of its taking, and does not disagree with the stomach. *Dose*, from two to four fluidounces (60 to 120 Cc.) three or four times a day.

Hydronal. *Viferral.*—This is produced by the action of pyridine upon chloral. It is a white powder having a disagreeable taste, soluble in cold water but decomposed by hot water. Used as a hypnotic. *Dose*, fifteen to thirty grains (1.0–2.0 Gm.).

Hydroquinone. *Hydrochinone.* $C_6H_4(OH)_2$. This is one of the three isomeric diatomic phenols, being *paradioxybenzene*. It was first prepared by the dry distillation of quinic acid, but is now made from quinone by reduction with sulphurous acid, the quinone being made by oxidizing aniline with dichromate mixture ($K_2Cr_2O_7 + H_2SO_4$). It is in shining white leaflets melting at 169° C. (336.2° F.), soluble in water, alcohol, and ether, and is used largely in photography as a developing agent. In 1877 Brieger found that hydroquinone produces in man giddiness, tinnitus aurium, and a lessening of the force and frequency of the pulse. The experiments of P. J. Martin have shown that in the frog hydroquinone causes violent convulsions, followed by paralysis and death through failure of the respiration, due to an action upon the spinal cord. In the mammal small doses produce a rise in the arterial pressure, followed by a depression; both these phenomena are apparently the result of an action of the drug upon the arterial vasomotor system, although it is probable, from the experiments of Beyer, that the toxic dose of hydroquinone paralyzes both the heart muscles and the muscle fibres in the coat of the arterioles. The bodily temperature is lowered by large doses of hydroquinone, and, according to the experiments of Martin, this is chiefly due to an increase of heat dissipation, and is, therefore, probably the result of a vasomotor paralysis.

Hydroquinone is also a distinct antiseptic, but, according to Antaeff, when it is mixed with a solution of urea the latter principle undergoes rapid decomposition. The influence of hydroquinone upon the human being has been especially studied by Silvestrini and Picchini, and by Gaetano Traversa. (*France Méd.*, May, 1890.) According to these authorities, it is a prompt antipyretic, producing depression of temperature in *fever*, the reduction beginning in half an hour, and reaching its maximum in an hour and a half. Usually the antipyretic action is not accompanied by disagreeable symptoms, although after the larger dose excessive sweating, chills, and some nervous disturbances have been noted. It was found in the experiments of Martin that the fall of temperature is due to an increase of heat dissipation; this is confirmed by the observation of Traversa, that the peripheral temperature may rise as much as two degrees, although the internal temperature is depressed. The excretion of urea is said to be diminished. Hydroquinone has been used with asserted good results in *infectious fevers*, and in *acute articular rheumatism;* also as a gastro-intestinal disinfectant. According to Forster, a 1 per cent. solution will arrest putrefaction and alcoholic fermentation. *Dose*, three to eleven grains (0.2–0.71 Gm.).

Hydroxylamine Hydrochloride. $NH_2.OH.HCl$. The free base is known only in solution, and is unstable. The crystalline hydrochloride forms colorless hygroscopic crystals similar to ammonium chloride in appearance, soluble in an equal weight of water, also in glycerin and in fifteen parts of alcohol. In 1888 Binz found that this substance caused in the lower animals stupor, convulsions, and a destruction of the red blood corpuscles, of such character that their hæmoglobin was reduced to methæmoglobin or even to hæmatin. In 1889 L. Lewin of Berlin, further investigated the subject, confirming in part the results obtained by Binz, and showing that the poison acts both upon the dead and living blood, and that its action upon the corpuscle is probably due to its decomposition, and the liberation of nitric or nitrous acid. In 1889 John Fabry (*Arch. de Derm. et de Syph.*, tome ii. 1889) found that a 10 per cent. solution is exceedingly irritating to most human skins, producing intense redness, violent burning, sweating, and not rarely vesication. Some skins will not bear a 1 per cent. solution, so that it is not safe in any new case to use a solution stronger than this. The substance was employed by Fabry, and since then by other clinicians, as an agent to replace pyrogallol and chrysarobin in the treatment of skin diseases, while it would offer the advantage of being colorless, and not staining the skin, linen, etc. It has been used in *chronic psoriasis*, in *scabies*, in *lupus*, *herpes tonsurans*, *parasitic sycosis*, etc., with asserted excellent results, though Groddeck condemns it as being too irritating and liable to produce constitutional symptoms, and inferior in its healing powers to chrysarobin and pyrogallol. The solution of hydroxylamine hydrochloride may be prepared with alcohol or water, but should always be rubbed up with prepared chalk to neutralize any excess of acid.

Hydrozone.—This name is applied commercially to an aqueous solution of hydrogen dioxide, said to be three times the strength of the official solution. It is used for the same purpose as solution of hydrogen dioxide.

Hygrophila. *Br. Add.*—The dried herb including the root of *Hygrophila spinosa*, T. And. (*Asteracantha longifolia*, Nees). *Br. Add.* (Fam. Acanthaceæ.) This species of Hygrophila has long been used in India as a diuretic in the treatment of *dropsies*, especially where there is hepatic obstruction, and also as a popular *aphrodisiac*. In Southern India the root is an article of commerce, but in Bombay the seeds are commonly employed. By means of petroleum benzin C. H. Warden obtained from the roots a crystalline principle (*Phg. Ind.*, vol. 3). The *decoction of hygrophila* (*Decoctum Hygrophilæ*, Br. Add.), two ounces of the root with three pints of water boiled to a pint, is given in *doses* of one-half to two fluidounces (15 to 60 Cc.).

Hypericum. *Hypericum perforatum*, L. *St. John's Wort. Millepertuis, Casse-diable*, Fr. *Johanniskraut, Harthen*, G. (Fam. Hypericaceæ.)—A perennial herb, abundant both in Europe and in this country. It has a peculiar balsamic odor, which is rendered more sensible by rubbing or bruising the plant. Its taste is bitter, resinous, and somewhat astringent. It imparts a yellow

color to cold water, and reddens alcohol and the fixed oils. Its chief constituents are volatile oil, a resinous substance, tannin, and coloring matter. This latter, known as *hypericum red*, is a reddish resin, smelling like the flowers, soluble in alcohol, ether, ethereal and hot fatty oils, coloring the solution from wine red to blood red. It is soluble in alkalies with green color, and gives yellow precipitates with the alkaline earths and metallic salts. As a medicine it was in high repute among the ancients and the earlier modern physicians. Among the complaints for which it was used were *hysteria, mania, intermittent fever, dysentery, gravel, hemorrhages, pectoral complaints, worms,* and *jaundice;* but it was, perhaps, most highly esteemed as a remedy in *wounds* and *bruises,* for which it was employed both internally and externally. It probably has somewhat analogous power to the turpentines. It formerly enjoyed great reputation for the cure of demoniacs, and the superstition still lingers among the vulgar in some countries. At present the plant is scarcely used except as a domestic remedy. The summits were given in the *dose* of two drachms or more. A preparation, *oleum hyperici* or *red oil,* made by macerating four ounces of the tops in a pint of olive oil, is still used in many families for bruises.

Hypnal.—*Chloralhydrate antipyrine,* $C_{11}H_{12}N_2O.CCl_3.CH.(OH)_2$, results by rubbing together 188 parts of antipyrine and 165.5 parts of hydrated chloral and crystallizing out the product. It forms colorless crystals melting at 67° C. (152.6° F.).

Hypnone.—*Phenyl-methyl-ketone,* $C_6H_5.COCH_3$, is obtained by the dry distillation of a mixture of calcium acetate and calcium benzoate; colorless or yellow liquid of oily consistency, boiling at 198° C. (388.4° F.).

Hypnopyrin.—This substance, which was brought forward by Bolognesi and Charpentier (*R. T.,* July, 1902), is said to be a derivative of quinine, although some French writers state that it is simply a mixture of undetermined quinine salts. It occurs in white, bitter needles, effervescing and turning yellow in the air, soluble in eight times its weight of cold water and very soluble in hot water and alcohol. In dose of thirty grains it is said to produce cinchonism. It is alleged that it is a rapid, efficient analgesic, and that as an antipyretic it produces a gradual fall of temperature without sweating; further antirheumatic properties are attributed to it. It is said to be harmless. *Dose,* four to eight grains (0.26–0.5 Gm.), given hypodermically.

Hyraceum.—The dried excrement of *Hyrax capensis,* of South Africa. It is rather hard, tenacious, of a blackish-brown color, and in taste and odor not unlike castor. Schrader has found in it stearin and gum-resin soluble in absolute alcohol. (See *A. J. P.,* 1879, 363.) See Léon Soubeiran (*J. P. C.,* xxix. 378). E. D. Cope states that a similar substance is found in fissures of the rocks in New Mexico, and is probably a fecal and renal deposit of the wild rat, *Neotoma.*

Hyrgol. *Hydrargyrum Colloidale. Colloidal Mercury. Colloïdales Quecksilber,* G.—In dull black, porous pieces forming a dark, neutral solution with water, which is not corrosive. It turns silver-gray when heated or upon the addition of alkalies and certain acids. Globules of mercury form when it is rubbed alone, in a mortar, and it should first be mixed with water if it is desired to make it into an ointment. It is said to contain from 70 to 80 per cent. of mercury.

Hyssopus. *Hyssopus officinalis,* L. *Hyssop. Hysope,* Fr. *Isop, Ysop,* G.—This is a European labiate plant, whose flowering summits and leaves have been used in medicine. They have an agreeable aromatic odor, and a warm, pungent, bitterish taste, due to the presence of a volatile oil. This oil is colorless or greenish yellow, of peculiar odor, sharp camphor-like taste, and neutral reaction. It has a sp. gr. from 0.88 to 0.98, distils between 142° and 162° C. (287.6°–323.6° F.), and is soluble in its own bulk of alcohol of 0.85 sp. gr. Hyssop is a warm, gently stimulant aromatic, applicable to the same cases as the other labiate plants.

Iberis. *Iberis amara,* L. *Bitter Candytuft.*—A small European herbaceous cruciferous plant. The leaves, stem, and root are said to possess medicinal properties, but the seeds are most efficacious. The plant appears to have been employed by the ancients in *rheumatism, gout,* and other diseases. In large doses it is said to produce giddiness, nausea, and diarrhœa, and to be useful in *cardiac hypertrophy, asthma,* and *bronchitis,* in *doses* of from one to three grains (0.065–0.2 Gm.), of the seed. (*Prov. M. S. J.*)

Ibogaine.—From a plant known as *iboga,* indigenous to the region of the Congo, Dybowski and Landrin have isolated an actively toxic alkaloid which is said to cause hallucination, paresis, and death by the paralysis of the respiratory muscles. (*S. M.,* Dec. 1901.)

Ichthoform.—This is said to be obtained by the action of formaldehyde upon the products of sulphonization of ichthyol hydrocarbons, and to be superior to iodoform as an antiseptic. Externally it has been used by Unna, and in skin diseases is superior to the ordinary formaldehyde preparations. He asserts that it softens rather than hardens the skin. It has also been employed as an intestinal antiseptic in *doses* of fifteen to thirty grains (1–2 Gm.) three to four times a day.

Ichthyocolla. *U. S.* 1890. *Isinglass. Colla Piscium,* P. G. *Fish-Glue. Ichthyocolle, Colle de Poisson,* Fr. *Hausenblase, Fischleim,* G. *Colla di Pesce,* It. *Cola de Pescado,* Sp.—Isinglass is a gelatinous substance prepared from the sounds or swimming bladders of many species of fish in various parts of the world, but is chiefly procured from the Volga and other streams of Southern Russia, in which are taken annually enormous numbers of the *Acipenser Huso,* or *beluga,* the *Acipenser ruthenus,* or *sterlet,* the *Acipenser Sturio,* or common *sturgeon,* and the *Acipenser stellatus* or *starred sturgeon.* The air bags, having been split open, cleansed, and dried, are known in commerce by the name of *staple isinglass,* which is divided into the *long* and the *short staple.* Sometimes the membranes are dried in a flat state, or simply folded, and then receive the name of *leaf* or *book isinglass.* The scraps or fragments of these varieties, with various other parts of the fish, are boiled in water, which dissolves the gelatin, and upon evaporation leaves it in a solid state. This is called *cake isinglass,* from the shape which it is made to assume. It is sometimes, however, in globular masses. Of these varieties, the long staple and the finest book isinglass are the best. One hundred grains of this isinglass dissolve in ten ounces of water, forming a tremulous jelly when cold, and yield but two grains of an insoluble residue. That in cakes is brownish, of an unpleasant odor, and employed only in the arts. Inferior kinds,

with the same commercial titles, are said to be prepared from the peritoneum and intestines of the fish. An inferior Russian product, known in English commerce by the name of *Samovey isinglass*, is procured, according to Pereira, from the *Silurius glanis*. It comes, like the better kind, in the shape of leaf, book, and the short staple. Isinglass, little inferior to the Russian, is made in Iceland from the sounds of the cod and ling. It is said also to be prepared by the fishermen of Newfoundland. We receive from Brazil the air-bladders of a large fish, prepared by drying them in their distended state. They are oblong, tapering, and pointed at one end, bifid with the remains of their pneumatic duct at the other, and of a firm consistence. The *Brazilian isinglass* is inferior to the Russian. Considerable quantities of isinglass are manufactured in New York and New England from the sounds of the *hake* (*Gadus merluccius*) and of the weak-fish (*Otolithus regalis*). This *American isinglass* is in thin ribbons several feet in length, and from an inch and a half to two inches in width. One hundred grains dissolve almost entirely in water, leaving but two grains of insoluble membrane, and form a jelly when cold with eight ounces of water; it retains a fishy taste and odor, which render it unfit for culinary or medicinal purposes. The sounds are dried whole, or merely split open, and vary much in size and texture, weighing from a drachm to an ounce. An article called *refined* or *transparent isinglass* is made by dissolving the New England isinglass in hot water, and spreading the solution to dry on oiled muslin. It is in very thin, transparent plates, and is an excellent glue, but retains a strong fishy odor. In India and China the swimming bladders of various species of fish furnish the so-called Indian and Chinese isinglass. At the present writing, 1905, all forms of isinglass are comparatively little used, their place being supplied by various brands of gelatin produced from fresh bones. (See *Gelatinum*, p. 576.)

In its purest form it is "in separate sheets, sometimes rolled, of a horny or pearly appearance; whitish or yellowish, semitransparent, iridescent, inodorous, insipid; almost entirely soluble in boiling water and in boiling diluted alcohol. A solution of Isinglass in 24 parts of boiling water forms, on cooling, a transparent jelly." *U. S.* 1890. The inferior kinds are yellowish and more opaque. In cold water it softens, swells up, and becomes opalescent. Boiling water entirely dissolves it, with the exception of a minute proportion of impurities, amounting, according to Hatchet, to less than 2 per cent. The solution on cooling assumes the form of a jelly, which consists of pure gelatin and water. Isinglass is in fact the purest form of *gelatin* with which we are acquainted, and may be used whenever this principle is required as a test. It is insoluble in alcohol, but is dissolved readily by most of the diluted acids, and by alkaline solutions. It has a strong affinity for tannin, with which it forms an insoluble compound. Boiled with sulphuric acid, it is converted into a peculiar substance, called *glycocoll* or *sugar of gelatin*, which is in reality *amido-acetic acid*, $C_2H_3(NH_2)O_2$. Its aqueous solution speedily putrefies. (See *Gelatinum*.) An ingenious adulteration has been practised by rolling a layer of gelatin between two layers of genuine isinglass. This may be detected by the disagreeable odor and taste of the adulterated drug, and the effects of water upon it. Genuine isinglass, cut into shreds and treated with water, becomes opalescent and more opaque than before; while the shreds, though they soften and swell, remain unbroken, and when examined by the microscope are seen to be decidedly fibrous. Gelatin, on the contrary, when similarly treated, becomes more transparent than before; the shreds are disintegrated, and the structure appears amorphous under the microscope. In the adulterated article both these characters are presented in layers more or less distinct. (*P. J.*, ix. 505.) Moreover, Redwood and Letheby observed that the ash of true isinglass does not exceed 0.9 per cent., while glue contains from 2 to 4 per cent. of ash. An adulterated isinglass would therefore yield more ash than the normal. A *false isinglass* has been imported into England from Para, in Brazil, consisting of the dried ovary of a large fish. It has somewhat the form of a bunch of grapes, consisting of ovoid or roundish masses attached by a footstalk to a central axis. It is not gelatinous, and is unfit for the purposes to which isinglass is applied. (*A. J. P.*, xxv. 144.) For table showing value of different kinds of European isinglass, see *P. J.*, 1884, p. 900.

Medicinal Properties and Uses.—Isinglass has no peculiar medicinal properties. It may be given internally, in the form of jelly, as a slightly nutritious article of diet, but it has no advantage over the jelly made from calves' feet. Three drachms impart sufficient consistency to a pint of water. It is employed for clarifying liquors, and imparting lustre to various woven fabrics. Added in small quantities to vegetable jellies, it gives them a tremulous appearance, which they lack when unmixed. As a test of tannin it is strongly recommended by Wm. T. Wenzell, who uses it instead of hide powder in the estimation of tannin. (*A. J. P.*, 1894, 447.)

Isinglass plaster or *court plaster* (*Emplastrum Ichthyocollæ, U. S.* 1890) was very properly dropped in the Eighth Decennial revision. The process of 1890 is as follows: "Isinglass, *ten grammes* [or 154 grains]; Alcohol, *forty grammes* [or 1 ounce av., 180 grains]; Glycerin, *one gramme* [or 15½ grains]; Water, Tincture of Benzoin, each, *a sufficient quantity*. Dissolve the Isinglass in a sufficient quantity of hot Water to make the solution weigh *one hundred and twenty grammes* [or 4 ounces av., 102 grains]. Spread one-half of this, in successive layers, upon taffeta (stretched on a frame), by means of a brush, waiting after each application until the layer is dry. Mix the second half of the Isinglass solution with the Alcohol and Glycerin, and apply it in the same manner. Then reverse the taffeta, coat it on the back with Tincture of Benzoin, and allow it to become perfectly dry. Cut the plaster in pieces of suitable length, and preserve them in well-closed vessels. The above-directed quantities are sufficient to cover a piece of taffeta *thirty-eight centimeters* [or about 15 inches] square." *U. S.* 1890.

Ichthyol. *Ammonium Ichthyol-Sulphonate.* $C_{28}H_{36}S_3O_6(NH_4)_2$.—The ichthyol preparations are obtained by the dry distillation of the bituminous shale of the Tyrol. The ichthyol salts are the salts of *ichthyol-sulphonic acid*, $C_{28}H_{36}S_3O_6H_2$, which is obtained by the treatment of the raw ichthyol distillate with sulphuric acid, and subsequently neutralizing with sodium or ammonium carbonate. Under the name *ichthyol* is ordinarily understood the *ammonium ichthyol-sulphonate*, $C_{28}H_{36}S_3O_6(NH_4)_2$. This is a reddish-brown

syrupy liquid, of a bituminous odor and taste, puffing up considerably and carbonizing when heated, and upon continued incineration volatilizing without residue. Water, or a mixture of equal volumes of alcohol and ether, dissolves it to form a clear red-brown liquid of a faintly acid reaction. Pure alcohol or ether dissolves it only partially; petroleum benzin takes up only a small quantity. Upon the addition of hydrochloric acid to the aqueous solution a dark resinous mass is precipitated, which when separated is soluble in ether and in water, but is again thrown out from the latter solution by hydrochloric acid or sodium chloride. Treated with potassium hydroxide solution, ichthyol develops an odor of ammonia, and the mixture dried and burnt yields an hepatic coal, which with hydrochloric acid gives off hydrogen sulphide. The ammonium ichthyolate loses upon drying in a water bath at least half its weight. The *sodium ichthyol* is a dark tar-like substance of an alkaline reaction, perfectly soluble in water. Both preparations combine with fat and vaseline in all proportions and are very rich in sulphur, containing, it is said, 10 per cent. According to Baumann, they have a great affinity for oxygen, and are powerful reducing agents. The ichthyol sulphonates of lithium, zinc, and mercury have also been prepared.

Odorless ichthyol has been made by treating ichthyol with hydrogen dioxide. It is questionable, however, whether the removal of the odorous constituents does not impair the therapeutic activity of the ichthyol.

Medicinal Properties.—So far as is known, ichthyol has little or no general action, although it has been used to some extent internally in *rheumatism* and *tuberculosis* and by Unna in *lepra*. As an external application it is much used. Applied in the pure form to the sound skin, it produces irritation and burning. Peculiar alterative properties are attributed to it, and also the power of penetrating through the skin, so that it has been used with alleged extraordinary success as a local alterative and anodyne discutient in *chronic eczema, chronic urticaria, acne, intertrigo, lupus,* and *lepra* and various *ulcerations of the skin,* in *lymphatic enlargements,* for the softening and dispersion of *lipomas,* in *burns, frost bites, sprains* and *contusions,* and in almost every form of *subacute* or *chronic gout* or *rheumatism*. When the skin is not destroyed or greatly inflamed the application should be made of the full strength or as a 50 per cent. ointment. In the various skin diseases or ulcerations the strength of the lotion or ointment may vary from 1 to 50 per cent. For internal administration, H. Wyatt (*P. J.*, xxi. 1891, 929) recommends the evaporation of the ichthyol on a water bath and the formation of the residue into pills. He also made a good combination by adding 15 grains of magnesia (made into a milk with 90 minims of water) to 120 grains of ichthyol and evaporating over a water bath to a pilular consistence. Latteux has found ichthyol to be an active germicide. (*Journ. de Méd.*, Paris, April, 1892.) *Dose,* five to ten minims (0.3–0.6 Cc.).

Ichthyol Albuminate. *Ichthalbin.*—This is a greenish-brown powder, insoluble in water and acid solutions, soluble in alkaline solutions, odorless, almost tasteless. It is prepared by precipitating *egg albumin* with ichthyol and prolonged washing of the precipitate until the ichthyol odor and taste are removed. It is stated to contain about 75 per cent. of ichthyol. It is not toxic, and when given internally, even in large doses, produces little or no irritation of the gastro-intestinal tract. It is affirmed that as an internal remedy it is practically ichthyol, and as such is useful in various conditions connected with wide-spread vascular dilatation, in *syphilis,* in *struma,* and in other states of lowered nutrition. *Dose,* from fifteen to thirty grains (1.0–2.0 Gm.) three times a day, best taken in capsules; or in the case of young children it should be mixed with chocolate.

Igazol.—This substance, which is said to be a combination of formaldehyde or tri-oxy-methylene (paraformaldehyde) and iodine, has been employed to a considerable extent in the treatment of *tuberculosis.* According to the method of Preisach the fumes of four grammes are daily liberated in a small room containing patients; the results are some diminution of cough and expectoration. (*Ungar. med. Presse,* vol. vi. 490.)

Ignatia. *U. S.* 1880. *Bean of Saint Ignatius. Semen Ignatiæ, Faba Ignatii, Faba Sancti Ignatii,* Lat. *Fève igasurique, Fève de Saint Ignace,* Fr. *Ignatiusbohne, Bittere Fiebernuss, Ignazbohnen,* G. *Fava di Santo Ignazio,* It. *Haba de Santo Ignacio,* Sp.—*Strychnos Ignatia,* Berg., *Ignatia amara,* L. f., is a tree of the fam. Loganiaceæ, of middling size, with numerous long, cylindrical, glabrous, vine-like branches, which bear opposite, nearly sessile, oval, pointed, entire, and very smooth leaves. The flowers are long, nodding, white, tubular, fragrant, and arranged in short, axillary racemes. The fruit is of the size and shape of a pear, with a smooth, whitish, ligneous rind, enclosing about twenty seeds, embedded in a dry medullary matter, and lying one upon the other. The seeds are the part used. The tree is a native of the Philippine Islands, where the seeds were highly esteemed as a medicine, and, having attracted the attention of the Jesuits, were honored with the name of their founder. Flückiger and Arthur Meyer have found that the seed has a close structural analogy to nux vomica. (*P. J.*, 1881, 1.)

The seeds are about an inch long, rather less in breadth, still less in thickness, convex on one side, obscurely angular, with two, three, or four faces on the other, and marked at one end with a small depression indicating their point of attachment. They are externally of a pale brown color, apparently smooth, but covered in fact with a short down or efflorescence, which may be removed by scraping them with a knife. They are somewhat translucent and their substance is very hard and horny. They have no odor, but an excessively bitter taste. They were officially described as "about an inch and a fifth (3 Cm.) long, oblong or ovate, irregularly angular, dull brownish or blackish, very hard, horny; fracture granular, irregular; the albumen somewhat translucent, enclosing an irregular cavity with an oblong embryo; inodorous; very bitter." *U. S.* 1880. To Pelletier and Caventou they yielded the same constituents as nux vomica, and, among them, 1.2 per cent. of strychnine and 0.5 per cent. of brucine. J. M. Caldwell found strychnine and brucine, combined with igasuric acid, a volatile principle, extractive, gum, resin, coloring matter, fixed oil, and bassorin, but no starch or albumen. (*A. J. P.*, 1857, 298.) Flückiger, on the other hand, found 1.78 per cent. of nitrogen, corresponding to about 10 per cent. of albuminoid matter. (*Pharmacographia,* 443.) In consequence of the relatively

larger proportion of strychnine which they yield, they have been used instead of nux vomica, in the preparation of that alkaloid, when their cost would permit of the substitution, but the nux vomica bean has been imported in such large quantities, and is now so low in price, that the ignatia bean is rarely used. The medicinal uses are those of nux vomica.

ABSTRACTUM IGNATIÆ. *U. S.* 1880. *Abstract of Ignatia.*—"Ignatia, in No. 60 powder, *two hundred parts* [or four ounces av.]; Sugar of Milk, recently dried and in fine powder, Alcohol, Water, each, *a sufficient quantity*, to make *one hundred parts* [or two ounces av.]. Mix Alcohol and Water in the proportion of *eight parts* [or six fluidounces] of Alcohol to *one part* [or five fluidrachms] of Water, and, having moistened the Ignatia with *one hundred parts* [or two fluidounces] of the menstruum, pack firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Ignatia is exhausted. Reserve the first *one hundred and seventy parts* [or three and one-half fluidounces] of the percolate, distil off the alcohol from the remainder, and mix the residue with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or one ounce av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or two ounces av.], reduce it to a fine, uniform powder. Preserve the powder in a well-stopped bottle." The yield of extract is usually about 10 per cent. The *dose* of abstract is from one-half to one and a half grains (0.032–0.096 Gm.).

A tincture of ignatia equivalent to the *U. S.* 1880 preparation may be made by dissolving sixty grains of dry alcoholic extract of ignatia in a mixture of fourteen fluidounces of alcohol and one and a half fluidounces of water. *Dose*, from five to fifteen minims (0.3–0.9 Cc.).

Ilex. *Holly. Houx*, Fr. *Stechpalme, Christdorn*, G.—Several species of Ilex (Fam. Ilicaceæ) are employed in different parts of the world. The *I. aquifolium*, L., or *common European Holly*, is usually a shrub, but in some places attains the magnitude of a middling-sized tree. The viscid substance called *bird lime* is prepared from the inner bark. The leaves, which are of a bitter, somewhat austere taste, were formerly much esteemed as a diaphoretic, and in the form of infusion were employed in *catarrh, pleurisy, small-pox, gout*, etc. At one time they enjoyed a brief reputation in France as a cure for *intermittents*. They were used in powder, in the *dose* of a drachm two hours before the paroxysm, and this dose was sometimes repeated frequently during the apyrexia. Their febrifuge virtues are said to depend on a bitter principle, *ilicin*. Labourdais obtained this principle by boiling a filtered decoction of holly leaves with animal charcoal, allowing the charcoal to subside, washing it, then treating it with alcohol, filtering off the alcoholic solution, and evaporating it to a syrupy consistence. The liquid thus obtained was very bitter, and, on being allowed to evaporate spontaneously, yielded an amorphous substance, having the appearance of gelatin, which was the principle in question. (See *A. J. P.*, xxi. 89.) A yellow coloring substance called *ilexanthin*, and a peculiar acid called *ilicic acid*, have been obtained by F. Moldenhauer. Ilexanthin is obtained in the following manner. The leaves are exhausted with alcohol, the alcohol is distilled off, and the residue set aside for several days. A sediment forms, which is separated from the mother liquor, treated with ether to remove the chlorophyll, and then purified by repeated solution in alcohol and crystallization. The composition of ilexanthin is $C_{17}H_{22}O_{11}$. It crystallizes in yellow needles, which change color at 185° C. (365° F.), melt at 198° C. (388° F.), and at 214° C. (417° F.) boil with decomposition, and are not sublimable. It is insoluble in ether, but soluble in alcohol. In cold water it is almost insoluble; but hot water dissolves it freely, and deposits it in crystals on cooling. (*Chem. Cb.*, 1857, 766.) The *berries* are about the size of a pea, red and bitter, and are said to be purgative, emetic, and diuretic. Ten or twelve of them will usually act on the bowels, and sometimes excite vomiting. Their expressed juice has been used in *jaundice*.

Ilex opaca, Soland., or *American holly*, is a middling-sized evergreen tree, growing throughout the Atlantic section of the United States, and especially abundant in New Jersey. It is so similar to the European plant that it has been by some writers considered as the same species. The berries, examined by D. P. Pancoast, were found to contain tannin, pectin, two crystallizable organic principles, and salts of potassium, calcium, and magnesium. One of the crystallizable principles was inodorous and tasteless, the other inodorous but intensely bitter. The latter was obtained by a treatment similar to that of Labourdais, above described; but, after the evaporation of the tincture to a syrupy consistence the process was continued by adding potassium carbonate and afterwards ether, and agitating briskly. The ethereal solution, rising to the surface on repose, was separated, and allowed to evaporate spontaneously. Crystals of the bitter principle were deposited. This is probably pure *ilicin*. (*A. J. P.*, xxviii. 314.) Walter A. Smith (*A. J. P.*, 1887, 1668) obtained a resin soluble in alcohol by the ether extraction, and in the portion of this soluble in water he obtained evidences of a glucoside. This species is said to possess the same medicinal properties as *I. aquifolium*, L.

Ilex Paraguensis, A. St.-Hil., the *I. Maté* of St.-Hilaire, yields the celebrated *Paraguay tea*, so extensively consumed as a beverage in the interior of South America. It is a small tree or shrub growing wild along the streams in Paraguay, and also cultivated for the sake of its leaves, which are the part used. These are stripped from each plant every two or three years. The period of their collection extends from December to August, sometimes beginning earlier but never continuing later. Companies are formed who penetrate far into the forest at a distance from the settlements, and devote a long time to the collection and preparation of the leaves. These are first dried by exposure to heat, and are then reduced to powder more or less fine, which is kept for several months protected from moisture, and then packed in sacks and delivered to commerce. (A. Demersay, *Ann. Thér.*, 1868, 72; see also *Pharm. Rec.*, May, 1891.) They have a balsamic odor and bitter taste, and

are usually at first disagreeable to the palate. They have a pleasant and corroborant effect upon the stomach, but, when largely taken, cause purging and vomiting. They are used in the form of infusion, which is prepared from the entire leaves as we prepare tea; or, under the name of *cha maté*, a fine powder is put in a cup of hot water by the drinker, and after a moment's stirring, the fluid is sucked up by means of a tube expanded below, and pierced with fine holes, so as to strain out the powder. They contain, besides other substances, a peculiar tannin and the alkaloid caffeine in variable amount. In the analysis of D. A. Strauch, the leaves yielded 0.450 of theine, 20.880 of caffetannic acid, 2.830 of gum, 5.902 of resin, chlorophyll, and wax, 1.200 of starch, 9.361 of protein compounds, 22.148 of cellulose, 8.640 of apotheme, 3.896 of salts, 8.100 of water, with a trace of volatile oil, and some sand and extractive. (*A. J. P.*, 1868, 314.) Some fresh leaves of *Ilex Paraguensis* grown in the Cambridge Botanical Gardens were found by A. H. Allen, after drying at 100° C. (212° F.), to contain: insoluble matter, 57.94 per cent.; tannin, by lead acetate method, 15.62; tannin, by cupric acetate method, 15.66; caffeine, 1.13; total ash, 6.14; soluble ash, 3.56. (*Com. Org. Anal.*, 2d ed., iii., PART II, 527.) Some elaborate proximate analyses of maté are also published by Theodore Peckolt. (*P. J.* (3), xiv. 121.) The consumption of *maté*, or *yerba*, in South America is enormous. Although largely produced in the Argentine Republic, fourteen thousand tons of the leaves were in 1880 imported into that country from Brazil and Paraguay, and six thousand tons into the republic of Uruguay. For an interesting account of the method of preparation, and an elaborate analysis, see *P. J.*, vol. xvi. 1017.

The *Ilex vomitoria*, Soland. (*I. Cassine*, Walt., not L.), is a handsome evergreen shrub, growing in our Southern States, and especially abundant along the southern coast of Florida. Analysis of its leaves by Venable (*A. J. P.*, 1885, 390) gave 7.39 per cent. of tannic acid and 0.27 per cent. of caffeine. It is the *cassena* of the Indians, who formerly employed a decoction made from the toasted leaves, called *black drink*, both as a medicine and as a drink of etiquette at their councils. It acts as an emetic. The leaves of the *Ilex Cassine*, L. (*I. Dahoon*, Walt.), have similar properties, and are also said to have entered into the composition of the black drink. The leaves of the *I. vomitoria*, Soland., known as *Yaupon* by the Indians, yielded to H. M. Smith 0.011 per cent. of volatile oil and 0.122 per cent. of caffeine. (*A. J. P.*, xliv. 217.)

Illicium. *U. S. Star-Anise.*—"The fruit of *Illicium verum* Hooker filius (nat. ord. *Magnoliaceæ*)." *U. S.* 1890. Of the genus Illicium, twelve species are recognized, of which two are found on the Atlantic coast of Southern North America, two in Hindostan, and three in China and Japan. Many of the species are possessed of aromatic properties. *I. floridanum*, Ell., *poison bay, sweet laurel*, a small evergreen tree or shrub with oblong-lanceolate, acuminate leaves, which grows westward from Florida along the coast bounding the Gulf of Mexico, has its bark, leaves, and probably also seed vessels endowed with a spicy odor and taste, analogous to those of anise. Another species, *I. parviflorum*, Vent. (*I. anisatum*, Bartr., not L.), a shrub found by Michaux in the hilly regions of Georgia and Carolina, has a flavor closely resembling that of sassafras root. A decoction of the seeds is said to produce violent gastro-intestinal irritation, followed by motor and sensory paralysis, with convulsions and death if the dose has been sufficient. E. Barral (*Revue Gén. de Clin.*, Oct. 1889) states that he has obtained a poisonous glucoside from the kernel. H. C. C. Maisch (*A. J. P.*, 1885, 280) obtained from the leaves a crystalline alkaloid to which the bitter taste is due, tannin, and a resin. In the root bark and capsules he found volatile oil and a crystalline principle, melting at 100° C., insoluble in alcohol and ether, but soluble in chloroform, and neutral to test paper. *Illicium religiosum*, Siebold (*I. anisatum*, L.), the sacred anise tree of Japan, is a small tree, twenty-five or thirty feet high, bearing small yellow and white flowers. As was pointed out by Piry in 1878, and confirmed by Bretschneider, star-anise is chiefly produced in the extreme southeast portion of China, in the provinces of Kwang-si and Kwang-tung, especially in the mountainous region between the Tso-kiang and the Yu-kiang, and also in Annam, and finds exit principally through the port of Pakhoi. Although Bentley and Trimen give *I. anisatum*, L., as the botanical source of star-anise, yet the assertion of Bretschneider that the botanical source of the plant is unknown, led to seeds being sent from the Hong-Kong Botanical Gardens to Kew, and a successful cultivation resulted in the description by Hooker of a new species of *Illicium*, under the name of *I. verum*. (*Bot. Mag.*, t. 7005, July, 1888.) The leading features in the plant appear to be the solitary axillary globular flowers, which do not expand fully, the segments remaining convex, the inner segments being red, and the ten stamens, in which the filament forms with the connective an ovoid body. The peduncles are curved and barely half an inch in length.

Star-anise was examined by C. E. Schlegel (*A. J. P.*, 1885, p. 426), who found *saponin* in the aqueous extract; in the alcoholic extract, a crystalline principle of a strong musk-like odor, which did not show alkaloid or glucosidal reactions, and *oil of star-anise*.

I. religiosum, Sieb., or *shikimi*, of India, is very poisonous, causing vomiting and epileptiform convulsions, with dilated pupil and exceedingly cyanosed countenance; in it has been found by J. F. Eykman (*P. J.*, xi. 1046) a crystalline principle, for which the name of *shikimine* or *sikimin* has been proposed. (See footnote, page 1526.)

Properties.—"The fruit is pedunculate and consists of eight stellately arranged carpels, which are boat-shaped, about 10 Mm. long, rather woody, wrinkled, straight-beaked, brown, dehiscent on the upper suture, internally reddish-brown, glossy, and containing a single, flattish, oval, glossy, brownish-yellow seed; odor anise-like; taste of the carpels sweet and aromatic, and of the seeds oily. Star-anise should not be confounded with the very similar but poisonous fruit of *Illicium anisatum* Linné (*Illicium religiosum* Siebold), the carpels of which are more woody, shrivelled, and have a thin, mostly curved beak, a faint, clove-like odor, and an unpleasant taste." *U. S.* 1890. Star-anise is used principally as a source of oil of anise, which is prepared by distillation not only in Southwestern China, but also in enormous quantities in Annam, where it is enclosed in tinned vessels and sent into commerce through China.

Eykman (*P. J.*, 1885, p. 985) has shown that in the essential oil of the fruit of *Illicium religiosum*, *safrol*, $C_{10}H_{10}O_2$, is found, accompanied by *eugenol*, $C_{10}H_{12}O_2$. On the other hand,

the chief constituent of the oil of *I. verum* is *anethol*, $C_{10}H_{12}O$. The constituents of low boiling-point in star-anise oil, consisting of terpenes essentially, have been reported upon by the chemists of Schimmel & Co. (*Schim. Rep.*, April, 1893).[1] They find *dextro-pinene*, boiling at 157° to 163° C. (314.6°–325.4° F.), and *lævo-phellandrene*, boiling at from 170° to 175° C. (338°–347° F.). The medicinal properties of the oil of star-anise are similar to those of oil of anise. Sikimin is not used in medicine.[2]

Impatiens. *Impatiens biflora*, Walt. (*I. fulva*, Nutt.), and *I. aurea*, Muhl. (*I. pallida*, Nutt.). *Touch-me-not. Jewel-weed. Balsam-weed.*—These two species of Impatiens (Fam. Balsaminaceæ), the former of which is better known commonly as *Spotted Touch-me-not* and the latter as *Pale Touch-me-not*, are indigenous, annual, succulent plants, from two to four feet high, growing in low, moist grounds, and flowering in July and August. They may be known by their tender, juicy, almost transparent stems; by their yellow flowers, which in the latter species are pale and sparingly punctate, in the former are deeper colored and crowded with dark spots, and by their capsules, which burst elastically, and curl up with the slightest pressure. They probably possess properties similar to those of *I. Noli-tangere*, D. Don (*I. Noli-me-tangere*, Crantz), of Europe, which has an acrid burning taste, and, when taken internally, acts as an emetic, cathartic, and diuretic, though considered dangerous, and therefore little used. Ruan of Philadelphia, employed with great advantage, in piles, an ointment made by boiling the American plants, in their recent state, in lard. The flowers may be used for dyeing yellow. The *I. Balsamina*, L., or *balsam-weed*, *touch-me-not*, etc., of the gardens resembles the other species in its effects.

Imperatoria. *Imperatoria Ostruthium*, L. *Masterwort. Rhizoma Imperatoriæ*, P. G. *Impératoire*, Fr. *Meisterwurz, Kaiserwurz*, G.—An umbelliferous plant, indigenous in Southern Europe. The root has a strong odor, similar to that of angelica, and a pungent, biting, aromatic taste, attended by a flow of saliva, and followed by a glowing warmth which remains long in the mouth. E. M. Holmes (*P. J.*, March 17, 1877) noticed this root mixed with aconite in the London market, but this probably arose from carelessness, as masterwort is worth twice as much as aconite. A crystallizable, tasteless principle, called *imperatorin*, was extracted from the root by Wackenroder, and Gorup-Besanez found in the root another principle, to which he gave the name of *ostruthin*. Besides these two crystalline compounds, masterwort contains a volatile oil, composed of a hydrocarbon and an oxygenated compound, probably the aldehyde of angelic acid. (Wagner, *J. P. C.*, lxii. 283.) Jassoy (*Ap. Ztg.*, v. 150) has since investigated the substance ostruthin and gives it the formula $C_{18}H_{20}O_3$. He states that it does not contain a methoxyl group but a phenol-like hydroxyl. By fusion with potassium hydroxide, it yields along with a carbonaceous residue small amounts of resorcinol and acetic and butyric acids. By the action of bromine in chloroform solution it is changed in the presence of acid sodium carbonate into *tribromostruthin*, $C_{18}H_{19}Br_3O_3$. (Schmidt, *Pharm. Chem.*, Bd. ii., 3te Auf., 1510.) The root of masterwort was formerly considered alexipharmic, stomachic, corroborant, emmenagogue, diuretic, and diaphoretic, and was used in a wide circle of complaints with so much supposed success as to have gained for it the title of *divinum remedium*. It is, however, merely a stimulant aromatic, which in this country is unknown as a remedy. Its leaves are used as a potherb and to flavor cheese.

Incassa Poison.—This is an African ordeal bark, which has been studied by Liebreich, who found in it a very violent cardiac poison.

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[1] The following table gives the distinctive characters which, according to J. F. Eykman, distinguish the oil of *Illicium religiosum* from allied oils (*P. J.*, xi. 1048):

	Ol. Anisi Vulgaris.	Oleum Fœniculi.	Ol. Illicii Anisati.	Ol. Illicii Religiosi.
Constituents	Chiefly solid and liquid anethol.	Small quantity of terpene boiling at 190° C., and liquid and solid anethol.	Chiefly solid and liquid anethol.	Rather much of a terpene boiling at 173° to 176° C.; liquid anethol boiling at 232° to 233° C.
Melting Point	+6° to +18° C.	−2° to +18° C.	About 0° C.	Not solid when cooled to 26° C.
Specific Gravity	About 0.903.	0.94 to 0.998.	0.978.	1.006.
Molecular Rotation	0° to +0.5°.	+13° to +19.6°.	0° to −0.4°.	−8.6°.
Alcoholic Hydrochloric Acid.	Colorless, afterwards reddish, then pale red.	Colorless.	Colorless.	Colorless, afterwards blue.
Chloral Reagent	Colorless, afterwards yellow and brownish.	Colorless, then beautiful red.	Colorless, then beautiful red.	Colorless, afterwards dirty brown-yellow.
Ammoniacal Silver Solution.	In 24 hours no reduction.	Like ol. anisi vulgaris.	Like ol. anisi vulgaris.	Reduction in a few hours.
Hager's Reaction	In alcohol, a portion of the sulphuric acid and oil mixture remains undissolved as a thick mass adhering to the sides of the tube.	Mixture of oil, sulphuric acid, and alcohol is perfectly clear.	Like ol. anisi vulgaris.	Mixture is nearly clear; separation of a little reddish-white deposit.
10 drops of oil, with 60 drops of ether and about 0.15 gramme of sodium.	Colorless; after 4 hours the mixture nearly colorless; deposit yellowish white.	. . . . .	Colorless; after 4 hours liquid and deposit yellow.	Colorless; quickly bluish; after 4 hours liquid pale yellow, deposit yellow.

[2] Sikimin is violently poisonous, belonging to the group of convulsants of which picrotoxin is the type. Plugge and Schutte associate in this group—*Dioscorine*, the alkaloid of *Dioscorea hirruta*; *cicutoxin*, from *Cicuta virosa*, L.; *coriamyrtin*, a glucoside of *Coriaria myrtifolia*, L.; *digitalirésin* and *toxirésin*, prepared by Schmiedeberg from digitalin and digitoxin; *phytolaccatoxine*, the alkaloid of *Phytolacca acinosa*; *sikimin*; *œnanthotoxine*, the alkaloid obtained from the *Œnanthe crocata*, L., by Pohl; *isonitroso-anilacétone*, an artificial substance prepared by Holleman. (See *Archiv. Internat. d. Pharmacodyn.*, iv. 1897.)

Indelible Ink.—This is prepared by dissolving two drachms of silver nitrate and a drachm of gum arabic in a fluidounce of distilled water, colored with a little Indian ink. It is used for writing with a pen on linen and muslin. The place to be marked is prepared by being moistened with a solution of two ounces of crystallized sodium carbonate and two drachms of gum arabic in four fluidounces of water, and then dried. This alkaline solution, called *mordant*, decomposes the nitrate, and protects the cloth from the action of the free nitric acid. At the end of twenty-four hours the spot is to be washed.

Redwood of London, proposes the following indelible ink, not requiring the use of a mordant. Dissolve an ounce of silver nitrate and an ounce and a half of crystallized sodium carbonate, separately, in distilled water, and mix the solutions. Wash the precipitated silver carbonate, and, having introduced it, still moist, into a Wedgwood mortar, rub it with 160 grains of tartaric acid, until effervescence ceases. Then add strong solution of ammonia, just sufficient to dissolve the silver tartrate formed (about two fluidounces). Lastly, having mixed in half a fluidounce of archil, half an ounce of white sugar, and an ounce and a half of powdered gum arabic, add sufficient distilled water to make the whole measure six fluidounces. Soubeiran has given the following formula for indelible ink, which he considers simpler than Redwood's. Dissolve 8 parts of crystallized silver nitrate, 3 of copper nitrate, and 4 of sodium carbonate, in 100 of ammonia water, and add to the solution a little gum. The marks produced by silver nitrate on linen or muslin may be completely removed by moistening them with a solution of corrosive sublimate or of potassium cyanide in distilled water, and afterwards washing them. A better way is to moisten with tincture of iodine, rinse and treat with a solution of sodium thiosulphate. Repeat if necessary. The chemicals used are not poisonous.

Jules Guiller has devised the three following formulas for marking inks for linen. 1. Silver nitrate 11 parts; distilled water 85; powdered gum arabic 20; sodium carbonate 22; solution of ammonia 20. Dissolve the sodium carbonate in the water, rubbing the solution with the gum, and the silver nitrate in the ammonia. Mix the solutions, and gradually heat the mixture in a flask until it boils. This ink flows readily from a pen. 2. Silver nitrate 5 parts; distilled water 12; powdered gum arabic 5; sodium carbonate 7; solution of ammonia 10. The ingredients are treated as in the preceding formula, with the exception that the mixed solution is heated until it becomes of a very dark color, and is reduced about one-twentieth in volume by evaporation. This ink is suitable for marking on linen with stamps. 3. Silver nitrate 17 parts; distilled water 85; powdered gum arabic 20; sodium carbonate 22; solution of ammonia 42; copper sulphate 33. Dissolve the silver nitrate in the ammonia, the sodium carbonate in 25 parts of the water, and the gum in the remaining 60. Then mix with the soda solution, first the gum solution, and afterwards the silver solution. Lastly, add the copper sulphate. This ink has a blue instead of the dark brown color of the others. (See *A. J. P.*, 1853, 33.)

Boettger gives the following formula: 3.65 Gm. of aniline black are rubbed down in a porcelain mortar with 60 drops of concentrated hydrochloric acid, and 22 Gm. of alcohol. This solution is mixed with a hot solution of 1.82 Gm. of gum arabic in 85 Gm. of hot water. This ink does not attack steel pens, and is not acted upon either by strong mineral acids or by alkalies. If the aniline black solution be diluted with shellac solution (21 Gm. in 85 of alcohol), an aniline black lake will be obtained, which is suited for coloring wood and leather.

Herberger recommends the following indelible ink for other purposes than marking linen. Dissolve wheat gluten, carefully freed from starch, in a little weak acetic acid, and dilute the solution with rain water, so as to have about the strength of wine vinegar. For every four ounces of the solution add ten grains of the best lamp black, two grains of indigo, and a little oil of cloves. This ink has a beautiful black color, and cannot be removed by chlorine or dilute acids.

Elsner states that an *indelible red ink* can be prepared as follows. Equal parts by weight of copperas and cinnabar, both in fine powder and sifted, are rubbed up with linseed oil with a muller, and finally squeezed through a cloth. The thick paste can be employed for writing or stamping woollen or cotton goods.

Indian Podophyllum Rhizome. *Podophylli Indici Rhizoma, Br. Add.*—The dried rhizome and roots of *Podophyllum Emodi*, Wallach. The contorted rhizome of *Podophyllum Emodi* is from a quarter to a third of an inch (six to eight millimeters) in thickness, crowded above with tuberosities, marked by depressed oval or circular scars, and giving off numerous simple rootlets from the whole of the under surface. The terminal bud is enclosed in whitish papery sheaths. The color is earthy-brown. The fracture is white, short, and mealy, or yellow and horny, exhibiting a circular arrangement of yellow vascular bundles, and bounded on the outside by a thin brown cortical layer. The rhizome of the Indian podophyllum has become a commercial article and appears to have been largely used in the making of podophyllin. The question as to the relative yield of the Indian and American plants is a matter of great importance to the manufacturer. Some years since Dymock and Hooper obtained 12 per cent. of resin from *P. Emodi;* Umney, working with very large quantities (*P. J.*, Sept. 1902), got out 11.4 per cent.; recently John Barclay (*P. J.*, lxx.) was not able to obtain a greater yield than 6.69 per cent. Umney, commenting on this, believes that of late years the Indian plant gives a much smaller product than formerly, probably on account of the time of year in which it is now dug. In regard to the therapeutic interchangeability of the two resins it has been demonstrated by the researches of Dunstan and Henry and J. C. Umney that the active substances in true podophyllin are all present in the Indian resin, but it is not assured that the proportion of these active principles is the same in the two resins. At one time it was claimed that the resin from the Indian species was more active than that obtained from the American plant, but this appears not to be correct. In the present state of our knowledge, the manufacturer is certainly not justified in putting upon the market a resin made from the Indian plant unless it is plainly marked as the Indian podophyllin. Distinguishing between the two resins has become a question of importance. The presence of a yellowish-green color does not, as has been affirmed, prove that a podophyllin is impure or of Indian origin. The test of solubility

is also uncertain. The Indian podophyllin, properly prepared, is freely soluble in alcohol. It is commonly stated that the true podophyllin will dissolve in ammonia (1 to 100). The Indian species is seemingly much less soluble in ammonia than this, but a properly prepared official resin does not always come up to this standard. E. J. Millard (*P. J.*, lx.) states that the Indian resin strikes with strong sulphuric acid an orange to red color, the official resin yellow coloration, tending to brown, but especially commends the following test:

To six grains (0.4 Gm.) of the resin in a test tube add one fluidrachm (3.75 Cc.) of diluted alcohol sp. gr. 0.920, and eight or ten drops (0.4–0.5 Cc.) of solution potash, B. P.; shake gently by rotating the test tube. In case of the Indian resin, the mixture becomes in a few seconds a semi-solid gelatinous mass, so that the test tube can be safely inverted. If this does not occur quickly, the mixture should be heated until it just begins to boil, and when cold it will be found to have gelatinized. The official resin similarly treated gives a dark fluid that shows no signs of gelatinizing even after standing for days. The Br. Add. recognizes the *Indian podophyllum resin* (*Podophylli Indici Resina*, Br. Add.) and directs it to be made by a process parallel to that given in the British Pharmacographia for the American resin. *Dose*, one-fourth to one grain (0.016 to 0.065 Cc.); also a *tincture* (*Tinctura Podophylli Indici*, Br. Add.); *dose*, five to fifteen minims (0.3 to 0.9 Cc.).

Indian Red.—A purplish-red pigment, brought from the island of Ormus in the Persian Gulf. It is *red ochre*, and owes its color to *ferric oxide*.

Indian Valerian Rhizome. *Valerianæ Indicæ Rhizoma. Br. Add.*—The dried rhizome of *Valeriana Wallichii*, DC., is officially described as "crooked, about two inches (five centimetres) long and from a quarter to half an inch (six to twelve millimetres) in diameter, of a full brown color, marked with transverse ridges, and thickly studded with circular prominent tubercles, to a few of which thick rootlets still remain attached. The crown is marked by a number of bracts; the lower end is blunt. The rhizome is very hard and tough; the fractured surface is greenish brown in color." According to the analysis made by J. Lindenberg (*Ph. Z. R.*, 1886), Indian valerian root is practically identical in its composition with the European drug, containing, however, a little more volatile oil. In India this valerian seems to be chiefly used as a perfume, but there is no doubt but that it is identical in its medicinal properties with the older valerian. The Br. Add. recognizes an ammoniated tincture (*Tinctura Valerianæ Indicæ Ammoniata*, Br. Add.), *dose* from one-half to one fluidrachm (1.8 to 3.75 Cc.).

Indian Yellow.—This is a pigment manufactured from a yellow substance from India, called *purree*. Purree occurs in commerce in balls, from three to four ounces in weight, which are dark brown externally and deep orange within. It has a peculiar odor, closely resembling that of castor. This circumstance gave rise to the belief that it was of animal origin, but Stenhouse found it to consist of magnesia, united with a peculiar acid, which he names purreic (*euxanthic acid* of Erdmann), and which forms nearly one-half of the crude substance. *Purreic acid* is in small crystals of a light yellow color, dissolving sparingly in cold water, quite readily in boiling water, and abundantly in hot alcohol and ether. It has at first a sweetish and then a slightly bitter taste, and possesses, in appearance, considerable resemblance to berberine. When acted upon by boiling nitric acid, it is finally converted into trinitro resorcinol, $C_6H(NO_2)_3(OH)_2$. Heated with diluted sulphuric acid (3 per cent.) to 140° C. (284° F.), it decomposes into *euxanthon* and *glycuronic anhydride*. The euxanthon is recognized as *dioxydiphenylene-ketone oxide*, $CO<\begin{matrix}C_6H_3(OH)\\C_6H_3(OH)\end{matrix}>O$, and has been made synthetically. Purreic or euxanthic acid is monobasic, and has the formula $C_{19}H_{16}O_{10} + 3H_2O$. Stenhouse concludes that purree is probably the juice of some plant, saturated with magnesia, and boiled down to a solid consistence.

Indigo. *Indicum. Pigmentum Indicum. Indigo*, Fr., G.—This well-known and highly important dye-stuff is obtained from various species of *Indigofera* (Fam. Leguminosæ), especially *I. tinctoria*, L., and *I. Anil*, L., and is afforded also by other plants, such as *Wrightia tinctoria*, R. Br. (Fam. Apocynaceæ), *Polygonum tinctorium*, Ait. (Fam. Polygonaceæ), *Tephrosia tinctoria*, Pers., *Galega tinctoria*, L., and *Tephrosia Apollinea*, Link. (Fam. Leguminosæ), etc. For an interesting account of the manufacture in Manchuria of indigo from *Polygonum chinense* see *Am. Drug.*, Aug. 1888. It does not exist ready formed, but is generated, during fermentation, from another principle existing in the plant. This principle appears to have been isolated from *Isatis tinctoria*, L. (Fam. Cruciferæ), by Ed. Schunck, who has named it *indican*. Through the agency of the mineral acids, it is resolved into indigo and sugar, and perhaps the same result may take place in fermentation. Indican is yellow, amorphous, of a nauseous bitter taste, with an acid reaction, and readily soluble in water, alcohol, and ether. In the process of preparing indigo, the plant is macerated in water; fermentation takes place; the liquor becomes of a greenish color, and in due time is decanted; the coloring principle dissolved by the water absorbs oxygen from the air, and assumes a blue color, becoming at the same time insoluble; a gradual precipitation takes place, favored by the addition of lime water or an alkaline solution, and finally the precipitated matter, having been washed upon linen filters, is dried, shaped usually into cubical masses, and sent into market. It is of an intensely blue color, but assumes a coppery or bronze hue when rubbed by a smooth hard body, as the nail. Heated to 287.7° C. (550° F.), it emits a reddish-violet vapor, which condenses in minute crystals. It is insoluble in water or alcohol, but is readily dissolved by concentrated or fuming sulphuric acid, because of the formation of *monosulphindigotic* and *disulphindigotic* acids, of which the first is difficultly soluble in water and the second easily soluble. The sodium salt of this latter constitutes the *indigo-carmine* of commerce. Indigo is soluble in chloroform, aniline, oil of turpentine, paraffin, phenol, and benzene. By deoxidizing agents it is deprived of its blue color, which it recovers by exposure to the air, in consequence of the absorption of oxygen. Such is the case with the acid sulphites, and in a less degree with sulphurous acid. Certain volatile oils are said to have the same effect when boiled with tincture of indigo, as the oils of turpentine, peppermint, lavender, juniper, savine, or sage. (*J. P. C.*, 1859, 399.) Its reduction and decolorization by glucose is the basis of one of the most delicate

tests we have for diabetic sugar in urine. Chlorine also destroys the blue color. For modes of testing the value of any specimen of indigo, see Sadtler's *Industrial Organic Chemistry*, 443. The most important of the methods for the determination of the indigo blue may be summarized under three heads,—viz., oxidation methods, reduction methods, and sublimation of the pure indigo blue from the commercial product. A table of analyses of commercial samples with results according to the several methods above referred to will be found in Allen, *Com. Org. Anal.*, 2d ed., iii. 311.

The artificial production of indigo has been the subject of much investigation and effort in recent years. The problem was successfully solved by A. von Baeyer of Munich, who proposed several methods capable of commercial utilization.

One method is to start with *cinnamic acid*, $C_9H_8O_2$, made artificially from benzaldehyde, which is changed into *ortho-nitro-cinnamic acid*, $C_9H_7NO_4$, and this by the intervention of the di-bromine derivative into *ortho-nitro-phenylpropiolic acid*, $C_9H_5NO_4$, and this by the action of alkalies in the presence of reducing agents, like grape sugar or xanthogenates, is converted directly into *indigo blue* $(C_8H_5NO)_2$.

A second method was by the action of dilute alkalies upon a solution of *o-nitro-benzaldehyde* in acetone according to the reaction

$$2C_6H_4(NO_2)CHO + 2C_3H_6O = C_{16}H_{10}N_2O_2 + 2C_2H_4O_2 + 2H_2O$$

A method of Heumann, also successfully carried out on a large scale, is to treat *phenylglycin*, $C_6H_5.NH.CH_2.COOH$, with alkalies, and then oxidize the resulting alkaline solution, when *indigotine* is formed. These methods were all too expensive, but it has finally been made commercially, and on a scale which is fast displacing natural indigo, by the following method:

Anthranilic acid, $C_6H_4(NH_2)COOH$, which can be prepared cheaply from naphthalene, combines with *monochloracetic acid* to form *phenyl-glycocollcarboxylic acid*, $C_6H_4{<}^{NH.CH_2COOH}_{COOH}$, and this on fusion with caustic soda yields *indoxyl*, $C_6H_4{<}^{NH}_{C(OH)}{>}CH$, which, in alkaline solution, is converted by atmospheric oxidation into indigo.

Synthetically prepared indigotine is now produced at a price much cheaper than refined indigo. It has several advantages, as purity, fineness of division, and ease with which it is tested.

In former years the importation of indigo from India into the United States averaged about 2,000,000 pounds, representing over 50 per cent. of the imported dye colors, the ports of entry being New York and Boston. During the year 1902 the importation of the natural indigo from India amounted to 239,580 pounds during the first six months, and ceased entirely after the month of June. It is stated that the artificial indigotine can be sold at about one-fourth the price of the vegetable dye.

Schunck first showed that all urines, whether pathological or not, contain an indigo-producing body in minute quantities. This body is commonly spoken of as *indican* in medical books. Its true chemical nature was first ascertained by Baumann, who showed that it was not a glucoside, like the indican of plants, but the potassium salt of a peculiar acid, *indoxylsulphonic acid*.

Indigo was at one time considerably used in medicine, but at present is very rarely if ever employed. It is said to produce, when taken in sufficient quantity, nausea, vomiting, purging with bluish, dark stools, a dark violet or dark green color of the urine, and sometimes to cause a menstrual flux. It has been especially used in *epilepsy, infantile convulsions, chorea, hysteria*, and *amenorrhœa*. *Dose*, from twenty grains to an ounce (1.3–31 Gm.) three times a day. For further details, see 16th ed. *U. S. D.*

Inks, Colored.—The following recipes are stated by the *Boston J. Chem.* to be preferable to the solutions of aniline dyes which are now so extensively used as colored inks.

Green.—Two parts copper acetate, one part potassium carbonate, and eight parts water. Boil until half is evaporated, and filter.

Blue.—Three parts Prussian blue, one part oxalic acid, and thirty parts water. When dissolved, add one part gum arabic.

Yellow.—One part fine orpiment, well rubbed up, with four parts thick gum water.

Red.—With the aid of a gentle heat dissolve four grains of carmine in one ounce of ammonia water, and add six grains of gum arabic.

Gold.—Rub gold leaf, such as is used by book binders, with honey till it forms a uniform mixture. When the honey has been washed out with water, the gold powder will settle at the bottom, and must be mixed with gum water in sufficient quantity.

Silver.—Silver leaf treated in precisely the same manner gives a silver ink. Both these inks may, when dry, be polished with ivory.

Black.—Three ounces crushed nut-gall, two ounces crystallized ferrous sulphate, two ounces gum arabic, and twenty-four ounces water.

White.—Fine French zinc white, rubbed up with gum water to a proper consistency.

Insect Powder. *Camomille de Perse*, Fr. *Persische Bertramblumen*, G.—There are three distinct commercial varieties of insect powder, the *Caucasian*, or *Persian*, the *Dalmatian*, and the *Montenegrin*. *Persian* or *Caucasian Insect Powder*, or *Guirila*, consists of the flowers of *Chrysanthemum coccineum*, Willd., including *C. carneum*, Weber (*Pyrethrum carneum*, Bieb), and *C. roseum*, Weber (*P. roseum*, Bieb), also *C. Marschalli*, Aschers, growing upon the Caucasian mountains, Armenia and Northern Persia, at an elevation of about a mile. *Dalmatian Insect Powder* is the product of *Chrysanthemum cinerariæfolium* (Trev.), Bocc. (*Pyrethrum cinerariæfolium*, Trev.), and it is more powerful than the Caucasian powder. *Montenegrin Insect Powder* is the product of the same species, growing wild in Montenegro. It is a very superior variety. Both it and the Dalmatian powder come into commerce chiefly through Trieste. There are recognized three grades of the Dalmatian insect powder, in accordance with the condition of the flowers. The finest is that with closed leaves, the second with half closed, and the poorest variety with open leaves. In the Montenegrin powder the flowers are always closed or half closed. For details as to the special anatomical character of these powders, see *P. J.*, lxvii. 474; also *J. P. C.*, 1902, xv. 409.

C. cinerariæfolium is now being cultivated on a large scale in California, and as more care is given to the preservation during drying of the color and of the volatile oil than in Dalmatia, the California product is said to be superior to the foreign drug. (*C. D.*, August, 1889; see also for method of cultivation *Reports of the Fourth U. S. Entomological Commission*, 1885.)

The insect powder of commerce varies in color from yellow, yellowish-brown, or brownish-yellow to yellowish-green, the finer qualities verging towards brown and the poorer towards green. Brilliant yellow powder should be viewed with suspicion. On microscopical examination of an insect powder, it will be found to consist of fragments of involucral scales composed of sclerenchyma, perhaps bits of stems composed of collenchymatous cells, pollen grains, fragments of the corolla and of its epidermis and papillæ. The absence or scarcity of pollen in the powder shows the absence or scarcity of the flowers in the drug, while the proportion of collenchymatous tissue indicates the proportion of stems. As the activity of the insect powder resides in the flower, specimens containing little of the flowers or much of the stems should be rejected. The powder yielded by the Dalmatian plant can usually be distinguished from Persian insect powder by the following characters. The outer surface and edges of the scales of the Dalmatian flowers contain numerous hairs, consisting of a long cell with attenuated ends placed horizontally upon a one- to three-celled stalk. The Persian flowers are almost entirely glabrous, a white hoariness being found only at and near the base of the scales, and very few hairs near the apex; the hairs are of the same structure as the preceding, only the terminal cell being much longer. Sclerenchymatous cells are much more numerous in the Persian than in the Dalmatian. The so-called *Hungarian* or *Russian daisy*, probably a species of the subgenus *Leucanthemum*, has been quite largely used as an adulterant. The importance of the adulteration is increased by the fact that the Hungarian daisy appears to be entirely free from insecticidal properties. The Hungarian daisy is distinguished from the true Pyrethrum by the orange-yellow disk florets, by the depression of the involucre, by its prominent dark receptacle, and by the absence of pubescence and pappus. The odor is less pungent than that of the true insect flower, being more like that of matricaria. The difference in odor is more pronounced on infusing in warm water. The Hungarian daisy yields a powder somewhat darker in color than true insect powder. Microscopically, the Hungarian or Russian daisy differs only in the absence from the involucre and stems of the peculiar hairs seen on the scales of the true insect powder, and the presence in their place of certain hairs, consisting of from four to ten cells, and terminating with a much elongated, thin-walled, or inflated cell. There seems to be no recognizable difference between the pollen of the two plants which yield insect powder and of the Hungarian daisy. The presence of quassia, fustic, turmeric, and other adulterants may be made out by the aid of the microscope, and chrome yellow (salt of lead) chemically, but the powder of Hungarian daisy cannot be detected microscopically. According to George R. Durrant, however, the Hungarian powder yields 10 per cent. of ash, whereas true insect powder yields but 6.5 per cent. F. Dietze, after careful study, found that the best method of valuation of insect powder is based on the amount, appearance and odor of the extract obtainable by the use of petroleum spirits boiling under 55° C. With such menstruum true insect powder affords a bright yellow percolate possessing the odor peculiar to the drug. (*P. J.*, lxiv. 81.)

Insect powder does not appear to be actively poisonous to man, though it is said to cause some confusion of head in those who sleep in close apartments where much of it is used. Upon the insects, however, which are apt to infest the person of man and animals, as well as bedding and sleeping apartments, it acts very destructively, first stupefying and then killing them. It is scattered over the person, upon the beds, about apartments, etc., and is even employed as a dressing for ulcers and wounds to prevent the formation of maggots. It also answers for preserving dried insects and plants in cabinet collections. The powder, exhausted by alcohol, is harmless to insects; its activity is therefore dependent upon some principle whose nature has not been positively determined. Trapp, and also Ivanel de Bellesme, assert that it is an alkaloid, while Rother denies that it is ot such nature. (*A. J. P.*, xxv. 1857; Dragendorff, *Jahresb.*, 1876, 121.) Texton has found it to be a soft resin (*A. J. P.*, 1881, 491.) In a series of experiments, Riley has found that the fumes of the burning powder are very poisonous to insects, and for certain purposes afford a ready mode of application, but that generally an aqueous infusion is the best and cheapest preparation. It is also used now in the form of cones made by making a mass with mucilage of gum, with the addition of a small quantity of potassium nitrate. After drying, these are ignited like a pastille. Twenty-five grains stirred up in two quarts of water were sufficient to kill young cotton worms. The infusion soon spoils. The tincture and the alcoholic extract are both efficient preparations. The tincture (one part to four) has been especially recommended, diluted with ten times its bulk of water, by F. Jager, to keep off vermin from the human body. According to Maisch (*A. J. P.*, 1869, 128), it is capable of causing a vesicular eruption like that produced by the poison ivy.

Insindiyandiya.—This substance, a remedy of the Kaffir doctors of South Africa, is a violent poison, and has been shown by E. M. Holmes to be derived from a Bersama, apparently identical with *B. abyssinica*, Fresen. (*P. J.*, lxxiii. 893.)

Inula. *U. S.* 1890. *Inula. Elecampane.*—"The root of *Inula Helenium* Linné (nat. ord. *Compositæ*)." *U. S.* 1890. *Aunée*, Fr. *Alantwurzel*, G. *Enula Campana*, It., Sp. About ninety species of this genus are recognized and distributed in Europe, Asia, and Africa, one species being naturalized in North America.

The fresh root of elecampane is very thick and branched, having whitish cylindrical ramifications, furnished with thread-like fibres. It is externally brown, internally whitish and fleshy; and the transverse sections present radiating lines. The dried root is "in transverse, concave slices or longitudinal sections, with overlapping bark, externally wrinkled and brown; flexible in damp weather; when dry, breaking with a short fracture; internally grayish, fleshy, slightly radiate, and dotted with numerous shining, yellowish-brown resin-cells; free from starch; odor peculiar, aromatic, taste bitter and pungent." *U. S.* 1890. A peculiar principle, resembling starch, was discovered in elecampane by Valentine Rose of Berlin, in 1804, who named it *alantin;* but the title *inulin*, proposed by Thomson, has been generally adopted. It differs from starch in being deposited unchanged from its solution in boiling water when the liquor cools, and in giving a yellowish instead of a blue color with iodine. It has been found in the roots of several other

plants. It may be obtained white and pure by precipitating a concentrated decoction with twice its volume of alcohol, dissolving the precipitate in a little distilled water, treating the solution with purified animal charcoal, and again precipitating with alcohol. (*A. J. P.*, xxxi. 69.) It readily dissolves in about three parts of boiling water; the lævogyre solution is perfectly clear and fluid, not paste-like, but on cooling deposits nearly all the inulin. Its formula, according to Kiliani (Tollens, *Handbuch der Kohlenhydrate*, 1888, p. 202), is $3C_{12}H_{20}O_{10} + H_2O$. On prolonged heating with water, more rapidly under the influence of dilute acids, it is changed into *levulose* and reduces Fehling's solution. As in the case of starch, intermediate products can be obtained before it is completely changed into reducing sugar. Dragendorff obtained by heating with water for ten hours *metinulin*, and by heating for forty to fifty hours *levulin*, an optically inactive amorphous substance easily changing into *levulose*. Tanret, who has since investigated inulin (*J. P. C.*, 27, 449), confirms Kiliani's formula as given above. He finds associated with inulin two closely related principles: *pseudo-inulin* and *inulenin*. The first of these, to which the formula $(C_6H_{10}O_5)_{16}.H_2O$ is given, forms irregular granules, very soluble in water and weak alcohol while hot, but only slightly soluble in cold water, and insoluble in cold alcohol; the second is given the formula $(C_6H_{10}O_5)_{10}.2H_2O$, and forms microscopical needles slightly soluble in cold water and weak alcohol. The amount of inulin varies according to the season, but is most abundant in autumn. Dragendorff obtained from the root in October not less than 44 per cent., but in spring only 19 per cent. A crystallizable substance was long since noticed to collect in the head of the receiver when the elecampane root is submitted to distillation with water. Similar crystals may also be observed after carefully heating a thin slice of the root, and are even found as a natural efflorescence on the surface of a root that has been long kept. They can be extracted from the root by means of alcohol, and precipitated with water. Kallen (*Ber. d. Chem. Ges.*, 1873, 1876) has found that these crystals consist chiefly of the anhydride, $C_{15}H_{20}O_2$, of *alantic acid*, melting at 66° C. (150.8° F.), and that what was formerly known as *helenin* was a mixture of these with a liquid, *alantol*, $C_{10}H_{16}O$, boiling at 200° C. (392° F.), the true *helenin* and *alant camphor*. The crystals of *helenin*, C_6H_8O, have a bitterish taste, but no odor, and melt at 110° C. (230° F.). The camphor melts at 64° C. (147.2° F.), and in taste and odor is suggestive of peppermint.

Korab (*L. L.*, vol. i., 1885, p. 672) states that helenin is a powerful antiseptic and bactericide, one part in ten thousand of urine being sufficient to arrest putrefaction, and a few drops of a solution of this strength immediately killing the ordinary bacterial organisms, including the tubercle bacillus. He lauds it as antiseptic in surgery and has given it with alleged success internally in *doses* of one-third to one grain (0.021–0.065 Gm.) in tubercular and catarrhal diarrhœas. It is also stated by J. B. Obiol (*L. L.*, April, 1886) to be an efficient local remedy in the treatment of diphtheria. Every four hours the false membrane is to be dusted over with powdered camphor, and then painted with a two per cent. solution of helenin in oil of sweet almond. It is affirmed that when the treatment was commenced on the first day of the patches the cure followed in twenty-four hours. The helenin was also given internally. *Dose*, one and a half grains (0.096 Gm.) to children six years of age.

Medicinal Properties and Uses.—Elecampane is tonic and gently stimulant, and was employed by the ancients in *amenorrhœa* and other diseases of women, also in *phthisis*, in *dropsies*, and in *skin affections*, in all of which diseases it was probably of no service. It has been given in powder, in the *dose* of twenty grains to one drachm (1.3–3.9 Gm.), or as a *decoction* (half ounce to the pint) in *doses* of one to two fluidounces (30–60 Cc.).

Iodal.—This substance, prepared by the action of iodine upon a mixture of alcohol and nitric acid, is decomposed by an alkali into iodoform and formic acid. Rabuteau found it to resemble hydrated chloral in its actions on animals. (*Ann. Thér.*, 1870, 98.)

Iodantifebrin. *Iodacetanilide.* $C_6H_4I.NH(C_2H_3O.)$—This occurs in rhombic flakes melting at 181.5° C. (358.7° F.), very slightly soluble in cold water, easily soluble in alcohol and in glacial acetic acid. In the experiments of E. Munz (*Pr. M. W.*, 1891) the physiological results following the administration of this remedy by the mouth were entirely negative, and neither iodine nor acetanilide could be recognized in the urine, the probable explanation of this being that the excessive insolubility of the drug prevents its absorption.

Iodic Acid. HIO_3.—This is obtained by decomposing calcium iodate with sulphuric acid (*A. J. P.*, xlvi. 558), or by heating iodine with nitric acid (sp. gr. 1.5), and allowing the crystals of iodic acid to separate on cooling. It has been proposed by Lutton as a remedy in chronic glandular enlargements and goitre, thirty minims (1.8 Cc.) of a 2 per cent. solution being injected into the affected part. (*Ann. Thér.*, 1874, 192.)

Its 5 per cent. solution has been highly commended as a hæmostatic, also as an astringent and alterative in *gonorrhœa* and other mucous membrane infections. Pencils made of it are also said to be a very useful caustic in *chancroids* and various other *ulcers*. In using it hypodermically it is essential to have an absolutely clean syringe. In *gastric hemorrhage* it may be given in the *dose* of from one to two grains (0.065–0.13 Gm.) three times a day in milk; in *gonorrhœa*, injections of 0.05 per cent. may be employed.

Sodium iodate, a white, odorless, crystalline substance, very soluble in water, has been recommended for internal use, but is much inferior to the iodides. As a local remedy it may be useful in tubercular and other inflammations of the nose and larynx, either pure or diluted. Subcutaneous injections of from one to three grains (0.065 to 0.2 Gm.) may be safely given to reduce adenopathies, relieve rheumatic swellings and pains, and in neuritis and nervous syphilis. *Dose*, from ten to fifteen grains (0.65–1.0 Gm.) in milk.

Iodine Trichloride. ICl_3.—This compound occurs in reddish-yellow crystals; very soluble in water and alcohol; rapidly decomposed with liberation of iodine and chlorine when brought in contact with organic matter. It has been especially recommended by Belfield (*B. M. J.*, Aug. 1892) as a powerful local antiseptic. A solution is prepared for medicinal use by suspending 5.5 Gm. of iodine in 22 Gm. of water, and passing in chlorine as long as it is absorbed by the well-cooled mixture. The solution contains 10 Gm. of

iodine trichloride. The strength of the solution used is 1 to 5 per cent. Gauze sterilized by boiling and immersing in 1 to 10 per cent. solution and dried is said to retain iodine trichloride indefinitely.

Iodipin.—A yellow, oily fluid, of a purely oleaginous taste, said by Winternitz (*D. M. W.*, xxiii.) to be an iodine addition product of sesame oil, and to contain 10 per cent. of iodine in chemical combination. Similar preparations have been made from lard, cacao butter, and other fats. It has been given successfully in *syphilis* and *scrofula*, in drachm *doses* (3.9 Gm.), three times a day, either pure or in emulsion.

Iodline.—This is affirmed to contain iodol and albumin, of which 36 per cent. is iodol. It is a yellowish, exceedingly fine, odorless, tasteless, and insoluble powder, and may be used externally for the same purposes as iodol.

Iodoformogen.—According to K. Gaab (*Ph. Centralh.*, 1898, xi. 189), iodoformogen is a chemical combination of iodoform and albumin. It occurs as a fine, loose, dry, non-conglutinating powder, having a faint acidulo-ethereal odor, and being two and one-half times as voluminous as powdered iodoform. According to Kromayer (*B. K. W.*, xxxv. 1898) and to Aspegren (*Festschrift des Prof. Kaposi*, Vienna, 1901), iodoformogen is more slow and continuous and certain in its local action than is iodoform. It bears sterilization at 100° C. (212° F.) without change.

Iodophenacetin. *Iodophenine.* $C_{20}H_{23}I_3N_2O_4$. To a solution of phenacetin in glacial acetic acid are added hydrochloric acid, water, and then a solution of iodine in potassium iodide. The product forms crystals resembling those of potassium permanganate, melting at from 130°–131° C. (266°–267.8° F.), with decomposition, and soluble in glacial acetic acid or alcohol. Decomposed by water. Scholvein (*O. Z.*, 1891) has found that this substance is a powerful germicide, and that it is locally very irritant, and when taken into the intestinal canal is decomposed with the liberation of iodine, and liable to produce iodine poisoning. The drug probably has no practical value.

Iodopyrine. $C_{11}H_4I.N_2O$.—This substance contains 60 per cent. antipyrine and 40 per cent. of iodine. It forms colorless crystals melting at 160° C. (320° F.), and has been recommended as an antiseptic, antipyretic, and antirheumatic, especially useful in *muscular rheumatism* and in *asthma*. It is capable of producing iodism. The *dose* given by Junkers was fifteen grains (1 Gm.) for adults every three or four hours. For children from 1 to 10 years old he gave one and a half to eight grains (0.096 to 0.5 Gm.). To those over 10 years he gave eight to twelve grains (0.5–0.78 Gm.). (*Th. M.*, vol. xiii. p. 604.)

Iodosyl. $C_6H_3I.OI.COOH$.—A bulky, amorphous powder of a deep red color, nearly odorless and having only a faint taste suggestive of that of iodine. Insoluble in water and in oils and only sparingly soluble in chloroform and ether. Although resisting decomposition by acids, alkalies, and most chemical reagents, it seems to give up iodine when brought in contact with animal tissues and so has a pronounced alterative and antiseptic action. Its medicinal uses are those of iodoform, but it has the advantage that it is odorless and in an impalpable powder. It is used as a dressing for *wounds* and *ulcers* of every description, as a local application in *nasal catarrh* and *ozæna*, in *ringworm* of the scalp, in various *cutaneous affections*, being especially recommended in the treatment of *corneal ulcers*. It is employed either as a dusting powder, in the form of an ointment, 2 to 10 per cent., or in that of a medicated gauze.

Iodoterpin. $C_{10}H_{16}I$.—This compound of iodine and terpin is a dark brown liquid, having the odor of turpentine, soluble in ether, benzene, and chloroform, with a specific gravity of 1.19, and a boiling point of from 165° to 175° C. (329°–347° F.). In a communication to the Twelfth International Medical Congress it was proposed by A. Lieven as a substitute for the tincture of iodine, and mixed with sterilized kaolin, 1 to 20 per cent., as an antiseptic dusting powder.

Iodozone.—This is stated to be a solution of iodine in ozone. It has been brought forward as a remedial agent by Robin, an apothecary of Bourges. (*Journ. d'Hygiène*, Aug. 1892.)

Iodylin. *Bismuth-iodo-salicylate.*—According to Israel (*Med. Wochens.*, 1902, p. 139) this substance is efficient as a substitute for iodoform.

Iodyloform.—This is a yellowish-brown insoluble powder, said to be a combination of iodine and gelatin, containing 5 per cent. of iodine, and has been used by Müller as a substitute for iodoform in *specific ulcerations*.

Ionidium. *Ionidium Marucci*—This name has been conferred by Bancroft upon a South American plant of the fam. Violaceæ, supposed to be the source of a medicine used with great asserted advantage, in Maracaibo and elsewhere, in *elephantiasis* and other cutaneous affections. A specimen, however, received from Bancroft, was reported by W. Hooker to be identical with the *Ionidium parviflorum* of Ventinat, which is now referred to *I. glutinosum*, Vent. The medicine is called by the Indians *cuichunchulli*, and grows at the foot of Chimborazo. It is said to be diaphoretic, diuretic, occasionally sialagogue, and in large doses emetic and cathartic. The root is the part used. For further information, see *A. J. P.*, iii. 125.

Iris. *U. S.* 1890. *Blue Flag.*—"The rhizome and rootlets of *Iris versicolor* Linné (nat. ord. *Irideæ*)." *U. S.* 1890. In all the species belonging to this genus, so far as examined, the roots are more or less acrid, and possessed of cathartic and emetic properties. In Europe, *Iris fœtidissima*, L., *I. florentina*, L., *I. germanica*, L., *I. pseudoacorus*, L., and *I. tuberosa*, L., have at various times been admitted into use, and the unpeeled roots of *I. germanica* are still sold in the Indian bazaars under the name of *Irisia*. *Iris versicolor*, L., or blue flag, is found in all parts of the United States, flourishing in low wet places in meadows. The flowers afford a fine blue infusion, which serves as a test for acids and alkalies. The recent root is without odor, and has a nauseous, acrid taste, which is imparted to water by decoction, and still more perfectly to alcohol, the acrimony as well as medicinal activity is impaired by age. If cut when fresh into slices, dried at the temperature of about 100° F., then powdered and kept in bottles excluded from the air, the root retains its virtues unimpaired for a considerable time. (Andrews.) It was officially described as follows: "Rhizome of horizontal growth, consisting of joints, 5 to 10 Cm. long, cylindrical in the lower half, flattish near the upper extremity, and terminated by a circular scar, annulated from the leaf-sheaths, grayish-brown; roots long, simple, crowded near the broad end; odor slight; taste acrid and nauseous." *U. S.* 1890. D. W. Cressler found in this plant starch, gum, tannin, sugar, an

acid resin, fixed oil, and indications of an alkaloid. (*A. J. P.*, 1881, p. 602.)

Blue flag is a cathartic and emetic, said to have been used by the Southern Indians, and may be given in *doses* of from ten to twenty grains (0.65–1.3 Gm.). *Iridin*, or *irisin*, of the eclectics, is an oleoresin obtained by precipitating a tincture of the root with water, and mixing the precipitate with an equal weight of some absorbent powder. Wm. E. Jenks (*A. J. P.*, 1881, p. 601) prepares the *oleoresin of iris* by exhausting the root with alcohol sp. gr. 0.835, and distilling off the alcohol. (See also paper on the constituents of the oleoresin by W. L. Cliffe, *A. J. P.*, 1884, p. 616.) The so-called irisin is undoubtedly purgative, and is generally believed to have a very decided action upon the liver, a belief which has been confirmed by the researches of Rutherford, who proved that in dogs it is a powerful stimulant to the liver and has also a decided influence upon the intestinal glands; he ranks it as less irritant to the intestines than podophyllin, and more purgative than euonymin. It may be given in pill in the *dose* of from three to four grains (0.20–0.26 Gm.).

The Pharmacopœia formerly recognized a solid *extract* (*Extractum Iridis*), made by the following process: "Iris, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity*. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three thousand cubic centimeters* [or 101 fluidounces, 3¼ fluidrachms] of tincture are obtained, or the Iris is exhausted. Distil off the Alcohol from the tincture by means of a water-bath, and evaporate the residue, on a water-bath, to a pilular consistence." *U. S.* 1890. The *dose* of the extract of iris is one to two grains (0.065 to 0.13 Gm.).

The *Extractum Iridis Fluidum*, U. S. 1890 (*fluid extract of iris*), was made as follows: "Iris, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Iris is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 207 minims] of the percolate. Distil off the Alcohol from the remainder by means of a water-bath, and evaporate the residue, on a water-bath, to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890. *Dose*, five to ten minims (0.3–0.6 Cc.).

Iron, Ammoniated. *Ammoniated Iron. Ferrum Ammoniatum. Ammonio-chloride of Iron. Ammonii et Ferri Chloridum. Ammonium Chloratum Ferratum. Sel Ammoniac Martial*, Fr. *Eisensalmiak*, G.—This drug was formerly recognized both by the U. S. and London Pharmacopœias, which contained formulas for its preparation. (See *U. S. D.*, 15th edition, 1568.) There is no reason to believe that the ferric chloride and ammonium chloride are chemically combined in the preparation. According to Phillips, they are in the proportion of 15 parts of the iron to 85 of the ammonium salt.

Ammoniated iron is in crystalline grains, of a fine reddish-orange color, and a sharp, styptic, saline taste. It is entirely soluble in water and diluted alcohol, is deliquescent, and should be kept in well-stoppered bottles. As procured by sublimation (*Flores martiales, Ens martis*), it is of a yellow color and feeble odor. It unites aperient with chalybeate properties, and is said to have been used with advantage in *amenorrhœa, epilepsy, scrofula, rickets*, etc.; but it is at best uncertain, and is now very seldom prescribed. *Dose*, from four to twelve grains (0.26–0.78 Gm.).

Iron and Bismuth Citrate. *Ferri et Bismuthi Citras.*—A solution of this so-called salt has been used in *dyspepsia*. It is made by dissolving bismuth citrate in an aqueous solution of ammonia, and adding the ferric ammonio-citrate. It is not a chemical salt. (*A. J. P.*, xliv.)

Iron and Magnesium Citrate. *Ferri et Magnesii Citras.*—This double salt, introduced by Van der Corput, is made by dissolving two ounces of freshly precipitated ferric hydroxide in a moderately heated solution of three ounces of citric acid, and saturating the liquor with magnesium carbonate. The solution, after filtration, is evaporated by means of a water bath to a syrupy consistence, and spread on glass to dry in scales. Three and a quarter ounces of ferrous sulphate will furnish by decomposition the necessary hydroxide for three ounces of the acid. (See formula for *Ferri Hydroxidum*, p. 505.) This salt is in transparent, greenish-yellow scales, having a slightly ferruginous, somewhat acid taste. It is very soluble in water, but insoluble in alcohol and ether. *Dose*, from five to ten grains (0.32–0.65 Gm.). (See *A. J. P.*, 1850, 315.)

Iron Caseinate. *Ferri Caseinas. Ferrum Caseïnatum. Ferrum nucleo-albuminatum.*—One part of freshly precipitated casein, thoroughly washed, and freed from fat by treatment with ether, is mixed with 1 part of calcium carbonate and 100 parts of water. The resulting solution, after being filtered, is precipitated by a slight excess of a 1 per cent., freshly prepared solution of ferrous lactate. The precipitated iron caseinate is washed and dried and is in the form of a flesh-colored, odorless, tasteless powder, insoluble in water but soluble in weak sodium carbonate and ammonia solutions. It is recommended as a form of iron which can be readily absorbed.

Iron Peptonate. *Ferri Peptonas. Ferrum Peptonatum. Peptonate de Fer*, Fr. *Eisen Peptonat*, G.—To a solution of 2 parts of dried peptone in 200 parts of water add a mixture of 24 parts of solution of dialyzed iron (*Liquor Ferri Oxychlorati, P. G.*) and 200 parts of water, in a thin stream and while stirring constantly. A solution of caustic soda (1.5 per cent.) is added until there is produced a very weak alkaline reaction. The precipitated iron peptonate is washed rapidly with water until no reaction with silver nitrate is shown. The precipitate is drained on a wet strainer and dissolved in three parts of 25 per cent. hydrochloric acid. The solution is evapo-

rated on a water bath and spread on plates to dry at a temperature not exceeding 50° to 60° C. (122°–140° F.). Iron peptonate, thus prepared, is in the form of shining brown scales, and contains from 24 to 25 per cent. of iron. It is slowly soluble in cold water, more quickly in hot water, and the solution is not clouded by boiling nor by the addition of alcohol. Iron peptonate, its solution, and a syrup prepared from it are used in preference to inorganic salts of iron because of the absence of injurious effects upon the teeth and mucous membrane and its deficiency in astringency. The *dose* is from three to ten grains (0.2–0.65 Gm.).

Liquor Ferri Peptonati.—Solution of iron peptonate is made according to the supplement of the German Pharmacopœia (1890 edition) as follows: Dried peptone, 8 Gm., is dissolved in 100 Gm. of hot water, and to the solution, when cold, are added 174 Gm. of solution of oxychloride of iron (*Liquor Ferri Oxychlorati*, P. G., sp. gr. 1.050), gradually and under constant stirring. The liquid is exactly neutralized with diluted solution of sodium hydroxide, and the precipitate washed with distilled water until the washings are unaffected by solution of silver nitrate. The precipitate is drained on a muslin strainer, mixed with 200 Gm. of syrup, then warmed and dissolved by the cautious addition of solution of sodium hydroxide (1.5 per cent.). To this solution are added alcohol, 100 Gm.; tincture of orange peel, 3 Gm.; aromatic tincture and tincture of vanilla, of each 1.5 Gm.; acetic ether, 5 drops, and sufficient distilled water to make the preparation weigh 1000 Gm. It is a transparent, reddish-brown liquid, containing about 0.6 per cent. of metallic iron, and should be protected against the light, to prevent precipitation.

Liquor Ferri Albuminati. Solution of Iron Albuminate. Eisenalbuminatlösung, G.—Thirty-five parts of dry egg albumin are dissolved in 1000 parts of water, the solution is strained and then poured slowly in a thin stream, under constant stirring, into a mixture of 100 parts of solution of oxychloride of iron (dialyzed iron) and 1000 parts of water; the precipitate is well washed with water and then dissolved in a mixture of 3 parts of 15 per cent. solution of sodium hydroxide and 50 parts of water; 150 parts of alcohol, 100 parts of cinnamon water, and 2 parts of aromatic tincture are added to the solution with sufficient water to make the finished preparation weigh 1000 parts. It contains about 0.4 per cent. of metallic iron, and when added to alcohol should form a transparent liquid.

On slowly heating 10 Cc. of a solution (1 in 20) of *iron peptonate* with 2 Cc. of hydrochloric acid to boiling, the liquid at first becomes turbid, then separates in flakes, which finally dissolve.

Iron-Wood. *Ostrya virginiana* (Mill.), Willd. (*O. virginica*, Willd. *Carpinus virginiana*, Mill.) (Fam. Betulaceæ.)—The wood of the *hop-hornbean* is said to be tonic, antiperiodic, and alterative, and the fluidextract has been used in *doses* of from a half to one fluidrachm (1.8–3.75 Cc.) in *ague*.

Isarol. *Ichthyodin.*—This is a substance prepared by the action of sulphuric acid on impure ichthyol. It occurs as a brownish-red thick liquid, having an odor like that of ichthyol; containing about 9 per cent., or, when dried, 17 to 19 per cent., of sulphur. It makes a clear solution in water, and is also soluble in ten parts of 95 per cent. alcohol. It is said to be therapeutically equivalent to ichthyol, and has been recommended on account of superior cheapness to the refined ichthyol.

Isatis. *Isatis tinctoria*, L. *Woad. Pastel.* (Fam. Cruciferæ.)—A biennial plant, indigenous and cultivated in Europe. The leaves have a fugitive, pungent odor, and an acrid, very durable taste; they have been used in scorbutic affections, jaundice, and other complaints, but are only valuable because of the indican present, which yields indigo blue. (See *Indigo*.) The leaves are prepared by grinding them to a paste, which is made into balls, placed in heaps, and allowed to ferment. When the fermentation is at an end, the mass falls into a coarse powder, which is woad.

Isopral. *Trichlorisopropylalkohol*, $CCl_3.CHOH.CH_3$.—This substance, which has been proposed as a hypnotic, occurs in microscopic prisms, melting at 49° C. (120.2° F.), readily soluble in water, alcohol, or ether, readily subliming and having a camphor-like odor and aromatic taste. Heated with alkalies for a long time it loses chlorine without the formation of chloroform. According to Impens, it is readily absorbed through the skin, subcutaneous tissue, and the digestive tract, the impression, when taken internally, being manifested in from three to five minutes. It is said, also, that a stream of air directed over warmed isopral will produce marked narcosis in the lower animals in ten or twelve minutes. It is eliminated through the kidneys chiefly as a compound glycuronic acid (*trichlorisopropylglycuronic acid*), although it is believed also to escape to some extent through the respiratory tract. According to Impens, in proportion to its narcotic influence it is only half as poisonous to the lower animals as is chloral. The *dose* is from ten to thirty grains (0.65–2 Gm.). In the dog the smallest dose certain to produce sleep is said to be 0.093 gramme per kilogramme, 0.6 gramme being the lethal dose.

Isopyrum. *Isopyrum thalictroides*, L. (Fam. Ranunculaceæ.)—F. A. Harsten believes he has found two alkaloids, *isopyrine* and *pseudoisopyrine*, in the root of this plant. (*A. J. P.*, xliv. 453.)

Ispaghula. *Br. Add.*—The dried seeds of *Plantago ovata*, Forsk. (*Plantago Ispaghula*, Roxb.) There are in the Indian bazaars two ispaghulas, one pinkish-white, the other brown, the pinkish-white being the official, the brown, the seeds of *P. amplexicaulis;* although both plants are found in the Punjab, the commercial supply of the seeds appears to come chiefly from Persia. The boat-shaped seeds are acute at one end, from one-tenth to one-eighth of an inch long, and have dark elongated spots on the convex side. They are odorless and tasteless and produce with water a viscid mucilage. They are used in India as a demulcent in *dysentery* and various intestinal irritations, and are also slightly laxative. On roasting they are said to become astringent, and as such are used for *diarrhœas*, especially of children. By European practitioners they have been chiefly employed in *chronic diarrhœa*. The Br. Add. recognizes a *decoction* (*Decoctum Ispaghulæ*, Br. Add., two drachms to the pint), given in *doses* of one-half to two fluidounces (15–60 Cc.). The *dose* of the powder is 50 to 150 grains (3.2 to 9.8 Gm.).

Issue Peas.—These are globular beads, of the size of a pea, made of woody substances of spongy structure, intended to be introduced into issues, abscesses, etc., for the purpose of promoting suppuration.

Jacaranda.—Several species of this genus (Fam. Bignoniaceæ) are employed in *syphilis* in Brazil and other portions of South America under the names of *caroba, carobinha,* etc. Peckolt (*A. J. P.,* 1882, 134) has found in them a crystalline substance, *carobin,* besides resins and acids, such as *carobic* and *steocarobic acids,* and *carobon, caroborelinic acid,* and *caroba balsam.* Hesse (*Ann. Chem.,* 252, 150) found only an aromatic resin, but no alkaloid. The value of the remedy has been asserted in the *B. M. J.,* vol. i. 1885. For further information, consult *P. J.,* 3d series, vols. v., xii., and xiv., and also *A. J. P.,* 1882.

Jambosa Root.—This is the root of *Eugenia Jambos* (*Myrtus Jambos,* H. B. K., *Jambos vulgaris,* DC., *Eugenia jambosa,* Crantz), of the fam. Myrtaceæ, which is widely cultivated in the tropics under the name of the *rose-apple.* It has been found by A. W. Gerrard to contain an oleoresin, besides a crystalline principle, *jambosin,* $C_{10}H_{15}NO_3$. Lyons has also found in it minute quantities of an alkaloid. The decoction of the bark of the root is used as an astringent in *dysentery, gonorrhœa,* and *leucorrhœa.* (*P. J.,* March, 1884.)

Jambu Assu. *Piper Jaborandi.*—The root of *Piper Jaborandi,* Vell. (*Serronia Jaborandi,* Guill., *Ottonia Jaborandi,* Kunth) (Fam. Piperaceæ), is one of the jaborandis of Brazil, which is used by the natives as a sudorific, a diuretic, and a febrifuge. It is said to contain an alkaloid and a pungent oleoresin. (See *Pilocarpus.*)

Jatropha. *Jatropha macrorhiza,* Benth. *Jicama.* This is a euphorbiaceous plant which inhabits Northern Mexico and the adjoining United States. It is a mild purgative, acting excessively in overdose, and is believed by the Mexicans to be cholagogue. The *dose* of the fluidextract is stated to be from one-half to two fluidrachms (1.8–7.5 Cc.).

Jeffersonia. *Jeffersonia diphylla* (L.), Pers. *Twinleaf.* (Fam. Berberidaceæ.)—This herbaceous perennial is found in various parts of the Middle and Middle-Western United States. The rhizome, which, with the rootlets attached, is the part used, has a brownish-yellow color, and a bitter, acrid taste, which resides in its cortical part, the inner portion being nearly tasteless. E. S. Wayne of Cincinnati, found it to contain albumen, gum, tannic acid, starch, pectin, a fatty resin, hard resin, sugar, lignin, and a peculiar acrid principle, having acid properties and resembling polygalic acid, in which it is supposed that the virtues of the root reside. The root is said to be emetic in large doses, tonic and expectorant in smaller doses and not unlike senega, as a substitute for which it is sometimes used. (*A. J. P.,* xxvii. 1.) According to Mayer of New York, the rhizome of this plant contains a small quantity of berberine and a second white alkaloid. The pectin of Wayne he considers to be saponin. (*Ibid.,* 1863, 99.) A. W. Flexor proved the absence of berberine from the root. (*Am. Drug.,* 1884.) Gordin has since confirmed this view (1902).

Jellies.—The form of jelly is sometimes a convenient method of administering medicines, especially the fixed oils, as cod liver oil, castor oil, resinous juices, etc. The following is a formula recommended by Parrish and William C. Bakes. "Take of the fixed oil or liquid resin a *troyounce;* honey, syrup, each, *half a troyounce;* gum arabic, in powder, *two drachms;* Russian isinglass, *forty grains;* orange-flower water, *six fluidrachms.* Dissolve the isinglass, with the aid of heat, in half a fluidounce of the orange-flower water, replacing the water as it evaporates. Triturate the other ingredients, with the remainder of the orange-flower water, into a homogeneous mass in a warmed mortar, then add the hot solution of isinglass, stir the mixture as it cools, and set it aside to gelatinize." (*A. J. P.,* 1861, 4.) Any other aromatic water may be substituted for that of the orange flower, and cinnamon water diluted with an equal measure of pure water would probably better cover the offensive taste. In reference to cod liver oil, the bitter-almond, or cherry-laurel water would be still more effectual, care, however, being taken, in this case, that the water be duly diluted, lest too large a dose of it be administered.

Juglans. *U. S.* 1890.—"The bark of the root of *Juglans cinerea* Linné (nat. ord. *Juglandaceæ*), collected in autumn." *U. S.* 1890. *Ecorce de Noyer gris,* Fr. *Graue Wallnussrinde,* G. Several products of *Juglans regia,* L., or common *European walnut,* are used medicinally in Europe. The hull of the fruit has been employed as a vermifuge from the times of Hippocrates, and has been recommended in *syphilis* and for old *ulcers.* The expressed oil of the fruit has been deemed efficacious against the *tapeworm,* and is also used as a laxative injection. The leaves, long occasionally employed for various purposes in both regular and domestic practice, have been found by Négrier of Angers, in the highest degree efficacious in *scrofula.* He gave to children a teacupful of a pretty strong infusion, or six grains (0.4 Gm.) of the aqueous extract, or an equivalent dose of a syrup prepared from the extract, two, three, or four times a day, and at the same time applied a strong decoction to the ulcers, and as a collyrium when the eyes were diseased. No injury ever resulted from a long-continued use of the remedy. It appears to act as a moderately aromatic bitter and astringent. (*A. G. M.,* 3e sér., x. 399 and xi. 41.) They are said also to have proved useful as a topical application in *malignant pustule.* (*Ibid.,* 5e sér., x. 609.) [1] The leaves of *J. nigra,* L. (*black walnut*),[2] and those of *J. cinerea,* probably possess the same properties.

Juglans cinerea, Willd. *Juglans cathartica,* Michaux. *Butternut. Oil Nut. White Walnut. U. S.* 1890.—An abundant tree of the Northern, Eastern and Western portions of the old United States, reaching into Canada. The fruit, when half grown, is sometimes made into pickles, and, when ripe, affords in its kernel a grateful article of food. The bark is used for dyeing wool a dark-brown color, though inferior for this purpose to that of the black walnut. It is said to be rubefacient when applied to the skin. The inner bark

[1] *Nucitannic Acid.*—In the walnut, between the kernel and the shell, is a thin membrane, which closely embraces the cotyledon, called the *episperm,* which consists of two layers, the inner very thin, colorless, translucent, and perfectly tasteless, the outer coarser, somewhat colored, and of a bitter, disagreeable taste. The latter, examined chemically by T. L. Phipson, was found to contain, among other principles, as gallic and ellagic acid, etc., a new variety of tannic acid, which he proposes to name *nucitannic acid* or *nucitannin,* to which the outer membrane chiefly owes its unpleasant taste. It is a glucoside, as when boiled for some hours with diluted hydrochloric acid it splits into glucose and a peculiar red acid substance, which he calls *rothic acid,* $C_{14}H_{12}O_7$, and the properties of which he has pretty thoroughly investigated. (*Chem. News,* Sept. 3, 1869, p. 116.)

[2] For an exhaustive chemical examination of black walnut leaves by Miss L. J. Martin, see *A. J. P.,* 1886, p. 468.

is the medicinal portion; that of the root, being considered most efficient, was directed by the U. S. P. It should be collected in May or June.

On the living tree, the inner bark, when first uncovered, is of a pure white, which immediately on exposure becomes a fine lemon color, and ultimately changes to deep brown. It has a fibrous texture, and was officially described as follows: "In flat or curved pieces, about 5 Mm. thick; the outer surface dark gray and nearly smooth, or deprived of the soft cork and deep brown; the inner surface smooth and striate; transverse fracture short, delicately checkered, whitish and brown; odor feeble; taste bitter and somewhat acrid." *U. S.* 1890. Its medicinal virtues are extracted by boiling water. Bigelow could detect no resin in the bark, and the presence of tannin was not evinced by the test of gelatin, though a brownish-black color was produced by ferrous sulphate. Charles O. Thiebaud found the bark to be destitute of tannic acid and of any vegetable alkaloid, but to contain bitter extractive, oily matter in large proportion, a volatilizable acid crystallizing in bright, orange-yellow crystals, and appearing to bear some analogy with chrysophanic acid, named *juglandic acid*, another acid crystallizing in tabular colorless crystals, and a volatile acid, with ashes, potassium largely, with traces of sodium, calcium, and aluminum. (*A. J. P.*, 1872, p. 253.) Dawson found resin in very small proportion, a volatile acid, and, besides the bases discovered by Thiebaud, magnesium, combined, as were the other bases, with carbonic, hydrochloric, phosphoric, and silicic acids. Maisch has no doubt that the juglandic acid of Thiebaud is the *nucin* of A. Vogel, Jr., found in green walnut peel. (*A. J. P.*, April, 1874, 167.) E. D. Truman (*Ibid.*, 1893, 426) made proximate analyses of the root bark and the trunk bark for comparison. In the trunk bark, instead of the crystallizable juglandic acid, he found an uncrystallizable acid and a crystalline resin. Tanret and Villiers isolated from the leaves a carbohydrate, *nucite*, $C_6H_{12}O_6 + 2H_2O$, which fuses at 218° C., is not fermentable, and does not reduce Fehling's solution. It has since been shown to be identical with *inosite*. Tanret also (*Jahresb. f. Pharm.*, 1876, 198) thinks that he has obtained an alkaloid from walnut leaves, which he proposes to call *juglandine*. The European walnut bark yielded *glycyrrhizin* abundantly to Sestini. *Juglon*, $C_{10}H_6O_3$, the characteristic constituent of *Juglans regia*, has been prepared synthetically by Bernthsen and Semper, and is now recognized as *a-oxynaphthoquinone*, $C_{10}H_5(OH)O_2$, as it can be made from dioxynaphthalene by the action of chromic acid mixture. It is in brownish-red crystalline needles having a faint odor of walnut hulls, and is sternutatory. (*Ber. d. Chem. Ges.*, 1887, 934.)

Extractum Juglandis. U. S. 1890. *Extract of Juglans. Extrait d'Ecorce de Noyer gris*, Fr.; *Butternussrinden-Extrakt, G. Extract of Butternut.*—"Juglans, in No. 30 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three thousand cubic centimeters* [or 101 fluidounces, 212 minims] of tincture are obtained, or the Juglans is exhausted. Distil off the Alcohol from the tincture by means of a water-bath, and evaporate the residue, on a water-bath, to a pilular consistence." *U. S.* 1890.

Butternut is a mild cathartic resembling rhubarb in its action, but less certain. It was much used during our Revolutionary war as an habitual laxative, and was especially esteemed by Rush in the treatment of *dysentery* and *hepatic congestions*. It should always be given in the form of extract. *Dose* of the extract, from twenty to thirty grains (1.3–2.0 Gm.), or as a laxative, five to ten grains (0.32–0.65 Gm.).

Juniperus. *U. S.* 1880. *Juniper. Fructus Juniperi*, P. G. *Baccæ Juniperi. Juniper Berries. Genièvre, Baies de Genièvre*, Fr. *Gemeiner Wachholder, Wachholderbeeren*, G. *Ginepro*, It. *Enebro, Bayas de Enebro*, Sp.

Juniperus communis, L. (Fam. Coniferæ), is an erect evergreen shrub, usually small, but sometimes twelve to fifteen feet high, with numerous very close branches.

The common juniper is a native of Europe and the northern regions of Asia and North America. Northward it becomes a trailing shrub, seldom more than two or three feet high, spreading in all directions, throwing out roots from its branches, and forming beds which are often many rods in circumference. The name of *J. depressa* has been proposed for this variety. The common juniper flowers in May, but does not ripen its fruit until late in the following year. All parts of the plant contain a volatile oil, which imparts to them a peculiar flavor. The wood has a slight aromatic odor, and was formerly used for fumigation. A terebinthinate juice exudes from the tree and hardens on the bark. This has been erroneously considered as identical with the gum known commercially as *sandarach*.

The berries, as the fruit is commonly called, are occasionally brought to the Philadelphia market from New Jersey. But, though equal to the European in appearance, they are inferior in strength, and are not much used. The best come from the south of Europe, particularly from Trieste and the Italian ports. They are globular, more or less shrivelled; about as large as a pea; marked with three furrows at the summit, and at the base with tubercles from the persistent calyx, and covered with a glaucous bloom, beneath which they are of a shining blackish-purple color. They contain a brownish-yellow pulp, and three ovate, long, bony, angular seeds. They have an agreeable somewhat aromatic odor, and a sweetish, warm, bitterish, slightly terebinthinate taste. These properties, as well as their medicinal virtues, they owe chiefly to a volatile oil. (See *Oleum Juniperi*, p. 849.) The other constituents, according to Trommsdorff, are resin, sugar, gum, wax, lignin, water, and various saline substances. The proportion of these constituents varies according to the greater or less maturity of the berries. The volatile oil is most abundant in those which have attained their full growth and are still green, or in those which are on the point of ripening. In the latter Trommsdorff found 1 per cent. of the oil. In those perfectly ripe it has been partly changed into resin, and in those quite black, completely so. The berries impart their virtues to water and alcohol. They are very largely consumed in the preparation of gin.

The tops of juniper were formerly directed by the Edinburgh and Dublin Colleges. Their odor is balsamic, their taste resinous and bitterish, and they possess similar virtues with the berries.

Juniper berries are gently stimulant and diuretic, imparting to the urine the odor of violets, and producing occasionally, when largely taken, disagreeable irritation in the urinary passages. They are chiefly used as an adjuvant to more powerful diuretics in dropsical complaints. The infusion is a good preparation. It is made by macerating an ounce of the bruised berries in a pint of boiling water, the whole of which may be taken in the course of twenty-four hours. The fluidextract is an eligible preparation, but for most purposes the oil is preferable. (See *Oleum Juniperi*, p. 849.)

Juniperus Virginiana. L. *Red Cedar. Cèdre de Virginie*, Fr. *Virginische Ceder, Rothe Ceder*, G.—The tops of this plant were formerly included in the Secondary List of the U. S. Pharmacopœia. The tree is an evergreen of slow growth, seldom very large, though sometimes attaining a height of forty or fifty feet, with a stem more than a foot in diameter.

It grows in all latitudes of the United States, east of the Rocky Mountains, from Vermont to the Gulf of Mexico, but it is most abundant and vigorous in the southern section. The interior wood is of a reddish color, and highly valuable on account of its great durability. Small excrescences, which are sometimes found on the branches of the tree, are popularly used as an anthelmintic, under the name of *cedar apples*, in the *dose* of from ten to twenty grains (0.65–1.3 Gm.) three times a day. The tops have a pleasant odor, and a strong, bitterish, somewhat pungent taste. These properties reside chiefly in a volatile oil, and are readily imparted to alcohol. The leaves, analyzed by Wm. J. Jenks, were found to contain volatile oil, gum, tannic acid, albumen, bitter extractive, resin, chlorophyll, fixed oil, lime, and lignin. (*A. J. P.*, xiv. 235.) They bear a close resemblance to the leaves of *Juniperus Sabina*, L., from which they can be certainly distinguished only by the difference of odor. The *oil of red cedar* is now an article of commerce; it is used generally in perfumery, and is one of the principal constituents of the popular extract of white rose. (*A. J. P.*, 1877, 186.) It possesses, in a marked degree, the well known agreeable odor of the red cedar wood. *Cedrene camphor*, $C_{15}H_{26}O = C_{15}H_{24} + H_2O$, may be obtained by cooling the oil until coagulated, and separating the crystalline portion by expression; the expressed liquid is *cedrene*, $C_{15}H_{24}$, which, after rectification and distillation, has the sp. gr. 0.984 at 15° C. (59° F.), boiling at 237° C. (458.6° F.). Cedrene may also be prepared from the cedrene camphor by the dehydrating action of phosphoric anhydride, P_2O_5. The resemblance of red cedar to savin is said also to extend to its medicinal properties. It is, however, much less energetic, and has not acquired the confidence of the profession. Externally applied it acts as an irritant, and an ointment, prepared by boiling the fresh leaves for a short time in twice their weight of lard with the addition of a little wax, is employed as a substitute for savin cerate in maintaining a purulent discharge from blistered surfaces. Sometimes the dried leaves in powder are mixed with six times their weight of rosin cerate, and used for a similar purpose. But neither of these preparations is as effectual as the analogous preparation of savin.

The volatile oil, which resembles oil of savin in its medicinal properties, has been used for the purpose of producing abortion, and in some cases has caused death. The symptoms have been burning in the stomach, vomiting, convulsions, coma, and a slow pulse, with evidences of gastro-intestinal inflammation after death. (See S. C. Watt, *B. M. S. J.*, vol. xl.)

Under the name of *cedar* are known in commerce various trees, some of which do not belong to the genus Juniperus. The wood of *Juniperus bermudiana*, L., is said to be largely used in making pencils. The cedar of Lebanon, *Cedrus Libani*, Barrel, and its two varieties, the *African cedar*, *C. atlantica*, Manetti, and the *Indian cedar* or *deodar*, *C. Deodara*, Loud., are sometimes distilled for oil, and, under the name of *libanol*, an oil obtained from *Cedrus atlantica*, Manetti, or *satin-wood*, has appeared in commerce and is said to be useful in the treatment of *blennorrhagia*, *phthisis*, *bronchitis*, and *eruptions* upon the skin, having properties very similar to those of the oil of santal. It may be given in capsules up to forty-five grains (3 Gm.) per day. In skin eruptions the 25 per cent. ointment made with vaseline has been used. Other trees known as cedars are the *white cedar*, *Cupressus thyoides*, L.; the American white cedar, *Thuja occidentalis*, Linn.; the Californian white cedar, *Libocedrus decurrens*, Torr.; the New Zealand cedar, *Libocedrus Bidwillii*, Hook. The Australian red cedar, *Cedrela Toona*, Roxb., and the West India cedar, *Cedrela odorata*, L., belong to an entirely different family, the Meliaceæ (Cedrelaceæ). The wood of the latter species is used in making cigar boxes, and, according to Schimmel, yields 3 per cent. of a volatile oil, which has a specific gravity of 0.915, boils between 265° and 270° C. (509° to 518° F.), and has an optical rotation of 5.053° in a 100 Mm. tube. It is said to be a powerful insecticide. (*P. J.*, Aug. 29, 1896, 179.)

Kairine. *Kairin*, G.—The hydrochloride of methyloxytetrahydroquinoline, $C_{10}H_{13}ON.HCl + H_2O$, is the commercial kairine (kairine M). Quinoline is treated with sulphuric acid, forming *quinoline-sulphonic acid*, which, fused with caustic soda, yields *oxyquinoline*, which is then reduced with tin and hydrochloric acid, forming *tetrahydroxyquinoline*, and this, on treatment with methyl bromide, yields *methyltetrahydroxyquinoline* or kairine. *Kairine A* is the corresponding ethyl compound, and has similar properties. Kairine, as brought into commerce, is readily soluble in water and alcohol, and forms a grayish-white crystalline powder, with bitter, salty taste. Ferric chloride produces a dark brown color, which upon the addition of sulphuric acid turns purple.

Kairine belongs to the antipyretic remedies, and is without doubt capable of producing pronounced fall of temperature in *fever*, accompanied by copious sweating. It is, however, a cardiac depressant, which is said to act directly upon the cardiac muscles, and is very prone to produce cyanosis and collapse. The reports have been so unfavorable that, in the absence of advantage over antipyrine and antifebrine, kairine is no longer used in practical medicine. *Dose*, five to ten grains (0.32–0.65 Gm.).

Kairoline, M. or A. *Tetrahydromethylquinoline*, or *Tetrahydroethylquinoline.*—These bases differ from kairine in not containing oxygen. Their characters are similar. The sulphates are the commercial salts. For physiological action, see *Ber. d. Chem. Ges.*, xvi. 739.

Kaladana. *Br. Add. Pharbitis Nil.*—"The dried seeds of *Ipomœa hederacea*, Jacq." Closely allied to *Ipomœa hederacea* is *I. muricata*, the seeds of which are largely imported into Bombay, from Persia, under the name of *tukm-i-nil*. The juice of this plant is employed to destroy bedbugs, and the seeds are said to be identical in their medicinal properties with those of the official plant. Kaladana seeds are in the form of the segment of a sphere, black, somewhat hairy, weighing from one-half drachm to nearly one drachm. From them is prepared *pharbitisin, kaladana resin* (*Kaladanæ Resina, Br. Add.*), by digesting the seed with twice its weight of alcohol until exhaustion, and precipitating with distilled water. (For detail see *Br. Add.*) Kaladana resin occurs "in brownish opaque fragments, translucent at the edges, brittle, breaking with a resinous fracture, readily reduced to a gray powder; sweetish, and acrid to the throat; somewhat disagreeable in odor especially when warmed; easily soluble in alcohol (90 per cent.), practically insoluble in benzol, ether, chloroform, or carbon bisulphide. It melts at about 320° F. (160° C.)." *Br. Add.*

Kaladana seeds are actively purgative. In small doses they produce little or no irritation, but in large doses are capable of acting as a violent drastic cathartic. The Br. Add. recognizes a *compound powder of kaladana* (*Pulvis Kaladanæ Compositus*, Br. Add.), composed of five parts of kaladana, nine parts of potassium tartrate and one part of ginger, which is an imitation of the compound powder of jalap, and is used for similar purposes, in the *dose* of twenty to sixty grains (1.2–3.9 Gm.). *Tincture of kaladana* (*Tinctura Kaladanæ*, Br. Add., four ounces in one pint) is given in the *dose* of one-half to one fluidrachm (1.8–3.75 Cc.). Much the best preparation is the resin, *dose*, two to eight grains (0.13–0.5 Gm.) administered in pill or capsule, combined with extract of belladonna or an aromatic.

Kalagua.—A study of this South American plant, which has been put upon the market as a specific for *tuberculosis*, made upon the lower animals by D. H. Bergey, shows that it has no specific influence upon the tubercle bacillus.

Kalmia. *Kalmia latifolia*, L. *Laurel. Mountain Laurel. Broad-leafed Laurel. Calico-bush. Spoonwood. Kalmie*, Fr., G.—This well-known ericaceous evergreen is found from New Brunswick to Florida and from Ohio to Louisiana, being especially abundant on the sides of hills and mountains. It is from three to ten feet in height. The leaves, which are supposed to be possessed of poisonous, narcotic properties, have been found by Charles Bullock to contain gum, tannic acid, resin, chlorophyll, fatty matter, a substance resembling mannite, an acrid principle, wax, extractive, albumen, yellow coloring matter, lignin, and salts of potassium, calcium, and iron. (*A. J. P.*, xx. 264.) George W. Kennedy detected the glucoside arbutin in them. (*Ibid.*, xlvii. 5.) Although chemists have failed to find the toxic principle in this plant, the leaves are popularly believed to be poisonous to sheep and other small animals, but are said to be eaten with impunity by deer, goats, and grouse. It is also affirmed that severe and fatal poisoning has been produced by eating grouse that have fed upon these leaves. (See 16th ed. *U. S. D.*) Scientific proof of the poisonous properties of the laurel still seems to be lacking. The leaves have been used internally in *diarrhœa* and in *syphilis*, and externally in skin diseases. (See 16th ed. *U. S. D.*)

It is probable that other species of Kalmia, as *K. angustifolia*, L., or *sheep-laurel*, and *K. glauca*, Ait., or *swamp-laurel*, have properties identical with those of *K. latifolia*. A decoction of the leaves of *K. angustifolia* is used by the negroes as a wash for ulcerations between the toes.

Kamala. *U. S.* 1890. *Kamala. Glandulæ Rottleræ.*—The U. S. Pharmacopœia, under the name of *Rottlera*, U. S. 1870, *Kameela*, formerly recognized the glands and hairs from the capsules of *Mallotus philippinensis* (Lamarck), Muell. Arg. (*Rottlera tinctoria*, Roxburgh). This tree grows in Abyssinia, Southern Arabia, Hindostan, the East India islands, China, and Australia, reaching a height of from fifteen to twenty feet, and yielding a roundish, three-valved, three-celled capsule about the size of a small cherry, thickly covered with a red powder, which is collected in Hindostan by rolling the berries about in large baskets until the freed powder sifts through the open wicker-work.

Kamala, as brought to our market, is a light, finely granular, very mobile powder, of a brownish-red or madder color, with little odor or taste, but producing a slight sense of acrimony in the mouth, and feeling gritty under the teeth. (When the grittiness is excessive, the drug has probably been adulterated with earthy matters.) It is inflammable, and flashes almost like gunpowder when dropped into the flame of a candle. It is insoluble in cold and but very slightly soluble in boiling water; but alkaline solutions, alcohol, and ether dissolve a large proportion of it, forming a deep red solution, from which water precipitates resinous matter, "imparting a deep red color to alkaline liquids, alcohol, ether, or chloroform, and a pale yellow tinge to boiling water." *U. S.* 1890. Under the microscope it consists of garnet-red, semi-transparent, roundish, glandular granules, from $\frac{1}{800}$ to $\frac{1}{250}$ of an inch in diameter, and containing numerous red, club-shaped vesicles, more or less mixed with minute stellate hairs, and the remains of stalks and leaves, the latter of which are easily removed by careful sifting. It has been examined chemically by Thomas Anderson of Glasgow, and by G. Leube, in Germany. As given by the former, the constituents are, in 100 parts, 78.19 of resinous coloring matter, 7.34 of albumin, 7.14 of cellulose, etc., a trace of volatile oil and volatile coloring matters, 3.84 of ashes, and 3.49 of water. The amount of earthy impurities, chiefly sand, in commercial kamala, varies greatly, sometimes amounting to fifty or even sixty per cent. It can readily be estimated by heating the drug to redness and weighing the residue. The U. S. P. permitted the presence of "not more than 8 per cent. of ash." Any specimen of kamala containing more than the official percentage of impurity should be rejected. Of the resinous coloring substances, Anderson obtained one in a pure state by allowing a concentrated ethereal solution to stand for two days, draining and pressing in bibulous paper the resulting mass of granular crystals, and purifying them from adhering resin by repeated solution in ether and recrystallization. To this substance he gave the name of *rottlerin*. It is in the form of minute crystalline plates, of a yellow color and a satin-like lustre, insoluble in water, sparingly soluble in cold but more so in boiling alcohol, and readily dissolved by ether, and by alkaline solutions, which assume a dark red color. Rottlerin melts when heated moderately, and at a higher heat is decomposed, giving off pungent vapors. Its

formula, according to Anderson, is $C_{11}H_{10}O_3$. A and W. Perkin (*Ber. d. Chem. Ges.*, 19, 3109) and Jawein (*Ibid.*, 20, 182) both stated that rottlerin can be extracted from kamala by the action of carbon disulphide. Jawein gave its fusing point as 200° C. (392° F.), and said that it was easily soluble in hot alcohol and acetic acid. In a later communication, A. G. Perkin (*P. J.*, 1893, 159, 236), stated that when he extracted it with ether, kamala yielded a dark brownish resinous product from which six distinct substances can be isolated. Rottlerin, iso-rottlerin, a wax, and two resins, one of high and one of low melting point, form the principal constituents. There is also present a trace of a yellow crystalline coloring matter melting at from 192°–193° C. (377.6°–379.4° F.). The formula $C_{11}H_{10}O_3$ for rottlerin is confirmed. Perkin also found in kamala a small quantity of a sugar soluble in water. Potassium permanganate oxidizes it to oxalic and benzoic acids; nitric acid of 1.5 sp. gr., on the other hand, oxidizes it to oxalic acid, ortho- and para-nitrocinnamic acids, and para-nitrobenzoic acid. The ashes were in the extraordinary proportion of 25.85 per cent., and of the ashes 83.8 per cent. consisted of insoluble silica. Silica probably enters essentially into the constitution of the minute granules, and its presence accounts for their grittiness under the teeth. The active constituent is supposed to be the resin.

Kamala is actively or even violently purgative in full doses, occasionally causing nausea, but seldom vomiting. Although long used in India against the *tape worm*, the value of kamala as a tænifuge was first made generally known by C. Mackinnon (*Ind. Ann. Med. Sci.*, 1854). It is given, without previous preparation of the patient, in the *dose* of from one to three drachms (3.9–11.6 Gm.), suspended in water, mucilage, or syrup. In the latter dose it sometimes acts violently. The worm is usually expelled dead at the third or fourth stool. If the first dose fails to operate on the bowels, it may be repeated in four hours, or followed by a dose of castor oil. The tincture (four ounces to eight fluidounces of diluted alcohol) is also said to be efficient in *doses* of from one to four fluidrachms (3.75–15 Cc.). As an external remedy, kamala is used by the people of India in various affections of the skin, particularly *scabies*. William Moore of Dublin, has employed it successfully in *herpetic ringworm*. (*Dublin Hosp. Gaz.*, Nov. 15, 1857.)

Kandol. *Canadol.*—This is a light fraction of petroleum of great volatility, which is said to afford a very cheap and efficient means of rapidly freezing the skin and subdermal tissues.

Kava Rhizome. *Kavæ Rhizoma.*—"The decorticated, dried, and divided rhizome, without the roots, of *Piper Methysticum*, Forster." *Br. Add.* *Ava*, or *kava*, is the native name of a beverage formerly prepared in the Sandwich Islands, by the aborigines, from the root of the *Piper Methysticum*, Forst. (*Macropiper Methysticum*, Miq., *Methysticum esculentum*. Raf.). The intoxication produced by this drug is wholly unlike that caused by alcohol, being of a silent and drowsy character, accompanied by incoherent dreams, with great loss of muscular power, which is probably due to the action of kava resin upon the spinal cord.

The rhizome of the kava is large, fibrous, and spongy. In commerce "it occurs in whitish or light brownish-gray irregularly cuboid or roughly wedge-shaped fragments, from which the gray periderm has been sliced off; from half an inch to two inches (one and a quarter to five centimetres) thick. Most of the fragments exhibit, when cut, a central portion of a close, even texture, surrounded by a distinct ring of narrow radiating vascular bundles, separated by relatively broad paler medullary rays. The rhizome has a starchy fracture, a slight somewhat pleasant odor, and, when masticated, a piperaceous, faintly bitter, and slightly saponaceous taste. Pieces of a coarsely porous or very woody character should be excluded." *Br. Add.*

Gobley isolated from kava root a crystalline principle (analogous to piperin), *methysticin*, or *kavahin*, which is without odor and taste, and is probably inert. (*J. P. C.*, Jan. 1860.) It possesses the formula $C_{16}H_{18}O_5$, and when purified forms silky, lustrous needles melting at 138° to 139° C. (280.4° to 282.2° F.). Kavahin differs from piperin and cubebin in being colored red by hydrochloric acid, the red color fading on exposure to air into a bright yellow, and in being colored by strong sulphuric acid a purplish violet, which passes into green. In 1844 Morson discovered an active principle, *kawine*. This is a greenish-yellow, strongly aromatic and acrid resin. It was again studied by Cuzaut in 1860, and by Lewin in 1886. This latter investigator separates it into two resins, of which the β-resin is greasy and of a reddish-brown color, appearing in mass almost black. This is less active than the α-resin, which is yellowish brown, has the characteristic odor of the drug, is freely soluble in alcohol, and placed upon the tongue produces a burning sensation followed by local anæsthesia. (*A. J. P.*, 1886, 450.) A volatile oil has also been found in the root. (*J. P. C.*, March, 1862.) Lavialle (*L'Union Pharm.*, Jan. 1889) claims to have obtained an alkaloid, *kavaine*. (See also *Proc. A. Ph. A.*, 1897, 564.)

The physiological action of kava root and its resin has been especially investigated by L. Lewin (*Piper Methysticum*, Berlin, 1886), and David Cerna (*T. G.*, 1891). The phenomena which follow the hypodermic injection of the fluidextract of kava or of a solution of its resin are, anæsthesia at the point of injection, followed after absorption by general paralysis, due to a direct paralysis of the motor side of the spinal cord, the motor nerves and the muscles remaining intact. The local anæsthesia is due to a paralysis of the sensory nerve filaments, and when the resin is brought in contact with the mucous membranes there is a burning pain, followed in time by a complete loss of sensibility, which is remarkably permanent, since Lewin found that from six to seven minims of a solution of kava injected beneath the skin produced a complete loss of sensibility in the surrounding area, which did not pass away for eight days. (*D. M. Ztg.*, Feb. 1886.) The action of the drug upon the circulation is subordinate to its nervous influence, but according to the experiments of Cerna it does stimulate the heart, although it decreases the number of pulsations by stimulating the inhibitory nerve centres. The same investigator found that at first it stimulates, afterwards depresses, and finally paralyzes the respiration, by an action upon the centres. The insolubility and irritant action of kava resin prevent its use as a practical local anæsthetic.

As long ago as 1857 kava root was employed in the treatment of *gonorrhœa*, and there is much testimony to its value both in the acute and the chronic form of the disease, as well as in *vaginitis*, *leucorrhœa*, *nocturnal incontinence*, and similar conditions of the genito-urinary tract.

Of the *liquid extract of kava* (*Extractum Kavæ Liquidum*, Br. Add.), one imperial pint represents twenty avoirdupois ounces of the rhizome; it is given in *doses* of from thirty to sixty minims (1.8–3.75 Cc.), and is probably the best form for the administration of the drug.

Kephir. *Kefir.*—This is milk which has undergone a peculiar fermentation caused by certain fungus masses, which have been long known by the Tartars as *Kephir seed*, or as the *Millet of the Prophet*. They are white, irregularly roundish bodies, of about the size of a walnut, with a very rough furrowed surface, a tough gelatinous, or, when dried, cartilaginous consistency. They have been found by morphologists (C. D. Spivak, *N. Y. M. J.*, 1896) to be composed of three different organisms. 1. *Saccharomyces cerevisiæ* (Meyen), or the yeast fungus; 2. *Bacillus acidi lactici* (Pasteur); and 3. *Dispora caucasica*, Kern, or *Bacillus kephir* (Sorokin), a rod-shaped bacterium. For an analysis of kephir, see König's *Nahrungs- und Genussmittel*, 3te Aufl., Bd. i. 420.

For the methods used by the Tartars in preparing kephir, see the previous editions of the *U. S. D.*, also the paper by Spivak. The method of Dmitrieff, which may be practised by any one having the kephir grains, is described in the *N. Y. M. J.*, Jan. 1896. According to Spivak, the changes in milk during kephirization are as follows: 1. Fat, salts, and water remain unchanged. 2. The quantity of lactose is gradually lessened from 30–50 per mille to 16–30 per mille in the second-day kephir, and to 12–20 per mille in the third-day kephir. 3. Lactic acid is increased from 3.5–8.6 per mille in second-day kephir to 6.3–9.0 in third-day kephir. 4. Alcohol is produced from 5.3–8.0 per mille in second-day kephir to 6.0–10.0 in third-day kephir. 5. Carbon dioxide is generated in quantities approximating 10 per cent. 6. A part of the casein—namely, about 10 per cent.—is transformed into acid albumin and peptone, 10 per cent. into hemialbumose, and the rest loses its lime, and therefore becomes digestible.

Kephir may be employed for the same purposes as are koumys and matzoon. It yields its constituents readily to assimilation, and is somewhat laxative and distinctly diuretic. It may be employed in various forms of *dyspepsia*, whether organic or functional, in *anæmia* and *chlorosis*, in *rachitis*, *chronic rheumatism*, *phthisis*, and other conditions of impaired nutrition.

Keratin.—The outer skin surface, the material of horns, hoofs, tortoise shell, the finger nails, all show a similar chemical composition, the empirical formula of which is said to be $C_{41}H_{71}N_{12}SO_{14}$. The percentage of sulphur varies, however, considerably. Keratin is prepared by Unna by steeping parings of horn in a digestive liquid composed of pepsin, 1, hydrochloric acid, 1, and water, 11, as long as the shavings yield anything to the solvent. The residue is then dissolved in ammonia by maceration lasting several weeks, after which the solution is evaporated.

Gissmann boils the quills of birds' feathers in glacial acetic acid for from twenty-four to thirty-six hours in a retort furnished with a return condenser. A thick yellow-brown liquid is thus obtained, which is filtered through glass wool, evaporated on a water bath to the consistence of an extract, and afterwards dried. Dieterich employs Gissmann's process, but before the treatment with acetic acid he subjects the feathers to ten hours' digestion in water and then to eight days' maceration in a mixture of equal weights of ether and alcohol, to eliminate fatty matters and cholesterin.

Keratin obtained by one of the foregoing processes is dissolved with the aid of a gentle heat either in acetic acid or ammonia, and the solution is allowed to clear by standing. Fischer recommends the employment of seven parts of keratin with either one hundred parts of acetic acid, or a mixture of equal parts of ammonia and diluted alcohol. Keratin is insoluble in water, alcohol, ether, and diluted acetic acid, or acidulated pepsin solution. Diluted sulphuric acid on boiling changes it into leucin, tyrosin, and other products. It is soluble in concentrated acetic acid, alkalies, and ammonia.

Keratin has been employed for the purpose of coating pills, so as to enable them to pass through the acid juices of the stomach and be dissolved in the alkaline intestinal fluids. It is proposed to use these coatings for four classes of medicine: 1. Medicines that can by prolonged contact cause irritation to the mucous membrane of the stomach: arsenic, salicylic acid, creosote, chrysarobin, quinine compounds, copaiba, cubeb, ferruginous preparations and especially ferric chlorides, opium, mercurial preparations and especially mercuric iodide and chloride, phosphorus, and all the tænifuge preparations. 2. Medicines that can injure the digestion by giving insoluble precipitates with pepsin and peptones: tannin, alum, lead acetate, preparations of bismuth, silver nitrate, corrosive sublimate, etc. 3. Medicines that are rendered inactive or decomposed by the gastric juice: alkali, bile, soap, calcium sulphide, iron sulphide, pancreatin, etc. 4. Medicines which should arrive in the intestines as concentrated as possible: kousso, santonin, extract of male fern, alkali. For the preparation of a solution of keratin suitable for the coating of pills several formulas have been proposed, in all of which either acetic acid or ammonia is used as a solvent. The acetic solution might be used for coating pills containing salts of mercury, gold, or iron, arsenic, creosote, salicylic acid, tannin, alum, etc. On the other hand, recourse might be had to an ammoniacal solution for pills containing pancreatin, trypsin, bile, alkalies, iron sulphide, etc. If the pill mass should contain water, the pills would shrink and fissures would be produced in the keratin coating. It is, therefore, recommended to use in the making of these pills a mixture of yellow wax, one part, and suet or cacao butter ten parts. It is also necessary to avoid the use of vegetable powders and to employ in their place kaolin or charcoal powder.

When the pills are finished they should be dipped in cacao butter, rolled in charcoal powder, and then keratinized. For this purpose the pills, placed in a porcelain capsule, are sprinkled with a suitable quantity of keratin solution and then shaken together until the evaporation of the solvent takes place. This moistening and drying require to be repeated several times (as many as ten) before the layer of keratin is sufficiently thick. The process employed for coating pills with gelatin, which consists in dipping into the solution the pill fixed on the point of a needle, is not suitable here, for it leaves a hole through the keratin coating that can never be completely closed.

In order to insure that the keratin used is insoluble in the stomach, Unna recommends that a

preliminary experiment should be made with calcium sulphide pills coated with it. If in the course of some hours after such pills are taken eructations of hydrogen sulphide are observed, it would indicate that the pills have been dissolved in the stomach. When the keratin is of good quality nothing of the kind should occur. Finally, the pills when placed in water should not liquefy or crack. (Bourquelot.)

Kinkeliba.—This is the leaf of a plant growing in Western Africa which is affirmed to be of great value in the treatment of bilious *hæmaturic malarial fevers*. The plant has been attributed to various species of the genus Combretum, but probably is the product of the *C. micranthum*. Heckel and Schlagdenhauffen found in the leaves nothing more active than tannin. (See Perrot and Lefevre, *Travaux du Laboratoire de Mat. Méd.*, page 67.)

Kola Nuts. *Cola acuminata* (Beauv.), Schott. (*Sterculia acuminata*, Beauv., *Bichea solitaria*, Stokes.) *Semen* (*Nuces*) *Colæ. Noix de Cola, Noix de Gourou, Café du Soudan*, Fr. *Kolanuss*, G. These are yielded by the large African tree extensively cultivated in various portions of the tropical world for its seeds, which, under their Guinea name, or the Soudan name of *guru nuts*, are extensively employed as a caffeinic stimulant in Africa and other portions of the world. Six hundred tons of them are said to be sent yearly to Brazil for the use of the negroes, who, it is affirmed, also employ the seeds of *S. Chica*, A. St.-Hil., and *S. striata*, A. St.-Hil. (*S. lasiantha*, Mart.). Three varieties of kola nuts are said to be the product of *C. acuminata*. The most valuable, the kola of Sakhala, is the largest, and is of a white color. The kola of Kassi, of Siarra, and of Touté, is of medium size, red or white. The kola of Maninian is small and red. According to Binger, in the Congo the white kola of Anno is yielded by a distinct species, *S. macrocarpa*. Of this white kola there are two varieties, one whitish, resembling the kola of Sakhala but smaller; the other more or less rose-colored and larger. The kola nut itself is irregular in form, reddish gray in color, from three-quarters of an inch to an inch and a quarter in length, flattened and rounded upon one surface, irregularly scooped out or infolded upon the other surface, the nut being apparently a cotyledon, marked above with another cotyledon which it has embraced. Daniell (*P. J.*, 1865) was the first to show that kola nuts contained caffeine. Subsequently an elaborate analysis yielded to Attfield 2⅔ per cent. of caffeine from the nut. Schuchardt summarizes the results of his chemical analyses as follows: 1, Martinique nuts contained 1.06 per cent. caffeine; 2, Ceylon, 1.39 per cent.; 3, Gaboon, 1.47 per cent.; 4, Tropical West Africa coast, Sierra Leone, 1.69 per cent.; 5, Tropical West Africa, interior, 1.61 per cent. The chemical studies of Parke, Davis & Co. show that as found in American commerce these nuts contain from 0.72 to 2.02 per cent. of caffeine. Heckel and Schlagdenhauffen (*A. J. P.*, 1884) give theobromine 0.023 per cent., caffeine 2.35 per cent., tannin 1.62 per cent., as the result of their analyses. The researches of Knebel (*A. J. P.*, 1892, 190), confirmed by Hilger (*Ibid.*, 568), show that fresh kola nuts probably contain no caffeine, but a glucoside, *kolanin*, which yields by its decomposition caffeine, glucose, and *kolared* ($C_{14}H_{13}(OH)_5$). The glucoside is decomposed by a ferment present in the nuts, and therefore readily yields the caffeine as a decomposition product. Schweitzer (1895) confirmed the results of Knebel and Hilger, and proposed for kolanin the formula $C_{40}H_{56}N_4O_{21}$. Knox and Prescott (*Proc. A. Ph. A.*, 1896, 136), after an investigation, assert that the kola ferment does not assist in the liberation of caffeine, but attribute the presence of caffeine to the action of heat and moisture; they also give the name of *kolatannin* or *kolatannic acid* to the tannin of kola nuts, and propose a method of assay. (*Proc. A. Ph. A.*, 1897, 131.) For Carle's method of assay, see *P. J.*, 1896, 289.

It has been asserted for kola nuts that they increase the power of enduring fatigue without food, and a dry powder or cake of kola nuts, deprived of their oil, is said to be used by the European Alpine clubs. Physiological studies have been made by Loginoff (*In. Dis.*, St. Petersburg, 1891), Davydoff (*In. Dis.*, St. Petersburg, 1891), and Kotlar (*Vrach*, 1891), which on the whole agree in showing the similarity of the action of the drug with that of others of its class. The question whether the action of kola is simply that of caffeine has been much debated, especially owing to the strenuous efforts of a drug firm to introduce kola as a popular stimulant of peculiar power. Several French observers, especially Marie, have found that kola-red is a powerful muscle stimulant, even exceeding caffeine. The very elaborate studies, however, of A. Mosso of Turin (*A. I. B.*, xix.), seem to us decisively to establish the correctness of his conclusion,—namely, that kola-red is, at least so far as the muscles are concerned, an entirely inert substance, and that the action which kola undoubtedly has upon the muscular contraction is due to the caffeine which it contains. Kola is evidently about equivalent to guarana, tea, coffee, etc., and may be substituted for them. In *dose* of one hundred and fifty grains (9.8 Gm.) a day, A. Hudson (*T. G.*, ii.) has found the nuts to act decisively in cardiac weakness.

The so-called *male kola* is essentially distinct from kola, being the product of a small tree, *Garcinia Kola*, and containing no caffeine. The seed is oblong, about one and a half to three inches long and from three-quarters to one inch broad; it is trigonal in section, with a readily removable thin testa of a reddish-yellow to dark brown color, covered by markings which resemble those on the seed coat of the nutmeg. In the section the microscope reveals a number of resinous masses surrounded by cells rich in starch.

The seeds of *Lucuma mammosa* (L.), Juss., (Fam. Sapotaceæ), sometimes mixed with kola nuts, are recognized at once by their strong odor of prussic acid. Heckel and Schlagdenhauffen have observed the seeds of *Heritiera littoralis* mixed with kola nuts. These *false kola nuts* contain no caffeine, and are nearly orbicular and flattened in shape, one of the fleshy, white cotyledons being only half the size of the other. (*A. J. P.*, 1887, 446.)

Kosam Seeds.—The seeds of the *Brucea sumatrana*, indigenous in China and Southern Asia. Schlagdenhauffen found in them saponin, and Physalis and Bertrand a glucoside, *kosamin*. They are asserted to be useful in *menorrhagia*, also in *dysentery* and *diarrhœa*. (*P. J.*, lxiv. p. 463.)

Kossala.—An Abyssinian remedy against *tape worm*. (*Proc. A. Ph. A.*, xxvi.) It is said, however, to produce gastric irritation.

Koumys. *Kumys.*—This is a liquor originally prepared by the Tartars from the milk of mares, but recently imitated with cow's milk to a great extent. It is said to be prepared in Tartary by putting the mare's milk in tall vessels while warm, adding koumys, one part for every ten of milk, stirring thoroughly every few minutes, and in three or four hours taking out and bottling in champagne bottles. (*J. P. C.*, 1875, 59.) For an account of the method employed in Russia, see *A. J. P.*, 1875, 261. The milk of the mares of the Steppes is stated to resemble that of women, being much richer than cow's milk in sugar and poorer in casein. For analyses, see *J. P. C.*, 1875, 62. The true koumys does not keep long, and therefore must be drunk at the place of production. For particulars as to the varieties of it, etc., see *J. P. C.*, Janv. 1875; also Truckenmiller, *A. J. P.*, 1880, 292. L. Wolff (*A. J. P.*, 1880, 291) has furnished, probably, the best formula for koumys: "Grape sugar, half an ounce. Dissolve it in four ounces of water. Dissolve twenty grains of Fleischmann's compressed yeast, or well-washed and pressed out brewer's yeast, in two ounces of milk. Mix the two solutions in a quart champagne bottle, which is to be filled with good cow's milk to within two inches of the top. Cork well, secure the cork with wire, and place in a cellar or ice chest, where a temperature of 10° C. (50° F.) or less can be maintained, and agitate three times a day. In three or four days the koumys is ready for use, and should not be kept longer than four or five days; it should be drawn only with a champagne tap." A beer bottle with patent stopper may be substituted for the champagne bottle.

The composition of true koumys, according to Stalberg, is given below; other analyses may be found in the *J. P. C.*, 1875, 62. *Koumys of June.* In 100 parts, alcohol 1.65, fat 2.05, sugar of milk 2.20, lactic acid 1.15, casein 1.12, salts 0.28, carbonic acid 0.75. *Koumys of September.* Carbonic acid 1.86, alcohol 3.23, fat 1.05, lactic acid 2.92, casein and salts 1.21. Stalberg gives the following as the result of an analysis of Swiss koumys, made from cow's skimmed milk to which sugar had been added. Alcohol 3.622, lactic acid 0.256, sugar 2.376, albumin 2.099, butter 2.008, mineral salts 0.574, carbonic acid 1.997. Warnikiewicz found in koumys from cow's milk 6.32 per cent. of solid material, casein 3.08, butter 0.22, milk sugar 1.77, salts 0.33, lactic acid 0.02, alcohol 1.23 parts per hundred. (See also König's *Nahrungs- und Genussmittel*, 416–419.)

These fermented milks vary in composition with the milk they are prepared from. In the following analyses, the first three columns are taken from *A. J. P.*, 1887; the matzoon analysis is by Uffelmann.

	Cow's milk.	Koumys.	Kephir.	Matzoon.
Albumin	48	11.2	38	31.2
Butter	38	20.5	20	16.0
Sugar of milk	41	22.0	20	16.2
Lactic acid	..	11.5	9	8.3
Alcohol	..	16.5	8	2.1
Water and salts	873	918.3	905	926.2

Gordon Sharp (*P. J.*, 1892, 512) stated that the composition of koumys is complex, and that the decomposition which its proteids undergo is closely allied to putrefaction.

The taste of koumys is sweet but acidulous and peculiar. In small quantities it is said to increase the appetite, in large quantities to take the place of solid food, each quart of it containing, according to Victor Jagielsky, four ounces of solid food. (*N. R.*, i. 1.) In warm weather it is said to act as a diaphoretic, in cold weather as a diuretic. It is used especially in chronic constitutional diseases attended by emaciation, such as pulmonary *phthisis*, in chronic *abdominal catarrhs*, and in *albuminuria*. Hourowicz states that in Russia "the cure" requires from twelve to fifteen pounds of milk daily (two mares), and that the koumys is taken in doses of from a teacupful to a tumblerful every half-hour or hour early in the morning. *Giaourdi* is a fermented milk prepared in Greece from sheep and goats' milk with enzyme obtained from fermented figs.

Kryofine. *Methoxacet-p-phenetidin. Methylglycollic Phenetidin.* $C_6H_4 \begin{cases} OC_2H_5 \\ NH.COCH_2OCH_3 \end{cases}$. This phenetidin derivative or condensation product is made by heating paraphenetidin and methylacetic acid together; the acid replaces the acetic acid in the phenetidin derivative and is thus closely allied to acetphenetidin or phenacetin. Kryofine crystallizes from aqueous solutions in needles, with a melting point of from 98°–99° C. (208.4°–210.2° F.). These crystals are white, and in moderate doses tasteless. In doses exceeding fifteen grains (1.0 Gm.), they cause, after a few moments, the sensation of chewing willow bark. It is soluble in boiling water 1 in 52, in cold water 1 in 600. It is soluble also in alcohol, ether, chloroform, and the oils in excess. The physiological action of kryofine has not been worked out, but it has been shown that the fatal dose for mice is three grains, and for a medium-sized dog two hundred and one grains, death occurring by general paralysis and extreme slowing of respiration and pulse. Seventy-five grains (5 Gm.) given to man have produced no more serious effect than cyanosis with some lessened frequency of respiration. Kryofine can be detected in the urine from fifteen to twenty minutes after taking, disappearing in from six to eight hours. (Ebstein.) In doses of from two and one-half to twenty-five grains it has been strongly commended by Ebstein, Eichhorst, Haas, Morrison, and other clinicians as an analgesic for *pains* of purely *nervous origin* and antipyretic in various *fevers*, and less dangerous, though acting more slowly, than other allied drugs.

The range of action of kryofine appears to be that of antipyrine. The assertion that it is less dangerous than that drug seems hardly to be sustained by the facts; depression and cyanosis have been produced by it in various cases. The usual *dose* is eight grains (0.5 Gm.), which may be repeated three or four times daily. In robust subjects the *dose* may be increased to twenty grains (1.3 Gm.), and sixty grains (3.9 Gm.) are said to have been given in the twenty-four hours with no injurious manifestations. In the feeble, great caution is necessary in its employment.

Kryogenin. *Meta-benzamino-carbazide.* $C_6H_4(CO.NH_2)(NH.NH.CO.NH_2)$.—This is a colorless, odorless, slightly bitter powder, soluble in forty parts of water. It is asserted by Lumiere (*Ph. Post*, 1903, 7) to be an antipyretic of value, especially used in *tuberculosis*, producing, it is said, a rapid fall of temperature without unpleasant symptoms. *Dose*, fifteen to twenty-three grains (1.0–1.5 Gm.) in capsules.

Ksopo. *Kissoumpo. Kisoumpa. Psokay. Tangin de Menabe.*—The ordeal poison of the Sakalaves of Madagascar (the fruit of the *Menabea venenata* (Fam. Asclepiadaceæ), H. Baillon). When given to the lower animals it produces quickly a very

persistent vomiting, with rapid, irregular heart action, ending in cardiac death, consciousness being preserved to the end. (See E. Perrot, *C. R. A. S.*, 1902, 134.)

Labdanum. *Ladanum.*—A resinous substance, obtained from various species of Cistus (Fam. Cistaceæ), especially *C. creticus*, L., *C. ladaniferus*, L., *C. cyprinus*, Lam., and *C. laurifolius*, L., small evergreen shrubs, inhabiting the islands of the Grecian Archipelago, and the different countries bordering on the Mediterranean. Upon the leaves and branches of these shrubs a juice exudes, which is collected by means of an instrument resembling a rake, with leather thongs instead of teeth, which is drawn over the plant. The juice adheres to the pieces of leather, and is afterwards separated. It is said that labdanum was formerly collected by combing the beards of goats which had been browsing upon the leaves of the cistus, and Landerer states that it is still gathered in Cyprus from sheep and goats whose fleeces become loaded with it while they are pasturing. (See *P. J.*, xi. 6; xv. 301; xvi. 386, 779.) It comes chiefly from the Grecian Islands. Two varieties exist in commerce. The purest labdanum is in masses of various sizes, sometimes weighing several pounds, enclosed in bladders, dark red, almost black externally, grayish internally when first broken, of the consistence of a plaster, softening in the hand and becoming adhesive, of an agreeable balsamic odor like that of amber, and of a bitter, balsamic, somewhat acrid taste. It is very inflammable, burning with a clear flame. On exposure it becomes dry, porous, and brittle. Little of this variety is found in the markets. Common labdanum is in contorted or spiral pieces, light, porous, blackish gray, hard and brittle, not softening between the fingers, similar in odor and taste to the preceding variety, but less inflammable, and mixed with sand and other earthy matters, which are obvious to the sight. A specimen exhibited at the International Exhibition of 1862, at London, was in flattish pieces, an inch or more thick, with remains of leaves on one side, of a very dark greenish-brown color, and a granular somewhat shining fracture. Guibourt found in 100 parts of the labdanum in masses, 86 parts of resin with a little volatile oil, 7 of wax, 1 of aqueous extract, and 6 of earthy substances and hair. In the contorted variety, Pelletier found 20 per cent. of resin, 3.6 of gum with calcium malate, 0.6 of malic acid, 1.9 of wax, 1.9 of volatile oil including loss, and 72 of a ferruginous sand. Schimmel & Co. (*Schim. Rep.*, April, 1893) state that they obtained from labdanum resin 0.91 per cent. of a golden-colored essential oil having the penetrating odor of ambergris. Its sp. gr. is 1.011 at 15°C. (59° F.). Labdanum is a stimulant expectorant, formerly given in catarrh and dysentery. At present it is employed only in plasters.

Lac. *Lacca. Resina* (*Gummi*) *Lacca. Laque, Gomme lacque*, Fr. *Lack, Gummilack*, G.—A resinous substance obtained from several trees growing in the East Indies, particularly from *Croton laccifera*, L. (Fam. Euphorbiaceæ), a form referable to *C. aromaticus*, L., two species of Ficus, *F. religiosa*, L., and *F. indica*, L. (Fam. Artocarpaceæ), and, according to Valentine Ball, *Schleichera trijuga*, Willd. (Fam. Sapindaceæ), *Butea frondosa*, Roxb., of the fam. Leguminosæ, and *Zizyphus jujuba*, Lam. (Fam. Rhamnaceæ). Stillman states that *Acacia Greggii*, A. Gray (Fam. Leguminosæ), and *Covillea tridentata* (DC.), Vail. (*Larrea mexicana*, Moric.) (Zygophyllaceæ), plants growing in Arizona, Colorado, and the Western territories, furnish both *shellac* and *lac dye*. (*A. J. P.*, 1880, 409.) Lac is found in the form of a crust, surrounding the twigs or extreme branches, and is generally supposed to be an exudation from the bark, owing to the puncture of an insect belonging to the genus Coccus, and denominated *C. lacca*. By some it is thought to be an exudation from the bodies of the insects themselves, which collect in great numbers upon the twigs, and are embedded in the concreted juice, through which the young insects eat a passage and escape. Several varieties are known in commerce. The most common are *stick-lac, seed-lac,* and *shellac.*

Stick-lac is the resin as taken from the tree, still encrusting the small twigs around which it originally concreted. It is of a deep reddish-brown color, of a shining fracture, translucent at the edges, inodorous, and of an astringent, slightly bitterish taste. Its external surface is perforated with numerous minute pores, as if made by a needle, and when broken it exhibits many oblong cells, often containing the dead insect. When chewed it colors the saliva beautifully red, and when burnt, diffuses a strong, agreeable odor. It is in great measure soluble in alcohol.

Seed-lac consists of minute irregular fragments, broken from the twigs and partially exhausted by water. It is of a light or dark brown color, inclining to red or yellow, feebly shining, almost tasteless, and capable of imparting to water less color than the stick-lac, sometimes scarcely coloring it at all. It is occasionally mixed with small fragments of the twigs.

Shellac is prepared by melting the *stick-lac* or *seed-lac*, previously deprived of its soluble coloring matter, straining it, and pouring it upon a flat smooth surface to harden. Valentine Ball (*Jungle Life in India, N. R.*, June, 1880) states that the stick-lac is first placed between two powerful rollers, which, by a simple arrangement, admit of any degree of approximation. The lac is then crushed off and is separated from the woody portions by screening; it is next placed in large tubs half full of water and is washed by the coolies, male or female, who, standing in the tubs, and holding to a bar above with their hands, stamp and pivot about on their heels and toes until, after a succession of changes, the resulting liquor comes off clear. The disposal of the liquor drawn off at the successive washings will be spoken of farther on. The lac, having been dried, is placed in long cylindrical bags of cotton cloth, of medium texture, and about ten feet long and two inches in diameter. These bags when filled have somewhat the appearance of enormous bologna sausages. They are taken to an apartment where there are a number of open charcoal furnaces. Before each of these there are one principal operator and two assistants. The former grasps one end of the long sausage in his left hand and slowly revolves it in front of the fire, and at the same time one of the assistants, seated as far off as the sausage is long, twists it in the opposite direction. The roasting before the glowing charcoal soon melts the lac in the portion of the bag nearest the operator's hands and the twisting of the cloth causes it to drop into a trough formed of the leaves of the American aloe (*Agave americana*). When a sufficient quantity in a molten condition is ready in the trough, the operator takes it up in a wooden spoon and places it in a wooden

cylinder some eight or ten inches in diameter, the upper half of which is covered with sheet brass. The stand which supports this cylinder gives it a sloping direction away from the operator. The other assistant, generally a woman, now steps forward, holding a strip of the aloe between her hands, and with a rapid and dexterous draw of this the lac is spread out at once into a sheet of uniform thickness, which covers the upper portion of the cylinder. The operator now cuts off the upper edge with a pair of scissors, and the sheet is then lifted up by the assistant, who waves it about for a moment or two in the air till it becomes quite crisp. It is then held up to the light, and any impurities (technically called "grit") are simply punched out of the brittle sheet by the finger. The sheets, laid upon one another, are placed in packing cases, and when subjected to pressure break into numbers of fragments. The dark red liquor resulting from the washing above described is strained in order to remove all foreign materials. It is then passed into large vats, where it is allowed to settle. The sediment is subjected to various washings, and at last allowed to settle finally, the supernatant liquid being drawn off. The sediment when of proper consistency is placed in presses, from which it is taken out in the form of hard, dark purple cakes, with the manufacturer's trade-mark impressed upon them. This constitutes what is known in commerce as "lac dye." By the addition of mordants this dark purple substance yields the most brilliant scarlet dyes, which are not inferior to those produced by cochineal. Shellac is in thin fragments of various sizes, from half a line to a line thick, often somewhat curved, of a lighter or darker brown color, inclining more or less to red or yellow, shining, more or less transparent, hard and brittle, inodorous and insipid, insoluble in water, but easily and almost entirely soluble in alcohol, especially with the aid of heat. According to Oberdörffer, cold ether takes from shellac only about 5 per cent., consisting of wax, and adulteration with resins soluble in ether is thus readily detected. (See *A. J. P.*, 1861, 313.) An alcoholic solution of shellac usually needs clarification (due to suspended wax); by agitating the solution with six parts of powdered chalk, decanting and filtering, it becomes transparent.

A variety of lac is mentioned by writers, in the form of cakes, called *cake-lac* or *lump-lac* (*lacca in placentis*); but this is at present rare in commerce.

According to John, lac consists of resin, coloring matter, a peculiar principle insoluble in alcohol, ether, or water, called *laccin*, a little wax, and various saline matters in small proportion. The resin, according to Unverdorben, consists of several distinct resinous principles differing in their solubility in alcohol and ether. The laccin is nearly or quite wanting in shellac, which also contains scarcely any of the coloring principle. Hatchett found in stick-lac 68 per cent. of resin, and 10 of coloring matter; in seed-lac 88.5 per cent. of resin, and 2.5 of coloring matter; in shellac 90.9 per cent. of resin, and 0.5 of coloring matter. The other constituents, according to this chemist, are wax and gluten, besides foreign matters. R. E. Schmidt (*Ber. d. Chem. Ges.*, 1887, 1285–1303) has prepared the lac dye in a pure crystallized state. He gives it the formula $C_{16}H_{12}O_8$, and calls it *laccaic acid*. It was obtained crystallized from ethereal solution. Caustic alkalies dissolve it, giving a magenta color. Baryta water forms a violet lake. Laccaic acid shows some analogy to carminic acid, but the colors they give on wool and silk are different. Laccaic acid is decomposed on heating with concentrated hydrochloric acid to 180° C. (356° F.), as well as on fusing with caustic potash.

The importations of lac, crude and stick, into the United States in 1904 were 1,107,131 pounds, valued at $324,874; of shellac in the same year, 10,934,627 pounds, valued at $3,505,229.

Lac in its crude state is slightly astringent, and was formerly used in medicine, but at present it is not employed. Shellac is wholly inert. Stick-lac and seed-lac are used on account of the coloring principle which they contain. Shellac, as well as the other varieties, deprived of their coloring matter, is applied to numerous purposes in the arts. It is the chief constituent of *sealing wax*. The best *red sealing wax* is made by melting together, with a very gentle heat, 48 parts of shellac, 19 of Venice turpentine, and 1 of balsam of Peru, and mixing with the melted mass 32 parts of finely powdered cinnabar. But common resin is often substituted in part for the lac, and a mixture of red lead and chalk for the cinnabar. The best *black sealing wax* consists of 60 parts of lac, 10 of turpentine, and 30 of levigated bone black; the best *yellow sealing wax*, of 60 parts of lac, 12 of turpentine, and 24 of lead chromate. (Berzelius.) Lac is also used as a varnish, and forms an excellent cement for broken porcelain and earthenware. It may be dissolved in alcohol, oil of turpentine, benzin, or naphtha. For a method of preparing a colorless varnish from lac the reader is referred to *P. J.*, 1864, 338. Lac has been highly recommended as an adhesive material for the dressing of *wounds*, *ulcers*, etc. It is prepared for use by dissolving, with the aid of a gentle heat, in alcohol contained in a bottle, sufficient lac to give it a gelatinous consistence, and then closing the bottle. It is used by spreading it on the bandages.

Lactanin. *Bismuth Dilactomonotannate.*—This is a yellow, odorless, tasteless powder, insoluble in water, which has been used in *doses* of three to five grains (0.2–0.32 Gm.) in *tubercular* and other *chronic diarrhœas* of young children.

Lactol (*Lactonaphthol*) is the lactic acid ester of β-naphthol, $CH_3.CHOH.COOC_{10}H_7$. It forms colorless crystals insoluble in water, but soluble in alcohol; used as an intestinal antiseptic.

Lactophenin. *Lactyl-phenetidin.* $C_6H_4\begin{cases}OC_2H_5\\NH.CO.CH.(OH).CH_3\end{cases}$.—A white crystalline powder, without odor, having a feeble, bitter taste, soluble in one part in five hundred of cold water, one in eight and a half parts of alcohol, and having a melting point of from 117.5° to 118° C. (243.5°–244.4° F.). It is produced by the action of lactic acid on phenetidin in the presence of dehydrating substances.

We have very little definite knowledge in regard to the physiological action of lactophenin, but it appears to be an active antipyretic and analgesic. It is said to be more calmative and hypnotic in its influence than is antipyrine or phenacetin. Jaquet puts it as between sulphonal and urethane as an hypnotic. When, in *pneumonia*, *typhoid fever*, or other infectious diseases, the nervous symptoms are very pronounced and the fever high, lactophenin would seem to be especially indicated. It is affirmed to be valuable in *rheumatism*, having specific curative properties inferior to but resembling those of the salicylates.

The statements which have been made that its use is free from danger are, however, not correct. It sometimes produces an exanthematous eruption, which may be macular or diffuse. Wenzel (*Cb. I. M.*, xvii. 1896) reports a case in which, after the patient had been taking, for two weeks, fourteen grains of lactophenin a day, there was suddenly developed violent jaundice, with dark brown urine, without fever or slowing of the pulse, with colorless stools. Similar cases had been previously recorded by Strauss, and Franz Rield (*Zeitsch. f. Heilk.*, xvi. 1895) details two. Kronig (*B. K. W.*, 1895) has reported a case of poisoning, with methæmoglobin in the blood and cyanosis, followed by rapid death. It is eliminated, at least in part, by the urine as a paramidophenol.

Lactophenin may be given in *doses* of from five to twenty grains (0.32–1.3 Gm.), repeated in special cases up to a drachm and a half (5.8 Gm.) in a day.

Lakes.—These paints are compounds of vegetable or animal coloring principles with alumina or other metallic oxide, and are usually obtained by adding alum or stannic chloride to the solution of the coloring matter in water, and precipitating by means of an alkali. The alumina or stannic oxide unites with the coloring matter at the moment of separation, and forms an insoluble compound. Lakes are obtained in this way from cochineal, madder, Brazil wood, seed-lac, French berries, etc.

Lamium. *Lamium album*, L.—Hemostyptic properties were long since attributed by Lusitanus and by Florain to the flowers of this labiate plant, and according to the more recent researches of Kalabin (*Cb. G. T.*, xx. No. 12) their decoction produces a rise of the arterial pressure due to contraction of the peripheral vessels. The extract was found to cause firm, lasting contraction of the uterus, and the saturated tincture, in *doses* of twenty-five to forty minims (1.6–2.5 Cc.) every two or three hours, to be useful in *hæmorrhagic metritis* and *metrorrhagia*. Its effects in puerperal hemorrhage were not pronounced.

Lantana. *Lantana brasiliensis*, Link. *Yerba Sagrada.* (Fam. Verbenaceæ).—This Brazilian plant contains, according to Negrete, an alkaloid, *lantanine*, which is actively antiperiodic in *doses* of from fifteen to thirty grains (1.0–2.0 Gm.) in the twenty-four hours, given directly after the paroxysm. (*T. G.*, 1885.)

Lanthanium Nitrate.—*Lanthanii Nitras*, $La_2(NO_3)_6.12H_2O$, occurs in large rose-colored prisms which are soluble in water and alcohol. This salt is employed as an antiseptic, preventing the growth of bacteria when used in solutions of the strength of 1 in 2000. (See *Cb. B.*, 1897, xxi.)

Larch Bark. *Laricis Cortex. Br.* 1885. *Ecorce de Mélèze*, Fr. *Lärchenrinde*, G.—The bark of *Larix europæa*, DC. (*L. Larix* (L.), Karst., *Pinus Larix*, L.), of the fam. Coniferæ, was found by Aldridge to contain gum, starch, resin, and tannic acid of the kind which precipitates the salts of iron olive-green. John Stenhouse has obtained from it a peculiar volatile acid, *larixinic acid* (*larixine*). (For method of separation see 16th edition, *U. S. D.*) Larixinic acid occurs in beautiful white, lustrous crystals, often more than an inch long, of a peculiar somewhat empyreumatic odor, and a slightly bitter and astringent taste, inflammable, volatilizing at 93° C. (199.4° F.) and melting at 153° C. (307.4° F.), soluble in 87.88 parts of water at 13.3° C. (56° F.), very soluble in boiling water, soluble in cold but much more so in hot alcohol, and sparingly soluble in ether. It readily crystallizes from its solutions. A very singular and characteristic property is that of forming, when added, in strong solution, in excess, to baryta water, a bulky, transparent, gelatinous precipitate, occupying the whole measure of the liquids if concentrated. The probable formula of the acid is $C_{10}H_{10}O_5$. The inner larch bark possesses astringent and gently stimulant properties, and is supposed to have a special tendency to the mucous membranes. It has been found particularly efficacious in *purpura* and other *hemorrhagic affections*, especially *hæmoptysis*, and has been given in *bronchitis* with copious expectoration, and in diseases of the urinary passages. It has been used also, mixed with soap and glycerin, as a local remedy in *psoriasis*, *chronic eczema*, and other cutaneous affections. Of the extract from three to five grains (0.20–0.32 Gm.), of the tincture from thirty minims to a fluidrachm (1.8–3.75 Cc.) or more may be given every three or four hours.

Lathyrus. *Lathyrus sativus*, L. (Fam. Leguminosæ.)—The *White* or *Chickling Vetch*, *Jarosse*, *Gesse*, which is used in Europe as a food both by man and animals, produces, when taken too freely, a condition known as *lathyrismus*. Horses which have been fed on the plant for a considerable period drop while performing the lightest work, in consequence of paralysis of the hinder extremities, and in many cases death has followed from bilateral paralysis of the recurrent laryngeal nerves and consequent asphyxia. This laryngeal affection does not occur in the human subject, and death very rarely takes place. In man the muscles of the lower extremities below the knee are apt to be especially affected, the abductors more than the adductors. The muscles of the face, neck, and upper extremities are very rarely, if ever, attacked. The reflexes and the general sensibility are usually not influenced; but Giorgieri has seen the tendon reflexes increased. According to Cantani, the galvanic contractility of the paralyzed muscle is altered, and the transverse markings of the muscles are nearly obliterated by fat globules. In fatal cases the spinal cord has been found normal. Astier obtained from the seeds a poisonous alkaline volatile liquid. According to him, this, being volatile, is not present in preparations such as pressed cakes made at a high temperature, which are consequently not poisonous. If, however, such cakes have been prepared at low temperature, they exhibit toxic properties, owing to the retention of the toxic principle. This is in conformity with the experience of the peasants in some parts of Europe, who mix the ground white vetch seeds with wheat flour, and boil the mixture for food.

Laurotetanine.—This alkaloid, $C_{19}H_{23}NO_5$, or $C_{16}H_{13}O_2(O.CH_3)_3NH$, according to Schmidt, has been found by Greshoff in a species of *Malapœnna* (*Tetranthera*) and in other plants belonging to the Lauraceæ. It is said to be a powerful poison, acting like strychnine on the spinal cord. It gives with Froehde's reagent a magnificent indigo-blue color, which on the addition of water changes to yellow; with Erdmann's reagent, a transitory bright blue color, becoming brown, and with more nitric acid it gives immediately a bright red-brown, and with pure nitric acid a dirty brown. It is soluble in excess of alkali. (*P. J.*, vol. xxi. 1891.)

Laurus. *Laurus nobilis*, L. *Sweet Bay. Laurier commun*, Fr. *Lorbeer*, G.—The *Bay tree, Laurus nobilis*, is an evergreen tree of the fam. Lauraceæ, inhabiting the countries bordering on the Mediterranean. The leaves are alternate, on short petioles, oval-lanceolate, entire, sometimes wavy, veined, of a firm texture, smooth, shining, deep green upon their upper surface, paler beneath. They have a fragrant odor, especially when bruised, and a bitter, aromatic, somewhat astringent taste. They yield by distillation a greenish-yellow volatile oil. The volatile oil, of which the fruit yields 0.23 per cent., has a sp. gr. 0.88, and is solid at 0° C. (32° F.). It is largely composed of oxygenated compounds. The constituents thus far recognized are *myrcene, phellandrene, methyl-chavicol, citral, methyl-eugenol, chavicol*, and *eugenol*. (*Schim. Rep.*, April, 1897.) Water distilled from the leaves has their peculiar odor. The *berries* when dried are black and wrinkled, and contain two oval fatty seeds within a thin, friable envelope; or they may be considered as drupes, with a kernel divisible into two lobes. They have the same aromatic odor and taste as the leaves, but are more pungent. Besides an essential oil, they contain a fixed oil, which, as obtained by expression from the fresh fruit, is of a greenish color, and aromatic odor from retained volatile oil. One of its chief constituents is the ether of *lauric acid*, the so-called *laurostearine*, $C_3H_5(C_{12}H_{23}O_2)_3$, which fuses at 45° C. (113° F.). The free acid may be obtained from this by saponification. It cannot be distilled without decomposition. Another constituent of the crude fat is *laurin*, $C_{22}H_{30}O_3$, which can be extracted by alcohol. It forms neutral, easily fusible prisms without odor or taste. Lard, impregnated with the odorous principle of the berries, and colored green by chlorophyll or sometimes by indigo and turmeric, is said to be often substituted for the genuine expressed oil. This may be detected by boiling alcohol, which dissolves the true oil. The leaves, berries, and oil are excitant and narcotic, but are never used internally as medicines, and in this country are scarcely employed in any manner. Their chief use is to communicate a pleasant odor to external remedies.

Lavender Flowers. *Lavandula. U. S.* 1880. *Lavandula angustifolia* (L.), Mill. (*L. officinalis*, Chaix, *L. vera*, DC.) *Lavender. Flores Lavandulæ*, P. G. *Lavande, Fleurs de Lavande*, Fr. *Lavandelblumen, Lavandelblüthen*, G. *Lavendola*, It. *Espliego, Alhucema*, Sp.

Lavender is a small labiate shrub. The plant is a native of Southern Europe, and covers vast tracts of dry and barren land in Spain, Italy, and the south of France. In England and America it is very largely cultivated. For method of culture and detailed descriptions of the various varieties that have been educed, see *B. M. S. J.*, Aug. 1873, 165. The cultivation of lavender has become an important industry, and inasmuch as that produced in England has the best reputation, the following extracts from a paper by J. C. Sawer (*P. J.*, Aug. 8, 1885, p. 125, and Feb. 15, 1890, p. 659) will be found useful in view of the fact that attempts are being made to cultivate the finer qualities of lavender in the United States.

"The first plants experimented on developed in the form of dense level topped rounded tufts of foliage with comparatively few flower heads. Each flower head formed a continuous spike, except the lowest whorl or verticillaster, which is separated from the upper portion of the spike by a short distance. This variety neither grows rapidly nor flowers freely, and the perfume is not so fragrant as in the others. Another variety was then tried, in which nearly all the floral whorls are distinct, so as to form an uninterrupted spike. This variety grew rapidly, flowered freely and was found to be delightfully fragrant, and was, therefore, adopted. It has the disadvantage, however, that the plant soon forms woody stems which, if the plants are much exposed to wind, easily break, and loss of flowers results. It should be observed that all the varieties presented the characteristic rhomboidal bracts of the true lavender. It is obvious, therefore, that the cultivation of lavender requires constant attention and habits of close observation on the part of the cultivator, and that the quality of the oil produced is likely to depend not only on the care with which the oil is distilled, but on cultivating only the best varieties, as well as on the character of the soil. The chalky soil on the hills near Brighton, where Sawer experimented, seemed peculiarly suited to the culture of lavender.

It is necessary to grow the lavender sufficiently far apart to allow of ready passage between the rows, as the plants soon spread their branches, and it is otherwise difficult, without injuring the plants, to carry the crop of flowers, if required for distillation. The collection has frequently to be done rapidly when the flower is arrived at a certain stage of maturity, and dry weather must be selected for the work. When the plant once begins to flower the blossoms are shed rapidly, and in damp weather the spikes carry much water and lose fragrance.

The flowers deprived of as much stalk as possible should be distilled, *without previous maceration*, the same day as cut, and not left in heaps as the flowers rapidly ferment and the character of the oil is quite changed. The water passing over with the oil should not be returned to the still; the very small quantity of oil saved by doing so would not compensate for the herbaceous flavor communicated to the next running."

Lavender flowers have a strong fragrant odor, and an aromatic, warm, bitterish taste. They retain their fragrance long after drying. Alcohol extracts their virtues, and a volatile oil upon which their odor depends rises with that liquid in distillation. Hager obtained from a pound of the fresh flowers from half a drachm to two drachms of the oil. Lavender is an aromatic stimulant and tonic, but is seldom given in its crude state. The products obtained by its distillation are much used in perfumery, and the volatile oil is official. (See *Oleum Lavandulæ Florum*, p. 850.)

Lawsonia. *Lawsonia inermis*, L. (*L. alba*, Lam.) *Henna Plant.*—This is a shrub of the fam. Lythraceæ, growing in the Levant, Egypt, Persia, and India, and well known as the source of a dyestuff denominated *henna*, much used throughout the Mohammedan countries of the East. It is largely cultivated in Egypt. The flowers have a strong, pungent odor, and a distilled water prepared from them is used as a cosmetic. The fruit is thought to have emmenagogue properties. The powdered leaves, under the name of *henna*, are used to stain golden yellow the feet and hair of women of the harem. Abd-el-Aziz of Cairo, Egypt, found in it a brown substance, of a resinoid fracture, having the chemical properties which characterize the tannins, and therefore named by him *hennotannic acid*. (*J. P. C.*, 1863, 35.) Henna is employed both internally and locally, in *jaundice, leprosy*, and affections of the skin.

Lead Oxide, Red. *Plumbi Oxidum Rubrum. Red Oxide of Lead. Red Lead. Minium,* P. G. *Deutoxide de Plomb, Oxide Rouge de Plomb, Minium,* Fr. *Mennige,* G. *Minio,* It., Sp.—Red lead is prepared on the large scale in a furnace, with the floor slightly concave and the roof arched, presenting a general resemblance to a baker's oven. The lead is placed on the floor, and gradually raised to a red heat, whereby it melts and becomes covered with a pellicle of monoxide, which is removed by means of a long iron scraper, and the pellicles, as they successively form, are scraped off until the whole of the metal has been converted into them. The product is subjected to further calcination, with occasional stirring, for some time, in order to oxidize any remaining particles of metallic lead; it is thus rendered yellow, and constitutes *lead monoxide,* or *massicot.*

This is taken out of the furnace, thrown upon a level pavement, and cooled by being sprinkled with water. It is next reduced to fine powder by trituration and levigation, and dried, and in this state is introduced into large, shallow, square tin boxes, which are placed in another furnace, closed from the air, and heated nearly to redness, the heat being allowed gradually to fall during a period of from twenty-four to thirty hours. At the end of that time the lead monoxide will have combined with an additional quantity of oxygen, and become the red oxide. This is taken out, and, after it has passed through a fine wire sieve, it is packed in barrels for the purposes of commerce.

The above is an outline of the French process for making red lead. In England and the United States the calcination of the monoxide is not performed in tin boxes, but by returning it to the furnace in which it was first calcined. H. N. Warren recommends the following process for preparing pure red lead. Either litharge or lead sulphate from vitriol tanks, etc., is introduced into canvas bags, through which is inserted a lead sheet. These bags are now immersed in diluted sulphuric acid, and connected respectively to sheets of iron; the sulphate or other plumbic compound contained therein is thus speedily and completely reduced to the spongy metal, the bags afterwards connected alternately by their lead plates and exposed to an electric current, the positives being thus completely converted into peroxide, while the temporary accumulator thus produced is again emptied of its current into further quantities of spongy metal, thus producing more peroxide. This process, when rightly conducted, yields an absolutely pure oxide on a cheap scale. (*Chem. News,* Sept. 18, 1896, 144.)

Properties.—Red lead is in the form of a heavy, scaly powder, of a bright red color, with a slight shade of orange. Its sp. gr. is about 9. When exposed to heat it gives off oxygen, and is reduced to the state of monoxide. It is sometimes adulterated with red ferric oxide and red bole, substances which may be detected by treating the red lead with nitric acid and testing the nitric solution with tincture of galls. This reagent will produce a black precipitate, in consequence of the iron being dissolved by the nitric acid. If brick dust be present, it will be left undissolved upon boiling the suspected specimen in water, with sugar and a small quantity of nitric acid. When free from impurities it is wholly reduced on charcoal by means of the blow-pipe, giving a globule of metallic lead. It is completely soluble in highly fuming nitrous acid. When treated with nitric acid it is resolved into monoxide, which dissolves, and dioxide, which remains in the form of a dark brown powder.

The red lead of commerce may be considered as a mixture of what may be called the true red oxide and variable proportions of monoxide. That this is its nature is rendered probable by the action of cold diluted acetic acid, not used in excess, which takes up a variable quantity of monoxide, leaving a portion unchanged in color, which may be deemed the pure red oxide. This latter, when analyzed by nitric acid, has been proved, by the coincident results of Dalton, Dumas, and Phillips, to consist of three atoms of lead and four of oxygen, equal to $2PbO.PbO_2$ (Dumas), or $PbO.Pb_2O_3$ (Winckelblech). Mulder gives $Pb_4O_5 = 3PbO.PbO_2$, or $2PbO.Pb_2O_3$, as the usual composition of red lead.

Red lead enters into no official preparation. In the arts it is used chiefly as a paint, for protecting metal surfaces, in the manufacture of flint glass, and in cements for metal joints.

Lead Saccharate. *Plumbi Saccharas. Saccharate of Lead.*—Lead saccharate is made by saturating a solution of saccharic acid in water with freshly precipitated lead carbonate gradually added. As the acid becomes saturated, the lead saccharate falls in the form of a white powder, being insoluble in cold water, and but very sparingly soluble in that liquid boiling hot. From this E. Hoskins prepared his *lead nitro-saccharate,* by dissolving the saccharate in diluted nitric acid, containing only one part of the acid in twenty parts of the mixture, filtering the solution, and gradually evaporating. The nitro-saccharate is deposited in yellow crystals of the form of regular six-sided plates or prisms. By dissolving one grain of this salt, with five drops of pure saccharic acid, in a fluidounce of distilled water, a solution was obtained which, though slightly acid to test paper, was perfectly bland. This solution has been used to dissolve urinary *calculi.* (See Pereira's *Mat. Med.,* 3d edition, 755.)

Lead Tannate. *Plumbi Tannas.*—This is obtained by precipitating a solution of tannin with one of lead acetate, added drop by drop. It has been used locally in *chronic inflammations* of the *joints, ulcerations, bed sores,* and *sore nipples,* in 20 to 40 per cent. ointments. (*Med. Rec.,* 1875, 575.) The preparation here described is a bitannate. Other lead tannates exist.

Lecithin. $C_{42}H_{84}NO_3P$.—The class of lecithins is now known to be widely distributed in both animal and vegetable tissues, although most familiar in its occurrence in the nerve tissues and embryonic cells.

The animal lecithin is *choline di-stearylglycerophosphate,* while the vegetable lecithin seems to be *betaine di-oleylglycerophosphate;* that is, the widely distributed vegetable base *betaine* (*oxyneurine*) replaces the choline of egg lecithin and the oleic acid radical appears instead of that of stearic acid.

Vegi-lecithin has been studied chemically by C. Gordon Richardson. Besides the replacement of the choline by betaine and the difference in the fatty acids, it differs from *ovi-lecithin* in not being precipitated by acetone and being quite insoluble in alcohol, but soluble in all proportions in cold ether. Otherwise it is readily soluble in all the solvents of ovi-lecithin. It seems to resemble somewhat the *cephaline* of Thudichum, which was obtained from the brain tissue.

Lecithin, as has been shown by H. C. Wood, Jr. (*U. P. M. B.*, May, 1902), is not poisonous. Danilewski has found that in young animals it causes an increase in the number of red corpuscles and a gain in weight more rapid than normal. Serono, in a series of careful studies on human beings, obtained a gain of bodily weight despite an increased output of nitrogen, and an augmentation of the number of red corpuscles without, however, any increase in the percentage of hæmoglobin; the phosphatic elimination did not keep pace with the increased ingestion of phosphorus.

Lecithin has been employed in practical medicine by Serono, Gilbert, Fournier, and other observers, in *tuberculosis* and *neurasthenia*, with favorable results; the most marked amelioration being an increase in the weight and an improvement in the subjective condition. Lancereaux and Paulesco commend it in *diabetes*, and it has been employed successfully in *chlorosis*. Most of the above observers obtained their lecithin from egg yolks; Moriggia, indeed, simply injects a solution of egg yolk in normal salt solution directly. Numerous agents decompose lecithin into its constituent parts—glycerin-phosphoric acid, choline, and fatty acids.

Choline is a substance of considerable toxic power, and is chemically and physiologically very closely allied to the animal alkaloid *neurine*, a toxic compound discovered by Strecker (*Ann. Ch. Ph.*, cxxiii.) and shown by Brieger (*Ueber Ptomaine*, Berlin, 1895) to occur in decomposing meat. In the frog, choline produces paralysis, partly by its depressing action upon the spinal cord, but largely by its paralytic effect upon the motor nerve endings. In the mammal fatal doses kill by the arrest of respiration. It produces slowing of the pulse and a slight temporary rise of blood pressure, followed by a secondary fall. It is a marked stimulant to involuntary muscle fibres, and to many glands, especially the salivary.

Ledum. *Ledum palustre*, L. *Marsh Tea. Rosmarinus Sylvestris. Marsh Cistus. Wild Rosemary. Lédon, Romarin sauvage*, Fr. *Porsch, Sumpfporsch, Wilder rosmarin*, G.—A small evergreen ericaceous shrub, growing in swamps and other wet places in the northern parts of Europe, Asia, and America, and in the mountainous regions of more southern latitudes. The leaves have a balsamic odor, and an aromatic, camphorous, bitter taste, and contain, among other ingredients, volatile oil and tannin. For the properties of the volatile oil, see *J. P. C.*, 4e sér., xx. 244; also *Proc. A. Ph. A.*, xxv. 154. It contains *ledum camphor*, a stearopten, together with valeric and other volatile acids, and *ericinol*, $C_{10}H_{16}O$. The tannin has been named *leditannic acid*, $C_{15}H_{20}O_8$. On boiling with dilute mineral acids it is decomposed, and *ledixanthin*, $C_{30}H_{34}O_{13}$, separates as a yellowish or reddish powder. (Thal, *Ph. Z. R.*, 1883, 268.) Thal also extracted *ericolin*, $C_{34}H_{56}O_{21}$. This is a glucoside, which on heating with diluted sulphuric acid decomposes into sugar and *ericinol*, $C_{10}H_{16}O$, a colorless, peculiar-smelling oil, which turns brown in the air, owing to oxidation. The leaves are thought to be narcotic and diaphoretic, and have been employed in *dysentery* and in various cutaneous affections, particularly *leprosy* and *scabies*. In complaints of the skin they are used both internally and externally, in the form of decoction. In Germany they are sometimes substituted for hops in the preparation of beer. *Ledum grœnlandicum*, Oeder (*L. latifolium*, Ait.), or *Labrador tea*, which is a larger plant than the preceding, is a native of North America, growing in damp places in Canada and the northern part of the United States. The leaves have an agreeable odor and taste, and are esteemed pectoral and tonic. They are said to have been used as a substitute for tea during the war for independence.

Leek. *Porrum. Porreau*, Fr. *Lauch*, G. The bulb of *Allium Porrum*, L. (Fam. Liliaceæ.) The leek is a biennial bulbous plant, growing wild in Switzerland, and cultivated in the gardens of Europe and this country for culinary purposes. All parts of it have an offensive, pungent odor and an acrid taste, dependent on an essential oil, of which allyl sulphide, $(C_3H_5)_2S$, is the main ingredient. The bulb, which is the medicinal portion, consists of concentric layers, like the onion, which it resembles in medicinal properties, though somewhat milder. It is generally stimulant, with a direction to the kidneys. *Dose* of expressed juice, a fluidrachm (3.75 Cc.).

Lenigallol. *Pyrogallol Triacetate.* $C_6H_3(O.C_2H_3O)_3$.—This is a white powder, insoluble in water, and is used in paste form. This derivative of pyrogallic acid has been highly commended as a local remedy in acute and moist *eczema*, and in *pityriasis rosea*. It is said not to act well in the dry desquamating eczemas. In the strength of 30 to 50 per cent. it is also useful as a keratolytic.

Eugallol (*pyrogallolmonacetate*), a second derivative of pyrogallic acid, is affirmed to be of great value in *psoriasis*, acting like chrysarobin but less irritating. It is non-toxic. The addition of acetone produces a liquid thin enough to be painted over a diseased part and to leave on evaporation a tense elastic pellicle.

Leonotis. *Leonotis Leonurus*, R. Br.—This handsome tropical labiate is said to possess purgative and emmenagogue properties. (See *P. J.*, May, 1885.)

Leonurus. *Leonurus Cardiaca*, L. *Common Motherwort. Agripaume, Cardiaire*, Fr. *Herzespann, Wolfstrapp*, G.—An aromatic perennial labiate herb, growing wild in this country in waste places, around dwellings, etc., whose infusion or decoction is sometimes used in *amenorrhœa* and sudden *suppression* of the *lochia*.

Lepargyræa. *Lepargyræa argentea* (Nutt.), Greene (*Shepherdia argentea*, Nutt.). *Buffalo Berry. Bull Berry. Grains de Bœuf*, Fr.—The acidulous fruit of this plant, of the fam. Elæagnaceæ, produced in great profusion in the region of the upper Missouri, is largely used as an article of food. According to Henry Trimble, it contains a little more acid than currants. (*A. J. P.*, Dec. 1888.)

Lewisia. *Lewisia rediviva*, Pursh. *Spathum. Chita. Bitter Root.*—The roots of this plant, of the fam. Portulacaceæ, abundant in the Northwestern United States, are very widely used by the Indians as an article of food. For analysis and description, see *A. J. P.*, 1889.

Liantral.—This substance is an extract of coal tar, obtained by treating with benzene, filtering from insoluble residue, and subsequently evaporating the benzene at a temperature not exceeding 80° C. (176° F.). It is a brownish-black viscous fluid which is insoluble in water, freely soluble in benzene, but dissolving only sparingly in fats, ethereal oils, alcohol, ether, acetone, petroleum benzin, and mixtures of these substances. Liantral has been commended by various clinicians as

a substitute for coal and wood tars in the treatment of *eczema* and allied skin diseases. It is said to resemble wood tar in its action, but to be more energetic. It has been used in ten per cent. solution with olive oil, applied with a brush, or in the form of a dusting powder made by triturating to dryness with the aid of a little ether, starch, or talc.

Liatris. *L. spicata*, Willd. *Lacinaria spicata* (L.), Kze. *Gay-feather. Devil's Bite. Colic Root. Button Snakeroot.*—An indigenous perennial composite plant growing in natural meadows and moist grounds throughout the Middle and Southern States. It has a tuberous root, and an erect annual stem, which terminates in a spike of beautiful, purple, compound flowers, appearing in August. The root is said by Schoepf to have a terebinthinate odor, and a warm, bitterish, terebinthinate taste; to be possessed of diuretic properties; and to be useful as a local application in *gonorrhœa* and *sore throat*. The leaves of the allied *Trilisa odoratissimus* (Walt.), Cass. (*Liatris odoratissimus*, Willd.), or *Vanilla leaf*, are very largely employed in the Southern United States to flavor tobacco, and to preserve clothing, etc., from moths. As a preservative it is worthless. The agreeable odor is due to *coumarin*, $C_9H_6O_2$, which may be frequently noticed in crystals upon the surface of the smooth spatulate leaves. (*A. J. P.*, March, 1875; Sept., 1881; xlvii. 116; *N. R.*, 1882, 66.) The roots of *L. scariosa*, Willd. (*Lacinaria scariosa*, Hill) and *L. squarrosa*, Willd. (*Lacinaria squarrosa*, Hill) (*rattlesnake's master*), have been employed to cure the bite of the rattlesnake. According to Wm. P. C. Barton, all the tuberous-rooted species of Liatris are active diuretics.

Lignol.—This is an oily or tarry substance which is said to be obtained by the dry distillation of a bituminous fossilized wood. Lignol is asserted to be in bactericidal power equal to the 5 per cent. solution of phenol, and is recommended in *eczema*, *acne*, *pruritus*, and other chronic skin diseases, and in *doses* of fifteen minims (0.9 Cc.) in pulmonary *tuberculosis*. Also, in chronic *irritation of the genito-urinary tract*.

Ligroine. *Ligroïn.*—This name has been applied to a petroleum product which is chiefly used as a solvent. It boils between 80° C. and 120° C. (176°–248° F.) and has a specific gravity varying between 0.710 and 0.730 (67°–62° B.).

Ligusticum. *Radix Levistici*, P. G. *Livèche, Ache de Montagne*, Fr. *Liebstöckel*, G.—Several species of this umbelliferous genus are employed as domestic remedies. The allied *Levisticum officinale*, Koch (*Ligusticum Levisticum*, L.), or *lovage*, of the south of Europe, is aromatic in all its parts, but only the roots and seeds are used. The seeds are small, ovate-oblong, somewhat flattened, curved, strongly ribbed and of a yellowish-brown color. The medicinal properties of lovage are closely analogous to those of angelica. It is a stimulant aromatic, and has been employed as a carminative, diaphoretic, and emmenagogue. The best form for administration is that of infusion. The coloring principle has been isolated by M. J. Nicklès, who gives it the name of *ligulin*, and suggests an important application of it that may be made in testing drinking water. If a drop of its alcoholic or aqueous solution is allowed to fall into distilled water, it imparts to the liquid its own fine crimson-red color, which undergoes no change; but if limestone water be substituted, the red color disappears in a few seconds, and is followed by a beautiful blue. (*J. P. C.*, 1859, 329.) The root of *Ligusticum sinense*, under the name of *kao-pên*, is largely used by the Chinese. In the Northwestern United States the large aromatic roots of *Ligusticum filicinum*, S. Wats., *Osha, Colorado cough-root*, are used to a considerable extent as stimulating expectorants. (See *A. J. P.*, 1890 and 1891.)

Ligustrum. *L. vulgare*, L. *Troène*, Fr. *Rainweide, Hartriegel*, G. *Privet.*—A shrub of the fam. Oleaceæ, from four to ten feet in height, growing wild both in Europe and the United States, usually in hedges and by the roadside. The leaves, which have an astringent, bitter taste, and the flowers, which are small, snow-white, and of an agreeable odor, have been used in the form of decoction in *sore throat* and *aphthous* and *scorbutic ulceration of the mouth*. The berries are black, have a sweetish bitter taste, and are said to possess purgative properties, and to color the urine brown. They are sometimes used for dyeing. Death in a child between two and three years old is recorded by James Cheese (*P. J.*, 2d ser., viii. 607), as due to the eating of privet berries. The bark was analyzed by M. G. Polex, who found a peculiar substance, which he denominated *ligustrin*, insoluble in ether and absolute alcohol, but soluble in water and diluted alcohol. Strong sulphuric acid gives with *ligustrin* a deep indigo-blue color. Kromayer (*A. Pharm.*, (2) cxiii. 19) proved that Polex's ligustrin was only impure *syringin*, $C_{19}H_{28}O_{10} + H_2O$. The large white crystals become anhydrous at 115° C. (239° F.), and fuse at 212° C. (413.6° F.). He found in addition (see Kromayer, *A. Pharm.*, (2) ci. 281) mannite, sugar, muco-saccharine matter, starch, chlorophyll, bitter extractive, bitter resin, tannin, albumen, and salts. (*A. J. P.*, xii. 347.) Kromayer found besides the *syringin* a crystallized bitter principle, fusing at a little over 100° C. (212° F.), which he named *ligustron*.

Lilium. *Lilium candidum*, L. (Fam. Liliaceæ.) *Common White Lily.*—This well known plant is a native of Syria and Asia Minor, but has been long cultivated in gardens. The bulb, which consists of imbricated fleshy scales, is without odor, but has a peculiar, disagreeable, somewhat bitter, and mucilaginous taste. It contains much mucilage, and a small proportion of an acrid principle. In the recent state it is said to have been employed with advantage in *dropsy*. Vomiting, purging, drowsiness, etc., are said to have been produced in a little girl by the pollen of the *tiger lily, L. tigrinum*, Andr. (Jeffries Wyman, *Am. J. M. S.*, 1863.)

Linaria. *Linaria Linaria* (L.), Karsten. *Linaria vulgaris*, Mill. *Antirrhinum Linaria*, L. *Common Toadflax. Butter and Eggs. Ramsted. Snapdragon. Linaire commune*, Fr. *Leinkraut, Flachskraut, Löwenmaul*, G.—This is a perennial herbaceous plant very common in America, Europe, and Asia. It should be collected when in flower, dried quickly, and kept excluded from the air. When fresh it has a peculiar, heavy, disagreeable odor, which is in a great measure dissipated by drying. The taste is herbaceous, weakly saline, bitter, and slightly acrid. This plant is said to be diuretic and cathartic, and has been used in *dropsy, jaundice*, and *cutaneous eruptions*. It is most conveniently employed in infusion. The fresh plant is sometimes applied, in the shape of poultice or fomentation, to *hemorrhoids*, and an ointment of the flowers has been

employed for the same purpose, and also locally in diseases of the skin. The flowers are used in Germany as a yellow dye.

Linden.—Boussingault calls attention (*J. P. C.*, 4e sér., xv.) to a saccharine exudation which occurs upon the leaves of the European Linden (*Tilia europæa*, L.), which he has found to have the same composition as *manna of Mount Sinai*.

Lint. *Linteum Carptum. Charpie*, Fr., G. The term lint is applicable to a substance prepared from linen. It is in fact linen made soft and somewhat fleecy by various mechanical processes, so as to render it suitable for the dressing of wounds. The qualities required in good lint are,—1, perfect softness, to prevent mechanical irritation to the wound; 2, looseness of texture, to render it capable of absorbing the secretions from the surfaces to which it is applied; 3, a certain tenacity, so that it may receive unctuous dressings, yet with a facility of being torn in one direction; and, 4, sufficient firmness of fibre to prevent small portions from being easily separated and remaining as foreign bodies in the wound. As formerly and still frequently made for domestic purposes, it consists of old linen scraped by means of a knife with the hand and thus brought into a soft flocculent state, almost destitute of visible fibres. It is obvious that, though this answers some of the above requisitions, it entirely fails to answer others, and is unfit for general surgical use. It will not readily admit of the application of cerates, and must very often leave portions of its substance in the wound, to serve as future sources of irritation. Much better is the old-fashioned lint, made by machines worked by the hand. This was formerly made in large quantities. Old linen was used for the purpose, such as shirts, sheets, table cloths, etc., and generally in irregular pieces. This was first cleansed thoroughly by washing with soap and water, or by boiling with a weak lye of soda or pearlash. Sometimes, when colored, it was bleached before being washed. Thus prepared, it was operated on by a simple machine, in which the rag, wrapped round a cylinder, was submitted to the interrupted action of a knife made to descend upon it at intervals of one-eighth of an inch, so as to cut the thread in one direction. On being removed from the machine, the cut ends of the thread became untwisted and loose, giving a flossy character to the fabric. To render it smooth, it was passed through rollers, and its ragged edges were trimmed. Of course it had different degrees of fineness according to the character of the rags used, and this diversity rendered it fit for different purposes, the finer pieces being used merely as a dressing with unctuous matter to exclude the air, while the thicker were better adapted to the absorption of the liquid secretions.

In the progress of improvement, machines were invented and patented for manufacturing lint on the large scale. Thus made, it is distinguished in commerce as *patent lint*. This is generally prepared out of cloth manufactured for the purpose, and therefore has whatever advantage may be derived from uniformity of shape and consistence. In other respects it is doubtful whether it has any superiority over the old-fashioned article; especially as, in consequence of competition, cotton, being the cheaper article, has frequently been in part or altogether substituted for linen. It is said that lint may be rapidly prepared by attaching a piece of linen to the toothed cylinder of the common carding machine, used in mills.

Cotton is in several respects inferior to linen for the preparation of lint, and, unless its presence in any manufactured article sold by this name be made known, it should be looked on as a fraudulent substitution. Its fibre is less soft and therefore more likely to irritate; it has much less absorbing power, and it conveys heat less rapidly. The following are methods by which it may be distinguished (Elsner): 1. A linen thread when held erect, and set on fire, appears, after the flame is extinguished, in a smooth continuous form, while cotton thread similarly treated has a tufted aspect. 2. Under a microscope which magnifies 300 diameters, the linen fibre appears to be a straight nearly solid cylinder, with a slender central canal; the cotton, flattened as a piece of tape, with a wide canal, and often twisted like a corkscrew. 3. The potassium test, proposed by Böttger, consists in exposing the doubtful substance to the action of a boiling concentrated solution of potassium hydroxide. If made of linen, it will in two minutes assume a deep yellow color; if of cotton, it will either remain colorless, or will become very faintly yellow, and if the texture be composed of both, it will exhibit a streaked or mottled aspect. The examination must be quickly made, as the yellow color of the potassium becomes faint with time. 4. Sulphuric acid dissolves the linen fibre, while it leaves that of cotton little changed. 5. Linen thoroughly oiled has the transparent appearance of oiled paper; cotton remains white and opaque. 6. Tinctures of all organic red dye-stuffs, as cochineal, madder, etc., will give a much deeper color to linen than to cotton, and cause a mottled appearance when the two are mixed.

Tow, and hemp in the state of *oakum*, have been employed for dressing wounds; but they are only applicable as exterior dressings to absorb the pus, when the discharge of this is very copious. L. A. Sayre prefers picked oakum to lint as more absorbent. (*B. M. S. J.*, lxvii. 84.) *Charpie*, so much used by French surgeons, generally consists of bundles of straight threads, each four or five inches long, made by unravelling old rather coarse linen.

Linum catharticum, L. *Purging Flax.*—Purging flax is a European annual of the fam. Lineæ, six to eight inches high. The whole plant is very bitter and somewhat acrid, and imparts its virtues to water, which acquires a yellow color. It appears to owe its activity to a peculiar drastic principle, which has received the name of *linin*, and which is afforded most largely by the plant after the flower has fallen. Schroeder (*N. R. Pharm.*, xi. 11) obtained it in lustrous, white, silky crystals, which are neutral in reaction and have a strong persistent bitter taste in alcoholic solution. Purging flax has enjoyed some reputation in Europe as a gentle cathartic, useful in *muscular rheumatism, catarrhal affections*, and *dropsy* with disease of the liver. *Dose* of the extract, from four to eight grains (0.26–0.5 Gm.); of the powder, one drachm (3.9 Gm.).

Lipanin.—A mixture of ninety-four parts of olive oil and six parts of oleic acid, which has been used as a substitute for cod liver oil. *Dose*, from one teaspoonful to half a fluidounce (3.75–15.0 Cc.).

Lippia. *Lippia Mexicana.* (Probably *Cedronella mexicana,* Benth., of the fam. Labiatæ.)—A Mexican evergreen shrub, the leaves and stalks of which have been used in medicine as a demulcent and expectorant. Podwissotzki analyzed the herb, and found it to contain tannin, a quercetin-like principle, liquid volatile oil, and a camphor-like body which he named *lippiol.* (*Proc. A. Ph. A.,* 1886, 400.) *Dose* of concentrated tincture (1 to 4), from a half to one fluidrachm (1.8–3.75 Cc.).

Liquidambar. *Liquidambar styraciflua,* L. *Sweet Gum.*—An indigenous tree (Fam. Hamamelidaceæ), growing in different parts of the United States from Connecticut to Florida, and flourishing also in Mexico, where, as well as in our Southern States, it sometimes attains a great magnitude. In warm latitudes a balsamic juice flows from its trunk when wounded. This has attracted some attention in Europe, where it is known by the name of *liquidambar* or *copalm balsam,* and is sometimes, though erroneously, called *liquid storax.* It is not afforded by the trees which grow in the Middle Atlantic States, but is obtained in the Western States bordering on the Ohio, and southward as far as Central America. It is a liquid of the consistence of thin honey, more or less transparent, of a yellowish color, of a peculiar, agreeable, balsamic odor, and a bitter, warm, and acrid taste. By cold it becomes thicker and less transparent. It concretes also by time, assuming a darker color. It is sometimes collected in the form of tears, produced by the spontaneous concretion of the exuded juice. According to Bonastre, it contains a colorless volatile oil, a semi-concrete substance which rises in distillation and is separated from the water by ether, a minute proportion of benzoic acid, a yellow coloring substance, an oleoresin, and a peculiar principle, insoluble in water and cold alcohol, for which Bonastre proposed the name of *styracin.* The styracin of Bonastre has since been found to be *cinnamyl cinnamate,* $C_9H_9.C_9H_7O_2$, which is found together with the *ethyl, benzyl,* and other esters of cinnamic acid. Examined by W. P. Creecy of Mississippi, it was found to contain cinnamic acid as the prominent acid ingredient, besides a volatile odorous principle melting at 65° C. (149° F.) and smelling of vanillin, and 30 per cent. of a hard resin (according to W. von Miller, *storesin,* $C_{36}H_{55}(OH)_3$). If the storesin be repeatedly extracted with diluted potassium hydroxide solution, it is separated into *α-storesin,* which is amorphous and melts at from 160° to 168° C. (320°–334.4° F.), and *β-storesin,* which forms white flocks melting at from 140° to 145° C. (384°–393° F.). Of these, the *β*-resin is first extracted, while the residue is nearly pure *α*-resin. The volatile oil mentioned above contains a hydrocarbon, *styrol* or *cinnamene,* C_8H_8, which changes on heating into the polymeric *metastyrol,* a colorless transparent solid, identical in composition. The results of W. L. Harrison, confirmed by Maisch (*A. J. P.,* xlvi. 160, 165), seem to prove that the American drug is identical with storax, except in containing no water mechanically mixed with it.

Another product is said to be obtained from the same tree by boiling the young branches in water, and skimming off the fluid which rises to the surface. It is of thicker consistence and darker color than the preceding, is nearly opaque, and abounds in impurities. This also has been confounded with liquid storax, which it resembles in properties, though derived from a different species of Liquidambar. It is said to be used in Texas in *coughs.* (Gammage, *N. O. M. S. J.,* xii. 636.) For an account of the collection of American storax, see *Ph. Rund.,* 1895, 57.

Liquidambar may be employed for the same purpose as storax, and is so used in the Southern United States, but it is almost unknown in the Northern States. The concrete juice is said to be chewed in the Western States in order to sweeten the breath. The bark of the tree is used with asserted great advantage in the Southern and Western States in *diarrhœa* and *dysentery,* especially in children. It is taken in the form of syrup, which may be prepared from the bark in the same manner as the syrup of wild cherry bark, according to the U. S. Pharmacopœia. The *dose* is a fluidounce (30 Cc.) for an adult, repeated after each stool. (*Am. J. M. S.,* N. S., xxxii. 126.)

Liquidambar Altingia (*Altingia excelsa*), a tree which inhabits a very wide region in Southern Asia, yields a storax-like substance varying in color from white to red. (See *P. J.,* viii. 243.) According to Tschirch and van Itallie, it differs from storax in the presence of benzoic and cinnamic aldehydes, the absence of ether and the small quantities of cinnamic acid in it. The resin of *Liquidambar storesin* is said also to be known in Eastern markets.

Liriodendron. *Liriodendron tulipifera,* L. *Tulip Tree Bark. American Tulip. Poplar Tree.* (Fam. Magnoliaceæ.) *White Tulip Bark. Ecorce de Tulipier,* Fr. *Tulpenbaumrinde,* G.—The tulip poplar is a large tree which is abundant in the forests of the Middle United States. Its formerly official bark was taken for use indiscriminately from the root, trunk, and branches, though that of the root is thought to be the most active. Deprived of the epidermis, it is yellowish-white, the bark of the root being somewhat darker than that of the stem or branches. It is very light and brittle, of a feeble, rather disagreeable odor, strongest in the fresh bark, and of a bitter, pungent, and aromatic taste. These properties are weakened by age, and we have found specimens of the bark, long kept in the shops, almost insipid. To the active principle its discoverer, Emmet, gave the name of *liriodendrin.* It is white, crystallizable, brittle, insoluble in water, soluble in alcohol and ether, fusible at 82.2° C. (180° F.), volatilizable and partly decomposed at 132.2° C. (270° F.), of a slightly aromatic odor, and a bitter, warm, pungent taste. It does not unite either with acids or alkalies, and the latter precipitate it from the infusion of the bark by combining with the matter which renders it soluble in water. Water precipitates it from its alcoholic solution. It is obtained by macerating the root in alcohol, boiling the tincture with magnesia until it assumes an olive-green color, then filtering, concentrating by distillation until the liquid becomes turbid, and finally precipitating the liriodendrin by the addition of cold water. (*A. J. P.,* iii. 5.) J. U. Lloyd believes that the active principle is the alkaloid *tulipiferine,* discovered by him in 1886, and this, according to Bartholow, appears to possess toxic properties. (*Ph. Rund.,* 1886, 169.) The virtues of the bark are extracted by water and alcohol, but are injured by long boiling.

Liriodendron is a stimulant tonic, with diaphoretic properties, and has been used in chronic *rheumatism* and *dyspepsia.* *Dose* of bark in pow-

der, from half a drachm to two drachms (2.0–7.7 Gm.); of saturated tincture, a fluidrachm (3.75 Cc.).

Lithio-mercuric Iodide. $3LiI + HgI_2$.—Under the name of *mercuricide*, a compound iodide of the above formula has been brought out as a germicide. It is soluble without decomposition in water, alcohol and ether, and crystallizes in lemon-yellow crystals which are deliquescent. It is alleged that it is as actively germicidal as corrosive sublimate, but is not corrosive, less poisonous and not precipitable by blood serum, albumins or alkalies.

Mercury and Lithium Iodide, or *Hydrargyrum-Lithium Iodatum* of Merck, is a red and granular crystalline powder of the formula $HgI_2.2LiI$. It is soluble in alcohol or ether, but wholly incompatible with water, forming a cloudy mixture which soon precipitates mercuric iodide. It has been used in Germany as an antisyphilitic, antilithic alterative, and especially in *gravel* complicated with *syphilis*.

Lithium Salolo-phosphite. *Lithii Salolo-phosphis.* $C_6H_4\begin{cases} O(PO(OH)(OLi) \\ COOC_6H_5 \end{cases}$. *Salvosal-Lithia*, the lithium salt of *salolorthophosphorous acid*, is a white crystalline compound, soluble in cold water but decomposed by boiling water with a phenol-like odor. This substance and the allied one known as *salvosal-potash* have been used in *doses* of four to five grains (0.26–0.32 Gm.) in *influenza* and *gouty conditions;* the half of one per cent. solution has been commended as a mouth wash.

Lithospermum. *Lithospermum officinale*, L. *Gromwell. Milium Solis.*—A European perennial of the fam. Boraginaceæ, the seeds of which are ovate, of a grayish-white or pearl color, shining, rather larger than millet seeds, and of a stony hardness, from which the generic name of the plant originated. They were formerly used as stimulant diuretics, but are nearly inert.

Lithræa. *Lithræa venenosa*, Miers (*L. caustica*, Hook. and Arn.).—The leaves of this Chilian plant are said to act upon the skin in a manner similar to *Rhus toxicodendron*, and to contain a resin and an ethereal oil. The tincture of the fresh leaves has been used as a counter-irritant.

Litmus. *Lacmus. Turnsole. Tournesol. Lacca Cærulea. Lacca Musica. Laquebleu*, Fr. *Lackmus*, G.—Three purple or blue coloring substances are known in commerce, obtained from lichenous plants. They are called severally *litmus*, *orchil*, and *cudbear*. Litmus is yielded by numerous species of lichens which, under the French name of *orseille*, are brought into commerce from the coasts of Sweden and Norway; from the Alps, the Pyrenees, and other European mountains; from the European and African coasts of the Mediterranean; from the Canaries, Madeira, and various other rocky islands, especially from Mozambique, Madagascar, and Angola, and from California. The species of lichens concerned represent various genera; at present the two most important of the lichens are said to be the *Roccella Montagnei* of Mozambique and the *Dendrographa leucophæa* of California. In the north of Europe *Lecanora tartarea*, Ach., or *Tartarean moss*, and on the Mediterranean coasts the *Roccella tinctoria*, Ach., or *orchilla weed*, at one time furnished the great bulk of the orseille of commerce. The chromogenous ethers which constitute the coloring matter of the lichens may be readily detected *in situ* by reagents. (*P. J.*, Nov. 19, 1904.) In some of the lichens these coloring principles are chiefly situated in the cortex; in others they are especially abundant in the gonidial layer.

The principles in these plants upon which their valuable properties depend are themselves colorless, and yield coloring substances by the reaction of water, air, and ammonia. They are generally acids or acid anhydrides, and are named *lecanoric*, *orsellic*, *erythric*, etc., according to their origin. *Lecanoric* (*diorsellinic*) *acid*, $C_{16}H_{14}O_7$, the original constituent of most of these plants, when boiled with water or alkaline solutions, is changed into *orsellinic acid*, as follows:

$$C_{16}H_{14}O_7 + H_2O = (C_8H_8O_4)_2$$

Orsellinic acid, $C_6H_2\begin{cases} CH_3 \\ (OH)_2 \\ COOH \end{cases}$, fuses at 176° C. (348.8° F.), and decomposes into *orcin*, $C_6H_3(CH_3)(OH)_2$, and CO_2. The same decomposition is readily effected by distillation with milk of lime. Orcin combines with ammonia gas to form $C_8H_9O_2.NH_3$, the solution of which exposed to the air becomes colored reddish by the formation of *orcëin*, $C_7H_7NO_3$. This latter compound forms the basis of the commercial *orseille* extract (*orchil* or *archil*).

Kane (*Watt's Dict.*, vol. iii. 731) described a deep red crystalline substance, *erythrolitmin*, and a brownish-red coloring principle, *azolitmin*, $C_7H_7NO_4$. This latter is considered as the distinctive coloring matter of the commercial litmus. It is nearly insoluble in cold water or benzene, but dissolves in alcohol with red, and in ether with yellow color. It appears to have the characters of a weak acid, the salts of which are blue and the potassium and calcium compounds of which exists in litmus.

To test the value of the plants as dye-stuffs, they may be macerated in a weak solution of ammonia, or a solution of calcium hypochlorite may be added to their alcoholic tincture. In the former case a rich violet-red color is produced; in the latter, a deep blood-red color appears, but soon fades.

Lacmus or *litmus* is prepared chiefly if not exclusively in Holland. The process consists in macerating the coarsely powdered lichens, in wooden vessels under shelter, for several weeks, with occasional agitation, in a mixture of urine, lime and potash or soda. A fermentation ensues, and the mass, becoming first red and ultimately blue, is after the last change, removed, mixed with calcareous or silicious matter to give it consistence, and with indigo to deepen the color, and then introduced into small moulds, where it hardens. It is said that ammonia may be substituted for urine in the manufacture of litmus, but that the reactions necessary for the production of the coloring matter of the litmus are due to the action of the diastase which is found in the lichens. Litmus occurs in rectangular cakes, from a quarter of an inch to an inch in length, light, friable, finely granular, of an indigo-blue or deep violet color, and scattered over with white saline points. It has the combined odor of indigo and violets, tinges the saliva a deep blue, and is somewhat pungent and saline to the taste. From most vegetable blues it differs in not being rendered green by alkalies. It is reddened by acids, and restored to its original blue color by alkalies.

Its chief use in medicine is as a test of acids and alkalies. For this purpose it is employed either in infusion or in the form of litmus paper. The infusion, usually called *tincture of litmus*,

may be made in the proportion of one part of litmus to twenty of distilled water, and two parts of alcohol may be added to preserve it. *Litmus paper* is prepared by first forming a strong clear infusion with one part of litmus to four of water, and dipping slips of white unsized paper into it, or applying it by a brush to one surface only of the paper. The paper should then be carefully dried, and kept in well stoppered vessels, from which the light is excluded. It should have a uniform blue or slightly purple color, neither very light nor very dark. As a test for alkalies the paper may be stained with an infusion of litmus previously reddened by an acid, care being taken to avoid all excess. By gas light it is said that the change of color cannot be determined by the eye exactly, as the blue of litmus becomes mauve; but this may be obviated by watching the process through a green glass, by which the faintest trace of blue becomes discernible. (*P. J.*, 2d ser., vi. 479.) For the official method of preparing litmus paper, see Tests, Test solutions, etc., PART III.

Orchil, or *archil*, as prepared in England, is in the form of a thickish liquid, of a deep reddish-purple color, but varying in the tint, being in one variety redder than in another. The odor is ammoniacal. It is made by macerating lichens in a covered wooden vessel, with an ammoniacal liquor, either consisting of stale urine and lime, or prepared by distilling an impure salt of ammonia with lime and water. (Pereira.) For details as to the method of preparation, see *Chem. News*, 1874, 143. It is occasionally adulterated with the extracts of colored woods, as logwood, sappan-wood, etc. A mode of detecting these adulterations is given by F. Leeshing in the *Chem. Gaz.* of June 1, 1855, 219.

Cudbear (*Orseille de terre*, Fr.; *Persio*, G.) is in the form of a purplish-red powder. It is procured in the same manner as orchil; but the mixture, after the development of the color, is dried and pulverized.

The point in which the preparation of these coloring substances differs from that of litmus appears to be, that potassium or sodium hydroxide is added, in the latter, to the ammoniacal liquid used. Orchil and cudbear are employed as dyestuffs, and sometimes, in like manner with litmus, as a test of acids and alkalies. For some practical applications, see *A. J. P.*, 1874. For chemical constituents of lichens, see *A. J. P.*, 1898, 455.

Loco Plants. *Crazy Weeds.*—These are plants growing in the far Western States, the eating of which by horses and cattle is believed to produce loss of flesh, disordered vision, delirium, convulsive movements, or stupor and death. It has been claimed that *Astragalus mollissimus*, Torr., is the loco of Kansas, while *A. Drummondii*, Dougl., is the loco plant of Colorado.

In conformity with this Isaac Ott found a plant, which he believed to be *A. mollissimus*, to act as a violent spinal poison and mydriatic (*N. R.*, Aug. 1882), and, according to Carl Ruedi, the decoction produces in the rabbit great hilarity, excitement, and even ferocity, and contains an alkaloid, *locoine*, and an acid. (*Tr. Col. State Med. Soc.*, 1895.) On the other hand, O'Brien, of the State Agricultural College of Colorado, was not able to obtain any active chemical substance from six U. S. species of the genus, including the two previously mentioned, while in a very careful study of a plant which was neither in flower nor in seed, but whose identification as *A. mollissimus* was clear, H. C. Wood found that it was not poisonous to rabbits or dogs, a result which has been confirmed by James Kennedy, *Ph. Rec.*, July, 1888; by Ingersoll, *Proc. A. Ph. A.*, 1890; and by L. E. Sayre, *Proc. A. Ph. A.*, 1888. This also is in accord with the researches of O'Brien (*Bulletin 25, Agricultural Experiment Station of Colorado*), and it would appear that *A. mollissimus* is not a poisonous plant. Other species of the genus, especially *A. Hornii*, A. Gray, *A. Bigelovii*, A. Gray, and *A. crassicarpus*, Nutt. (*A. caryocarpus*, Ker.) have had poisonous properties attributed to them, and in the fruit of the last-mentioned species G. B. Frankforter believes he has demonstrated the presence of an alkaloid. There can be no doubt that domestic animals are destroyed in the West in very large numbers from an affection which is known as "loco," and hundreds of thousands of dollars have been spent in bounties by the State of Colorado for the extirpation of the supposed poisonous astragalus. It is probable that many of the deaths attributed to loco have been from other causes. Thus, Ingersoll of the Colorado State Agricultural College, found in a large number of locoed sheep masses of *Tænia expansa*, which he believed to be the cause of death. It is a probable explanation that the phenomena of loco disease are due to the fermentation of an astragalus or other plant in the intestines of the animals, and the production of one or more poisons which are absorbed and produce narcotic symptoms. If this be correct the loco disease is parallel in its etiology and nature to the lathyrismus of Europe. See *Lathyrus sativus;* also *N. Y. M. J.*, 1889, xlix. Similar effects are produced in horses by the pods of the mesquite (*Prosopis juliflora*, Swz., DC.), when eaten too freely. According to Haeckel (*Die naturlichen Pflanzen Familien*), the Russian grass *Stipa capillata* frequently kills sheep, not, however, by a direct poisonous action, but by its glumes working through the skin into the vital organs; and *Stipa viridula*, Trin., which is said in some parts of New Mexico and Texas to be known by the name of "*sleepy grass*," is believed by some ranchers to be the cause of loco disease. In the experiments of A. Lockhart Gillespie (*B. M. J.*, ii. 1898) the extract of this grass was found to act upon rabbits and frogs as an active poison, especially affecting the nerve centres but also influencing the heart.

Lolium. *Lolium temulentum*, L. *Darnel. Bearded Darnel. Ivraie*, Fr. *Lolch, Taumelkorn*, G. This grass, which has spread over the world wherever wheat is cultivated, owes its importance to its growing especially with wheat, so that its ground seeds are eaten in the flour. From ancient times its seeds have been believed to produce an intoxication similar to that of alcohol; hence its specific Latin name and the French name, *Ivraie*. In the sweetish seeds, P. Antze (*A. J. P.*, 1891, 568) believed that he found a solid alkaloid, *temulentine*, and a volatile one, *loliine;* but Hofmeister (*A. J. P.*, 1892, 611) determined that the volatile alkaloid was an impure ammonia, while the temulentine was a mixture which contained a nitrogenous acid and an uncrystallizable alkaloid, *temuline*, of which the hydrochloride has the formula $C_7H_{12}N_2O.2HCl$.

It is alleged that lolium seeds produce vertigo, dizziness, headache, somnolence, and general intoxication in man, as well as in dogs, sheep and horses, while they are innocuous to hogs, cows,

and poultry. Rivière and Maizière (*J. P. C.*, 1863, 280) have recorded death as occurring from the use of bread containing large amounts of darnel. P. Antze found that both *loliine* and *temulentine* are poisonous, causing violent gastro-intestinal irritation, dyspnœa, and general depression. (*Cb. G. T.*, 1891.) M. P. Guerin believes the poisonous properties of darnel are due to the presence of a fungus. (*Morots Journ. de Bot.*, 1898.)

Lonchocarpus. *Lonchocarpus violaceus. Stinkwood.*—The wood of this papilionaceous tree is said to be used by the natives of Surinam as a fish poison. (*Ph. Cb.*, xxxix. 282.)

Lonicera. *Lonicera Caprifolium*, L. *Honeysuckle.* (Fam. Caprifoliaceæ.)—The flowers of the common honeysuckle are sometimes used in perfumery, and a syrup of the fruit has been commended in *asthma*. The fruit of all the species of Lonicera is said to be emetic and cathartic (Mérat and De Lens), and that of *L. xylosteum* (L.) to have caused serious poisoning. (*J. P. C.*, 4e sér., xviii. 65.)

Loretin. *Meta-iodo-ortho-oxyquinoline-ana-sulphonic Acid.* $C_9H_4IN.OH.SO_3H$.—This organic iodine compound, discovered by Claus of Freiburg, contains 36.2 per cent. of iodine and is a bright yellow, odorless, crystalline powder, insoluble in ether and oils, soluble in 500 to 1000 parts of cold water, and in 167 to 200 parts of boiling water; it forms neutral soluble salts with sodium, potassium, ammonium, and magnesium, yielding deep orange-yellow solutions. It is very stable for an iodine compound, not being affected by exposure to direct sunlight. It was found by Ammelburg to be much more powerful as a germicide than iodoform, with seven different pathogenetic germs essayed. Given hypodermically to guinea pigs (5 Cc. of a 5 per cent. solution for long periods), it produced no poisoning, and no iodine could be detected in the urine. (*Deutsche Zeitsch. für Thier. Med. und Vergleich. Path.*, 1894.)

It has been especially commended as a substitute for iodoform by Schinsinger and by Snow. (*B. M. J.*, ii. 1895.) It may be used as a dusting powder alone or mixed with calcined magnesia or starch; as collodion, from 2 to 10 per cent.; as ointment, 5 to 10 per cent.; and in solution, 1 to 2 per cent. of the soluble sodium salt. The soluble calcium salt, *calcium loretin*, has been especially recommended for the manufacture of antiseptic gauze. Snow states that the pure powder may be used without danger of poisoning or of local irritation.

Lotus. *Lotus arabicus.*—According to W. R. Dunstan and T. A. Henry, the leaves of this leguminous plant contain a yellow crystalline glucoside, *lotusin*, $C_{22}H_{19}NO_{10}$, and an enzyme, *lotase*, by which lotusin is converted into prussic acid and a yellow substance, *lotoflavin*. (*Proc. Roy. Soc.*, 67, 224.)

Lucuma.—This Brazilian genus of the fam. Sapotaceæ yields a number of species, which are used in Brazil as medicines or articles of diet. For an account of them, see *Ph. Rund.*, 1888. See also *Monesia*.

Luffa. *Luffa ægyptiaca. Vegetable Sponge. Wash-rag Sponge. Gourd Towel.*—A cucurbitaceous genus, indigenous to Arabia and Egypt, furnishing a gourd-like fruit, which presents upon the removal of the epidermis a durable skeleton of interwoven woody fibres, which are used in place of sponge. Reinhard J. Weber has furnished the following description of *Luffa ægyptiaca* as grown in this country: It is a large climbing vine, with a thin but very tough light green, succulent stem, attaining a length of from 10 to 30 feet. The leaves are alternate and palmately-lobed, of a light green color, and almost destitute of taste. The flowers are monœcious, petals five, united below into a bell-shaped corolla; anthers cohering in a mass; ovary two-celled, style slender, stigmas three. The fruit is elliptical-ovate, fleshy and dehiscent, with a green epidermis, longitudinally marked with black lines, varying from ten to fifteen in number; under each of these lines is found a tough, woody fibre. The seeds are numerous and almost flat, broadly-ovate, three-eighths of an inch long. (*A. J. P.*, 1884, 6.) The fruit of *L. echinata*, Roxb., of India, is a violent irritant poison, from which C. J. H. Warden has separated a principle allied to, if not identical with, *colocynthitin*. (*P. J.*, June, 1890.)

Lupinus. *Lupinus albus*, L. *Lupin. Lupin*, Fr. *Feigbohne, Wolfsbohne*, G.—A plant belonging to the Leguminosæ, and a native of Europe and Western Asia, which is sometimes cultivated in our gardens. Other species are also met with,—*L. hirsutus*, L., *L. luteus*, L., *L. polyphyllus*, Lindl., *L. densiflorus*, Benth. The last two are indigenous to the Pacific slope and the West. The bitter principle *lupinin*, $C_{29}H_{32}O_{16}$, is a glucoside, and its solution in alkalies is of a dark brownish-yellow color. On boiling with dilute acids it is decomposed into *lupigenin*, $C_{17}H_{12}O_6$, and a fermentable, dextro-rotatory glucose. The bruised seeds of white lupin, after soaking in water, are sometimes used as an external application to *ulcers*, etc., and internally are said to be anthelmintic, diuretic, and emmenagogue. An instance has been recorded where a decoction used as an injection in the rectum caused symptoms which suggested a poisonous character for the drug. Schulze and Steiger have isolated an alkaloid, *arginine*, $C_6H_{14}N_4O_2$, from the germinated seeds of *Lupinus luteus*. (*A. J. P.*, 1887, 428.) Steiger (*J. Soc. Chem. Ind.*, 1886, 385) has also studied a carbohydrate analogous to dextrin, which Baeyer and Eichborn discovered in *Lupinus luteus*. He finds that it is not changed by yeast, that nitric acid converts it into mucic acid, and that diluted sulphuric or hydrochloric acid converts it into galactose.

Lycetol. *Dimethylpiperazine Tartrate.* $NH(CH_2CHCH_3)_2NH + H_2C_4H_4O_6$.—This is the tartrate of a substitution product from piperazine, in which an atom of hydrogen in each of two CH_2 groups is replaced by the methyl group CH_3. Lycetol is a white powder melting at 250° C. (482° F.), readily soluble in water, having a taste which is described as pleasant and acidulous. It is asserted that it is an active diuretic, exerting a powerful solvent influence upon uric acid, and causing no disturbance of digestion even when given continually in large doses. According to Hamonic, it acts very favorably in purulent *cystitis*, lessening suppuration and the tendency to decomposition of the urine. It has been used with asserted excellent results in *chronic* and *acute gout*, and in various other forms of *uric acid diathesis*, as well as for solution of *calculi*. *Dose*, of lycetol, from fifteen to thirty grains (1.0–2.0 Gm.) daily, administered in from one to two pints of water.

Lycium. *Lycium vulgare* (Ait. f.), Dunal (*L. barbarum*, var. *vulgare*, Ait. f.). *Matrimony Vine.* The genus Lycium belongs to the Solanaceæ. Different species have been used in various parts of

the world for supposed medicinal virtues. *Lycium vulgare,* which is indigenous in the south of Europe and in Asia, is a thorny shrub, with long flexible branches, and is cultivated for hedges and arbors. Husemann and Marmé found in the leaves and stem an alkaloid, *lycine,* $C_5H_{11}NO_2$. (*A. J. P.,* 1864, 226.) It is characterized by its strong affinity for water, which causes it to deliquesce in a few minutes after exposure, and renders it very soluble in that liquid. It is also readily soluble in alcohol, but nearly insoluble in ether. It is crystallizable, of a sharp but not bitter taste, and forms crystallizable salts with the acids. Aug. Husemann believes that lycine does not exist in the plant, but is formed during the process of extraction, and also that it is identical with *betaine,* $C_5H_{11}NO_2$, the alkaloid obtained from beet juice by Scheibler, and with the oxyneurine of Liebreich. (*A. J. P.,* xlvii. 209.) E. Schmidt found in *Lycium vulgare* traces of mydriatic alkaloids, resembling those of belladonna. (*Ap. Ztg.,* 1890, 511.) The young shoots of one of the species of Lycium are eaten in Spain as asparagus, and its leaves as salad, and the aborigines of Colombia used another species against *erysipelas.* The leaves of *L. vulgare,* as well as the fruit, are said to be used by the physicians of Japan. (Mérat and De Lens.)

Lycoctona.—For its physiological action, see *P. M. T.,* Oct. 1875.

Lycopodium Saururus, Lam. *Piligan.*—In this Brazilian lycopod Adrian has found an actively poisonous alkaloid, *piliganine* (*C. R. A. S.,* June, 1886). (See also *B. G. T.,* cxi. 174.)

Lycopus. *U. S.* 1870. *Lycopus virginicus,* L. *Lycope de Virginie,* Fr. *Virginischer Wolfsfuss,* G.—The *bugle-weed* is a labiate which grows throughout the greater part of the Eastern United States. Its flowering period is August. The whole herb is used. Jos. L. Weil found 0.41 per cent. of a fat melting at 50° C. (122° F.), 0.68 per cent. of a granular wax melting at 70° C. (158° F.), 0.43 per cent. of a crystallizable resin soluble in ether, a crystallizable glucoside, and a small quantity of gallic acid and tannin. (*A. J. P.,* 1890, 72.) It has a peculiar odor and a nauseous slightly bitter taste, and imparts these properties, as well as its medicinal virtues, to boiling water.

Lycopus europœus, L., is said to be frequently collected and sold for *L. virginicus.* The former may be distinguished by its acutely quadrangular stem, its narrow lanceolate leaves, of which the lower are somewhat pinnatifid, its more crowded flowers, and the acute segments of its calyx, armed with short spines. It has been employed in Europe as a substitute for quinine.

According to A. W. Ives, the bugle-weed is a mild narcotic and an astringent, useful in pulmonic and other *hemorrhages. Dose* of decoction, (one ounce to one pint of boiling water), from half a pint to one pint (240–480 Cc.) daily.

Lycoris. *Lycoris Radiati.* (Fam. Amaryllidaceæ).—According to Morishima (*A. E. P. P.,* 40) this plant contains two alkaloids, *lycorine,* $C_{32}H_{32}N_2O_8$, which occurs in large colorless polyhedric crystals, and is physiologically very active; and *sekisanine,* $C_{34}H_{34}N_2O_9$ which occurs in colorless, anhydrous columns and is quite inactive physiologically.

Lygosin. *Di-ortho-cumar-ketone.*—The sodium salt is a ruby-red compound readily soluble in water; the quinine salt is an amorphous orange-yellow powder. According to Aujezki, *sodium lygosinate* is very feebly bactericidal, and is capable of lowering the temperature in fevered rabbits. Filep asserts that the *quinine lygosinate* is actively bactericidal and suggests its use in the treatment of *wounds.*

Lysidine.—Lysidine is a reddish-white, crystalline substance, melting at 105° C. (221° F.), readily soluble in water and alcohol and having a peculiar nauseous taste suggesting the odor of mice. On account of its great hygroscopicity it is now supplied to the trade in a uniform 50 per cent. solution. It was brought forward by Ladenburg as a solvent for *uric acid,* with the statement that it had five times the power of piperazine. See also Grawitz (*D. M. W.,* 1894) and Woodcock Goodbody (*B. M. J.,* ii. 1896). Goodbody believes that lysidine is more active as a diuretic than is piperazine. We have used it in our cases with apparent good results. *Dose,* ten to twenty grains (0.65–1.3 Gm.) may be given three times a day in a half pint of aerated water.

Lysoform is an alcoholic potash soap containing formaldehyde. This preparation of formic aldehyde resembles in its general appearance glycerin, is miscible in water in all proportions, but should not be heated above 37.7° C. (100° F.) lest the formic aldehyde be volatilized. Diluted with its own bulk of water it forms a lather, and is useful for skin disinfection. Its 5 per cent. solution is said to be effectively germicidal, and it is stated not to be irritating either to the skin or to the mucous membrane. According to the researches of Franz Nagelschmidt (*Th. M.,* 1902) it is about three times less poisonous to rabbits than is lysol.

Lysoform may be used as an antiseptic mouth or nose wash, one to three teaspoonfuls to a pint; as a vaginal or uterine douche, from four to six teaspoonfuls to a pint; for abscess cavities, suppurating sinuses, etc., six teaspoonfuls to the pint or stronger; for disinfecting the hands or instruments, six to twelve fluidrachms to the pint.

Carbollysoform, so-called, is said to be a 3 per cent. solution of phenol in lysoform.

Lysulfol.—A black unguentous mass said to contain lysol with 10 per cent. of sulphur. It is entirely soluble in water and is highly commended by E. Rumpf in *pityriasis versicolor, scabies, acne, psoriasis* and *prurigo,* well rubbed in on the part, in the evening and thoroughly washed off in the morning.

Lythrum. *L. Salicaria,* L. *Loosestrife. Purple Willow-herb. Salicaire,* Fr. *Röther Weiderich,* G.—This is an elegant perennial plant of the fam. Lythraceæ, a native of Europe, but naturalized from Ontario to Kentucky and Arkansas. The dried herb is inodorous, and has an herbaceous, somewhat astringent taste. It has been used as a demulcent astringent in *diarrhœa* and chronic *dysentery,* especially in Ireland and in Sweden. The *dose* of the powdered herb is about a drachm two or three times a day. A decoction of the root, prepared by boiling an ounce in a pint of water, may be given in the *dose* of two fluidounces (60 Cc.).

Macallo or Yaba Bark.—For an article on this Yucatan bark, see *A. J. P.,* 1879, 392.

Mackay Bean.—This is the seed of *Entada scandens,* Benth. (Fam. Leguminosæ), of Queensland, which has the reputation in the colony of being strongly poisonous, and in which John Moss found saponin. (*P. J.,* vol. xviii. 242.)

Magnesium Acetate. *Magnesii Acetas.* $Mg(C_2H_3O_2)_2.4H_2O$.—This salt has been used as a

substitute for the citrate, but is much inferior. For further information, see previous editions, *U. S. D.*

Magnesium Benzoate. *Magnesii Benzoas. Benzoate de Magnésie,* Fr. *Magnesiumbenzoat,* G. $Mg(C_7H_5O_2)_2 + 3H_2O$.—Made by neutralizing a hot solution of benzoic acid with magnesium carbonate and crystallizing. A white, crystalline powder, permanent in the air, soluble in 20 parts of water or alcohol. Used for *gout, urinary calculi,* and *tuberculosis,* in *doses* of from three to fifteen grains (0.2–1.0 Gm.).

Magnesium Bromide. *Magnesii Bromidum. Bromure de Magnésie,* Fr. *Magnesiumbromid,* G. $MgBr_2 + 6H_2O$.—Made by neutralizing hydrobromic acid with magnesium oxide, evaporating and crystallizing. In the form of colorless, very deliquescent crystals, used as a nervine, in *doses* of from five to thirty grains (0.32–2.0 Gm.).

Magnesium Chlorate. *Magnesii Chloras.* $Mg(ClO_3)_2$.—This salt in 20 per cent. ointment has been highly commended (*S. M.,* 1899) by Herscher and Gaucher in the treatment of *epithelioma.*

Magnesium Chloride. *Magnesii Chloridum.* $MgCl_2$.—This is produced at Stassfurt in the potash and bromine industries. When a concentrated solution of this salt is evaporated to dryness, it is partially decomposed into magnesium oxide and hydrochloric acid, the latter being evolved. By a careful evaporation, stopping it so soon as the vapor begins to redden litmus paper, the chloride may be obtained in the state of a fused hydrate, having the composition $MgCl_2.6H_2O$. Or, by adding ammonium chloride to the solution, the mixed chlorides can be evaporated to dryness, and the sal-ammoniac volatilized without decomposing the magnesium chloride. Lebert found this bitter and very deliquescent salt to act mildly and favorably as a purgative, producing a flow of bile and an increase of appetite. On account of its extreme deliquescence, he recommended it in the liquid form, prepared by dissolving the salt in its weight of water. *Dose,* for an adult, an ounce (31. Gm.) sufficiently diluted, and half an ounce (15.5 Gm.) to a child ten years old. (*A. G. M.,* 4e sér., iii. 448.)

Magnesium Dioxide. *Magnesii Dioxidum. Biogen.*—This dioxide is an odorless white powder, insoluble in water, alcohol, or ether, which like hydrogen dioxide, readily yields up one atom of oxygen. Magnesium dioxide probably has some influence as an intestinal antiseptic, but beyond this it is not probable that it has any therapeutic value; ten to forty grains (0.65–2.6 Gm.) may be given at the *dose.*

Magnesium Lactate. *Magnesii Lactas. Lactate de Magnésie,* Fr. *Magnesiumlactat, Milchsaure Magnesia,* G. $Mg(C_3H_5O_3)_2 + 3H_2O$.—The salt is made by double decomposition between 6 parts of calcium lactate and 5 parts of magnesium sulphate, or by neutralizing diluted lactic acid with magnesium carbonate and evaporating to dryness. In white granular crystals, soluble in about 30 parts of cold water and 6 parts of boiling water, insoluble in alcohol. Used as a mild laxative in *doses* of from fifteen to forty-five grains (1–3 Gm.).

Magnesium Salicylate. *Magnesii Salicylas.* $Mg(C_6H_4(OH)CO_2)_2.4H_2O$.—This salt has been enthusiastically recommended by Huchard in *typhoid fever,* given in daily *doses* of from fifty to one hundred grains (3.2–6.5 Gm.) continuously: diarrhœa is not a contraindication to its use. According to B. Fischer (*Ph. Ztg.,* 1888, 146), the salt is prepared by dissolving salicylic acid in boiling water, saturating the solution with magnesium carbonate, filtering, and crystallizing. It forms long, colorless hygroscopic needles, which are readily soluble in water and alcohol, and have a somewhat bitter taste. (*A. J. P.,* 1888.)

Magnesium Silicate. *Hydrated Magnesium Silicate. Meerschaum.* $H_2Mg_2Si_3O_9 + H_2O$.—Meerschaum is one of several hydrated silicates of magnesium, talc and serpentine being others of analogous formula. It is used for the manufacture of tobacco pipes. It was brought into notice as a medicine by Garraud, who used it successfully as a substitute for bismuth subnitrate in obstinate *diarrhœa.* Trousseau employed it also with great success in numerous cases of diarrhœa. It no doubt acts mechanically, either as an absorbent or a protective of the intestinal coats. (*J. P. C.,* 4e sér., iii. 385.) It should be reduced to a very fine powder, and given in *doses* of from one to four drachms (3.9–15.5 Gm.) a day.

Magnesium Sulphite. *Magnesii Sulphis. U. S.* 1880. $MgSO_3.6H_2O$.—This salt may be prepared by double decomposition between magnesium sulphate and neutral sodium sulphite. Owing to the almost universal presence of sulphate in the sodium sulphite, Jos. P. Remington proposes to prepare it by suspending eight parts of pure magnesia in sixteen parts of water, and then adding gradually, with stirring, official aqueous sulphurous acid in excess. The crystals which form are washed with very cold water, drained, and dried. (*A. J. P.,* xl. 97.) "A white, crystalline powder, gradually becoming oxidized on exposure to air, odorless, having a slightly bitter, somewhat sulphurous taste, and a neutral or slightly alkaline reaction. Soluble in twenty parts of water at 15° C. (59° F.), and in nineteen parts of boiling water; insoluble in alcohol. When heated to 200° C. (392° F.), the salt loses its water of crystallization (50.9 per cent.), and is converted into magnesium oxide and anhydrous magnesium sulphate. The aqueous solution of the salt, mixed with ammonium chloride, yields, with excess of test-solution of sodium phosphate and water of ammonia, a white, crystalline precipitate soluble in acids. When treated with four times its weight of diluted hydrochloric acid, the salt dissolves completely and emits the odor of burning sulphur, without becoming cloudy (difference from hyposulphite). A 1 per cent. aqueous solution, strongly acidulated with hydrochloric acid, should not afford more than a slight cloudiness with test-solution of chloride of barium (limit of sulphate)." Magnesium sulphite shares the general medicinal properties of the sulphites, but is better fitted for internal administration on account of its less solubility and less disagreeable taste, etc. (See *Sodii Sulphis.*) The *dose* is from fifteen grains to half a drachm (1–2 Gm.).

Magnolia. *U. S.* 1880. *Magnolia Bark. Ecorce de Magnolier,* Fr. *Magnolienrinde,* G. (Fam. Magnoliaceæ.)—Three species of magnolia were formerly official, as follows: 1. *Magnolia virginiana,* L. (*M. glauca,* L.), which in the Northern States is often nothing more than a shrub, sometimes attains in the South the height of forty feet.

M. virginiana is found along the seaboard of the United States, from Cape Ann, in Massachusetts, to the shores of the Gulf of Mexico. It is usually

known as *magnolia* in the North, and as *white bay* or *sweet bay* in the South, but is occasionally called *swamp sassafras, beaver-tree,* etc.

2.—*M. acuminata,* L. *Cucumber-tree.* Grows to the height of seventy or eighty feet.

3.—*M. tripetala,* L., is a small tree, sometimes, though rarely, attaining a height of thirty feet. It extends from Northern New York to the southern limits of the United States. Wallace Procter found in the fruit a neutral crystalline principle, *magnolin.* When pure, this is without odor and has at first little taste, in consequence of its insolubility in the liquids of the mouth, but after a time produces an irritant effect on the fauces. It is nearly insoluble in cold, but slightly soluble in hot water, very soluble in alcohol, ether, chloroform, carbon disulphide, and benzin. Procter considered it analogous to the liriodendrin obtained by Emmet, but quite distinct. Magnolin has also been obtained by Stephen Procter (*A. J. P.,* xiv. 95) from the bark of *M. fœtida* (L.), Sarg. (*M. grandiflora,* L.), and by W. D. Harrison from that of *M. glauca.* (*A. J. P.,* xxxiv. 29.) For a more detailed account of it, see *A. J. P.,* 1872, 145; also Lloyd's paper in *Ph. Rund.,* 1866, 224. W. F. Rawlins (*A. J. P.,* 1889, 7) obtained from the leaves of *M. glauca* a small quantity of a volatile oil of bright green color, with an odor resembling fennel or anise, but more pleasant. From the ethereal solution of this oil small crystals deposited. Indications were also obtained of a bitter glucosidal principle.

The bark and fruit of all the species of Magnolia are possessed of similar medicinal properties; but the bark only was official, and that of the root has been thought to be most efficient. "The bark from young wood is quilled or curved, thin, externally orange-brown and glossy, or light gray, with scattered warts and somewhat fissured, internally whitish or pale brownish and smooth; fracture short, in the inner layer somewhat fibrous; inodorous; taste somewhat astringent, pungent, and bitter. The bark of old wood, deprived of the cork, is whitish or brownish, fibrous, and less pungent." *U. S.* 1880. The aromatic property, which resides in a volatile principle, is diminished by desiccation, and entirely lost when the bark is long kept. The bitterness, however, remains. The bark is destitute of astringency.

Magnolia is a gently stimulant aromatic tonic and diaphoretic. It has been used in *malaria* and in *rheumatism.* The *dose* of the recently dried bark in powder is from half a drachm to a drachm (2.0–3.9 Gm.), frequently repeated. Diluted alcohol extracts all the virtues of the medicine, and a tincture, made by macerating the fresh bark or fruit in brandy, is a popular remedy in chronic rheumatism.

Malakin. *Salicyliden-paraphenetidin.* $C_6H_4 \begin{cases} OC_2H_5 \\ N:CH.C_6H_4(OH) \end{cases}$.—This occurs in small, bright yellow, fine needles, melting at 92° C. (197.6° F.), insoluble in water, sparingly soluble in cold, but quite so in hot alcohol, insoluble in carbonates of the alkalies, but soluble with a yellow color in soda lye; weak mineral acids decompose it, forming salicylaldehyde and paraphenetidin.

Malakin contains about 50 per cent. of salicylaldehyde, and in 1893 Jacquet called attention to it as an anti-rheumatic remedy, stating that it is decomposed in the stomach, yielding salicylaldehyde to the blood, and offering, therefore, a method of giving salicylic acid. Cases have been reported not only by Jacquet, but by Merkel, by Korotkoff, by Oussoff, by Abernethy, and others, in which, in *doses* of from forty-five to ninety grains (3.0–5.8 Gm.) a day, malakin acted very favorably in *acute rheumatism.* On the other hand, Ottolenghi (*Ther. Woch.,* ii. 1895) has found that after the administration of malakin, crystals of it can be found throughout the whole intestines, even as low as the rectum, so that the decomposition and after-absorption of it must be exceedingly slow and uncertain, and the contention of Bauer, that it is distinctly inferior to the older salicylates, is in all probability correct. Ottolenghi suggests that malakin must act on tænia and other intestinal parasites, and may therefore prove useful as an anthelmintic.

Malambo or **Matias Bark.**—A bark received from South America by Alex. Ure, under the name of *matias bark,* was found to have the characters of the *malambo bark,* which is held in high esteem in Colombia, where it is produced. According to H. Karsten, it is derived from a hitherto undescribed species of Croton, which he names *Croton Malambo.* (See *Floræ Colombiæ Terrarumque adjacentium Specimina Selecta.*) This is a small tree or shrub, growing on the coast of Venezuela and Colombia. (*P. J.,* 1859, 321.) The bark is described by Ure as being three or four lines thick, brittle, though somewhat fibrous, of a brown color, and covered with an ash-colored tuberculous epidermis. It has an aromatic odor and a bitter pungent taste, and yields these properties to water and alcohol. Its active ingredients appear to be a volatile oil and a bitter extractive matter. According to Mackay, it has been used successfully in *intermittents,* convalescence from continued fevers, *hemicrania, dyspepsia,* and other cases in which tonic remedies are useful, and also as an adjuvant to diuretics. It is probably nothing more than an aromatic tonic. Ure has administered it with good effect as a substitute for Peruvian bark. (*P. J.,* iii. 169.)

Under the name of *Winter's bark,* a considerable quantity of bark was some time since imported into the United States from South America, which E. S. Wayne of Cincinnati, has identified with the malambo bark above described, having found it to correspond with that product both in sensible characters and composition. (*A. J. P.,* xxix. 1.) George B. Wood confirmed this decision of Wayne; a specimen in his possession answered precisely to the description given by Ure. The malambo bark, analyzed by Cadet de Gassicourt, yielded volatile oil, bitter resin, and extractive, but no tannic or gallic acid, and no alkaloid, and the same was the case with the so-called Winter's bark examined by Wayne. (*Ibid.*) The same bark has been analyzed by F. B. Dancy, who found in it volatile oil, gum, starch, albumen, resin, extractive, fixed oil, wax, and several inorganic substances. (*Ibid.,* 219.)

Malarin.—This is a yellowish-white powder, insoluble in cold water, which is said to be a condensation product obtained by heating molecular equivalents of acetophenone and paramidophenetol. It has been suggested for use as an antipyretic.

Malouetia. *Malouetia nitida,* Spruce. *Gauchamacà.* (Fam. Apocynaceæ.)—This plant, of Venezuela, contains an alkaloid, *guachamacine,* which Kobert believes to be identical with *curarine.* (*A. J. P.,* 1885, 560.)

Malva. *Malva sylvestris*, L. *Common Mallow. Flores Malvæ, Folia Malvæ*, P. G. *High Mallow. Mauve Sauvage, Grande Mauve*, Fr. *Käsepappel, Waldmalve*, G.—This is a perennial, herbaceous European plant of the fam. Malvaceæ. Almost all the species of the genus are possessed of the same properties. *M. rotundifolia*, L., one of the most common, may be substituted for *M. sylvestris*. The herb and flowers have a weak, herbaceous, slimy taste, without odor. They abound in mucilage, which they readily impart to water, and the solution is precipitated by lead acetate. The infusion and tincture of the flowers are blue, and serve as a test of acids and alkalies, being reddened by the former and rendered green by the latter. The roots and seeds also are mucilaginous. Common mallow is emollient and demulcent. The infusion and decoction are sometimes employed in *catarrh*, *dysentery*, and *nephritic complaints*, and are applicable to all other cases which call for the use of mucilaginous liquids.

Manaca.—This is a portion of the root and stem of *Brunfelsia hopeana*, Benth. (*Franciscea uniflora*, Pohl.), a Brazilian plant belonging to the fam. Solanaceæ. It occurs in pieces from a few inches to one foot in length, and about one-half inch in diameter, very tough and woody, with a yellowish centre and a dark, very thin outer bark. The stem portion has a very small yellowish pith. H. B. Parsons (*Am. Chem. J.*, vol. i. No. 6) came to the conclusion that it contains no alkaloid, but R. Lenardson (*In. Dis.*, Dorpat, 1884) asserts that he has found in it an alkaloid, *manacine*, besides a peculiar fluorescent substance supposed to be identical with *gelseminic acid*. Manacine is described as a light yellow, very hygroscopic powder, of a faint bitter taste, possessing very feeble basic properties, melting at 115° F., freely soluble in water and ethyl and methyl alcohol, but insoluble in ether, benzene, amyl alcohol, and chloroform. E. P. Bruer (*T. G.*, 1882), as the result of experiments made upon the lower animals, arrived at the conclusion that manaca acts upon the spinal cord, first stimulating, and then abolishing the activity of the motor centres, the action being shared in by the respiratory centres. All the glands, especially the kidneys, were stimulated by it. In large doses he found it to produce in man lassitude, perspiration, and loose, greenish alvine discharges. Manaca has been very strongly recommended in the treatment of chronic or subacute *rheumatism* and *syphilis*. The *dose* of the fluidextract is from ten to thirty minims (0.6–1.8 Cc.) three times a day. (See *T. G.*, 1880; also New Series, vols. ii. and iii.)

Mandragora. *Mandragora officinarum*, L. *Atropa Mandragora*, L. *Mandrake. Mandragora, Mandragore*, Fr. *Alraunwurzel*, G.—A perennial European plant, with spindle-shaped root, which is often forked beneath, and is therefore compared, in shape, to the human figure. In former times this root was supposed to possess magical virtues, and was used as an amulet to promote fecundity, etc., and the superstition is still cherished by the vulgar in some parts of Europe. The plant is a poisonous narcotic, somewhat similar in its properties to belladonna, to which it is botanically allied. Crouzel isolated an alkaloid, *mandragorine*, which he found similar in properties to atropine. (*P. J.*, 1885, 1067.) It has since been more thoroughly studied by F. B. Ahrens. (*Ber. d. Chem. Ges.*, 1889, 2159–2161.) *Mandragorine* is colorless, inodorous, deliquescent, melts at from 77° to 79° C. (170.6°–174.2° F.), and has the formula $C_{17}H_{23}NO_3$. It seems to be isomeric with atropine, but is not converted into it by alkalies. The sulphate and the hydrochloride are crystalline and deliquescent. A second alkaloid in much smaller amount was also extracted, of which the gold and platinum double chlorides were formed. Both alkaloids had a mydriatic action. It was much used by the ancients as a narcotic, and as an anæsthetic agent before surgical operations. (*J. P. C.*, xv. 290.) *Morion* or *death-wine*, said to have been administered previous to the torture, was made from it. Its physiological action has been partially investigated by B. W. Richardson. (*B. F. M. R.*, 1874, 242.)

Manganese. *Manganum.*—This metal and its compounds with oxygen have been described. (See *Mangani Dioxidum Præcipitatum*, p. 759.) Several of its salts have been proposed as medicines, to be used as tonic and anti-anæmic remedies. Manganese as well as iron is always present, in minute proportion, in healthy blood, and has been detected in various solids and fluids of the body. According to an analysis by Burin-Dubuisson, the amount of manganese in the blood corpuscles is about one-twentieth that of the iron. It is stated, as an advantage of the preparations of manganese, that they may be prescribed in conjunction with tannic acid and the various astringent medicines, which are all incompatible with the preparations of iron. Of the manganous oxides, the *monoxide* only is strongly salifiable, and this is the oxide present in the ordinary salts of the metal. It may be obtained by precipitation, as a white hydrate, from any of the soluble manganous salts by the addition of a caustic alkali. This, according to Hannon, is a good medicinal preparation; but a strong objection to it is that it rapidly absorbs oxygen, and passes to the state of the brown hydrated sesquioxide.

Manganese Carbonate. Mangani Carbonas. Manganous Carbonate. $MnCO_3$.—This salt may be obtained by the following formula, which is that of Hannon: Dissolve seventeen ounces of crystallized manganous sulphate, and nineteen ounces of sodium carbonate, separately, in two pints of water, a fluidounce of syrup having been previously added to each pint, and, having mixed the solution in a well stoppered bottle, allow the precipitate to subside. Decant the supernatant liquid, wash the precipitate with sweetened water, allow it to drain from a cloth saturated with syrup, express, mix with ten ounces of honey, and evaporate rapidly to form a pilular mass, which is to be divided into four-grain pills. By a double decomposition between the manganous sulphate and sodium carbonate, manganous carbonate is precipitated, and sodium sulphate remains in solution. The sulphate is washed away, and the carbonate is brought to a pilular consistence with honey, which, together with the syrup, prevents the manganous oxide in the pill from rising to a higher stage of oxidation. The *dose* is from two to ten pills daily. Manganous carbonate was tried by Hannon as a medicine on himself. After its use for fifteen days he found his appetite improved and his pulse increased in force, and he experienced a feeling of sanguineous plethora. He afterwards exhibited the remedy in several anæmic cases, with the effect of exciting the functions to a more healthy action, increasing the strength, and improving the blood.

Manganous phosphate, *tartrate*, and *malate* have also been proposed by Hannon as useful

remedies. The phosphate is prepared by double decomposition between manganous sulphate and sodium phosphate. A *syrup of manganous phosphate* has been made by T. S. Wiegand of Philadelphia. (See his formula in *A. P. J.* for July, 1854.) Simpson of Edinburgh, informed Geo. B. Wood that a syrup made with two grains of ferrous phosphate and one grain of manganous phosphate, in a fluidrachm of syrup, was much and advantageously used by himself and others in Edinburgh. This may be easily prepared by adding to the two ingredients mentioned five grains of glacial phosphoric acid for each grain of the ferrous phosphate. (*P. J.*, 1859, 288.) *Manganous lactate* has been given, associated with ferrous lactate, in *chlorosis*, in the *dose* of a grain (0.065 Gm.), which may be increased to five grains (0.32 Gm.).

Manganese Chloride. Mangani Chloridum. Manganchloriir, G. $MnCl_2 + 4H_2O$.—Usually obtained by evaporating the solution left after the preparation of chlorine, freeing it from excess of acid, redissolving the residue in water, treating with manganous carbonate to precipitate any iron which may be present, filtering, evaporating and crystallizing. In the form of tabular crystals or a granular powder of a pale-rose color, soluble in alcohol and water. Manganese chloride is used locally as a stimulant to *syphilitic* and other *indolent ulcers*.

Manganese Citrate. Mangani Citras.—F. B. Power (*Report of Wellcome Chemical Research Laboratories* No. 22) proposed the following processes: Manganese sulphate, cryst., 100 Gm.; sodium carbonate, cryst., 140 Gm.; citric acid, 62.8 Gm. The manganese sulphate and sodium carbonate are dissolved separately in a convenient quantity of water, with the aid of heat, and filtered. To the solution of manganese sulphate the sodium carbonate is added gradually, with constant stirring, and the precipitate, after being allowed to subside, is washed repeatedly by affusion and decantation with water until the washings afford not more than a slight reaction for sulphate. The moist manganese carbonate is then mixed with a little water in a porcelain dish, the citric acid added, and the mixture heated on a water bath for about half an hour, with occasional stirring. If the dry salt is desired, the product, which should form a somewhat thick mixture, is poured on a filter, washed with a little water, and dried at a gentle heat. It is thus obtained as a white crystalline powder.

Soluble Manganese Citrate was prepared as follows: To the simple manganese citrate, obtained as above from 100 Gm. of manganese sulphate, while still moist and contained in a porcelain dish, 105 Gm. of crystallized sodium citrate are added, and the mixture heated on a water bath until complete solution is effected. The liquid is then diluted sufficiently to filter readily, and at once spread on glass plates, so that on drying it may be obtained in the form of scales. The salt in the state of solution, oxidizes readily and becomes brown, but in the dry state it is quite permanent when protected from the light. The salt forms handsome pearly scales, which are very freely soluble in water.

Manganese Citrate and Iron (Soluble).—Power's process is as follows: Manganese sulphate, cryst., 100 Gm.; sodium phosphate, cryst., 240 Gm.; solution of ferric citrate (containing 8 per cent. Fe), 616.5 Gm., or a corresponding amount of solution of other percentage strength. The salts are dissolved separately in a sufficient amount of water with the aid of heat and filtered. To the solution of manganese sulphate, while warm, is added the warm solution of sodium phosphate. The precipitate of manganese phosphate is allowed to subside, and washed by affusion and decantation with water until the washings afford not more than a very slight reaction for sulphate. The precipitate, while still moist, is then put into a porcelain dish, the solution of ferric citrate added, and the mixture heated on a water bath until complete solution is effected. It is then filtered and the liquid spread on glass to scale in the usual manner. The salt should be kept protected from the light. It forms handsome, greenish-yellow scales, which are slowly soluble in cold, but readily in warm water. It ordinarily contains about 14 per cent. of iron and 7 per cent. of manganese.

Manganese Iodide. Mangani Iodidum. Manganous Iodide. MnI_2.—This very deliquescent salt may be prepared by adding manganous carbonate to aqueous hydriodic acid, filtering the solution, and granulating, carefully regulating the heat. This iodide may be administered in syrup or pill. Procter proposed the following formula for the *syrup*: Dissolve sixteen drachms of manganous sulphate, and nineteen drachms of potassium iodide, separately, in three fluidounces of water, each portion of water being previously sweetened with two drachms of syrup. Mix the solutions in a glass-stoppered bottle, and when the crystals of potassium sulphate have ceased to precipitate, throw the liquor on a strainer of fine muslin, and allow it to filter into a pint bottle, containing twelve ounces of powdered sugar. When the solution has ceased to pass, wash the filter with a little sweetened water, and add sufficient of that liquid to make the whole measure a pint. Lastly, agitate the liquid until the sugar is dissolved. Procter stated that this syrup contained about a drachm of manganous iodide in each fluidounce. The small proportion of potassium sulphate which remains dissolved in the syrup does not interfere with its medicinal efficacy. The *dose* is from ten to thirty drops (0.5–1.5 Cc.), repeated several times a day. (*A. J. P.*, Oct. 1850.) Hannon makes a *pill of manganous iodide* by double decomposition between equal weight of potassium iodide and crystallized manganous sulphate. The salts are perfectly dried, accurately mixed in powder, and then rubbed up with honey, so as to reduce the whole to a pilular mass, which may be divided into four-grain pills. Assuming that the honey added compensates for the loss of water in drying, each pill will consist of about two grains of manganous iodide, one of potassium sulphate, and one of honey, and manganous sulphate in excess. The *dose* is one pill daily, gradually increased to six. According to Hannon, manganous iodide is particularly useful in the *anæmia* attendant on scrofula, phthisis, and cancer, and in syphiliticia. It is also affirmed that when given with cinchona it removes the enlargement of the spleen of malarial fevers.

Manganese Tannate. Mangani Tannas. Manganntannat, G.—Made by adding freshly precipitated manganese carbonate to a hot solution of tannic acid until it is neutralized, filtering and evaporating to dryness. Iron must be absent, and the solution must be protected from contact with iron or the solution and salt will acquire an inky color. It is soluble in water.

Ferro-Manganic Preparations.—Hannon conceives that manganese is peculiarly suited to the treatment of anæmic cases in which iron has failed, or acts very slowly; but, instead of passing at once from the use of iron to that of manganese, he prefers to give intermediately a mixture of the two. For this purpose he recommends the following formula. Take of crystallized ferrous sulphate six drachms and a half; crystallized manganous sulphate two drachms; sodium carbonate nine drachms; honey five drachms. Rub together, and with syrup make a mass, to be divided into four-grain pills. In this pill both the metals are present as carbonates, and, as the sodium sulphate is not washed away, it contains that salt also. The *dose* is from two to ten pills daily. (See the paper of Hannon, *J. P. C.*, 3e sér., xvi. 41 and 189.) The *syrup of ferrous and manganous iodides* may be prepared by the following formula. Take of potassium iodide 1000 grains; ferrous sulphate 630; manganous sulphate 210; iron filings 100; sugar, in coarse powder, 4800. Powder the iodide and sulphates separately, and, having mixed them with the filings, add half a fluidounce of distilled water, and triturate to a uniform paste. Then add another half fluidounce of distilled water to the paste, and triturate again, and, after an interval of fifteen minutes, add a third half fluidounce, and mix. Next transfer the magma of salts to the moistened filter, supported on a funnel, and allow it to drain into a bottle holding a little more than twelve fluidounces, and containing the sugar. After it has drained, add cold boiled water by small portions at a time, until the solution of the iodides has been displaced and washed from the crystalline magma of potassium sulphate. Finally, add sufficient cold boiled water to make the whole measure twelve fluidounces. The object of adding iron is to prevent the liberation of iodine. This syrup has a very pale straw color. It contains a little potassium sulphate, which does not injure it as a therapeutic agent. If the salts have not been all decomposed during their reaction, it will be greenish. Each fluidounce contains fifty grains of the mixed iodides, in the proportion of three parts of ferrous iodide to one of manganous iodide. The *dose* is from ten to thirty minims (0.6–1.8 Cc.). (Procter, *A. J. P.*, 1853, 198.) J. U. Lloyd proposed a process (*A. J. P.*, 1874, 6) whereby a less amount of potassium sulphate remained in the finished preparation. Manganous sulphate 240 gr.; potassium iodide 288 gr.; iodine 744 gr.; iron wire (small) 240 gr.; sugar 17 oz. av.; distilled water q. s. Place the iodine, three ounces of distilled water, and the iron wire in a glass flask, and agitate until the solution has acquired a clear greenish color, without a tinge of yellow. Filter the solution into the sugar contained in a porcelain dish; wash the filter by pouring into it two ounces of distilled water, allowing the liquid to filter into the sugar. Dissolve the manganous sulphate and potassium iodide separately in half an ounce of cold distilled water by trituration in a mortar; mix the two solutions together, and allow the potassium sulphate to separate; transfer the mixture to a wetted filter, and allow the solution of manganous iodide to filter into the sugar; when well drained, wash the precipitate in the funnel with half an ounce of *ice-cold* distilled water, and finish by agitating the mixture until the sugar is dissolved; add enough distilled water to make the whole measure twenty fluidounces; filter. Syrup of iron and manganous iodide is considered by Pétrequin to be particularly suited to the treatment of *anæmia* resulting from obstinate intermittent fevers, prolonged suppuration, and scrofulous, syphilitic, and cancerous affections.

T. S. Speer of Cheltenham, prefers a saccharine carbonate of the two metals, made by the following formula. Dissolve three ounces and one drachm of ferrous sulphate, one ounce and twenty grains of manganous sulphate, and five ounces of sodium carbonate, each, in thirty Imperial fluidounces of water, and thoroughly mix the solutions. Collect the precipitated carbonates on a cloth filter, and wash them immediately with cold water, to separate the sodium sulphate. Then press out as much water as possible, and, without delay, triturate the pulp with two and a half ounces of finely powdered sugar. Lastly, dry the mixture at a temperature not exceeding 48.8° C. (120° F.). The *saccharine iron and manganous carbonate*, as thus prepared, has a reddish-brown color, devoid of all taste, except that imparted by the sugar. The *dose* is five grains (0.32 Gm.), gradually increased to twenty grains (1.3 Gm.), three times a day, given with the meals, or immediately after them. (See *A. J. P.*, 1854, 127.)

Mangosteen.—The pericarp of the fruit of the *Garcinia Mangostana*, L. (Fam. Clusiaceæ), is an active astringent, and has been used as such locally in various catarrhs, and also in *diarrhœa* and in *leucorrhœa*. *Dose* of fluidextract, from half to one fluidrachm (1.8 to 3.75 Cc.).

Manzanillo. *Manchineel. Hippomane Mancinella*, L. (*Mancinella venenata*, Tussac.)—According to A. Betancourt, the milky juice of this euphorbiaceous tree, growing in the West Indies, is a violent irritant, acting as a vesicant when applied to the skin, and when taken internally in *doses* of twenty drops causing a fatal gastro-enteritis. In *doses* of two drops it acts as a powerful and very certain cathartic; it is also diuretic. In Cuba it has much repute in *tetanus*. (*L. M. R.*, Feb. 1889.)

Maranta. *Arrowroot. Arrowroot de la Jamaïque, Salep des Indes occidentales*, Fr. *Marantastärke, Amerikanisches Stärkmehl, Arrowmehl*, G. (Fam. Marantaceæ.)—Under this name the U. S. Pharmacopœia 1870 recognized the fecula obtained from the root of *M. arundinacea*, L.

The arrowroot plant is a native of the West Indies, where it is largely cultivated for the sake of its fleshy, irregularly cylindrical rhizomes whose cells are gorged with starch granules. It is cultivated also in the East Indies, Ceylon, Sierra Leone, the south of Africa, and formerly in our Southern States, especially Georgia and Florida. The plant is easily propagated by cuttings of the root. An analysis by Macdonald (*J. Soc. Chem. Ind.*, 1887, 336) gives the following as the composition of the St. Vincent root: Starch, 27.07 per cent.; fibre, 2.82; fat, 0.26; albumen, 1.56; sugar, gum, etc., 4.10; ash, 1.23; water, 62.96; total 100.00. An analysis of the arrowroot starch from the same locality by Macdonald gave: Starch, 83.70 per cent.; fibre, 0.04; fat, 0.07; sugar, gum, etc., 0.18; ash and sand, 0.14; water, 15.87; total, 100.00. The fecula is prepared in the following manner. The rhizomes are dug up when a year old, washed, and then beaten into a pulp, which is thrown into water, and agitated so as to separate the amylaceous

from the fibrous portion. The fibres are removed by the hand, and the starch remains suspended in the water, to which it gives a milky color. The milky fluid is strained through coarse linen, and allowed to stand that the fecula may subside, which is then washed with a fresh portion of water, and afterwards dried in the sun.

The *Bermuda arrowroot* is in general the most highly esteemed. About 1897–98 the production of it in the island had almost ceased, but in 1905 twelve to fourteen tons were produced, all except a few hundredweight being exported to Great Britain. The Bermuda arrowroot of the American, and probably largely also of the English, markets, is of various sources, the name seemingly being applied to any superior product.

Other plants contribute to furnish the arrowroot of commerce. Lindley states that it is procured in the West Indies from *Calathea allouia*, Lindl. (*Maranta allouia*, Aubl.), and possibly other species, besides *M. arundinacea*, L. Under the name of *M. indica*, Tussac describes a distinct species, which he says was originally brought from the East Indies, and is now cultivated in Jamaica. This, however, is generally considered as a mere variety of *M. arundinacea*, from which it differs chiefly in having leaves more elongated at the point and smooth on both sides. Very fine arrowroot is obtained in the East Indies from the root of *Curcuma angustifolia*, Roxburgh, which is cultivated in Travancore. But the product is lighter than the Maranta arrowroot, and does not so quickly make a jelly. *Cassava arrowroot* is prepared in Brazil from *Manihot utilissima*, Pohl. (*Jatropha Manihot*, L., *Janipha Manihot*, Kunth.), and sometimes sold as arrowroot or used to adulterate the true arrowroot. A variety of arrowroot has been imported from the Hawaiian Islands. Nuttall, during a visit to these islands, found that it was obtained from a species of tacca, which he described by the name of *Tacca oceanica*. (*A. J. P.*, ix. 305.) The plant is in fact *Tacca pinnatifida*, Forst., from which a similar fecula is prepared in the East India province of Arracan. (*P. J.*, vi. 383.) The tuberous roots of different species of *Alstrœmeria*, growing in South America, yield a fecula used for the same purposes as the maranta, and a specimen, under the name of *Talcahuana arrowroot*, was sent from Chili by Ruschenberger to Carson of this city, who ascertained it to be the product of the *Alstrœmeria Ligtu*, L. (Fam. Amaryllidaceæ). (*Ibid.* xxxii. 289.) In the West Indies, substitutes for arrowroot are furnished by the roots of *Dioscorea sativa*, L. (*D. spinosa*, Roxb.). of the fam. Dioscoreaceæ or *yam*, and of *Colocasia antiquorum*, Schott. (*Arum esculentum*, L.), of the fam. Dioscoreaceæ, or *yam*, and of *Colocasia antiincisa*, L. (Fam. Urticaceæ), the *bread-fruit* tree.

Under the name of *koonti* there is prepared in Southern Florida an excellent arrowroot from the rhizomes of *Zamia integrifolia*, Jacq. (Fam. Cycadaceæ). It is characterized by muller-shaped starch granules,—*i. e.*, like rounded irregular lumps of glass cut off at one end for pulverizing. Koonti is locally used, but is chiefly shipped to the Bahamas, where it is largely eaten by the negroes. The refuse of the rhizomes is esteemed in Florida as a mulch for the orange trees.

Attempts have been made to substitute finely prepared potato starch for arrowroot, and there is no doubt that in nutritive properties it is quite equal, but patients complain of an unpleasant taste of the potato which it is likely to retain.

Arrowroot is in the form of a light, white powder, or of small pulverulent masses, without odor or taste. It is firm to the touch when pressed between the fingers, and produces a faint creaking sound when rubbed. It is a pure starch, corresponding in chemical properties with that of wheat and the potato. It is liable to become musty, and should then be rejected. The odor and taste are the best criteria of its purity. It should be perfectly free from odor and unpleasant flavor. Procter rendered musty arrowroot sweet and fit for use by washing it thoroughly with two successive portions of cold water, and then drying it upon frames of muslin in a warm place. (*A. J. P.*, xiii. 188.) Arrowroot is sometimes adulterated with wheat or potato starch. These may be detected by a microscope. Hydrochloric acid has been proposed as a test. A mixture of equal parts of that acid and of water, rubbed with about half its weight of potato or wheat starch, very quickly forms so thick a mucilage that the mortar in which the trituration is effected may be raised by the pestle, while the same result does not take place with rice flour or arrowroot under twenty-five or thirty minutes. So small a proportion as from 4 to 6 per cent. of the impurity may, it is asserted, be detected in this way. (*J. P. C.*, 3e sér., ii. 246.)

The microscope offers the best means of distinguishing the different varieties of fecula sold as arrowroot, or used for its adulteration. The granules of *Maranta arrowroot* are rarely oblong, somewhat ovate-oblong, or irregularly convex, with very fine rings, a circular hilum which cracks in a linear or stellate manner, and small mammillary processes occasionally projecting from them. (Pereira.) The largest are the 750th of an inch, but many are not more than the 2000th of an inch long, and their breadth is generally two-thirds of their length. (Christison.) The granules of the *East India arrowroot* are, according to Pereira, of unequal size, ovate or oblong-ovate, flattened, and often furnished with a very short neck or nipple-like projection. The rings are numerous, close, and very fine, and the hilum, which is situated at the narrow extremity, is circular, small, and indistinct. The microscopic appearance of the *tapioca fecula* will be described under the head of *Tapioca*. The *Tacca fecula* from the South Sea Islands, examined by Pereira, consisted of circular, muller-shaped, or polyhedral granules, with few and not very distinct rings, and a small circular hilum, which cracked in a linear or stellate manner. The *potato starch* granules are of various shape and size, but generally ovate or elliptical, and from the 7000th to the 300th of an inch in length, the largest being inferior in size only to the largest of the canna starch or *tous-les-mois*. (See *Canna*.) They are strongly marked with concentric rings, and have a circular hilum, from which usually proceed the cracks observable in some of the larger grains.

Medicinal Properties and Uses.—Arrowroot affords a light, very mild, and easily digested article of diet, well adapted for the sick and convalescent, and peculiarly suited, from its demulcent properties, to bowel complaints. It is prepared by dissolving it in hot water or hot milk, with either of which it forms a pearly gelatinous solution, and, if in sufficient quantity, a jelly-like mass on cooling. A tablespoonful will communicate sufficient consistence to a pint of water. It should first be formed into a perfectly smooth paste with a little cold water or milk, and the boiling water

then gradually added with brisk agitation. The preparation may be rendered more palatable by lemon juice and sugar, or by wine and spices.

Maretin.—This substance is a methylacetanilide, in which the acetyl group is substituted by the group $NH.CONH_2$. In this last group the urea nucleus is so strongly combined that aniline is not liberated as a decomposition product. Maretin has the structural formula:



It occurs in white, glittering, tasteless crystals, soluble only to the extent of 1 to 1050 of water, almost insoluble in ether, readily dissolved by chloroform and acetone. It melts at 183°–184° C. (361.4°–363.2° F.).

It is affirmed to be a valuable antithermic, useful in hectic and other *fevers*, also to have no action on the kidneys, and no tendency to produce collapse. *Dose*, three grains (0.2 Gm.) given in powder form.

Massoi Bark.—In Eastern commerce certain aromatic barks occur under the name of massoi barks. Of these, three are believed by F. Hekmeyer to be the products respectively of *Cinnamomum xanthoneurum*, Blume, *Cinnamomum Burmanni*, Blume (*C. Kianis*, Nees), and *Massoja aromatica*, Becc. (*Sassafras gœsianum*, Teijsm. and Binn.), all of the fam. Lauraceæ. For a description of these barks, by E. M. Holmes, see *P. J.*, 1888, 465. The massoi bark which comes from New Guinea, and from which Messrs. Schimmel have distilled an oil resembling that of nutmeg and cloves, probably has a different origin from the true massoi bark.

Mata.—This name is given, in New Mexico, to an herb much used in that region as an addition to tobacco in smoking. It is said, when burning, to have an odor like that of the tonka bean, and, when smoked with tobacco, to correct the extremely disagreeable odor imparted by this to the clothing and apartments. From imperfect specimens of the plant raised by E. S. Wayne and sent to Maisch, it is supposed to be a Eupatorium, probably *E. incarnatum*, Walter, which is indigenous in Texas. (*A. J. P.*, 1868, 122.)

Meat, Raw.—*Raw meat* has been recommended as an article of diet for consumptive patients, and especially for scrofulous children and in other cachectic cases, and is asserted to have proven highly useful. It may also be employed with great advantage in *dyspepsia* and *chronic diarrhœa*, especially in children. It was brought into notice by Fuster of Montpellier, France. The following formula is recommended by Reveil. Take of fillet of beef 100 grammes, deprive it carefully of all fatty and membranous matter, cut it up finely, beat it in a mortar, and add of powdered sugar 20 grammes, sodium chloride 1.5 grammes, potassium chloride half a gramme, and powdered black pepper one-fifth of a gramme. The mixture is to be taken in teaspoonful (3.9 Gm.) doses through the day. (*Ann. Thér.*, 1866, 145.) An excellent method of exhibiting raw meat is to *scrape* a thin steak and mix the pulp thus obtained with brandy. Ivon asserts that a very pleasant emulsion is afforded by the following formula (*A. J. P.*, 1874, 346). Take of raw meat 250 parts, of sweet almonds 75 parts, of bitter almonds 5 parts, of white sugar 80 parts. Blanch the almonds and beat the whole into a paste. In dissolving, milk may be used instead of water.

Pemmican, which before the extermination of buffaloes was much used in the northwestern part of the United States as an excellent condensed food, was made by mixing equal parts of buffalo meat and buffalo tallow, and pouring the melted mixture into sacks of untanned buffalo hide. For processes for *meat biscuit* and *flour of meat*, see *U. S. D.*, 17th ed., p. 1685; see also *Extractum Carnis*, 18th ed., p. 1654.

Medeola. *Medeola virginiana*, L. *Gyromia virginica*, Nuttall. *Indian Cucumber.*—An indigenous perennial herb of the fam. Convallariaceæ, growing in all parts of the United States. The root, which in shape and flavor bears a strong resemblance to a small cucumber, is said by Pursh to be eaten by the Indians, and by Barton to be useful as a diuretic in *dropsies*.

Melaleuca (Cajuputi).—Under the name of *gomenol* there has been put upon the market a volatile oil obtained from the leaves of *Cajuputi viridiflora* (Gaertn.), Lyons (*Melaleuca viridiflora*, Gaertn.), a myrtaceous plant of New Caledonia. Its sp. gr. is 0.922, and its rotatory power plus 0.42°. Its odor and taste are said to resemble those of camphor and peppermint. The chief constituent of the oil (66 per cent.) is cineol, and in addition to this is a crystallized terpineol, $C_{10}H_{18}O$, and the valeric ester of the same. These together make up 30 per cent. additional. (Gildemeister and Hoffman, *Ætherische Oele*, p. 686.) It has been recommended in the *chronic catarrhs* of the pulmonary mucous membrane, and especially in *whooping cough*. It may be given by the mouth or exhibited in the form of intramuscular injections of a sterilized fixed oil four parts, to volatile oil one part. The hypodermic *dose* of a 10 per cent. solution is two and one-half fluidrachms to one-half fluidounce (9.3–15 Cc.). The injections should be practised every other day.

Melastoma. *Melastoma Ackermanni.*—This Colombian plant of the fam. Melastomaceæ is used in South America as an anti-neuralgic. Its abundant essential oil resembles methyl salicylate, if indeed it be not identical with it. (See *N. R.*, Aug. and Sept., 1883.)

Melilotus. *Melilotus officinalis* (L.), Lam. *Melilot. Herba Meliloti*, P. G. *Yellow Sweet Clover. King's Clover. Summitates meliloti. Mélilot officinal*, Fr. *Steinklee, Melilotenklee*, G.—An annual or biennial plant of the fam. Leguminosæ, indigenous in Europe, and growing also in this country. The plant, when in flower, has a peculiar sweet odor, which, by drying, becomes stronger and more agreeable, somewhat like that of the tonka bean. This similarity is accounted for by the fact that *coumarin*, $C_9H_6O_2$, the chief constituent of tonka beans, is present in melilot, combined with *melilotic acid*, $C_9H_{10}O_3$, and *coumaric acid*, $C_9H_8O_3$, of which latter acid *coumarin* is the anhydride. *M. alba*, Desv., is a more robust species, distinguished by its white flowers. Its properties are the same as those of the yellow melilot. Melilot is practically inert.

Melissa. *U. S.* 1890. *Melissa. Balm.*—Under this name were formerly recognized by the U. S. P. the leaves and tops of *Melissa officinalis*, L. (Fam. Labiatæ), or the ordinary *balm* of Southern Europe, which has become naturalized in this country. Balm contains some tannic acid, and a yellowish, highly flavored essential oil which, however, is present in such small quantities that the plant has practically no remedial value. The allied *Clinopodium Calamintha* (L.), Kze. (*Me-*

lissa Calamintha, L.), is said to contain sufficient aromatic volatile oil to be of possible commercial interest.

Menispermum. *U. S.* 1890. *Yellow Parilla. Canadian Moonseed.*—"The rhizome and roots of *Menispermum canadense* Linné (nat. ord. *Menispermaceæ*)." *U. S.* 1890.

M. canadense. L.—This is a woody, climbing plant, which grows throughout Eastern North America. It is specifically characterized by its peltate three to seven-lobed leaves, its small clusters of greenish-yellow flowers, and its somewhat kidney-shaped glaucous fruit, which is ripened in the month of September. Its root was first brought into market as *Texas sarsaparilla*, and identified by Robt. P. Thomas. (*A. J. P.*, xxvii. 7.) Menispermum was officially described as follows: "Rhizome several feet long, 5 Mm. thick, brown or yellowish-brown, somewhat knotty, finely wrinkled longitudinally and beset with numerous thin, rather brittle roots; fracture tough, woody; internally yellowish, the bark rather thick, the wood-rays broad, porous, and longest on the lower side; pith distinct. Nearly inodorous; taste bitter." J. M. Maisch proved the presence of a white alkaloid, and of a small quantity of berberine. The former reacts with the usual alkaloidal precipitants, is not very soluble in water, but soluble in alcohol and ether. H. L. Barber (*A. J. P.*, 1884, p. 401) obtained the white amorphous alkaloid above referred to, for which Maisch proposed the name *menispine*. Starch was also found in the root. (*A. J. P.*, 1863, p. 301.) Menispermum has been used as a substitute for sarsaparilla but is probably inert. A *fluidextract* was recognized by the U. S. P. 1890; *dose* one-half to one fluidrachm (1.8–3.75 Cc.). The following was the official process:

"Menispermum, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Alcohol, Water, each, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Mix *six hundred cubic centimeters* [or 20 fluidounces, 138 minims] of Alcohol with *three hundred cubic centimeters* [or 10 fluidounces, 69 minims] of Water, and, having moistened the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of Alcohol and Water as before, until the Menispermum is exhausted. Reserve the first *nine hundred cubic centimeters* [or 30 fluidounces, 208 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

Mentha Pulegium, L. *European Pennyroyal. Pouliot commun*, Fr. *Polei*, G. *Pulegium vulgare*, Mill.—This European labiate yields an oil which is known in England as the *oil of pennyroyal*, and must not be confounded with the American plant of the same name. The oil, which is also known as the *oil of poley*, has been examined by Beckmann and Pleissner (*Ann. Ch. Ph.*, 262, 1), who discovered as the most important constituent *pulegone*, $C_{10}H_{16}O$, an unsaturated ketone, which makes up 80 per cent. of the oil. It boils under a pressure of 60 Mm. at from 130°–131° F., turns the plane of polarization to the right, and has a sp. gr. 0.9323 at 0° C. It forms crystalline compounds with hydroxylamine and with hydrogen bromide. When reduced by sodium in ethereal solution pulegone is changed into menthol. Pulegone is most abundant in the Spanish oil, and less abundant in American and Algerian oils. (See also Wallach, *Ann. Ch. Ph.*, 272, 122, and Semmler, *Ber. d. Chem. Ges.*, 25, 3515.) It is stated (*B. M. J.*, March, 1890) that the oil is largely used for the purpose of producing abortion, and is popularly believed to be safer and more certain than the other volatile oils. Taylor denies, however, that the oil is an abortifacient and it appears to be demonstrated that it is capable of causing fatty degeneration. (See *S. Jb.*, 267, p. 230.)

Menthiodol.—This substance has been recommended as a local application in neuralgia. It is prepared by carefully heating four parts of menthol in a capsule, adding one part of finely powdered iodol, and triturating into a homogeneous mass, which is made into cones or pencils of a suitable size. If the mass is too hard, it may be softened by remelting with a minute quantity of camphor.

Menyanthes. *Menyanthes trifoliata*, L. *Buckbean. Marsh Trefoil. Bogbean. Water Shamrock. Folia Trifolii Fibrini*, P. G. *Menyanthe, Trèfle d' eau*, Fr. Cod.; *Fieberklee, Bitterklee, Dreiblatt*, G.—This gentianaceous plant is a native both of Europe and North America, from Greenland to Alaska and south to Pennsylvania, Minnesota, and California. All parts of menyanthes are efficacious, but the leaves were formerly official.

The taste of buckbean is intensely bitter and somewhat nauseous, the odor of the leaves faint and disagreeable. The plant has been examined by Trommsdorff, Brandes, Landerer, and Kromayer. Its virtues depend on a bitter principle denominated *menyanthin*, which may be obtained sufficiently pure for use by treating the spirituous extract of the plant with hydrated lead oxide, removing the lead by hydrosulphuric acid, filtering and evaporating the liquor, exhausting the residue with alcohol, and again evaporating with a gentle heat. It has a pure bitter taste, is soluble in alcohol and water, but not in pure ether, and is chemically neutral. Kromayer (1865) assigns to it the formula $C_{30}H_{46}O_{14}$, and states that it breaks up on heating with diluted sulphuric acid into a fermentable sugar and *menyanthol*, C_8H_8O, a colorless, difficultly volatilizable oil, with an odor like that of bitter almond. K. Leuderich (*A. Pharm.*, 1892, 38 and 48) has since studied *menyanthin*, and gives it the formula $C_{33}H_{50}O_{14}$, and states that its decomposition products are a phenol-like body, menyanthol, $C_7H_{11}O_2$, a resinous product, and a left-rotatory sugar. With the ordinary properties of the bitter tonics, menyanthes unites a cathartic power; in large doses it may cause vomiting. The *dose* of the powdered leaves or root as a tonic is from twenty to thirty grains (1.3–2.0 Gm.); of an infusion, prepared with half an ounce to a pint of boiling water, from one to two fluidounces (30–60 Cc.); and of the extract, ten or fifteen grains (0.65–1.0 Gm.), to be repeated three or four times a day. A drachm of the powder, or four fluidounces of the strong decoction, generally purges, and often occasions vomiting.

Mercurethyl Chloride. $Hg(C_2H_5)Cl$.—This has been proposed as a substitute for corrosive sublimate, but is not likely to come into use. (See *A. J. P.*, xlv. 337.)

Mercurialis. *Mercurialis annua*, L. *Mercury Herb. French Mercury.*—An herbaceous European plant, of the family of Euphorbiaceæ, which has been employed from the most ancient times as a purgative, diuretic, and emmenagogue. When boiled, it loses its acridity, and in this condition has been used as an emollient. Another species, *M. perennis*, L., or *dog's mercury*, also a native of Europe, is poisonous. (Mérat and De Lens.) Reichardt has discovered in *M. annua* a volatile alkaloid, which he named *mercurialine*. According to E. Schmidt (*P. J.*, vol. x. 29), *mercurialine* is identical with *methylamine*, CH_3NH_2, and is associated in the mercurialis with *trimethylamine*. It is a liquid of an oily appearance, narcotic odor, and alkaline reaction; boils at 140° C. (284° F.); forms salts with the acids; absorbs carbon dioxide; has a strong affinity for water; on exposure to the air it is changed into a resin of a buttery consistence, and is said to be poisonous to man; but Hugo Schulz (*A. E. P. P.*, April, 1886, 88) found that neither the fluidextract nor the herb given as food was capable of killing either the pig or the rabbit, and that four and a half grains (0.29 Gm.) of the mercurialine hypodermically injected had no effect. The urine is increased in quantity and colored reddish.

Mercuric Acetate. $(CH_3COO)_2Hg$.—Colorless, laminar crystals, soluble in 4 parts of water, also in alcohol and ether. Used as a wash for freckles, in 1 to 300 solution and internally as an antisyphilitic in *doses* of one-sixth to one grain (0.010–.065 Gm.).

Mercuric Albuminate. *Hydrargyri Albuminas. Quecksilberalbuminat*, G.—This compound is not constant and is made by adding a 4 per cent. solution of mercuric chloride to a 1 in 8 solution of desiccated egg albumin and heating. The digestion is continued for 48 hours, during which time the albumin is kept in excess. The moist precipitate is then carefully dried and mixed with enough sugar of milk to make the amount of mercuric chloride present represent 0.4 per cent. It is used as an antiseptic surgical powder.

Mercuric Amidosuccinamate. *Hydrargyri Amidosuccinamas. Asparagin Mercury. Asparagin-Quecksilber*, G. $Hg(C_4H_7N_2O_3)_2$.—Made by dissolving mercuric oxide in a warm solution of amido-succinamic acid, or asparagin, and setting aside to crystallize. Colorless, needle-like crystals, soluble in water. Used in *syphilis*, subcutaneously, in a 1 per cent. solution.

Mercuric and Zinc Cyanide.—*Hydrargyri et Zinci Cyanidum* is stated by Dunstan to be a true chemical compound, with the formula $Zn_4Hg(CN)_{10}$. It is a white powder, entirely insoluble in water. This substance has been very highly recommended by Lister as an antiseptic dressing, and is believed by him to be practically free from irritating or poisonous properties.

Mercuric Benzoate.—*Hydrargyri Benzoas*, $Hg(C_6H_5COO)_2 + H_2O$, is obtained by double decomposition between an alkaline benzoate and a mercuric salt; it is a white crystalline, odorless, and tasteless powder, which is sparingly soluble in water, but easily in alcohol as well as in aqueous solutions of sodium chloride, the latter effect being due to its property of forming easily soluble double salts with the haloids. It has been strongly recommended by Stukowenkow for hypodermic use and in *gonorrhœa*. For urethral injections the solution may be 1 to 1000 or 2000, with an equal quantity of sodium chloride. For subcutaneous injections it is employed in conjunction with cocaine, the following being the proportions: mercuric benzoate, 0.2 to 0.3; sodium chloride, 0.1; cocaine hydrochloride, 0.15; distilled water, 40. (*A. Pharm.*, April, 1889.)

Mercuric Chloride-urea Solution. *Hydrargyri Chloridi Carbamidum. Hydrargyrum bichloratum carbamidatum solutum.*—As the solution quickly changes it should be prepared extemporaneously as follows: 1 Gm. of mercuric chloride is dissolved in 100 Cc. of water with the aid of heat, and, when cold, 0.5 Gm. of urea is added and the liquid filtered. The solution is given in doses amounting to 15 minims (0.9 Cc.) in 24 hours, equal to one-sixth grain (0.010 Gm.) of mercuric chloride. It is employed subcutaneously in *syphilis*.

Mercuric Cyanide. *Hydrargyri Cyanidum. U. S.* 1890. $Hg(CN)_2 = 250.18$. *Hydrargyri Cyanuretum, U. S.* 1850. *Cyanide of Mercury. Hydrargyrum Cyanatum* (*Borussicum*).

The process for the preparation of this substance, given in the U. S. P. 1870 was: "Take of Ferrocyanide of Potassium *five troyounces;* Sulphuric Acid *four troyounces and one hundred and twenty grains;* Red Oxide of Mercury, in fine powder, Water, each, *a sufficient quantity*. Dissolve the Ferrocyanide of Potassium in twenty fluidounces of Water, and add the solution to the Sulphuric Acid, previously diluted with ten fluidounces of Water, and contained in a glass retort. Distil the mixture nearly to dryness into a receiver, containing ten fluidounces of Water and three troyounces of Red Oxide of Mercury. Set aside two fluidounces of the distilled liquid, and to the remainder add, with agitation, sufficient Red Oxide to destroy the odor of hydrocyanic acid. Then filter the solution, and, having added the reserved liquid, evaporate the whole in a dark place, in order that crystals may form. Lastly, dry the crystals and keep them in a well-stopped bottle, protected from the light." *U. S.* 1870.

The formula of the U. S. P. 1870 is based upon that of Winckler. Hydrocyanic acid is generated by the action of sulphuric acid on potassium ferrocyanide, and, being received in a vessel containing water and a portion of mercuric oxide, reacts with the oxide, according to the reaction

$$(HCN)_2 + HgO = Hg(CN)_2 + H_2O$$

generating, by double decomposition, water, and mercuric cyanide which is held in solution. Sufficient mercuric oxide is not used at first to saturate the whole of the hydrocyanic acid generated, because should there happen to be any excess of the oxide there would be produced on evaporation, instead of the substance wanted, a peculiar salt composed of cyanide and mercuric oxide, which would crystallize in small acicular crystals. Hence a portion of the water still containing uncombined hydrocyanic acid is set aside, to be added to the liquid in which the acid had been been completely saturated by the addition of mercuric oxide, and thus at least neutralize any mercuric oxide that might be present in it in excess. A surplus of hydrocyanic acid would be of no disservice, except for the loss of material incurred, as it is evaporated in the subsequent concentration. Mercuric cyanide should be kept in well-stoppered, dark amber-colored bottles.

Properties.—"Colorless or white, prismatic crystals, odorless, and having a bitter, metallic

taste (the salt is exceedingly poisonous). Becoming dark-colored on exposure to light. Soluble, at 15° C. (59° F.) in 12.8 parts of water, and in 15 parts of alcohol; in 3 parts of boiling water, and in 6 parts of boiling alcohol; very sparingly soluble in ether. When slowly heated in a glass tube, the salt decrepitates, and decomposes into metallic mercury and inflammable cyanogen gas, which burns with a purple flame. On further heating, the blackish residue, consisting of paracyanogen with globules of metallic mercury, is wholly dissipated. If 1 part of the salt be gently heated with 1 part of iodine in a dry test-tube, it will afford at first a yellow sublimate which afterwards becomes red, and above this a sublimate of colorless, needle-shaped crystals will be formed. On adding hydrochloric acid to the aqueous solution of the salt, the odor of hydrocyanic acid is evolved. A 5 per cent. aqueous solution of the salt should be neutral to litmus paper, and should not yield, on the gradual addition of a few drops of potassium iodide test-solution, either a red or a reddish precipitate, soluble in an excess of the precipitant, nor should it yield a white precipitate with silver nitrate test-solution (absence of *mercuric chloride*)." *U. S.* 1890. In composition, it is a normal mercuric cyanide, consisting of one atom of the metal and two atoms of cyanogen, its formula being $HgCy_2$, or $Hg(CN)_2$.

Mercuric cyanide has been used as a substitute for corrosive sublimate, with the statement that it is less irritating, equally germicidal, and free from action upon surgical instruments. Prochorow gives from twenty-five to thirty-five drops of a 1 per cent. solution hypodermically without causing local irritation, and with great asserted benefit, in chronic *syphilis*. Chaleix (*Journ. de Méd. de Paris*, March, 1900) reports death from the use of a vaginal injection containing fourteen grains of mercuric cyanide. *Dose*, internally, from one-sixteenth to one-eighth of a grain (0.004–0.008 Gm.).

Mercuric Formamide Solution. *Hydrargyri Formamidum. Hydrargyrum formamidatum solutum. Quecksilberformamidlösung*, G.—A solution made by dissolving freshly precipitated mercuric oxide, obtained from 10 Gm. of mercuric chloride, in a sufficient amount of formamide, and adding sufficient water to make 1000 Cc. It is intended for hypodermic injection in *syphilis*, sixteen minims (1 Cc.) of the solution being given in 24 hours, corresponding to one-sixth grain (0.010 Gm.) of mercuric chloride.

Mercuric Gallate. *Hydrargyri Gallas. Mercurigallat*, G. $[C_6H_2(OH)_3CO_2]_2Hg$.—Made by rubbing together molecular proportions of gallic acid and moist precipitated mercuric oxide and drying the product. It forms a blackish or greenish powder, insoluble in most solvents. The compound is used in place of the tannate, which is less stable, as an antisyphilitic, in *doses* of from one-half to one grain (0.032–0.065 Gm.) daily.

Mercuric Iodotannate. *Hydrargyri Iodotannas.—Iodotannate of Mercury*, according to J. Nourry (*B. G. T.*, April, 1888), is a soluble, non-irritating compound. For hypodermic use a solution is prepared from mercury 0.008 Gm., iodine 0.03 Gm., kramerotannic acid 0.04 Gm., and glycerin 1 Cc.

Mercuric Lactate. *Hydrargyri Lacticum.* $(C_3H_5O_3)_2Hg$.—It forms a white crystalline powder, soluble in water. This preparation has been used hypodermically in *dose* of one-sixth grain (0.010 Gm.) a day.

Mercuric Oxycyanide. *Hydrargyri Oxycyanidum.* $Hg_2O(CN)_2$.—This oxycyanide has been suggested as a substitute for corrosive sublimate (dose the same), for hypodermic use in *syphilis*, and as a local agent in *conjunctivitis* and *gonorrhœa;* 1 to 5000, increased as borne.

Mercuric Peptonate. *Hydrargyri Peptonas.* Under this name there has been introduced a yellowish liquid, having a saline feebly metallic taste and slightly acid reaction. It is a solution of mercuric peptonate and it is alleged that it may be used hypodermically without production of pain. Fifteen minims (0.9 Cc.) is said to be equivalent to one-sixth of a grain (0.010 Gm.) of mercuric chloride. As a substitute for this has been proposed *gluten-peptone sublimate.* This has been introduced as a white lustrous hygroscopic powder, or more commonly in 1 per cent. solution. It is said to contain 25 per cent. of corrosive sublimate, and to be an efficient, non-irritating preparation for hypodermic use.

Mercuric Phenylate.—*Hydrargyri Carbolas, Mercuric Carbolate*, $(C_6H_5O)_2Hg$, occurs as colorless needles, insoluble in water and cold alcohol, but taken up by hot alcohol, by ether, or a mixture of alcohol and ether, and by glacial acetic acid. This substance has been used as an antisyphilitic in *doses* of from a third to a half grain (0.021–0.032 Gm.).

Mercuric Pyroborate.—*Hydrargyri Pyroboras*, HgB_4O_7, is an amorphous, brown, insoluble powder, which has been commended by V. Tokayer (*Ph. Post*, 1892) as a local application in the treatment of specific and other ulcerations.

Mercuric Salicylate. *Hydrargyri Salicylas. Neutral Mercuric Salicylate.*—This is a white, amorphous, tasteless and odorless powder, scarcely soluble in alcohol and water, and having the formula $(C_6H_4OHCO_2)_2Hg$. It was first introduced as a remedy by Silva Araujo of Rio Janeiro, who affirmed that it had less influence upon the alimentary tract, that it was better borne than any other preparation of mercury, and that it was also more effective in *syphilis.*

The statements of Araujo have, in a measure, been confirmed by various physicians, and especially has it been asserted that the salicylate may be given by intra-muscular injection without producing local effects, and with a rapid mercurialization of the system. The *dose* internally is from one-fourth to one grain (0.016–0.065 Gm.), two or three times a day. Hypodermically, one-sixth of a grain (0.010 Gm.) may be given with an equal amount of potassium carbonate, in distilled water.

Mercuric Sozoiodolate. *Hydrargyrum Sozojodolicum.* $(C_6H_2I_2(OH)SO_3)_2Hg$.—This compound is a lemon-yellow powder, scarcely soluble in water, but more so in solution of sodium chloride. This preparation, which is said to contain 31 per cent. of mercury and 38 per cent. of iodine, has been especially recommended by Witthauer (*M. M. W.*, Aug. 1892) in the treatment of *syphilitic ulcerations, enlarged glands*, and skin diseases, in the form of a 1 per cent. ointment. The 1 per cent. solution is also used by Genzmer, as an injection into diseased joints, etc.

Mercuric Subsulphate, Yellow. *Hydrargyri Subsulphas Flavus. U. S.* 1890. *Yellow Mercuric Subsulphate. Basic Mercuric Sulphate. Turpeth Mineral.* $Hg(HgO)_2SO_4 = 722.61$. *Hydrargyri Sulphas Flava, U. S.* 1870. *Hydrargyri Subsulphas.*

"Mercury, *one hundred grammes* [or 3 ounces av., 230 grains]; Sulphuric Acid, *thirty cubic*

centimeters [or 1 fluidounce, 7 minims]; Nitric Acid, *twenty-five cubic centimeters* [or 405 minims]; Distilled Water, *a sufficient quantity*. Upon the Mercury, contained in a capacious flask, pour the Sulphuric Acid, previously mixed with *fifteen cubic centimeters* [or 243 minims] of Distilled Water, then add, very gradually, the Nitric Acid, previously mixed with *twenty-five cubic centimeters* [or 405 minims] of Distilled Water, and digest at a gentle heat until reddish fumes are no longer given off. Transfer the mixture to a porcelain capsule, and heat it on a sand-bath, under a hood or in the open air, with frequent stirring, until a dry, white mass remains. Reduce this to a fine powder, and add it in small portions at a time, with constant stirring, to *two thousand cubic centimeters* [or 67 fluidounces, 5 fluidrachms] of boiling Distilled Water. When all has been added, continue the boiling for ten minutes; then allow the mixture to settle, decant the supernatant liquid, transfer the precipitate to a strainer, wash it with warm Distilled Water, until the washings no longer have an acid reaction, and dry it in a moderately warm place. Keep the product in well-stoppered bottles, protected from light." *U. S.* 1890.

When normal mercuric sulphate is thrown into boiling or even warm water it is instantly decomposed, and an insoluble salt is precipitated, which is turpeth mineral. Its composition is Hg_3SO_6, or, more clearly expressed, $HgSO_4 + 2HgO$; that is, a compound of one molecule of mercuric sulphate and two molecules of mercuric oxide.

Yellow mercuric sulphate is "a heavy, lemon-yellow powder, odorless and almost tasteless; permanent in the air. Soluble in about 2000 parts of water at 15° C. (59° F.), and in 600 parts of boiling water; insoluble in alcohol; readily soluble in nitric or hydrochloric acid. When heated, the salt turns red, becoming yellow again on cooling. At a red heat it is volatilized, evolving vapors of mercury and of sulphur dioxide, and leaving no residue. A solution of the salt in nitric or hydrochloric acid, diluted with water, gives with potassium iodide test-solution a red precipitate, and with barium chloride test-solution a white one. The salt should be completely soluble in 10 parts of hydrochloric acid (absence of *mercurous salt* or of *lead*)." *U. S.* 1890. It was originally called *turpeth mineral*, from its resemblance in color to the root of *Ipomœa Turpethum*.

Turpeth mineral is capable of acting as a mercurial and producing ptyalism. It is, however, in full dose violently emetic, and in modern medicine has been chiefly used in true *croup*, especially on account of its very high recommendation by Fordyce Barker. It is a dangerous remedy, especially with young children, several cases having been reported in which, failing to cause vomiting, it has produced death preceded by symptoms similar to those of corrosive sublimate poisoning. (See *M. News*, xliii. 1883; also, *London Med. Gaz.*, 1847.) Emetic *dose* for a child two years old, two to three grains (0.13–0.2 Gm.); for adult, three to five grains (0.2–0.32 Gm.), repeated in fifteen minutes if it does not operate. Alterative *dose*, one-fourth to half a grain (0.016–0.032 Gm.).

Mercuric Succinimide. *Hydrargyri Succinimidum.* $(C_4H_4O_2N)_2Hg$.—This drug may be formed by heating together succinic acid, carbonic anhydride, and ammonia, which combine with mercuric oxide to form a compound which occurs as a white silky powder soluble in water. This solution remains quite unchanged when kept. According to Vollert, the solution of one and three-tenths grammes of this salt in one hundred of water is free from irritant properties, and when used hypodermically produces no disagreeable local or even secondary symptoms. (*Th. M.*, 1888.)

Mercuric Sulphate. *Hydrargyri Sulphas. Hydrargyrum Sulphuricum. Normal Mercuric Sulphate. Sulfate mercurique*, Fr. *Mercurisulfat*, G. $HgSO_4$.—Made by heating together 18 parts of mercury, 10 parts of concentrated sulphuric acid, 3 parts of water and 4 parts of 25 per cent. nitric acid, in a flask, on a sand bath, until reddish vapors cease to be given off, then drying with the aid of heat, in an open dish, constantly stirring. It is a heavy white crystalline powder, used in making turpeth mineral, and mercuric and mercurous chlorides. It has no use in medicine.

Mercuric Sulphide. *U. S.* 1880. *Hydrargyri Sulphidum Rubrum. Red Sulphide of Mercury. Cinnabar.* $HgS = 230.33$. *Hydrargyri Sulphuretum Rubrum, U. S.* 1870. *Cinnabaris. Hydrargyrum Sulfuratum Rubrum*, P. G. *Sulfuretum Hydrargyricum. Sulfure rouge de Mercure*, Fr. *Rothes Schwefelquecksilber, Zinnober*, G.—This preparation, which was formerly official both in the United States and British Pharmacopœias, has been finally dropped from each. It can be made by mixing together forty parts of mercury and eight parts of sulphur, and subliming the mass after it has become cold. In order to render the combination more prompt, the sulphur is first melted, and the addition of the mercury should be made gradually, while the mixture is constantly stirred. Barker recommends the addition of the metal by straining it upon the melted sulphur through a linen cloth, whereby it falls in a minutely divided state. When the temperature has arrived at a certain point, the combination takes place suddenly with a slight explosion, attended by the burning of the sulphur, which must be extinguished by covering the vessel. A black mass will thus be formed, containing generally an excess of sulphur, which, before the sublimation is performed, should be separated by gently heating the powdered mass on a sand bath. The sublimation is best performed, on a small scale, in a closely stoppered glass flask, which should be placed in a crucible containing sand, and thus arranged, exposed to a red heat. The equivalent quantities for forming this sulphide are 31.83 of sulphur and 198.5 of mercury.

Cinnabar is seldom prepared on a small scale, being made in large quantities for the purposes of the arts. Until within a few years it was nearly all manufactured in Europe, but it is now made to an enormous extent in this country. In Holland, where it is largely manufactured, the sulphur is melted in a cast iron vessel, and the mercury is added in a divided state, by causing it to pass through chamois leather. As soon as the combination has taken place, the iron vessel is surmounted by another, into which the cinnabar is sublimed. The larger the quantity of the materials employed in one operation the finer will be the tint of the product. It is also important in the manufacture to use pure materials, and to drive off any uncombined sulphur which may exist in the mass before submitting it to sublimation. In the United States, Martin's method, consisting of the agitation together of quicksilver, sulphur, and an alkaline sulphide, appears to have the pref-

erence. Another process for its manufacture in the wet way very largely employed is Brunner's. (Wagner's *Chem. Tech.*, 13th ed., 1889, 552.)

Properties.—"Brilliant, dark red, crystalline masses, or a fine, bright scarlet powder, permanent in the air, odorless and tasteless, insoluble in water, alcohol, nitric or hydrochloric acid, or in dilute solutions of alkalies. It is dissolved by nitrohydrochloric acid with separation of sulphur. When heated, the salt becomes brown and then black, but, on cooling, it reassumes its red color. At a higher temperature it takes fire, burns with a bluish flame, emitting the odor of burning sulphur, and is finally volatilized without residue. On dissolving the salt in nitrohydrochloric acid and adding an excess of stannous chloride, metallic mercury is precipitated. If the salt be treated with warm solution of potassa, the filtrate, after being acidulated with hydrochloric acid, should not yield a yellow or orange-colored precipitate (arsenic, antimony) nor should it produce a colored precipitate with acetate of lead (chromates, iodides, or other sulphides). If the salt be digested with diluted nitric acid for five minutes, the filtrate, after being much diluted, should not be darkened by hydrosulphuric acid (abs. of red oxide of mercury or of lead)." *U. S.* 1880. In close vessels at a red heat it sublimes without decomposition, and condenses in a mass, composed of a multitude of small needles. When duly levigated, it furnishes a brilliant red powder, which is the paint called *vermilion*. The same compound occurs native, being the sole ore—cinnabar—from which mercury is extracted. The preparation, if purchased in powder, should be carefully examined, as, in that state, it is sometimes adulterated with red lead, dragon's blood, or chalk. If red lead be present, acetic acid digested with it will yield a yellow precipitate (lead iodide) with potassium iodide. Dragon's blood may be detected by alcohol, which will take up the coloring matter of that substance, if present, and, if chalk be mixed with it, effervescence will be caused on the addition of an acid.

Cinnabar is at present only employed in medicine by fumigation, as a rapid sialagogue, in syphilitic affections, when it is desired to obtain an immediate mercurial impression. Half a drachm may be thrown on a red-hot iron, in a close apartment, and fumes inhaled as they arise. These consist of sulphurous acid gas and mercurial vapor, the former of which must prove highly irritating to the patient's lungs. A better substance for mercurial fumigation is black mercurous oxide.

Mercuric Thymolacetate. *Hydrargyri Thymolacetas. Thymolquecksilberacetat*, G. $(C_{10}H_{13}O)Hg—HgC_2H_3O_2$.—Made by adding a warm alkaline thymol solution to a warm solution of mercuric acetate as long as the precipitate which forms redissolves on shaking. The crystals are afterwards purified by recrystallizing from dilute sodium hydroxide solution. In colorless crystals, not readily soluble in water or alcohol, very soluble in alkaline solution, from which it is precipitated by acids. It contains about 55 per cent. of mercury. Used by injection, in *syphilis*, suspended in liquid petrolatum, one-fifth grain (0.012 Gm.) being given once a week.

Mercuric Thymolate. *Hydrargyri Thymolas.* $C_{10}H_{12}OHgOH$.—Made by precipitating a solution of mercuric nitrate with sodium thymolate. An unstable, violet-green powder.

Mercuric Thymolnitrate. *Hydrargyri Thymolnitras.*—This salt, $(C_{10}H_{13}O)Hg.HgNO_3$, and *mercuric thymosulphate* $[(C_{10}H_{13}O)Hg.Hg]_2SO_4$, have been used with asserted benefit in *syphilis*, in hypodermic *doses* of from one-twelfth to one-sixth of a grain (0.005–0.010 Gm.). (See *Merck's Jahresbericht*, 1891, 1892; also *W. K. W.*, March, 1892.) Besides these preparations *mercuric naphtholate*, a lemon-yellow powder, containing 30.8 per cent. of mercury, and the *mercuric formamidate*, a solution obtained by the action of formamide upon mercuric oxide, and the *mercury tribromphenol acetate*, containing about 30 per cent. of quicksilver, have been put upon the market; also under the name of *Hydrargyrol, mercury paraphenylthionate* $(C_6H_4.OH.SO_3)_2Hg$, has been suggested as an antiseptic, but in proportion to its cost is probably of no practical value.

Mercurous Acetate. *Hydrargyri Acetas. Mercuroacetat*, G. CH_3COOHg.—White, scaly crystals, soluble in about 330 parts of water, insoluble in alcohol and ether. It should be kept dry and away from light as it is decomposed, by boiling water and exposure, into mercury and mercuric acetate. Used internally in *doses* of from one-fifth to one grain (0.012 to 0.065 Gm.) for *syphilis*.

Mercurous Bromide.—*Hydrargyri Bromidum*, HgBr, is formed by adding potassium bromide to mercurous nitrate. It falls as a white curdy precipitate. *Mercuric bromide* ($HgBr_2$) may be obtained by digesting mercurous bromide in water containing bromine. A. E. Ebert prepared it by reaction between potassium bromide and official solution of mercuric nitrate. For the particulars of the process, see a paper by Ebert in the *A. J. P.*, March, 1867, 107. It is in the form of colorless crystals, soluble in water and alcohol. Exposed to heat it melts and sublimes. These bromides are analogous in composition and medicinal properties to the corresponding mercury iodides. Mercurous bromide is given in the *dose* of a grain (0.065 Gm.) daily, gradually increased. Mercuric bromide resembles corrosive sublimate, is an irritant poison, and may be administered in *doses* of the fifteenth of a grain (0.004 Gm.), gradually increased to one-fourth (0.016 Gm.), either in the form of pill or in ethereal solution made by dissolving a grain in a fluidrachm of ether.

Mercurous Sulphide. *Hydrargyri Sulphidum Nigrum. Black Sulphide of Mercury. Ethiops Mineral.*—This now disused remedy was prepared as follows: "Take of Mercury, Sulphur, each, *a pound*. Rub them together till all the globules disappear." *U. S.* 1850. For properties, see *U. S. D.*, 14th ed., 1259.

Mercurous Sulphocyanate. *Hydrargyri Sulphocyanas.* Hg(CNS).—This substance, formerly called sulphocyanide of mercury, is produced by mixing diluted solutions of mercurous nitrate and potassium sulphocyanate. The white precipitate which falls, after drying, swells up suddenly when heated, giving off nitrogen, carbon disulphide, and poisonous vapor of mercury, leaving a gray residue, *mellone*. The salt is used in the preparation of the toy, *Pharaoh's serpents*.

Mercurous Tannate. *Hydrargyri Tannas.* Mercurous tannate, which was first brought forward by Lustgarten (*N. Y. M. J.*, March, 1892), has received some favor at the hands of syphilographers, and is official in the Austrian Pharmacopœia under the name of *Hydrargyrum tannicum oxydulatum*. It is declared that it has the especial advantage of being unabsorbed in the stomach, but decomposed by

the alkaline juices of the duodenum, in such a way as to yield very minute globules of metallic mercury for ready absorption. It may be prepared either by precipitating concentrated solution of tannic acid and mercurous nitrate or by rubbing together tannic acid and mercurous nitrate. According to Lustgarten, the first process yields the better preparation. It is asserted that it does not irritate the alimentary canal. In *syphilis*, three grains (0.2 Gm.) may be given to the adult daily, increasing to five grains (0.32 Gm.) or more until one hundred or one hundred and fifty grains (6.5–9.8 Gm.) have been taken.

Mesembryanthemum. *Mesembryanthemum crystallinum*, L. *Iceplant. Diamond Fig. Glaciale, Cristalline*, Fr. *Eiskraut*, G.—A biennial plant of the fam. Ficoidaceæ, a native of the south of Europe. The stem and under surface of the leaves are covered with crystalline drops, which give the plant the appearance of being coated with ice. H. Mangon obtained as much as 43 per cent. of salts of potassium and sodium from the dried leaves. (*A. J. P.*, 1883, 370.) The herb is without odor, and has a saline somewhat nauseous taste. It is considered demulcent, diuretic, and has been useful in *inflammations* of the *pulmonic* and *genito-urinary* mucous membrane.

Mesenna. *Musenna. Bisenna. Muséna, Moucéna*, Fr. *Musennarinde*, G.—Under these different names has been brought into notice, as a powerful *tænifuge*, the bark of an Abyssinian tree, *Albizzia anthelmintica* (Baill.), Courd. (*Acacia anthelmintica*, Baill., *Besenna anthelmintica*, Rich.) (Fam. Leguminosæ). The bark is in flat pieces from five to ten inches long, smooth, slightly fissured, of a rusty gray color exteriorly, and pale yellow and fibrous within. It consists of four layers, one of which contains very large cells, with thick coats, and is supposed to be the active part. E Caventou and Legendre found in the bark no alkaloid, but a peculiar, acid, acrid, resinous substance. The *musennin* of Theil is probably the same, although not as yet in a pure state. The Abyssinians employ the powdered bark, in the *dose* of about two ounces, suspended in water or other liquid, or mixed with flour in the form of bread, or made into a confection with honey, butter, etc. It is taken in the morning, three or four hours before breakfast, and no other precautions are used. It produces no pain nor any disturbance of the functions, not even purging actively. Fragments of the worm are voided the same evening, and the greater portion of it the next day.

Mesotan. *Salicylic-acid Methyloxymethylester.* $C_6H_4\begin{cases}OH\\COOCH_2.OCH_3\end{cases}$. This preparation is a yellow clear fluid with a peculiar odor, miscible in all proportions with ordinary oils. It has been brought forward as a local application in all forms of *rheumatism*. In from half an hour to an hour after its local application the presence of salicylic acid can be demonstrated in the urine. When applied pure to the skin and confined by waxed paper or other appropriate dressing it produces redness and sometimes pronounced burning pains, so that it should be diluted with olive or castor oil. Even when diluted mesotan may produce eczematous, urticarial, or other eruption upon the skin, requiring its removal or further dilution. From one and a half to two and a half fluidrachms (5.5–9.3 Cc.) of an oily solution, containing 20 to 50 per cent. of mesotan, may be applied daily to the affected part.

Methacetin. *Para-acetanisidine. Para-oxymethylacetanilide.* $C_6H_4(OCH_3).NHC_2H_3O$.—This differs from acetanilide in having an atom of the nucleus replaced by the oxymethyl group (OCH_3) or from acetphenetidin by having oxymethyl instead of oxyethyl as a replacing group. It forms lustrous crystals free from color, odorless, melting at 127° C. (260.6° F.), and distilling at higher temperatures unchanged. It is scarcely soluble in cold water, readily soluble in hot water, soluble in alcohol, acetone, chloroform, glycerin, and fatty oils. According to F. Mahnert, when given in toxic dose to rabbits, it causes convulsions and death through its action on the central nervous system, and is germicidal in 1 per cent. solution. Methacetin appears to be a powerful antipyretic, producing in fever a very marked fall of temperature, with a slow after-rise; this effect being accompanied by a violent sweating, which, especially in *phthisis* and allied diseases, greatly interferes with the practical use of the drug. It has also been much used in *acute rheumatism*, but is not as effective as the salicylates. As an analgesic, in *ataxic* and *neuralgic pains*, it appears to be distinctly inferior to phenacetin and antipyrine. No eruption from it has been noticed. During its administration the urine responds to Trommer's test, but does not contain sugar, nor is there hæmoglobinuria. *Dose* for adults, eight grains (0.5 Gm.).

Methethyl.—Under this name there has been offered for use as a local anæsthetic a colorless neutral liquid, having a boiling point of 10.6° C. (51° F.) and a specific gravity of 0.9173 at 3.9° C. (39° F.). It is said to be ethyl chloride with a little methyl chloride and chloroform. (*Ph. Ztg.*, xliii.)

Methonal. $(CH_3)_2C(SO_2CH_3)_2$. *Dimethylsulphonedimethylmethane.*—In the form of colorless crystals, made by a process similar to that for preparing sulphonal, excepting that methylmercaptan is used in place of ethylmercaptan. It is used as a hypnotic in *doses* of from twenty to forty grains (1.3–2.6 Gm.).

Methyl Alcohol. *Methylic Alcohol. Spiritus Pyroxylicus Rectificatus, Br.* 1864. *Pyroligneous Spirit. Pyroxylic Spirit. Wood Spirit. Wood Alcohol. Wood Naphtha. Alcool méthylique, Alcool formique, Alcool de Bois, Esprit de Bois, Esprit pyroligneux*, Fr. *Holzgeist, Methylalcohol*, G. $CH_3.OH$.—Methyl alcohol was discovered in 1812 by Taylor. When wood is subjected to destructive distillation, there is formed, besides acetic acid, tar, and other products (see *Creosotum*, p. 402), about 1 per cent. of an inflammable volatile liquid, which, when separated and purified, constitutes methyl alcohol. The crude liquor, derived from the wood, separates on standing into two liquids: the heavier containing the tarry matters, and the lighter consisting of water, acetic acid, methyl alcohol, etc. The lighter liquid is saturated with lime, and subjected to distillation, whereby the impure methyl alcohol first comes over, mixed, however, with various compounds, among which are aldehyde and pyroacetic spirit (acetone). This, after having been redistilled and deprived of water by repeated rectifications from lime, forms the methyl alcohol of commerce. The commercial spirit may be purified by adding to it as much calcium chloride as it can dissolve, and allowing the mixture to stand for a few days. The methyl alcohol unites with the calcium chloride, and the compound formed is subjected to distillation to separate cer-

tain contaminating substances, which distil over. Finally, the methyl alcohol is separated from the calcium chloride by the addition of water and a new distillation, and from water by rectification from dry lime. Methyl alcohol, like the other monatomic alcohols, can also be formed synthetically in a variety of ways,—from marsh gas, from formic acid, and from formaldehyde. Pure anhydrous methyl alcohol is a mobile, colorless liquid, possessing a hot, pungent taste, and a peculiar odor, recalling that of acetic ether. It mixes in all proportions with water, alcohol, and ether, without having its transparency disturbed. It burns like alcohol, but with a less luminous flame. Its sp. gr. as a liquid is 0.8021 at 15.5° C. (59.9° F.). Its vapor is irritating to the eyes. It boils at 66° C. (150.8° F.) (according to other authorities at 55° C., when absolutely anhydrous), and during ebullition its vapor causes concussions, which render its distillation difficult, but may be prevented by placing in the bottom of the vessel a layer of mercury. As a solvent it resembles alcohol, all bodies soluble in that menstruum being likewise soluble in it. Methyl alcohol is the first of a series of organic hydroxides known as *alcohols*. It may be considered as a molecule of water in which one hydrogen atom is replaced by the monad group CH_3 (methyl), derived from marsh gas (methane) by the withdrawal of one hydrogen atom. These organic hydroxides are basic, and form with both organic and inorganic acids salts called *esters*.

The official pyroxylic spirit was directed in the Br. Pharmacopœia to have a sp. gr. from 0.841 to 0.846. From the density thus recognized, it might be implied that not the pure but the commercial pyroxylic spirit was contemplated, which has a straw-yellow color and a powerful odor of wood smoke. But the Pharmacopœia also directed that the spirit should be without action on litmus paper, free from smoky taste, and not rendered turbid by water. It therefore intended a purified spirit, and the greater density must be ascribed to the presence of the 10 per cent. of water allowed. According to Morson of London, the impure commercial spirit, which is unfit for medicinal use, may be purified "by largely diluting it with water, when an oily substance separates, after the removal of which the spirit may be recovered by distillation." By passing the mixed liquids through animal charcoal the purification is rendered more complete. Pyroxylic spirit has been confounded with pyroacetic spirit. They may be distinguished, according to Scanlan, by calcium chloride, which is without action on the latter, but dissolves in the former. In applying the test, a drop or two of a *saturated* solution of calcium chloride is added to the doubtful liquid in a test tube. This solution is immiscible with pyroacetic spirit, separating after agitation, but dissolves instantly in pyroxylic spirit. The liquid examined must be so pure as not to separate into two layers, nor to become milky with water.

It is sometimes desirable to be able to distinguish the presence of methyl alcohol in ordinary alcohol, and in ether or nitrous ether which may have been prepared from the methylated instead of the pure spirit. For this purpose the official test is the best which has been proposed (see Test for methyl alcohol under *Alcohol*, page 105).

Columbian spirit is simply a brand of wood alcohol of a higher quality, free from empyreumatic odor and with only a slight trace of acetone as impurity.

Methylated spirit, much used in England, contains nine parts of ethyl alcohol to one part of methyl alcohol.

Crude methyl alcohol is very largely used in the arts as a solvent, especially in the formation of varnish and other resinous solutions. It is also considerably employed as a source of heat, but the ordinary varieties of the spirit during burning give off a very offensive odor.

Methyl alcohol is capable of producing an intoxication similar to that caused by ethyl alcohol, but distinct in the slowness of the onset and the extraordinary duration of the symptoms, which may last from three to four days after the comparatively moderate dose of the drug. After distinctly toxic doses the fall of the bodily temperature is very marked, and convulsive movements of rhythmic or choreic character, followed for a day or two by loss of sensation and of reflex movements are common phenomena. Hemorrhage, also, frequently occurs from the abdominal tract. The eyes are specially affected, nystagmus of a pronounced type often being present; also, dilatation of the pupil. Chronic methyl alcohol poisoning is far more dangerous than is ordinary alcoholism, and amblyopia due to degenerative changes in the ganglion cells of the retina is a very common phenomenon. Both in human poisoning and in that produced upon the lower animals experimentally, excessive fatty degeneration of the liver and other organs is usually found after death.

Methyl alcohol amblyopia may appear after a single debauch. It is accompanied with contraction of the field of vision, absolute, usually central, scotoma, and rapid failure of vision, and though temporary improvement may occur, in 90 per cent. of the cases it ends in permanent loss of useful vision. It is worthy of note that in many cases methyl alcohol amblyopia has resulted from the excessive use of essence of ginger, or peppermint, or other aromatics, in the preparation of which the alcohol has been used as a menstruum. The permanency and severity of the symptoms caused by methyl alcohol depend in part upon the fact demonstrated by Reid Hunt that it is oxidized in the system with the formation of formic acid, a highly poisonous substance.

Methyl alcohol has been used to some extent in practical medicine, but appears to have no other remedial properties than those of ethyl alcohol, and to be a much more dangerous remedy. It has very properly fallen into complete desuetude in medicine, and under no circumstance should it be employed by pharmacists as a menstruum. The treatment of *methyl alcohol poisoning* is very unsatisfactory. The best that can be done is to aid in the elimination of the alcohol, and of the products of its destruction within the body, by free sweating and by the administration of large quantities of alkalized (sodium bicarbonate) water.

Methyl Chloride.—*Monochlormethane*, CH_3Cl, is obtained by the action of hydrochloric acid gas upon methyl alcohol, best in the presence of a little zinc chloride.

It is a colorless gas, condensing to a liquid at —23° C. (—11.4° F.), and is very soluble in alcohol, which dissolves thirty-five volumes of it, while water dissolves four volumes. On account of its extreme volatility, methyl chloride, when applied in the form of a spray, produces extreme cold and freezing of the part. It has been used in this way as a local anæsthetic. According to Richet

and Marcille (*S. M.*, 1902), methyl chloride acts upon the animal as an efficient anæsthetic, which has practically no influence upon the circulation. Its usefulness seems to be limited by its failure to produce complete muscular relaxation. We know of no clinical reports upon its activity.

Methyl Fluoride. CH_3F.—Henri Moissan (*B. A. M.*, 1890) affirms that this fluoride possesses anæsthetic properties.

Methyl Iodide. CH_3I. *Iodure de Methyl*, Fr. *Jodmethyl*, G.—This is a heavy sweet-smelling liquid, boiling at 43° C. (109.4° F.), and has a sp. gr. of 2.23 at 15° C. (59° F.). In the cold it unites with water to form a crystalline hydrate, $CH_3I + H_2O$. It turns brown gradually on exposure to light. It is made by the action of dry hydrochloric acid gas upon a mixture of potassium iodide and anhydrous methyl alcohol.

R. Kirk (*L. L.*, Oct. 1885) commends methyl iodide as a vesicant, applied on lint under a watch glass, a drop or two of soda solution being added to neutralize the free iodine that may be present. It produces at once a tingling, burning, biting sensation, like pricking with a number of needle points. The maximum pain is reached in a few minutes, when the substance is to be removed. The blister produced is said to be as full of serum as that caused by cantharides.

Methyl Ether. $(CH_3)_2O$. *Methylic Ether. Methyl Oxide. Hydrate of Methylene. Ether méthylique, Oxyde de Méthyl*, Fr. *Methyläther, Holzäther, Formäther*, G.—This substance was discovered by Dumas and Péligot, but was first employed as an anæsthetic by B. W. Richardson in 1867. He prepares it by mixing one part pure methyl alcohol with two of strong sulphuric acid, heating, collecting and washing repeatedly with potassium hydroxide solution the methyl ether which passes over. It is a gas even at low temperature. Richardson saturates absolute ethyl ether, at 0° C. (32° F.), with it, and at once closely bottles the compound under the name of *methyl-ethylic ether*. For a detailed description of the preparation of methyl ether and of its properties, see *J. P. C.*, 4e sér., xix. 438. According to Richardson, methyl ether is a very rapid and safe anæsthetic, producing great muscular relaxation with extreme quickness. (*A. J. P.*, Sept. 1870; *Dublin Q. J.*, Aug. 1870; *L. L.*, March, 1870.)

Methylal. *Methylene Dimethyl Ether.* $CH_2(OCH_3)_2$.—This is made by distilling methyl alcohol with sulphuric acid in the presence of manganese dioxide, or by abstracting one molecule of water from a mixture of one molecule of formaldehyde and two of methyl alcohol. It is a limpid colorless liquid, of sp. gr. 0.855 at 17° C. (62.6° F.), and boils at 42° C. (107.6° F.). It is soluble in water, alcohol, ether, and fatty and ethereal oils. It was originally proposed as an anæsthetic and hypnotic by B. W. Richardson in 1868. Richardson, Motrokhin, and Personali are in general accord as to its physiological action. It produces in man a sleep closely resembling the normal sleep; or, if the dose has been large enough, a profound coma in which reflex actions are suspended. Recovery is rapid on account of its rapid elimination. The arterial pressure is reduced, as is also, according to Motrokhin, the irritability of the cerebral cortex. Both Personali and Motrokhin found that it arrests the tetanic spasms produced by small doses of strychnine, although in Motrokhin's experiments, when large doses of strychnine were given, methylal seemed to accelerate rather than put off death. It is employed as an hypnotic, and is said to be free from danger and unpleasant effects; but in most cases patients become so rapidly accustomed to it that its influence soon disappears, unless enormous doses are used. The *dose* of methylal is from one to two fluidrachms (3.75–7.5 Cc.), given in emulsion.

Methylethylcarbinol. $\begin{cases} CH_3 \\ CH.OH. \\ C_2H_5 \end{cases}$

There are two compounds known respectively as *methylethylcarbinol* and *trimethylcarbinol*. The former is a strong-smelling liquid, boiling at from 98° to 100° C. (208.4°–212° F.); the latter crystallizes in plates melting at 28° C. (82.4° F.) and boils at from 83° to 84° C. (181.4°–183.2° F.). These alcohols are said to be vasomotor depressants and antipyretics, the dimethylethyl compound being the more powerful of the two. (*Ph. Post*, Jan. 1888.)

Methylphosphin.—Fürbringer (*Deutsch. Arch. f. klin. Med.*, lix. 1897) has found that this substance is a powerful convulsant poison, killing when in sufficient dose by respiratory paralysis, and having very little direct influence upon the circulation. The *di-methylphosphin* was found to be very slightly more poisonous than the methylphosphin, the fatal *dose* being about 0.5 gramme per kilo for the rabbit. Di-methylphosphin has been used in malaria by Julius Mannaberg, in the *dose* of nineteen grains (1.2 Gm.) per day, but is inferior to quinine. The urine becomes dark reddish-yellow and distinctly fluorescent, while numerous small yellow spots appear upon the skin.

Methylthebaine. $C_{20}H_{23}NO_3$.—This product from thebaine has been physiologically investigated by Crum Brown and Fraser, and by Stockman and Dott, and found to have an action similar to that of thebaine, but less powerful. (*B. M. J.*, Jan. 1891.)

Michelia. *Michelia nilagirica*, Zenker. (Fam. Magnoliaceæ.)—This tree, which is said to be abundant in the Neilgherry hills, India, yields an aromatic, volatile oil, which has entered commerce. (*P. J.*, Jan. 1888.)

Micrampelis. *Micrampelis fabacea* (Naud.), Greene. (*Megarrhiza californica*, Torr., *Echinocystis fabacea*, Naud.) *Man Root. Big Root. Gerba marra.* (Fam. Cucurbitaceæ.)—J. P. Heaney has obtained a substance from this root of resinous character which he calls *megarrhizitin*, and another which he believes to be a glucoside and calls *megarrhizin*. It is said to be actively cathartic. (*A. J. P.*, 1876, 451.) A second glucoside was obtained by W. M. Young (*A. J. P.*, 1883, 195), to which the name of *megarrhin* was given. It resembles saponin, and possesses the property of dilating the pupil. Young also found two resins, one soluble in alcohol and the other soluble in ether.

Microcidin.—Under this name the varying compounds of *sodium naphthalate* with other naphthalates and phenates have been put upon the market, and used as a surgical antiseptic, in solution varying from three to eight parts per thousand.

Micromeria. *Micromeria Douglasii*, Benth. *Yerba Buena.*—This labiate of California is said to be a grateful aromatic, and also an anthelmintic and an emmenagogue. For description, with figures, see *A. J. P.*, Sept. 1882. *Dose* of fluidextract, from a half to two fluidrachms (1.8–7.5 Cc.).

Migrainine.—A white powder, said by J. Hoffman to be composed of 85 per cent. of antipyrine,

9 per cent. of caffeine, and 6 per cent. of citric acid. It is used in *migraine* and *neuralgia* in *doses* of fifteen grains (1 Gm.).

Mitchella. *Mitchella repens*, L. *Squaw Vine. Partridge Berry. Checkerberry. Winter Clover.* (Fam. Rubiaceæ.)—This small indigenous evergreen has been supposed to possess remedial properties, and is said to be employed, in decoction, by the Indian squaws, to facilitate parturition. It appears to be diuretic, tonic, and astringent, resembling in these respects the pipsissewa, for which it is often substituted. E. Breneiser (*A. J. P.*, 1887, 228) found it to contain some resin, wax, mucilage, dextrin, and what appeared to be saponin.

Mixture of Magnesia and Asafetida. *Mistura Magnesiæ et Asafœtidæ*, U. S. 1880. *Mixture de Magnésie et d'Asafétide*, Fr. *Magnesia und Stinkasant-Mixtur*, G.—This preparation, which has had some popular vogue under the name of *Dewees's Carminative*, was directed by the U. S. Pharmacopœia of 1880 to be made as follows: "Carbonate of Magnesium, *five parts* [or three hundred and sixty grains]; Tincture of Asafetida, *seven parts* [or ten fluidrachms]; Tincture of Opium, *one part* [or seventy-five minims]; Sugar, *ten parts* [or one and a half ounces av.]; Distilled Water, *a sufficient quantity*, to make *one hundred parts* [or fifteen fluidounces]. Rub the Carbonate of Magnesium and Sugar, in a mortar, with the Tincture of Asafetida and Tincture of Opium. Then gradually add enough Distilled Water to make the mixture weigh *one hundred parts* [or measure fifteen fluidounces]." There is but 1 per cent. of tincture of opium in the formula just given, while the usual quantity is 3 per cent. The *dose* is twenty minims (1.3 Cc.).

Mollin is a base for ointments that has attracted some dermatological notice in Germany. It is a soft soap, containing 17 per cent. of uncombined fat, and is stated to be prepared by saponifying without heat 100 parts of cocoa-nut oil or of fresh fat with 40 parts of solution of caustic potash, sp. gr. 1.145, mixing intimately with 30 parts of glycerin, and heating carefully. It is yellowish white, of a smooth and soft consistence, not readily altered by exposure, free from rancidity, and easily removed from the skin by warm or cold water.

Momordica. *Momordica Balsamina*, L. *Balsam Apple. Balsamina.* (Fam. Cucurbitaceæ.)—An annual climbing East Indian plant, cultivated in our gardens for the sake of the ornamental fruit. This is ovate, attenuated towards each extremity, angular, warty, not unlike a cucumber in appearance, of a lively red or orange-yellow color, easily falling when touched, and spontaneously separating into several pieces. A liniment formed by infusing the fruit, deprived of its seeds, in olive or almond oil, is applied to *chapped hands, burns, piles, prolapsus ani*, etc; and the mashed fruit is sometimes used as a poultice. According to Descourtilz, two or three drachms taken internally will kill a dog. An extract prepared from it is said to be useful in *dropsy*. *Dose*, six to fifteen grains (0.4–1.0 Gm.).

Monarda. *Monarda punctata*, L. *Horsemint. Menthe de Cheval*, Fr. *Pferdeminze*, G.—This is an indigenous perennial or biennial labiate, growing in light gravelly or sandy soils from New York to Louisiana and west to Wisconsin. The whole herb is employed. It has an aromatic odor, and a warm, pungent, bitterish taste, and abounds in a volatile oil, which may be separated by distillation with water. Herman J. M. Schroeter (*A. J. P.*, 1888, 120) found the oil to consist of a hydrocarbon, $C_{10}H_{16}$ (56 per cent.), thymol, $C_{10}H_{14}O$ (25 per cent.), and higher oxygenated compounds, $C_{10}H_{18}O$. Kremers (*Ph. Rev.*, 1896, 223) examined the oil from authentic specimens and found it to yield from 56 to 61 per cent. of a phenol (thymol). Horsemint is stimulant and carminative, but is seldom used in regular practice. In the state of infusion it is occasionally employed in families as a remedy for flatulent *colic* and sick stomach, and for other purposes to which the aromatic herbs are applied. *Monarda fistulosa*, L., *wild bergamot, Oswego tea*, an active diuretic (see *Proc. A. Ph. A.*, 1895, 256; 1896, 238), contains, according to J. W. Brandel and E. Kremers, *hydrothymoquinone, thymoquinone*, besides *cymene, carvacrol* and *limonene* (*Ph. Rev.*, 19). The oil of *Monarda citriodora*, Cerv., or *prairie bergamot*, according to Brandel (*P. J.*, 53, 547), contains 65 per cent. of a phenol and 1.2 per cent. citral. For the composition of monarda oils see *Ph. Archiv.*, 1899, 73.

Monesia.—A South American vegetable extract, which is believed to be derived from the bark of *Lucuma glycyphlœa*, Mart. and Eichl. (*Chrysophyllum glycyphlœum*, Casar) (Fam. Guttiferæ), a tree of moderate size, growing in the forests near Rio Janeiro and elsewhere in Brazil. (*J. P. C.*, 3e sér., vi. 63.) The bark, which has also entered commerce, is in pieces, some of which are three or four lines thick, is very compact and heavy, of a deep brown or chocolate color, contrasting strongly with the grayish color of the epidermis when this remains, and of smooth fracture. The extract was received from South America in cakes weighing rather more than a pound, from three-quarters of an inch to an inch in thickness, of a dark brown almost black color, very brittle, of a fracture neither very dull nor very shining, and of a taste at first sweet, then astringent, and ultimately acrid, the acrimony being very persistent, and especially felt in the fauces. It is entirely soluble in water. The bark was found by Derosne, Henry, and Payen to contain, in one hundred parts, 1.2 of stearin, chlorophyll, and wax, 1.4 of glycyrrhizin, 4.7 of an acrid principle analogous to saponin, called monesin, 7.5 of tannic acid, 9.2 of a red coloring substance, 1.3 of malic acid and calcium malate, 3.0 of various salts, including silica, ferric oxide, and manganese, and 71.7 of pectic acid or pectin and of lignin, including loss, besides traces of an aromatic principle and of gum. A more recent analysis by Peckolt (*A. J. P.*, 1884, 626) gives *monesiatannic acid*, which gives a black coloration with iron salts, gallic acid, *moncsin*, an acrid, amorphous body, *lucumin*, a body crystallizing in silky needles, a bitter substance, glycyrrhizin, tartaric and citric acids, wax, etc. *Moncsin*, which is now considered as identical with saponin, $C_{32}H_{54}O_{18}$, was obtained by treating the bark or extract with alcohol, adding to the tincture an excess of calcium hydroxide in fine powder, filtering, evaporating the clear liquor to dryness, treating the residue with water and animal charcoal, filtering, and again evaporating to dryness. Thus procured it was in transparent yellowish scales, which were easily pulverized, forming a white powder. It was uncrystallizable, readily soluble in alcohol and water, to the latter of which it gave the property of frothing, and insoluble in ether. It had no power to saturate acids, was without odor, but had a slightly bitterish taste, followed by a de-

cided and permanent acrimony in the posterior mouth and fauces. Monesia owes its activity probably to this principle and to tannic acid.

Monesia is stomachic and feebly astringent, and has been used with asserted advantage in *diarrhœa, hæmoptysis, menorrhagia, scrofula, scurvy*, also as a local remedy in *leucorrhœa, ulcerations of the mouth and fauces*, and *ulcers*. It is applied to ulcers either by being sprinkled in powder upon the surface or in the form of ointment made with one part of the extract and seven parts of simple ointment. The *dose* of the extract is from two to ten grains (0.13–0.65 Gm.), repeated every one to three hours. Monesin has been given internally in the *dose* of about half a grain (0.032 Gm.), and has also been applied to ulcers. It is said to be a powerful oxytocic, but it is seldom used.

Mongumo Bark.—For analysis of this Madagascar bark, which is said by E. M. Holmes to resemble the bark of *Ochrosia borbonica*, see *P. J.*, ix. 816. It was examined by Dragendorff, who found *mongumic acid*, resin, waxy substance, a glucoside soluble in water and alcohol, metarabic acid, fatty matter, calcium oxalate and a substance insoluble in alcohol and soluble in water.

Monsonia.—According to John Maberly (*L. L.*, Feb. 1897; July, 1898), certain South African plants belonging to the family of Geraniaceæ, having large fleshy roots, are valuable remedies in the treatment both of acute and chronic *dysentery;* such are especially *Monsonia ovata*, Cav., and *M. burkeana*, Planch., ex. Harv. and Lond.; also certain Pelargoniums. Under the name of *t'Namie*, the natives of Namaqualand are said to use the root of *Pelargonium antidysentericum*, Kostel. Maberly believes that the Pelargoniums are especially valuable in ulceration of the stomach and upper portions of the intestinal tract, and the Monsonias when the disease is low down in the intestines. The *dose* of monsonia is given as half an ounce (15.5 Gm.). It is believed that the plants are not poisonous. *Dose* of the saturated tincture from one to two fluidrachms (3.75–7.5 Cc.) every three or four hours.

Morindin.—This principle, discovered by Anderson in *Morinda tinctoria*, Roxb. (*M. citrifolia*, Hunt., not L.), or *Indian mulberry* (Fam. Rubiaceæ), and supposed to be identical with ruberythric acid, is said to be distinct. (*P. J.*, Dec. 1886.)

Moringa. *Moringa pterygosperma*, Gaertn. *Horseradish Tree.* (Fam. Moringaceæ.)—A decoction of the root of this Jamaica tree is said to be used by the peasantry as an active and persistent diuretic. (*The Satellite*, Feb. 1890.)

Morphigenin.—This nitrogenated derivative of morphine, made by E. Vahlen, has been obtained by him only in solution in the form of morphigenin hydrochloride, $C_6H_4{=}C.OH$ / $C_6H_4{=}C.NH_2HCl$. It is said to possess distinct narcotic properties (*A. E. P. P.*, xlvii. p. 368).

Mountain Green or **Mineral Green.**—A pigment obtained by powdering green *malachite* or *copper oxycarbonate*, artificially prepared.

Moxa. *Moxa*, Fr. *Brenncylinder*, G.—These are small combustible masses used to produce an eschar by being burned in contact with the skin. In Japan and China they are made from the leaves or the downy hairs on the leaves and stems of one or more species of Artemisia. *A. chinensis*, L., and *A. indica*, Willd. (*A. vulgaris*, L.), were indicated by the Dublin College; but Lindley states that it is the *A. moxa* of De Candolle which is employed. A similar moxa has been made in France, by a similar process, from the leaves of *A. vulgaris*. According to Percy, the dried stem of the ordinary sunflower may be used for moxa. Artificial moxas may be made by the following process: One pound of cotton is introduced into a vessel containing two ounces of nitre dissolved in half a gallon of water, and a moderate heat applied till all the liquid is evaporated. The cotton, when perfectly dry, is formed into thin, narrow sheets, which are rolled round a central cord of linen, so as to form a cylinder from half an inch to an inch in diameter, and several inches long. This is enclosed in a covering of silk or linen sewed firmly around it; and, when used, may be cut by a razor into transverse slices a few lines in thickness. By leaving a hole in the centre of the cylinder, the combustion will be rendered more vigorous, and a deeper eschar produced. Lime, in the act of slaking, has been used as a substitute for the moxa. (*Dublin Q. J.*, Jan. 1842.)

Cauterization by fire has been used from time immemorial among savages, half-civilized, and intelligent communities, and is said to have been reintroduced into Europe by the early Portuguese navigators from the Far East. Though at one time much employed for the purposes of revulsion, this form of cauterization has fallen into complete desuetude. The curious reader may find the details of its application described in the 18th ed. *U. S. D.* The first sensation experienced is not disagreeable; but the operation becomes gradually more painful, and towards the close is for a short time very severe. The pain could probably be prevented by the use of cocaine.

Muawin Bark.—This is the bark of a Mozambique tree, which in Eastern Africa is used as an ordeal poison. In appearance and structure it closely resembles the Erythrophlœum bark. An alkaloid, *muawine*, was discovered in it by E. Merck, 1891. So far it has been obtained only in the form of a thick, syrupy liquid, easily soluble in alcohol, ether and chloroform. The characteristic test is said to be that with vanadinsulphuric acid, which gives with muawine first a pale green, passing into a pale blue. (H. Jacobsohn, *In. Dis.*, Dorpat, 1892; see also *Merck's Jahresbericht*, 1891.) According to Jacobsohn, the hydrobromide when injected subcutaneously does not cause any irritation, but produces in frogs symptoms similar to those caused by digitalin, and in warm blooded animals slowing of the pulse, increase of the heart action, elevation of blood pressure, and contraction of the arterioles. The action of muawine is, therefore, like that of digitalin, but is distinguished by being very temporary.

Mucuna. *Mucuna pruriens* (L.), De Cand. *Dolichos pruriens*, L. *Stizolobium pruriens*, Medic. *Cowhage. Cowage. Setæ Siliquæ Hirsutæ. Pois velus, Pois à gratter*, Fr. *Kratzbohnen, Kuhkrätze*, G.—This is a leguminous climbing plant which grows in the West Indies and tropical America. The East Indian plant, which was formerly considered identical with it, is a distinct species, *M. prurita*, Hook. The fruit is a coriaceous pod, shaped like the Italic letter *f*, about four inches long, and covered with brown bristly hairs, which easily separate, and when handled stick in the fingers, producing an intense itching sensation.

The spicula are said to be very destructive to the *round worm*, acting mechanically by penetrating their bodies. Neither the tincture nor the decoction is effective. Cowhage is efficient, but so disagreeable that it has passed out of vogue. The usual mode of preparing it is to dip the pods into syrup or molasses, and scrape off the hairs with the liquid, which is in a proper state for administration when it has attained the consistence of thick honey. The *dose* of this preparation is a tablespoonful (15 Cc.) for an adult, a teaspoonful (3.75 Cc.) for a child three or four years old, to be given every morning for three days, and then followed by a brisk cathartic.

Muira-Puama.—The wood of a Brazilian tree, believed to be from *Dulacia ovata* (Miers), Kze. (*Liriosma ovata*, Miers) (Fam. Olacaceæ), which, according to Th. Peckolt, contains an alkaloid, *muira-puamine*, and is used by the Brazilian aborigines as an aphrodisiac, also in the treatment of *dysentery*. In *impotence*, ten to twenty minims (0.6–1.3 Cc.) of the fluidextract may be taken three or four times a day. (See *M. R.*, 1902.)

Mulberry.—There are in the United States three species,—the indigenous *Morus rubra*, L., with red fruit; *M. alba*, L., originally from China, and at one time extensively cultivated as a source of food for the silk worm, having a white fruit; and *M. nigra*, L., a tree of middle size, supposed to have been brought originally from Persia into Italy and thence spread over Europe and America. The fruit of the last species has a sweet, mucilaginous, acidulous taste, and abounds in a deep red juice having the sp. gr. 1.060. (*Mori Succus*, Br. 1885.) In an analysis made by H. Van Hees, 100 parts of mulberries yielded the following percentage results: glucose and uncrystallizable sugar, 9.19; free acid (supposed to be malic with admixture of tartaric), 1.86; albuminous matter, 0.39; pectic matter, fats, salts, and gum, 2.03; ash, 0.57; insoluble matters (the seeds, pectose, cellulose, etc.), 1.25; water, 84.71. In amount of grape sugar the mulberry is surpassed only by the cherry, 10.79, and the grape, from 10.6 to 19.0. Mulberries are refreshing and laxative, and serve to prepare a grateful drink well adapted to febrile cases.

Murexide. $C_8H_4(NH_4)N_5O_6 + H_2O$.—A fine purple dye-stuff, made by the reaction of nitric acid on uric acid. As resulting from the action of nitric acid on urine, it was supposed by Prout to consist of purpuric acid and ammonia (which belief has been confirmed by further investigation), and hence was named *ammonium purpurate*. It is now made from guano. This is first treated with hydrochloric acid to remove foreign substances, and then with soda to dissolve the uric acid, which is separated by neutralizing the soda with hydrochloric acid. The uric acid is dissolved in nitric acid, the solution is heated, and after it cools ammonia or its carbonate is added, which develops the purple color. Murexide is obtained in crystals, which have a square form, and are a rich green color by reflected, but of a purple-red by transmitted light. They are slightly soluble in cold water, more so in boiling water, and insoluble in alcohol and ether. With potassium hydroxide they form a rich purple solution. It has been replaced as a dye by aniline colors.

Muscari. *Muscari comosum*, Mill. (*Hyacinthus comosus*, L.) (Fam. Liliaceæ.)—In the bulbs of this plant Curci (*Rép. de Pharm.*, March, 1889) has found *comosic acid*, which he believes to act physiologically like saponin.

Musculus. *Musculus venenosus.*—That certain mussels, or that mussels in certain condition, are actively poisonous is well ascertained. F. Crumpe (*Dublin Q. J.*, Oct. 1873) has reported collapse with complete paralysis of the voluntary muscles as produced by the mussel, and has also treated traumatic tetanus successfully with raw mussels. M. Brieger (*D. M. W.*) has isolated certain bases out of mussels. He thinks the most important is *mytilotoxine* ($C_6H_{15}NO_2$), which he has demonstrated to possess physiological properties closely resembling those of curare. These poisonous principles are all probably ptomaines, and disappear when the mussel is boiled with sodium carbonate; so that boiling the mussel in an alkaline solution (three and a half grammes per liter of water) renders it harmless.

Mushrooms and Toadstools. (*Edible and Poisonous Fungi.*)—Notwithstanding the fact that it has been shown that edible fungi, when compared with other articles of food, do not possess a high food value, the interest in the study of the fungi, as well as the consumption of edible forms, is constantly increasing. The study of the fungi is one of the most highly specialized, as there have been up to the present time no less than 39,000 species described. From a food standpoint the differentiation of the edible from the poisonous is one of the most difficult that the novice can undertake, as it is almost impossible to lay down any invariable rules.

The fungi are divided into a number of classes, each of which is again subdivided into sub-classes, series, and families. The family Hymenomycetes (consisting of more than 8000 species) includes all of the mushrooms and toadstools. It is commonly believed that mushrooms are edible and that toadstools are poisonous; in reality, however, no such distinction should be made. The plants of the Hymenomycetes are characterized in general in that they arise from a mass of colorless threads, known as "mycelium" or "spawn," produced in the ground, bark of trees, etc. Their first appearance above ground is marked by the production of small solid balls (called buttons), which gradually enlarge, and at length shoot up into a stem or stipe bearing at its summit the umbrella top or "pileus," which is at first closed around the stalk like a closed umbrella and then expands more or less widely, according to the species. The under side of the pileus is the part which bears the spores, which correspond to the seeds of higher plants. In some cases the under surface consists of a series of gills resembling knife blades, which radiate from the top of the stalk to the circumference, like the spokes of a wheel, as in Agaricaceæ; in others it consists of a mass of small pores or tubes packed closely together, side by side, as in Polyporaceæ; in others of teeth, as in Hydnaceæ; in others only slightly wrinkled or undulated, as Thelephoraceæ, etc. The Hymenomycetes are divided into six orders, viz.:

1.—*Agaricaceæ* (the mushrooms and toadstools proper) comprises about 4600 species, some of which are poisonous, as the Amanitas (Fly Mushrooms), Lactarius (with a milky juice), whereas others are edible, as *Agaricus* (Psalliata) *campestris*, L., the common mushroom, *Cantharellus cibarius*, Fr., etc.

2.—*Polyporaceæ* (Pore-Fungi) includes about 2000 species, many of which are parasites on trees and destructive to timber; some are edible, as *Boletus edulis*, Bull., whereas others are poisonous, as *B. satana*, Lenz.

3.—*Hydnaceæ* (Teeth-bearing Fungi); most of the species are too small and woody to be eaten. *Hydnum repandum*, L., forms "fairy rings" in woods.

4.—*Thelephoraceæ;* most of the species are small, and the larger species are tough and leathery.

5.—*Clavariaceæ* (Coral-shaped Fungi) includes some large fungi; none are poisonous and some, as *Clavaria flava*, Schaeff., are palatable.

6.—*Tomentellaceæ* are the simplest of the Hymenomycetes. They generally form leathery coverings on bark and wood and some are parasites.

The *Common Mushroom* (*Agaricus campestris*, L.) is practically the only species cultivated in this country, and is the only fresh species sold in the Northern markets during the winter months. It is found wild in open grassy fields or pastures in great abundance in August and September. It is not common in the mountains, never found in woods, and never grows on trees or fallen trunks. The color of the stalk and pileus varies from whitish to a shade of drab, but the *color of the gills, a point which must never be overlooked, is at first pinkish and then a brownish purple.* This color is due to the spores, which are borne on the gills. The *stalk is cylindrical and solid*, and has, rather more than half way up, *a membranous collar* called the *ring;* but there is no membrane or scales found at the base of the stalk, which appears to come directly out of the ground. "In specimens which are not fully expanded there is a thin membrane or veil which extends from the stalk to the margin of the pileus. When the veil is ruptured, exposing the gills behind, a part remains attached to the stalk, forming the ring already referred to. In older specimens the ring shrinks, but generally a mark remains showing where it has been attached." Two of the most common poisonous forms resembling the common mushroom, and which have been eaten by mistake for it, are the deadly agaric and the fly agaric.

The *Fly Agaric* (*Amanita muscaria* (L.), Pers.), so called because decoctions have been used for killing flies, is in some localities much more abundant than the common mushroom. It is seldom found in the grassy pastures preferred by the common mushroom, but more generally in poor soil, especially in groves of coniferous trees. "It grows singly and not in groups, and differs from the common mushroom in having *gills which are always white*, never pink or purple, and in having *a hollow stem*, which is *bulbous at the base and clothed with irregular fringy scales on all the lower part.* The pileus varies in color from a brilliant yellow to orange and a deep red, the yellow and orange being more frequent than the red. The *surface is polished and has scattered over it a larger or smaller number of prominent, angular, warty scales*, which can be easily scraped off. The gills and stalks are white, and there is a large membranous collar which hangs down from the upper part of the stem."

The *Deadly Agaric* (*Amanita phalloides* (Pers.), Fr.), so named because it probably has been more frequently the cause of death than any other fungus, prefers a damper and less sandy soil than the fly agaric and is not pre-eminently an inhabitant of grassy pastures. "The pileus is often a shining white, but may be of any shade from a dull yellow to olive, and when wet is more slimy than the common mushroom or the fly agaric. It has no distinct scales and only occasionally a few membranous patches on the pileus. The *gills and stalks are white, and the latter has a large ring like the fly agaric and is hollow*, or, when young, is loosely filled with cottony threads, which soon disappear. The base of the stalk differs from that of the fly agaric in being more bulbous and in having the upper part of the bulb bordered by a sac-like membrane called the volva. The volva is often of considerable size, but more frequently it is reduced to a membranous rim."

The lists of edible and poisonous fungi are relatively long, and while most belong to the Hymenomycetes, some are also yielded by the Gasteromycetes, as the puff balls. The *giant puff ball*, *Lycoperdon Bovista*, L. (*L. giganteum*, Batsch) is found in the region of San Francisco Bay, not rarely forty inches in diameter.

It is not possible in this limited space to even mention the various poisonous and edible fungi that experience has demonstrated are such. The number of species which have been eaten or experimented with, however, is small compared to the number of species recognized by botanists. Many students of fungi have formulated rules for distinguishing the edible from the poisonous fungi. "The different popular tests for distinguishing edible from poisonous fungi, such as, for instance, the blackening of a silver coin or spoon when placed in a mass of poisonous fungi while they are being cooked, are all absolutely worthless." The following rules, given by W. G. Farlow, should not be neglected by the beginner:

1.—Avoid fungi when in the button or unexpanded stage; also those in which the flesh has begun to decay, even if only slightly.

2.—Avoid all fungi which have stalks with a swollen base surrounded by a sac-like or scaly envelope, especially if the gills are white.

3.—Avoid fungi having a milky juice, unless the milk is reddish.

4.—Avoid fungi in which the cap, or pileus, is thin in proportion to the gills and in which the gills are nearly all of equal length, especially if the pileus is bright colored.

5.—Avoid all tube-bearing fungi in which the flesh changes color when cut or broken, or when the mouths of the tubes are reddish, and in the case of other tube-bearing fungi experiment with caution.

6.—Fungi which have a sort of spider-web or flocculent ring round the upper part of the stalk should in general be avoided.

Rules 1, 2, and 5 may, for the beginner, be regarded as absolute, with the exception to Rule 2, *Amanita cæsarea* (Scop.) Kaiserling, the gills of which are yellow. Rules 3, 4, and 6 have more numerous exceptions; but these rules should be followed in all cases, unless the collector is content to experiment first with very small quantities and learn the practical result.

The poisonous mushrooms are divided by R. Kobert (*Ueber Pilzvergiftung*, Dorpat, Nov. 1891) into four groups. The first group comprises those fungi which contain *muscarine* or some alkaloid allied to it. (See *Muscarine*, p. 1377.) In this group are included species of the old genus *Agaricus*, especially of the section *Amanitas*. In the second group are fungi containing a milky juice and having the generic name of *Lactarius* or *Galorrhœus*. Some of these species, such as *L. deliciosus*, are stated to be edible, but most of them have in their juice a violently irritant resin, which may produce severe, or even fatal, gastro-enteritis.

The third group contains species belonging to the genus *Helvella*, whose juice contains *helvellaic acid*, isolated by Boehm. It is asserted that these fungi, when thoroughly dried, are not poisonous, and that hot water also extracts from them the poisonous acid, so that boiling makes them edible. The chief physiological action of the acid seems to be to destroy the red blood corpuscles, and, probably by such action, to produce vomiting, hæmoglobinuria, jaundice, irritation of the kidneys, etc.

The fourth and most important group of poisonous fungi is that which contains a large number of fungi which resemble edible species. According to the researches of Kobert, the toxic property of these fungi is a toxalbumin, which he has isolated from *Amanita phalloides* and given the name of *phallin*. Ordinarily, poisoning from mushrooms is due to plants of the present group. In many cases the fungi as eaten have tasted well, and no evil result has been apparent for many hours after their ingestion; in some cases for twenty hours. The symptoms have been great prostration and collapse, cold sweat, headache, stupor, amaurosis, delirium often with wild cries, coma, mydriasis, convulsions, marked cyanosis, and not rarely icterus; sometimes there is pronounced urticaria. There are usually distinct fever and rapid feeble pulse, while hæmoglobinuria, methæmoglobinuria, hæmaturia, albuminuria, and even suppression of urine have been noted. After death, post-mortem rigidity is often wanting, the gastro-intestinal tract is violently inflamed, the blood fluid and often escaping from the vessels and staining the tissues; while the liver, the heart, the diaphragm, and the muscles have been found in a state of fatty degeneration. The treatment of the poisoning consists in the immediate emptying of the alimentary canal by emetics, castor oil, and cathartics, and the meeting of symptoms as they arise.

B. W. Richardson, having noticed that the smoke of the *Lycoperdon Proteus* or *puff ball* was used for stupefying bees, found that the inhalation of the fumes caused various animals to become insensible. He has himself inhaled the fumes clarified by passing them through water, and experienced symptoms of intoxication and drowsiness. (*M. T. G.*, 1853, 610.) Thornton Herapath, however, maintains, as the result of his experiments, that these anæsthetic effects are in reality not owing to any narcotic principle present in the fungus, but to the carbon dioxide gas generated during their combustion. (*Philos. Mag.*, July, 1855.)

Musk, Artificial. *Moschus Factitius.*—The artificial musk introduced within recent years as a patented preparation, called "*Musk Baur*," from the name of the discoverer, A. Baur, is *trinitrobutyltoluene*, $C(CH_3)_3.C_6H(NO_2)_3CH_3$. It is prepared by adding tertiary butyltoluene slowly in the cold to five times its weight of a mixture of concentrated nitric and sulphuric acids, and afterwards heating the mixture for from eight to nine hours on a water bath. It crystallizes from alcohol in yellowish-white needles, melts at from 96° to 97° C. (204.8°–206.6° F.), and is insoluble in water. It is, however, soluble in alcohol, ether benzene, chloroform, and petroleum benzin.

Artificial musk is an antispasmodic and nervine, which has been highly commended in *spasm of the glottis* of children. *Dose*, ten grains (0.65 Gm.); for a child two years old, from half a grain to a grain (0.032–0.065 Gm.), every two or three hours.

Mutisia. *Mutisia viciæfolia*, Cav.—This composite, a native of Chile, is stated to be a valuable anti-spasmodic, useful in hysteria and croup; it is also a cardiac tonic.

Mydrine. *Mydrin.*—A colorless powder, composed of 100 parts of *ephedrine*, the active principle of a Japanese gnetaceous plant, or "species of Ephedra," and 1 part of homatropine. It is easily soluble in water, is employed in 10 per cent. solution, and is said to be a useful evanescent mydriatic.

Mydrol. *Iodo-methyl-phenyl-pyrazolon.* — A colorless, inodorous powder of bitter taste, easily soluble in water and alcohol. It is used as a mydriatic in 5 and 10 per cent. solutions.

Myrcia. *Myrcia acris*, Swartz; De Cand., *Prodrom.*, v. 243; Curtis's *Bot. Mag.*, 2d. ser., vol. vi. pl. 3153.—*Myrtus acris*, Willd., *Sp. Plant.*, p. 973. The *bayberry*, as it is sometimes called, is a tree of considerable size, with a straight stem and a thick pyramidal summit. The young branches are green and sharply four-angled. The leaves are opposite, from 3 to 5 inches long, very coriaceous, lanceolate, obtuse, wavy, somewhat revolute at the edges, with numerous parallel nerves, reticulated on the upper surface, and sprinkled with pellucid dots. They have a very fragrant odor, and are somewhat astringent. The flowers, which are arranged in pedunculate, axillary panicles, longer than the leaves, are small, and white with a reddish tinge. The aromatic berries are round, about as large as a pea, with seven or eight seeds.

The tree is a native of Jamaica and other West India islands. The spirit is probably prepared by distilling rum from the leaves; but we are without precise information on the subject, and it is not impossible that the leaves of other species may also be used. Indeed, an odor of pimenta which it appears to us may be sometimes detected suggests the idea that the leaves of this tree may be at least occasionally added to those of the bayberry. A *volatile oil* is also obtained from the leaves by distillation, and was official in 1890. (See *Oil of Myrcia.*)

Myrica. *Myrica cerifera*, L. *Wax Myrtle. Bayberry. Candle Berry. Arbre à suif*, Fr. *Wachsbaum, Wachsgagel*, G.—This is an indigenous myrtaceous shrub growing in great abundance in the sandy soil along the sea shore, and even on the shores of our northern lakes. The leaves of the wax-myrtle have resinous dots on both sides, and are very fragrant when rubbed. The fruit is covered with a coating of white wax, and sometimes continues on the plant for two years or more. The coating of wax upon the surface is collected, and known in commerce as *myrtle wax.* (See *Vegetable Wax.*) A volatile oil might probably be obtained by distillation from the leaves. The bark of the stem and root is supposed to possess valuable remedial properties, and has been employed to a considerable extent. In the dried state it is in quilled pieces of variable length, covered with a thin epidermis of a grayish color somewhat mottled, and marked with slight circular fissures. Within the epidermis the color is reddish brown. The bark is brittle, and of a peculiar, astringent, bitterish, and pungent taste, followed by a slight sense of acrimony. Its powder has a peculiar aromatic odor, and irritates the nostrils and throat when inhaled. It yields its virtues to water and alcohol. George M. Hambright found in it volatile oil, starch, lignin, gum, albumen, extractive, a red coloring substance,

tannic and gallic acids, an acrid resin soluble in alcohol and ether, an astringent resin soluble in alcohol and not in ether, and a peculiar acrid principle having acid properties. (*A. J. P.*, 1863, 193.) Myrtle wax consists of the glycerides of stearic, palmitic, and myristic acids and a small quantity of oleic acid (Lewkowitsch, *Oils, Fats, and Waxes*, p. 542). The bark appears to be moderately tonic and astringent, and in large doses emetic. It has been considerably used by the eclectics in *diarrhœa, jaundice, scrofula*, etc. Externally the powdered bark is used as a stimulant to indolent *ulcers*, and the decoction as a gargle and injection in chronic *inflammation of the throat, leucorrhœa*, etc. *Dose* of the powder, twenty or thirty grains (1.3–2.0 Gm.), of a decoction (one ounce to one pint), one or two fluidounces (30–60 Cc.). An alcoholic extract, very inappropriately named *myricin*, is given in the medium *dose* of about five grains (0.32 Gm.).

From the bark of *Myrica Nagi*, Thunb., the yellow coloring matter of which is known as *myricetin*, A. G. Perkin has separated a new glucoside, *myricetrin*, closely resembling *quercitrin*. (See *Proc. Chem. Soc.*, xviii. 11.) (For analysis of the rhizome of the allied *Comptonia peregrina* (L.), Coulter (*Myrica asplenifolia*, L.), see *A. J. P.*, 1892, 303.)

Myrobalans. *Myrobalanum, Br. Add. Myrobalani. Myrobalans*, Fr. *Myrobalanen*, G.—Five varieties of these East India fruits are distinguished by authors. 1. *Myrobalani bellericæ*. These are obtained from *Buceras Bellirica* (Gaertn.), Lyons, (*Myrobalanus Bellirica*, Gaertn., *Terminalia Bellerica*, Roxb.). They are roundish or ovate, from the size of a hazel-nut to that of a walnut, of a grayish-brown color, smooth, marked with five longitudinal ribs, and sometimes furnished with a short, thick footstalk. They consist of an exterior, firm, resinous, brown, fleshy portion, and an interior kernel which is light brown, inodorous, and of a bitterish very astringent taste. 2. *Myrobalani chebulæ*. This variety, which is recognized by the Br. Add., is produced by *Buceras Chebula* (Retz.), Lyons (*Terminalia Chebula*, Willd.) (considered by some to be identical with *B. Bellerica*). The fruit is oblong, pointed at each extremity, from fifteen to eighteen lines in length, of a dark brown color, smooth and shining, with five longitudinal wrinkles, but without footstalks. In their internal arrangement and their taste they resemble the preceding. 3. *Myrobalani citrinæ* vel *flavæ*. These are from a variety of the same tree which affords the last-mentioned myrobalans, from which they differ only in being somewhat smaller, of a light brown or yellowish color, and of a taste rather more bitter. They were formerly sometimes sold in the shops of Philadelphia, under the name of *white galls*, to which, however, they bear no other resemblance than in taste. 4. *Myrobalani indicæ* vel *nigræ*. These are thought to be the unripe fruit of *Buceras Chebula*, or *B. Bellerica*. They are ovate-oblong, from four to eight lines long and from two to three lines thick, of a blackish color, wrinkled longitudinally, and presenting, when broken, a thick brown mass, without kernel, but with a small cavity in the centre. They are sourish and very astringent. 5. *Myrobalani emblicæ*. This variety is wholly different from the preceding, and derived from a plant having no affinity to the Terminaliæ, of the fam. Combretaceæ, —namely, the *Phyllanthus Emblica*, L. (Fam. Euphorbiaceæ.) It is often in segments, as found in commerce. When the fruit is entire, it is blackish, spherical depressed, of the size of a cherry, presenting six obtuse ribs with as many deep furrows, and separating into six valves, and has a strongly astringent and acidulous taste. These fruits were in high repute with the Arabians, and were long employed by European practitioners, as primarily laxative and secondarily astringent, in various complaints, particularly *diarrhœa* and *dysentery*. Their *dose* was from two drachms to an ounce. Pierre Apery states that when roasted they are still used in Turkey with excellent results in *intestinal catarrhs*. (*R. T.*, Dec. 1887.) Although the myrobalans are of various origin, they all probably depend for their physiological activity upon the presence of gallotannic acid. Procter states that they contain from 30 to 35 per cent. of gallotannic and ellagitannic acids.

Myrobalan ointment (*Unguentum Myrobalani*, Br. Add., one to four) and *myrobalan and opium ointment* (*Unguentum Myrobalani cum Opio*, Br. Add.), are used as local astringents. The internal *dose* of myrobalans is one-half to one drachm (2.0–3.9 Gm.), given in the form of a powder.

Myrtus. *Myrtus communis*, L. *Common European Myrtle.* (Fam. Myrtaceæ.)—The leaves of this plant yield, by distillation, *myrtol*, which is a mixture of a dextro-rotatory terpene, recognized as pinene, cineol, $C_{10}H_{18}O$, which is identical with cajuputol and eucalyptol, and dipentene. The mixture usually known as *myrtol* is collected between 160° and 180° C. (320°–356° F.). Myrtol has been recommended as an antiseptic and a powerful stimulant to the pulmonic and genito-urinary mucous membranes, and useful in chronic *bronchitis, cystitis*, or *pyelitis*. Jahns believes that the medicinal activity of the oil depends upon the presence in it of *cineol*. *Dose*, from one to two minims (0.06–0.13 Cc.), given in capsules, from four to eight times a day. A. de Vevey (*R. T.*, lxiii. 1896) has used the 10 per cent. solution in sterilized olive oil hypodermically in *doses* of eighty to one hundred and sixty minims (5–10 Cc.) once or twice in twenty-four hours, with asserted very good results in all forms of chronic or bronchial catarrh.

Nabalus. *Nabalus albus* (L.), Hook. (*Prenanthes alba*, L.) *Rattlesnake Root. White Lettuce. Cancer Weed. Gall of the Earth. Lion's Foot.*—In certain portions of Virginia and North Carolina, where this perennial herb grows, great value is attached to it in *rattlesnake bite*. The milky juice is taken freely internally, and its leaves steeped in water which is locally applied and frequently changed. The plant is also used in *dysentery*, and N. B. Williams has found tannin in the rhizome. (*A. J. P.*, 1887.)

Nag-Kassar.—This is the anthers of an ornamental tree much cultivated in Southern Asia. (See *Ph. Post*, May, 1888.)

Nance Bark.—This bark is believed to be obtained from the *Malpighia glabra*, L. (Fam. Malpighiaceæ); it is much used in Mexico for tanning, and, according to F. Holberg, contains 26.2 per cent. of tannin. (*A. J. P.*, xvi. 239.)

Naphthalan. *Naftalan.*—This is a greenish-black soft mass, prepared by the fractional distillation of naphtha obtained from the Armenian highlands, having a slightly empyreumatic odor, a neutral reaction, and a specific gravity of 0.89. It melts at 70° C. (158° F.), is insoluble in water and glycerin, but mixes readily with fats and oils, and

is soluble in ether and petroleum benzin. It has been recommended by Rosenbaum and others as very efficacious in the treatment of *pruritus* and *burns*, as well as in *chronic eczema*, *sycosis*, and other parasitic skin affections, and as having a range of usefulness closely parallel to that of the oil of cade. It is necessary to apply it in the form of a thick coat to the affected skin and envelop it so as to exclude the air. Stains produced by it on the clothing can be removed by petroleum or benzene. Applied as a paste, 50 per cent. naftalan, 25 per cent. each of zinc oxide and of starch, with or without 2 to 5 per cent. of menthol. (See *Praktitchesky Vratch*, vol. i. No. 31.)

Naphthylaminsulfonic Acid. *Acidum Naphthylaminsulfonicum. Naphthionic Acid.—Sulphonaphthylaminic acid* ($C_{10}H_6(NH_2)HSO_3$) is a white powder, soluble in about four thousand parts of cold water, which has been proposed by E. Riegler on chemical grounds as an antidote for poisoning by the nitrites and in severe *iodism*. It is eliminated through the kidneys, causing acidity of the urine, and has been recommended in the treatment of chronic *cystitis*. The *dose* is eight grains (0.5 Gm.), taken with starch in a capsule every three or four hours.

Naples Yellow.—A yellow pigment prepared by calcining a mixture of lead, antimony sulphide, dried alum, and ammonium chloride, or a mixture of lead carbonate, diaphoretic antimony, dried alum, and ammonium chloride. (Gray.)

Narcissus. *Narcissus Pseudonarcissus*, L. *Daffodil. Narcisse des prés, Porillon*, Fr. *Gelbe Narcisse*, G. (Fam. Amaryllidaceæ.)—Both the bulb and the bright yellow flowers of this common garden plant have been used in medicine. The flowers have a feeble peculiar odor, and both have a bitter mucilaginous taste. They are an uncertain emetic. It is probable that the flowers of the wild European plant are more powerful than those of the cultivated. A. W. Gerrard examined the bulbs of daffodil, and obtained a crystalline neutral principle and an amorphous alkaloid, which he calls *pseudonarcissine*. According to Ruiger, the alkaloid obtained by Gerrard from the bulb of the flowering plant dries the mouth, checks perspiration, dilates the pupil, especially when applied locally, quickens the pulse, and acts on the heart of the frog antagonistically to muscarine and pilocarpine, while the alkaloid taken from the bulb after flowering causes salivation and perspiration, internally taken contracts the pupil, and topically applied dilates it slightly. (*J. P.*, i. 436.) In France, narcissus flowers have been used as an antispasmodic. The *dose* of the powder, to produce an emetic effect, varies, according to the statements of different physicians, from twenty grains to two drachms (1.3–7.7 Gm.); while the extract is said to cause vomiting in the *dose* of two or three grains (0.13–0.20 Gm.). The bulb is most powerful in the recent state.

Narcotile.—This is a colorless, highly volatile, very inflammable liquid, said to be a mixture of methyl and ethyl chlorides, and to be produced by the action of hydrochloric acid on a mixture of ethyl and methyl alcohols. It has been highly recommended as an anæsthetic. (*L. L.*, 1903, 1.)

Nard. *Spikenard.*—Several aromatic roots were known to the ancients under the name of *nardus*, distinguished, according to their origin or place of growth, by the names of *Nardus Indica*, *Nardus Celtica*, *Nardus montana*, etc. They are supposed to have been derived from different valerianaceous plants. Thus, the *Nardus Indica* is referred to *Nardostachys Jatamansi* (Roxb.), DC. (*Valeriana Jatamansi*, Roxb.), of Bengal, the *Nardus Celtica* to *V. celtica*, L., inhabiting the Alps, Apennines, etc., and the *Nardus montana* to *V. tuberosa*, which grows in the mountains of the south of Europe. The *Indian nard*, or spikenard, sometimes also called *Syrian nard*, is still occasionally to be found in commerce. It is a small delicate root, from one to three inches long, beset with a tuft of soft, light brown, slender fibres, of an agreeable odor, and a bitter aromatic taste. It was formerly very highly esteemed as a medicine, but is now almost out of use. Its properties are analogous to those of valerian.

Naregamia, or **Goanese Ipecacuanha.**—The root of *Naregamia alata*, Wight and Arn. (Fam. Meliaceæ), of Western India, has been much employed as an emetic, as an hepatic stimulant in *dysentery*, and in small doses as an expectorant in *bronchitis*. Drasche of Vienna, confirms the value of the drug. (*Cb. G. T.*, 1890.) In it Hooker has found an alkaloid, *naregamine*, an oxidizable fixed oil, and a wax. (See *P. J.*, vol. xv. 1887.) The *dose* of a concentrated tincture (1 to 4) is from five to ten minims (0.3–0.6 Cc.); as an emetic, from fifteen to thirty minims (0.9–1.8 Cc.).

Nargol.—*Nuclein Silver* contains about 10 per cent. of silver and is a light brownish white powder, easily soluble in water. The solutions are not precipitated by albumin, salt, or alkalies. It is used like protargol.

Nasrol. $C_8H_9N_4O_2.SO_3Na$. *Sodium Sulphocaffeate. Sodium Caffeine Sulphonate.—Symphoral-sodium* is an intensely bitter powder recommended as a diuretic in *dropsy*. *Dose*, 1 grain (0.065 Gm.) given in capsules.

Nasturtium. *Watercress. Cresson de fontaine*, Fr. *Brunnenkresse*, G. *Roripa Nasturtium* (L.), Rusby (*Sisymbrium Nasturtium*, L., *Nasturtium officinale*, R. Br.). (Fam. Cruciferæ.)—In sensible and medicinal properties watercress bears some resemblance to scurvy grass, though milder, and on this account is preferred for the table. It is thought to be useful in *scorbutic affections* and *visceral obstructions*. It contains a volatile oil, which, according to A. W. Hofman, contains as its chief constituent a body boiling at 253° C. (487.4° F.), which he considers to be the nitrile of *phenyl-propionic acid*, $C_9H_{10}O_2$, and therefore has the formula $C_9H_{10}N$. The expressed juice is sometimes given in the *dose* of one or two fluidounces (30–60 Cc.); but the herb is more frequently used in the form of a salad.

Other species of Roripa (Nasturtium), as *R. palustris* (L.), Bass. (*N. palustre*, DC.), or *marsh watercress*, and *R. amphibium* (L.), Lyons, or *water radish*, grow in similar situations with the *R. Nasturtium*, and act similarly.

Nerium. *Nerium Oleander*, L. *Laurier Rose, Laurose*, Fr. *Oleander, Rosenlorbeer*, G. (Fam. Apocynaceæ.)—The common ornamental shrub known as *oleander* is affirmed to have been used from time immemorial in portions of Southern Europe for destroying rats, and a number of cases of poisoning by it have been reported. For collection, see *T. G.*, July, 1888. The symptoms have been vomiting, abdominal pain with frequent cries, dilatation of the pupil, vertigo, convulsive movements, insensibility, small, very slow pulse, and in fatal cases epileptiform convulsions with coma ending in death. The action on the heart has in some cases in which death

has not ensued, been very pronounced, the pulse for five days remaining as low as forty per minute. The infusion made from four ounces of the root is affirmed to have taken life. M. E. Pelikan (*C. R. A. S.*, 1866, 239) found that in the frog the extract of oleander causes immediate increase in the number of the heart beats, followed after a little by slowing of the cardiac movements, and later by irregularity of contraction, ending in systolic arrest of the ventricles at a time when the auricles continue to beat and the frog is still able to jump about freely. Pelikan's experiments upon dogs have not, we believe, been published in detail, but they led him to the conclusion that the oleander acts in the mammal upon the heart in the same way as does digitalis. He also convinced himself that the active principle was a yellow, resinous principle, insoluble in water, easily soluble in amyl alcohol and chloroform, previously discovered by Latour. (*J. P. C.*, t. xxxii. 32.)

Two supposed alkaloids have been discovered in oleander by Leukowsky (*J. P. C.* (3), 46, 397), one named *pseudocurarine*, the other named *oleandrine*. Both neutralize acids; the former dissolves in water and alcohol, but not in ether, and is neither volatile nor poisonous; the latter is yellow, amorphous, very bitter, very slightly soluble in water but more freely in alcohol and ether, and poisonous in its action on the system. H. G. Greenish isolated two substances, *neriodorin* and *neriodorein*, which are probably not pure proximate principles. (*A. J. P.*, 1881, 350.) B. C. L. Bose (*P. J.*, 1901, 553) obtained a resinous substance, *karabin*, $C_{21}H_{42}O_6$, which he states is one of the active constituents of this plant. Haemel (*Ph. Ztg.*, 1901, 58) obtained a semi-concrete oil to the amount of 0.025 per cent. from the leaves of *N. Oleander*. Dubigadoux and Durieu affirm that they have obtained strophanthin from the oleander of Algeria.

Schmiedeberg (*A. E. P. P.*, 1883, Bd. xvi. 145) finds two active substances in the oleander leaf,—*neriin* and *oleandrin*. Schmiedeberg shows that the latter, which had been previously described by Leukowsky as an alkaloid, is a glucoside, and on boiling with very dilute acids breaks up into sugar and a yellow resinous substance like digitaliresin. With concentrated acids it also decomposes, yielding an inactive resin. Schmiedeberg also obtained from African leaves a glucoside, *nerianthin*, which he surmises to be an educt from oleandrin. He found oleandrin to be a powerful cardiac poison, but nerianthin not to have the power of arresting the frog's heart, although it exerts some influence upon it, possibly, as Schmiedeberg surmises, through contaminating oleandrin. Pieszczek obtained from oleander bark a principle which he named *rosaginin*, which was very poisonous, resembling strychnine in its action (*A. Pharm.*, ccxxviii. 352).

Pouloux (*B. G. T.*, May 15, 1888) finds that five centigrammes of the extract of oleander produced in the frog paralysis and death in about forty minutes; that the ventricle is thrown into a state of tetanus which is complete in about five minutes, the auricles continuing to contract for a considerable length of time. The mortal dose for the rabbit he determined to be about fifty centigrammes of the hydro-alcoholic extract. In a few cases of valvular *heart disease* Pouloux found oleander to do very well, and in seventy-five cases under the care of Freiherr (*Aerzt. Rund.*, 1892) it acted promptly as a heart stimulant and tonic in cardiac weakness. Its diuretic action is said to be very marked, and not rarely it acts as a cathartic. Any irritation of the alimentary canal contra-indicates its use. Under its influence the pulse rapidly becomes regular and slow, and dyspnœa and œdema disappear. Freiherr asserts that it is safer than digitalis in atheromatous diseases. S. Wateff has reported a case of poisoning by oleander in which the symptoms were vomiting, violent headache, cardiac oppression, cold, blue hands, at first rapid and afterwards very slow, weak pulse, with marked failure of temperature. Freiherr uses it in infusion or tincture, representing as the daily *dose* from three-quarters to one and a half grains (0.048–0.096 Gm.) of the dried oleander bark, one and a half to three grains (0.096–0.2 Gm.) of the fresh bark, one and a quarter to three and and a half grains (0.08–0.23 Gm.) of the dried fruit. Pouloux's *dose* of the extract was three-quarters of a grain (0.048 Gm.). Orfele has used the dried flowers—*dose*, three grains (0.2 Gm.) in substance, or from ten to twenty minims (0.5–1.0 Cc.) of a 10 per cent. tincture—with success. The fluidextract would probably be the best preparation.

Nervocidine.—This is a yellow, amorphous, hygroscopic powder, readily soluble in water, which is affirmed to be an alkaloid, obtained from the East Indian plant, *Gasu Basu*, and to be a powerful local anæsthetic, its 1 per cent. solution producing marked anæsthesia of the cornea. It is stated to be so irritant that its 2 per cent. solution will cause in dogs and rabbits an ulcerative keratitis along with an anæsthesia which lasts for days. It is affirmed, further, to be a paralyzing poison, causing such symptoms as to almost invalidate its usefulness and render it unsafe. (*L. L.*, 1902, 1.)

Neurodin. *Acetyl-p-oxy-phenyl-urethane.* $C_6H_4(OCOCH_3)NH.COOC_2H_5$.—Forms colorless, odorless crystals, fusing at 87° C., soluble in 1400 parts of cold water. It is used as an anodyne in *neuralgia* in *doses* of from fifteen to twenty grains (1–1.3 Gm.).

Neurolæna. *Neurolæna lobata*, R. Br.—From the leaves of this plant, used in the Windward Islands as a substitute for quinine, and in *dysentery*, B. H. Paul and A. J. Cownley obtained an uncrystallizable alkaloid. (*P. J.*, ix.)

Nickel. *Niccolum.*—T. P. A. Stewart (*A. E. P. P.*, Bd. xviii. 154) finds that in frogs soluble preparations of nickel produce palsy with convulsive movements which are due to an action upon the nerve centres, the muscles remaining intact, the heart also being affected, as it is believed, by an action upon its motor ganglia. In mammals the chief symptoms produced by nickel are paralysis, with motor disturbance bearing some resemblance to chorea, with convulsions and great irritation of the gastro-intestinal tract, and a marked fall of the blood pressure, due to paralysis of the vasomotor centre. Large doses of nickel seem, however, to be necessary for a toxic influence, and the use of nickel in culinary instruments appears to be entirely safe. Riché (*B. A. M.*, 1888), as the result of experiments made upon dogs and guinea pigs, reaches the conclusion that nickel is not more poisonous than iron. Thus, a dog absorbed over five drachms of it in sixty days, and increased in weight. The results obtained by Riché have been confirmed in Germany by Von Hamel Roos and by Schulz. (*P. J.*, Dec. 1887.)

Nickel Bromide is a greenish-yellow powder, of a sharp, almost burning taste, freely soluble in water, and making a grass-green solution. It is made by the action of bromine vapor upon the finely divided metal, either by heating the nickel in the vapor, or by the action of the two in the presence of water. It forms deliquescent needles of $NiBr_2 + 3H_2O$. It was first brought forward by J. M. Da Costa as a remedy for *epilepsy* and kindred disorders, and its value has been confirmed by R. Leaman. (*Med. Gaz.*, April 18, 1885.) He affirms that ten grains of the nickel salt are equal to thirty grains of potassium bromide; that it is best used in effervescing form, made by mixing the salt with sodium bicarbonate and tartaric acid and moistening with alcohol and passing the moist powder through a sieve and drying in a warm closet. It has been physiologically investigated by H. A. Hare, who finds (*T. G.*, vol. ii. 297) that it is a powerful paralyzant to the spinal cord, the motor and sensory nerve trunks, and also to the voluntary muscle. In sufficient dose it causes immediate diastolic cardiac arrest. In smaller doses it lessens the arterial pressure by depressing the heart and the vasomotor centres.

Nickel Carbonate. *Niccoli Carbonas. Carbonate Niccolique*, Fr. *Nickelkarbonat*, G.—Made by precipitating the solution of a nickel salt with potassium carbonate. It is from pale green to dark green, of variable composition and is little used, though at one time it was often employed in *anæmia* in *doses* of two grains (0.13 Gm.).

Nickel Carbonyl. *Carbonic Oxide-Nickel. Nickel-Kohlenoxyd*, G. $Ni(CO)_4$.—This substance was first investigated by Mond, Lang, and Quincke, who reported to the Société de Biologie, 1890, that it is difficult to handle because its vapors produce excruciating headache, and that it is a violent poison, evidently destroying the hæmoglobin of the blood. A. Mittasch (*A. E. P. P.*, xlix. 367; *L. L.*, 1903, i.) found that the vapors produced febrile reaction with violent disturbances of respiration, followed by great and very persistent malaise and weakness. Langlois (*C. R. S. B.*, 1891), also McKendrick and Snodgrass (*B. M. J.*, June, 1891), have shown that it acts by being broken up in the body and yielding carbon dioxide to the hæmoglobin. It produces prolonged fall of temperature, but it is not probable that it will prove of any practical value in medicine. For physical properties and methods of preparation, see authors already quoted.

Nickel Chloride. *Niccoli Chloridum. Clorure de Nickel*, Fr. *Nickelchlorür*, G.—A green, very deliquescent salt, containing $6H_2O$, 45.4 per cent. of its weight. The anhydrous chloride is yellow and sublimes in yellow scales, without melting.

Nickel Sulphate.—*Niccoli Sulphas*, $NiSO_4.7H_2O$, is formed by dissolving *nickel carbonate* in diluted sulphuric acid, concentrating the solution, and setting it aside to crystallize. The carbonate is procured by dissolving the impure *nickel arsenide*, sold under the name of *speiss*, coarsely powdered and mixed with half its weight of iron filings, in nitrohydrochloric acid. The solution is evaporated to dryness, and the residue treated with water, which takes up the impure nickel chloride, and leaves the arsenic in the form of the insoluble ferric arsenate. The liquid is then acidulated with hydrochloric acid, treated with hydrogen sulphide in excess, which precipitates the copper, and, after filtration, boiled with a little nitric acid to oxidize any remaining iron. The cold liquid, largely diluted with water, is next treated with a solution of sodium bicarbonate, gradually added, which throws down the iron in the state of ferric oxide. Lastly, the filtered solution, containing the nickel chloride nearly pure, is boiled with sodium carbonate, which, by double decomposition, throws down a pale green precipitate of nickel carbonate. Nickel sulphate is in the form of emerald-green crystals, efflorescent in the air, soluble in three parts of cold water, but insoluble in alcohol and ether. It has a sweet, astringent taste. Simpson of Edinburgh, found this salt to act as a gentle tonic; useful in *migraine* in *doses* of from half a grain to a grain (0.032–0.065 Gm.) three times a day. In large doses it is liable to produce nausea and vomiting, especially when the stomach is empty. (See *Braithwaite's Retrospect*, xxvii. 446.)

Nicotine Salicylate. *Nicotinæ Salicylas.* $C_6H_4(OH)COOH.C_{10}H_{14}N_2$. This substance occurs in colorless crystals, soluble in water and alcohol, fusing at 118° C. (244.4° F.). Under the name of *eudermol* a substance composed chiefly of lanolin, containing 0.1 per cent. nicotine salicylate, has been put upon the market and highly commended for the treatment of *scabies* and other parasitic diseases of the skin, also of *itching eczema*. Ointments containing a larger per cent. are said to be dangerous. (*Th. M.*, 1898.) The application of the ointment should be followed after some hours by a soap bath. L. C. Fettich has used the 1 per cent. lanolin ointment of nicotine salicylate in cases of *mange* of dogs. When the mange is of the acaridic variety the treatment should be assisted by baths containing 2 to 4 per cent. of potassium sulphide.

Nigella. *Nigella sativa*, L. *Nutmeg-flower. Small Fennel-flower. Faux Cumin*, Fr. *Schwarzkümmel*, G. (Fam. Ranunculaceæ).—A small annual plant, growing wild in Syria and the south of Europe, and cultivated in various parts of the world. The seeds, *semen nigellæ*, are ovate, somewhat compressed, about a line long and half as broad, usually three-cornered, with two sides flat and one convex, black or brown externally, white and oleaginous within, of a strong, agreeable, aromatic odor, like that of nutmegs, and a spicy, pungent taste. (*P. J.*, 1882, 681.) Their chief constituents are a volatile and a fixed oil (1.5 per cent. of the former and 35 per cent. of the latter), and an amorphous glucoside, *melanthin*, which is decomposed by diluted hydrochloric acid into *melanthigenin* and sugar. The *nigellin* of Reinsch does not seem to have been a pure substance. Rochebrune has found a powerful paralyzing alkaloid, to which he gives the name of *nigelline*. (*Toxicol. Africaine*, vol. i.) Melanthin, according to W. von Schulz, exhibits the typical physiological action of the most poisonous saponins. In India the seeds are considered as stimulant, diaphoretic, and emmenagogue, and are believed to increase the secretion of milk. They are also used as a condiment, and as a corrigent or adjuvant of purgative and tonic medicines.

Nirvanin. *Hydrochloride of diethylglycocoll-p-amid-o-oxybenzoic-methylester*, of the formula:

$$\begin{cases} CH_2.N=(C_2H_5)_2.HCl \\ CO.NH.C_6H_4(OH)COOCH_3 \end{cases}$$

Nirvanin occurs in white prisms with a melting point of 185° C. (365° F.), affording a violent reaction with ferric chloride, and soluble in water.

Nirvanin has been brought forward as a local anæsthetic, with a claim that it is only about one-tenth as actively toxic as cocaine, and is

as effective as a local anæsthetic. It is also alleged to be actively antiseptic, the 1 per cent. solution effectively preventing the growth of bacteria. The 5 per cent. solution placed in the eye produces a temporary irritation followed by lasting anæsthesia. It has been used to a considerable extent as a substitute for cocaine in infiltration anæsthesia, the strength of the solution used varying from one-tenth to one-third of 1 per cent. Nirvanin has also been used to a considerable extent in dentistry; eight grains (0.5 Gm.) are stated to have been given to an adult, hypodermically, without the production of toxic symptoms. (Elsberg, *Ther. Prog.*, April, 1900.)

Nitrated Alcohols.—The following substances of the possible series of nitrated alcohols have been studied by J. B. Bradbury (*B. M. J.*, ii. 1895);

Methyl Nitrate, $CH_3.ONO_2$ (CH_3NO_3).

Glycol (Ethylene) Dinitrate $C_2H_4(NO_3)_2$

$$\begin{matrix} CH_2.ONO_2 \\ | \\ CH_2.ONO_2 \end{matrix}$$

Glycerol Trinitrate (Nitroglycerin) $C_3H_5(NO_3)_3$

$$\begin{matrix} CH_2.ONO_2 \\ | \\ CH.ONO_2 \\ | \\ CH_2.ONO_2 \end{matrix}$$

Erythrol Tetranitrate $C_4H_6(NO_3)_4$

$$\begin{matrix} CH_2.ONO_2 \\ | \\ (CH.ONO_2)_2 \\ | \\ CH_2.ONO_2 \end{matrix}$$

Arabinol Pentanitrate $C_5H_7(NO_3)_5$

$$\begin{matrix} CH_2.ONO_2 \\ | \\ (CH.ONO_2)_3 \\ | \\ CH_2.ONO_2 \end{matrix}$$

Mannitol Hexanitrate $C_6H_8(NO_3)_6$

$$\begin{matrix} CH_2.ONO_2 \\ | \\ (CH.ONO_2)_4 \\ | \\ CH_2ONO_2 \end{matrix}$$

Of the group the first three are liquid. The others are crystalline colorless solids, stable in the dark at a moderately low temperature, turning yellow and exploding when heated rapidly or percussed. Of slight solubility in water, soluble in alcohol and ether, responding when heated to the meta-phenylene diamine test.

Bradbury has shown that all these substances have similar physiological action, differing among themselves and from amyl nitrite simply in the rapidity and fugaciousness of influence. Glycol dinitrate in $\frac{1}{100}$ of a grain (0.0006 Gm.) *doses* markedly influences arterial tension in the human being, but its effect is not maintained longer than sixteen minutes. Erythrol and mannitol nitrates were found to be slow in action but of remarkable permanence and influence, their effect on the lower animals lasting more than four or five hours. Methyl nitrate was feeble and fugacious in its influence.

Both erythrol and mannitol nitrates have been used by Bradbury in *angina*, *aneurism*, *Raynaud's disease*, *asthma*, *headache*, and various other affections for which nitroglycerin has been employed. Erythrol nitrate, as more soluble, appears to be preferable to mannitol nitrate; it has been used and highly commended by Arthur Burton and others. It may be given in powder or in solution. It is less easily exploded than nitroglycerin, but great care must be practised in any attempt at powdering, as a very serious explosion has occurred from rubbing it in a mortar with sugar of milk. One part of it may be dissolved in sixty parts of alcohol and a fluidrachm of this taken in an ounce of water every four to six hours. The *dose* of the 1 per cent. alcoholic solution of mannitol nitrate is one and a half fluidrachms (5.5 Cc.). These solutions are said to be stable.

Nitrobenzene. *Nitrobenzole. Oil of Mirbane.* $C_6H_5NO_2$.—Nitrobenzene is formed by the action of strong fuming nitric acid upon benzene,

$$C_6H_6 + HNO_3 = C_6H_5NO_2 + H_2O$$

The product, after having been washed with water, is an oily, yellowish, intensely sweet liquid, with an odor like that of oil of bitter almond. Its density is 1.186, and boiling point 213° C. (415° F.). It has become of commercial importance, being produced as an intermediate product in the manufacture of aniline oil, and, under the name of *artificial oil of bitter almonds*, or *oil of mirbane*, being employed for scenting soaps and pomades. Its use in articles of food and for flavoring, as a substitute for bitter almond oil, is properly forbidden under pure food regulation. For method of detecting nitrobenzene in oil of bitter almond, see *Oleum Amygdalæ Amaræ*, p. 829.

In manufactories where nitrobenzene is made, headaches, with sleepiness, are not infrequently produced by inhalation of the fumes; much more serious poisoning is liable to occur, and there have been a number of deaths produced by nitrobenzene. The symptoms may come on almost immediately, or they may be delayed for some hours. According to Filehne (*A. E. P. P.*, Bd. ix.), the slowness of action is chiefly dependent on the fact that nitrobenzene, when mixed with the contents of the stomach and intestines, is absorbed with very great slowness; for if the drug be injected directly into the blood of the rabbit, it produces death in convulsions in less than a minute. The first symptoms of poisoning are headache, with muscular weakness, and a peculiar bluish color of the face, and disturbance of consciousness. In the fully developed poisoning the whole surface of the body is a deep bluish color, and the mucous membranes a bluish gray; the pupils are dilated; the muscular relaxation is complete, except that sometimes the jaw is rigidly set; the consciousness is lost; the respiration is rapid, but shallow and irregular; the pulse rapid and thready, or entirely absent. The urine contains urobilin, indican, and acetone. Recovery may occur, as in a case reported by Stevenson (*Guy's H. R.*, vol. xxi. 1876), after many hours of unconsciousness, the bluishness of the skin and the headache remaining for several hours longer. After death, the blood is of a deep chocolate brown, and, according to Filehne, has lost the power of absorbing oxygen. Lewin has seen the blood so changed that, after five weeks' standing, the oxyhæmoglobin lines could still be made out, and its spectrum is altered. (See *A. Phys.*, 1879.)

In poisoning of the lower animals convulsions are frequent phenomena, and, according to Letheby (*P. J.*, Sept. 1863), after small doses, the animal sometimes for days will have more or less unconsciousness, with epileptic attacks, and at length die of exhaustion, or gradually recover. In the guinea pig, but not in the dog, Ewald has found nitrobenzene to produce glycosuria. (*P. M. T.*, vol. iv. 312.)

The cause of death appears to be paralysis of the motor nervous centres. Letheby states that nitrobenzene is partly converted in the body into aniline, but this is denied by Filehne, who asserts that the aniline was produced by the processes used by Letheby. According to Caspar,

death from prussic acid and nitrobenzene may be distinguished by the fact that when the body is left open for some hours, the odor of prussic acid leaves, while that of nitrobenzene persists. The minimum fatal dose is not known; according to Taylor, fifteen drops (0.75 Cc.) taken by the mouth, have proved fatal, and in Stevenson's case, twenty-three minims (1.42 Cc.), taken in seven doses, in forty-eight hours produced unconsciousness and respiratory arrest, so that death would probably have occurred if treatment had not been instant.

The proper treatment would appear to be emetics, the early use of artificial respiration, maintenance of the bodily temperature, and the stimulation of the respiration and circulation by hypodermic injections of atropine, strychnine, and digitalis. In a case reported by Werner (*B. K. W.*, 1884, xxi.), life was apparently saved by bleeding sixteen fluidounces (480 Cc.) and transfusing twelve fluidounces (360 Cc.) of defibrinated blood.

Dinitrobenzene. Dinitrobenzol. $C_6H_4(NO_2)_2$. On boiling benzene with fuming nitric acid, there is formed chiefly metadinitrobenzene, fusing at 90° C. (194° F.), with small amounts of the ortho and para compounds. By crystallizing out of alcohol, the meta compound can be obtained pure. Dinitrobenzene has attracted considerable attention on account of the number of cases of poisoning by it occurring among the workmen in aniline works. The symptoms are said to be jaundice, enlargement with tenderness of the liver, diarrhœa with colorless stools, and dark brown urine in which dinitrobenzene can be located by the phenylene-diamine test. The toxicology has been especially studied by Strassmann and Strecker (*Friedreich's Blätt. f. Gerich. Med. u. Sanitätspolizei*, Heft iv. 1896), who add to the symptoms already given, headache, a peculiar bluish discoloration of the face and general surface, a tendency to fainting, with excessive sweating, vomiting, fall of temperature, great muscular weakness, and finally collapse. It is noted also that in animals experimentally poisoned there has been destruction of the red blood corpuscles with consequent hæmoglobinuria and wide-spread fatty degeneration. According to White and Hay (*L. L.*, ii. 1901) pure dinitrobenzene is much less poisonous to the workers than is the commercial dark colored substance which contains mononitrobenzene. Mononitrobenzene is, however, according to the same authority, scarcely poisonous, the reason that the commercial mixture is more poisonous than the pure dinitrobenzene being that the mononitrobenzene is a powerful solvent of dinitrobenzene, making an oily mass which adheres to the skin and yields to absorption the dinitrobenzene. The fact that the dinitrobenzene is absorbed through the skin of the workmen is so generally recognized that in most commercial laboratories the workmen are required to wear specially close fitting clothing over the body and head, and to practise absolute cleanliness.

Nitrogen Monoxide, so-called *Nitrous Oxide. Laughing Gas. Oxyde nitreux, Protoxide d'Azote,* Fr. *Stickstoffoxydul, Lachgas,* G. N_2O.—These names have been given to a gaseous substance, discovered by Priestley in 1776, but first brought into general notice in 1800 by Humphry Davy, who discovered and made known the remarkable exhilarating properties which earned for it the name of laughing gas.

Preparation.—In its preparation, pure fused ammonium nitrate is submitted in a glass retort to a heat sufficient to decompose it, not exceeding 204.4° C. (400° F.), and the resulting gas and vapor are collected in a glass receiver over warm water or a saturated aqueous solution of common salt. Warm water is preferred because cold water absorbs much of the gas, and would consequently occasion loss, and even warm water, though it takes up much less, is not entirely unobjectionable on this score; the saline solution is therefore probably, on the whole, best adapted to the purpose. When ammonium nitrate is heated to the point of decomposition, it is wholly resolved into aqueous vapor and nitrogen monoxide, according to the reaction:

$$NH_4.NO_3 = 2H_2O + N_2O$$

But it is necessary not to let the heat employed in the process be too high, as otherwise, besides nitrous oxide, there will come over portions of nitric oxide, uncombined ammonia, and probably even nitric acid, which contaminate the product, and render it unfit for use. This may be avoided by arresting the process as soon as any white fumes appear in the retort. Peculiar care also must be taken that the ammonium nitrate should be pure, and especially free from ammonium chloride, which might cause an admixture of chlorine in the product. To insure against impurities of this kind, it is best in any case in the least doubtful, and perhaps it might be best in all cases, to cause the nitrous oxide, before it is used by inhalation, to pass successively through two solutions: one, of ferrous sulphate, to remove any nitric oxide that might be present; the second, of potassium or sodium hydroxide, to neutralize acid impurities and chlorine. At times nitrogen gas is also found in the nitrogen monoxide, probably resulting from a trace of nitrite present or some reducing action upon the nitrate in the moment of its decomposition. When the monoxide is liquefied under pressure this free nitrogen remains as unliquefied gas.

Nitrogen monoxide gas is colorless, nearly or quite inodorous, slightly sweetish to the taste, and of the sp. gr. 1.527. Cold water will absorb about three-fourths of its bulk of the gas, and, under pressure, much more, and, thus impregnated, has a slight, not unpleasant odor, and a sweetish taste. By the joint influence of cold and pressure the gas may be condensed into a liquid, which is colorless, very mobile, and capable, under the ordinary atmospheric pressure, of remaining liquid at —12.7° C. (9° F.). The liquefaction was effected by Bianchi at 0° C. (32° F.), under a pressure of thirty atmospheres. (*A. J. P.*, 1865, 275.) Inflammable bodies will generally burn with increased vigor in nitrous oxide, which is entirely incapable of giving oxygen to the blood.

The anæsthetic property of nitrogen monoxide was discovered by Humphry Davy; but the first practical application of it to this purpose was made by Horace Wells of Connecticut.

For short minor surgical operations the gas is an excellent anæsthetic, but in severe operations it is not to be relied on, any interruption of the inhalation being followed by immediate return to consciousness. The apparatus required for its production, storage, exhibition, and administration is also so cumbrous that practically nitrous oxide is only employed by the dentist. It is certainly a very safe agent when used with due care, although it has caused death. The common

mode of exhibition is by means of an air-tight bladder or bag, with a tube and mouth piece attached.

Nitrous Oxide Water.—Water impregnated under pressure with nitrogen monoxide forms the *nitrous oxide water*, or so-called *oxygenous aërated water*, which has been used to some extent as an internal remedy, but is probably physiologically inactive and has passed into desuetude.

Nitro-Propiol. *Ortho - nitro - phenyl - propiolic acid*, when heated with grape sugar in the presence of soda, forms indigo, according to the following equation:

$$2C_6H_4(NO_2).C{\equiv}C{-}COOH + 4H = C_{16}H_{10}N_2O_2 + 2CO_2 + 2H_2O$$

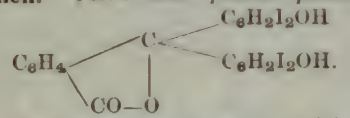
The formation of indigo is rendered evident by a blue coloration of the fluid. The compound therefore serves as a qualitative test for the glucose in urine. Von Gerhardt recommends the following method for carrying out the test: Place 10 to 15 drops of the urine under examination in a test tube, add one hundred and sixty minims (10 Cc.) distilled water and a nitro-propiol tablet, and carefully heat the mixture for two to four minutes. In the presence of sugar the fluid first becomes green and subsequently intensely blue. This reaction is sufficiently sensitive to indicate with certainty 0.3 per cent. of sugar and possesses the advantage that it only takes place if grape sugar is actually present in the urine.

Njimo Wood.—*Njimo* was introduced into Germany from the Cameroons with the statement that it had digestive properties similar to those of pepsin. It is a stem wood, often with pieces of root, of a yellow color, musk-like odor, and bitter taste. Schulz (*Ph. Ztg.*, June 12, 1886) finds that it is not a digestive, and that it yields a resinous extract not poisonous to frogs. The alcoholic extract of the drug is yellow by transmitted light, but exhibits a green fluorescence resembling uranium glass.

Noctilucine.—For an account of this substance, to which is ascribed the phosphorescence of animals, see *J. P. C.*, 4e sér., xvii.

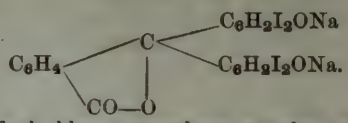
Normalin is said to contain hæmoglobin and arsenic serum-albuminate, and to be an alterative tonic used in skin diseases and various other disorders in which such an alterative is indicated.

Nosophen. *Tetra - iodo - phenol - phthalein.*



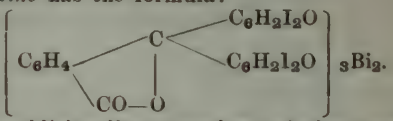
Nosophen is obtained by the action of iodine on solutions of phenolphthalein. It is an impalpable, yellowish-gray, odorless, tasteless powder, containing 61.7 per cent. of iodine in combination. It may be heated up to 220° C. (428° F.) without decomposition. It is insoluble in water and acids, soluble with difficulty in alcohol, glacial acetic acid, ether, and chloroform, but readily soluble in alkalies, with the last of which it forms salts from which it is easily freed at low temperature by carbon dioxide. In the presence of heat it liberates carbon dioxide from its alkaline salts. By virtue of its two hydroxyl groups, nosophen is an acid, readily soluble in alkalies with replacement of the hydrogen atoms of both hydroxyl groups by a metal. Two of the salts of nosophen have been put upon the market,—the sodium salt (antinosine) and the bismuth salt (eudoxine).

Antinosine has the following structural formula:



It is a dark blue, amorphous powder which is readily soluble in water and alcohol.

Eudoxine has the formula:



It is a reddish-yellow, tasteless, odorless powder, insoluble in water, which is decomposed by alkalies into bismuth oxide and a soluble salt of tetra-iodo-phenol-phthalein. It contains 52.9 per cent. of iodine and 14.5 per cent. of bismuth.

Medicinal Properties and Uses.—It is stated that in nosophen and its two salts the iodine is so firmly combined that it is not liberated in the human system, either when applied locally or administered internally, and that the preparations are therefore incapable of producing toxic effects. It is further affirmed that nosophen is in itself germicidal and locally an alterative, and that, being free from toxic properties, it is superior to iodoform. It is not irritant, and may be used freely as a local application in powdered form in all those cases to which iodoform is applicable, and has been especially recommended in nasal and laryngeal diseases. It has been administered internally as an intestinal antiseptic in *doses* of from five to eight grains (0.32–0.5 Gm.).

It is affirmed that antinosine has the same general properties as a germicide as nosophen, and that being soluble in water it affords a valuable application in many cases to which the nosophen as a dusting powder is scarcely applicable. The strength of the local application varies: from 2 to 3 per cent. in diseases of the nose, mouth, and throat, from 1 to 2 per cent. in *gonorrhœa*, from ½ to 1 per cent. for irrigation of the bladder and in *cystitis*, from 1 to 500 to 1 to 1000 for washing out of the stomach in *gastric catarrh*, *cancer*, etc.

Its 2 per cent. solution is said by W. F. Coleman to act most favorably in all forms of external inflammation about the eye, in purulent *otitis media*, etc. Owing to its solubility in water and its freedom from odor and taste, it is coming into vogue as a mouth wash; for this purpose its glycerin solution is preferable, aromatics being added to taste. A teaspoonful (3.75 Cc.) of the 1 per cent. solution in a tumblerful of water is the strength commonly employed, but when there is a severe *stomatitis* a 2 per cent. or even stronger solution may be used without dilution.

Its intravenous use has been suggested, but, according to Binz and Zantz (*Fort. Med.*, xiii. 1895), it is decomposed in the blood when so given and nosophen precipitated.

Eudoxine is believed to be slowly decomposed by the alkaline juices of the intestines, with liberation of antinosine and bismuth. It has been given in *doses* of from a half to eight grains (0.032–0.5 Gm.) three times a day, with alleged most excellent results, in *diarrhœas*, *gastric* and *intestinal indigestions*, and even *gastric cancer*.

Nuclein is a compound proteid closely resembling mucin, but distinguished by its phosphorus content (1.89–2.88 per cent.), while it contains no sulphur. It is probable that numerous varie-

ties of nuclein exist, all being compounds of simple proteids with *nucleic acid*. Nuclein may be isolated by treating the cells with artificial gastric juice, by which the investing protoplasm is dissolved, leaving the nuclein unaffected. Nucleic acid is an amorphous white powder of strong acid reaction, readily soluble in water containing a small amount of alkali, insoluble in alcohol and ether.

The nuclein solution is a 5 per cent. solution of nucleic acid from yeast in water. It is at present probable that nucleic acid, when given internally, enters the circulation and circulates unchanged. It has been asserted that it has an extraordinary power in improving the general nutrition and increasing the resistive power of the system to pathogenetic germs, and is therefore a very valuable remedy in *tuberculosis*, in *anæmia*, in *general debility*, in *neurasthenia*, and even in acute germ diseases, such as *diphtheria*. It appears to be nontoxic, since Vaughan and McClintock have injected it into the blood of animals in such amount that the entire blood contained 1.8 per cent of pure nucleic acid, and it is probable that the good results which have occasionally followed its use in practical medicine have been accidental, or due to a psychical influence rather than any remedial power of the remedy. The assertion frequently made that nucleic acid is the substance to which the human body owes its resistive power to morbific organisms is unproved and highly improbable. Its hypodermic injection produces so much pain that patients will rarely tolerate it. According to its manufacturers, the 5 per cent. solution may be given in *doses* of one fluidrachm (3.75 Cc.) three times a day.

Various metallic compounds of nucleinic acid have been put upon the market, as follows:

Cuprol. Copper Nucleinate.—Cuprol occurs as a greenish powder, soluble in water, containing about 6 per cent. of metal. It is used as an astringent alterative application in all those cases in which the older copper salts have been employed. In *conjunctivitis* a 5 to 10 per cent. solution has been recommended, and it is claimed for it that it produces little gastric inflammation.

Ferrinol. Ferric Nucleinate.—Ferrinol is a brown powder, freely soluble in water, containing about 6 per cent. of iron and 4.5 per cent. of phosphorus combined in the nuclein. It is stated that it produces little gastro-intestinal irritation.

Mercurol. Mercuric Nucleinate.—This is a colorless or brownish-white powder containing 10 per cent. of mercury, soluble in water with a weak alkaline reaction, and has been used both internally and locally as a substitute for corrosive sublimate, over which it has the advantage of not coagulating albumin. In *syphilis* from half to one grain (0.032–0.065 Gm.) of it may be given hypodermically. Two grains (0.13 Gm.) are said to have produced salivation.

Nargol. Argentic Nucleinate.—This substance forms a light brownish-white powder, readily soluble in water, contains 10 per cent. of silver, and has been recommended as a local application in all forms of diseases for which silver nitrate has been used. It is stated that it is much less irritating even than protargol, and that on account of its not coagulating albumin it has great penetrating power. It may be used in solution up to 25 per cent. on most mucous membranes. The solution should be recently made, as it undergoes change after a few weeks.

Nutrin.—This is a fatty saccharated albuminated compound derived from olive oil, of which it is said to contain 51 per cent. The preparation formerly called nutrin, a meat-albumin product, has been withdrawn from commerce. Nutrin is reported to be a palatable, digestible cholagogue and a substitute for cod liver oil.

Nymphæa.—The seed of *Nymphæa lutea*, L. (*Nuphar luteum*, Sibth. and Sm.), *Yellow Pond Lily* (Fam. Nymphæaceæ), according to W. Grüning, contains *nuphar-tannic acid*, $C_{56}H_{56}O_{37}$, in considerable quantity. (*A. J. P.*, 1883, 96.) The name Nymphæa has been incorrectly applied also to the white pond lilies, which belong to the genus Castalia, *Castalia odorata* (Dryand.), Woodv. and Wood. (*Nymphæa odorata*, Dryand.), *Sweet-scented Water Lily*. The root of this well-known American plant is very astringent and bitter, and, according to Bigelow, contains much tannin and gallic acid. The root of *Castalia alba* (L.), Lyons (*Nymphæa alba*, L.), or European *white water lily*, was esteemed anaphrodisiac by the ancients. The tannic acid contained in this root has been named *nymphæ-tannic acid*, and the formula $C_{56}H_{58}O_{33}$ given it. (*A. J. P.*, 1883, 96.)

Nyssa. *Nyssa aquatica*, L. (*N. uniflora*, Wang.) *Tupelo Gum. Sour Gum. Swamp Tupelo.* (Fam. Cornaceæ.)—*Tupelo root* has been recommended for surgical tents. (*A. J. P.*, 1883.)

Oatmeal. *Avenæ Farina. Farine d'Avoine*, Fr. *Hafermehl*, G. *Farina dell' Avena*, It. *Harina de Avena*, Sp.—*Avena sativa*, L., or the common oat, is so well known that a minute description would be superfluous. It is specifically distinguished by its "loose panicle, its two-seeded plumes, and its smooth seeds, one of which is awned." It was known to the ancients, and is now cultivated in all civilized countries; but its original locality has not been satisfactorily ascertained. It grows wild in Sicily, and is said to have been seen by Anson in the island of Juan Fernandez, off the coast of Chili. The seeds deprived of their husks are sometimes known as *groats*. As a human food coarsely ground oatmeal is usually preferred to the fine meal, and the grain grown in a northern climate is superior to that produced farther south. Hence Canada and Irish and Scotch oatmeals are better than the meals produced in the middle of the United States, the product of which country is chiefly consumed by horses. Diuretic properties have been attributed to the oatmeal, but probably incorrectly. *Tinctura Avenæ Sativæ* may be made by percolating 4 troyounces of the ground oatmeal with 1 pint of diluted alcohol, reserving the first 5½ fluidounces, and evaporating the remainder down to half a fluidounce and adding to the reserved portion. (H. E. Heinitsh, *A. J. P.*, 1886, 86.)

Oatmeal contains, according to Vogel, in 100 parts, 59 of starch, 4.30 of a grayish substance, resembling coagulated albumin rather than gluten, 8.25 of sugar and a bitter principle, 2.50 of gum, 2 of fixed oil, and 23.95 of fibrous matter, including loss. A very elaborate report on the composition of American cereals by Clifford Richardson (*Department of Agriculture, Bulletin* No. 9, 1886) gives as the average ratio in oats from all parts of the country 70 per cent. of kernel to 30 per cent. of husk. According to the same authority, the composition of the kernel (average of 179 analyses) is as follows: water, 6.93 per cent.; ash, 2.15; oil, 8.14; carbohydrates, 67.09; fibre, 1.38; albuminoids, 14.31; corresponding to

nitrogen per cent. 2.28. The nitrogenous principle has been called *avenin*, and resembles legumin somewhat. Ritthausen (*Die Eiweisskörper*, Bonn, 1872, 135) considers Nortin's avenin to have been a mixture of legumin or vegetable casein and a vegetable gluten containing sulphur, to which he gives the name *gliadin*, the legumin, however, predominating.

Gruel made with fine oatmeal affords a nutritious, bland aliment, which, from its somewhat laxative tendency, is often preferable to other amylaceous preparations. *Oatmeal gruel* may be prepared by boiling an ounce of the meal with three pints of water, to a quart, straining the decoction, allowing it to stand until it cools, and then pouring off the clear liquor from the sediment. Sugar, lemon juice, or wine may be added to improve its flavor.

Ochres.—These are native mixtures of argillaceous or calcareous earth and iron and manganese oxides, employed in painting. They are prepared for use by agitating them with water, decanting the turbid liquor after the coarser particles have subsided, then allowing it to rest in order that the finer parts may be deposited, and, lastly, drying the sediment which forms. The color of the ochres varies with the state of oxidation of the iron, and with the proportion which the iron bears to the other ingredients, and is sometimes artificially modified by the agency of heat. Several varieties are known in commerce under different names, according to their color or place of origin. Such are the *brown ochre*, the *yellow ochre*, the *red ochre*, the *Roman ochre*, of a brownish-yellow changing by heat to a purple-red, the *Oxford ochre*, of a brownish-yellow color less deep than the Roman, and the *French ochre*, which is yellow. The *Indian red*, from the Persian Gulf, and the *Spanish brown* and *Venetian red* may also be ranked in this class of pigments. Sometimes ochres come in powder, and sometimes in hard masses known as *stone ochres*.

Ocimum. *Ocimum Basilicum*, L. *Basil. Sweet Basil. Grand Basilic*, Fr. *Basilienkraut*, G. (Fam. Labiatæ.)—An annual aromatic plant, a native of India and Persia, and cultivated in Europe and in this country in gardens. It yields by distillation a yellowish-green volatile oil, lighter than water, which on being kept solidifies into a crystalline camphor, isomeric with turpentine camphor. (*Gmelin's Handbook*, xiv. 359.) Basil has the ordinary properties of the aromatic plants, and is used as a condiment. The seeds are said by Ainslie to be used in India in *gonorrhœa*.

Odontodol.—This is said to be a mixture of one part each of cocaine hydrochloride and oil of cherry laurel, 10 parts of tincture of arnica, and 20 parts of solution of ammonium acetate.

Œnanthe. *Œ. crocata*, L. *Water Hemlock. Water Dropwort. Dead Tongue.*—A perennial umbelliferous, aquatic European plant, exceedingly poisonous both to man and inferior animals. The root, which has a sweetish not unpleasant taste, is sometimes eaten by mistake for other roots, often with fatal results. The symptoms produced are those of irritation of the stomach, besides failure of circulation, and great cerebral disturbance, indicated by giddiness, convulsions, and coma. (See *P. J.*, 1874, 202.) Externally applied, the root produces redness and irritation of the skin, with an eruption. It is said to be sometimes used empirically as a local remedy in *piles*. Other species of *Œnanthe* are poisonous, and the whole genus should be suspected. We have two or three indigenous species. In cases of poisoning, the stomach should be at once evacuated, and symptoms met as they arise. A peculiar resinoid principle, denominated *œnanthin*, has been found by Gerding in *Œnanthe fistulosa*, L., the common water hemlock of Europe, of which half a grain (0.032 Gm.), given to an adult, produced long-continued irritation of the fauces, and a grain (0.065 Gm.), occasional vomiting. (See *A. J. P.*, xxi. 68.) A resinous principle, *œnanthotoxin*, $C_{17}H_{22}O_5$, has been extracted from *Œ. crocata*, which is reputed to be very poisonous. In the *P. J.*, vol. xvi. 357, is a paper by Henry William Jones upon the recognition of *Œ. crocata* in cases of suspected cattle poisoning; he found that the starch granules possessed characters which enabled him to distinguish the tubers from all others.

Œnanthe Phellandrium, Lam. *Phellandrium aquaticum*, L. *Fine-leaved Water Hemlock. Fructus Phellandrii. Wasserfenchel*, G. *Phellandrie aquatique, Fenouil d'Eau*, Fr.—A biennial or perennial, umbelliferous, European water plant, the fresh leaves of which are said to be injurious to cattle, producing a kind of paralysis when eaten. By drying, they lose their deleterious properties. The *seeds* are from a line to a line and a half in length, ovate-oblong, narrow above, somewhat compressed, marked with ten delicate ribs, and crowned with the remains of the calyx, and with the erect or reverted styles. Their color is yellowish brown; their odor peculiar, strong, and disagreeable; their taste acrid and aromatic. Among their constituents is a volatile oil, upon which their aromatic flavor depends. By C. Fronefield it has been rendered probable that they contain a volatile alkaloid, analogous to coniine, if it be not *coniine* itself, for if the powdered seeds are rubbed with solution of potassa, the peculiar mouse-like odor of that alkaloid is exhaled. The powder was submitted to distillation with caustic potassa, the alkaline liquid obtained was neutralized with sulphuric acid and evaporated to a syrupy consistence, alcohol was added to precipitate the ammonium sulphate, the liquid was then filtered, treated with caustic potassa, and again distilled. On the surface of the distillate a yellow oily fluid floated, which was only slightly soluble in water but readily so in ether and alcohol, evinced an alkaline reaction with turmeric paper, and neutralized the acids. (*A. J. P.*, May, 1860, 211.) In overdoses the seeds produce vertigo, intoxication, and other narcotic effects. They have been used in chronic pectoral affections, such as *bronchitis, pulmonary consumption*, and *asthma;* also in *dyspepsia, intermittent fever*, obstinate *ulcers*, etc. The *dose* of the seeds, to commence with, is five or six grains (0.32–0.4 Gm.), so repeated as to amount to a drachm (3.9 Gm.) in twenty-four hours. They should be given in powder. *Dose* of the alcoholic extract, three grains (0.2 Gm.). (*P. J.*, xii. 591.)

Œnothera. *Œnothera biennis*, L. *Tree Primrose. Evening Primrose. Onagre*, Fr. *Nachtkerze*, G. (Fam. Onagraceæ.)—The fleshy root of this plant, before the introduction of the potato, was used as a table vegetable. Many years ago R. E. Griffith commended very highly a strong decoction of the plant frequently applied in eruptive skin diseases. More recently the drug has been commended in *whooping cough* and spasmodic *asthma*, and the ointment has been used in *prurigo* and other cutaneous affections of in-

fants, and as an application to *ulcers*. *Dose* of fluidextract, from a half to one fluidrachm (1.8–3.75 Cc.). The ointment may be made by incorporating four ounces of the fluidextract in a pound of vaseline or lard.

Œsypus.—A cheap, crude wool fat obtained as a by-product in cleansing sheep wool. (See *Adeps Lanæ Hydrosus*, p. 96.)

Oil of Ajowan. *Oleum Ajowan, Br. Add. Ptychotis Oil.*—The oil distilled from the fruit of *Ptychotis Coptica* (L.), Lyons (*Ammi Copticum*, L., *Carum Copticum*, Benth., *C. Ajowan*, Bentley). Under the name of *ajowan, ajwain, ajwan*, and other vernacular appellations, the seeds of *Ptychotis Coptica* are largely used in India as an aromatic. They resemble in size the fruits of the ordinary parsley and are of a grayish-brown color and have a tubercular surface with five prominent ridges to each mericarp. The odor and taste resemble that of thyme. These fruits yield from 4 to 6 per cent. of an agreeably aromatic volatile oil. Ajowan oil is officially described as "colorless, with an odor and taste resembling thyme. Specific gravity 0.917 to 0.930. It rotates the plane of a ray of polarized light from 1.0° to 1.5° to the right in a tube 100 Mm. long. If a portion of the oil be cooled to 0° C. (32° F.), it should yield from 30 to 36 per cent. of crystalline thymol." *Br. Add.* Oil of ajowan is used for the same purposes as allied aromatic oils in *doses* of from one-half to three minims (0.032–0.2 Cc.).

Oil of Akee.—This is a yellow, non-drying, butter-like fat obtained from the *Blighia sapida* of Koenig (Fam. Sapindaceæ), native of Guinea, but cultivated in Jamaica. (*P. J.*, 65, p. 691.)

Oil of Aleurites triloba.—The *Aleurites triloba*, Forst., is a small tree belonging to the Euphorbiaceæ. It is widely diffused throughout the tropics. The fruit is a nut nearly as large as a walnut, consisting of a thick shell enclosing a kernel containing much azotized matter and rich in oil, of which it is said to yield nearly one-half its weight by expression. The nuts strung together on the fibres of the palm leaf were formerly used in many Pacific islands as a substitute for candles. The oil has been long known in the various countries inhabited by the plant, being called in Jamaica *Spanish walnut oil*, in India *Belgaum walnut oil*, in Ceylon *kekune oil*, and in the Hawaiian Islands *kukui oil*. It is very fluid, of an amber color, without odor, of a nutty, pleasant taste, congealing at 0° C. (32° F.), insoluble in alcohol, readily saponifiable, "and very strongly drying." It is said to be a mild cathartic, acting like castor oil, but more promptly and without griping effects. (*J. P. C.*, 3e sér., xxiv. 228.) The *dose* is from one-half to one fluidounce (15–30 Cc.), the smaller quantity generally answering. The cake left after the expression of the oil, given to a dog in the *dose* of about half an ounce (15 Gm.), produced no vomiting, but acted strongly as a purgative.

The oil of the *Tung Tree, Aleurites cordata*, R. Br. (the synonyms being *Elæococca cordata, Elæococca vernicia, Dryandra cordata*, and *Dryandra vernicia*), is used to a large extent in the arts in China, under the name of *wood oil*. It is prepared in China by a crude process of expression. It occurs in two forms, *white oil*, a moderately thick, yellowish, transparent liquid, and the *black oil*, which is thick, blackish, and opaque. Wood oil is used in China and Japan either as a direct application to wood or mixed with various substances, as lacquer varnish, or paint. Its most remarkable property is its extraordinary siccative quality, which is said to exceed that of any known oil. When applied to wood it forms a resinous layer which is affirmed to be impermeable by water and ordinary solvents. Wood oil is also exported to Europe, where it is used in the making of varnishes. According to R. H. Davies, its sp. gr. at 15.5° C. (60° F.) is 0.94015; it remains liquid at —13.3° C. (8° F.). 100 Gm. of the oil require 0.39 Gm. potassium hydroxide for neutralization, and 21.1 Gm. for complete saponification. (*P. J.*, 1885, 636.) E. M. Holmes believes that the dark colored oil is made by boiling the kernels previous to expression, the cold drawn oil being colorless, inodorous, and nearly tasteless. The latter, according to Cloëz (*C. R. A. S.*, 1875, vol. lxxxi. 469), has the sp. gr. 0.9362, congeals at —18° C. (—0.4° F.) to a transparent mass, solidifies rapidly when exposed to light in a closed vessel, and is the most drying oil known. (*C. D.*, May, 1902.) It has been used in *ulcerations* and *skin diseases*.

Oil of Anda.—A fixed oil procured by expression from the seeds of *Joannesia princeps*, Vell. (*Anda brasiliensis*, Raddi, *A. Gomesii*, A. Juss., *Andicus pentaphyllus*, Vell. (Fam. Euphorbiaceæ). The bark of *J. princeps*, of Brazil, yields on being wounded a milky juice, which is said to be poisonous, and to be used for stupefying fish. The fruit, which is about as large as an apple, ash-colored, with two larger and two smaller angles, encloses a two-celled nut, containing two seeds, about the size of a chestnut. Like the seeds of other euphorbiaceous plants, these are actively purgative, one seed, according to Martius, being the *dose* for a man. By expression these seeds yield a pale yellow, transparent oil, with little odor or taste, which is said to be used in Brazil for burning and painting. It has a sp. gr. 0.927, and in properties belongs to the class of semi-drying oils. Mello Olliveira has found in it an alkaloid, *joannesine*, which Couty affirms to be inert. (*N. R.*, 1881, 260.) Norris, who tried the oil at the Pennsylvania Hospital, found it to operate on the bowels moderately in the *dose* of fifty drops (2.5 Cc.), and copiously when more largely given. Manoel de Castro and other Brazilian physicians assert that in *doses* of from one to two teaspoonfuls (3.75–7.5 Cc.) it acts in a manner very similar to castor oil, over which it has the great advantage of not being nauseous to the taste.

Oil of Anise Bark.—There has appeared in the European markets a bark, closely resembling Massoi bark, derived from an unknown source in Madagascar, which yields fully three and a half per cent. of a light yellow oil, the odor of which slightly resembles safrol. It has a spicy taste, but is only slightly sweet. Its specific gravity is 0.969 at 15° C. (59° F.). Optical rotation —0° 46′ in a 100-Mm. tube. Refraction equivalent for the sodium line at 16° 1.52510. It contains a small quantity of ordinary anethol, but consists principally of the isomeric fluid anethol, the *methyl-chavicol* of Eykman, $CH_3O.C_6H_4.CH_2.CH:CH_2$.

Oil of Ben.—This is a fixed oil extracted from the seeds of *Moringa pterygosperma*, Gaertn. (*Hyperanthera Moringa*, Vahl.), and *M. aptera* of Gaertner, and not to be confounded with oil of benne from *Sesamum indicum*, L. (Fam. Pedaliaceæ). These are trees of the fam. Moringaceæ, inhabiting different parts of India,

Arabia, Syria, etc., and introduced into the West Indies. James Macfadyen, in his *Flora of Jamaica* (i. 325), states that it is not the *M. pterygosperma* which yields the commercial oil of ben, but the *M. aptera*, which has not been introduced into Jamaica. He says, however, that an excellent and palatable oil may be obtained by expression from the seeds of *M. pterygosperma*, growing in that island. The leaves and other parts have an acrid property, which has probably given the name of *horseradish tree* to *M. pterygosperma*. According to Henry Shachan (*Nouv. Rem.*, 1890), the tincture of the root is very actively diuretic and useful in cardiac dropsy. The oil of the seeds has long been known, though used in the arts rather than in medicine. It is prepared in Europe from the seeds brought from Egypt; and it would appear, from the statements of Macfadyen, that the idea generally prevailing that it is also extracted in the West Indies is incorrect. The oil has a sp. gr. of from 0.912 to 0.917; it solidifies at about 0° C. (32° F.); indeed at 7° C. (44.6° F.) it begins to deposit the solid fats. It is inodorous, clear, and nearly colorless, and keeps long without becoming rancid. It resembles olive oil, and is used for similar purposes. Mérat and De Lens say that it is purgative; but most of the fixed oils are so in sufficient doses. According to Völcker, the oil contains palmitin, olein, and a peculiar fatty matter yielding an acid by saponification, which he names *benic* (or *behenic*) *acid*. (*J. P. C.*, xvi. 77.) Heintz considered benic acid as simply a mixture of palmitic and myristic acids. (*Pogg. Ann.*, xcii. 601.) It is, however, now recognized as one of the normal fatty acid series, possessing the formula $C_{22}H_{44}O_2$.

Oil of Bergamot. *Oleum Bergamottæ. U. S.* 1890. *Oleum Bergamii, U. S.* 1880.—"A volatile oil obtained by expression from the rind of the fresh fruit of *Citrus Bergamia* Risso et Poiteau (nat. ord. *Rutaceæ*). It should be kept in well-stoppered bottles, in a cool place, protected from light." *U. S.* 1890.

Citrus Bergamia.—The bergamot tree has oblong-ovate, dentate, acute, or obtuse leaves, somewhat paler on the under than on the upper surface, and with footstalks more or less winged or margined. The flowers are white, and usually small; the fruit is pyriform or roundish, about three inches in diameter, terminated by an obtuse point, with concave receptacles of oil in the rind. The pulp of the fruit is sourish, somewhat aromatic, and not disagreeable. The rind is shining, and of a pale-yellow color, and abounds in a very grateful volatile oil. This may be obtained by expression or distillation. In the former case it preserves the agreeable flavor of the rind, but is somewhat turbid; in the latter it is limpid but less sweet. The mode of procuring it by expression is exactly the same as that used for oil of lemon. (See *Oleum Limonis.*) It is brought from Italy, the south of France, and Portugal.

The oil of bergamot, often called *essence of bergamot*, has a sweet, very agreeable odor, a bitter, aromatic, pungent taste, a pale greenish-yellow color, and a slightly acid reaction. Its sp. gr. varies from 0.870 to 0.888. (Lewis, Zeller.) "Specific gravity: 0.880 to 0.885 at 15° C. (59° F.). Its optical rotation should not be more than 20° to the right in a 100 Mm. tube, and at a temperature of about 15° to 20° C. (59° to 68° F.). Two volumes of the Oil, when mixed with 1 volume of alcohol, should give a clear solution of a slightly acid reaction, and this solution should not become turbid on the further addition of alcohol (distinction from *oil of orange* or *oil of lemon*). The oil should also be soluble at 20° C. (68° F.), without the separation of oily drops, in 1.5 to 2 volumes of alcohol of 80 per cent. by volume. It is soluble, in all proportions, in glacial acetic acid. If about 2 Gm. of the Oil be evaporated in a small, tared capsule, on a water-bath, until the odor has completely disappeared, a soft, green, homogeneous residue should be left, amounting to not more than about 6 per cent. of the Oil (absence of *fatty oils*)." *U. S.* 1880. It contains limonene, dipentene, linalool, a solid greasy compound called *bergaptene*, or *bergamot camphor*, and *linalool acetate*, $C_{10}H_{17}.C_2H_3O_2$, which latter makes up about 40 per cent. of the expressed oil, but is decomposed in large part by the process of steam distillation. Bergaptene has been very fully studied by Pomeranz. (*M. Chem.*, 1891, 379.) It melts at 188° C. (370.4° F.), and has the composition $C_{12}H_8O_4$, being the lactone or inner anhydride of *bergaptenic acid*, $C_{12}H_{10}O_5$. By fusion with potassium hydroxide, bergaptene yields *phloroglucin*. (See *Schim. Rep.*, April, 1893, and 1895, 24; also *Proc. A. Ph. A.*, 1897, 630.) The oil is distinguished from lemon and orange oils by readily dissolving in solution of potassium hydroxide and forming with it a clear solution. (Zeller.) Though possessed of the excitant properties of the volatile oils in general, it is employed chiefly, if not exclusively, as a perfume.

Oil of Chione.—The bark of this West Indian tree, *Chione glabra*, yields on distillation 1.5 per cent. of a light yellow volatile oil, consisting chiefly of *o-oxyacetophenone*, $C_6H_4.OH.CO.CH_3$. A compound obtained synthetically from *o-nitrocinnamic acid* proved to be identical with that isolated from the oil. (See *J. Chem. S.*, vol. lxxv. 1899.)

Oil of Citronella. *Oleum Andropogon Nardi.* This oil is distilled from the *Andropogon Nardus*, L. (Fam. Gramineæ), a plant growing sometimes to the height of five or six feet, which is cultivated in Ceylon and in the Straits Settlements, and also on the Malabar coast. According to the statements of Consul Freudenberg, this oil is produced largely in the southern provinces of Ceylon by natives, either by distillation with steam or with a naked fire. The production and exportation of Ceylon citronella oil reached a maximum in 1899 when the exportation was 1,478,756 pounds, whereas in 1903 it amounted to 1,062,594 pounds, of which 554,689 pounds came to the United States. Some came from other sources, however, as the total importations of citronella oil into the United States for 1903 were 725,842 pounds, and in 1904, 828,446 pounds. For a method of production, see *West. Drug.*, 1888, 243. Oil of citronella is of a yellowish-green color, having a characteristic odor and pungent taste. Its sp. gr. is, according to Gildemeister and Hoffman, 0.886–0.900. It mixes with alcohol in all proportions, and the test for purity given by Schimmel & Co. is based upon its behavior towards alcohol of 80 per cent.: "One volume of the oil must form an absolutely clear solution with *two* or at most *two and a half*, volumes of 80 per cent. alcohol at a temperature not below 20° C. (68° F.). A cloudy mixture indicates the presence of turpentine, certain fixed oils, and other essential oils which are sometimes used

to adulterate it." The oil contains, according to Gildemeister and Hoffman (*Aetherische Oele*, p. 377), *camphene, dipentene, methyl heptenone, citronellal, borneol, and geraniol*, and esters of acetic and valeric acids. Oil of citronella is an aromatic not used in medicine, but largely employed in perfuming so-called *honey soap*. Externally applied it protects against the attacks of mosquitos and other insects.

Oil of Coconut. *Cocoanut Oil. Cocoanut Butter. Oleum Cocos*, P. G. *Oleum Cocois. Beurre de Coco*, Fr. *Kokosnussöl*, G.—This must not be confounded with the fixed oil of the chocolate nut, which is often called *cocoa butter*. (See *Oleum Theobromatis*, p. 881.) The substance here considered is the fixed oil of the coconut, which is the fruit of a species of palm, *Cocos nucifera*, L., universally known as the *coconut tree*, or *cocoanut tree*. The oil is obtained either by expression or decoction, often by *insolation*,—*i.e.*, exposing the rasped nuts to the heat of the tropical sun. It is of a fine white color, of the consistence of lard at ordinary temperatures, becoming solid, like suet, between 4.4° C. (40° F.) and 10° C. (50° F.), and liquid at about 26.7° C. (80° F.), of a bland taste, and a peculiar, not disagreeable odor. It is readily dissolved by alcohol. It contains large quantities of the glycerides of myristic and lauric acids, with smaller quantities of the glycerides of palmitic and oleic acids. It has also been found to contain several volatile acids, as caproic, caprylic, and capric acids. (Lewkowitsch, *Chemical Analyses of Oils, Fats, and Waxes*, 2d ed., 1898, 538.)

The oil has been used for various purposes in medicine and pharmacy. It has been employed as a substitute for cod liver oil, especially in the form of a proprietary preparation, *coco-olein*. In Germany it has been used in pharmacy, to a considerable extent, as a substitute for lard, to which, according to Pettenkofer, it is preferable on account of its lesser tendency to rancidity, its more ready absorption when rubbed on the surface of the body, and its lesser liability to produce chemical changes in the substances with which it is associated. Thus, the ointment of potassium iodide, when it is made with lard, becomes yellow in a few days, while, if made with coconut oil, it remains unchanged for two months or more. Vegetable substances also keep better in ointments prepared with this oil than with lard. Besides, it takes up one-third more water, which is a useful quality when it is desirable to apply saline solutions externally. To prepare it for use, nothing more is ordinarily necessary than to melt it at a moderate heat, and strain it through linen. If colored, it may be digested with powdered animal charcoal, and subsequently filtered through paper. (*A. J. P.*, xxix. 331.) When chilled and pressed, a solid residue, which is *coco-stearin*, is obtained. This is extensively used as a substitute and adulterant of the genuine cocoa butter in the confectionery trade. Coconut oil is employed in the manufacture of soap, particularly of the transparent varieties, and the so-called "*marine soaps*" and *filled soaps;* it is also largely used for giving firmness to the ordinary soap; this property also permits of the addition of a large quantity of water to the soap. Unfortunately, coconut oil soap is very apt to contain free caprylic acid; and the persistent rancid odor, resembling that of infants' vomit, left upon the skin after washing with its soap is an effectual bar to its very extended use. The exportations of coconut oil from Ceylon amount to 15,000 tons annually, from British India to 4000 to 6000 tons, and from the Dutch Indies to 1300 tons per annum. Besides the oil itself, the dried pulp of the coconut is sent to European markets in large amounts under the name of *copra*. The export of copra from Ceylon amounts to 5000 tons annually, from Tahiti to 4000 tons, from Samoa to 3000 tons, and from Singapore to 4000 tons.

The importations of coconut oil into the United States for 1905 amounted to 43,773,208 pounds, valued at $2,568,048.

According to Parisi, the endocarp or meat of the coconut is a powerful tænicide. The patient should drink the milk and then eat the flesh of the nut. The coconut is said to be largely used in India as a vermifuge, and the matter appears to have practical importance.

Powdered coconut shells have been largely used in America as an adulterant for spices. Their debris is readily recognized by the microscope. (See *A. J. P.*, 1901.)

Oil of Colza.—An oil expressed from the seed of *Brassica campestris*, L., or *field cabbage*, a cruciferous plant which grows wild through the greater part of Europe, and is largely cultivated in France and Germany for the sake of this oil. Colza oil is used in Europe as a burning oil, as a lubricating oil, and, after purification by heating with starch, as a table oil. The raw oil has a sp. gr. of 0.915, and the refined oil 0.9136. Chilled to —4° C. (24.8° F.), stearin separates out, and at —6° C. (21.2° F.), it becomes a yellowish buttery mass. The oil contains the glycerides of stearic, *erucic* (or *brassic*) *acid*, $C_{22}H_{42}O_2$, and an acid, isomeric with but differing in some respects from ordinary oleic acid. The total consumption of rape and colza oil in Europe is estimated at from 280,000 to 300,000 tons per annum. For analysis of commercial samples, see *C. D.*, 1894, 140.

Oil of Cypress.—An oil derived from *Cupressus sempervirens*, L. (Fam. Coniferæ), has been strongly recommended by Bravo in *whooping cough;* it is used by sprinkling the oil upon the clothes, bed, etc., of the patient.

Oil of Dœgling. *Oleum Chænoceti. Dœgling Oil. Dœgling Thran. Huile de Rorqual Rostré*, Fr. The oil derived from the Norwegian whale, *Balæna rostrata*, is said by Gustave Guldberg to possess a lower specific gravity than any other animal oil (0.876 at 15° C.), and also remarkable penetrative properties. It is affirmed that if mixed in equal quantities with chloroform it carries the latter agent through the skin, and enables it to act as a local anæsthetic in *pruritus, neuralgia*, etc. Mixed with wax, it is highly recommended as a basis for ointments by the same authority.

Oil of Eulachon.—The fish known by the North Pacific Indians under the name of *Eulachon* or *Oulachon*, and by the English as *Hoolakins* or *Candle fish*, the *Thaleichthys pacificus* of scientists, yields a great abundance of an oil which has been proposed as a substitute for cod liver oil. According to the editor of *N. R.* (1881, 356), this oil first begins to congeal and become opaque at —7° C. (19.4° F.), although authorities state that at ordinary temperatures it grows solid and lard-like. Specific gravity at 15.5° C. (60° F.), 0.907; mixed with one-half its volume of nitric acid, specific gravity 1.37, it develops a beautiful pink color which fades slowly to amber, and after standing fifteen hours it is considerably thickened and its color is changed to a deep amber of a

reddish cast. It contains about 20 per cent. of palmitic and stearic acids, and 60 per cent. of oleic acid and 13 per cent. of an unsaponifiable substance, which resembles the similar constituent of sperm oil. (*T. G.*, Sept. 15, 1884.)

Oil of Euphorbia.—A fixed oil, obtained from the seeds of *Euphorbia Lathyris*, L. (Fam. Euphorbiaceæ), a biennial plant growing wild in this country, though believed to have been introduced from Europe. It is often found near gardens and in cultivated fields, and is generally called *mole plant*, under the impression that moles avoid the ground where it grows. (Pursh.) It is the *caper plant* of England. Like the other species of Euphorbiaceæ, it contains a milky juice, which is extremely acrid, and the whole plant possesses the properties of a drastic purge; but the oil of the seeds is the only part used in medicine. This may be extracted by expression, or by the agency of alcohol or ether. In the first case, the bruised seeds are pressed in a canvas or linen bag, and the oil which escapes is purified by decanting it from the whitish flocculent matter which it deposits upon standing, and by subsequent filtration. By the other process, the bruised seeds are digested in alcohol, or macerated in ether, and the oil is obtained by filtering and evaporating the solution. According to Soubeiran, however, the oils obtained by these different processes are not identical. That procured by expression is probably the purest.

Oil of euphorbia is colorless, inodorous, and, when recent, nearly insipid; but it speedily becomes rancid, and acquires a dangerous acrimony. Soubeiran has ascertained that it has a complex composition, containing, besides the pure oil, four distinct proximate principles. (*J. P. C.*, xxi. 259.) From 40 to 44 parts are obtained by expression from 100 of the seed. It is a powerful purge, but in *doses* of from five to ten drops is stated by Continental physicians to act kindly upon the bowels. In this country, however, it has been found very uncertain in its effects, and very liable to cause vomiting. (*A. J. P.*, iv. 124.)

Oil of Gynocardia. *Oleum Gynocardiæ, Br. Add. Chaulmoogra Oil.*—The fatty oil expressed from the seeds of *Gynocardia odorata*, R. Br. (*Chalmoogra odorata*, Roxb.), or *G. Prainii*, Desp. (Fam. Bixaceæ). The origin of the chaulmoogra seed and the oil obtained from it is still a matter of doubt. According to D. Prain the trees growing in the Calcutta Botanical Gardens do not belong to the genus Gynocardia, but are probably *Hydnocarpus heterophyllus*, Kurz. The seeds of the Gynocardia are said to be essentially different from the chaulmoogra seeds, having the radicle laterally placed, a thinner testa, and when moistened giving off hydrocyanic acid. (*P. J.*, lxvi.) The chaulmoogra seeds are from one to one and a quarter inches long, more or less angular or flattened, and yield upon expression, from 25 to 30 per cent., to ether, about 50 per cent. of oil. The commercial oil is obtained by expression, or sometimes by boiling the crushed seeds with water; is brownish-yellow, with a characteristic odor, acrid taste and acid reaction. "It may fully liquefy only at 42° C. (107.6° F.), resolidifying in different periods and at different temperatures down to 15.5° C. (60° F.). Specific gravity not constant, but usually from 0.930 to 0.954 at 30° to 40° C. (86° to 104° F.). Cold alcohol (90 per cent.) dissolves the greater part of the oil, repeated treatment with warm alcohol (90 per cent.) dissolving the remainder. It is soluble also in purified ether, chloroform, and carbon bisulphide. It may contain a little non-fatty matter not taken up by these solvents and causing turbidity of the solutions. Twenty drops with one drop of sulphuric acid in a watch-glass acquires a reddish-brown coloration changing to olive-green." *Br. Add.* Power & Gornall (*Proc. Chem. Soc.*, June, 1904) state that the expressed oil has a specific gravity 0.951 at 25° C. and 0.940 at 45° C.; melting point 22°–23°; saponification value 213, and iodine value 103.2.

John Moss (*P. J.*, x. 251) found in chaulmoogra oil, *gynocardic acid* 11.7, *palmitic acid* 6.3, *hypogæic acid* 4, *cocinic acid* 2.3 per cent. in combination with glyceryl as fats, while gynocardic and palmitic acids were also found in the free state; the activity of the oil he believes to be due to gynocardic acid, and states that the green coloration produced by treating the oil with sulphuric acid (Dymock's test) can also be obtained by treating palm oil in the same manner, yet purified gynocardic acid gives the same green color. *Gynocardic acid* has a yellowish color, forms crystalline plates, melting at 29.5° C. (85° F.), has an acrid burning taste, and is probably of the formula $C_{14}H_{24}O_2$. Power & Gornall (*loc. cit.*) have extracted *chaulmoogric acid*, $C_{18}H_{32}O_2$, crystallizing in leaflets melting at 68° C. Like the oil from which it is derived, the acid is optically active. They consider that this acid belongs to a series $C_nH_{2n-4}O_2$, intermediate between the linolic and the linolenic series. The chaulmoogra seeds are in themselves an article of commerce and are sometimes given internally in place of the oil in *doses* of six grains (0.4 Gm.). Chaulmoogra oil is said at present to be very largely used in England, being sold by the ton, as a local application to open *sores*, *wounds*, *sprains*, etc., in domestic animals, and to be officially employed in the English cavalry and artillery. It is also said to be employed against *bruises*, *sprains*, *rheumatism*, and *stiffness* by sportsmen and athletes. In *leprosy* it is given internally, and also applied regularly and freely externally, and seems to be one of the most useful of known drugs. It has also been given with asserted benefit in various forms of *external syphilis*, *ichthyosis*, and in other chronic skin diseases. *Gynocardic acid* is sometimes used as a substitute for chaulmoogra oil internally in *doses* of from one-half to two grains (0.032–0.13 Gm.) or externally dissolved in oil (1 to 10 or 30). According to J. Moeller, the commercial seed is not the product of *Gynocardia* alone. For a description of seed and plants, see *P. J.*, xv. 321.

Unna has proposed the use of a soap made from the oil as affecting the stomach and intestines less unpleasantly than the oil itself. (See *P. J.*, lxiv. 615.) The *dose* of the oil is from five to ten minims (0.3–0.6 Cc.), gradually increased, best administered in capsule or in olive oil solution.

Oil of Indian Grass.—The Indian grass oils are at least five in number,—namely, oils of citronella, lemon grass, Indian or Turkish geranium, ginger grass, and vertivert or cus-cus. They are derived from various tropical grasses of the genus Andropogon, but there is some confusion as to the particular species from which the individual oils are obtained. These oils are used solely for perfumery. (See *Oils of Citronella* and *Lemon grass*, pages 1586 and 1589.)

Oil of Jasmine.—This oil is obtained from the flowers of *Jasminum officinale*, L., or *common white jasmine*, of *J. Sambac*, Solander, and of *J.*

grandiflorum, L. Alternate layers of the fresh flowers, and of cotton saturated with the oil of ben or other fixed oil, are exposed in a covered vessel to the warmth of the sun, the flowers being renewed until the oil becomes impregnated, when it is separated from the cotton by pressure. This method is necessary, as the flowers do not yield their aroma by distillation. According to Gildemeister and Hoffmann, jasmine oil contains 65 per cent. of *benzyl acetate*, and in addition *linalyl acetate*, *benzyl alcohol*, and *linalool*. The oil is used only as a perfume. W. H. Hall records (*M. S. Rep.*, Jan. 1861) the case of a child poisoned by the fruit of a jasmine, probably the common white species. The symptoms were coma, widely dilated pupil, and snoring respiration, with a cold pale surface, and slow and feeble pulse, followed by violent convulsions, with rigidity of the muscles about the head and throat.

Oil of Kuromoji.—Under this name there have entered commerce two fragrant Japanese oils—one, *Kouro motsi*, said to be obtained from the *Lindera sericea*, and one, *Kuro matsi*, yielded by *Lindera umbellata*. (See *Schimmel's Bericht*, 1904.)

Oil of Lemon Grass. *Oleum Graminis Citrati, Br. Add. Oleum Andropogon Citrati. Indian Oil of Verbena.*—This oil is distilled from *A. citratus*, DC., *A. Schœnanthus*, Wall., and probably other grasses of the genus *Andropogon*, as *A. ivarancusa*, Roxb., *A. Calamus*, Royle, *A. Martini*, Roxb. *Andropogon citratus* is a large, coarse-looking grass, cultivated largely in India, the Malay Peninsula, Ceylon, and the neighborhood of Singapore. It grows in light soil, requiring very little care in cultivating, but considerable moisture. The oil is exported in large quantities from Ceylon, India, and adjacent countries. It is a yellowish-brown liquid having a characteristic odor and a pungent taste. "Specific gravity 0.895 to 0.905. It should not rotate the plane of a ray of polarized light more than 3° in either direction in a tube 100 Mm. long. Soluble in alcohol (70 per cent.). If 10 Cc. be well shaken with 50 Cc. of a boiling 30 per cent. solution of sodium hydrogen sulphite, an oily layer separates, which, when cooled to 15.5° C. (60° F.), should not measure more than 3.5 Cc. (absence of more than 35 per cent. of constituents other than aldehydes)." *Br. Add.* The chief constituent of lemon grass oil is *citral*, $C_{10}H_{16}O$, of which it contains from 70 to 85 per cent. Oil of lemon grass is sometimes used in Eastern countries as a carminative and stimulant in doses of one-half to three minims (0.03–0.2 Cc.). Its sole use is in perfumery.

Oil of Maize.—Our American maize or Indian corn yields a bright golden-yellow oil, of peculiar pleasant odor and taste. It is moderately thick, and has a sp. gr. at 15° C. (59° F.) of 0.916 to 0.924. It consists of olein and palmitin, and solidifies at —10° C. (14° F.). The oil is contained in the germs of the seed alone. Reckoned on the whole weight of the seeds the oil constitutes 11 per cent., of which from 6 to 8 per cent. is extracted; reckoned on the weight of the germ itself, after separation from the starchy body of the seed, the oil amounts to 22 per cent. It is now being extensively produced in the Western United States in connection with the working of starch and glucose factories. It is used as a lubricant and for soap making, but especially as a substitute for cotton seed oil and other adulterations of lard. In 1901 the amount of corn oil exported from the United States was 4,808,545 gallons, and in 1905, 3,108,917 gallons.

Oil of Mexican Lignaloes.—This volatile oil, which is used chiefly on account of its fragrant odor (which has been described as resembling that of a mixture of lemon and jasmine), is said to be obtained by the distillation of the wood of undetermined species. For characters of aloe wood, see *Ph. Post*, 1898; of the oil, see *P. J.*, Aug. 1887.

Oil of Myrcia. *Oleum Myrciæ. Oil of Bay.* "A volatile oil distilled from the leaves of *Myrcia acris* De Candolle (nat. ord *Myrtaceæ*)." *U. S.* 1890. The commercial oil of bay is a mixture of both heavy and light oils, as G. M. Beringer found the specific gravity of two samples of undoubted purity to be 0.975 and 0.994. (*A. J. P.*, 1887, 286.) Mittmann (*A. Pharm.*, 1889, 529) reported the following constituents: 1, *pinene;* 2, possibly *dipentene;* 3, a polyterpene, probably *diterpene* (insoluble in alcohol); these three in small quantity only; 4, *eugenol*, the chief constituent; and, 5, *methyl-eugenol*, in smaller quantity. It has since been examined (March, 1895) by Power and Kleber, who state that it contains from 60 to 65 per cent. of phenols, of which two were identified: *eugenol*, $C_{10}H_{12}O_2$, and *chavicol*, $C_9H_{10}O$; two phenol esters, *methyl-eugenol*, $C_{11}H_{14}O_2$, and *methyl-chavicol*, $C_{10}H_{12}O$; *phellandrene* and a newly discovered terpene which they name *myrcene;* and *citral*, $C_{10}H_{16}O$. (*Ph. Rund.*, 1895, 60.) The oil was officially described as "a yellow or brownish-yellow liquid, having an aromatic, somewhat clove-like odor, and a pungent, spicy taste. Specific gravity: 0.975 to 0.990 at 15° C. (59° F.). With an equal volume of alcohol, glacial acetic acid, or carbon disulphide, it yields slightly turbid solutions. The alcoholic solution is slightly acid to litmus paper. When mixed with an equal volume of a concentrated solution of sodium hydroxide, it forms a semi-solid mass. If 2 drops of the Oil be dissolved in 4 Cc. of alcohol, and a drop of ferric chloride test-solution be added, a light green color will be produced; and if the same test be made with a drop of diluted ferric chloride test-solution, prepared by diluting the test-solution with four times its volume of water, a light bluish coloration will be produced, which soon disappears. If to 3 drops of the Oil, contained in a small test-tube, 3 drops of concentrated sulphuric acid be added, and, after the tube has been corked, the mixture be allowed to stand for half an hour, a resinous mass will be obtained. On adding to this mass 4 Cc. of diluted alcohol, vigorously shaking the mixture, and gradually heating to the boiling point, the liquid should remain nearly colorless, and should not acquire a red or purplish-red color (distinction from *oil of pimenta* and *oil of cloves*). If 1 Cc. of the Oil be shaken with 20 Cc. of hot water, the water should not give more than a scarcely perceptible acid reaction with litmus paper. If, after cooling, the liquid be passed through a wet filter, the clear filtrate should produce, with a drop of ferric chloride test-solution, only a transient grayish-green, but not a blue or violet, color (absence of *carbolic acid*)." *U. S.* 1890. Oil of bay is not used internally, but solely for making spirit of myrcia or bay rum; the U. S. P. 1890 process is given:

Spiritus Myrciæ. U. S. 1890. *Spirit of Myrcia. Bay Rum.*—"Oil of Myrcia, *sixteen cubic centimeters* [or 260 minims]; Oil of Orange Peel, *one cubic centimeter* [or 16 minims]; Oil of Pimenta, *one cubic centimeter* [or 16 minims]; Alcohol, *twelve hundred*

and twenty cubic centimeters [or 41 fluidounces, 122 minims]; Water, *a sufficient quantity*, to make *two thousand cubic centimeters* [or 67 fluidounces, 302 minims]. Mix the Oils with the Alcohol, and gradually add Water until the solution measures *two thousand cubic centimeters* [or 67 fluidounces, 302 minims]. Set the mixture aside, in a well-stoppered bottle, for eight days, then filter it through paper in a well-covered funnel." *U. S.* 1890. The distilled spirit has been abandoned and a formula for its preparation substituted. It will in many cases be found that, even when complying strictly with the directions of the formula, simple filtration will not produce a transparent spirit. The addition to the filter of a small quantity of magnesium carbonate rubbed up with a little of the spirit to a smooth paste will accomplish the object of clarification. For an English formula for bay rum, see *P. J.*, 1896, 468. This was a new official of the U. S. Pharmacopœia of 1860, and was defined as obtained by distilling rum with the leaves of *Myrcia acris*. It had been long in use as a most agreeable and refreshing perfume, and many persons, on account of the name, believed it to be prepared by distilling spirit from the leaves of the bay tree (*Laurus nobilis*). It appears, however, that this was an error. (*A. J. P.*, July, 1861.) A leaf was presented to Maisch, brought from the West Indies, with the information that it was from the tree the leaves of which were used in preparing this spirit. He observed that it had precisely the characteristic odor and taste of bay rum, and on comparing it with the leaves of a twig in the collection of the Academy of Natural Sciences of this city, brought by Griffiths from St. Croix, and labelled as the plant from which bay rum was prepared, found that the two closely corresponded. From the characters of the leaf, Bridges suggested that it might belong to a plant of the family Myrtaceæ, most probably the *Myrcia acris* of De Candolle (see *Myrcia acris*), and there is little room to doubt that *Myrcia acris* is the source of this very agreeable perfume. Bay rum is used chiefly as a refreshing perfume in cases of *nervous headache, faintness*, and other *nervous disorders*, either held to the nostrils, or applied on soft linen to the head and forehead. It is also grateful to the feeble and convalescent patient, by being sprinkled on the bed covering or otherwise made to impregnate the air of the chamber. The oil of bay is often adulterated, and is frequently sold by smugglers.

Oil of Neat's-Foot. *Oleum Bubulum. Oleum Pedum Tauri. Axungia Pedum Tauri. Huile (Graisse) des Pieds du gros Bétail*, Fr. *Klauenöl, Ochsen Klauenfett*, G.—This formerly official oil is obtained by boiling for a long time the feet of the ox, previously deprived of hoofs. The fat and oil which rise to the surface are removed and introduced into a fresh portion of water, heated nearly to the boiling point. The impurities having subsided, the oil is drawn off, and, if required to be very pure, is again introduced into water, which is kept for twenty-four hours sufficiently warm to enable the fat which is mixed with the oil to separate from it. The liquid being then allowed to cool, the fat concretes, and the oil is removed and strained, or filtered through layers of small fragments of charcoal free from powder. The oil is clear and yellowish in color, of sp. gr. 0.916 at 15° C. (59° F.), and, when properly prepared, inodorous and of a bland taste. It thickens or congeals with great difficulty, and is, therefore, very useful for greasing machinery. It is also used for softening leather and in grinding metals. It has been given as a substitute for cod liver oil in scrofulous diseases. It is apt to be laxative, and in certain cases proves useful in this way. It is given in the same dose as cod liver oil. (See *Am. J. M. S.*, N. S., xxiv. 498.) It is at present difficult to obtain pure neat's-foot oil in commerce.

Oil of Neroli. *Oleum Aurantii Florum. U. S.* 1890. *Oil of Orange Flowers. Oleum Naphæ*, G. "A volatile oil distilled from the fresh flowers of the Bitter Orange, *Citrus vulgaris* Risso (nat. ord. *Rutaceæ*). It should be kept in well-stoppered bottles, in a cool place, protected from light." *U. S.* 1890.

This oil, official in the U. S. P. 1890, is employed for its odor and taste, and is largely used as an ingredient in cologne water, perfumes, etc. The best quality of oil of neroli, as it is universally called in commerce, comes from Nice, and is derived from the flowers of the *Citrus Aurantium*, L., or *sweet orange*, by distillation with water; this is called *néroli pétale*. The next quality is obtained in the same way, but by using the blossoms of the *Citrus Bigaradia*, Loisel. (*C. amara* (L.), Lyons), or bitter orange: this is called *néroli bigarade;* while an inferior sort, *essence de petit grain*, is made by distilling the leaves and unripe fruit. This should not be classed with neroli, as it is unworthy of the name. *Oil of petit grain citronnier* is a fragrant oil, distilled from the leaves and twigs of the lemon tree; it closely resembles the essence de petit grain which is made from the orange leaves and fruit. (*C. D.*, 1897, 53.)

Properties.—It was officially described as "a yellowish or brownish, thin liquid, having a very fragrant odor of orange flowers, and an aromatic, somewhat bitter taste. Specific gravity: 0.875 to 0.890 at 15° C. (59° F.). Soluble in an equal volume of alcohol, the solution being neutral to litmus paper. If a little alcohol be poured on the surface of the oil, and the mixture gently undulated, a bright, violet fluorescence will usually be observed. In contact with a saturated solution of sodium bisulphite it assumes a handsome and permanent purplish-red color." *U. S.* 1890. The greater part of the oil is a hydrocarbon, distilling at from 185° to 195° C. (365°–383° F.), with which is a small amount of the crystalline solid called *neroli camphor*. According to Flückiger, this is a neutral, inodorous, tasteless substance, fusing at 55° C. (131° F.). According to Semmler (*Ber. d. Chem. Ges.*, 26, 2711), the oil contains about 20 per cent. of limonene, 30 per cent. of linalool, $C_{10}H_{18}O$; 40 per cent. of linaloyl acetate, and 3 per cent. of geraniol. *Schim. Rep.*, April, 1897, mentions a small amount of a paraffin as also present. Noel distinguishes the different volatile oils of the orange tribe by shaking five drops of the oil with one Cc. of pure concentrated hydrochloric acid. After one minute seven or eight Cc. of 90 per cent. alcohol are added, whereby the color is changed, and increased or decreased according to the extent of the adulteration. It is obvious that to use effectually such a test requires special education. (See *Proc. A. Ph. A.*, 1887.)

Under the name of *nerolin* an artificial product has been placed upon the market in the form of a white crystalline powder, soluble in alcohol and fixed oils and almost insoluble in water. It is used by soap makers as a substitute

for oil of neroli, and is said to be ten times as strong. This compound is said to be the *ethyl ether of β-naphthol.* (*Ber. d. Chem. Ges.*, 1893, 2706.) It is also used in the manufacture of eau-de-Cologne with advantage instead of neroli oil. (*Schim. Rep.*, April, 1893.) Oil of neroli of excellent quality is now produced artificially; Schimmel & Co. state that it contains pinene, camphene, dipentene, terpineol, phenyl, acetic acid, benzoic acid, decylic aldehyde, and linalool.

Oil of Palm. *Huile (Beurre) de Palme*, Fr. *Palmöl, Palmbutter*, G.—This highly valuable fixed oil is the product of *Elæis guineensis*, Jacq., a palm growing on the western coast of Africa, and cultivated in the West Indies and South America. It is among the handsomest trees of its graceful family which flourish in the tropical regions of Africa. The oil is obtained by expression from the fruit. It is brought to this country chiefly from Liberia and other places on the African coast, though prepared also in the West Indies, Cayenne, and Brazil. It is not improbable that various species of Palmaceæ contribute to the supply of this article of commerce. At present the chief ports for its shipment are Cape Palmas and Lagos, prima and secunda Lagos being the choicest varieties. The annual export from the African coast now reaches 50,000 tons, of which the bulk goes to England. The importation into the United States amounted in 1903 to nearly 19,000 tons, but fell off in 1904 to about 10,000 tons.

Palm oil has the consistence of butter, a rich, orange-yellow color, a sweetish taste, and an agreeable odor, compared by some to that of violets, by others to that of the Florentine orris. By age and exposure it becomes rancid and of a whitish color. It melts with the heat of the hand, and when perfectly fluid passes readily through blotting paper. Highly rectified alcohol dissolves it at common temperatures, and in ether it is soluble in all proportions. Its constituents are *tripalmitin* and *triolein*, $C_3H_5(C_{16}H_{31}O_2)_3$ and $C_3H_5(C_{18}H_{33}O_2)_3$. The tripalmitin is converted into *palmitic acid* by superheated steam, with liberation of glycerin. It appears also that a considerable proportion of this acid, together with some glycerin, exists uncombined in the oil, as ascertained by Pelouze and Boudet; so that the changes which are effected in oils, through the agency of alkalies, in the process of saponification, take place, to a certain extent, spontaneously in palm oil. (*J. P. C.*, xxiv. 389.) Hence it is more easily saponified than any other fixed oil. Preparatory to saponification, it may be bleached rapidly, according to J. J. Pohl, by heating it quickly to 240° C. (464° F.) and keeping it for ten minutes at that temperature. It loses for a time its peculiar odor by the process, acquiring an empyreumatic one; but this after a while ceases to be perceived, and the characteristic odor returns. (See *A. J. P.*, xxvii. 346.) Englehart bleaches it in the following manner. 1000 lbs. of the oil are heated in a boiler to 62.2° C. (144° F.) and kept at that temperature until the next day, when it is decanted into a clean vessel, and cooled to a point between 36.6° C. (98° F.) and 40° C. (104° F.). In another vessel 15 lbs. of potassium dichromate are dissolved in 45 lbs. of boiling water, and, when the solution is partially cooled, 60 lbs. of hydrochloric acid are added. This solution is then mixed with the oil, and briskly agitated. In five minutes the color changes to green, through the reduction of the chromic acid, and, with a continuation of the agitation, the chromium oxide separates, and then nothing more is necessary than washing with water to get the oil colorless. (*A. J. P.*, 1868, 333.) Palm oil is said to be frequently imitated by a mixture of lard and suet, colored with turmeric, and scented with Florentine orris. It is much employed in the manufacture of toilet soap, which retains its pleasant odor. Palm oil is emollient, and has sometimes been employed in friction or embrocation, though not superior for this purpose to many other oleaginous substances.

Oil of Patchouli.—This oil is distilled from the leaves of the plant, *Pogostemon heyneanus*, Benth. (*P. Patchouly*, Pelletier), or *Patchouli Balm* (Fam. Labiatæ). The plant is cultivated at Singapore and other Eastern localities and has an interesting history. The drug was first offered at public sale in London in 1844; it is now imported for European consumption in immense quantities. It is believed by the Arabs, Chinese, and Japanese to possess prophylactic powers. The oil as found in commerce is of two kinds. The best is that distilled in the East in the neighborhood of the patchouli plantations, from selected fresh leaves; the other kind is distilled in Europe from imported leaves; the latter often arrive in a more or less damaged condition, and are frequently adulterated. Oil of patchouli is a thick, brownish-yellow oil with a green tint, and was shown by Gladstone to contain *cœrulein*, an intensely blue compound found in oils of absinthium, calamus aromaticus, matricaria, achillea, etc. The oil has the sp. gr. 0.970 and is lævo-rotatory. It deposits a solid, *patchouli alcohol*, $C_{15}H_{26}O$, which crystallizes in hexagonal prisms, melts at 56° C. (132.8° F.), and boils at 206° C. (402.8° F.), while *cadinene*, $C_{15}H_{24}$, remains; oil of cedar and oil of cubeb are frequently used to adulterate the oil. They may be detected by fractional distillation. Oil of patchouli is used in perfumery mainly for its valuable property of conferring upon other odors lasting qualities; its characteristic and persistent odor when uncombined is usually not popular among Caucasians.

Oil of Sesame. *Oleum Sesami, U. S.* 1890. Under the name of *Oleum Sesami* the Br. Add. recognizes sesame oil with the following official characteristics and tests. "Specific gravity 0.921 to 0.924. It congeals at a temperature of 23° F. (5° C.). If 10 cubic centimetres be treated with 10 cubic centimetres of *hydrochloric acid* containing 0.6 gramme of *pyrogallol*, and the mixture be shaken vigorously and then set aside for one minute, two layers will be formed. The upper oily layer is to be carefully removed by means of a pipette; the lower acid layer is to be boiled for five minutes, when it will gradually assume a color which is purple by transmitted light and blue by reflected light." The oil was official in the U. S. P. 1890 and defined as follows: "A fixed oil expressed from the seed of *Sesamum indicum* Linné (nat. ord. *Pedaliaceæ*)." *U. S.* 1890.

Benne Oil, or *Teel Oil*, is inodorous, of a bland, sweetish taste and a neutral reaction, and will keep long without becoming rancid. Flückiger finds that 76 per cent. of the oil consists of olein, and that the solid portions yield on saponification palmitic, stearic, and myristic acids. The oil also contains a small quantity of what is probably a resinoid substance, which may be removed by gla-

cial acetic acid or alcohol. It bears some resemblance to olive oil in its properties, and may be used for similar purposes. It is not a drying oil. Villavecchia and Fabris (*Zeit. für Ang. Chem.*, 1893, 505) have investigated sesame oil, and find, in addition to the main constituents before mentioned, a higher alcohol of the formula $C_{25}H_{44}O$, fusing at 137° C. (278.6° F.), a finely crystallizing substance of the formula $C_{11}H_{12}O_3$, fusing at 123° C. (253.4° F.), which substance they name *sesamin*, and a thick uncrystallizable oil, non-nitrogenous, which is the cause of the cherry-red coloration which sesame oil shows with hydrochloric acid and sugar. Tocher (*P. J.*, 1893, 700), after analyzing *sesamin* and determining its molecular weight by Raoult's method in benzene and glacial acetic acid, maintains that its formula should be $C_{18}H_{18}O_5$. Tocher, as quoted by Lewkowitsch (*Chem. Anal. of Oils, Fats, and Waxes*, 2d ed., 389), also believes that the higher alcohol mentioned is cholesterol. "Specific gravity, 0.919 to 0.923 at 15° C. (59° F.). When cooled to —3° C. (26.6° F.) it becomes thick, and at —5° C. (23° F.) it congeals to a yellowish-white mass. Concentrated sulphuric acid converts it into a brownish-red jelly. If 5 Cc. of the Oil be shaken with an equal volume of concentrated hydrochloric acid, the latter will usually assume a bright emerald-green color, especially if the Oil has been exposed for some time to the action of air and light; and, on the subsequent addition of about 0.5 Gm. of sugar, and again shaking the mixture, a blue color, changing to violet, and finally to deep crimson, will be produced." *U. S.* 1890. Soltzien recommends stannous chloride solution for testing benne oil. (*Proc. A. Ph. A.*, 1897, 195.) According to Schaedler, if one Cc. of pure benne oil is shaken with one Cc. of pure hydrochloric acid, sp. gr. 1.125, and one gramme of cane sugar, a rose-red color is developed in fifteen minutes, changing to violet in twenty-five minutes, and increasing in intensity until, after five hours, the acid has assumed a violet color corresponding in intensity to that of a solution of iodine in carbon disulphide or in chloroform. In the case of all other fixed oils, this color reaction does not begin until after three-quarters of an hour. Olive and almond oils containing as little as one-fourth per cent. of benne oil exhibit the reaction in from twenty to twenty-five minutes. The failure of some experimenters to find the reactions available rests upon the fact that they searched for the color in the oil, and not, as they should have done, in the acid. (*A. Pharm.*, 1887, p. 185.) Benne oil was known to the ancient Persians and Egyptians, and is esteemed by the modern Arabs and other people of the East both as food and as an external application to promote softness of the skin. It is laxative in large doses.

Oil of Turtle. *Turtle Oil.*—In South America an oil is prepared from the eggs of turtles, and in the Seychelle Islands and in Jamaica from the fat of the turtle itself. These oils are said to be of equal value with cod liver oil for strumous persons and others in whom the nutritive processes are defective. (See *P. J.*, vol. xv. 573.) It is stated that 50,000 gallons are sent to Pará yearly from the Orinoco, the Amazon, and the Rio Negro, and that 60,000 gallons are consumed by the tribes who prepare the oil. The Seychelle Islands are said to produce 6000 gallons of oil yearly.

Oil of Wood. *Wood Oil. Gurjun Balsam. Balsamum Dipterocarpi.*—In the *P. J.* for August, 1854 (p. 65), appeared an account by Charles Lowe of Manchester, of a "new variety of balsam of copaiba," derived from the East Indies. In a subsequent communication to the same journal (1856, 321) from Daniel Hanbury, it appears that this product, though offered for sale in the London market as *balsam of copaiba*, is known in India under the names of *wood oil* and *gurjun balsam*. Considerable quantities had been imported from Maulmain, in Burmah, specimens of a similar drug had been received from Canara and Tenasserim, and it appears to be widely diffused in the Indian markets.

This liquid is obtained from *Dipterocarpus turbinatus*, Gaertn. f. (*D. lævis*, Buch. Ham.) (Fam. Dipterocarpaceæ), a very large gregarious tree which forms forests in Pegu and other parts of Farther India. A large notch is cut in the trunk of the tree, between two and three feet from the ground, and a fire made so as to char the wound. The juice then begins to flow, and is received in suitable vessels. Every three or four weeks the charred surface is cut off and burned anew. A single tree sometimes yields forty gallons in a season. Other species of Dipterocarpus afford a similar product, and hence probably the difference which has been observed in the specimens examined. It is at first turbid, but may be clarified either by filtration or deposition. After filtration, wood oil is a clear, dark brown liquid, of the sp. gr. 0.964 (Hanbury), and, in consistence, odor, and taste, bears a close resemblance to copaiba. It is soluble in two parts of alcohol of the sp. gr. 0.796, with the exception of a very small proportion of darkish flocculent matter, which subsides on standing. According to Lowe, it contains 65 per cent. of volatile oil, 34 of resin, and 1 of acetic acid and water. A characteristic property noticed by Lowe, by which it may be distinguished from copaiba, is that, when heated in a closed vial to 266° F. (230° F., Lowe), it becomes slightly turbid and coagulates, so that the vial may be inverted without changing the position of its contents, and this consistence is retained when the liquid cools. By a gentle heat with agitation the fluidity returns; but the liquid again coagulates if heated to 266° F. According to D. Brandis, this property of coagulation is characteristic of the wood oil from *D. alatus*, Roxb. (*P. J.*, xxv.), a wood oil which is further to be distinguished by the greenish opalescence of its surface.

Guibourt states that wood oil does not solidify, like copaiba, with one-sixteenth of magnesia, and the two separate on standing. (*J. P. C.*, xxx. 192.) De Vrij of Rotterdam, proposes the reaction of benzene with wood oil and copaiba respectively as a test to distinguish them. With an equal volume of the wood oil, benzene forms a turbid mixture, from which, after a long time, a resinous matter is deposited in flocculi; with copaiba it forms a transparent solution. (*P. J.*, 1857, 374.) The volatile oil from gurjun balsam is a yellow, somewhat thick liquid, of sp. gr. 0.915 to 0.930, and has at times a high optical rotation,—viz., —35° to —130°. The oil boils in larger part at 255° to 256° C. (491°–492.8° F.) and consists of a sesquiterpene, $C_{15}H_{24}$. With hydrochloric acid it yields a deep blue color. The resin left after distilling off the volatile oil is essentially *gurjunic acid*, $C_{22}H_{34}O_4$. This when purified dissolves readily in ether and strong alcohol, and slowly in benzene. It melts at 220° C. (428° F.) and congeals again at 180° C. (356° F.). Flückiger has also described a neutral resin from gurjun

balsam, which is insoluble in caustic potash, fuses at 126° C. (258.8° F.), and is of the composition $C_{28}H_{46}O_2$. Flückiger (*A. Pharm.*, 1876, 420) noticed that wood oil may be recognized by the violet color it assumes if dissolved in twenty parts of carbon disulphide and mixed with a drop of a cold mixture of equal parts of concentrated sulphuric and nitric acids. A liquid is much employed in India for painting ships, houses, etc., which is also called *wood oil;* this is obtained from a different source, being a fixed oil derived from the seeds of *Aleurites cordata*, R. Br. According to O'Shaughnessy, the oil of dipterocarpus is little inferior to copaiba in the diseases for which that medicine is employed. T. B. Henderson has found it very useful in *gonorrhœa*, given in the *dose* of a teaspoonful two or three times a day, uncombined. (*M. T. G.*, 1865, 571.) It probably has a remedial influence on diseased mucous membranes similar to the different turpentines, which it appears to resemble in composition. The juice may be given in emulsion, in *doses* of from fifteen to forty minims (0.9–2.5 Cc.); the volatile oil from ten to thirty minims (0.6–1.8 Cc.).

East India wood oil, or gurjun balsam, must not be confounded with *Chinese wood oil* or *tung oil*, a fixed oil obtained from the euphorbiaceous *Aleurites cordata*, R. Br. This oil has a specific gravity at 15.6° C. (60° F.) of 0.94015, and does not congeal at a temperature of —22.2° C. (—8° F.). If a drop of it be added to nitric acid it changes on heating into an orange-yellow solid. When a drop of sulphuric acid is brought in contact with the oil the latter apparently solidifies around the acid, forming a black envelope, which grows in size and gradually absorbs and acts upon so much of the surrounding oil as to assume the appearance of an irregular, large, dried currant. *Chinese wood oil* saponifies readily with potassium hydroxide, two hundred and eleven parts of the potassium hydroxide being required for a thousand parts of oil. For details see *P. J.*, vol. xv. (See also *Proc. A. Ph. A.*, 1897, 677.) It is much used in China and Japan as a natural varnish for wood work, having notable drying properties. Over 60,000 kilogrammes are said to be sent yearly from Hankow, on the Yang-tse-Kiang, in the interior of China, to Chinese seaports. The seeds of the tung oil plant are said to be poisonous, and are used in China for killing rats, and also to produce vomiting, especially in would-be opium suicides.

Oil of Ylang Ylang. *Cananga Oil. Oleum Anonæ. Oleum Unonæ.*—This is a volatile oil obtained from the flowers of *Cananga odorata*, Hook. f. and Thoms (Fam. Anonaceæ), a large tree inhabiting most parts of Southern Asia. According to Schimmel & Co. (*Schim. Rep.*, April, 1897), it contains pinene, linalool, geraniol, esters of acetic and benzoic acids, cadinene, and paracresol-methyl ester. It is used only as a perfume. (See *N. R.*, April, 1881.) The so-called *Macassar hair oil* is said to be a solution of it in coconut oil. (See *A. J. P.*, 1881, 123; also *A. J. P.*, 1893, 529.)

Ointment of Casein. *Unguentum Caseini. Caseinsalbe*, G.—Made by dissolving dried and powdered casein in 50 parts of a solution containing 0.345 part of potassium hydroxide and 0.895 part of sodium hydroxide. To this add 7 parts of glycerin, 0.5 part of phenol and finally 21 parts of petrolatum. When this has been thoroughly incorporated enough water is added to make 100 parts. It has the consistence of thick cream, is incompatible with acids and acid salts, but mercury, tar, balsam of Peru, zinc oxide, resorcinol, pyrogallol, and ichthyol may be incorporated with it.

Ointment of Cucumber. *Cucumber Ointment.* An emollient ointment, prepared from the common cucumber (fruit of *Cucumis sativus*, L., Fam. Cucurbitaceæ), has been considerably employed in *irritated states of the skin.* The following is the mode of preparing it, recommended by Procter. Take of green cucumbers 7 pounds avoirdupois, pure lard 24 ounces, veal suet 15 ounces. Grate the washed cucumbers to a pulp, express, and strain the juice. Cut the suet into small pieces; heat it over a water bath till the fat is melted out from the membrane; then add the lard, and, when melted, strain through muslin into an earthen vessel capable of holding a gallon, and stir until thickening commences, when one-third of the juice is to be added, and the whole beaten with a spatula till the odor has been almost wholly extracted. The portion which separates is to be decanted, and the remaining two-thirds of the juice is to be consecutively incorporated and decanted in the same manner. The jar is then closely covered and placed in a water bath, until the fatty matter entirely separates from the juice. The green coagulum floating on the surface is now removed, and the jar put in a cool place that the ointment may solidify. The crude ointment is then separated from the aqueous liquid on which it floats, melted and strained, and placed in glass jars, which must be kept closely sealed. A layer of rose water upon its surface will favor its preservation. A portion may be triturated with a little rose water until white and creamy, and put into a separate jar for present use. (*A. J. P.*, xxv. 409.)

Emile Mouchon prepares the ointment by obtaining the juice mixed with a little alcohol, and incorporating this with benzoinated lard and stearin. He directs 16 parts of the cucumber to be reduced to a pulp, 1 part of alcohol of 36° B. (87 per cent. vol.) to be added, and the mixture to be placed on the diaphragm of a percolator. Twenty-four hours afterwards 10 parts of the liquid are obtained of 19° B. Of this liquid 6 parts are to be incorporated with 37.5 parts of benzoinated lard and 12.5 of stearin; the fatty matters having been previously melted together by means of a water bath, and beaten vigorously on cooling. The liquid is to be added before the completion of the beating, which should then be continued until the whole becomes as light and white as possible. The benzoin and alcohol enable the ointment to keep a long time. (*J. P. C.*, Juillet, 1854, 41.) We prefer to make this ointment by incorporating one part of distilled *spirit of cucumbers* with seven parts of benzoinated ointment. The spirit is made by distilling a mixture of one part of grated cucumbers with three parts of diluted alcohol, retaining the first two parts or distillate which come over. This spirit is permanent, and ointment or cream made from it keeps well.

Olibanum. *Thus. Oliban, Encens*, Fr. *Weihrauch*, G.—Olibanum, the *frankincense* of the ancients, was erroneously ascribed by Linnæus to *Juniperus phœnicea*, L. (*J. lycia*, L.). There are two varieties of olibanum, one coming to Europe from the Mediterranean, and the other directly from Calcutta. These varieties were formerly considered distinct, but recent researches indicate

their common origin. In 1843 Captain Kempthorne, of the East India Company's navy, saw the olibanum tree growing upon the mountains, on the African coast, between Bunder Maryah and Cape Guardafui. According to his statement, it grows on the bare marble rocks composing the hills of that region, without any soil or the slightest fissure to support it, adhering by means of a substance thrown out from the base of the stem. This rises forty feet, and sends forth near the summit short branches, covered with a bright green, singular foliage. The juice, which exudes through incisions made into the inner bark, has at first the color and consistence of milk, but hardens on exposure. (*P. J.*, iv. 37.) Sir William J. Hooker says that the African olibanum is derived from *Boswellia papyrifera*, Hochst. (*Plösslea floribunda*, Endl.), one of the Burseraceæ; but thinks it highly probable that it is furnished by more than one species. (*Ibid.*, 1859, 217.) Bennett, of the British Museum, has also identified Kempthorne's specimens as *P. floribunda*. But in 1847 Carter described very closely the olibanum district, and procured living specimens, the descendants of which appear still to flourish in the "old gardens" of the Bombay Agri-Horticultural Society. Birdwood asserts (*Tr. Linn. Soc.*, xxvii.) that no olibanum is obtained in India, all coming from a coast district of Arabia (the same district as that described by Theophrastus), and being the product of a new species of Boswellia, *B. Carterii*, Birdwood. It is very likely that several species of Boswellia furnish the olibanum of commerce.—viz., *B. Carterii*, Birdw. (furnishes what is known as *Luban Bedowi* or *Luban Sheheri*), and *B. frereana*, Birdw. (furnishes *Luban Meyeti* or *Luban Matti*). It appears that the resin of *B. papyrifera*, Hochst., is not gathered at all. The product of *B. serrata*, Roxb. (known as *Salaigugul*), is not sent into general commerce, but is employed medicinally only in India.

The Arabian or African frankincense is in the form of yellowish tears, and irregular reddish lumps or fragments. The tears are generally small, oblong or roundish, not very brittle, with a dull and waxy fracture, softening in the mouth, and bearing much resemblance to mastic, from which, however, they differ in their want of transparency. The reddish masses soften in the hand, have a stronger taste and odor than the tears, and are often mixed with fragments of bark and small crystals of calcium carbonate which are visible under the microscope.

The Indian frankincense, or olibanum, consists chiefly of yellowish, somewhat translucent, roundish tears, larger than those of the African, and generally covered with a whitish powder produced by friction. It has a balsamic resinous odor, and an acrid, bitterish, somewhat aromatic taste. When chewed it softens in the mouth, adheres to the teeth, and partially dissolves in the saliva, which it renders milky. It burns with a brilliant flame and a fragrant odor. Triturated with water, it forms a milky imperfect solution. Alcohol dissolves nearly three-fourths of it, and the tincture is transparent. Tschirch (*Harze und Harzbehälter*, 1900, p. 253) has made a thorough study of olibanum and determined all of its constituents with care. Alcohol extracts 72 per cent., consisting of resins 65 per cent. and volatile oil 6 per cent.; water soluble gum, 20 per cent.; bassorin, 6–8 per cent.; plant residue 2–4 per cent. The resins were composed of *boswellic acid*, $C_{32}H_{52}O_4$, a resin acid of which well crystallized salts were obtained, and *olibanoresin*, $C_{14}H_{22}O$, a neutral resin.

In the essential oil Wallach identified *l-pinene* and dipentene, while the chemists of Schimmel & Co. found in addition *phellandrene*.

W. F. Daniell has described an odorous product, used as *frankincense* in Sierra Leone, and obtained from a large tree, growing in the mountainous districts of that region. The tree has been described by J. J. Bennett in *P. J.*, 1854, 251, as *Daniella thurifera* (Fam. Leguminosæ). According to Daniell, the juice exudes through openings made by an insect, and, concreting in connection with the woody particles resulting from the boring of the insect, falls at length to the ground, where it is collected by the negroes. (See *A. J. P.*, xxvii. 338.)

Olibanum is stimulant like the other gum-resins, but is now very seldom used internally. According to Delioux of Toulon, however, it affords a cheap, efficient substitute for the balsams of Tolu and Peru. It appears to act more favorably when combined with a little soap. Delioux has also obtained advantage from the inhalation of its fumes, when heated, in chronic *bronchitis* and *laryngitis*. (*B. G. T.*, Fév. 28, 1861.) It is chiefly employed for fumigation, and in unofficial plasters. *Dose*, fifteen grains (1.0 Gm.), which may be increased to a drachm (3.9 Gm.) or more.

Oliver Bark. *Oliveri Cortex. Black Sassafras.* The dried bark of *Cinnamomum Oliveri*, Bailey (*Proc. Linn. Soc. of New South Wales*, July 28, 1897, part 2). "In flat pieces usually about eight inches (two decimetres) in length, and one and a half inches (thirty-seven millimetres) in width. It is covered with a coarsely granular periderm of a deep orange-brown color marbled with patches of a yellowish-brown hue; the tissues beneath the periderm are of a deep umber-brown color. The inside of the bark is of an umber-brown color, and has a close satin-like surface marked with very fine striæ. It has a close fracture, slightly fibrous in the liber portion. Odor aromatic and spicy, recalling sassafras and camphor; taste agreeably spicy and camphoraceous." *Br. Add.*

"*Tinctura Oliveri Corticis* (*Tincture of Oliver Bark*).—Oliver Bark, in No. 40 powder, 2 oz. (or 100 Gm.); alcohol (60 per cent.), a sufficient quantity. Moisten the powder with one fluid ounce (or 50 Cc.) of the alcohol, and complete the percolation process. The resulting tincture should measure one pint (or 1000 Cc.)." *Br. Add. Dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Omphalea.—According to Calmody, the government chemist in Trinidad, the seeds of the *Omphalea megacarpa* yield an oil which acts as a brisk cathartic in about three hours after taking, without pain or much continuance. (*P. J.*, Feb. 1898.)

Onion. *Cepa.*—The bulb of *Allium Cepa*, L. (Fam. Liliaceæ.) Fourcroy and Vauquelin obtained from the ordinary onion a white acrid volatile oil containing sulphur, albumen, much uncrystallizable sugar and mucilage, phosphoric acid both free and combined with lime, acetic acid, calcium citrate, and lignin. The expressed juice is susceptible of the vinous fermentation. The oil is essentially the same in chemical composition as the oil of *Allium sativum*, L., and consists largely of allyl sulphide $(C_3H_5)_2S$. (See *A. Pharm.*, 1892, 434.) Perkin and Hummel found *quercetin* in the outer skin of onion bulbs, and the skins have been used in dyeing.

By virtue of its volatile oil the onion taken in moderate quantities is a stimulant to the stomach and promotes digestion, but in large quantities is apt to cause gastric uneasiness. It is slightly rubefacient, said to be diuretic, and belongs among those expectorants to be employed in the advanced stages of subacute *bronchitis* or in chronic *bronchitis*. Remarkable physiological powers have been attached to it by various investigators. As the result of a very elaborate experimental study, Alfred K. Pilacki reached the conclusion that taken freely it depresses nitrogenous metabolism; a conclusion directly opposite to that of Popoff, whose studies led him to the belief that it increases nitrogenous change in the body. It can scarcely be doubted that any apparent influence which it may exert in the direction spoken of is secondary to its action upon digestion.

Onion poultices are somewhat effective as a counter-irritant and nerve stimulant in cases of *bronchitis* or *pneumonia* in young children, with nervous symptoms. According to M. V. Pogorelsky, a decoction made with the outer reddish skin of the bulb is widely used in Russia for the production of abortion. He attributes the ecbolic effect to the presence of allyl sulphide. One or two tumblerfuls of the concentrated dark brown or dark red infusion are taken at a *dose*.

Ononis. *Ononis spinosa*, L.—Reinsch obtained from this plant *ononin*, $C_{30}H_{34}O_{13}$, a glucoside. *Onocerin*, a di-secondary alcohol, $C_{26}H_{42}(OH)_2$, was isolated by Thoms, who proposed to change its name to *onocol*. (*A. Pharm.*, 1897, 28.)

Ophioxylon. *Rauwolfia serpentina*, Benth. ex Kurz. (*Ophioxylon serpentinum*, L.) (Fam. Apocynaceæ).—In the root of this plant, which is used in East India as a purge and anthelmintic, Wefers-Bettink found a yellow crystalline principle, *ophioxylin*, melting at 72° C. (161.6° F.), and possessing the formula $C_{16}H_{12}O_6$; also a volatile oil. (*A. J. P.*, 1890.)

Opopanax.—A concrete juice sometimes ascribed to *Opopanax hispidum*, Griseb. (*Pastinaca Opopanax*, L., *O. Opopanax* (L.), Lyons). This species of parsnip has a thick, yellow, fleshy, perennial root, which sends up annually a strong branching stem, rough near the base, about as thick as a man's thumb, and from four to eight feet in height. The leaves are variously pinnate, with long sheathing petioles, and large, oblong, serrate leaflets, of which the terminal one is cordate, others are deficient at their base upon the upper side, and the whole are hairy on their under surface. The flowers are small, yellow, and form large flat umbels at the termination of the branches. The plant is a native of the Levant, and grows wild in the south of France, Italy and Greece. When the base of the stem is wounded, a juice exudes, which, when dried in the sun, constitutes the opopanax of commerce. Some authors state that it is obtained from the root. A warm climate appears necessary for the perfection of the juice, as that which has been collected from the plant in France, though similar to opopanax, is of inferior quality. The drug is brought from Turkey. It is said to come also from the East Indies; but Ainslie states that he never met with it in any Indian medicine bazaar. The method of its production is not known with any certainty.

It is sometimes in tears, but usually in irregular lumps or fragments, of a reddish-yellow color, speckled with white on the outside, paler within, and, when broken, exhibiting white pieces intermingled with the mass. Its odor is strong, peculiar, and unpleasant, its taste bitter and acrid. Its sp. gr. is 1.622. It is inflammable, burning with a bright flame. In chemical constitution it is a gum-resin, with an admixture of other ingredients in small proportion. The results of its analysis by Pelletier were, from 100 parts, 33.4 of gum, 42 of resin, 4.2 of starch, 1.6 of extractive, 0.3 of wax, 2.8 of malic acid, 9.8 of lignin, 5.9 of volatile oil and loss, with traces of caoutchouc. Subsequently, Tschirch found opopanax to consist of resin, 19 per cent., ethereal oil, 6.5 per cent.; gum and plant tissues, 70 per cent.; water and loss, 4.5 per cent. (*A. Pharm.*, 1895, 209.) Water by trituration dissolves about one-half of the gum-resin, forming an opaque milky emulsion, which deposits resinous matter on standing, and becomes yellowish. Both alcohol and water distilled from it retain its flavor; but only a very minute proportion of oil can be obtained in a separate state. Opopanax was formerly employed, as an antispasmodic and deobstruent, in *hypochondriasis, hysteria, asthma*, and chronic visceral affections, and as an emmenagogue; but it is now scarcely ever used. *Dose*, ten to thirty grains (0.65–2.0 Gm.).

Opuntia. *Opuntia Opuntia* (L.), Coult. (*O. vulgaris*, Mill.) (Fam. Cactaceæ.) *Prickly Pear. Figue de Barbarie*, Fr. *Indische Feige*, G.—For analyses of fruit of this cactus, see *A. J. P.*, 1884, 3, and 1896, 170.

Orange Red. *Orange Mineral. Sandix.*—Red lead oxide, prepared by calcining lead carbonate. It is of a lighter color than *minium*, and is used as a pigment.

Orcin. *Dihydroxytoluene.* $C_6H_3(CH_3)(OH)_2$. This is a white stable powder, of a peculiar sweetish taste and aromatic odor, crystallizing with one molecule of water. It is easily soluble in water, alcohol, and ether, and has a sweet taste. It melts at 56° C. (132.8° F.) when it contains water, but, deprived of this, melts at 107° C. (224.6° F.). It boils at 290° C. (554° F.). It is said to resemble resorcinol in its local action and to be useful in the same class of skin diseases. According to J. Andeer (*Med. Chron.*, Dec. 1885), it is distinctly antiseptic, and in poisonous doses produces death by a direct action upon the heart muscle.

Oreodaphne. *Umbellularia californica* (Arnott), Nutt. *Oreodaphne californica*, Nees. *Tetranthera californica*, Hook. and Arn. *Litsea californica*, Benth. (Fam. Lauraceæ.)—The *California Bay Laurel* is an evergreen tree of considerable size, rather abundant throughout the State. Its wood is much prized on account of the beauty of its grain and its immunity from the attacks of insects. The leaves yield about 4 per cent. of a neutral, straw-colored, limpid volatile oil, which has a warm camphoraceous taste and a pungent aromatic odor, resembling somewhat that of a mixture of oils of nutmeg and cardamom. It is soluble in 1000 parts of water, and in alcohol and ether in all proportions. It is said, when inhaled, to cause dizziness and headache. Its chemical characters have been studied by John P. Heamy. (*A. J. P.*, 1875, 105.) He finds it to consist of a pure hydrocarbon, sp. gr. 0.894, boiling at 175° C. (347° F.), and an oxygenated pungent portion, which boils at 210° C. (410° F.). This he calls *oreodaphnol*. *Oreodaphnene* was obtained by distilling oreodaphnol with glacial phosphoric acid. For the reactions, see Heamy's paper.

Orexin. *Phenyldihydrochinazoline Hydrochloride.* $C_9H_4\begin{cases}CH_2.N.C_6H_5\\N{=}CHHCl\end{cases}$. A complex derivative of quinoline. It forms colorless, odorless, lus-

trous crystals with bitter, pungent taste, freely soluble in hot water. Orexin was first brought forward by F. Penzolt as a true stomachic. It appears to be practically free from toxic properties, two grains of it per pound not being sufficient to kill a rabbit. It appears to be a very active remedy in those cases of failure of appetite in which simple bitters are indicated, and to be contra-indicated by hyperacidity of the stomach, gastric catarrh and gastric ulcer.

The *tannate* is affirmed to be more efficient than the hydrochloride, which salt it has practically replaced in the market. The tannate is a yellowish powder, tasteless, odorless, insoluble in water, freely soluble in acid solutions. It is very highly praised in all forms of *atonic dyspepsia, loss of appetite* in convalescence, and similar conditions. It is affirmed also to be very useful in the treatment of *vomiting* following the use of narcotics, such as opium, chloroform, etc. It is chemically incompatible with iron salts. It is best administered in the form of powder, five to twelve grains (0.32–0.78 Gm.) given in capsules, one to two hours before meals.

Origanum. *Wild Marjoram. Marjolaine sauvage*, Fr. *Wilder Majoran* (*Meiran*), G.—Two species of Origanum have been used in medicine, *O. Majorana*, L., or *sweet marjoram*, and *O. vulgare*, L., or common marjoram. The former grows wild in Portugal and Andalusia, and is cultivated as a garden herb in other parts of Europe and in the United States. Some authors, however, consider *O. majoranoides*, Willd., which is a native of Barbary, and closely allied to *O. Majorana*, as the type of the sweet marjoram of our gardens. This is by others considered to be simply a form of *O. vulgare*, L. *Sweet marjoram* has a pleasant odor, and a warm, aromatic, bitterish taste, which it imparts to water and alcohol. By distillation with water it yields a volatile oil. It is tonic and gently excitant, but is used more as a condiment than as a medicine. In domestic practice its infusion is employed to hasten the tardy eruption in *measles* and other exanthematous diseases.

The plant is a native of Europe and America. In this country it grows along the roadsides, and in dry stony fields and woods, from Pennsylvania to Virginia, and is in flower from June to October; but it is not very abundant, and is seldom collected for use. It has a peculiar, agreeable, aromatic odor, and a warm, pungent taste. These properties it owes to a volatile oil, which was formerly employed, but has been superseded altogether by the oil of thyme, which is called in commerce oil of origanum. (See *Oleum Thymi*.)

Two kinds of origanum oil are now known commercially: the Trieste oil, of dark color and high specific gravity, and the Smyrna oil, of lighter color, lower specific gravity, and milder taste. The former contains from 60 to 85 per cent. of *carvacrol*, $C_{10}H_{14}O$, a trace of another phenol, and *cymene*, $C_{10}H_{14}$. The latter contains from 25 to 60 per cent. of *carvacrol* and, in addition, *linalool* and *cymene*. The specific gravity of the Trieste oil ranges from 0.94 to 0.98, while that of the Smyrna oil is from 0.915 to 0.945. (Gildemeister and Hoffmann, *Aetherische Oele*, pp. 813, 814.)

The French oil of marjoram is said to be distilled from *Clinopodium Nepeta* (L), Kze. (*Calamintha Nepeta*, Link. and Hoffm.) It is colorless, but gradually turns yellow on exposure. It is neutral in reaction, sp. gr. 0.904 at 16° C., and optical rotation $[a]_D = +18° 39'$ in chloroform solution. On fractionating, three constituents were isolated, *lævo-pinene, calaminthone*, and *pulegone*. *Calaminthone* is a new ketone, $C_{10}H_{16}O$. (See *P. J.*, March, 1903.)

Origanum floribundum, of Algeria, yields largely of a volatile oil containing 25 per cent. of thymol. (*P. J.*, Feb. 1903.)

Orobanche. *Leptamnium virginianum* (L.), Raf. (*Orobanche virginiana*, L., *Epifagus americana*, Nutt., *Epiphegus virginiana*, Bart.) *Beechdrops. Cancer Root. Orobanche de Virginie*, Fr. *Krebswurz*, G.—This is a parasitic, fleshy plant, found in Northeastern America, growing upon the roots of the beech tree. The plant has a bitter, nauseous, astringent taste, which is said to be diminished by drying. It has been given internally in bowel affections; but its credit depends mainly upon the idea that it is useful in obstinate ulcers of a cancerous character, to which it was directly applied. Other species of Orobanche, growing in America and Europe, have been employed. They are all parasitic, fleshy plants, without verdure, and of a bitter, nauseous taste. In Europe they are called *broom rape*. The allied plants, *Conopholis americana* (L. f.), Wallr. (*Orobanche americana*, L. f.), and *Thalesia uniflora* (L.), Raf. (*Orobanche uniflora*, L., *Aphyllon uniflorum*, T. and G.), of America, are used for the same purposes as the species above noticed, and, like it, are called *cancer root*.

Oroxylum. *Oroxylum indicum*, Vent. (Fam. Bignoniaceæ.)—This East India bark is said to be not only a tonic and astringent, useful in *diarrhœa*, but also a powerful sudorific. A yellow crystalline substance, *oroxylin*, has been separated from the bark by Naylor and Chapman (*P. J.*, Sept. 1890), and from the seeds by Hooper (*P. J.*, vol. lxi.). The seeds have been used in veterinary medicine.

Orpiment. *King's Yellow.* As_2S_3.—A native arsenic trisulphide. It is in masses of a brilliant lemon-yellow color, composed of flexible laminæ, and slightly translucent. It exists in various parts of the world, but is obtained for use from Persia and China. (Guibourt.) It is sometimes mixed with realgar, which gives it a reddish or orange hue. A similar sulphide may be made artificially by passing hydrogen sulphide through a solution of arsenic trioxide in hydrochloric acid.

Artificial orpiment is prepared for use by fusing together equal parts of arsenic trioxide and sulphur. (Turner.) In Germany, according to Guibourt, it is prepared by subliming a mixture of these two substances. In this case, however, it retains a large portion of the acid undecomposed, and is therefore highly poisonous. Guibourt found a specimen which he examined to contain 94 per cent. of arsenic trioxide and only 6 per cent. of the trisulphide.

Orpiment is an ingredient of certain depilatories. *Atkinson's depilatory* is said to consist of one part of orpiment and six parts of quicklime, with some flour and a yellow coloring matter. (*Ann. Ch. Ph.*, xxxiii. 348.) But this arsenical sulphide is chiefly used in fireworks and as a pigment.

Orris Root. *Iris Florentina*, L. U. S. Secondary List, 1870. *Rhizoma Iridis*, P. G. *Radix Iridis Florentinæ, Radix Ireos. Iris de Florence*, Fr. *Florentinische Violenwurzel, Veilchenwurzel*, G. *Ireos*, It. *Lirio Florentino*, Sp.—The root (rhizome) of the Florentine Iris is perennial, horizontal, fleshy, fibrous, and covered with a brown epidermis. This plant is a native of

Italy and other parts of the south of Europe, where it is also cultivated. The root is dug in spring, and prepared for the market by the removal of its cuticle and fibres. It is cultivated for commerce chiefly in the neighborhood of Florence, and is exported from Leghorn in large casks.

Florentine orris is in pieces of various form and size, often branched, usually about as thick as the thumb, knotty, flattened, white, heavy, of a rough though not fibrous fracture, an agreeable odor resembling that of the violet, and a bitterish acrid taste. The acrimony is greater in the recent than in the dried root, but the peculiar odor is more decidedly developed in the latter. The pieces are brittle and easily powdered, and the powder is of a dirty white color. Vogel obtained from Florentine orris, gum, a brown extractive, fecula, a bitter and acrid fixed oil or soft resin, a volatile crystallizable oil, and vegetable fibre. According to Landerer, the acrid principle is volatile, separating in the form of a stearopten from water distilled from the root. (*A. Pharm.*, lxv. 302.) The solid oil which is prepared in Europe from orris root by distillation has been examined by Flückiger. By repeated crystallization from alcohol and treatment with animal charcoal, inodorous crystals were obtained, having the composition $C_{14}H_{28}O_2$ and the properties of myristic acid, while the odorous principle remained in the mother liquor, so that *oil of orris* must be regarded as myristic acid impregnated with volatile oil. The acid does not pre-exist in orris root, and is probably liberated from a fat by the influence of steam. (*A. J. P.*, 1876, 411, also 1885, 133.) According to Hager, the commercial oil has the following properties. At the ordinary temperature it is a pea-yellow acid, resembling basilicon ointment (*P. G.*) in color and consistence. It is lighter than water, fuses at from 38° to 40° C. (100.4°–104° F.) to a transparent liquid, and commences to congeal at about 28° C. (82.4° F.). Two drops of the fused oil dissolve in ten or twelve drops of warm stronger alcohol, and the solution does not separate at a medium temperature. Three drops of the oil and from twenty to twenty-five drops of concentrated sulphuric acid carefully heated to 30° C. (86° F.) yield a clear red-brown liquid, which, after ten minutes, dissolves in 7 Cc. of 90 per cent. alcohol, with a light violet color, gradually becoming darker. Two drops of a solution of the oil in petroleum benzin evaporated spontaneously leave a residue which, with a magnifying power of from fifty to one hundred diameters, has a radiating appearance after a few hours, and shows distinct crystals after a day. One part of orris oil yields, with from three thousand to four thousand parts of weaker alcohol, a solution of which a few drops put upon a handkerchief develop a persistent odor of violets. (*A. J. P.*, 1877, 302.) In order to preserve the root from the attacks of insects, it is recommended to put a little chloroform in the bottle in which it may be kept. (*A. J. P.*, 1858, 310.) The odoriferous principle of orris root was found by Tiemann to be *irone*, $C_{13}H_{20}O$. In endeavoring to effect its synthesis Tiemann was led to the discovery of an isomeric body, *pseudoionone*, by the condensation of acetone and citral. While pseudoionone does not possess the violet odor it can be changed into *ionone*, which has the true violet odor and is now largely manufactured for the perfumery trade in making toilet waters and handkerchief extracts.

Orris root is cathartic, and in large doses emetic, and was formerly employed to a considerable extent on the continent of Europe. It is said also to be diuretic, and to have proved useful in *dropsies*. At present it is valued chiefly for its agreeable odor. It is occasionally chewed to conceal an offensive breath, and enters into the composition of tooth powders. In the form of small round balls, about the size of a pea, it is used by the French for maintaining the discharge from issues, a purpose to which it is adapted by its odor, by the slight acrimony which it retains in its dried state, and by the property of swelling very much by the absorption of moisture.

Orthin. $C_6H_3\begin{cases}OH\\COOH\\HN.NH_2\end{cases}$. *Orthohydrazin-para-oxybenzoic acid* is very unstable, but unites with hydrochloric acid, forming *orthin hydrochloride*, which is stable. This substance was proposed by Kobert (*D. M. W.*, 1890) as an antipyretic; but in the experiments conducted by Unverricht, which have been confirmed by Kaufmann, it was found to have comparatively feeble antipyretic action, and to produce in a great many cases sweating and collapse.

Orthoamidosalicylic Acid. *Acidum Orthoamidosalicylicum.* $C_6H_3(NH_2)(OH)COOH$.—This is a grayish, amorphous, almost odorless, slightly sweetish powder, insoluble in water, alcohol, and ether, which has been used by R. Neisser (*In. Dis.*, Bern, 1892) in subacute *rheumatism*, with alleged good results.

Orthoform. *Methyl paramido-metaoxybenzoate.* $C_6H_3\begin{cases}COOCH_3\ (1)\\NH_2\ \ (4)\\OH\ \ (3)\end{cases}$. This compound forms a white, odorless and tasteless powder, difficultly soluble in water, easily soluble in alcohol, melting at 118° to 120° C. (244.4°–248° F.). Orthoform was introduced into practical medicine by Einhorn and Heinz (*M. M. W.*, 1897). Its chloride is very soluble in water, but is so acid in its reactions as to interfere with its use.

The physiological action of orthoform is only so far made out as to show that, probably on account of its insolubility, it has very little influence upon the system whether given by the stomach or hypodermically, Heinz having found that ninety grains produce no distinct symptoms in the lower animals, and seven hundred grains have been applied to a facial ulcer in a week without injurious effect (*L. L.*, 1897); also, according to Neumayer (*M. M. W.*, xliv. 1897), sixty grains taken by a man in the course of a day produced no symptoms whatever, not even evidences of gastro-intestinal irritation.

Locally orthoform has been believed to be actively antiseptic, but Lichtwitz and Sabrazes (*B. M.*, xi. 1897) found that bouillon saturated with it was still capable of serving as a culture medium. The antiseptic influence of orthoform is probably due to its decomposition by ulcerated surfaces. Brought in contact with sound skin or mucous membrane orthoform has no perceptible anæsthetic influence, but in any variety of ulceration, abscess, etc., where it would be brought in contact with the exposed sensitive nerve endings, its influence is decided and prolonged on account of its slow solution and consequent non-absorption for many hours. Externally, orthoform may be used either as a dusting powder, ointment or solution.

According to Yonge (*B. M. J.*, i. 1898), for many purposes the saturated solution of orthoform in collodion is most effective. In diseases of the larynx the parts may be sprayed with a solution of five grains of orthoform and fifty minims each of alcohol and water, which soon coats the diseased surface. In *keratitis* with ulceration, Boisseau commends an ointment made with one drachm each of lard and lanolin and twenty-four grains of orthoform. In many cases orthoform may also be added with advantage, on account of its anæsthetic properties, to ointments containing medicinal substances. According to Neumayer, its local analgesic action is not accompanied by abolition of the sense of touch.

Internally, orthoform in *doses* of eight grains (0.5 Gm.) has been used with asserted good results in *cancerous* and other *ulcerations of the stomach* and has been found useful in the treatment of *gastralgia*. Gustav Spiess found that insufflations into the posterior part of the pharynx may greatly alleviate the paroxysms of *whooping cough*.

Occasionally orthoform produces marked irritation and even violent inflammation at the seat of its application, and several cases have been reported in which it has produced sloughing, which has been compared to that caused by pure phenol. According to the majority of clinical reports, orthoform is of very little value except as a local remedy, though relief has been claimed from it in the treatment of *syphilitic headaches*. In the treatment of *sciatica*, *locomotor ataxia*, and other nervous affections, it seems to be of very little use. *Doses* of five to ten grains (0.32–0.65 Gm.) may be given three to four times a day.

Orthoform, New.—*Methyl metamido-paroxybenzoate* is isomeric with orthoform and possesses the same properties. It forms colorless crystals melting at 142° C. (287.6° F.), or a white powder, slightly agglutinating. It has been used by F. Klaussner in *fissures*, *wounds*, *burns*, etc., with alleged great advantage. (*M. M. W.*, xlv.)

Orthosiphon. *Orthosiphon stamineus*, Benth. *Java Tea.* (Fam. Labiatæ.)—This drug occurs in commerce in the form of small, oval, finely toothed, green leaves, rolled up like tea. Van Itallie has discovered in it a volatile oil and a crystalline glucoside, *orthosiphonin*. (*Ph. Ztg.*, Sept. 1886; see also *Répertoire de Pharm.*, 1887, 191.) It is said to be a powerful diuretic, and is highly recommended in *nephritic colic*, *gravel*, *uric acid diathesis*, and even *ascites*. The *dose* is from fifteen to fifty grains (1.0–3.2 Gm.) a day.

Osha Root.—This is the root of *Ligusticum filicinum*, Wats. (Fam. Umbelliferæ), indigenous in Utah and neighboring States and known as *Colorado cough root*. H. Haupt found in it an acid, *oshaic acid*, closely resembling angelic acid (*A. J. P.*, 1867, 1868, 1873.)

Osmic Acid. *Osmium tetroxide.* OsO_4.—A volatile, very odorous, crystalline compound, produced by the action of nitrohydrochloric acid on osmium or either of its lower oxides. Its vapor is very pungent and poisonous, attacking the eyes and respiratory organs. Claus recommends as an antidote to its action cautious inhalation of hydrogen sulphide. Osmic acid melts to a colorless liquid at 90° C. (194° F.), softening at a temperature of 35° C. (95° F.). It is slowly soluble in water; soluble in alcohol and ether; but these solutions are unstable, depositing black *osmic hydroxide*, $Os(OH)_4$. *Potassium osmate*, $K_2OsO_4 + 2H_2O$, is made by adding potassium hydroxide to an alcoholic solution of osmium tetroxide, and separating the crystals by careful evaporation. In the form of deep, garnet-red crystals, readily soluble in water, but decomposing when in solution or moist air; permanent in dry air. Usually used by injection, hypodermically, in the form of a 1 per cent. solution. The potassium salt is preferred by many to osmic acid for administration. Osmic acid, on account of its action upon tissues, is largely used in the making of microscopic preparations. We have no definite knowledge as to its influence upon the animal system when given in small doses. It has, however, been used with alleged success in *sciatica* and also in rheumatic affections both as osmic acid and in the form of *potassium osmate*. By Wildermuth it was used in *epilepsy* in *doses* of one-sixty-fourth of a grain (0.001 Gm.), repeated until the daily *dose* amounted to one-quarter of a grain (0.016 Gm.). Stekoulis affirms great success from the injection of fifteen drops (0.75 Cc.) of a 1 per cent. solution deep into the gluteal region close to the sciatic nerve in obstinate *sciatica*. At first the injections are repeated daily, afterwards every three or four days, care being exercised never to insert the needle into the same point twice, and to practise injection along the course of the nerve. Severe but very temporary pain is produced. (*L. L.*, Aug. 13, 1887.) Schapiro confirms the value of the remedy. He injects five drops (0.26 Cc.) of a solution made by the following formula: Osmic Acid 1 part, Glycerin 40 parts, Distilled Water 60 parts. Auerbach has used parenchymatous injections with alleged success for the destruction of morbid growths. (*Journ. of Laryngology and Rhinology*, June, 1891.)

Oxalic Acid. *Acidum Oxalicum. Acide oxalique ou carboneux*, Fr. *Oxalsaure, Kleesaure*, G. $H_2C_2O_4.2H_2O = 125.1$.—"In small, colorless, prismatic crystals, odorless and of a very sour taste, slightly efflorescent in dry air, fusible at 98° C. (208° F.), and entirely volatile at a red heat."[1]

This acid is found both in animals and vegetables. It is generated occasionally in disease, and it may be deposited in the bladder as calcium oxalate, forming the *mulberry calculus*. In vegetables, it occurs in a free state in the bristles of the chick pea (*Cicer arietinum*, L., Fam. Leguminosæ), as an acid potassium oxalate in *Rumex Acetosa*, L. (Fam. Polygonaceæ),[2] or common sorrel, in *Oxalis Acetosella*, L. (Fam. Oxalidaceæ), or wood sorrel, in *Chenopodium Quinoa*, Willd. (Fam. Chenopodiaceæ), *Amaranthus caudatus*, L. (Fam. Amaranthaceæ), *Mesembryanthemum crystallinum*, L. (Fam. Aizoidaceæ), and in many other plants. It is said to be formed in the leaves. (*J. Chem. S.*, 1886.) United with lime as raphides, it is abundant in almost every portion of the vegetable kingdom.

Preparation.—According to W. Zopf, a certain Saccharomyces (*S. Hausenii*) has the property of producing a fermentation which forms oxalic acid out of sugar; but in the practical arts the sugar is decomposed by nitric acid. Four parts of sugar are acted upon by twenty-four of nitric acid of the sp. gr. 1.24, and the mixture is heated so long as any nitrogen tetroxide is disengaged. A part of the carbon of the sugar is converted

[1] See test-solution of oxalic acid in PART III.

[2] For fatal poisoning by *Rumex Acetosa*, see *Hospital Gazette*, June, 1886.

into carbon dioxide by oxygen derived from the nitric acid, which thereby is reduced to nitrogen tetroxide. The undecomposed nitric acid, reacting with the remaining elements of the sugar, generates oxalic and saccharic acids, the former of which crystallizes as the materials cool, while the latter remains in solution. The crystals being removed, a fresh crop may be obtained by further evaporation. The thick mother water which now remains is a mixture of saccharic, nitric, and oxalic acids, and, by treating it with six times its weight of nitric acid, the greater part of the saccharic will be converted into oxalic acid. The new crop of crystals, however, will have a yellow color, and contain a portion of nitric acid, the greater part of which may be driven off by allowing them to effloresce in a warm place. It is probable that, in the reaction occurring between nitric acid and sugar, half the carbon of the latter is converted into carbon dioxide, and the other half into oxalic acid. This process has, however, been replaced in practice by the "sawdust process."

Many substances, besides sugar, yield oxalic acid by the action of nitric acid, as molasses, rice, potato starch, gum, wool, hair, silk, and many vegetable acids. In every case in which it is thus generated, the proportional excess of oxygen which it contains, compared with every other organic compound, is furnished by the nitric acid. When the acid is obtained from potato starch, this is first converted into starch sugar by the action of sulphuric acid. For details of this process, see 15th edition *U. S. D.*, p. 90. The yield of oxalic acid from a given quantity of material has been much understated. If properly treated with nitric acid, 100 lbs. of good sugar will yield from 125 to 130 lbs. of oxalic acid, and the same weight of molasses from 105 to 110 lbs.

Certain organic substances yield oxalic acid when heated with potassium hydroxide. Wood shavings, if mixed with a solution of potassium hydroxide and exposed to a heat considerably higher than 100° C. (212° F.), will be decomposed, and partly converted into oxalic acid, which then combines with the alkali. At present most of the oxalic acid of commerce is obtained by heating sawdust with a mixture of sodium hydroxide and potassium hydroxide. Sodium hydroxide alone will not generate the acid, and potassium hydroxide is too costly to be used by itself for the purpose; but Dale ascertained that, by mixing the two in the proportion of two molecules of sodium hydroxide to one of potassium hydroxide, the same or an even better result was obtained than from the latter alone. The mixture of caustic alkalies and sawdust is made into a thick paste and then heated for several hours to a temperature which is gradually brought to 240° C. (464° F.). The gray mass is then washed with sodium carbonate, whereby the potassium is removed as carbonate, the less soluble sodium oxalate remaining. This is converted into calcium oxalate by milk of lime, and the calcium salt then decomposed with sulphuric acid. The impure oxalic acid is then purified by recrystallization. Bohlig has suggested an improvement by precipitating the solution of potassium oxalate with magnesium chloride or sulphate. (Bayer, *N. R.*, Aug. 1877.) As the oxalic acid of commerce often contains foreign matter, it requires for certain purposes to be purified. It has sometimes been fraudulently mixed with 25 per cent. of Epsom salt. E. J. Maumené gives the following process for purification, which he says answers better than the method generally recommended. Sufficient hot water is added to the crystals to leave, on the cooling of the solution, from 10 to 20 per cent. undissolved, according to the degree of impurity. The first crystals are put aside. The mother water is then concentrated, and, if the resulting crystals be submitted to two or three successive crystallizations, the acid will finally be obtained free from alkaline oxalate. (*J. P. C.*, 1864, 154.) Stolba prefers the method of purification by crystallization from hydrochloric acid (boiling hot). (*Journ. App. Chem.*, Aug. 1874.) Villiers (*J. Chem. S.*, 1880, 544) prepares anhydrous oxalic acid by dissolving one part of ordinary acid in about twelve parts of warm concentrated sulphuric acid, allowing the oxalic acid to crystallize out.

Properties.—Oxalic acid is a colorless crystallized solid, possessing considerable volatility, and a strong, sour taste. Its crystals have the shape of slender, flattened, four- or six-sided prisms, with two-sided summits, and, when exposed to a very dry atmosphere, undergo a slight efflorescence. It is soluble in 4.5 parts of absolute alcohol, in 7 parts of alcohol, and almost insoluble in ether, chloroform, benzene, and petroleum benzin. The crystals should dissolve in not less than from eight to ten parts of water at 15° C. (59° F.) (greater solubility indicating contamination with adherent nitric acid).

It fuses in its water of hydration at 98° C. (208.4° F.), although continued exposure to a heat of from 60° C. (140° F.) to 70° C. (158° F.) will render it perfectly anhydrous. Solutions of oxalic acid at 100° C. (212° F.) lose acid by sublimation, and at 157° C. (314.6° F.) the anhydrous acid itself sublimes rapidly. If the heat rise to 160° C. (320° F.), much loss of acid occurs. (Allen, *Com. Org. Anal.*, 1879, 233.)

It combines with salifiable bases, and forms salts called oxalates. The most interesting of these are the three *potassium oxalates*, severally called *oxalate*, *binoxalate*, and *quadroxalate* (acid potassium oxalate plus free oxalic acid), and the *calcium oxalate*. The potassium binoxalate and quadroxalate, both popularly called *salt of sorrel* or *essential salt of lemons*, are employed for removing iron mould from linen, and act by their excess of acid, which forms a soluble salt with the ferric oxide constituting the stain. Salt of sorrel is also used extensively in the bleaching of straw goods and other vegetable fibres. Oxalic acid is used for removing ink stains and iron mould, for cleaning the leather of boot tops, and for discharging colors in calico printing. Prussian blue dissolves in aqueous oxalic acid to a clear blue liquid which is often employed as a *blue ink*.

This acid has a very strong affinity for lime, and makes with it an insoluble precipitate consisting of *calcium oxalate*, whenever the acid and the earth are brought into contact in solution. An aqueous solution forms with solution of lime a white precipitate, insoluble in an excess of oxalic or acetic acid, but dissolved by diluted hydrochloric acid. It is even capable of decomposing calcium fluoride, evolving hydrofluoric acid. (J. W. Slater.) Oxalic acid and its soluble combinations are the best tests for lime, and, conversely, a soluble salt of lime for oxalic acid. In weak solution the acid is said to absorb oxygen and to be converted into carbonic acid; but a strong solution is quite permanent. (*A. J. P.*, 1870, 317.) When lime is searched for, ammonium

oxalate is the most convenient test. So strong is the mutual attraction between this acid and lime, that the former takes the latter even from sulphuric acid. Hence the addition of a soluble oxalate disturbs the transparency of a solution of calcium sulphate.

Oxalic acid is distinguished from all other common acids by the form of its crystals, and by its solution yielding a precipitate with lime water, insoluble in an excess of the acid or of acetic acid.

Composition.—Anhydrous oxalic acid consists of two atoms of carbon, two of hydrogen, and four of oxygen. It is a dibasic acid. When crystallized, two molecules of water must be added, making the molecular weight of the crystals 125.1. These two molecules of water may be driven off by a regulated heat, by which the acid is made to effloresce. As oxalic acid is the final oxidation product of the diatomic alcohol *glycol*, to which the formula $\begin{matrix}CH_2.OH\\|\\CH_2.OH\end{matrix}$ is given, we may conclude that its structural formula is $\begin{matrix}CO.OH\\|\\CO.OH\end{matrix}$ which explains the readiness with which sulphuric acid splits it up into carbon dioxide, CO_2, and carbon monoxide, CO, by withdrawing H_2O from its formula, and with which oxidizing agents like manganese and lead dioxide change it into carbonic acid. Anhydrous oxalic acid may be obtained by dissolving the ordinary crystals in ten times their weight of sulphuric acid or concentrated nitric acid and cooling the solution.

Uses and Toxicology.—Oxalic acid has been strongly recommended by F. Poulet and by A. W. Marsh (*T. G.*, 1891) in *amenorrhœa*. Marsh has also found it extraordinarily serviceable in *cystitis*. It is a very active germicide, and, according to Howard A. Kelly, its solution is almost the only practical substance for the perfect disinfection of the surgeon's hands. *Dose*, half a grain (0.032 Gm.) from three to five times a day.

Attention was first called to it as a poison by Royston in 1814, and the certainty and rapidity of its action have caused it to be largely used for suicidal purposes. Death has been produced by it in ten minutes. (Case, *Chem. News*, April 24, 1868.) The minimum fatal *dose* recorded is one drachm (3.9 Gm.). From the general resemblance which the crystallized oxalic acid bears to Epsom salt, many fatal mistakes have occurred in consequence of its being sold for that saline purgative. It is, however, at once distinguished by its sour taste.

Oxalic acid acts on the economy in two principal ways, according as its solution is concentrated or dilute. When concentrated it causes exquisite pain, followed by violent efforts to vomit, then sudden dulness, languor, and great debility, and finally death without a struggle. When dissolved in twenty times its weight of water, it possesses no corrosive and hardly any irritating power, but causes death by acting on the brain, spinal marrow, and heart. It should be noted, however, that the acid, even in weak solution, always exercises a corroding or softening power on the animal tissues.

The morbid appearances caused by oxalic acid are various. In a dissection reported by Christison, the mucous coat of the throat and gullet had an appearance as if scalded, and that of the gullet could be easily scraped off. The inner coat of the stomach was pultaceous, in many points black, in others red, and that of the intestines similarly but less violently affected. In another case the whole villous coat of the stomach was either softened or removed, as well as the inner membrane of the œsophagus, so that the muscular coat was exposed, and this coat exhibited a dark, gangrenous appearance, being much thickened and highly injected. The stomach usually contains a dark fluid, resembling coffee grounds, consisting chiefly of altered blood. The tongue and mouth are sometimes white or spotted with white. In a few cases no morbid appearances have been discovered.

In 1879 Kobert and Kürsner announced that in animals oxalic acid may produce glycosuria; this has since been confirmed, and Sarganeck has noted the symptom in human poisoning, so that it is probably a constant phenomenon.

In the treatment of poisoning by oxalic acid, the remedial measures must be employed with great promptitude. Vomiting may be encouraged and the stomach tube used, but unless the antidote be at hand death will rarely be averted. The proper antidote is chalk or magnesia, mixed with water, and as soon as either can be procured, it must be administered in large and repeated doses. In many cases whitewash or some other preparation of lime can be obtained sooner than chalk, and should be at once administered; tooth powder can usually be obtained quickly, and generally (not always) consists chiefly of calcium carbonate. These substances act by forming with the poison an insoluble, inert calcium or magnesium oxalate. The soluble salts of oxalic acid, as ammonium oxalate and potassium oxalate, are equally poisonous, and the antidotes for them are lime water or solutions of magnesium salts.

Oxalis. *O. Acetosella*, L. *Wood Sorrel. Acetosella. Alléluia, Surelle, Pain de Coucou*, Fr. *Sauerklee, Hasenklee*, G.—The wood sorrel is a small, stemless plant of the fam. Oxalidaceæ. It is a native both of Europe and North America. Other indigenous species of oxalis possess similar properties to *O. Acetosella*. The whole herbaceous portion may be used.

Wood sorrel is without odor, and has an agreeable sour taste. It owes its acidity to *acid potassium oxalate* or *potassium binoxalate* (HKC_2O_4). The same salt may be prepared by exactly neutralizing one part of oxalic acid in solution, with potassium hydroxide, or potassium carbonate, then adding one part more of the acid, and evaporating the solution so that it may crystallize upon cooling. Acid potassium oxalate is in rhomboidal crystals, of a sour, pungent, bitterish taste, soluble in forty parts of cold and six parts of boiling water (Kane), and unalterable in the air. *Potassium tetroxalate* or *quadroxalate* is often substituted for the binoxalate. It is prepared in the same manner except that, instead of one part, three parts of the acid are added to the original proportion neutralized by potassium hydroxide. Both are poisonous, though in a less degree than uncombined oxalic acid. The fresh plant, eaten raw, is useful in *scurvy*.

Oxalis crassicaulis, Zucc., a Peruvian species, yields edible tubers and, by expression from its leaves, a very sour and astringent juice, which is employed, in the form of syrup, in *hemorrhages*, chronic *catarrh*, and *gonorrhœa*, with asserted advantage.

Oxycamphor. $C_8H_{14}\begin{matrix}CHOH\\|\\CO\end{matrix}$. This oxidation product of camphor is a white crystalline powder,

melting at from 203° to 205° C. (397.4°–401° F.) and volatile in a current of steam. Soluble to a slight degree in cold water; more soluble in hot water. It is stated that it acts as a stimulant to the cardiac muscle and also to the centric and peripheral vasomotor nervous system, and as a calmative to the respiratory centres. It has been used with asserted good results for the relief of both cardiac and pulmonic *dyspnœa*. *Dose*, from eight to fifteen grains (0.5–1.0 Gm.).

Oxychinaseptol. *Diaphtherin.* $C_6H_4(SO_2)\begin{cases}O—NH.C_9H_6(OH)\\O—NH.C_9H_6(OH)\end{cases}$. This substance is made by uniting two molecules of oxychinoline, $C_9H_6N(OH)$, with one molecule of phenol-sulphonic acid, $C_6H_5(HSO_3)OH$. It occurs in yellowish hexagonal crystals, melting at 85° C. (185° F.), very soluble in water and diluted alcohol. Its solution is decomposed by alkalies. According to the researches of Emmerich (*M. M. W.*, 1892), it is much more powerful as an antiseptic than phenol; two-tenths of one per cent. solution is sufficient to kill the comma and diphtheria bacilli in ten minutes, and three-tenths of one per cent. solution destroys the pus organisms in thirty minutes. It is also asserted that it is practically innocuous to higher animals, the subcutaneous injection of five cubic centimeters of a 5 per cent. solution producing no serious effects upon guinea pigs. It has been used in practical surgery, especially by Kronacher, who has employed from ½ to 1 per cent. solution with great satisfaction for the general purposes of the antiseptic treatment of wounds. Such solution produces no irritation except in some cases a momentary burning. Rohrer (*Corresp. f. Schweiz. Aerz.*, Nov. 1892) commends the remedy as a local application in disease of the nasal mucous membrane. The solution does not stain the hands, but forms on steel instruments a black deposit which is readily washed off.

Oxydendrum. *Oxydendrum arboreum* (L.), DC. *Sour Wood. Elk Tree. Sorrel Tree.* (Fam. Ericaceæ.)—The leaves of this indigenous tree are said by eclectic physicians to be a powerful diuretic, useful in *dropsy*. A semi-solid extract may be made, one part representing five of the drug. *Dose*, from five to fifteen grains (0.32–1.0 Gm.). Of the fluidextract the *dose* is from a half to two fluidrachms (1.8–7.5 Cc.).

Oxynaphthoic Acid. *Alpha-naphthol-carboxylic acid*, $C_{10}H_6\begin{cases}COOH\\OH\end{cases}$. This is the counterpart among the naphthalene derivatives of salicylic acid among the benzene derivatives, and is made in an analogous way by the action of carbon dioxide and sodium upon *α-naphthol*. It forms a white, inodorous, microcrystalline powder fusing at from 185° to 186° C. (365°–366.8° F.), and is soluble in 30,000 parts of cold water, more readily soluble in alcohol, chloroform, benzene, and oils, both fixed and volatile, also in aqueous solutions of ammonium bicarbonate, which form salts. It is antizymotic, disinfectant, and recommended against phylloxera. Its antizymotic action is said to exceed that of salicylic acid as five to one, and a 5 per cent. ointment has been lauded in *scabies*.

Oxypropylenediisoamylamine.—Louise affirms that this colorless liquid, which is soluble in alcohol, ether, and oils and insoluble in water, resembles atropine in its action upon the heart, and that it causes great rise of the arterial pressure and of the temperature of the body. (*L. L.*, 1887.)

Ozokerite.—This substance, which is brought from Galicia, in Austria, and from near the Caspian Sea, as well as mined in Southern Utah, in its crude state is a solid, varying in color from a dirty greenish to nearly black. When purified by treatment with sulphuric acid and alkali and subsequent filtration while melted through bone black or other filtering medium, it is a hard, white, spermaceti-like substance, and is extensively used in England as well as in Austria in the manufacture of candles. (See *Ceresin.*) It is a mixture of natural paraffins. It is said to resemble tar in its therapeutic properties, and, mixed with glycerin or linseed oil, has been employed in *skin diseases* by Purdon as a substitute for that remedy. (*B. F. M. R.*, 1872, 535. See also *A. G. M.*, Avril, 1873, and *Am. Drug.*, 1892, 40.)

Ozone (O_3) is recognized as an active modification of the element oxygen. It is considered to differ from the common form in being more condensed and at the same time more active. It has a peculiar odor, somewhat resembling that of diluted chlorine. Ozone changes gradually at the ordinary temperature into common oxygen, and at 237° C. (458.6° F.) the change is instantaneous. It is one of the most powerful oxidizing agents known, attacking and at once destroying organic substances, such as caoutchouc, paper, cork, etc. It also decolorizes most organic pigments. Ozone is somewhat soluble in water, imparting to water its peculiar odor, as well as its oxidizing power. According to Carius, 1000 volumes of water dissolve 4.5 volumes of ozone, and it is much more soluble in certain ethereal oils. The power of these latter as carriers of oxygen and disinfectants is thus explained. At one time ozone was thought to be peroxide of hydrogen, but Marignac and De la Rive demonstrated its true nature. Hautefeuille and Chappius (*C. R. A. S.*, xciv. 1249) succeeded in producing "liquid ozone" by applying a pressure of 125 atmospheres to richly ozonized oxygen at —100° C. (—148° F.). It is stated to be of a dark indigo color.

Ozone has not been obtained free from oxygen; indeed, it is probable that 1 per cent. of ozone is the highest concentration reached in its production. It is prepared by the decomposition of water by the battery, by the passage of the silent electric discharge through air or oxygen, by the slow oxidation of phosphorus in moist air and in other cases of slow combustion, and, lastly, by the action of sulphuric acid upon barium dioxide and potassium permanganate. Poulsen has suggested the following method of making ozone. The apparatus consists of a wide-necked glass jar, with a double cover of porcelain plates, finely perforated; the upper plate closes in the mouth of the jar, while the lower one is inserted in the neck of the jar, about two inches below the other. Through the centre of each of these covers a glass rod passes, terminating at the lower end (which is curved upward) in a small cup for holding a piece of phosphorus; in the jar is placed a given quantity of acidulated water, its level just above the cap containing the phosphorus, which, when the apparatus is not in action, is always submerged. A little potassium permanganate is added to the acid solution, and to produce ozone the phosphorus is raised, by means of the glass rod, just to the surface of the water. Chemical action produces phosphorous acid in the form of fumes by the contact of the phosphorus with the air, and the fumes are seen

to rise to a certain height, when they are deflected down upon the solution, into which they are absorbed, and converted into phosphoric acid by being oxidized by the potassium permanganate. Meanwhile, ozonified oxygen is produced, and, passing out through the perforations in the covers, is distributed in the atmosphere. The presence of ozone in the air or in gases is indicated by its action on paper moistened with potassium iodide and starch solution. This is turned blue, and if reddened litmus paper is moistened with potassium iodide, this is also blued. Another test is found in the use of paper moistened with an alcoholic solution of guaiacum, which is changed to light blue. Its presence in the air is now fully established, although in thickly inhabited districts it is almost always absent, as it is reduced to ordinary oxygen by the organic emanations constantly sent out into the air. In the air of the country, and especially in sea air, the presence of ozone can often be recognized by its peculiar odor. The probable cause of the formation of ozone in the air has been pointed out by Gorup-Besanez, as he has shown that ozone is invariably formed when water evaporates, and it is to this source, rather than to the electrical discharges, that the production of ozone must be traced.

Pæonia. *Pœonia officinalis*, L. *Peony. Pivoine*, Fr. *Gichtrose, Pfingstrose*, G. (Fam. Ranunculaceæ.)—The root of the garden peony consists of a caudex about as thick as the thumb, which descends several inches into the ground, and sends off in all directions spindle-shaped tubers, which gradually taper into thread-like fibres, by which they hang together. It has a strong, peculiar, disagreeable odor, and a nauseous taste, which is at first sweetish, and afterwards bitter and somewhat acrid. The odor is lost, or much diminished, by drying. Peony root was in very great repute among the ancients as a charm and as a medicine in *epilepsy*. In modern times it has been used as an antispasmodic. According to Rochebrune (*Toxicolog. Africaine*, i.), it contains an active alkaloid, *pœonine*. The expressed juice is milky, of a strong odor and very disagreeable taste. The *seeds* are roundish-oval, about as large as a pea, externally smooth, shining, and nearly black, internally whitish, inodorous when dry, and of a mild oleaginous taste. By some authors they are said to be emetic and purgative, by others antispasmodic. The *dose* of the fresh root or seeds is from two drachms to an ounce (7.7–31.0 Gm.), boiled in a pint of water down to half a pint, which should be taken daily. It is said to be less active when dried. *Dose*, of the expressed juice of the root, one fluidounce (30 Cc.).

W. Will obtained from an aqueous distillate of the root of the Japanese *Pœonia Moutan*, Simson, an aromatic ketone in colorless crystals. (*Ber. d. Chem. Ges.*, xix. 1777.) According to Nagae, this substance has the formula $C_9H_{10}O_3$. (*Ibid.*, xxiv.) It has been prepared by Schimmel & Co., under the name of *peonol*. It has a pleasant aromatic odor, and crystallizes in large needles. No essential oil was found in the root. (*Schim. Rep.*, Oct. 1890.) Dragendorff has found in the seed of *P. peregrina*, Mill., a fixed oil, an alkaloid, and *pœonic acid*. (*Jahresb.*, 1879.)

Palicourea. *Palicourea rigida*, H. B. K. (Fam. Rubiaceæ.)—The leaves of this tree are used in Brazil as a diuretic and diaphoretic. In 1866 Peckholdt found in them an alkaloid and three organic acids. One of these acids, consisting of a yellow, oily liquid with an overpowering odor, was found to be distinctly poisonous, one drop injected into a pigeon being enough to cause death. This was called *myotonic acid*. A crystalline *palicouric acid*, an amorphous tannin, and another amorphous non-toxic bitter principle were also isolated. Santesson has confirmed the presence of an alkaloid. (*A. Pharm.*, 235.)

Palladous Chloride. *Palladii Chloridum.* $PdCl_2$.—This is a blackish-brown mass, soluble in water, which has been recommended as a reagent for determining the malic acid in wine. It has been used to some extent in medicine as a local germicide, and has been recommended in the treatment of *phthisis* in *doses* of one-fourth to one-third of a grain (0.016–0.021 Gm.) three or four times a day.

Panax. *Panax quinquefolius*, L. *Panax, U. S.* 1870. *Ginseng*, Fr., G., Sp. *Ginsen*, It.—*American* or *false ginseng* grows in the hilly regions of the Northern, Middle, and Western States, preferring the shelter of thick, shady woods. The root is the part employed. This is collected in considerable quantities in Ohio and West Virginia, Minnesota, etc. It is also cultivated. (*A. J. P.*, 1891; *Ph. Era*, 1895, 359.) It is not used in America, but is exported to China. While supplied with ginseng exclusively from their own country, which furnished the root only in small quantities, the Chinese entertained the most extravagant notions of its virtues, considering it a remedy for all diseases, and as possessing almost miraculous powers in preserving health, invigorating the system, and prolonging life. It is said to have been worth its weight in gold at Pekin, and the first shipment from North America to Canton yielded enormous profits. John Henry Wilson (*P. J.*, July, 1888) states that there are in the Chinese market five ginsengs, four of them of Asiatic origin, derived from *Panax Ginseng*, Nees, not C. A. Meyer (*Aralia Ginseng*, Decne. and Planch.), the fifth the American ginseng from *Panax quinquefolius*. According to E. M. Holmes, *T'ang-shên*, which is used by the poor of China as a substitute for the costly ginseng, is a root of a new campanulaceous plant, *Codonopsis Tangshen*, and is exported from Hankow and Oo-chang to the extent of five hundred tons annually. (*P. J.*, xxi.) For an account of the Chinese methods of using ginseng, see *P. J.*, vi. 86.

On account of the growing scarcity of the American ginseng plant, experiments have been made by the State of Pennsylvania to determine whether it can be grown profitably, resulting in the conclusion that in five years an acre of ground would yield a profit of fifteen hundred dollars, without allowance for rental, but, according to Jackson (*P. J.*, 70, p. 785), many precautions are necessary for success. The cultivated roots were larger than those of the wild plant. (For details of culture and preparation, see *Bulletin 62, Pennsylvania State Agricultural Experiment Station;* J. U. Lloyd's paper, *Proc. A. Ph. A.*, 1901, p. 90; *Ph. Era*, 1900, p. 581; 1903, p. 497; *P. J.*, 1904, p. 652.)

The root is fleshy, somewhat spindle-shaped, from one to three inches long, about as thick as the little finger, and terminated by several slender fibres. Frequently there are two portions, sometimes three or more, connected at their upper extremity, and bearing a supposed, though very remote, resemblance to the human figure, from which circumstance it is said that the Chinese name *ginseng* originated. For an account of the

ginseng cultivation in Corea, see *P. J.*, 1885, 732; and of its collection in the United States, see *D. C.*, 1884, 33. When dried, the root is yellowish-white and wrinkled externally, and within consists usually of a hard central portion, surrounded by a soft whitish bark. It has a feeble odor, and a sweet, slightly aromatic taste, somewhat analogous to that of licorice root. It has not been accurately analyzed, but is said to be rich in gum and starch, and contains albumen. S. S. Garrigues obtained from it a peculiar substance, which he named *panaquilon*, and gave the formula $C_{12}H_{25}O_9$. To prepare it he heated a cold infusion so as to separate the albumen, filtered, concentrated to a syrupy consistence, precipitated by a concentrated solution of sodium sulphate, washed the precipitate thoroughly with the saline solution, and then treated it with alcohol, which dissolves the principle in question, and yields it on evaporation. To purify it, he dissolved it in water, treated the solution with animal charcoal, again evaporated, and dissolved the residue in absolute alcohol, which is finally distilled off. Panaquilon is an amorphous yellow powder, soluble in water and alcohol, but not in ether, of a sweet bitterish taste, and has the characteristic property that, when treated with strong acids, it is converted into a white substance, insoluble in water, with the escape of carbon dioxide and water. Garrigues proposed for this white substance the name of *panacon*, $C_{11}H_{19}O_4$. (*A. J. P.*, xxvi. 511.) Davydow (*A. J. P.*, 1890, 338) investigated these principles discovered by Garrigues, but adds nothing new to our information concerning them. The root is sometimes submitted, before being dried, to a process of clarification, which renders it translucent and horny, and enhances its value as an article of export. The extraordinary medicinal virtues formerly ascribed to ginseng had no other existence than in the imagination of the Chinese. It is little more than a demulcent, and in this country is not employed as a medicine. Some persons, however, are in the habit of chewing it, having acquired a relish for its taste, and it is sold chiefly to supply the wants of these.

Panbotano Bark.—The root of the Mexican leguminous tree *Calliandra Houstoni*, Benth., has been highly recommended by Valude as an antiperiodic, although Villejean was not able to find in it either an alkaloid or a glucoside. (*Journ. de Sci. Méd. de Lille*, 1890.) Pouchet (*Nouv. Rem.*, 1896), however, states that he has found in panbotano, besides saponin, an alkaloid which produces death by systolic arrest of the heart. Both Dinau (*Thèse de Paris*, 1896) and Crespin confirm its antiperiodic value. (*B. G. T.*, Aug. 1895.) A tincture representing two ounces of the root is taken in four *doses* during twenty-four hours.

Pancreon is a preparation obtained by the action of tannic acid on pancreatin, containing ten per cent. of the former in combination. It is a grayish, odorless powder which is affirmed to have strong trypsilytic, amylolytic, and emulsifying properties. It is further claimed to be superior to pancreatin in not losing its activity in the stomach. *Dose*, eight to fifteen grains (0.5–1.0 Gm.).

Pangium. *Pangium edule*, Reinw. (Fam. Samydaceæ.)—This East Indian tree, which is said to possess anthelmintic and narcotic properties, and to be capable of causing death, according to Blume, containes an alkaloid resembling *menispermine*.

Pao-Pereira Bark.—Under this name a bark is employed in Brazil as a febrifuge. It is supposed to be the product of *Geissospermum lævе*, Miers., or of *G. Vellosii*, Allem. (Fam. Apocynaceæ.) O. Hesse has found an alkaloid, *geissospermine*, $C_{19}H_{24}N_2O_2 + H_2O$, in it, (see *P. J.*, viii. 648), but he seems to have been preceded in this discovery by Santos. (*A. J. P.*, 1878, 184.) Peretti has discovered in the root a second alkaloid, *pereirine*, $C_{19}H_{24}N_2O$, which, according to Guimaraes (*B. M. J.*, vol. i. 1887), in sufficient doses causes paralysis with elevation of temperature, ending in death. It has been given to man as an antiperiodic in *doses* of thirty grains (2.0 Gm.) a day. (See also *A. J. P.*, 1886, 278.) Later a third alkaloid, *vellosine*, $C_{23}H_{28}N_2O_4$, was found. This forms colorless crystals, melting at 189° C. (372.2° F.), insoluble in water, easily soluble in alcohol and ether. In concentrated nitric acid it dissolves with a purplish-red color, which is very stable.

Papaya. *Melon Tree. Papaw.*—The *Carica Papaya*, L. (Fam. Papayaceæ), is an herbaceous tree, everywhere cultivated in tropical countries for the sake of its fruit. The fruit sometimes attains a size larger than that of a man's head. According to Peckholdt (*P. J.*, Nov. 1879), the milky juice is contained in all parts of the tree, but in such small quantity, save in the unripe fruit, that it is always procured from the latter. One fruit will yield about 33 Gm., which is obtained by scratching through the skin in various places; the process does not interfere with the ripening of the fruit, but it is said that the seeds will not germinate. The milk has an acid reaction, an astringent bitterish taste, and a sp. gr. of 1.023. Upon standing for a few minutes it separates into two parts, an aqueous liquid and a white, somewhat coagulated pulpy mass. In the aqueous portion is an albuminous substance, to which the names of *papaïn* and *papayotin* have been given. According to the researches of S. H. C. Martin, papaw juice contains papaïn, which is associated with an albumose, also a milk-curdling ferment. The proteids present in papaw juice were found to be as follows: 1. Globulin, resembling serum globulin in its most important properties. 2. Albumin. 3. β-phytalbumose, precipitated almost completely by heat, by saturation with neutral salts, but not by dialysis. It differs from the heteroalbumose of Kühne and Chittenden by not being precipitated by dialysis, by copper sulphate, or by mercuric chloride. 4. α-phytalbumose, soluble in cold or boiling water; not precipitated by saturation with neutral salts, except in an acid solution. This is the *vegetable peptone* referred to by Vines (*J. P.*, iii.) as *hemialbumose*. It differs from the protalbumose of Kühne and Chittenden by its non-precipitation by sodium chloride or by copper sulphate. No peptones occur in the juice, but *leucine* and *tyrosine* are present. (*J. Chem. S.*, 1886, 642; see also *P. J.*, 1885, 129.) The milky juice of the papaw can be imagined as quite akin to the gastric or pancreatic juice of the animal organism. In a representative preparation the ferment action seems to be most marked when all the proteids are associated together in the natural form; but the action of this ferment presents features which contrast peculiarly with those of the ordinary digestive ferments. In its action upon albumin the enzyme of the papaw produces products which have a close relation to those produced by tryptic and pepsin digestion. The action of the papaw fer-

ments on milk is quite identical with the action of fermentation. There is first the act of curdling, in which the casein is separated into a soft flocculent precipitate, and this is followed by a digestion of the proteids, during which process they are converted into soluble and diffusible products. The amount of starch-converting ferment is not large, but sufficient in the fresh latex to promptly act upon starch paste, thinning it, and converting a portion at least into soluble starch and dextrin. The import of the rennet ferment and the pectase probably present require further investigation. The statement appears to be warranted that the digestive action of the ferments contained in the papaw latex and the products formed in such are quite identical with that of animal and vegetable ferments in general. Other constituents of the papaw tree—*Carica Papaya*—are a glucoside, *caricin*, and an alkaloid, *carpaine*. The glucoside resembles *sinigrin*, and is obtainable, so far as the author's experience is concerned, only from the seed, in which it is fairly abundant. These seeds also contain the glucoside-splitting ferment, *myrosin*, and by the reaction of the two a volatile pungent body is produced, suggestive of oil of mustard in odor. The alkaloid, *carpaine*, has so far only been obtained from the leaves. Physiologically, this alkaloid has the effect of a heart stimulant, quite similar to that of digitalis. (*A. J. P.*, July and August, 1901, 336–48 and 383–39.) Van Rijn extracted from the leaves of *C. Papaya* an alkaloid, *carpaine*, $C_{14}H_{25}NO_2$, which is used as a febrifuge. Oefele regards this alkaloid as a substitute which may be used for digitalin.

According to Wurtz, the fibrin is dissolved whether the solvent solution be alkaline or acid. Brunton and Wyatt and also Martin affirm, however, that one-half per cent. of hydrochloric acid will prevent digestion, but Albrecht reasserts that hydrochloric acid hastens the action of the ferment, and states that the official preparation in use in the Paris hospitals is an acid one. In order entirely to convert fibrin into pure peptone so that nitric acid will produce no precipitate, the proportion of the ferment should be as great as 3 per cent., and digestion must continue for forty-eight hours at 50° C. (122° F.).

Papaya juice has a tendency to spoil by undergoing a butyric fermentation, but Wurtz found that the addition to it of glycerin preserved it without interfering with its digestive power. Imported in this form, it was a thick, milky liquid. As it now occurs in commerce, papaïn is a grayish, fine powder, which in appearance, odor, and taste strongly suggests pepsin. Recently it has been much used as an internal medicine in *dyspepsia* and *gastric catarrh*, and as a local application for the destruction of false membranes, *warts*, *tubercles*, walls of old sinuses, and even of *epithelioma*. It is not caustic nor astringent, but destroys the part by virtue of its power of dissolving not only muscular but connective tissue. Jacobi affirms (*T. G.*, vol. ii.) that diphtheritic membranes are dissolved in a few hours by the hourly application of a mixture of one part of papaïn with two parts each of water and of glycerin. It is stated that from time immemorial the fresh leaves of the papaya plant have been used by the Indians to wrap meat in to make it tender, and as a dressing to *foul wounds*. Peckoldt says that, taken internally, the juice is reputed to cause intestinal inflammation. No recent observers have noted such influence. According to Brunton, the *dose* is from five to ten grains (0.32–0.65 Gm.). Injected into the venous circulation it acts as a powerful poison, of which a single grain is sufficient to kill a rabbit.

Under the name of *papayotin*, *papaïn*, or *papoid*, the more or less impure ferment of the *Carica Papaya* is put upon the market, and, according to various authorities, it acts powerfully upon starch, converting it into maltose; emulsifies fat, and converts albuminoids into peptones. It is asserted for it that, when the stomach is acid, it is much superior to pancreatin, because its action is not markedly affected by contact with the acid. In experiments made by H. C. Wood with a papoid from one of the most renowned manufacturers no digestion occurred, and it is probable that much of the article of commerce is inert.

Paraform. *Paraformaldehyde. Triformol. Trioxymethylene.*—This compound, which may be considered as a polymerized formaldehyde, is a colorless, crystalline powder, melting at 171° C. (339.8° F.), which even at ordinary temperature, but more rapidly on heating, evolves vapors of formaldehyde. It is soluble in water, but scarcely soluble in alcohol and ether. It is used as an internal antiseptic in *doses* of from eight to fifteen grains (0.5–1.0 Gm.) and externally in surgery as an antiseptic, and in the form of tablets to liberate formaldehyde gas by heating in "formaldehyde lamps."

Parameria. *Parameria vulneraria*, Radlkofer. (Fam. Apocynaceæ.)—This tree yields the *Balsamo de Taguloway* of the Malays. (See *A. Pharm.*, Nov. 1885.)

Paramidoacetophenone. $C_6H_4.NH_2.CO.CH_3$. This substance occurs in crystals soluble in boiling water, alcohol, and ether, and melting at 106° C. (222.8° F.). It has been used in the practical application of Ehrlich's *diazo test*. Two solutions are used for this purpose, as follows:

Solution 1.—Paramidoacetophenone, 0.5 Gm.; hydrochloric acid, 50 Gm.; water, 1000 Gm. Solution 2.—Sodium nitrite, 0.5 Gm.; distilled water, 100 Gm. Both solutions must be kept in dark bottles, and when required for use 2 Cc. of Solution 2 should be added to 100 Cc. of Solution 1. In testing, fill one-fourth of the test glass with the urine, add an equal quantity of the diazo reagent and mix both fluids; then add at one pouring a quantity of ammonia equal to about one-seventh or one-eighth of their combined bulk and shake vigorously. The reaction is regarded as positive if the fluid acquires a distinctly red color, while the foam produced by shaking should be wine-colored.

Parietaria. *Parietaria officinalis*, L. *Wall Pellitory. Pariétaire, Perce-muraille*, Fr. *Glaskraut*, G. (Fam. Urticaceæ.)—A perennial European herb, growing on old walls and heaps of rubbish. It is diuretic and refrigerant, and was formerly used in urinary complaints and *dropsy*, in the form of decoction or of the expressed juice.

Paris Green. *Schweinfurt Green. Aceto-Arsenite of Copper.* $Cu(C_2H_3O_2)_2.3Cu(AsO_2)_2$. This substance, which was originally made for a pigment, is now used to an enormous extent for dusting on potato vines to destroy the so-called *potato bug*, or *Colorado beetle*, *Doryphora decemlineata*. It is made by mixing five parts of verdigris with sufficient water to form a thin paste, and adding to this a boiling solution of four parts of arsenic trioxide in fifty parts of water, keeping the mixture at the boiling temperature, and adding a little acetic acid to cause it to retain a

brilliant color. It is rarely found pure in commerce. Numerous cases of poisoning have occurred through carelessness in its use as an insecticide. The treatment would be the same as that for poisoning by arsenic. *Lead arsenate* (*Chem. News*, 1896, 17) has been used as a substitute for Paris green as an insecticide.

Parkia. *Parkia biglandulosa*, W. and A. (*P. africana*, R. Br.). *African Locust. Nitta* or *Nutta tree. Doura. Houllé. Neretou.*—This is an African leguminous tree, from the dried seeds of which a farinaceous food is prepared by the natives. According to De Rochebrune (*Toxicolog. Africaine*, 1898), it contains a peculiar crystalline alkaloid, *parkine*, which resembles in its physiological activity physostigmine.

Parthenium. *Chrysanthemum Parthenium* (L.), Pers. (*Matricaria Parthenium*, L., *Pyrethrum Parthenium*, Sm.) *Feverfew. Matricaire*, Fr. *Mutterkraut*, G. (Fam. Compositæ.) A perennial herbaceous plant, about two feet high, with an erect, branching stem, pinnate leaves, oblong, obtuse, gashed, and dentate leaflets, and compound flowers in a corymb upon branching peduncles. It is a native of Europe, but cultivated in our gardens. The whole herbaceous part is used. The plant has an odor and taste analogous to those of chamomile, which it resembles also in the appearance of its flowers and in its medicinal virtues. According to Zeller, a pound of it yields 4.8 grains of volatile oil. (*Centralblatt*, 1855, 205.) The volatile oil is greenish, boils between 165° C. (329° F.) and 220° C. (428° F.), and separates on standing *pyrethrum camphor*, $C_{10}H_{16}O$, containing in addition a hydrocarbon and an oxidized oil. (Dessaignes and Chautard, *J. P. C.* (3), 13, 241.) Though little employed, it is undoubtedly possessed of useful tonic properties. The flowers of this and of a closely resembling species, *Matricaria parthenoides*, Desf., are said to be used in France, to a considerable extent, indiscriminately with those of the true chamomile plant, *Anthemis nobilis*, which they closely resemble, especially when double. They may, however, be distinguished, in this state, by their peculiar odor, their smaller receptacle, which is, moreover, rounded and flattened above, instead of being conical and somewhat pointed as in the Anthemis, and by the tubular five-toothed central florets, which in the chamomile are small, few, and scarcely visible, but in the two former species are large, very numerous, and very long.

Parthenium hysterophorus, L.—José Torar has found *parthenine* and four other alkaloids besides *parthenic acid*, in this Cuban plant which is used by the natives as a febrifuge and antiperiodic. Of the alkaloids, *parthenine* is crystallizable and is apparently the active principle. It has been extracted and studied again by H. Vin Arny (*A. J. P.*, 1890, 121), who believes it to be a bitter glucoside and not an alkaloid. In *doses* of three grains (0.2 Gm.) it is said to quicken the heart, and in *doses* of fifteen grains (1.0 Gm.) to slow cardiac action, while fifty grains (3.2 Gm.) not only lessen the arterial pressure and respiratory frequency but reduce the bodily temperature. In *doses* of from seven to ten grains (0.45–0.65 Gm.) it is affirmed to be useful in neuralgia. (See *D. M. W.*, Feb. 1886; *Journ. de Méd. de Paris*, March, 1887; *J. P. C.*, xii. 1885; *A. J. P.*, 1897, 169.)

Parthenium integrifolium, L., *American Feverfew, Wild Quinine* (Fam. Compositæ), is an herbaceous perennial, growing abundantly in the prairies of the Southwestern States, which has been used as a tonic and antiperiodic; two ounces (62 Gm.) of the flowering tops may be given in infusion.

Passiflora. *Passiflora incarnata*, L. (Fam. Passifloraceæ.)—The indigenous *American Passion Flower* has been used in *doses* of from ten to thirty minims (0.6–1.8 Cc.) of a saturated tincture, in *neuralgias, sleeplessness, dysmenorrhœa*, as well as in *diarrhœa* and *dysentery*. I. Ott (*Medical Bulletin*, Dec. 1898) finds that it is a depressant to the motor side of the spinal cord, but increases the rate of the respiration, and that it has very little effect upon the circulation, only temporarily reducing the arterial pressure.

Patent Yellow. *Mineral Yellow.*—A pigment, consisting of lead chloride combined with lead monoxide. It is prepared by mixing common salt and litharge with a sufficient quantity of water, allowing the mixture to stand for some time, then washing out the liberated soda, and exposing the white residue to heat.

Paulowilhelmia. *Paulowilhelmia speciosa*, Hochst.—This acanthaceous plant is used by the Aquapine tribe on the Gold Coast, as a fish poison, under the name of *adubiri*. (*P. J.*, xx. 1890.)

Peach Leaves. *Leaves of Amygdalus Persica*, L. *Persica vulgaris*, Miller. *Prunus Persica*, Stokes. *Pêcher*, Fr. *Pfirsich*, G.—The peach tree is supposed to have been originally brought from Persia, but flourishes everywhere in the warm temperate zone. Peaches are among the most grateful and wholesome of our summer fruits. They abound in saccharine matter, which renders their juices susceptible of the vinous fermentation, and a distilled liquor prepared from them has been much used, in some parts of the country, under the name of *peach brandy*. The kernels of the fruit resemble, physically and chemically, bitter almonds, for which they are frequently, and without inconvenience, substituted in our shops. The flowers, leaves, and bark also have the peculiar odor and taste of bitter almonds, and yield hydrocyanic acid. The leaves afford a volatile oil by distillation. The distilled water prepared from them was found in one instance to contain 1.407 parts of hydrocyanic acid in 1000, and in another only 0.437 parts in the same quantity. From some experiments it is inferred that the proportion of acid is greatest where there is least fruit. (*A. J. P.*, xxiv. 72.)

Peach kernel oil made by expression has found its way into Western Europe from the Levant, and is used in Italy and Southern France largely as an adulterant of almond oil. It is described as of a light yellow color, having the taste and odor of almond oil. It thickens at —9° C. or —10° C. (15.8° F. or 14° F.), and solidifies at —18° C. (—0.4° F.). The sp. gr. at 15° C. (59° F.) is 0.915. It gives with strong nitric acid a dark brown color, with sulphuric acid a dark brown becoming lighter, with solution of zinc chloride a purplish brown; forming with the elaidin test in two hours a mass of butter-like color and consistence. Peach kernel oil has a saponification value of 189–192 and an iodine figure of 93.5.

The leaves of the peach are said to be laxative, and, owing to the hydrocyanic acid which they yield, almost all parts of the tree have a sedative influence over the nervous system, and have been used with asserted advantage in *whooping cough, irritability of the bladder*, etc. The dried leaves may be employed (an ounce to a pint of hot

water) in infusion, but the tincture of the inner bark (an ounce to a pint of diluted alcohol), *dose*, from ten to thirty minims (0.6–1.8 Cc.) is possibly preferable. The flowers of the peach are affirmed to be laxative and vermicidal, in half-fluid-ounce (15 Cc.) doses when fresh, given in the form of syrup. Cases of fatal poisoning in children from their use are on record. The peach kernels are distinctly active, and when rubbed up with cold water form an emulsion which may be used in place of cherry-laurel water or other preparations of hydrocyanic acid.

Pearl White. *Pearl Powder.*—Bismuth oxychloride prepared for cosmetic use.

Peganum. *Peganum Harmala*, L. (Fam. Rutaceæ.)—In the seeds of this plant Goebel (1837) found the alkaloid *harmaline*, and Fritzsche (1847) a second alkaloid, *harmine*, which have been restudied by Fischer and Täuber. (*A. J. P.*, 1886, 89.)

Pelargonium. *Pelargonium odoratissimum*, Soland. *Rose Geranium.* (Fam. Geraniaceæ.) This well-known plant, which is a favorite for its odor in our dwellings and conservatories, is a native of Cape Colony, South Africa, but is said to be cultivated extensively in the south of France and in Turkey for the sake of its volatile oil, which is much employed for the adulteration of the otto of roses. According to Guibourt, three species of Pelargonium yield a volatile oil by distillation, closely analogous in odor to that of the rose: the species above named, *P. capitatum*, Soland., and *P. roseum*, Willd. (*Hist. Nat. des Drogues*, 4e ed., iii. 52.) The oil is obtained from the leaves. Recluz obtained from thirty-five ounces of *P. odoratissimum*, W., two drachms of a volatile, crystallizable oil. (Mérat and De Lens, *Dict. de Mat. Méd.*, iii. 368.) According to Septimus Piesse, one cwt. yields about two ounces. (See *A. J. P.*, xxvi. 368.) The oil which occurs in commerce, purporting to be the oil of *P. odoratissimum*, is perfectly fluid at ordinary temperatures, of a pale brownish-yellow color, and the characteristic odor of the plant, recalling merely that of the rose. This oil is now much used in perfumery. Piesse states that, as this oil is used to adulterate that of roses, so is it in its turn adulterated with the cheaper oil of *Andropogon Nardus*, L., cultivated in the Moluccas. (*A. J. P.*, xxvi. 368.) It appears, however, that the oil known as *oil of palmarosa* is the product of *Andropogon Schœnanthus*, L., distilled in India, and this oil is used most largely to adulterate oil of rose and oil of rose geranium. According to Baur, the oil is shipped in large copper flasks from Bombay to the Red Sea, and thence to Constantinople and Kizanlik. Jallard states that the true oil of rose geranium from *P. roseum* is freely soluble in 70 per cent. alcohol. The oils likely to be used to adulterate it are insoluble in this liquid. If, therefore, six drops of the suspected oil be mixed with 5 Cc. of 70 per cent. alcohol, there should be no separation. (*A. J. P.*, 1878, 260; from *J. P. C.*) F. W. Semmler (*Ber. d. Chem. Ges.*, xxiii. 1098) has shown that the chief ingredient in the various geranium oils is an alcohol, *geraniol*, $C_{10}H_{18}O$, which boils at from 231° to 232° C. (447.8°–449.6° F.), and has a sp. gr. 0.884 at 15° C. (59° F.). When oxidized by chromium trioxide mixtures, it is changed into *citral*, $C_{10}H_{16}O$, an aldehyde found in many of the essential oils, and this when oxidized by silver oxide yields *geranic acid*, $C_{10}H_{16}O_2$. The geraniol is both free and combined as *tiglic acid ester*. The oil also contains citronellol. (*Schim. Rep.*, April, 1897.)

Pengawar Djambi. *Paku Kidang.*—This is composed of silky, long, yellow or brownish hairs, very soft, which are obtained in Sumatra from the rhizomes of various ferns, especially of species of the genus *Cibotium*, especially *C. djambianum*, Hassk., *C. Barometz*, J. Sm., and *C. glaucescens*, Kze. It has the power of causing rapid coagulation of blood, and, when properly used, of mechanically arresting hemorrhages from capillaries. It has been much used in the physiological laboratories of Europe and this country, and was employed in human medicine during the Middle Ages under the name of *Agnus Scythicus*. The mediæval drug was composed of pieces of the rhizome with the attached scales and petioles so cut as to resemble animals. Attention has been called to the Pengawar Djambi on account of the assertions of Junker of its usefulness during the Franco-German war. (*L. M. R.*, Dec. 1887.) It is undoubtedly a very efficient styptic.

Pental. *Tri-methyl-ethylene. Isoamylene.* $(CH_3)_2C:CH.CH_3$.—A hydrocarbon prepared by distilling amyl alcohol with zinc chloride and treating the distillate with sulphuric acid. A colorless liquid, sp. gr. 0.6783, boiling at 38° C. (100.4° F.), insoluble in water, and miscible with alcohol, ether, and chloroform. It was proposed as an anæsthetic, but is probably of very little value in medicine.

Penthaclethra. *Penthaclethra macrophylla.* The nuts of this plant, which grows in the Congo States, are said to contain an alkaloid, *paucin*, crystallizing in yellow foliaceous crystals, melting at 126° C. (258.8° F.), insoluble in ether and chloroform, having the formula $C_{27}H_{38}N_8O_8$. (*P. J.*, lix.)

Peptones.—The general name of a class of albuminoids into which the nitrogenous elements of food (such as albumin, fibrin, casein, etc.,) are converted by the action of the gastric or pancreatic juices. This conversion is caused by the ferment pepsin, normally present in the gastric juice, but used to produce peptones on a large scale for food and medicinal uses, and also by trypsin present in the pancreatic juice.

Peptones are not precipitated by potassium ferrocyanide in the presence of acetic acid like other proteids, and are not coagulated by heat. They are readily assimilated by the intestinal mucous membrane and peptonized meats are used as a *nutritive medicine*.

Perezia Root.—This root is obtained from several Mexican plants, *Perezia Wrightii*, A. Gray, *P. Nana*, A. Gray, and *P. Dugesii*, A. Gray. (Fam. Compositæ.) It contains *pipitzahoic acid*, a substance which crystallizes in beautiful golden-yellow needles. R. Anschütz and J. W. Leather obtained from the dried roots of *P. adnata*, A. Gray (*Trixis Pipitzahoac*, Schaffner), an average of 3.6 per cent. of this acid, which melts at from 103° to 104° C. (217.4°–219.2° F.), sublimes readily, and is easily soluble in alcohol, ether, chloroform, benzene, and glacial acetic acid. The authors confirm the formula given to the acid in 1855,—viz., $C_{15}H_{20}O_3$. It is a quinone, and bears great resemblance, when recrystallized from diluted alcohol, to *oxythymoquinone*, which, recrystallized from the same liquid, is scarcely distinguishable from it. (*A. J. P.*, 1884, 185, and *Ph. Rund.*, 1883, 245; *A. Pharm.*, 1887, 183.)

Under the name of *perezol* the 0.5 per cent. alcoholic solution of *pipitzahoic acid* has been recommended by Duyk as an alkalimetrical indicator. By acids it is at once decolorized; with alkalies

it becomes reddish. Boric, and perhaps other acids, and acetates, borates, bicarbonates, and carbonates act with respect to the solution like alkalies.

Periploca. *Periploca græca*, L.—From the bark of this asclepidaceous plant, growing in the neighborhood of the Black Sea, has been separated by Lehmann and Burschinski (*A. Pharm.*, 1897) a colorless crystalline glucoside, *periplocin*, soluble in 125 parts of water, freely soluble in alcohol. According to the experiments of Lehmann and Burschinski, it is an active cardiac poison belonging to the digitalis group.

Peronine. *Peronin.* $C_{17}H_{18}NO_2.O.C_6H_5CH_2$ HCl.—This is the hydrochloride of morphine benzyl-ester, produced by replacing the hydrogen of the hydroxyl group in morphine, which is analogous to the hydroxyl group of phenols, with the alcohol radical ($C_6H_5CH_2$). Peronine occurs as a bitter, odorless white powder, consisting of prismatic crystals. At 65.5° C. (150° F.) it dissolves in water in the proportion of 7.5 to 1000, but dissolves readily in 10 parts of boiling water, the aqueous solutions having a bitter taste and being neutral to litmus. It is further soluble in 218 parts of 95 per cent. alcohol, in 100 parts of methyl alcohol, and in 390 parts of chloroform. Although precipitated from its solutions by the general alkaloidal reagents, peronine differs both in its solubilities, and also in its behavior towards special reagents, from morphine and codeine.

Peronine was first therapeutically investigated by Schröder (*Th. M.*, 1897), and the conclusion reached that in its medicinal activities it is intermediate between morphine and codeine. Reports have been made upon it by Nowak (*Ther. Woch.*, 1897), by Munk (*Aerztl. Central-Anzeiger*, 1897), and by Eberson (*Th. M.*, 1897). The physiological action of the drug has been partially studied by Mayor (*Revue Méd. de la Suisse Romande*, 1898), who finds that it produces in guinea pigs and rabbits exaggerated reflexes, ending, if the dose have been large enough, in convulsions and death by asphyxia. The lethal dose for rabbits, according to Mayor, is 2.5 Gm. per kilo, or little less than one-third that of codeine. On the other hand, Pierart affirms, as the result of his experiments, that peronine is more poisonous than morphine. Clinically, peronine has been used to some extent as a substitute for morphine, having analgesic and hypnotic powers inferior to those of that alkaloid, but being of distinct value in the treatment of *phthisis*, *chronic bronchitis*, and other pulmonary diseases. The *dose* is from one-third of a grain to one grain (0.021–0.065 Gm.). Given during the day in the smallest dose mentioned, every five to six hours, in cases with severe cough, it is said to act most favorably in producing comfort during the day and rest at night.

According to Bufalini, confirmed by Gevaert, the 1 to 2 per cent. solution of peronine placed in the conjunctival sac produces a complete anæsthesia which lasts for many hours. The drug, however, probably has no practical value on account of its causing pain, œdematous swelling, and even serous chemosis of the conjunctiva.

Persulphates.—Persulphates are obtained by the electrolysis of solutions of sulphates. Sulphuric acid is decomposed into H_2 and SO_4 and the SO_4 ion unites with a molecule of the normal sulphate, as:

$$Na_2SO_4 + SO_4 = Na_2S_2O_8$$

They have been brought forward for use in medicine and dentistry on account of their yielding oxygen when heated and their germicidal properties. According to Friedländer (*Th. M.*, Feb. 1899), the half per cent. aqueous solution checks the growth of pathogenic bacteria, and the 5 per cent. solution kills them. They are said to be actively poisonous, 0.5 gramme per kilo rapidly causing death in the rabbit, and to be violently irritant to mucous membranes; one and one-half to five per cent. solutions have been used to some extent in the dressing of wounds.

The important persulphates are *ammonium persulphate*, $(NH_4)_2S_2O_8$, which occurs in colorless crystals, making a turbid solution with water; the *potassium persulphate*, $K_2S_2O_8$, which occurs in colorless crystals, very slightly soluble in water; and the *sodium persulphate*, $Na_2S_2O_8$, a colorless crystalline powder, sparingly soluble in water.

The *ammonium persulphate* has been strongly recommended by Strzyzowski (*Schweizer Wochen. f. Chemie u. Pharmacie*, 1898, No. 48) as a urinary reagent; if its ten per cent. solution is allowed to fall into a test tube containing urine the presence of albumin will be revealed by a whitish-gray zone at the juncture of the two liquids. The development of a green tint indicates the presence of biliary pigments.

Löwenberg prepares *sodium persulphate* as follows: A concentrated solution of sodium sulphate and a diluted solution of sulphuric acid, separated from each other by a porous diaphragm—a clay cylinder—are so arranged that the positive pole of an electric battery dips into the saline solution in form of platinum wire, while the negative pole is joined to a sheet of platinum immersed in the acid solution. By electrolysis sodium persulphate ($Na_2S_2O_8$) is formed in the saline solution, a necessary precaution being that the solution be neutralized from time to time so as to overcome too great acidity—sodium sulphate being then simultaneously produced for the next operation. The sodium persulphate so obtained is not absolutely pure, usually containing several per cent. of sodium sulphate. It is a white, crystalline, odorless powder, which when heated in the presence of water easily decomposes, thus:

$$Na_2S_2O_8 + H_2O = Na_2SO_4 + H_2SO_4 + O$$

Its therapeutic energy depends upon the production of free sulphuric acid and oxygen. The salt is readily soluble in water, and its solutions keep unchanged for weeks unless they be heated or in contact with easily oxidizable bodies. (*Th. M.*, 1899, 99.)

Sodium persulphate has been recommended internally as an aperitive stimulant to digestion, in *hypochondria*, *chlorosis*, *neurasthenia*, and various other conditions. The *dose* in a day is three and one-half grains (0.23 Gm.).

Persodine is the one and three-tenths aqueous solution which has been supplied commercially in France.

Peruol.—This is a twenty-five per cent. solution in castor oil of *peruscabine*, the active principle of Peruvian balsam, which has been produced synthetically by Erdmann. Peruscabine itself is pure *benzoic benzyl-ester* and is a colorless oil, boiling at 173° C. (343.4° F.). It has been used in skin diseases and is said to be especially valuable in *scabies* and in *mange*. The whole or a part of the body should be freely anointed with some friction three or four times in thirty-six hours, and after a day or more a soap bath given.

Petroleum. *Rock Oil. Oleum Petræ. Coal Oil. Pétrole, Huile minéral*, Fr. *Bergöl*, G. Petroleum is a native mixture of hydrocarbons

with very small amounts of oxidation or alteration products admixed. The hydrocarbons may be gaseous, liquid, or solid, and in crude oil, fresh from the wells, all three classes are present. The hydrocarbons belong to several of the homologous series known to organic chemistry. The researches of Pelouze and Cahours, of Warren, and more especially of Schorlemmer, have established the presence of the paraffin series, C_nH_{2n+2}, beginning at methane and continuing through the liquid members, which constitute the bulk of the oil, to the solid hydrocarbons known commercially as "paraffine;" of the olein series, C_nH_{2n}; of the benzene series, C_nH_{2n-6}. After the oil has been heated, as in distillation, pyrogenic products form, so that in the residues of petroleum distillation, naphthalene, anthracene, and other higher hydrocarbons have been detected. In Caucasian petroleum, Beilstein and Kurbatow (*A. J. P.*, 1880, 612) have also found another homologous series of hydrocarbons, *hexahydrobenzene*, C_6H_{12}, and its homologues known as the *naphtenes*.

Pennsylvania petroleum consists, however, chiefly of paraffins, and the individual hydrocarbon making the bulk of illuminating oil is *heptane*, C_7H_{16}. The oxidation products accompanying petroleum constitute only a small fraction of 1 per cent. usually, and have not been very fully studied. It is known, however, that these alteration products are largely acid in character. Prolonged atmospheric exposure may, however, cause a petroleum to thicken, at least superficially. In this way the semi-solid deposits of California are explained, as well as Rangoon tar and Trinidad pitch or bitumen. When the bitumen is in the solid state it is called *asphaltum*. This is black, dry, friable, and insoluble in water or alcohol. Not infrequently asphaltum exists in nature mixed with more or less of the liquid substance, and this semi-solid mixture is distinguished by the name of *maltha* or *mineral tar*.

Petroleum has been known from the earliest historical period. Within the limits of the United States it has long been known to exist in a few localities. On the borders of Seneca Lake in the State of New York small quantities of it were collected, and to some extent used in medicine under the name of *Seneca oil*. In Western Pennsylvania, on Duck Creek in Ohio, near Scottsville in Kentucky, and on the Kanawha in Virginia it attracted local attention, and a certain locality in Western Canada had acquired some notoriety by its burning spring. But little attention was paid to it until the year 1859, when, the preparation of oil for burning, distilled from bituminous shales, having proved very profitable, and a strong resemblance having been shown to exist between this and petroleum, enterprise was directed towards some of the known sources of the latter liquid, and, being greatly stimulated by success, soon led to further and astonishing discoveries. At first the most productive locality of petroleum was in Western Pennsylvania; but it has been found to exist in great quantities elsewhere, and in fact occupies large portions of a region commencing in Western Canada, and extending, through New York and Pennsylvania, westward into Ohio and Kentucky, and far southward into West Virginia. After the Pennsylvania field, in order of development, is that of Ohio; but most of the oil produced in this State is from a different geological horizon,—viz., the Trenton limestone,—and contains a persistent sulphur impurity. This renders the Ohio oil (popularly known also as *Lima oil*, from the town of Lima, Ohio) more difficult and expensive to refine. It is hence very largely used in the crude state as *fuel oil*, and as such has been of the greatest industrial value, being shipped by pipe line or tank cars to great distances. Within recent years large quantities of petroleum have been found in California, Texas, Louisiana, Kentucky, and Kansas, but in the main it is of a grade much inferior to that known as Pennsylvania oil, being largely used as fuel oil.

In the early days of the petroleum discovery the oil was gathered as it floated on the surface of the water in springs or small streams. In 1859 the first oil well, the Drake well, was sunk near Titusville, Pa., and the oil-bearing strata were reached at a depth of seventy-one feet, with the result of some eight barrels per day. In 1861 and 1862 the first large flowing wells were struck in drilling for oil. The explanation of these flowing wells is simply that in new territory the gaseous hydrocarbons have accumulated with the liquid oil in such amount that they exert an enormous pressure, causing a flow of oil at the rate of two, three, and in one case as high as eight thousand barrels per day. Often, however, the pent up gas escapes with enormous force without any accompanying oil. These *gas wells*, as they are termed, are well known throughout the oil regions, and they have been utilized on a large scale as sources of gaseous fuel for manufacturing and domestic purposes. The statistics show that the value of the coal displaced by natural gas as fuel in 1903 was $35,815,360, and in 1904, $38,496,760. Of this amount nearly one-half was obtained in Pennsylvania, while Indiana, West Virginia, and Ohio followed in the order named. (*Mineral Resources of the U. S.*, Washington, 1904.) Sadtler has analyzed numerous samples of this natural gas, and finds it to consist chiefly of methane and its homologues, with traces of the olefines and of carbon monoxide. In one case free hydrogen was present. (*Proc. Amer. Philos. Soc.*, xvi. 585, 1877.) After a well has flowed oil for a time, it will continue to yield on pumping. Indeed, many smaller wells never have flowed, and have to be pumped from the start. In some districts "torpedoing" with nitroglycerin has been largely resorted to after a well has begun to decline in power, in order to increase the flow. The explosion effects this by shattering the sandstone and pebble conglomerate which holds the oil, so that new channels are opened.

Oil wells are of various depths. The first or Drake well, as stated, was only seventy-one feet deep, while in Butler County the fourth sand rock was reached only at a depth of from 1500 to 1800 feet, and in Washington County and other localities in the southwestern part of Pennsylvania the oil was obtained from a depth of 2000 feet.

There are two theories as to the origin of petroleum. According to one, it is simply a product of distillation from the bituminous shales which underlie almost the whole of this oil producing country. The gas and the liquid oil are equally products of this distillation. According to the other, it represents the decomposition of marine plants and animal life which accumulated in these sand rock formations. These decomposition products may have also been in part subjected to distillation.

Studies by Engler (*Ber. d. Chem. Ges.*, 1888, 1816) on the distillation under pressure (ten atmospheres) of fish oils and of olein and other

fats show that large amounts of light oils, composed of pentane, hexane, heptane, octane, and nonane, can be obtained, thus making the second theory very probable.

S. P. Sadtler (*Proc. Amer. Phil. Soc.*) has shown that linseed oil, distilled under pressure, may be made to yield hydrocarbons of the paraffin series, and has obtained products of all gravities from light benzin to solid scale paraffin. Thus, Engler's theory must be broadened sufficiently to allow of the vegetable seed oils being taken as original sources of petroleum production as well as animal oils.

Crude petroleum is occasionally of a clear color when taken from the earth, but is generally of a greenish color, appearing claret-red by transmitted light. The green color may, however, become so dark as to be almost black. In gravity it varies from 0.865 to 0.777, or from 32.5° to 52° Baumé.

The enormous production of crude petroleum in the last twenty-five years has had the effect of developing a variety of new industries connected with the working or shipping of it. The whole producing area of Western Pennsylvania and adjacent States is now covered with a net work of wrought iron pipes, for the conveyance of the oil; and these "pipe lines" now extend to Cleveland, Buffalo, Pittsburg, New York, Philadelphia, and Baltimore, so that crude oil is pumped from the vicinity of the wells to the seaboard cities, to be refined there or to be exported in bulk. The refining of crude oil, and the working up of the several liquid and solid products that are known commercially, are also immense industries. The production of crude petroleum for the year 1904 amounted to 120,000,000 barrels, of which 30,316,328 barrels were what is known as Pennsylvania grade (produced in the Appalachian field), 21,241,058 barrels of what is known as Lima oil (produced in Ohio and Indiana), 29,805,000 barrels in California, 19,500,000 barrels in Texas, 6,600,000 barrels in Louisiana, 5,600,000 barrels in Kentucky, 5,600,000 barrels in Kansas, and 1,387,614 barrels in other States. The exports of crude and refined petroleum for the year 1904 were: crude petroleum, 95,974,645 gals.; naphtha and light distillates, 22,837,347 gals.; illuminating oils, 745,742,071 gals.; lubricating oils and paraffin, 87,459,482 gals.; residuum, 33,736,412 gals.; total of all grades, 985,729,957 gals., valued at $78,221,167.

After American petroleum the next in importance is Russian or Caucasian. The wells here, although only a few hundred feet in depth, are wonderfully prolific and are veritable "oil fountains." Two of them, the Droobja well and Nobel's No. 9, each yielded for a time nearly 48,000 barrels of crude oil every twenty-four hours.

The method of purifying petroleum is analogous to that already described for purifying coal tar. The crude oil is put into large retorts of wrought iron and exposed to a heat rising gradually to between 315.5° C. (600° F.) and 426.6° C. (800° F.), by which all the volatile ingredients are distilled, leaving from five to ten per cent. of solid residue, constituting a sort of coke. The liquids thus obtained are comparatively colorless, though still retaining the strong odor of the crude oil. The several fractions are collected separately and show very varying gravity and volatility, and are applied to different uses. An average result of a normal distillation may be stated as follows: gasoline 1½ per cent., refined naphtha 10 per cent., benzin 4 per cent., refined petroleum or kerosene 55 per cent., lubricating oil 17½ per cent., paraffin 2 per cent., loss, gas, and coke 10 per cent. As the greater demand for illuminating oil makes it desirable to get the maximum quantity of this fraction, the distillation is generally so conducted that by the process of "cracking" the yield of burning oil is increased at the expense of the lubricating oil and heavy naphtha. Many distilleries obtain, therefore, from 75 to 80 per cent. of illuminating oil from the crude material. A crude distillate, however, would not be adapted for the purposes of an illuminating oil, so the distillate must be treated with acid. It is placed in the treating tank or "agitator" and 1 or 2 per cent. of strong sulphuric acid is added, when by the aid of an air blast introduced below the whole is violently agitated. The acid combines with the impurities of the oil and forms a tarry substance, called "*sludge acid*," which settles to the bottom, and after the whole has subsided is removed. The oil is then washed with water and again agitated, the process being repeated once or twice. It is then treated with caustic soda solution and again washed. The oil is now clear and almost colorless. It is then placed in large settling tanks to allow the water to separate. If it does not have the desired fire test, it is "steam stilled" and the lighter vapors taken out until the desired test is obtained. In most States of the Union the legal fire test for illuminating oil is 110° F. (43.3° C.); that is, it must not evolve inflammable vapors below the temperature of 110° F. (43.3° C.). Many special brands of illuminating oil have a much higher fire test, as high even as 300° F. (148.8° C.).

Lubricating oils, on the other hand, are valued according to their "cold test;" that is, they must not congeal except at very low temperatures. A lubricating oil, therefore, consists of the heavy liquid hydrocarbons of the paraffin and olefin series, but is free from the solid paraffin.

Medicinal Properties and Uses.—Petroleum is accounted a stimulating antispasmodic, expectorant, and diaphoretic. In large quantities it may prove poisonous, as shown by a case recorded in the *J. P. C.* (Mars, 1869, 227), in which, after swallowing by mistake a quantity of rectified petroleum, a workman was seized almost immediately with violent inflammation of the throat, with colicky pain, and a desire to vomit, followed in an instant by a fearful tetanic seizure, and a general rigidity, attended by the most frightful cries. After a relaxation of ten minutes the symptoms returned with still greater violence; and life was probably saved only through the prompt action of the powerful emeto-cathartic medicines administered. It is occasionally given in disorders of the chest, when not attended by inflammation. In Germany it has been extolled as a remedy for *tape worm*. Schwartz's formula in such cases was a mixture of one part of petroleum with one and a half parts of tincture of asafetida, of which forty drops were given three times a day. Externally, petroleum is employed in *chilblains*, *chronic rheumatism*, affections of the joints, *paralysis*, and diseases of the skin, and is said to be very effectual in *psora* and *prurigo*. (See *Petrolatum*, p. 922.) It also affords a good antiseptic dressing for wounds. (*M. T. G.*, 1870, 101.) It is an ingredient in the popular remedy called *British Oil*. The *dose* of petroleum is from thirty drops to a teaspoonful, given in any convenient vehicle. Crude petroleum is used to a

considerable extent as an external application in domestic practice. The finer kinds of petroleum have been used with alleged advantage in *cholera* by Andreosky of the Russian army, by Cloquet, physician to the Shah of Persia, and by Moretin of France. They gave from ten to twenty drops in half a glass of white wine or mint water. It is affirmed that many cases of *asthma* are much benefited by inhaling petroleum vapors.

Petrosapol.—This is a brown ointment-like compound of soap and the by-products of petroleum; especially used as a vehicle for ointments. It does not melt below 90° C. (194° F.) and does not therefore liquefy on the skin.

Petrosulfol.—This is said to be an ichthyol-like compound useful as a local remedy in *eczema* and allied diseases.

Peucedanum. *Chucklusa.*—Two North American species of this genus, of the fam. Umbelliferæ, are used by the Western Indians as food. For an account of them, with analysis, see *A. J. P.*, 1890. They contain *peucedanine.*

Peucedanum palustre (L.), Michx. (*Selinum palustre*, L.) *Marsh Parsley. Marsh Smallage. Persil de Marais*, Fr. *Radix Olsnitii. Sumpfsilge, Elsenich*, G.—The root of this European umbellifer is, when dried, of a brown color externally, having a strong aromatic odor, and an acrid, pungent, aromatic taste. Peschier found it to contain a volatile oil, a fixed oil, and a peculiar acid which he calls *selinic.* It has been used for *epilepsy* in Russia. *Dose*, from twenty to thirty grains (1.3–2.0 Gm.) thrice daily, rapidly increased to four times the amount. (*J. P. C.*, 1859.)

Pharbitis.—A genus constituted by Choisy, 1833, its species referable to Ipomœa or Convolvulus. *Ipomœa hederacea* (L.), Jacq. (*Convolvulus hederaceus*, L., *Pharbitis Nil*, Choisy, *P. triloba*, Miq.). The seeds of the Japanese convolvulaceous plant *P. triloba* have been chemically examined by K. Hirano and also by Y. Inoko, who find that they contain a large proportion of a resinous substance, seemingly identical with *convolvulin*, and acting as a cathartic in *doses* of from seven to ten grains (0.45–0.65 Gm.). (*Sei-i-kwai*, 1891.)

Phaseolus. *Phaseolus vulgaris*, L. *Common Bean.* (Fam. Leguminosæ.)—Soltsien found an alkaloid, *phaseoline*, in the legumes of the common bean. He, during a toxicological analysis, traced the source of the alkaloid which might, under other circumstances, have been mistaken for a ptomaine, to the beans found in the stomach under examination. The new substance is not crystallizable in the free state, but it crystallizes as a hydrochloride. (*A. Pharm.*, 1884.)

Phenalgin. *Ammonio-phenylacetamide.*—This is a white salt, having a peculiar mild, somewhat ammoniacal taste, forming with water an alkaline solution, and when warmed with strong nitric acid emitting dense ruddy nitric fumes, giving a solution resembling that of picric acid. It is now recognized to be a mixture of acetanilide, sodium bicarbonate, and ammonium carbonate of varying composition. It is asserted to be an analgesic, especially useful in *dysmenorrhœa*, also anti-rheumatic, and by virtue of its ammonia to act as a vascular stimulant. It is evident, however, that the effect of the ammonia which it contains must be very transient and unimportant. *Dose*, from three to twenty grains (0.2–1.3 Gm.).

Phenatol.—An antipyretic, said to be a mixture of acetanilide, caffeine, sodium bicarbonate, carbonate, chloride, and sulphate. (*Ph. Ztg.*, 1894, 784.)

Phenocoll Hydrochloride. *Amido-aceto-para-phenetidin-hydrochloride. Glycocoll-para-phenetidin-hydrochloride.* $C_6H_4 \begin{cases} OC_2H_5 \\ NH.COCH_2NH_2HCl \end{cases}$. This is formed by the action of glycocoll (amido-acetic acid) upon phenetidin. It is a white finely crystalline powder, soluble at 17° C. (62.6° F.) in sixteen parts of water; also soluble in warm alcohol. Ammonia, alkalies, and alkaline carbonates throw down the pure base phenocoll from the solution of the hydrochloride, in the form of white needles with one molecule of water of crystallization.

According to Kobert, the phenocoll hydrochloride is scarcely at all poisonous to the lower animals, and does not alter the constitution of the blood. Von Mering found that twenty-three grains could be given to the rabbit without the production of any symptoms. Further experimental research is, however, necessary before any conclusions as to the action of phenocoll can be reached, since I. Ott has found that in frogs it is paralyzant to the cerebrospinal axis, while in rabbits it produces cyanosis, reduces the force and frequency of the heart's action, and kills by centric respiratory paralysis. W. S. Carter and D. Cerna found that while ordinary doses do not affect the circulation, toxic doses lessen blood pressure by a direct action on the heart, and first stimulate and then paralyze the cardiac inhibitory system. Oby failed to get any action upon the blood itself. The fall of temperature produced by it is said to be due to lessened heat production. Hertel (*D. M. W.*, 1891) and Herzog (*Ibid.*) find that phenocoll in man usually produces no gastro-intestinal irritation or other disagreeable symptoms; that its antipyretic action, when given in doses of a gramme, is a quick, certain one; and that it acts well even in the *hectic fever* of *phthisis.* It is apt to cause considerable sweating, which can be prevented, however, by the administration of minute doses of atropine. During the taking of the drug the urine becomes of a dark reddish-brown color, but does not contain albumin; both indican and biliary substances have been noted. The observers also noticed the remedy to act very well both in acute and chronic *rheumatism.* The first reports of Hertel, so far as concerns the antipyretic influence of the drug, have been generally confirmed by clinicians, but numerous reports state that as an antirheumatic or antineuralgic phenocoll is inferior. Active antiperiodic powers are attributed to it, and both in Algiers and in Italy it has been used to a considerable extent in *malarial fevers.* As much as seventy-seven grains (5 Gm.) a day have been given without evil results, and in cases of rheumatism less than this amount usually fails to accomplish good results. Cohnheim found that phenocoll appears in the urine in one hour, and can still be recognized nine hours after its ingestion by the ferric chloride test. The *dose* is from eight to twelve grains (0.5–0.78 Gm.). It is best given in capsules.

Salocoll, Phenocoll Salicylate, $C_6H_4 \begin{cases} OC_2H_5 \\ NH.COCH_2.NH_2.C_6H_4(OH)COOH \end{cases}$, has been put upon the market as an antirheumatic. It may be used in the same doses as phenocoll.

Phenol-Bismuth. $Bi(OH)_2(C_6H_5O)$.—This is a white, neutral, non-irritant and non-toxic powder, almost odorless and tasteless, which, according to its manufacturer, contains 80 per cent. of bismuth in chemical combination with 19 per

cent. of phenol. It is stated by M. F. A. Jasenski to be decomposed in the gastro-intestinal tract, with absorption of the phenol and escape of the bismuth, in great part with the fæces. It is also asserted by Jasenski that even the largest *doses* (seventy-five grains) of it produce no evidences of phenol poisoning, and the probabilities are that but a small portion of the compound suffers decomposition in the intestinal tract. It has been used in *doses* of from eight to thirty grains (0.5–2.0 Gm.) in all forms of gastro-intestinal *catarrhs*, fermentative *dyspepsias*, and similar complaints, as an antiseptic; also to some extent locally in various mucous inflammations.

Phenolphthalein. $C_6H_4<\begin{matrix}C(C_6H_4.OH)_2\\ \text{———CO———}\end{matrix}>O$.

A coal tar product used as an indicator in volumetric analysis. It occurs in colorless powder almost insoluble in water, soluble in alcohol and in alkalies, with which latter it yields a fine red color, disappearing on addition of excess of acid.

According to the experiments of Oscar Schwarz (*M. M. W.*, June, 1903), phenolphthalein is converted in the intestines into sodium salt, which has little diffusibility and is therefore only in very small part absorbed, so that out of a *dose* of 3 grammes given to the dog 2.55 grammes were recovered from the stools; 10-gramme *doses* of phenolphthalein have no distinct effect on the elimination of the sulphates in the dog, so there can be little or no decomposition with elimination of phenol in the system. *Purgen*, said to be essentially phenolphthalein, is affirmed to be a useful laxative. *Dose*, for children, two-fifths to five-sixths grain (0.025–0.05 Gm.); for adults, one to five grains (0.065–0.32 Gm.).

Phenosal. *Phenetidin Salicylate.*

$C_6H_4\left\{\begin{matrix}OC_2H_5\\ NH.CO.CH_2.OC_6H_4.COOH\end{matrix}\right.$ It forms colorless crystals of acidulous taste, difficultly soluble in water. Phenosal is said to contain 57 per cent. of phenacetin and 43 per cent. of salicylic acid; to be decomposed into its constituents in the alimentary canal, and to be a useful remedy in the treatment of *rheumatism*, and also of *tabetic* and other *nerve pains*. *Dose*, eight grains (0.5 Gm.).

Phenosalyl.—An antiseptic mixture composed of phenol 9 Gm., salicylic acid 1 Gm., lactic acid 2 Gm., menthol 0.10 Gm., and at times benzoic acid and sodium glyceroborate and other ingredients. It has been used in aqueous solution to sterilize tuberculous expectorations.

Phenylchinaldine. *Phenylquinaldine.—Methylquinol*, $C_{10}H_8(C_6H_5)N$, is prepared by the action of hydrochloric acid on a mixture of aniline, acetophenone, and aldehyde. The hydrochloride occurs in colorless crystals, which are readily soluble. It forms with sulphuric acid a crystalline salt, easily soluble in water, with a feebly acid reaction. Leo Fürbringer (*Deutsch. Arch. f. klin. Med.*, lix. 1897) finds that it produces in the lower animals tremors, violent cramps, fall of temperature, and death (if the dose has been large enough) from failure of respiration. The fatal *dose* to the rabbit is about fifteen grains (1 Gm.). It has been used by Julius Mannaberg in *malarial fever* in the *dose* of eight grains (0.5 Gm.) three times a day, but found to be much inferior to quinine.

Phenylchinoline. *Phenylquinoline.* $C_9H_6(C_6H_5)N$.—According to Tappeiner (*Deutsch. Arch. für klin. Med.*, lvi. 1896), the action of this substance on the lower organisms is almost identical with that of quinine and about equal to it in strength.

Phenylenediamine. $C_6H_4(NH_2)_2$.—*Para-phenylenediamine* and *meta-phenylenediamine* have been physiologically studied by Dubois and Vignon (*C. R. A. S.*, cvii. 533), who find that in doses of 0.01 Gm. per kilogramme they cause in the dog vomiting, diarrhœa, and fatal coma, with peculiar symptoms.

Phenylhydrazine. $C_6H_5NH.NH_2$.—This is prepared from diazobenzene hydrochloride (resulting from the action of sodium nitrite upon aniline hydrochloride) by reduction with stannous chloride or sodium sulphite. It is a colorless, peculiar-smelling oil solidifying to plate-like crystals melting at 23° C. (73.4° F.); difficultly soluble in water; easily soluble in alcohol and ether. The various compound derivatives of this substance have been tested by Heinz (*B. K. W.*, 1890) and others, and found to be too toxic for use in practical medicine. Phenylhydrazine itself has been employed in the following manner as a test for sugar in the urine. (*Fischer's Test.*) "To 8 Cc. (120 min.) of the urine, add 1 Cc. of normal solution of barium chloride with a few drops of solution of potassium hydroxide; filter, add 0.2 Gm. (3 grains) of sodium carbonate, heat to boiling, and filter. To the filtrate add 2 Cc. (30 minims) of acetic acid (36 per cent.), and about 0.1 Gm. (1½ grains) of phenylhydrazine hydrochloride, evaporate the solution on the water-bath to one-half its volume." An amorphous precipitate will be formed if only a small quantity of sugar be present, but if the sugar be present in considerable quantity a precipitate of minute yellow needles will be deposited. This test was discovered by Emil Fischer, and is founded on the property of glucose in the urine forming with phenylhydrazine, crystals of *phenylglucosazone*.

Phenylhydrazine is an active irritant and toxic agent, producing in warm blooded animals violent disturbances of breathing, with gastro-enteritis. It is remarkable for the changes which it produces in the blood, causing that fluid to become of a distinct green color when seen in thin sheets. The coloring matter appears not to be due to a derivative of phenylhydrazine, but to have at least spectroscopic relations to acid hæmatoporphyrin and to chlorophyll. (See *Z. B.*, N. F., xxiv. 1901.)

Phenylhydroxylamine. $C_6H_5.NH.OH$.—This substance has no known application to the treatment of disease, but requires notice on account of the occasional poisoning by it of those who are engaged in the manufacture of certain chemicals. For cases, see Hirsch and Edel (*B. K. W.*, xxxii. 1895), L. Lewin (*A. E. P. P.*, Bd. xxxv.). The symptoms, which have developed with great suddenness, have consisted of coma, cyanosis, pulselessness, abolition of corneal and pupillary reflexes, chocolate-colored blood, methæmoglobinuria, grayish-blue lips, and intense blue-red surface of limbs. The treatment of these cases should consist in active artificial respiration, together with hypodermic injections of strychnine and of digitalis. For the action of phenylhydroxylamine upon the blood, see L. Lewin (*A. E. P. P.*, Bd. xxxv.).

Phenylo-boric Acid. *Acidum Phenylo-boricum.* $C_6H_5.B(OH)_2$.—A white powder, soluble with difficulty in cold water, which was found by G. Molinari (*Chem. Cb.*, 1892, ii. 224) to be a powerful germicide, checking putrefaction in 0.75 per cent. solution, and being very poisonous to the *cholera* and other pathogenetic bacilli. It is said to act especially well locally upon *venereal*

ulcers, and to be less poisonous than phenol. The fatal *dose* for the rabbit is fixed at twenty-three grains (1.5 Gm.).

Phenylo-salicylic Acid. *Acidum Phenylo-salicylicum. Oxydiphenylcarbonic Acid. Ortho-oxydi-phenyl-carboxylic Acid.* $C_6H_3(OH)(C_6H_5)COOH$.—A whitish powder, soluble in water with difficulty, easily soluble in alcohol, ether, and glycerin; which, according to F. Bock (*In. Dis.*, Berlin, 1892), is about equivalent in germicidal properties to salicylic acid. Its salts are said to be less poisonous than are those of salicylic acid. It is made by subjecting a mixture of calcium benzoate and salicylate to dry distillation and fusing the product with potassium hydroxide. It is used as an antiseptic dusting powder.

Phenylurethane. *Euphorin. Ethyl Phenylcarbamate. Carbamilic Ether.* $C_9O_2H_{11}N.(CO\begin{cases}OC_2H_5\\NH(C_6H_5)\end{cases})$. This is a white crystalline substance, which is made by the action of ethyl chloroformate (or ethylic ether) on aniline. It is almost insoluble in cold water, very soluble in boiling water, alcohol, and ether, and melts at 51° C. (123.8° F.). It has been physiologically investigated by Giacoasa, who finds that its 2 per cent. solution very distinctly hinders or altogether arrests the growth of bacteria and bacilli; that in the frog it produces a general paralysis due to an action upon the nerve centres; that in the rabbit it causes somnolence, hebetude, albuminuria, gastritis, etc.; but very large doses are required to have any effect, over three hundred grains having been given to a dog without producing inconvenience. It does not form methæmoglobin in the blood. After its ingestion about 8 per cent. of it was found in the urine in the form of *oxyphenylurethane* in combination with sulphuric acid. It has been used by Sansoni, Giacomini, and Adler, as an antipyretic and antirheumatic, also as an analgesic. It has also been employed as an antiseptic dressing in various ulcerations, as a substitute for iodoform. (*B. G. T.*, Jan. 1892.) *Dose*, eight to fifteen grains (0.5–1.0 Gm.).

Phesin. *Acet-p-phenetidine-sodium sulphonate.* $C_6H_3\begin{cases}O—C_2H_5\\SO_3Na\\NH—CO—CH_3\end{cases}$. Phesin is a sulphonic derivative of phenacetin, and occurs as a reddish-brown, amorphous, tasteless powder, having a slightly irritant salt taste, very soluble in water, affording a Bismarck-brown solution of acid reaction. It has been studied by Von Vámossy and Fenyvessy (*Th. M.*, 1897), who find that it resembles phenacetin very closely in its action, but is characterized by the promptness and shortness of its influence.

Phlorizin. *Phloridzin. Phlorrhizin.* $C_{21}H_{24}O_{10} + 2H_2O$.—This is a bitter principle, discovered by De Koninck of Germany, in the bark of the apple, pear, cherry, and plum trees. It is most abundant in the bark of the root, and derived its name from this circumstance (from two Greek words, φλοιός, bark, and ῥίζα, a root). It is light, white, crystallizable in silky needles, of a bitter taste, soluble in about 1000 parts of cold and in all proportions in boiling water, very soluble in alcohol and methyl alcohol, scarcely soluble in ether, cold or hot, dissolved without change by solutions of the alkalies, deprived of its water of crystallization at 100° C. (212° F.), and fusible at a somewhat higher temperature. The ammoniacal solution becomes red on exposure to the air on account of the formation of *phlorizeïn*, $C_{21}H_{30}N_2O_{13}$. Phlorizin is without acid or alkaline reaction, and belongs to the class of glucosides. When heated with diluted hydrochloric or sulphuric acid, it is converted into sugar and a peculiar substance called *phloretin*, $C_{15}H_{14}O_5$. (See *Chem. Gaz.*, viii. 392.) To obtain phlorizin, the fresh bark of the root of the apple tree should be selected, as the dried bark is said to contain it in much smaller proportion. The bark is to be boiled for an hour or two successively in two separate portions of water, each sufficient to cover it, and the decoction set aside. At the end of thirty hours they will have deposited a considerable quantity of colored phlorizin, which may be purified by boiling for a few minutes with distilled water and animal charcoal, filtering, repeating this process two or three times, and then allowing the solution to cool slowly. The phlorizin is deposited in the crystalline state. An additional quantity may be obtained by evaporating the decoction to one-fifth of its bulk, allowing it to cool, and purifying the substance deposited in the same manner as before. Rochleder states that the leaves contain a principle, *isophlorizin*, isomeric with phlorizin.

Phlorizin is physiologically quite inactive, but when given to the lower animals in very large doses (from seven to ten grains to the pound), it produces great polyuria, with the elimination of large amounts of sugar, emaciation, polydipsia, and other symptoms of diabetes, with chronic nephritis. (See Coolen, *Archiv. de Pharmacod.*, vol. ii. 1896; also Kossa, *Z. f. B.*, xl. 1900.) Although at one time recommended as an *antiperiodic* in *doses* of from ten to fifteen grains (0.65–1.0 Gm.), it is of no use in practical medicine except as a test for renal insufficiency. In the *phlorizin test*, five to ten milligrammes of phlorizin are added to a sterilized solution containing an equal quantity of sodium carbonate, and given subcutaneously, the bladder having been emptied just before administration. If the kidney be normal, sugar should appear in the urine half an hour later; if there be no excretion, or if the excretion of sugar be delayed, the renal function is considered to be insufficient. (*Boston City Hospital Report*, 1902.)

Phosphine. *Diamidophenylacridine Binitrate.* This is a reddish powder, a solution of which in alkaline fluid is phosphorescent. Notwithstanding its commercial name, it contains no phosphorus and should not be confounded with the definite chemical substance, phosphine, PH_3. It has been asserted to be a valuable analgesic, but Dujardin-Beaumetz finds phosphine too irritant to the stomach for practical use. (*G. H. M. C.*, June, 1888.)

Phosphorescent Powder or **Paint.**—Made by mixing calcined oyster shells, 100 parts; caustic lime, 100 parts; calcined sodium chloride 25 parts; then incorporate about 55 parts of sulphur and from 8 to 18 parts of calcium, barium, strontium or magnesium sulphide. It may be used as a paint by mixing it with varnish. If the substance has been exposed to sunlight, it becomes luminous in the dark. *Canton's phosphorus* consists of 2 parts of oyster shells and 1 part of sulphur.

Photoxylon.—This is a nitro-cellulose, which is said to be entirely soluble in a mixture of equal parts of concentrated ether and alcohol. According to Beringer, a 3 per cent. solution leaves on evaporation a very tough collodion-like film. Pho-

toxylon is made from wood pulp, by methods of nitration similar to those given under pyroxylin, which is its chemical counterpart.

Phyllanthus. *Phyllanthus Niuri*, L.—Ottow isolated from this widely distributed euphorbiaceous plant *phyllanthin*, $C_{30}H_{37}O_8$, which crystallizes in colorless needles, is intensely bitter, insoluble in water, but soluble in alcohol, petroleum benzin, chloroform, and ether.

Physalis. *Physalis Alkekengi*, L. *Alkekengi. Common Winter Cherry. Alkékenge, Coqueret*, Fr. *Judenkirsche, Schlutte*, G.—A perennial herbaceous plant, belonging to the Solanaceæ, growing wild in the south of Europe, and cultivated in our gardens. The fruit is a round red berry, about as large as a cherry, enclosed in the inflated calyx, and containing numerous flat kidney-shaped seeds. All parts of the plant are bitter, especially the leaves and the capsules enveloping the fruit. The berries are very juicy, and have an acidulous, bitterish taste. By drying they shrink, and become of a brownish-red color. The bitter principle, *physalin*, has been isolated by Dessaignes and Chautard. It is obtained by agitating an infusion of the plant with chloroform, which extracts the bitter principle, and yields it on evaporation. To purify it, dissolve it in hot alcohol, add a little animal charcoal, filter, precipitate by water, and wash the precipitate with the same liquid. It is a light powder, white with a shade of yellow, of a taste slight at first, but in the end permanently bitter, very slightly soluble in cold water, somewhat more soluble in boiling water, and freely soluble in alcohol and chloroform, especially with the aid of heat. Its composition is $C_{14}H_{16}O_5$. (*J. P. C.*, 3e sér., xxi. 24.) The berries are said to be aperient and diuretic, and have been recommended in *suppression of urine, gravel*, and other diseases of the urinary passages. Gendron recommends them very highly as a febrifuge. (*A. G. M.*, xxiii. 536.) They also have been highly commended in *gout*. (*Braithwaite's Retrospect*, Am. ed., No. 46, 214.) From six to twelve berries, or half an ounce of the expressed juice, may be taken for a *dose;* and much larger quantities are not injurious. They are consumed to a considerable extent in some parts of Europe as food. The berries of *Physalis viscosa*, L., of this country, are said by Clayton to be remarkably diuretic.

Phytelephas.—*Phytelephas macrocarpa*, Ruiz. and Pav., or *negrito-palm*, of Ecuador, yields the *Tagud nut*, from which is derived the hard white substance, *vegetable ivory* or *corajo*. The nuts contain a fixed oil which is said to enter commerce. (*J. P. C.*, xvi.)

Phytolacca acinosa, Roxb. (Fam. Phytolaccaceæ.)—This plant has long been used in Japan as a diuretic, and is said to be violently poisonous. C. Nagai has separated from it an amorphous resin, *phytolaccotoxin*, which appears to be a spinal convulsant, and at the same time stimulant to the circulation, probably through the vasomotor centres. (*Sei-i-kwai Med. Journ.*, April, 1891.)

Pichurim Beans. *Sassafras Nuts. Fèves Pichurim, Noix de Sassafras*, Fr. *Pichurimbohnen, Sassafrasnüsse*, G.—The seeds of Nectandra *Puchury-major*, Nees (*Ocotea Puchury-major*, Mart.), and *N. Puchury-minor*, Nees (*O. Puchury-minor*, Mart.) (Fam. Lauraceæ), yielding respectively "*Fabæ Pichurim majores*" and "*Fabæ Pichurim minores.*" The two species are closely allied and both have been known to botanists as *Ocotea Pichurim*, H. B. K. (*Laurus Pichurim*, Willd.). The trees grow in Brazil, Guiana, Venezuela, and other parts of South America, and are sometimes spoken of as *Brazilian* or *South American Sassafras*. Carson of the University of Pennsylvania, had specimens of the fruit and other parts of the trees sent him, sufficient to verify the ascription of the pichurim beans to this source. (*A. J. P.*, xxvii. 385.) The beans are the kernels of the fruit separated into halves. They are ovate-oblong or elliptical, flat on one side, convex on the other, of a grayish-brown color externally, chocolate-colored within, of an aromatic odor between that of nutmegs and sassafras, and of a spicy pungent taste. There are two kinds, one about an inch and a half long by half an inch in breadth, the other little more than half as large, rounder, and of a dark brown color. The former were said by Carson to come from Brazil, the latter from Venezuela, being derived respectively from the two species mentioned above. (*Ibid.*, 387.) Bonastre has found them to contain a concrete volatile oil, a fatty matter of the consistence of butter, stearin, resin, brown coloring matter, fecula, gum, sugar, and lignin. Their virtues depend on the volatile oil. The buttery portion, known as *pichurim fat*, amounting to about 30 per cent., contains *laurostearin*, $C_3H_5(C_{12}H_{23}O_2)_3$, and *pichurim camphor*, which, according to Gerhardt, is identical with laurel camphor. In *A. J. P.*, 1851, 1, Procter described a liquid product brought from South America, known as *the native oil of laurel* or *sassafras*, or *aceite de sassafras*, said to be obtained by making incisions in the trunk of a tree growing on the Orinoco. As described by Procter, it is an oleoresin, of the sp. gr. 0.898, of a light auburn color, a peculiar penetrating odor, and an aromatic, bitterish, pungent, and somewhat camphorous taste. On distillation, almost the whole passes over in the shape of a colorless volatile oil, a small proportion only of resinous matter being left behind. This oleoresin is conjectured to be the same as that employed for adulterating the copaiba exported from Maracaibo. It may be distinguished from copaiba by its ready solubility in alcohol of 0.838, and by the fact that its volatile oil is acted on by potassium. It is believed to be the same product as the "native oil of laurel" described by Pereira, which was obtained from Demerara, and by incisions in a large tree. Carson, on comparing it with a specimen of oil presented to him as obtained from the same tree with the fruit mentioned, had no hesitation in considering them as identical, and, therefore, in referring the so-called native oil of laurel to *Nectandra Puchury*. Müller, by distilling the oil in contact with sulphuric acid, obtained a greenish-yellow oil possessing the peculiar odor of the beans. By fractional distillation he separated—1, a colorless oil, boiling at 150° C. (302° F.); 2, a colorless oil, boiling between 165° C. (329° F.) and 170° C. (338° F.); both of these oils consisting principally of hydrocarbons, $C_{10}H_{16}$; 3, a greenish-yellow viscid oil, boiling between 235° C. (455° F.) and 240° C. (464° F.), and having the composition $C_{38}H_{58}O_2$; 4, a deep blue oil, having a faint odor, boiling between 260° C. (500° F.) and 265° C. (509° F.). In medicinal properties the pichurim beans resemble the common aromatics, and may be employed for the same purposes. In South America they are said to be used as a substitute for nutmeg, and have even been called by that name. They are rare in this country. The oil obtained from the tree is said

to impart its odor to the perspiration and urine, and to be useful in *rheumatism*, *gout*, etc. The bark is sometimes employed as a tonic and febrifuge.

Picrasma. *Picrasma quassioides* (Ham.), Benn. (Fam. Simarubaceæ.)—The wood of this tree, which grows in the subtropical Himalayas, and resembles closely the Ailanthus in its appearance, has an intensely bitter taste, and has been proposed as a substitute for quassia. W. Dymock and C. J. H. Warden have found in it a crystalline principle which they believe to be quassin, and to exist in the probable proportion of from 0.02 to 0.03 per cent. The same investigators believe that the drug has in it a peculiar alkaloid. (*P. J.*, xx. 1889.) A principle analogous to quassin was isolated by Shimoyamo from the bark of *P. ailantoides*. (*Ap. Ztg.*, 1892, 439.)

Picric Acid. *Acidum Picricum. Carbazotic Acid. Trinitrophenol. Nitrophenic Acid.* $C_6H_2(NO_2)_3.OH$.—This acid is obtained by the action of nitric acid on indigo, silk, leather, wool, aloes, benzoin, Australian gum, and other substances, or, as the name indicates, from phenol (carbolic acid). It may be cheaply prepared by adding coal tar creosote (impure phenol) gradually to strong nitric acid and heating, when, on standing, the picric acid will crystallize out; but in practice it is now almost always made by dissolving crystallized phenol in strong sulphuric acid, and adding either nitric acid or sodium nitrate to the resultant phenolsulphonic acid. It is in pale yellow shining scales, fusing at 122.5° C. (252° F.) and subliming undecomposed. It is soluble in water, to which it gives a strong yellow color and very bitter taste. Its salts crystallize readily, and explode when heated. The potassium salt is so sparingly soluble that an alcoholic solution of the acid may be used as a test for this alkali. It is largely used in dyeing, producing magnificent yellow colors, and, in connection with indigo or Prussian blue, different shades of green. The salts which picric acid forms with potassium and sodium are yellow and bitter, and are much used in the arts. They are, however, violent explosives, and as such have produced very serious consequences. A saturated aqueous solution of picric acid is a very delicate test for albumin. *Ammonium picrate* is universally preferred for use in medicine. It crystallizes in rhombic scales, which are somewhat more soluble than the corresponding potassium salt. It is explosive when heated or struck.

Picric acid and its salts, when in sufficient dose, are poisonous both to man and to the lower animals, though a teaspoonful of ammonium picrate has been taken without the production of other symptoms than those of gastro-intestinal irritation. Toxic doses in the lower animals stain the tissues, and produce falling temperature, weakness, diarrhœa, collapse, convulsions, and death; in man six and one-half drachms (25.2 Gm.) have caused leucocytosis, intense yellow color of nails, skin, and cornea with violent vomiting, and purging and collapse, followed by recovery. (*W. M. P.*, 1900.) According to Erb, picric acid changes the color of the blood, increases the number of the white corpuscles, and so alters the red blood disks as to produce the appearance of nucleation. Picric acid is a very feeble germicide. The ammonium salt has been used to a considerable extent in *malarial diseases* and in *trichiniasis*. Experience, however, has shown that it has no value in the latter disorder, and is of very little importance as an antiperiodic. The local application of the solution (from 8 per cent. to saturation) of picric acid has been strongly recommended by various surgeons in the treatment of *burns*. In some cases it causes a great deal of pain, and in a number of instances, especially children, it has produced by its absorption, vomiting, purging, jaundice, and other symptoms of poisoning. The 1 per cent. solution is sometimes used to harden the feet of soldiers and pedestrians, also in *erysipelas*, *eczema*, *seborrhœa*, and parasitic diseases of the skin and hair. The *dose* of ammonium picrate, in pill, is half a grain (0.032 Gm.), three times a day; though Erb affirms that from nine to fifteen grains (0.6–1.0 Gm.) may be given in a day without danger.

Ferric Picrate may be prepared by digesting pure crystallized picric acid with an excess of recently precipitated ferric oxide and water at a gentle heat, till the acid has disappeared, filtering, and evaporating the filtrate at a temperature not exceeding 100° C. (212° F.). Thus prepared it is amorphous, reddish brown in mass, lighter colored in powder, of an astringent and intensely bitter and persistent taste, and readily soluble in water. On account of its bitterness it is best given in pill. (*A. J. P.*, 1862.)

Picrol. *Di-iodo-resorcin-potassium Monosulphonate.* $C_6HI_2(OH)_2SO_3K$.—This antiseptic contains about 52 per cent. of iodine. It occurs in colorless and odorless crystals having a very bitter taste, soluble in water, glycerin, and ether. It is used as a substitute for iodoform and corrosive sublimate.

Picrorhiza. *Br. Add.*—Under the name of *kutki* or *katki* there has long been used in India a rhizome which has been frequently spoken of by European and Mahometan writers as *black hellebore*, but is essentially different. It is the dried rhizome of an Alpine-Himalayan plant, *Picrorhiza Kurroa*, Royle (Fam. Scrophulariaceæ.) From this rhizome H. Warden has separated a glucoside, *picrorhizin*, which is freely soluble in water and alcohol and appears to be the bitter principle of the drug; also a red-brown, resinous, tasteless body, *picrorhizetin*, and, perhaps, cathartic acid (*Pharmacog. Indica*, vol. 3). The natives of India attribute active antiperiodic power to picrorhiza, which appears to be a powerful bitter tonic with slight laxative action. It is given in *doses* of from one to twenty grains (0.065–1.3 Gm.) as a tonic and from forty to fifty grains (2.6–3.2 Gm.) as an antiperiodic, usually in combination with aromatic.

The Br. Add. recognizes the *liquid extract* (*Extractum Picrorhizæ Liquidum*, Br. Add.), *dose*, twenty to sixty minims (1.3–3.75 Cc.); and a *tincture* (*Tinctura Picrorhizæ*, Br. Add.), two and one-half ounces to a pint (77.7 Gm. to 473 Cc.); *dose*, one-half to one fluidrachm (1.8–3.75 Cc.).

Pimpinella. *Pimpinella Saxifraga*, L. *Small Burnet Saxifrage. Saxifraga. Radix Pimpinellæ*, P. G. *Grand Boucage*, Fr. *Pimpinell, Bibernell*, G. A perennial umbelliferous European plant, growing on sunny hills, and in dry meadows and pastures. The root has a strong, aromatic, yet unpleasant odor, and a sweetish, pungent, biting, aromatic, bitterish taste. Its active constituents are volatile oil and an acrid resin. The volatile oil is described as a golden-yellow, limpid liquid, lighter than water, of penetrating odor recalling parsley, and of biting taste. Buchheim obtained from the alcoholic extract an active principle, which he called *pimpinellin*, insoluble in water and petro-

leum ether, but soluble in alcohol. It is considered diaphoretic, diuretic, and stomachic, and has been used in *chronic catarrh, asthma, dropsy, amenorrhœa,* etc. The *dose* in substance is about half a drachm (2.0 Gm.), and in infusion two drachms (7.7 Gm.). The root is used also as a local stimulant in toothache, etc.

Pinckneya. *Pinckneya pubens,* Michx. *Fever tree.* (Fam. Rubiaceæ.)—A large shrub or small tree, growing in South Carolina, Georgia, and Florida, in low and moist places along the seacoast. It is botanically allied to the Cinchonas. The bark is bitter and has been used with alleged advantage in *intermittent fever.* E. H. Naudain (*A. J. P.,* April, 1885) found in it a glucoside, *pinckneyin,* but no alkaloid.

Pineapple. *Ananas sativa,* Schult. f. (*Ananassa sativa,* Lindl., *Bromelia Ananas,* L.) (Fam. Bromeliaceæ.)—Some years ago V. Marcano discovered that the juice of the ordinary pineapple has the power of digesting proteid vegetable and animal substances. R. H. Chittenden (*Trans. Connecticut Academy,* vol. viii. 1891) found that the fresh pineapple juice is a very constant and powerful digestant of albuminous matters; that the ferment is decidedly active in the presence of either acids or alkaline carbonates, but is most energetic in neutral solution; that the ferment is most active between 50° and 60° C. (122° and 140° F.); still digests at 30° C. (86° F.), but is destroyed at a temperature of 70° C. (158° F.); that the digestion takes place with rapidity; that the ferment, to which the name *bromelin* has been given, is more nearly related to trypsin than to pepsin, forming during its action not only proteoses and peptone, but also leucine and tyrosine.

Piper Novæ-Hollandæ, Miq. (Fam. Piperaceæ.)—The berries of this Australian pepper contain a volatile oil, and are said to be useful in *gonorrhœa* and allied diseases.

Piper ovatum, Vahl.—From the leaves of this plant, found growing in Trinidad, Dunstan and Carr (*Chem. News,* 1895, 278) extracted a crystalline principle, *piperovatine,* $C_{16}H_{21}NO_2$. It is insoluble in water, but soluble in alcohol. It is said to act as a depressant of both motor and sensory nerves, and as a stimulant to the spinal cord.

Piperazine. *Arthriticine. Diethylenediamine.* $N_2 \begin{cases} H_2 \\ (C_2H_4)_2 \end{cases}$. This is formed by the action of ammonia upon ethylene bromide or chloride. A mixture of bases from this reaction is fractionated, and from the fraction boiling between 130° and 180° C. (266°–356° F.), the diethylenediamine separates on cooling. It forms glassy lustrous tables, melting at from 104° to 107° C. (219.2°–224.6° F.), and boils at 145° C. (293° F.). Both the free base and the hydrochloride are very soluble in water. The latter crystallizes in silky, lustrous, lanceolate forms. Piperazine has an alkaline taste and reaction and a weak but characteristic odor. It is very soluble in water and slightly less so in alcohol. In experiments made by Bock upon rabbits, no evidences of stimulating properties could be obtained. The blood pressure was never increased, but if the dose were large enough was temporarily depressed. In a cold aqueous solution it is said to dissolve twelve times as much uric acid as will lithium carbonate, and one part of uric acid and piperazine dissolves in fifty parts of water, while lithium urate requires three hundred and sixty-eight times its own weight to dissolve it.

Outside of the body, piperazine acts as a powerful solvent of uric acid; not only when the acid is pulverulent, but also when it is in the form of hard calculi. It was also found by J. H. Brik of Vienna, that even when the calculi are largely composed of other materials they are broken up by the piperazine affecting the uric acid in them. As piperazine seems in ordinary doses without marked general influence upon the system, and as it does not irritate the mucous membranes of the gastro-intestinal or genito-urinary tract, it would appear to be a very valuable remedy in the treatment of *uric acid gravel* and *calculi.* Van der Klip, as the result of a carefully conducted series of experiments, denies, however, that piperazine is as powerful a solvent of uric acid as is the lithium carbonate. In regard to the action of piperazine upon the system, Van der Klip has found that in the lower animals, in sufficient dose, it produces vomiting, irregular breathing, general muscular weakness, and relaxation; that it also decreases the coagulability of the blood, and has power in checking the action of peptonizing ferments. He further states that it decreases the evolution of oxygen by oxyhæmoglobin. How far piperazine will prove to be of value in uric acid diathesis remains at present uncertain, although the results so far are, on the whole, encouraging. Umpfenbach found it to be a powerful diuretic and even recommends it in *dropsies.* Vogt (*Soc. Thérap.,* 1891) affirms, as the result of his investigations, that in *doses* of fifteen grains (1.0 Gm.) a day it produced a diminution both of the relative and absolute quantity of uric acid. On the other hand, Ebstein and Sprague found that the drug did not affect either the absolute or relative excretion of urea or of uric acid. There is much clinical testimony as to the value of the remedy in *gout* and *rheumatism,* and certainly in those cases in which deposition of urates has occurred the remedy should have a thorough trial. H. C. Wood has found it to act very well in some cases and fail entirely in others. In *stone,* injections of piperazine into the bladder are also worthy of trial. The injection of small doses of piperazine immediately into gouty joints may be essayed. During the taking of piperazine the urine usually is reddish brown, and the drug can be readily obtained from the urine by methods which are detailed in *N. R.,* 1892. Piperazine may be given in the hypodermic injection of a 2 per cent. solution, which is said to produce some pain but no abscesses; or, better, fifteen grains (1.0 Gm.) of it may be administered during the day in a quart of plain or carbonated water. It is so hygroscopic that it cannot well be given in pill or powder.

Pipi Root.—The root of the *Petiveria hexaglochin,* Fisch. and Mey. (Fam. Phytolaccaceæ), which more than sixty years ago attracted notice in Europe, is said to have re-entered commerce. It is described as consisting of irregularly bent pieces, 3 to 6 Mm. thick, externally grey brown, upon transverse section showing a brownish bark with white dots, and a lighter colored radiating ligneous cord. The cork layer consists of 3 or 4 rows of cells, the thick primary bark encloses crystals of calcium oxalate; the woody cord contains tracheids with narrow dotted ducts, two-rowed medullary rays and in the centre a thin pith. The genus Petiveria is confined to tropical America and the shrubby plants are mostly acrid and have an alliaceous odor. It is reported to be a stimulant, expectorant and diaphoretic. (*A. J. P.,* Aug. 1887.)

Piscidia. *Piscidia Erythrina*, L. *Jamaica Dogwood.*—This is a leguminous tree growing throughout the West Indies, and yielding to commerce a very valuable wood. From time immemorial the bark has been used for catching fish. The leaves, twigs, and root bark are collected, macerated with the residue from the distillation of rum or with lime water, then transferred into baskets, and the latter dragged up and down the water until the fish are stupefied.

In 1844 William Hamilton called the attention of the profession to the plant (*P. J.*, Aug. 1844) as a powerful narcotic and analgesic. The bark of commerce is "in pieces of from two to four inches in length, and from one to two inches wide, and about one-eighth of an inch in thickness. The outer surface of some of the pieces is of a dark gray-brown, while others are of a yellow-brown, with no shade of gray present. The bark is frequently studded with flattened protuberances of a lighter color than the surrounding cork. The central part of the bark is much lighter colored, and, when wet or freshly broken, is of a peculiar blue-green color. The inner part of the bark is of a dark brown color and very fibrous. It has a strong disagreeable odor of opium when broken into pieces. It is acrimonious, and produces a burning sensation in the mouth and pharynx."

E. Hart obtained a neutral principle, $C_{29}H_{24}O_8$, to which he gave the name *piscidin*. When purified by crystallization from alcohol it was obtained in colorless crystals, fusing at 192° C. (377.6° F.), insoluble in water, slightly soluble in ether, easily soluble in benzene, chloroform, and boiling alcohol. (*A. J. P.*, 1883, 369. See also *Ibid.*, Sept. 1898.) Paul C Freer and A. M. Clover have examined Hart's piscidin and found it to consist of two distinct chemical compounds. The first of these forms colorless, highly refracting rectangular prisms, melting at 201° C. (393.8° F.); composition $C_{23}H_{20}O_7$. It is soluble in chloroform, moderately soluble in benzene and in acetic acid, sparingly so in alcohol; insoluble in ether, ligroin, and in alkaline solutions. The second separates from alcohol in fine yellow needles, melting at 216° C. (420.8° F.); composition $C_{22}H_{18}O_6$. It is soluble in benzene and chloroform, sparingly so in ether; insoluble in ligroin. The authors found also in the aqueous extract of the bark *piscidic acid*, soluble in water; insoluble in chloroform, benzene or ligroin. It forms acicular crystals, which melt at 182° to 185° C. (359.6°–365° F.); composition $H_2.C_{11}H_{10}O_7$. (*A. Pharm.*, Feb. 1901.)

The action of the drug upon the lower animals has been studied by J. Ott and A. C. Nagle with similar results. (*Jamaica Dogwood*, Parke, Davis & Co., 1881.) The conclusions reached are, 1. It is narcotic to frogs, rabbits, and men. 2. It does not affect the irritability of the motor nerves. 3. It does not attack the peripheral ends of the sensory nerves. 4. It reduces reflex action by a stimulant action on the centres of Setschenow. 5. It produces a tetanoid state by a stimulant action on the spinal cord, and not by a paralysis of Setschenow's centres. 6. It dilates the pupil, which dilatation passes into a state of contraction upon the supervention of asphyxia. 7. It is a salivator. 8. It increases the secretion of the skin. 9. It reduces the frequency of the pulse. 10. It increases arterial tension by stimulation of the vasomotor centre. 11. This increase of pressure is soon succeeded by a fall, due to a weakening of the heart itself.

The exact practical value of the drug has not been determined, nor are the results produced in man, by doses approaching toxic, known. Hamilton took a drachm, when suffering with severe toothache, on going to bed. He first felt a violent sensation of heat internally, which gradually extended to the surface, and was followed by profuse perspiration, with profound sleep for twelve hours. On awaking, he was quite free from pain, and without the unpleasant sensations which follow a dose of opium. Various practitioners have reported good results from its use as an anodyne in *neuralgia, nervous insomnia, whooping cough*, etc., but in other hands it has failed to do good. H. C. Wood found it in one case of neuralgia to produce great nausea and gastric distress without evincing the slightest narcotic effect. Joseph L. Lemberger offers a formula for the preparation of a *fluidextract*, as follows. Forty-eight troyounces of the bark, in No. 8 powder, are moistened with sufficient of a mixture of three pints of alcohol, half a pint of glycerin, and half a pint of water; it is packed in a percolator, allowed to stand for six hours, and then percolated with the menstruum until three pints of percolate are obtained. (*D. C.*, 1881, 179.) The *dose* of the fluidextract is a fluidrachm (3.75 Cc.), to be carefully increased.

Pithecolobium.—*Pithecolobium Saman*, Benth. (Fam. Leguminosæ.)—A shade-tree, indigenous in South America and planted for shade in Japanese coffee plantations, which yields a poisonous alkaloid, *pithecolobine*, whose physiological action is analogous to that of sapotoxin.

Pixol is a form of wood tar, soluble in water, made by warming three parts of wood tar and one part of green soap together and gradually adding three parts of a 10 per cent. solution of potassium hydroxide with stirring. It is a clear dark brown syrupy liquid. The disinfecting power of a 5 per cent. solution is said to be not less than that of a 5 per cent. solution of phenol.

Plantago. *Plantago major*, L. *Plantain. Rib Grass. Ribwort. Ripple Grass. Plantain*, Fr. *Wegerich*, G. (Fam. Plantaginaceæ.)—The leaves are saline, bitterish, and austere to the taste; the root is saline and sweetish. The common plantain weed was formerly considered refrigerant, diuretic, deobstruent, and somewhat astringent. The ancients esteemed it highly, but it is at present never used, except it be externally in domestic practice as a stimulant application to sores. The leaves are put on whole or bruised in the form of a poultice. *Plantago media*, L., and *P. lanceolata*, L., or *rib grass*, which are also naturalized in America, possess properties similar to those of *P. major*, and may be used for the same purposes.

Theo. Koller, in 1868, obtained from the leaves of *Plantago major*, *P. lanceolata*, and *P. media*, chlorophyll, resin, wax, albumen, pectin, citric acid, and oxalic acid. David Rosenbaum found in the leaves of *P. major*, wax, chlorophyll, resin, and a notable quantity of calcium oxalate. (*A. J. P.*, 1886, 418.) J. F. Strawinski found in the rhizome a substance which he believes to be either phlobaphene or protocatechuic acid. (*A. J. P.*, 1898, 189.)

Semen psyllii is the name given to the seeds of several species of European Plantago. The best are those of *Plantago Psyllium*, L., or *fleawort*, which grows in the south of Europe and in Barbary. They are small, about a line long by half a line in breadth, convex on one side, concave on the other, flea-colored, shining, inodorous, and nearly tasteless, but mucilaginous when chewed.

They are demulcent and emollient, and may be used internally and externally in the same manner as flaxseed, which they closely resemble in medicinal properties. *Spogel seed*, used in India as a demulcent in intestinal irritation, is derived from *P. Isphagula*, Roxb., probably a variety of *P. ovata*, Forsk. (See *Journ. Méd. de Paris*, Sept. 1887.)

Platinum. *Platine, Orblanc*, Fr. *Platin*, G. Colloidal platinum, formed by the action of an electric arc between platinum wires under water, forms in water a deep black liquid which has a strong catalytic effect, resembling in many respects the action of organic ferments. The most useful salt of platinum is the *tetrachloride*, $PtCl_4.5H_2O$, which may be obtained by mixing an aqueous solution of chloroplatinic acid, H_2PtCl_6, with a solution of silver nitrate; a precipitate containing the silver, combined with some platinum and chlorine, separates, and the yellowish-red solution yields on evaporation fine large red crystals of *platinum chloride*. The compound usually called platinum chloride is said by Roscoe and Schorlemmer to be *chloroplatinic acid*, $H_2PtCl_6.6H_2O$, and is made by dissolving the metal in nitro-hydrochloric acid, and evaporating with hydrochloric acid until all the nitric acid is removed. In 1826 Gmelin of Tübingen, made experiments to determine the action of this metal on the economy. In 1841 Ferdinand Hoefer published some observations on the same subject. The latter experimented chiefly with the chloride, formerly called *bichloride*, and the double *platinum and sodium chloride*. They are both poisonous, the chloride when given in the quantity of fifteen grains (1 Gm.), the double chloride in that of thirty grains (2 Gm.). When a concentrated solution of the chloride is applied to the skin, it produces violent itching, followed by an eruption; administered internally, it irritates the mucous membrane of the stomach and occasions headache. The double chloride has no action when externally applied, and, when given internally, operates on the system in a less sensible manner than the chloride. It possesses the power of augmenting the urine. Hoefer ranks the preparations of platinum with the alteratives, by the side of those of iodine, arsenic, and gold. He considers them particularly suited to the treatment of *syphilitic diseases:* the chloride to cases of long standing and inveterate, the double chloride to those which are recent. Eight grains may be made into sixteen pills, with a drachm of the extract of guaiacum wood of the French Codex, and sufficient powdered licorice root. Of these, one, two, or three may be taken morning and evening. The double chloride may be prepared by dissolving five grains of the chloride and eight of pure sodium chloride in seven fluidounces of gum water, and the whole may be taken by tablespoonfuls in the course of twenty-four hours. For frictions on *indolent ulcers*, Hoefer used an ointment composed of fifteen grains (1 Gm.) of the chloride, thirty grains (2 Gm.) of extract of belladonna, and an ounce (31 Gm.) of lard. (*J. P. C.*, xxvii. 213.) The *dose* of the chloride is from half a grain to two grains (0.032–0.13 Gm.) twice a day, given in pill.

Plumbago europæa. L. *Leadwort. Dentellaria.* (Fam. Plumbaginaceæ.)—A perennial, herbaceous plant, growing in the south of Europe. It has an acrid taste, and, when chewed, excites a flow of saliva. This is particularly the case with the root, which has been long used to relieve toothache; hence its French name *dentelaire*. A decoction of the root in olive oil has been highly recommended for *itch*. A crystallizable, acrid principle, called *plumbagin*, has been extracted from the root by Dulong. (*J. P. C.* (2), xiv. 441.) *Plumbago zeylanica* is said to be a very powerful diaphoretic.

Pneumin.—This is a yellowish, odorless, tasteless powder obtained by the action of formaldehyde upon creosote, freely soluble in alcohol and ether; insoluble in water. It is supposed to be a mixture of the methylenic compounds of phenols of beech tar and their ethers, and has been recommended by Jacobson in the treatment of *tuberculosis* and in *pulmonic catarrh* in *doses* of eight grains (0.5 Gm.) three to five times a day, as required. (See *Med. Wochen.*, 1900, No. 36; 1901, No. 4.)

Polyformin.—Two kinds of polyformin are found in commerce, soluble and insoluble. The soluble form, *di-resorcin-hexa-methylene-tetramine*, $(C_6H_4(OH)_2)_2-(CH_2)_6N_4$, occurs in handsome colorless crystals, soluble in water and alcohol, insoluble in ether and oils, and is used as an antiferment and diuretic. Insoluble polyformin results when polyatomic phenols or such as possess condensed benzene nuclei are dissolved in formaldehyde, an excess of ammonia being added subsequently; if resorcinol be used, the polyformin is odorless, amorphous, and yellowish brown in color. The name polyformin is applied particularly to that kind which is employed as a bactericide.

Polygala. *Polygala polygama*, Walt. (*P. rubella*, Muhl.) (Fam. Polygalaceæ.) *Bitter Milkwort. American Bitter Polygala. Polygale, Laitier*, Fr. *Kreutzblume, Milchwurz*, G.—Bitter polygala is an indigenous, perennial plant, which was formerly official. It has a strong and permanent bitter taste, which it yields to water and alcohol. In small doses bitter polygala is tonic, in larger, laxative and diaphoretic. It appears to be closely analogous in medicinal virtues to *Polygala amara*, L., of Europe, which is used for a similar purpose. From the seeds of the *P. butyracea*, Heck. and Schlag., an African plant, the natives prepare an edible fat. (See *P. J.*, xx. Aug. 1889.)

Polymnia. *Polymnia Uvedalia*, L. *Bear's Foot.* (Fam. Compositæ.)—Great virtues as a remedy in *malarial splenic enlargements* have been attributed to this North American plant. (See *Newer Mat. Med.*, 53.)

Polypodium.—Various species of this genus of ferns are asserted to have medicinal properties. *Polypodium vulgare*, L., very common both in Europe and America, was believed by the ancients to be an active cholagogue purgative, and has been used in modern times as an expectorant in chronic *catarrh* and *asthma*. *Dose*, from one to eight drachms (3.9–31 Gm.), usually given with a cathartic. The rhizome, as it usually occurs in commerce, is about as thick as a goose quill, somewhat contorted, covered with brown, easily separable scales (often wanting), furnished with slender radicles, and marked by numerous small tubercles. Its color is reddish brown with a tinge of yellow, its odor disagreeably oleaginous, its taste peculiar, sweetish, somewhat bitter, and nauseous. *P. adiantiforme*, of Porto Rico, is believed by the natives to be a powerful antisyphilitic. It must be used freely for several months in the advanced stages of the disease. *P. friederichsthalianum*, of Central America, has similar properties attributed to it.

Polytrichum. *Polytrichum juniperinum*, Hedw. *Hair Cap Moss. Robin's Rye.*—This indigenous moss is stated by William Wood to be a powerful diuretic, and, when given indefinitely in infusion, very useful in *dropsy*. (*Am. J. M. S.*, N. S., xxvii. 267.) Ariel Hunter confirms these statements. (*N. J. Med. Rep.*, ix. 417.)

Pongamia. *Pongamia glabra*, Vent. (Fam. Leguminosæ.)—*Pongamia* or *kurung oil* is expressed from the seeds of an East Indian tree. It is deep yellow to reddish brown, fluid at 15.6° C. (60° F.), but below that it is solid with sp. gr. of 0.9352 (*P. J.*, 72, p. 492). It is especially commended in *pityriasis versicolor* and other parasitic skin diseases. (*P. J.*, February, 1883.)

Populus. *Poplar.*—In most trees belonging to this genus the leaf-buds are covered with a resinous exudation, which has a peculiar, agreeable, balsamic odor, and a bitterish, balsamic, somewhat pungent taste. It is abundant in the buds of *Populus nigra*, L., or the *black poplar* of Europe, which are official in some parts of that continent. They contain resin and a peculiar volatile oil. The buds of *P. balsamifera*, L., growing in the northern parts of North America and Siberia, are also highly balsamic; and a resin is said to be furnished by the tree, which is sometimes, though erroneously, called *tacamahac*. *Balm of Gilead buds* are obtained from *P. balsamifera* var. *candicans*. The virtues of the *poplar buds* are probably analogous to those of the turpentines and balsams. They have been used in pectoral, nephritic, and rheumatic complaints, in the form of a tincture, and a liniment, made by macerating them in oil, has been applied externally in local *rheumatism*. The *unguentum populeum* of European pharmacy is made, according to the directions of the French Codex, by bruising in a marble mortar, and boiling in 2000 parts of lard, with a gentle fire, till the moisture is dissipated, 250 parts, each, of the fresh leaves of the white poppy, deadly nightshade, henbane, and black nightshade; then adding of the dried buds of the black poplar, bruised, 400 parts; digesting for twenty-four hours; straining with strong expression, and finally allowing the ointment to cool after defecation. This is an anodyne ointment, occasionally employed in Europe in painful local affections. It has been ascertained that poplar buds are capable of imparting a principle to ointments which obviates their tendency to rancidity.

The bark of *P. tremuloides*, Michx., or *American aspen*, and of *P. tremula*, L., or *European aspen*, is possessed of tonic properties, and has been used in *intermittent fever*. In the bark of the latter Braconnot found *salicin*, $C_{13}H_{18}O_7$, and another crystallizable principle which he named *populin*, $C_{20}H_{22}O_8$. It is in these, probably, that the febrifuge properties of the bark reside. They may be obtained by precipitating a saturated decoction of the bark with solution of lead subacetate, filtering, precipitating the excess of lead by sulphuric acid, again filtering, evaporating, adding animal charcoal towards the end of the evaporation, and filtering the liquor while hot. Salicin gradually separates, upon the cooling of the liquor, in the form of crystals. If, when this principle has ceased to crystallize, the excess of sulphuric acid in the liquid be saturated by a concentrated solution of potassium carbonate, the populin will be precipitated. If this be pressed between folds of blotting paper, and redissolved in boiling water, it will be deposited, upon the cooling of the liquid, in the crystalline state. The leaves of *P. tremula* are also said to yield more populin than does the bark. It is probable that both principles exist in the bark of *P. tremuloides* and other species. Schaak (*A. J. P.*, 1892, 226) found a bitter principle in the bark of *P. alba*, L., which was most likely populin. Salicin is described under *Salix*. *Populin* is very light, purely white, of a bitter, sweetish taste, analogous to that of licorice. It is soluble in 1896 parts of cold and about 70 parts of boiling water, and is more soluble in boiling alcohol. It loses its two molecules of water of crystallization at 100° C. (212° F.), and at 180° C. (356° F.) it fuses to a colorless liquid, from which at a higher temperature benzoic acid may be sublimed. Acetic acid and the diluted mineral acids dissolve it, and, upon the addition of an alkali, let it fall unchanged. Piria first showed it to be *benzoyl salicin*, $C_{13}H_{17}(C_7H_5O)O_7 + 2H_2O$. He then decomposed it and prepared salicin from it. Populin has been prepared synthetically by Schiff and by Dobbin and White (*P. J.*, 73, p. 233). When populin is boiled with baryta water or milk of lime, the benzoic acid precipitated by ferric chloride, the excess of iron removed by lime, and the excess of lime by carbon dioxide, the remaining liquid yields salicin on evaporation. The same conversion may be effected by heating populin with an alcoholic solution of ammonia to 100° C. (212° F.). Piria obtained from populin 28.9 per cent. of benzoic acid. (*P. J.*, xv. 378.) T. L. Phipson, basing his experiments upon the results of Piria, has succeeded in preparing populin artificially by combining salicin and benzoic acid. Nothing more is necessary than to dissolve the two substances in alcohol, and to concentrate the solution. Crystals are formed having all the characters of populin, and consisting of salicin and benzoic acid combined in the proportion of their equivalents. (*Chem. News*, Dec. 6, 1862, 278.) The flower-buds of *P. tremuloides* yielded a bitter resin to R. Glenk. It was of yellowish-brown color, strong hop-like odor, and had a melting point of 51° C. (123.8° F.). (*A. J. P.*, 1889, 240.)

Portulaca. *Portulaca oleracea*, L. *Garden Purslane.* (Fam. Portulacaceæ.)—This indigenous annual has been considered a cooling diuretic, and recommended in *scurvy* and urinary affections. The seeds have been thought anthelmintic, but are inert.

Potassio-Mercuric Iodide. *Mercuric Potassium Iodide. Iodohydrargyrate of Potassium.*—It has been found by chemists that mercuric iodide, HgI_2, unites with the more positive metallic iodides, forming a series of double salts, sometimes called *iodohydrargyrates*. These have been particularly studied by Boullay (*Ann. Ch. Phys.* [2], 34, 345), who finds that a concentrated solution of potassium iodide will dissolve mercuric iodide in the ratio of three molecules of the mercuric salt for every two of the potassium salt. When the solution is cooled, one molecule of red mercuric iodide crystallizes out, and then from the mother liquor deposits yellow prisms, having the composition $2(HgI_2.KI) + 3H_2O$. Clayton suggests the practical method of simply evaporating Nessler's reagent and collecting the crystals. (*Chem. News*, 1894, 102.) This is an active preparation, which may be given in the same dose and for the same purposes as corrosive sublimate. It is formed when its components are prescribed together extemporaneously. It is not decomposed by the compound syrup of sarsaparilla, which is frequently used as a vehicle for it.

Potassio-mercuric iodide was suggested by F. L. Winckler as a qualitative test of the organic alkaloids. F. F. Mayer subsequently employed, for volumetric analysis, a solution made with 13.546 grammes of corrosive sublimate, 49.8 grammes of potassium iodide, and a liter of distilled water. (See *Mercuric Potassium Iodide Test Solution, U. S. D.*, PART III.) For further observations, see *A. J. P.*, 1886, 579, and 1887, 1.

Potassium Bisulphate. *Potassii Bisulphas. Acid Sulphate of Potassium.* $KHSO_4 = 135.21$. "Take of Potassium Sulphate, in powder, *three ounces* [avoirdupois]; Pure Sulphuric Acid *one fluid ounce* [Imperial measure]. Place the Acid and Salt in a small porcelain capsule, and to this apply a heat capable of liquefying its contents, and which should be continued until acid vapors cease to be given off. The Bisulphate, which concretes as it cools, should be reduced to a fine powder, and preserved in a well-stopped bottle." *Br.* It is often a by-product in chemical operations, being left as residue when potassium salts are decomposed by sulphuric acid in excess. It is a white salt, the crystals having the form of right rhombic prisms so flattened as to be tabular. The salt has a bitter and extremely acid taste. It is soluble in twice its weight of cold and in less than its weight of boiling water. Alcohol does not dissolve it, but when added to an aqueous solution, precipitates the neutral sulphate. Exposed to the air, it effloresces slightly on the surface, and when moderately heated readily melts, and runs like oil. At a red heat it loses water and the excess of acid, and is reduced to a neutral sulphate. Owing to its excess of acid, it acts precisely as an acid on the carbonates, causing them to effervesce. It is incompatible with alkalies, alkaline earths, and their carbonates, with many of the metals, and with most oxides. This salt was formerly called *sal enixum*. It is aperient. It answers, according to Barker, for preparing a cheap aperient effervescing draught. Equal weights—a drachm, for instance—of the bisulphate and of sodium carbonate may be dissolved separately, each in two fluidounces of water, then mixed, and taken in the state of effervescence. *Dose*, one or two drachms (3.9–7.7 Gm.).

Potassium Bromate. *Potassii Bromas. Bromate de potasse*, Fr. *Kaliumbromat, Bromsaures Kali*, G. $KBrO_3$.—This salt is formed in the process employed for making the bromide and may be separated by crystallization. Colorless, cubical or tabular crystals, soluble in 15 parts of cold and 2 parts of hot water. Like potassium chlorate it oxidizes matter like sugar and sulphur and must be mixed with great caution, with readily oxidizable substances. It is an ingredient in *Koppeschaar's solution* (which see) and is employed in titrating phenol.

Potassium Chloride. *Potassii Chloridum. Kalium chloridum (chloratum). Sal digestivum Sylvii. Sel digestif*, Fr. KCl.—An important source of this salt is *carnallite*, a double chloride of potassium and magnesium mined at Stassfurt. In colorless, cubical prisms, without odor, the taste resembling common table salt; very soluble in water, slightly so in alcohol. It is chiefly of value as the source of other potassium compounds.

Potassium Chloro-Platinite.—Eight grains (0.5 Gm.) of this salt, which is used as a toning agent in photography, caused death in an infant of two months, preceded by violent gastro-enteritis and collapse. (*B. M. J.*, i. 1896.)

Potassium Cobalti-Nitrite. $Co_2(NO_2)_{12}K_6 + 2H_2O = 934.32$.—When potassium nitrite is added to a cobalt salt solution acidified with acetic acid, nitrogen is set free, and in course of time the double cobaltic and potassium nitrite separates as a yellowish crystalline powder, almost totally insoluble in acid solution. Wolcott Gibbs having suggested that this nitrite might be less fugacious than other nitrites, on account of its stability and relative insolubility, J. W. Roosevelt tried it in *doses* of from one-quarter to one-half grain (0.016–0.032 Gm.), every two hours, in kidney cases with high arterial tension and dyspnœa, in *asthma*, and also in *cardiac valvular diseases*. He stated that the effects of the drug are similar to those of the nitrites, beginning in fifteen minutes and lasting from two to four hours.

Potassium Ferricyanide. *Ferridcyanide of Potassium. Red Potassium Prussiate.* $K_6Fe_2Cy_{12}$. This is formed by passing a current of chlorine through a solution of potassium ferrocyanide, until the liquid ceases to form a precipitate with a solution of ferric chloride, a proof that the whole of the ferrocyanide has been converted into the ferricyanide. The solution, by due evaporation, yields the compound in question. It may also be prepared, in the dry way, by agitating finely powdered ferrocyanide with chlorine as long as it is absorbed. The theory of the formation of this compound is that two atoms of chlorine withdraw from two molecules of the ferrocyanide two atoms of potassium, forming potassium chloride, which remains in the mother water, while the two atoms of iron, having assumed the ferric condition, together with the remaining potassium, saturate the cyanogen. The reaction is explained by the following equation:

$$2K_4Fe(CN)_6 + Cl_2 = K_6Fe_2(CN)_{12} + 2KCl$$

The radical ferricyanogen is supposed to be formed by the coalescence of two molecules of ferrocyanogen, and is sometimes represented by the symbol Cfdy. This salt, discovered by Gmelin, is in beautiful deep hyacinth-red anhydrous crystals, which are soluble in four parts of water. Its solution forms a delicate test for ferrous salts, with which it produces a blue precipitate; but with ferric salts it only strikes a green or brown color. It is used in dyeing and calico printing. (See *Test Solutions*, PART III.)

Potassium Glycerophosphate. *Potassii Glycerophosphas.* $C_3H_7O_3.PO_3K_2$.—The salt is very hygroscopic and has an alkaline reaction. A more permanent commercial form is a 50 per cent. aqueous solution. It is used as a tonic and nervine in *doses* of from three to six grains (0.2–0.4 Gm.).

Potassium Iodate. *Potassii Iodas. Iodate de Potasse*, Fr. *Kaliumjodat, Jodsaures Kali*, G. Demarquay and Custin propose the following mode of preparation, which is followed by the Br. Pharm. (1885) in making its test solution. Take of iodine and potassium chlorate, each, one part, and mix them with five or six parts of water, previously acidulated with a few drops of nitric acid, and heated to ebullition. As soon as chlorine ceases to escape, treat the liquid with a concentrated solution of barium chloride. Wash with distilled water, and decompose with diluted sulphuric acid the barium iodate precipitated; filter to separate the barium sulphate, and slowly evaporate the solution. Wash with distilled water the crystals of iodic acid that are formed, dissolve them in boiling distilled water, and saturate with potassium bicarbonate. On cooling the iodate is

deposited in small crystals. Stas prepares it by moderately heating equal molecular weights of potassium iodide and chlorate, dissolving out the chloride formed with cold water, and repeatedly crystallizing the iodate from hot water. (*A. J. P.*, 1870, 217.) Egidio Pollacci has found that phosphorus affords a very delicate test for the iodate, as does also the iodate for phosphorus, free iodine being liberated. (*J. P. C.*, 4e sér., xx. 104.) Demarquay and Custin assert that potassium iodate is superior to potassium chlorate as a local remedy in ulcerative and gangrenous *stomatitis, ptyalism, diphtheria,* and other diseases of the pharyngeal and buccal mucous membrane. *Dose,* from four to eight grains (0.26–0.5 Gm.). (*Dorvault's Rev. Pharm.*, 1858.)

Potassium Nitrite. *Potassii Nitris.—Nitrite of Potassium* ($KNO_2 = 84.55$) is most readily obtained by fusing saltpetre with lead, which withdraws one atom of oxygen from the former, changing it thereby to litharge. It is a white, fusible, and uncrystallizable mass, usually cast into sticks like the hydroxide. It is very deliquescent, and absorbs carbon dioxide from the air. It shares the activities of the nitrites, producing in animals their physiological effects, and being capable of replacing them in the treatment of disease. Its influence is comparatively slow and permanent. Five grains (0.32 Gm.) have produced mild poisoning. *Dose,* three grains (0.2 Gm.).

Potassium Percarbonate, $K_2C_2O_6$, is a colorless powder which slowly decomposes under the action of water, as follows:

$$K_2C_2O_6 + H_2O = 2KHCO_3 + O$$

In the presence of sulphuric acid, potassium percarbonate decomposes and forms hydrogen peroxide.

$$K_2C_2O_6 + 2H_2SO_4 = 2KHSO_4 + 2CO_2 + H_2O_2$$

This substance has not as yet been used in practical medicine, but is believed to be the material known as *antihypo,* much used in photography, and which has been recommended by Müller for the purposes of decolorizing and counterstaining tubercular bacilli. He washes the preparations for this purpose in 50 to 70 per cent. alcohol and places them for fifteen minutes in a 5 to 10 per cent. solution of potassium percarbonate, and after differentiating rinses in water and counterstains with methylene blue.

Potassium Perchlorate. *Potassii Perchloras. Hyperchlorate of Potassium.* $KClO_4 = 137.56$. This salt is prepared by fusing potassium chlorate until it begins to assume a pasty condition. The cooled mass consists of potassium perchlorate and chloride. The absence of undecomposed chlorate may be known by a sample failing to communicate a yellow color to hydrochloric acid. The mass must be dissolved in the smallest possible quantity of boiling water, when perchlorate crystallizes out. It is sparingly soluble in water, and insoluble in alcohol. Its effects are wholly different from those of potassium chlorate, and it has been commended in *intermittents.* (*Ann. Thér.*, 1869, 141.)

Potassium Persulphate. *Potassii Persulphas. Kaliumpersulfat,* G. *Anthion.*—Obtained by electrolyzing a solution of potassium bisulphate. Colorless crystals, soluble in about 50 parts of water. Used in photography, owing to its oxidizing of sodium thiosulphate to sulphate.

Potassium Phosphate. *Potassii Phosphas. Phosphate of Potassium.* $K_2HPO_4 = 173.01$.—The potassium phosphate which has come into use as a medicine is the *dipotassic orthophosphate,* having a composition precisely analogous to that of the medicinal sodium and ammonium phosphates. It may be formed precisely as sodium phosphate is prepared; or by nearly saturating, by means of potassium carbonate, common or orthophosphoric acid, H_3PO_4. The medicinal potassium phosphate is a white, amorphous, deliquescent salt, crystallizing with difficulty. It has been given as an alterative in *scrofula* and *phthisis* with supposed advantage. The *dose* is from ten to thirty grains (0.65–2.0 Gm.), three times a day, dissolved in a teaspoonful of water.

Potassium Picrate. *Potassii Picras. Kaliumpikrat, Pikrinsaures Kalium,* G. $C_6H_2(NO_2)_3OK$. This salt may be made by neutralizing a hot solution of 20 parts of picric acid with 7 parts of potassium carbonate and crystallizing in a cool place. Small yellow crystals, or a yellow powder of a bitter taste, soluble in 230 parts of cold water and 15 parts of hot water; nearly insoluble in alcohol. It must be handled with care as it explodes by a blow or when heated.

Potassium Silicate. *Potassii Silicas.—Silicate of Potassium,* K_2SiO_3, also known as *soluble glass,* is prepared in the same way as the sodium salt. These salts have been used in *rheumatism, gout,* etc. (*A. J. P.*, 1857, 314; *Ann. Thér.*, 1865, 236), but are probably of no service. They form excellent substitutes for starch, dextrin, and plaster of Paris in the preparation of immovable surgical dressings. The solution is applied, of a syrupy consistence, by means of a brush, to the bandages, upon which it rapidly hardens, requiring only five or six hours for this result. The facility of removing the bandages by means of hot water is another advantage which potassium silicate possesses over most other dressings. (*J. P. C.*, 4e sér., iv.)

Potassium Sulphite. *U. S.* 1880. *Potassii Sulphis.* $K_2SO_3.2H_2O = 192.95$. *Kali Sulfurosum, Sulfis Potassicus, S. Kalicus. Sulfite de Potasse,* Fr. *Schwefligsaures Kali,* G.—*Potassium sulphite* is prepared by causing sulphurous acid to pass through a strong solution of potassium carbonate until decidedly acid; an equal weight of potassium carbonate is now added. The sulphite crystallizes out upon standing. "White, opaque, obliquely-rhombic, octahedral crystals, or a crystalline powder, somewhat deliquescent, odorless, having a bitter, saline, and sulphurous taste, and a neutral or feebly alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.) and in 5 parts of boiling water; only sparingly soluble in alcohol. When gently heated, the salt loses its water of crystallization (18.5 per cent.); at a red heat it is decomposed and leaves a residue of an alkaline reaction. The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. Addition of diluted hydrochloric acid to the aqueous solution gives rise to the odor of burning sulphur, and the solution does not become cloudy (difference from *hyposulphite*)." *U. S.* 1880. It decrepitates when heated. In the air it effloresces, absorbing oxygen, and being partially converted into the sulphate. The occurrence of a yellow precipitate, when it is added to a solution of platinic chloride, shows that it is a salt of potassium. "A one per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should produce no precipitate, or, at most, only a white cloudiness, on the addition of a few drops of test-solution of chloride of barium (limit of sulphate). If 0.485 Gm. of the salt be dissolved in 25 Cc. of water, and a little gelatinized starch added, at least 45 Cc. of the volumetric solution

of iodine should be required, until a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure Potassium Sulphite)." *U. S.* 1880.

The medicinal uses of this salt are essentially those of the other sulphites. It acts only as a slight laxative and diuretic. From four to six drachms (15.5–23.5 Gm.) in twenty-four hours have been given without unpleasant results. It escapes from the system with the urine, and may be found for some hours unchanged in the state of the sulphite; at the end of twenty-four hours potassium sulphate is found in the urine instead of the sulphite, proving that the salt undergoes oxidation in the body. It was at one time much used as a germicide in bacterial diseases, but has no power over microscopic organisms in the blood, and has passed out of vogue.

The local effects of the salt are probably less doubtful than the constitutional, but even as a local remedy it is inferior to sodium sulphite and sulphurous acid. *Dose*, from fifteen grains to a drachm (1–3.9 Gm.), repeated so as to amount to from a fourth of an ounce to an ounce in twenty-four hours.

Potassium Sulphocyanate. *Potassii Sulphocyanas.* KSCN. *Sulfocyanure de Potassium*, Fr. *Kalium Sulfocyanat, Rhodankalium*, G.—Potassium sulphocyanate, formerly called potassium sulphocyanide, is prepared by fusing in an iron vessel, at a low red heat, a mixture of two parts of dried potassium ferrocyanide and one part of sublimed sulphur. The mass, when cold, is dissolved in boiling water, and to decompose some ferric sulphocyanate, the solution is treated with potassium carbonate, which throws down the iron as a carbonate, and gives rise to the formation of a fresh portion of potassium sulphocyanate. The whole is then boiled for a quarter of an hour, filtered to separate the precipitated iron, and evaporated that crystals may form. These are purified from potassium carbonate by being dissolved in alcohol, which takes up the sulphocyanate and leaves the carbonate. The alcoholic solution is then allowed to crystallize. Potassium sulphocyanate is in long, striated, anhydrous prisms, deliquescent in a moist atmosphere, very soluble in alcohol, and having a cooling, somewhat biting taste. It has been proposed by Sömmering as a substitute for hydrocyanic acid and potassium cyanide, on the ground that it possesses the same therapeutic properties without their inconveniences.

Potentilla.—*Potentilla reptans*, L., the *creeping cinquefoil* of Europe, and *Potentilla canadensis*, L., the common cinquefoil of America (Fam. Rosaceæ), have each been used as astringents in *diarrhœa, chronic catarrhs, night sweats*, etc. According to J. C. Peacock (*A. J. P.*, 433, 1900), dried *P. norvegica*, L., contains four, and *P. canadensis* thirteen, per cent. of tannic acid.

Powder of Algaroth. *Pulvis Algarothi. Oxychloride of Antimony. Nitro-muriatic Oxide of Antimony.*—A powder rarely used now. For a description of its uses, properties, etc., see 14th edition *U. S. D.*

Prasoid.—A solution, of which one hundred drops contain 0.135 Gm. of *globularin* and 0.153 Gm. of *globularetin*. It is used in *gout* and *rheumatism* in *doses* of from fifteen to twenty drops (0.75–1.0 Cc.), three times daily.

Primula.—The leaves of the various species of this genus produce irritation when handled, due to a secretion in the glandular hairs. From the roots of *Primula grandiflora*, Bongault and Alland have separated a crystalline polyatomic alcohol, *primulite*, which is said to be identical with the heptatomic alcohol *volemite*. (*C. R. A. S.*, 135, 796.)

Prinos. *Black Alder. Winterberry. Feverbush. Prinos*, Fr., G.—The U. S. P. formerly recognized under this name the bark of *Ilex verticillata* (L.), A. Gray (*Prinos verticillatus*, L.) (Fam. Ilicaceæ). This shrub grows in the United States from Canada to Florida, and west to Missouri and Wisconsin, frequenting low, wet places. The berries, which have a bitter, sweetish, somewhat acrid taste, are sometimes used medicinally for the same purposes as the bark. The dried bark was officially described as in "thin, slender fragments, about one-twenty-fifth of an inch (1 Mm.) thick, fragile, outer surface brownish ash-colored, with whitish patches and blackish dots and lines, the corky layer easily separating from the green tissue; inner surface pale greenish or yellowish; fracture short, tangentially striate; nearly inodorous, bitter, slightly astringent." *U. S.* 1880. It has no odor, but a bitter and slightly astringent taste. Boiling water extracts its virtues. William J. Lerch failed to find berberine in it. (*A. J. P.*, 1873, 251.)

Black alder has been considered tonic and astringent, and has been used in *diarrhœa* and as a substitute for Peruvian bark, but has no antiperiodic properties. In cases of flabby or ill-conditioned *ulcers* it is popularly used both locally and internally in decoction (two ounces in three pints of water boiled to a quart). *Dose*, from two to three fluidounces (60–90 Cc.).

Prioria. *Prioria Copaifera.* Griseb. (Fam. Leguminosæ.)—The *oil tree* is a native of the West Indies, where it attains the height of eighty feet, and yields an exudate which is known as the *gum of the oil tree.* This is a thick adhesive liquid, resembling copaiba, usually turbid on account of a greenish substance, which, however, finally subsides, leaving a clear, brownish-yellow liquid. For chemical study, see *A. J. P.*, Jan. 1898.

Propione. *Di-ethyl-ketone.* $C_2H_5.CO.C_2H_5$. (Corresponding to acetone or di-methyl-ketone.) A mobile, easily soluble liquid, boiling at 101° C. (213.8° F.). *Dose*, as an hypnotic, from eight to forty-five grains (0.5–3.0 Gm.).

Propyl Alcohol (normal propyl alcohol, $C_2H_5.CH_2OH$) is formed in the fermentation of certain sugar and wine residues, as from the marc of grapes, and is separated from the fusel oil of this fermentation. It is a colorless, pleasant-smelling liquid, boiling at 96° C. (204.8° F.).

Protargol. *Protargolum.*—A combination of silver and albumin, containing about 8 per cent. of metallic silver. A yellow powder, soluble in 1 part of water, the solution not being affected by heat, albumin, hydrochloric acid, weak sodium chloride solution or sodium hydroxide solution. The dry salt as well as the solution should be protected from light. It is especially valuable because of its non-irritant properties; a 5 per cent. solution producing no pain, only a slight burning sensation, when applied to the eye. A ¼ to 2 per cent. solution may be used in acute *gonorrhœa;* a 5 to 10 per cent. solution in *urethritis.*

Protea. *Protea mellifera*, Thunb. (Fam. Proteaceæ.) *Sugar Bush.*—A plant growing in South Africa, from the leaves of which Merring Beck in 1886 obtained *proteacin.* Merck and Hesse subsequently named the principle *leucodrin.* Hesse

found the leaves to yield from 2 to 5 per cent. of *hydroquinone* associated with *proteacic acid.* (*P. J.*, 1896, 426.)

Protogen.—An albuminoid compound, obtained by the action of formaldehyde on serum or egg albumin. Used as a dietetic food for children. *Dose*, two ounces (62 Gm.), twice daily in enema.

Prunella. *Prunella vulgaris*, L. *Self-heal. Heal-all. Brunella vulgaris. Paquerette*, Fr. *Braunelle, Braunheil*, G.—A small perennial labiate herb, which is common both in Europe and the United States. It was formerly used in *hemorrhages* and *diarrhœa*, and as a gargle in *sore throat.*

Psidium. *Psidium Guajava*, L. (*P. pomiferum*, L., and *P. pyriferum*, L.) (Fam. Myrtaceæ.) *Guava.*—Hartwich has examined the root, bark, and leaves of this plant from India. (See *Ph. Rev.*, 1896, 257.)

Psoralea.—Of this genus (Fam. Leguminosæ) various species are useful. *P. castorea*, S. Wats., *P. mephitica*, S. Wats., and especially *P. esculenta*, Pursh, are all employed by the Indians of the Northwestern United States, and by the settlers, as articles of food, *P. esculenta* being the *prairie turnip* or *prairie potato*, the *tipsinah* and *taahgu* of the Indians. C. Richardson found in it nearly 70 per cent. of starch, and 5 per cent. of a new, rapidly crystallizing sugar, which has not been further investigated. *P. glandulosa*, L., *culen, yolochiahitl*, of the Mexican Pharmacopœia, yields a leaf which is used as a tonic or anthelmintic, and an emetic root. *P. bituminosa*, of Europe, and *P. physodes*, Dougl., of California, are popularly considered tonic and emmenagogue, while *P. pedunculata* (Mill.), Vail. (*P. melilotoides*, Michx.) (*Congo root, Bob's root, Samson's snake-root*), of Virginia, has been recommended as an aromatic bitter tonic, especially useful in *chronic diarrhœa.* The part employed is the root, from which MacNair obtained about 2 per cent. of a volatile oil, having the specific gravity 0.93, a pungent and bitter taste, and a neutral reaction; also a bitter principle, but not tannin. For further description, see *A. J. P.*, July, 1889; also 14th and 16th editions of *U. S. D. P. corylifolia*, L., of India, yields an oleoresin which is used in the treatment of *leucoderma* and other skin diseases. (*P. J.*, Sept. 1881.)

Ptelea. *Ptelea trifoliata*, L. *Water Ash. Wing Seed. Shrubby Trefoil. Hop Tree. Orme à trois feuilles*, Fr. *Hopfenbaum, Kleebaum*, G. (Fam. Rutaceæ.)—This is a shrub, six or eight feet in height, growing in rocky places from Long Island to Florida and west to Texas and Minnesota. The root bark, dried, occurs in cylindrical rolls or quills, one or two lines in diameter and from one to several inches long, of a light brownish color, irregularly wrinkled, and covered with a thin epidermis. Internally it is a yellowish white, but darkens by exposure. It has a peculiar somewhat aromatic odor, and a bitter, persistently pungent, and slightly acrid, yet not disagreeable taste. It yields its virtue to water, but more readily to alcohol. Steer found it to contain an oleoresin of an acrid and bitter taste. He also extracted from it the alkaloid *berberine*, which is probably the tonic principle, while the oleoresin may impart to the bark somewhat stimulant properties. (*A. J. P.*, 1867, 337. See also *Ibid.*, 1862, 198.) It is said to have been much employed among the physicians of the Western States in the treatment of *dyspepsia*, and generally in diseases requiring a mild, non-irritating, bitter tonic.

Ptomaines.—Within recent years a class of very interesting compounds have been described and are known under this name. They are alkaloid-like bases obtained from animal tissue after decomposition has commenced, hence sometimes called *cadaveric alkaloids.* Bence Jones and Dupré (*Ph. Centralh.*, 16, No. 10) first published a notice of the finding of an alkaloid-like base from a decomposing human liver. Its sulphate solution fluoresced, and in other ways resembled quinine, yielding precipitates also with the usual alkaloidal reagents, potassio-mercuric iodide, phosphomolybdic acid, and gold and platinic chlorides. It appears, however, that Marquardt had isolated such bases even previous to this. The chief investigators of this class of alkaloids have been Selmi, who first systematically studied them and gave them the name ptomaines, and Brieger, who since 1882 has published a series of elaborate studies and has classified their reactions. From cadavers which had been buried one, three, six, and ten months, in different cases, Selmi obtained bases of strongly alkaline reaction, all of which formed characteristic crystalline compounds with a solution of hydrogen iodide containing dissolved iodine. Three were soluble in ether, but not poisonous; one, insoluble in ether but soluble in amyl alcohol, was in the highest degree poisonous, producing in rabbits tetanus, strong dilatation of the pupil, paralysis of the heart, and death. All of these bodies are precipitated by the usual alkaloidal reagents, although they do not give the color reactions of the alkaloids. They, however, change rapidly when exposed to the air. Brieger's researches established the additional fact that ptomaines are formed during the earlier stages of decay, and that they are in general of a non-benzenoid character, but that as putrefaction continues they gradually disappear and give place to well-known benzenoid compounds, phenol, cresol, indol, etc. Brieger studied the ptomaines from (*a*) putrid horse flesh, beef, and human muscular tissue; (*b*) from putrid fish; (*c*) from putrid cheese; (*d*) from putrid glue; and (*e*) from putrid yeast. The bases obtained are of two classes. At first are obtained oxygenated bases, like *choline*, $C_5H_{15}NO_2$, *muscarine*, $C_5H_{15}NO_3$, *neurine*, $C_5H_{13}NO$, *gadinine*, $C_7H_{18}NO_2$, and *tetanine*, $C_{13}H_{20}N_2O_4$. These seem later to disappear, and amines seem to be almost the only products. Among those mentioned, the simplest are *dimethylamine*, $(CH_3)_2NH$, *trimethylamine*, $(CH_3)_3N$, and *triethylamine*, $(C_2H_5)_3N$. A number of the others seem to be diamines, like *putrescine*, $C_4H_{12}N_2$, *cadaverine*, $C_5H_{14}N_2$, *saprine*, $C_5H_{16}N_2$, *neuridine*, $C_5H_{14}N_2$, all four discovered by Brieger in the cadaver, *collidine*, $C_8H_{11}N$, *hydrocollidine*, $C_{11}H_{13}N$, *parvoline*, $C_9H_{13}N$, and *tyrotoxicon* (*diazobenzene*), $C_6H_5N_2$, discovered by Vaughan in poisonous cheese and in ice cream which had been allowed to become stale.

The formation of these volatile and frequently actively poisonous bases in the cadaver would seem to make the task of the toxicologist very difficult when the search for poisonous bases has been delayed until decomposition has set in. Any reagent or reagents, therefore, which will enable the chemist to decide between vegetable bases and these ptomaines becomes very important. Brouardel and Bontury (*C. R. A. S.*, 92, 1056) state that they have found such a decisive reagent in potassium ferricyanide. This compound when treated with a solution of a pure vegetable alkaloid is unacted upon by it; while, under the same con-

ditions, it is instantly reduced to the state of ferrocyanide by a ptomaine, and thus becomes capable of forming Prussian blue with a ferric salt. Up to the present but two exceptions to this rule have been found,—morphine, which readily reduces potassium ferricyanide, and veratrine, which gives traces of such reduction. It is possible, however, that in this last case the reducing action is due to certain impurities which the investigators were unable to remove completely from the veratrine employed by them.

Ptomaines are probably devoid of medicinal properties, but are of great interest to the toxicologist, not only from a chemical standpoint, but also from the fact that they are excessively fatal in their effects upon the animal economy. The well-known action of putrescent flesh, the curious poisonings sometimes produced by lobsters and other animals which feed upon carrion, are in all probability caused by them. In regard to treatment of poisoning by putrid animal matters, our present knowledge only justifies the immediate evacuation of the stomach and bowels and the meeting of the various indications as they arise. For fuller information as to the formation of ptomaines, their detection, separation, and clinical features, see *Ptomaines and other Animal Alkaloids*, by A. C. Farquharson, M.D. Bristol, Eng.: John Wright & Co., 1892.

Pulmoform. *Methylene-diguaiacol.* $CH_2<^{C_6H_3(OCH_3)(OH)}_{C_6H_3(OCH_3)(OH)}$. This is a substance obtained by the action of formaldehyde upon guaiacol. It is a yellow, tasteless powder, having the same properties as *pneumin*, for which it may be substituted in the same dose.

Pulmonaria. *Pulmonaria officinalis*, L. *Lungwort. Pulmonaire*, Fr. *Lungenkraut*, G. (Fam. Boraginaceæ.)—An herbaceous perennial, European plant, sometimes cultivated. The leaves have been employed in *catarrh*, *hæmoptysis*, and *consumption*, but their virtues are doubtful.

Pulsatilla. *U. S.* 1890. *Pulsatilla.*—"The herb of *Anemone Pulsatilla* and of *Anemone pratensis* Linné (nat. ord. *Ranunculaceæ*), collected soon after flowering. It should be carefully preserved, and not be kept longer than one year." *U. S.* 1890.

The genus Anemone is composed of small herbal plants growing in almost all the temperate countries of the world, and probably possessed very generally of the acrid rubefacient properties of the Ranunculaceæ. The *A. ludoviciana*, Nutt. (*Pulsatilla ludoviciana* (Nutt.), Heller, *A. nuttalliana*, Gray), an American species, growing in Minnesota and other parts beyond the Mississippi, has been employed with supposed advantage by W. H. Miller of St. Paul, in chronic diseases of the eyes, in cutaneous eruptions, and in syphilitic affections. A. W. Miller also found *anemonin* in it. (*A. J. P.*, 1862, p. 300; see also *A. J. P.*, xlv. 299.) *A. nemorosa*, L., which is common in Europe, is said to act as a poison to cattle, producing bloody urine and convulsions. It is stated also to have proved, when applied to the head, a speedy cure for *tinea capitis*. It is probable that the American *A. quinquefolia*, L., at first described as a variety of *A. nemorosa*, has similar properties.

A. patens, L., var. *nuttalliana*, Gray, was formerly recognized as a source of pulsatilla. The plant is that mentioned in the foregoing paragraph as *A. ludoviciana*. As Gray has pointed out, it is more like *A. Pulsatilla*, L., than like *A. patens*, L.

A. Pulsatilla, L. (*Pulsatilla vulgaris*, Mill.) This plant has its flower-stalk from five to eight inches high, with large solitary flowers, having six dull violet-purple sepals, which are very downy on the exterior, and an involucre which is at first near the flower and afterwards becomes more remote. The radical leaves are on long footstalks, and two or three times divided into long linear segments. It is a very common plant in England and Northern Europe.

Beckurts obtained *anemone camphor* by treating in each case the aqueous distillate of *A. nemorosa*, *A. pratensis*, and *A. Pulsatilla* with chloroform. It is unstable, splitting easily into anemonin and anemonic acid, the latter, when treated with alkalies, yielding *anemoninic acid*, $C_{10}H_{12}O_6$. (*P. J.*, 1885, 365.) The formula of anemonin is $C_{10}H_8O_4$. It is only slightly soluble in cold alcohol, but readily soluble in hot alcohol, and very slightly soluble in boiling ether or water. It is decomposed at temperatures above 152° C. (305.6° F.), and dissolves in alkalies with yellow color, changing at the same time into *anemonic acid*, $C_{10}H_{10}O_5$. Hanriot (*J. C. S.*, 1887, 843) has further studied anemonin. He finds that it melts at 156° C. (312.8° F.) and decomposes at 270° C. (518° F.) with partial sublimation. With zinc dust or hydriodic acid in sealed tubes, a small quantity of a hydrocarbon is formed which appears to be cymene or cumene. If anemonin be dissolved in chloroform and treated with excess of bromine, it will yield the compound $C_{10}H_8Br_4O_4$; this crystallizes from benzene in octohedra which do not melt without decomposition. When treated with nascent hydrogen in an acid solution, anemonin yields *hydroanemonin*, $C_{10}H_{12}O_4$, which crystallizes from boiling petroleum in large colorless laminæ which contain 1 molecule of H_2O, melt at 78° C. (172.4 F.), and distil without decomposition at from 210° to 212° C. (410°–414° F.) under a pressure of 10 Mm. Hydroanemonin is much more stable than anemonin.

Medicinal Properties and Uses.—Pulsatilla is a violent irritant, producing when taken in sufficient amount excessive vomiting and purging, with pain, hæmaturia, tremors, dyspnœa, and collapse. The statements of the physiological action of anemonin vary so much that there can be little doubt that different experimenters have used different substances under the same name. Noel and Lambert (*A. J. P.*, 1897) affirm that it has no action upon the heart but affects powerfully the central nervous system, producing in the lower animals progressive paralysis of spinal origin. On the other hand, Bronevski (*Med. Press*, Aug. 1886) affirms that anemonin affects very powerfully not only the nerve centres but the heart itself. The strength of commercial anemonin is variable. Broudgeest gives the fatal dose for the rabbit as 200 Mgm. per kilo, while in Noel and Lambert's experiments 0.16 gramme per kilo was required to kill the guinea pig. Authors place the *dose* for man at from five-sixths to one and one-half grains (0.05–0.096 Gm.) a day, in divided amounts.

It has been claimed for pulsatilla that it acts powerfully upon the genitalia in men and women, and is useful in *dysmenorrhœa* and *ovarian irritation;* also *epididymitis* and *orchitis*. Our own experience with it is in accord with that of many practitioners,—that unless given in infinitesimal dose, with much ceremony, it fails to achieve any good in these various cases, so that the effect which sometimes follows its use in hysterical

women is of psychical origin. Noel and Lambert especially commend a fluidextract made from the fresh herb, of which they state that from seventy-five to one hundred and twenty-five minims (4.6–7.8 Cc.) may be exhibited in the course of twenty-four hours. The *dose* of the dried powder is commonly given as from two to three grains (0.13–0.2 Gm.), but probably much larger amounts can be safely taken.

Pumice Stone. *Pumex. Obsidian.*—A very light porous stone, found in the vicinity of active and extinct volcanoes, and believed to have been thrown up during their eruption. The spongy structure of pumice is believed to be due to the effects of aqueous vapor upon lava while in a fluid state. The pumice stone of commerce is said to be obtained chiefly from Lipari. It is used whole, in the manner of a file, for removing the outer surfaces of bodies, or for rubbing down inequalities, and, in the state of powder, for polishing glass, metals, stones, etc., purposes to which it is adapted by the hardness of its particles. (See *P. J.*, 1882.)

Pural.—Powdered wood charcoal is saturated with a mixture of menthol, phenol, and benzoic acid, and compressed into cylinders. The latter when dried are ignited by a flame and used for disinfecting rooms.

Purgatol. *Purgatin. Anthrapurpurine-diacetate. Diacetyl Ester of Anthrapurpurine*, or *Trioxyanthraquinone.* $C_{14}H_5(OH)(OC_2H_3O)_2O_2$. This substance occurs as an orange-colored crystalline powder, melting at 175° to 178° C. (347°–352.4° F.), insoluble in water and in dilute acids, but slowly soluble in weak alkali and splitting up with development of a deep violet-red coloration.

Purgatol is said to be a laxative similar to emodin, to which it is chemically allied. It is absorbed to some extent, causing the urine to become red. It has been specially recommended in *chronic constipation* in *doses* of eight grains (0.5 Gm.), increased if necessary, and is said to act in from three to twelve hours without pain.

Pycnanthemum. *Koellia flexuosa* (Walt.), MacM. (*Origanum flexuosum*, Walt., *Pycnanthemum linifolium*, Pursh.) *Dysentery Weed.* This American mint is popularly used in bowel complaints; its hot infusion is diaphoretic. (See *A. J. P.*, 1894, 65, 169; *Ph. Rund.*, 1896, 32.)

Pyramidon. *Di-methyl-amido-phenyl-dimethyl-pyrazolon.*—This is a derivative of antipyrine in which an H atom of the pyrazolon group is replaced by a dimethyl-amido group. It is said to be formed by reducing iso-nitroso-antipyrine and methylating the product so obtained. Pyramidon is a yellowish-white crystalline powder, soluble in water to the extent of 1 in 10 (maximum of solubility is reached at 80° C., 176° F.), and practically tasteless. Pyramidon may be easily distinguished from antipyrine by its color reactions with various reagents. Ferric chloride gives a deep blue-violet fugitive color, and not the red of antipyrine. Nitrous acid gives a fugitive violet instead of the more permanent green of iso-nitroso-antipyrine. Nitric acid also gives a violet to amethyst coloration. In the urine pyramidon may best be detected by ferric chloride, although the color produced is no longer a pure blue, but Tokay red with a tinge of amethyst.

Filehne (*B. K. W.*, 1896) states that pyramidon resembles in its action antipyrine, and is equally efficient as an antipyretic and analgesic, but affirms that it is much more active and that its effects are more lasting than those of antipyrine. It is readily absorbed and is said to be eliminated through the kidneys in part unchanged, in part converted into *rubaronic acid*, and in part into a material which is colored deeply by ferric chloride and is probably *antipyryl urea.* According to Ssadkowski it is a stimulant to the heart and blood vessels, so that in phthisis with high arterial pressure it may produce *hæmoptysis.* It has been used as an antipyretic and as an analgesic. As an antipyretic its influence is slow and continuing, and some observers assert that it is more prone than antipyrine and acetphenetidin to produce excessive sweating and collapse. It has been highly commended in *migraine*, *neuralgia*, and similar conditions; also in *asthma* of nervous origin. The statements of Filehne are confirmed by Horneffer (*B. K. W.*, xxxiv. 1897), who further says that he has given it daily for two months without any disagreeable results. The *dose*, from five to twenty grains (0.32–1.3 Gm.), may be repeated every three or four hours, not exceeding forty grains (2.6 Gm.) in the twenty-four hours, administered in capsule or in aromatic solution.

Pyramidon Camphorate. *Pyramidonis Camphoras. Pyramidon Bicamphorate. Pyramidonis Bicamphorus.*—It is asserted that the union of camphoric acid with pyramidon markedly lessens its tendency to produce sweating, so that it may be used as an antipyretic, and the bicamphorate has been strongly recommended as an antihidrotic in the *night sweats* of phthisis.

Pyramidon Salicylate. *Pyramidonis Salicylas.* This substance has been proposed as a substitute for the older salicylates, and may be used in their stead in subacute and chronic cases. The *dose* of any of these preparations of pyramidon is eight to twelve grains (0.5–0.78 Gm.).

Pyrantin. *P-ethoxyphenylsuccinimide. Phenosuccin.* $\begin{matrix}CH_2—CO\\ \\ CH_2—CO\end{matrix}\!\!>\!N—C_6H_4—OC_2H_5$. It is prepared by melting together *p*-amidophenetol hydrochloride or acetphenetidin with succinic acid and extracting with alcohol. It is colorless, crystallizes in needles melting at 155° C. (311° F.), is insoluble in ether, but soluble in 83.6 parts of boiling water and in 1317 parts of water at 17° C. (62.6° F.). Alkalies convert it into salts of *p*-ethoxyphenylsuccinamic acid, which are soluble in water. A. Piutti states that this drug possesses properties analogous to acetphenetidin. Renzi and De Govanni have found it especially useful in acute *rheumatism* in *doses* of from fifteen to forty-five grains (1–3 Gm.) per day. It is said to have no action on the cardiac, respiratory, or digestive organs. (*Chem. Ztg.*, xx.)

Pyranum. *Pyrenol. Thymol-sodium Benzoyl-oxybenzoate.*—This is a white, hygroscopic, crystalline powder with an aromatic odor and a sweetish taste. It dissolves readily in water, one part to five, and in alcohol, one part to ten. This substance, which apparently undergoes change in the system (salicylic acid and thymol having been detected in the urine after its administration), was brought forward by Schlesinger (*Th. M.*, Feb. 1903) as an antipyretic and antineuralgic. Fifteen grammes given to a healthy man in three days produced no other symptoms than sweating, and in the animal large doses caused only a slight fall in the arterial pressure. It was used in various cases of chronic and acute *fevers;* was found to be superior to salicylic acid in acute

rheumatism, and to have very remarkable analgesic properties. *Dose*, fifteen grains (1 Gm.) repeated up to forty-five grains (3 Gm.) in a day, if required.

Pyrazole. $C_3H_4N_2.\left(\begin{matrix}CH=CH\\ |\\ CH=N\end{matrix}\right)NH$.—This compound has been prepared by acting upon epichlorhydrin with hydrazine in the presence of zinc chloride. It is a basic substance, crystallizing in needles, melting at 70° C. (158° F.), and boiling at 188° C. (370.4° F.). It is readily soluble in water, alcohol, and ether. All of the pyrazole derivatives were found by Tappeiner (*A. E. P. P.*, 1891) to act as paralyzants of the central nervous system. Only one of them, *phenylmethylpyrazolcarboxylic acid*, seems to promise value in practical medicine, on account of its extraordinarily active diuretic effects upon both the lower animals and man. Daily *dose*, from fifteen to thirty grains (1.0–2.0 Gm.).

Pyridine. C_5H_5N.—Pyridine is the first of a series of homologous bases which are found in coal tar naphtha, in shale oil, in peat tar, in tobacco smoke, and more especially in the product known as *Dippel's oil*, obtained by the distillation of bones and other animal matter. It has been used as an antiseptic and germicide, and is employed in Germany for "denaturating" alcohol for manufacturing uses. Pure pyridine is a colorless liquid, with a powerful and persistent odor, of sp. gr. 0.9858 at 0° C. (32° F.), and boils at 115° C. (239° F.). It is miscible with water in all proportions, but is precipitated from its solution by excess of sodium hydroxide. It is also miscible with alcohol, ether, chloroform, benzene, and fatty oils. In toxic dose pyridine is a violent poison, producing cyanosis, methæmoglobinæmia, great muscular weakness from paralysis both of the motor centres and nerves, and finally death from failure of respiration. De Renzi asserts that in small doses it stimulates the heart, increases the blood pressure, and is a useful remedy in angina pectoris. It was first introduced into practical medicine, as a remedy for *asthma*, by Germain Sée, whose statement has since been confirmed by various clinicians. Sée employed it by exposing about a drachm upon a plate in a small room, in which the patient remained from twenty to thirty minutes, the process being repeated several times a day; or from five to fifteen minims in two ounces of water may be taken by an atomizer; or five minims may be inhaled directly. De Renzi has given it internally in the daily *dose* of six minims gradually increased to twenty-five.

Pyridine Tricarboxylic Acid. $C_5H_2(COOH)_3N$. This important derivative of pyridine may be prepared by the oxidation of methyl-pyridine (picoline), or is obtained from certain natural alkaloids, such as quinine, quinidine, and cinchonidine, by boiling with an alkaline solution of potassium permanganate. It forms prisms melting at 244° C. (471.2° F.). This substance is said to be an active antiseptic and antipyretic, and, according to Rademaker, in *malarial fever* even surpasses quinine, when given in *dose* of ten grains (0.65 Gm.) after the paroxysm. The same authority asserts that, when given in *doses* of from one to two grains (0.065–0.13 Gm.), it will arrest the paroxysm of spasmodic *asthma*. It has also been used in *typhoid fever* as an antipyretic, and as a specific in *gonorrhœa*, when it is given by injection. (*Medical Herald*, June, 1887, 1888.) No accidents have been reported from its use.

Pyrosal.—*Antipyrine salicyl-acetate* forms colorless needles or plates of an acid but not bitter taste which are difficultly soluble in water. Pyrosal is said to contain about 50 per cent. of antipyrine, 36 per cent. of salicylic acid, and 14 per cent. of acetic acid. It is asserted to be broken up in the intestinal canal into its constituents, and to exert their influence in the human system, and has been used in *polyarthritis*, severe *influenza*, *febrile cystitis*, *migraine*, and *sciatica*, in *doses* of from eight to fifteen grains (0.5–1.0 Gm.), from two to six times daily.

Quebracho Colorado and *Quebracho Gum* are respectively the wood and the dried juice or aqueous extract of the *Loxopterygium Lorentzii* (Fam. Anacardiaceæ), a large tree growing in the Argentine Republic. The wood is very heavy, hard, and of a reddish-brown color. (See *A. J. P.*, 1879, p. 152; also Penzoldt, *loc. cit.*; *P. J.*, xii.) Quebracho colorado has been used as a substitute for the true quebracho, but is essentially different from it, and probably is a simple astringent and gastro-intestinal stimulant, although Penzoldt claims that it is similar in its action, but much weaker than quebracho blanco. Perkin and Gunnel have determined the yellow coloring matter of the wood of quebracho colorado to be identical with *fisetin*, $C_{15}H_{10}O_6$, the coloring matter of young fustic, *Cotinus Cotinus* (L.), Karst. It occurs in glistening yellow needles, dyeing similarly to quercetin, and yields compounds with mineral acids. Its benzoyl and acetyl derivatives have also been prepared. Fused with alkalies it yields protocatechuic acid and probably resorcinol. Ellagic and gallic acids have also been obtained from the wood, these being probably formed during the isolation of the fisetin. (*A. J. P.*, Nov. 1896, 626.)

Quina Morada.—This drug, growing in Bolivia and the Argentine Republic, and there credited with the therapeutic values of cinchona, is produced by *Chrysoxylum* (*Pogonopus*, Kl.) *febrifugum*, O. Kze. (Fam. Rubiaceæ.) It has been studied by Arata and Canzoneri, who find in it a blue fluorescent substance, *moradin*, and an alkaloid, *moradeine*. (*P. J.*, April, 1890.)

Quinacetine Sulphate. $(C_{27}H_{31}N_3O_2)_2H_2SO_4.H_2O$.—This is obtained by the reaction of certain organic compounds with methoxylated ditetrahydro-chinolyl. It is a colorless, odorless, and tasteless powder, and dissolves readily in acidulated water. It is antipyretic and anodyne.

Quinic Acid. *Acidum Quinicum. Kinic Acid. Hexahydro-tetraoxybenzoic Acid.* $C_6H.H_6.(OH)_4COOH$.—Forms colorless rhombic prisms, easily soluble in water, difficultly soluble in strong alcohol, which fuse at 162° C. (324° F.) Found naturally in cinchona bark, in the coffee bean, and other sources. Led by the belief that the decrease in the elimination of uric acid, which is said to be produced by strawberries, is due to quinic acid, Weiss of Basel, experimentally determined that quinic acid checks the formation of uric acid in the body, and was led to propose it and its salts as remedies in the treatment of *gout*. This theory of the action of quinic acid is certainly not established and of doubtful correctness, but has given rise to practical trials of quinates by various clinicians in gout with asserted good results. Quinic acid is converted in the system, first into benzoic, and second into hippuric acid. Various combinations of quinic acid have appeared in commerce, often under proprietary names. The most important are the following:

Chinotropin. Hexamethylenetetramine Quinate. It is claimed for this combination of quinic acid and hexamethylenetetramine that it is superior to quinic acid alone in many cases because of the decomposition of the hexamethylenamine in the system with the formation of formaldehyde and consequent reactions of that body with uric acid resulting in soluble compounds. It appears to be specially useful in cases of *gouty diseases* of the urinary tract.

Piperazine Quinate. Piperazine Kinate (Sidonal).—The quinates of piperazine and its derivatives, such as dimethylpiperazine, are white crystalline powders which are of slight taste and are soluble in water. They form salts with the alkali metals when their aqueous solutions are mixed with alkaline carbonate and evaporated. It is claimed that they exert the activity of quinic acid and of piperazine in *gout*, restraining the production of uric acid and causing the formation of hippuric acid in the organism. It is asserted that, while this substance gives brilliant results in the treatment of gout, especially during the attack, it is of little value in articular rheumatism. *New sidonal* is the salt of an inner anhydride of quinic acid which changes in the intestines and blood readily into quinic acid. Piperazine quinate is a white powder, freely soluble in cold water, which is given in *doses* of from seventy-five to one hundred and twenty grains (5–7.7 Gm.) per day. Richter found that the deposits of uric acid which are produced in pigeons by injecting potassium chromate were prevented by the simultaneous administration of sidonal, and a number of observers have reported excellent results, both in acute and chronic *gout*, from the use of the remedy.

Quinotropine. Urotropine Quinate.—This quinic compound is furnished commercially in two forms, Quinotropine I, containing 73 per cent. quinic acid and 27 per cent. urotropine; Quinotropine II, containing 80 per cent. quinic acid and 20 per cent. urotropine. These compounds yield aqueous solutions of an acid, agreeable taste. According to Nicolaier and Hagenberg (see also De la Camp, *M. M. W.*, 1901, No. 30), quinotropine does not decrease the excretion of uric acid, but aids in its solution in the urine.

Dose, Quinotropine I: fifty-five to eighty grains (3.6–5.2 Gm.) per day; Quinotropine II: seventy-five to one hundred and ten grains (5.0–7.1 Gm.) per day.

Urol, Urea Quinate, a combination of two molecules of urea and one of quinic acid, has the composition $C_7H_{12}O_6.2CO(NH_2)_2$; forms prismatic crystals melting at 106° to 107° C. (222.8°–224.6° F.). It is recommended by Van Noorden in *doses* of thirty to seventy-five grains (2–5 Gm.) dissolved in a tumblerful of hot water, on rising and going to bed, as a solvent for uric acid.

Urosin.—Lithium Quinate, a mixture of quinic acid and lithium citrate, has been put upon the market in the form of tablets which contain 0.5 Gm. of quinic acid and 0.15 Gm. of lithium citrate. Six to ten 5 grain tablets may be given in a day.

Quinine Arsenate. *Quininæ Arsenas.* $2(C_{20}H_{24}N_2O_2).H_3AsO_4 + 8H_2O$.—Made by precipitating a solution of 10 parts of quinine hydrochloride in 200 parts of water with a solution of 3.9 parts of sodium arsenate dissolved in 100 parts of water. The precipitate is washed and purified by recrystallization. In white prismatic crystals, slightly soluble in cold water, very soluble in hot water. The salt contains 69.39 per cent. of quinine and 12.30 per cent. of arsenic acid. *Dose*, one to three grains (0.065–0.20 Gm.).

Quinine Benzoate. *Quininæ Benzoas.* $C_{20}H_{24}N_2O_2.C_7H_6O_2$.—It may be made by neutralizing 3 parts of benzoic acid, dissolved in hot alcohol, with 8 parts of anhydrous quinine and crystallizing. The salt contains about 73 per cent. of quinine. Difficultly soluble in water, requiring about 370 parts for solution.

Quinine Borate. *Quininæ Boras.* $C_{20}H_{24}N_2O_2.H_3BO_3$.—Mix 10 parts of anhydrous quinine and 1.91 parts of boric acid with 20 parts of water, evaporate and powder the dried residue. The salt contains about 84 per cent. of quinine.

Quinine Bromate. *Quininæ Bromas.* $C_{20}H_{24}N_2O_2.HBrO_3$.—Made by salifying quinine with hydrobromic acid. It forms needle-like masses of crystals, is soluble in about 250 parts of cold water, freely in warm water and in alcohol.

Quinine Carbonate. *Quininæ Carbonas.* $C_{20}H_{24}N_2O_2.H_2CO_3 + H_2O$.—The carbonate is made by passing carbon dioxide through a mixture, in which freshly precipitated quinine is suspended, until all the quinine is dissolved; the solution is then evaporated and crystallized.

In the form of fine, needle-like crystals, soluble in water and alcohol.

It contains 73.66 per cent. of quinine.

Quinine Chlorhydrophosphate. *Quininæ Chlorhydrophosphas.* $C_{20}H_{24}N_2O_2.HCl(H_3PO_4)_2 + 3H_2O$.—The salt is made by dissolving 35 parts of quinine hydrochloride in a mixture of 70 parts of 25 per cent. phosphoric acid and 9 parts of 12.5 per cent. hydrochloric acid and allowing the crystals to form during spontaneous evaporation. Soluble in about 2 parts of water, having an acid reaction, and containing about 53 per cent. of quinine.

Quinine Chlorhydrosulphate. *Quininæ Chlorhydrosulphas.* $(C_{20}H_{24}N_2O_2)_2H_2SO_4(HCl)_2 + 3H_2O$.—Made by dissolving 10 parts of quinine sulphate in 3.3 parts of 25 per cent. hydrochloric acid and allowing the solution to crystallize during spontaneous evaporation. It forms colorless crystals, soluble in 1 part of water. The salt contains about 74 per cent. of quinine.

Quinine Chromate. *Quininæ Chromas.* $C_{20}H_{24}N_2O_2.H_2CrO_4 + 2H_2O$.—It may be made by precipitating 4 parts of quinine hydrochloride, in 100 parts of warm water, with 1 part of neutral potassium chromate, dissolved in 15 parts of water. The crystals are washed and purified by recrystallization from hot diluted alcohol. In the form of yellow crystalline needles, almost insoluble in cold water, soluble in 160 parts of boiling water.

Quinine Eosolate. *Quininæ Eosolas.* $C_9H_7S_3O_{12}(C_{20}H_{24}N_2O_2)_2$.—This is the commercial name of the neutral quinine salt of *trisulpho-acetyl-creosote*. Very active anti-periodic properties have been claimed for it. *Dose*, three grains (0.2 Gm.) three times a day.

Quinine Glycerophosphate. *Quininæ Glycerophosphas.*—*Kineurine*, $C_3H_7O_3PO_3(C_{20}H_{24}N_2O_2)_2$, forms a white powder, soluble in hot water and alcohol, which contains 68 per cent. of quinine in combination with glycerophosphoric acid. This substance has been recommended as an anti-periodic in *doses* of five to ten grains (0.32–0.65 Gm.). The tonic *dose* is set down as one and one-half to three grains (0.096–0.2 Gm.).

Quinine Iodate. *Quininæ Iodas.* $C_{20}H_{24}N_2O_2.HIO_3$.—Made by dissolving freshly precipitated

quinine in hydriodic acid, using molecular proportions, and afterwards evaporating and drying the salt. In small needle-like crystals, freely soluble in alcohol and in 700 parts of cold water. It contains about 63 per cent. of quinine.

Quinine Phenolsulphonate. *Quininæ Phenolsulphonas. Quinine Sulphocarbolate.* $C_{20}H_{24}N_2O_2[C_6H_4(OH)SO_3H]$.—Made by precipitating 10 parts of quinine sulphate, in 500 parts of water, by adding it to a boiling solution of 6 parts of barium phenolsulphonate, dissolved in 75 parts of water. The precipitate is washed and dried. A yellowish-white mass, melting when warmed, only slightly soluble in water, soluble in alcohol.

Quinoa.—The *Chenopodium Quinoa,* Willd. (Fam. Chenopodiaceæ), is largely cultivated in Southern Peru and Southern Chili, often above the height at which barley and rye will ripen, for the sake of its seeds. These are about the size of white mustard seeds, but flatter, and afford a flour resembling somewhat oatmeal. The starch grains are very small, and constitute about 40 per cent. of the grain, which also contains 5 per cent. of sugar, 7½ of casein, and 11 of albumen and other protein compounds. One variety, the *red quinoa,* contains a bitter principle in the seed husks, and is used to some extent as an emetic and antiperiodic. (*A. J. P.,* 1872, 559.)

Quinoline Bismuth-Sulphocyanate or **Rhodonate.** *Quinolinæ Bismuth-Sulphocyanas.*—A granular, reddish-yellow powder, insoluble in water, alcohol and ether, melting at 70° C. (158° F.).

Quinoline Sulphocyanate or **Rhodonate.** *Quinolinæ Sulphocyanas.*—A colorless or yellowish, crystalline powder, only slightly soluble in cold water and ether, but freely soluble in hot water and alcohol. The salt melts at about 137° C. (278.6° F.).

Radium.—*History and Discovery.*—The fact that *pitch blende,* the native uranium mineral, gives out rays, which act upon photographic plates when the latter are wrapped in black paper, cause certain phosphorescent substances to become illuminated and make air through which they pass a conductor of electricity, was discovered by the physicist Bequerel. These properties were found to be possessed by all the uranium and thorium minerals as well as by the metals themselves. In 1897 Madame Curie began an investigation of the relative activity of the various salts of uranium and later of the minerals containing that element. While she found that the radio-activity of the different uranium and thorium salts was always less than that of these two metals themselves, yet certain native uranium and thorium minerals possessed these properties in a notably higher degree than either of the metals first mentioned. She was therefore led to the conclusion that these minerals contained one or more new elements to which this property belonged in a much higher degree than to uranium or thorium.

Physical and Chemical Properties.—The extraction of radium salts from the residues of the pitch blende remaining from the working of it for uranium is a long and tedious process, one ton of the residues having finally yielded a few decigrammes of a substance resembling barium. This was, however, many thousand times as active as uranium. After radio-active barium bromide is obtained, 60 times more active than metallic uranium, the bromide is subjected to a long series of crystallizations dependent upon the fact that radium bromide is less soluble in water than the barium bromide. The element itself has not yet been obtained, although radium amalgams have been prepared, Its chloride, bromide, carbonate, nitrate and sulphate resemble similar barium salts.

Radium bromide, however, shows a characteristic spectrum and colors the Bunsen flame carmine-red. All radium salts are luminescent and excite phosphorescence in a variety of chemical compounds and minerals. This power is notably shown upon zinc sulphide and barium platinocyanide. Photographic plates covered with black paper are also at once affected. Radium compounds also bring about many chemical decompositions and exert notable physiological effects upon vegetable and animal organisms.

Most remarkable, however, is the fact that radium compounds show what is apparently evidence of continuous breaking up without any extraneous inciting cause. By reason of this decomposition radium salts spontaneously develop heat and in consequence always show from 3° to 5° C. higher temperature than surrounding objects. It is estimated that one gramme of radium will thus emit in a day 2400 or in a year 876,000 gramme calories.

In connection with this decomposition, radium is capable of giving off rays or emanations which have been respectively designated as α, β, and γ rays, all of which differ in their physical characters. Of these rays, the α-rays are easily absorbed, the β-rays are the same as the cathode rays, and the γ-rays in some respects resemble the Roentgen rays. Ramsay and Soddy submitted the radium emanations to a spectroscopic investigation and discovered that the emanation could be in part condensed by the aid of liquid air, and that this portion in a few days *changed into the element helium.* Chemists have been led therefore very generally to accept at least provisionally the theory of Rutherford and Soddy that radio-activity is an atomic and not a molecular property and that the atoms of certain elements of high atomic weight, which alone show radio-activity, undergo spontaneous disintegration.

Metallic radium has, as before stated, not as yet been isolated. By the analysis of the purest of its salts, however, the atomic weight 225 has been deduced for it. Two other rare elements have been also indicated as present in the residues from pitch blende, viz.: *polonium,* the salts of which were obtained by Madame Curie in 1898, and *actinium,* announced by Debierne in 1899. Besides these three, the only other known radio-active elements are uranium and thorium. All of these elements have very high atomic weights and all are supposed to show by their emanations evidence of atomic disintegration.

Physiological Action, Therapeutic Applications, and Uses.—The therapeutic properties of radium appear to be very similar to those of the X-ray. A moderate exposure to the radium produces an inflammatory reaction, which after more prolonged or severe exposure leads to a destruction of tissue. London (*B. K. W.,* xliii.) found that rabbits kept for two weeks in a cage on top of which was placed 25 mgm. of radium lost their hair, the ears necrosed and the sexual organs degenerated; he believes that the emanations have no effect on fibroid tissue. The therapeutic value of the substance seems to be due to the fact that diseased tissue is more susceptible to the radium rays than healthy, so that the chief utility is for the purpose of destroying morbid growths, as *epitheliomata, lupus, rodent ulcers* and

the like. It was at one time hoped that radium would offer a means of treating the deeper *cancers* which are beyond the reach of the X-ray; unfortunately, however, the radium emanations do not appear to have any greater penetrative powers; according to Metzenbaum (*N. Y. M. R.*) even when tubes of radium are placed within large carcinomata there is produced merely a local change. On the other hand in certain cavities, as the mouth, rectum, or vagina, the ease with which radium can be brought in contact with the disease focus gives the element a distinct place in therapeutics.

As regards the dosage no definite statement can be made; the amount employed must be governed by the effects. It must be remembered that radium is a powerful substance capable of much harm and should be applied only by those with special skill.

Raisins. *Uva Passa. U. S.* 1870.—The dried ripe fruit of the *Vitis vinifera*, L. (Fam. Vitaceæ), is no longer recognized by the Pharmacopœia. The grape vine itself is too well known to require description. Its leaves and tendrils are somewhat astringent, and were formerly used in *diarrhœa, hemorrhages*, and other morbid discharges. The juice which flows from the stem was also thought to be possessed of medicinal virtues, and the idea still lingers among the vulgar in some countries. The unripe fruit has a harsh sour taste, and yields by expression a very acid liquor, called *verjuice*, which was much esteemed by the ancients as a refreshing drink when diluted with water. It contains malic and tartaric acids, and an acid called *racemic acid*, a compound isomeric with tartaric acid, but differing from it in being optically inactive. M. A. Petit has ascertained that grape leaves contain 2 or 3 per cent. of glucose, and a quantity of acid varying from 1.3 to 1.6 per cent. Of the acid, tartaric acid constituted one-third, and most of this was in the form of cream of tartar. In a subsequent investigation, Petit found that, besides glucose, or sugar of grapes, the leaves contained a notable portion of common or cane sugar. In one instance he secured 0.97 per cent. of cane sugar and 2.665 of glucose; in another, in which he operated so that the common sugar in the leaves had less opportunity to be converted into glucose, he obtained 1.58 per cent. of the former and 1.749 of the latter. (*J. P. C.*, Janv. 1874, 41.) The seeds afford from 15 to 18 per cent. of a bland fixed oil, which is occasionally extracted. Fitz (*Ber. d. Chem. Ges.*, 1871, 442) has shown that it consists of the glycerides of *erucic acid*, $C_{22}H_{42}O_2$, stearic and palmitic acids, the first-named acid largely prevailing. The seeds further contained from 5 to 6 per cent. of tannic acid, which also exists in the skin of the fruit. The grape, when quite ripe, is among the most pleasant and grateful fruits, and is admirably adapted, by its refreshing properties, to febrile complaints. If largely taken, it proves diuretic and gently laxative. The ripe fruit differs from the unripe in containing more sugar and less acid, though never entirely destitute of the latter. The plant is supposed to have been derived originally from Asia; but it has been cultivated in Europe and Northern Africa from the remotest antiquity, and is now spread over all the temperate civilized regions of the globe. The fruit is exceedingly influenced by soil and climate, and the varieties of the plant which have resulted from culture or situation are innumerable.

Several varieties of raisins are known in commerce. The best of the European fruit are the *Malaga raisins*, imported from Spain. They are large and fleshy, of a purplish-brown color and sweet agreeable taste. Those produced in Calabria are similar. The *Smyrna raisins* are also large, but of a yellowish-brown color, slightly musky odor, and less agreeable flavor. They are originally brought from the coast of Syria. The *Corinthian raisins*, or *currants* as they are commonly called in this country, are small, bluish black, of a fatty appearance, with a vinous odor and a sweet, slightly tartish taste. Their name is derived from the city in the vicinity of which they were formerly cultivated. At present they are procured chiefly from Zante, Cephalonia, and the other Ionian Islands. In the older Pharmacopœias they are distinguished by the title of *uvæ passæ minores*. Within recent years the production of raisins in California has become an industry of the highest importance. According to official reports, the California raisin crop for 1902 was 108,000,000 pounds. These raisins are coming into large use in the United States and are rapidly replacing those obtained from Malaga; the importation of the latter has decreased in the years between 1876 and 1900 at least 90 per cent. The ripe grapes are cut from the vines, spread out on a clay floor, and dried by exposure to the heat of the sun. The drying process usually requires about ten days' time. Artificial heat is used to dry them in rainy weather; sometimes the grapes are partially dried on the vines; this is done by cutting the stalks of the ripe grapes half way through, and allowing the bunches to remain for a few weeks, a portion of the bark of the vine being removed also to facilitate the process. If it is desirable to remove the waxy bloom on the grapes, the bunches are steeped for a short time in weak alkaline solution, washed and then thoroughly dried.

Raisins usually contain more sugar than do recent grapes. This principle, indeed, is often so abundant that it effloresces on the surface or concretes in separate masses within the substance of the raisin. The average composition of the raisin is given as 32.02 per cent. water, 2.42 nitrogenous material, 0.59 fat, 54.56 sugar, 7.48 other nitrogenous organic matter, 1.72 wood fibre, and 1.21 ash. (König, *Nahrungs- und Genussmittel*, 3te Aufl., ii. 815.) The *sugar of grapes* (*glucose*) differs from that of the cane, being less sweet, less soluble in cold water and much less so in alcohol. In these respects it does not differ from artificial glucose, which is now made in enormous quantities and consumed in food products and candies; the artificial product is made by acting on starch with sulphuric acid (see page 1071).

The chief medicinal use of raisins is to flavor demulcent beverages. Taken in substance they are gently laxative, but are also difficult of digestion, and, when largely eaten, sometimes produce unpleasant effects, especially in children.

Randia. *Randia dumetorum*, Lam. (Fam. Rubiaceæ.)—The fruit of this East India shrub is used by the natives as a fish poison, and is said to act in man as an irritating emetic. According to the *Pharmacographia Indica*, each fruit contains about four grains (0.26 Gm.) of saponin, besides valeric acid. The tincture has been used by James Sawyer (*L. L.*, 1891) as an antispasmodic.

Ranunculus. *Crowfoot. Renoncule*, Fr. *Hahnenfuss*, G.—Most of the plants belonging to the genus Ranunculus have similar acrid prop-

erties, and, from their close resemblance, are confounded under the common name of *buttercup*. *R. bulbosus*, L., was formerly on the Secondary List of the U. S. Pharmacopœia; but *R. sceleratus*, L., had attracted more attention in Europe, and *R. acris*, L., and *R. flammula*, L., were recognized by the Dublin College. In all these species the plant itself is a violent irritant, producing when chewed excessive inflammation in the mouth and throat, and, when swallowed, toxic gastritis which may be fatal. The acrid principle appears to be volatile; according to Bigelow, it is yielded to water in distillation. Clarus discovered, in *R. sceleratus*, L., besides the acrid volatile oil, a nearly inert resin, and a narcotic principle called *anemonin* or *anemone camphor*, $C_{15}H_{12}O_6$. The volatile oil is soluble in ether, and is decomposed, on standing, into a white amorphous substance having acid properties (*anemonic acid*), $C_{15}H_{14}O_7$, and into anemonin. (*Brit. and For. Med.-Chir. Rev.*, 1859, 181.) Rochebrune states that he has separated from *R. aquatilis*, L., *R. flammula*, L., *R. sceleratus*, L., and *R. bulbosus*, L., crystalline alkaloids to which he has given the name of *ranunculine*, although their identity is doubtful. These alkaloids are violent irritants and active cardiac poisons. (*Toxicolog. Africaine*, i.) Before the introduction of cantharides the green buttercup plants were much employed as vesicants.

Realgar. As_2S_2. *Red Orpiment.*—This is *arsenic disulphide*. It is found native in Saxony, Bohemia, Transylvania, and in various volcanic regions. Realgar is artificially made by melting arsenic trioxide with about half its weight of sulphur. Thus prepared, it is of a crystalline texture, of a beautiful ruby-red color, of a uniform conchoidal fracture, somewhat transparent in thin layers, and capable of being sublimed without change. Native realgar is said to be innocuous when taken internally, while that artificially prepared is poisonous, in consequence, according to Guibourt, of containing a little free arsenic trioxide. Realgar is used only as a pigment.

Red Chalk. *Reddle.*—A mineral substance of a deep red color, of a compact texture, dry to the touch, adhering to the tongue, about as hard as chalk, soiling the fingers when handled, and leaving a lively red trace when drawn over paper. It consists of clay and ferric oxide, and is intermediate between *bole* and *red ochre*, containing more ferric oxide than the former and less than the latter. It is used for drawing lines upon wood, etc., and is sometimes made into crayons by levigating and elutriating it, then forming it into a paste with mucilage of gum arabic, moulding this into cylinders, and drying it in the shade. It has been used internally as an absorbent and astringent.

Regianin.—This is a principle obtained by Phipson from the nut of *Juglans regia*. It occurs in octahedral, prismatic, or feathery crystals, and gives with ammonia and other alkalies a reddish-purple solution, from which hydrochloric acid precipitates an amorphous powder, *regianic acid*. It is probably identical with the *nucin* obtained from green walnut shells.

Rennet. *Gastric Juice. Liquor Seriparus. Laabessenz*, G.—For a full account of the constitution of gastric juice and its properties the reader is referred to works upon physiology. The crude juice was applied by P. S. Physick to foul ulcers. *Rennet* is an aqueous or vinous infusion of the dried stomach of the calf, though that of the sheep or other animal would probably answer the same purpose. It is much used, as every one knows, for curdling milk, a property which it owes to a portion of the gastric secretion, retained and dried in the mucous tissue of the stomach. To the same material it probably owes the property which it possesses of converting glucose into lactic acid, and there is little doubt that it is capable, in greater or less degree, of exercising the solvent property of gastric juice over albuminous and fibrinous food. It is highly probable that the preparation usually employed to curdle milk may contribute to the ready digestibility of the curds and whey. George Ellis prepared *rennet wine* as follows: Take the stomach of a calf immediately after the animal has been killed, cut off and reject about three inches of the upper or cardiac portion, slit the stomach longitudinally, wipe it gently with a dry napkin so as to remove as little of the clean mucus as possible, then cut it into small pieces, the smaller the better, put it into a common wine bottle, fill the bottle with good sherry, and let it stand corked for three weeks. It is known to be good if a teaspoonful will coagulate half a pint of milk in two minutes at 37.7° C. (100° F.). The *dose* is a teaspoonful in a wineglassful of water, immediately after each meal.

Resaldol, $C_{20}H_{14}O_5(CH_3CO)_2$.—Resaldol is an acetyl derivative obtained by acetylating the product of the reaction between chlormethyl-salicylic aldehyde and resorcinol. It is an amorphous yellowish-brown powder of an astringent taste, insoluble in water and dilute acids, but soluble in alkalies. Its peculiar solubilities led Eichengrün to use it as an intestinal antiseptic, with the expectation that it would escape gastric action and be dissolved in the intestines. It has been tried in *tubercular* and other forms of *intestinal ulcerations* with asserted good results. *Dose*, forty-five to sixty grains (3–3.9 Gm.), taken in the course of the day, either in powder or capsule.

Resalgin. *Antipyrine Resorcylate.*—This occurs in crystalline needles soluble in 150 parts of cold water and 20 parts of boiling water, readily soluble in alcohol, ether, and chloroform. It is obtained by acting on antipyrine with potassium resorcylate. Forms colorless, odorless crystals melting at 110.5° C. (231° F.).

Reseda. *Reseda Luteola*, L. *Weld. Dyer's Weed. Herbe Jaune, Gaude*, Fr. *Wau, Gelbkraut, Harnkraut*, G. (Fam. Resedaceæ.)—An annual European plant, naturalized in the United States. It is inodorous, and has a bitter taste, which is very persistent. Volhard showed that allyl thiocyanate, $C_3H_5.SCN$ (volatile oil of mustard), was present in the root, and Chevreul obtained from it by sublimation a peculiar yellow coloring matter, which he called *luteolin*, and which has the formula $C_{20}H_{14}O_8$. Hlasiwetz and Pfaundler (1895) assign to it the formula $C_{15}H_{10}O_6$. This forms yellow crystals of silky lustre, insoluble in water, soluble in alcohol. It dissolves in alkalies with deep yellow color. It is used especially in silk dyeing. Rochleder and Brener (*J. Pr. Chem.*, xcix. 433) found that when fused with potassium hydroxide it was decomposed into phloroglucin and protocatechuic acid with evolution of carbon dioxide. A. G. Perkin (*J. Chem. S.*, 1896) investigated the salts of luteolin, and called attention to the similarity of its properties to those of *fisetin*. In medicine it has been employed as a diaphoretic and diuretic, but it is now used only for dyeing purposes.

Resol.—A proprietary disinfectant said to be made by saponifying wood tar with potassium hydroxide and adding wood spirit.

Resopyrine. $C_{11}H_{12}N_2O + C_6H_4(OH)_2$.—Made by mixing solutions of 30 parts of antipyrine and 11 parts of resorcinol. A crystalline mass separates which should be recrystallized from alcohol. It is insoluble in water.

Resorbin.—An ointment vehicle made by emulsifying almond oil and water by means of a little yellow wax, gelatin, and soap, to which is added some lanolin. It is asserted that it greatly facilitates the absorption of medicaments.

Retamine. $C_{15}H_{26}N_2O$.—This is an alkaloid, crystallizing in long needles, melting at 162° C. (323.6° F.), with decomposition, which has been isolated by Battandier and Malosse from the young shoots and branches of *Retama sphærocarpa*, Raf. (*Cytisus sphærocarpus*, O. Kze.).

Retinol. *Codol.* $C_{32}H_{16}$.—A product obtained by the distillation of Burgundy pitch or resin. It forms a yellowish oil boiling at temperatures over 280° C. (536° F.). It is stated that retinol does not irritate the skin, is unaltered by light, is mildly antiseptic, does not become rancid, and is very inexpensive; qualities which, taken along with its extraordinary solvent power, bid fair to make it a valuable vehicle for ointments. Among the substances dissolved by it are: salol, 1–10; iodol, 1–50; naphthol, 1–50; thymol iodide, 1–50; camphor, 1–20; chrysophanic acid, 1–40; cocaine, 1–30; codeine, 1–40; and strychnine, 1–40. It is miscible in all proportions with oil of juniper, phenol, turpentine, alcohol, and ether. Resorcinol, if dissolved in glycerin, may be mixed with retinol, and so may iodoform if it be dissolved in a little ether. Iodol is dissolved, but soon precipitates as a resinous mass. Phosphorus is also dissolved, and the solution remains unchanged indefinitely. Retinol mixes readily with fats, oils, vaseline, lard, lanolin, glycerin, cacao butter, etc., and may be used in ointments. In cases where a liquid is not undesirable, retinol, owing to its antiseptic properties, can with great advantage replace these bodies. Upon the mucous membrane retinol seems to act as a mild stimulant antiseptic; it has been used with alleged excellent results locally in *otitis*, *vaginitis*, *rhinitis*, and other mucous diseases. Injections of it in *gonorrhœa* are said to be remarkably effective. As a means of administering phosphorus it is especially recommended.

Rhigolene.—This name was given by H. J. Bigelow of Boston, to a very light, inflammable liquid, obtained by distilling petroleum, and separating the liquids of the lowest boiling point by redistillation, until one is obtained which boils at about 18° C. (64.4° F.). A degree of cold —9° C. (15.8° F.) is, according to Bigelow, obtained through the evaporation of this liquid by means of the common atomizer or "spray-producer." This is the chief use of the liquid, which may be employed in producing congelation of any part of the body preparatory to a surgical operation, or a great degree of cold for any other purpose. It should, when not in use, be kept in a cool place, in bottles tightly corked, or otherwise it will be rapidly evaporated. In a warm place it might break the bottles through its extreme volatility, unless the stopper should previously be driven out. The vapor is inflammable and care should be exercised in using it near a flame.

Rhododendron. *Rhododendron Chrysanthemum*, Pall. *Yellow-flowered Rhododendron. Rosebay. Snowrose. Rosage*, Fr. *Alpenrose, Schneerose, Gichtrose*, G. (Fam. Ericaceæ.)—The leaves of this rhododendron have long been employed in Siberia as a remedy in *rheumatism*, and to a less extent in *gout* and *syphilis*. They yield their virtue to water and alcohol, and, according to von Archangelski, contain three proximate principles; *rhododendrol*, $C_{10}H_{12}O_2$; *rhododendrin*, $C_{16}H_{22}O_7$; and a glucoside resembling digitalin and very toxic. The *dose* of the dried leaves is said to be two drachms (7.7 Gm.), given in infusion.

G. F. Kuehnel found in leaves of the "great laurel," *Rhododendron maximum*, L., *arbutin*, *ericolin*, and *ursone*. (*A. J. P.*, 1885.)

Rhus.—The genus Rhus contains various species which have the property—probably even without direct contact—of so violently irritating susceptible skins as to produce severe poisoning. Of these poisonous species there are six which are recognized in the United States by most modern botanists.

R. Vernix, L. (*R. venenata*, DC.).—*Swamp Sumac, Poison Sumach, Poison Elder*, is a handsome shrub or small tree, usually ten or fifteen feet high, but sometimes thirty feet. The bark of the trunk is dark gray, of the branches lighter, of the extreme twigs and petioles pale to deep red. The leaves are pinnate, with four or five pairs of opposite leaflets, and an odd terminal one. These are oblong or oval, entire or slightly sinuated, acuminate, smooth, and, except the one at the end, nearly sessile. The flowers are diœcious. They are very small, greenish, and in loose axillary panicles. The berries are small, roundish, and greenish white. The tree grows in swamps and low grounds from Canada to Carolina, and flowers in June and July. It was confounded by the older botanists with *R. vernicifera*, DC., of Japan, the Japanese lacquer tree, which has similar poisonous properties. Its activity is said to depend upon *urushic acid*.

Rhus Michauxii, Sargent (*R. Pumila*, Michx.), is a rare Southern species, growing in upper Carolina and Georgia, and not more than a foot in height. It is characterized by its pubescent branches and petioles, by its pinnate leaves, with many pairs of oval, nearly acuminate, incised-dentate leaflets, downy beneath, and by its silky fruit. According to Pursh, it is the most poisonous of the genus.

Rhus diversiloba, Torrey and Gray (*R. lobata*, Hooker, *Flor. Bor. Am.*, i. 127, t. 46), is found on our Pacific border. It is there generally known as *Poison Oak*. It has a somewhat climbing stem, with short, leafy branches. The leaves have three or rarely five leaflets, which are very obtuse, in the female plant slightly, in the male rather deeply pinnately lobed, the lobes being very obtuse, and the incisions acute. The flowers are in axillary, racemose panicles often shorter than the petioles; the fruit is white, somewhat pubescent, and subglobose. The leaves in the male and the female plant are so different that they might readily be mistaken for different species. (Torrey and Gray.) Though generally a shrub, the plant sometimes climbs over large trees, and may have a stem six inches in diameter.

Rhus Metopium, L. (*Metopium Linnœa*, Engelm.), *Mountain Manchineel, Coral Sumac*, is a West Indian species, growing also in the "hummock" lands of Southern Florida. It is a small tree, the bark, when wounded, exuding a gum-resin (*hog gum*) to which medicinal properties

are ascribed. The leaves are pinnate with fine leaflets. To the acid red fruit is due the name Coral Sumac. It is exceedingly poisonous.

Rhus Toxicodendron, L., *Poison Oak*, of the Southern States, is a low, erect plant, the leaflets ovate, mostly obtuse, crenate or crenately lobed, often to the middle, so as to resemble the leaves of an oak; the sinuses sharp, petals about 2 millimeters long, fruit depressed-globose, 6 to 8 millimeters in diameter.

Rhus radicans, L., *Poison Oak, Poison Ivy*, whose fresh leaves were formerly official in the U. S. Pharmacopœia under the name of *Rhus Toxicodendron*, U. S. 1890, is a woody vine climbing by numerous aerial rootlets; the leaves petioled, leaflets ovate or rhombic, 2.5 to 15 Cm. long, entire or sparingly dentate or sinuate, acute or short-acuminate, the lateral sessile or short-stalked, inequilateral, the terminal ones stalked, flowers green, 3 Mm. broad, in loose axillary panicles, 2 to 8 Cm. long; the fruit globose-oblong, gray.

The leaves were officially described as "long-petiolate, trifoliate; the lateral leaflets sessile or nearly so, about 10 Cm. long, obliquely ovate, pointed; the terminal leaflets stalked, ovate or oval, pointed, with a wedge-shaped or rounded base; the leaflets entire and glabrous, or variously notched, coarsely toothed or lobed, more or less downy; when dry, papery and brittle; inodorous; taste somewhat astringent and acrid." *U. S.* 1890.

The milky juice of the poisonous rhus becomes black on exposure to the air, and leaves upon linen or other cloth a stain, which cannot afterwards be removed by washing with soap and water, or by alcohol either hot or cold, but deepens by age. It has been proposed as an indelible ink. Ether dissolves it; applied to the skin it frequently causes inflammation and vesication.

Analyzed by Joseph Khittel, rhus yielded tannic acid of the variety which gives greenish precipitates with salts of iron, with chlorophyll, wax, fixed oil, resin, sugar, albumen, gum, pectin, starch, oxalic acid, a peculiar neutral substance, and a *volatile alkaloid*, on which the poisonous properties of the plant were supposed to depend. (*A. J. P.*, 1858, p. 544.) This supposed alkaloid probably does not exist. Maisch thought that the activity of the plant depended upon an acid (*toxicodendric acid*). To obtain this acid, the leaves were bruised with 6 per cent. of slaked lime, and after maceration with water were expressed. The expressed liquid, having been mixed with an excess of sulphuric acid, was distilled, and the vapors were condensed, partly by themselves, so as to obtain the pure acid, and partly in water containing barium carbonate in suspension, so as to get barium toxicodendrate. The solution thus obtained was colorless and strongly acid. (*A. J. P.*, Jan. 1866.) F. Pfaff has obtained Maisch's toxicodendric acid both in the form of barium salt and as free acid in aqueous solution, and found both to be non-toxic. The real active principle he found to be a non-volatile oil. This oil, which he terms *toxicodendrol*, is present in all parts of the plant, whether in a fresh green state or in old and dried specimens. *R. venenata* yields a larger percentage of the oil than *R. radicans*, but no difference was found in the oils from the two. This oil applied to the skin caused the well-known eruption. Pfaff recommends a washing with alcoholic solution of lead acetate, as the oil is soluble in alcohol and forms a lead compound nearly insoluble. (*Proc. A. Ph. A.*, 1895, 843, and 1898, 865.)

The poisonous rhus when taken internally appears to be possessed of narcotic besides irritant properties, vomiting, drowsiness, stupor, dilated pupils, convulsive movements, delirium, and fever having been present in poisoning by them (*Am. J. M. S.*, April, 1866; also *M. Rep.*, Nov. 1867). The tincture of rhus has been used especially by homœopathic practitioners in the treatment of *subacute* and *chronic rheumatism*, and the practice has found imitation.

Some years ago H. C. Wood made extended trials of the remedy, using a homœopathic tincture obtained from a homœopathic pharmacy, in various doses (homœopathic, small, and large), upon a large number of cases of *subacute, chronic*, and *acute rheumatism*, in the Philadelphia Hospital, but he was not able to perceive that the patients progressed more rapidly when taking it than when they were simply nursed. The best preparation would undoubtedly be a concentrated alcoholic tincture, made from the green drug; strength of one to four. The *dose* of a 25 per cent. tincture given by H. C. Wood was from one to five minims (0.06–0.3 Cc.), three times a day. The solid extract is an ineligible preparation, owing to the extreme volatility of the active principle of the crude drug.

For the violent dermatitis which is produced by the poison ivy very numerous specifics have been from time to time proposed. There seems, however, to be no method of treatment better than the use of lead water and laudanum. If the belief of Pfaff be correct, that the acrid substance is a fixed oil, thorough washing and irrigation of the part with a diluted solution of sodium carbonate would seem to be indicated for the removal of the irritant.

Rhus aromatica, Ait. (Fam. Anacardiaceæ.) This indigenous drug has been highly recommended in the treatment of *nocturnal incontinence* of urine by a number of clinicians of repute. (See *G. H. M. C.*, 1889; also *Annals of Gynæc.*, 1890.) For elaborate description of the bark, see *Newer Materia Medica*. The adult *dose* is twenty or thirty minims (1.3–1.8 Cc.) of the fluidextract of the bark, three times a day, given in aromatized solution.

Ricin is the name given by Kobert and Stillmark to the toxic constituent of castor beans. It belongs to the class of albuminoids and is of the character of an enzyme. According to Cushny (*A. E. P. P.*, 1898, 41) ricin is the most active poison known, 0.04 milligramme per kilo of body weight being fatal to the rabbit. The toxic symptoms, which frequently do not come on for several hours after the ingestion of the poison, are due primarily to the intensely irritant action of the substance, and consist of diarrhœa, with suppression of the urine, and frequently jaundice, probably from irritation of the mucous membrane of the biliary ducts. Müller (*A. E. P. P.*, 1899, 42) states that the poison also has a direct action upon the medulla, leading to the fall of blood pressure and lessened respiratory activity.

The effects of ricin in many directions bear a striking resemblance to the effects of bacterial toxins. Thus, for example, it produces a leucocytosis and an agglutination of the red corpuscles. The most interesting, however, of these resemblances is the production of immunity and the formation of antitoxic substances.

Ricinine. $C_{17}H_{18}N_4O_4$.—Tuson first obtained from the seeds of *Ricinus communis*, L., a crystalline substance which he believed to be alka-

loidal in nature, and to which he gave the name of *ricinine*. To obtain it, the crushed seeds are exhausted by successive portions of boiling water; the decoction is filtered through wet muslin; the filtered liquor is evaporated to dryness over a water bath; the extract thus obtained is exhausted by boiling alcohol; the alcoholic solution is allowed to cool, then filtered to separate a little resinous matter, and lastly concentrated and permitted to stand. In the course of some hours, a mass of nearly white crystals is deposited, which when recrystallized from alcohol and decolorized by animal charcoal is the alkaloid in a pure state. Ricinine crystallizes in rectangular prisms and tables, melting at 194° C. (381.2° F.), has a feebly bitter taste, somewhat resembling that of bitter almonds, is fusible, and crystallizes on cooling, volatilizing unchanged, inflammable, soluble most readily in water and alcohol, and very slightly in ether or benzene. Heated with potassium hydroxide it evolves ammonia, and therefore contains nitrogen. It appears to combine with sulphuric, nitric, and hydrochloric acids. But a more accurate investigation is needed before it can be admitted to be undoubtedly a distinct and pure alkaloid. A minute quantity is said to be obtained from castor oil by shaking it with water, evaporating the liquid, treating the residue with boiling benzene, and allowing the solution to evaporate spontaneously. Tuson does not claim for the new alkaloid the possession of purgative properties. Two grains (0.13 Gm.) given to a rabbit produced no observable effect. E. E. Wayne obtained from the leaves of *Ricinus communis*, L., a substance which is apparently identical with Tuson's ricinine, but he does not consider it to be an alkaloid. (*A. J. P.*, 1874, p. 97.)

Rimu Resin.—The resin of the *Dacrydium cupressinum*, Solander, the New Zealand red pine or *rimu*, a large coniferous tree of New Zealand, is characterized by its rose color and its crystalline appearance. It is composed chiefly of a crystalline acid resin, *rimuic acid* (*Chem. News*, lxxxviii. 20).

Robinia. *Robinia Pseudacacia*, L. *Locust Tree. False Acacia. Robinier*, Fr. *Falsche Akasie*, G. (Fam. Leguminosæ.)—This well-known indigenous tree has a place in the materia medica of the eclectics. The bark of the root is the most active part, and is said to be tonic, and in large doses purgative and emetic. (For an elaborate investigation of its histology see *P. J.*, 67, 153.) F. B. Power and J. Cambier (*Ph. Rund.*, Feb. 1890) found an alkaloid identical with *choline;* also globulin and phytalbumose, which produces purging and vomiting. It is precipitated by alkaloidal reagents. The bark also contains a poisonous albuminoid or enzyme, *robinalbin*, which, according to Kobert (*M. Bull.*, April, 1891), is similar to but not identical with ricin. Power (*P. J.*, Aug. 17, 1901) summarizes the results of a more recent and detailed investigation of this bark. He names the poisonous proteid *robin* and states that it belongs to the class of nucleoproteids. He finds evidences of one or more alkaloids; by hydrolysis he obtained *syringic acid*, $C_9H_{10}O_5$, and a red amorphous substance *syringenin*. These products indicate the glucoside *syringin*, $C_{17}H_{24}O_9$. He also considers that *gluco-syringic acid*, $C_{15}H_{20}O_{10}$, may pre-exist in the bark. Robin has emetic and purgative properties. Three cases of the poisoning of children by the root have been recorded. (*Ann. Thér.*, 1860, 64.) Z. T. Emery (*N. Y. M. J.*, Jan. 22, 1887) reports the poisoning of thirty-two boys from chewing the inner bark of the tree. The symptoms in the mildest cases were vomiting and flushed face, dryness of the throat and mouth, and dilated pupils. In the severest cases, to these were added epigastric pain, extremely feeble, intermittent heart action, and stupor.

Robinia Nicon.—According to the researches of Geoffroy (*Annal. de l'Inst. botanico-geologique colon. de Marseille*, 1895), this leguminous plant, which is used in Guiana for the purpose of stupefying fish, contains an active principle, *niconline* (C_3H_4O), which crystallizes in oblique, rhomboidal tables. It has been found by E. Boinet (*C. R. S. B.*, 1896, 10 s., iii.) to produce in the lower animals a short primary stage of excitation, followed by one of stupor, great muscular relaxation, enfeeblement of sensibility, mydriasis, fall of temperature, cyanosis, and death through centric paralysis of the respiration, though there is also fall of arterial pressure. In the dog there were salivation and vomiting.

Roborin.—This is a dark grayish-green powder, or a dark-brown finely granular mass, said to be obtained from blood, and, according to Lebbin, is composed of water 7.6 per cent., calcium carbonate 10.23 per cent., common salt 1.7 per cent., ferric oxide 0.49 per cent., other mineral substances 1.28 per cent., albuminoids 78.63 per cent. The albuminoids consist principally of calcic albuminates, a small portion of which is soluble in water.

Rosa.—Of the genus Rosa at least four species have been, and probably to some extent are still, used in medicine,—namely, *Rosa canina*, L., *Rosa centifolia*, L., *Rosa damascena*, Mill., and *Rosa gallica*, L.

Rosa canina.—The *Dog Rose*, *Wild Brier*, or *Hip Tree*, of Europe, is distinguished by its glabrous ovate ovaries, smooth peduncles, prickly stem and petioles, and ovate, smooth, rigid leaves. It grows from eight to ten feet high, and bears white or pale red flowers, having usually five obcordate fragrant petals. The fruit is fleshy, smooth, oval, red, and of a pleasant, sweet, acidulous taste. It was formerly official in the British Pharmacopœia under the name of *Rosæ Caninæ Fructus*. It contains about 30 per cent. of sugar, combined with citric and malic acids, also salts of these acids, and was used for the preparation of an acidulous confection.

Rosa centifolia has prickly stems, usually from three to six feet high. The leaves consist of two or three pairs of leaflets, with an odd one at the end, closely attached to the common footstalk, which is rough, but without spines. The leaflets are ovate, broad, serrate, pointed, and hairy on the under surface. The flowers are large, with many petals, generally of a pale red color, and supported upon peduncles beset with short bristly hairs. The varieties of *R. centifolia* produced by its almost universal cultivation are very numerous, but the plant is said to grow wild with single flowers in the eastern part of the Caucasus. It is very closely allied to *R. gallica*, some botanists maintaining that the species are really one. The petals, which were recognized by the U. S. P. 1890 as *pale rose*, are roundish-obovate and retuse, or obcordate, pink, fragrant, sweetish, slightly bitter and faintly astringent. They are extremely fragrant, and have a sweetish, slightly acidulous, somewhat bitterish taste. They contain volatile oil, malic and tartaric acids, tannin,

fat, resin, sugar, and a coloring matter which seems to be identical with that of the red rose. They should be collected when the flower is fully expanded but has not begun to fall. Their fragrance is impaired but not lost by drying. They may be preserved for a considerable time by compressing them with alternate layers of common salt in a well-closed vessel, or beating them with twice their weight of that substance. A rose water is often prepared from them by distillation.

Rosa damascena is not known in the wild state, and is thought by some botanists to have been produced by cultivation from *R. gallica*. It is the rose which is cultivated in Turkey and yields the commercial *otto of rose*. (See *Oleum Rosæ*, p. 870.) It is a tall shrub with semi-double, light red to white flowers of moderate size, having several on a branch, though not clustered. Its volatile oil is the basis of rose water.

Rosa gallica is still official (see p. 1067).

Rosemary. *Rosmarinus. Folia Rosmarini, s. Roris Marini. Folia Anthos. Feuilles de Romarin*, Fr. Cod. *Rosmarin, Rosmarinblätter*, G. *Rosmarino*, It. *Romero*, Sp.

"The leaves of *Rosmarinus officinalis*, Linné (nat. ord. *Labiatæ.*)" *U. S.* 1880. *Rosmarinus officinalis*, Willd., *Sp. Plant.* i. 126; *B. & T.* 207. Rosemary is an evergreen shrub, three or four feet high, with an erect stem, divided into many long, slender, ash-colored branches. The leaves are numerous, sessile, opposite, more than an inch long, about one-sixth of an inch broad, rigid, linear, entire, obtuse at the summit, folded backward at the edges, of a firm consistence, smooth and green on the upper surface, whitish, woolly, and glandular beneath. The flowers are pale blue or white, and disposed in opposite groups at the axils of the leaves, towards the ends of the branches. The naked seeds are four in number, oblong. The plant grows spontaneously in the countries which border on the Mediterranean, and is cultivated in the gardens of Europe and this country. The leaves, which have already been described, have a strong balsamic odor, which is possessed, but in a less degree, by all parts of the plant. Their taste is bitter and camphorous. These properties are imparted partially to water, completely to alcohol, and depend on the volatile oil. (See *Oleum Rosmarini*, p. 872.) The tops lose a portion of their sensible properties by drying, and become inodorous by age. Rosemary is gently stimulant, and has been considered emmenagogue. In the practice of this country it is scarcely used; but in Europe, especially on the continent, it enters into the composition of several syrups, tinctures, etc., to which it imparts its agreeable odor and excitant property. It is sometimes added to sternutatory powders, and is used externally in connection with other aromatics in the form of fomentation. In some countries it is employed as a condiment; and its flowers, which are much sought after by the bees, impart their peculiar flavor to the honey of the districts in which the plant abounds.

Rotten Stone. *Terra Cariosa.*—An earthy mineral, occurring in light, dull, friable masses, dry to the touch, of a very fine grain, and of an ash-brown color. It is obtained from Derbyshire, in England, and is used for polishing metals. For a particular account of it, see *A. J. P.*, 1860, 463.

Rourea. *Rourea oblongifolia*, Hook. and Arn. (Fam. Connaraceæ.)—This Mexican creeper is affirmed to contain an alkaloid, and to act as a violent convulsant poison. (*El Estudio*, 1890.)

Rubia. *Garance*, Fr. *Krappwurzel, Färberröthe*, G. *Robbia*, It. *Rubia de tintoreros, Granza*, Sp.—Under this name the U. S. P. formerly recognized *madder, Rubia tinctorum*, L. (Fam. Rubiaceæ.) The root of *dyer's madder* is perennial, and consists of numerous long, succulent fibres, varying in thickness from the size of a quill to that of the little finger, and uniting at top in a common head, from which also proceed side-roots that run near the surface of the ground, and send up many annual stems. These are slender, quadrangular, jointed, procumbent, and furnished with short prickles, by which they adhere to the neighboring plants upon which they climb. The leaves are elliptical, pointed, rough, firm, about three inches long and nearly one inch broad, having rough points on their edges and midrib, and standing at the joints of the stem in whorls of four, five, or six together. The branches rise in pairs from the same joints, and bear small yellow flowers at the summit of each of their subdivisions. The fruit is a round, shining, black berry. The plant is a native of the south of Europe and the Levant, and is cultivated in Asia Minor, France, Holland, and the south of Italy. The root, which is the part used, is dug up in the third summer, and, having been deprived of its cuticle, is dried by artificial heat, and then reduced to a coarse powder. In this condition it is packed in barrels and sent into the market. Madder from the Levant is in the state of the whole root; from the south of France, either whole or in powder. The plant was formerly cultivated in this country, in the States of Delaware and Ohio. The root consists of a reddish-brown bark, and a ligneous portion within. The latter is yellow in the recent state, but becomes red when dried. The powder as found in commerce is reddish brown. Madder has a weak, peculiar odor, and a bitterish, astringent taste, and imparts these properties, as well as a red color, to water and alcohol. It contains as its most important constituent *alizarin*, $C_{14}H_6(OH)_2O_2$, and with it as coloring matter of secondary importance *purpurin*, $C_{14}H_5(OH)_3O_2$. Besides these two technically important constituents there have been recognized *pseudopurpurin*, an orange dye color, and a yellow one (*xanthopurpurin*). These coloring matters, however, are probably decomposition products from glucosides existing in the fresh plant. Thus, alizarin is known to result along with glucose from the treatment with dilute acids of *rubianic* or *ruberythric acid*, $C_{26}H_{28}O_{14}$, according to the reaction:

$$C_{26}H_{28}O_{14} + 2H_2O = C_{14}H_8O_4 + 2C_6H_{12}O_6$$

The most interesting of the coloring substances is the *alizarin*. It may be obtained from the alcoholic extract by sublimation, in the method employed by Mohr in obtaining benzoic acid. (See *J. P. C.*, 3e sér., xxxi. 267.) It is orange-red, inodorous, insipid, crystallizable, capable of being sublimed without change, scarcely soluble in cold water, soluble in boiling water, and very readily so in alcohol, ether, the fixed oils, and alkaline solutions. The alcoholic and aqueous solutions are rose-colored; the ethereal, golden yellow; the alkaline, violet and blue when concentrated, but violet-red when sufficiently diluted. A beautiful rose-colored lake is produced by precipitating a mixture of the solutions of alizarin and alum. Alizarin was recognized by Graebe and Liebermann in 1868 as a derivative of anthracene, $C_{14}H_{10}$—a hydrocarbon contained in coal tar—and in the same year they elaborated a method

for preparing it commercially from anthracene. Upon this arose rapidly a great chemical industry, so that in 1881 the amount of artificial alizarin annually produced was 14,000 tons of 10 per cent. paste, valued at $8,000,000. The production of madder, of course, decreased correspondingly. The exportations of madder from France, which in 1872 had a value of $1,850,000, decreased to $70,000 in 1878, and $53,000 in 1883. The importations of alizarin into the United States for the following years have been: for 1903, 4,448,886 lbs., and for 1904, 4,456,145 lbs. Madder also contains sugar; and Döbereiner succeeded in obtaining alcohol from it by fermentation and distillation, without affecting its coloring properties.

Madder is used in *amenorrhœa* and *dropsy*, and when taken into the stomach imparts a red color to the milk and urine, and to the bones of animals, without sensibly affecting any other tissue. The effect is observable most quickly in the bones of young animals, and in those nearest the heart. Under the impression that it might effect some change in the osseous system, it has been prescribed in *rhachitis*, but without favorable result. *Dose*, about half a drachm (2.0 Gm.), repeated three or four times a day.

Rubidium.—Salts of rubidium may be obtained much more cheaply than in former years, on account of Erdmann's process for the recovery of these salts from the Stassfurt potash deposits. Two salts have been brought forward for use in practical medicine.

Rubidium iodide, RbI, which occurs in whitish crystals, freely soluble in water, has been recommended by Harnack, Neisser, and others as a substitute for potassium iodide, than which it is asserted to be better borne by the stomach. The *dose* is that of potassium iodide. G. Jacontini affirms that rubidium iodide is a specific in *coryza*.

Rubidium ammonium bromide, $RbBr.3NH_4Br$. The double ammonium and rubidium bromide is affirmed by Laufenauer to be the most active of all the bromides in the treatment of *epilepsy*. It is given in *doses* of sixty to eighty grains (3.9-5.2 Gm.) once a day.

Rubidium bromide, RbBr, may be used as a substitute for, and in the dose of, potassium bromide, than which it is said to be better borne, especially by feeble patients.

Rubus. *Rubus Chamæmorus*, L. *Cloud Berry.* (Fam. Rosaceæ.)—This plant, which inhabits the northern portions of both continents, is largely employed in Northern Russia, in the form of an infusion of the berries or leaves, as a diuretic in *dropsy*. Popoff found in it a crystallizable acid which is an essential diuretic, acting directly upon the renal secreting structures without affecting either cardiac action or arterial tension. (*Vrach*, iv. 1886.)

The U. S. Pharmacopœia formerly recognized under the name of *Rubus idæus*, or *raspberry*, the fruit of the ordinary cultivated raspberry, *Rubus idæus*, L., to which plant *Rubus strigosus*, Michaux, or the wild red raspberry of the Northern United States, is so closely allied as by some botanists to be considered as simply a variety. *Rubus strigosus* has also yielded to cultivation certain superior raspberries, especially those which have been known commercially as the Cuthbert and Hansall raspberries. *Rubus neglectus*, Peck, the purple wild raspberry, with a fruit which varies from dark red or purple to yellowish in cultivation, has also yielded a commercial raspberry.

The fruit of these raspberries may be employed for the production of raspberry syrup (*Syrupus Rubi Idæi*, U. S. 1890). For the making of this syrup the former directions of the U. S. Pharmacopœia were sufficient. They are as follows: "Fresh, Ripe Raspberries, *any convenient quantity;* Sugar, *a sufficient quantity*. Reduce the Raspberries to a pulp, and let this stand, at a temperature of about 20° C. (68° F.), until a small portion of the filtered juice mixes clear with half its volume of alcohol. Then separate the juice by pressing, set it aside, in a cool place, until the liquid portion has become clear, and filter. To every *forty parts* by weight of the filtrate (which should not be allowed to remain, unprotected by sugar, more than about two hours) add *sixty parts* of Sugar, heat the mixture to boiling, avoiding the use of tinned vessels, and strain. Keep the product in well-stoppered bottles, in a cool and dark place." The U. S. P. of 1890, for the purpose of detecting aniline, which is not rarely added to raspberry syrup to give it color and conceal lack of strength, required that on shaking separate portions of the syrup with ether, chloroform, or amyl alcohol, no color should be imparted to the liquid used. The primary fermentation of raspberry juice frees it from albuminous and pectinous substances, which interfere with the transparency of the syrup, and, if not separated, would seriously increase the risk of its spoiling. The flavor of the juice is not injured, although the process must be carefully watched to keep the fermentation from passing from the vinous to the acetous.

The *Rubus occidentalis*, L., *black raspberry* or *thimbleberry* of the Northern United States, which is also cultivated, is sometimes employed for the making of a raspberry syrup, but yields a very inferior product.

Rumex. *U. S.* 1890. *Rumex. Yellow Dock.* Several species of Rumex have sour leaves, and are distinguished by the common name of *sorrel* from the others, which are called *dock*. Of the former, *Rumex Acetosa*, L., or *common English sorrel*, formerly held a place in the London and Dublin Pharmacopœias. *R. Acetosella*, L., is the common sorrel of our fields, though supposed to have been originally introduced from Europe. The leaves of both these plants are agreeably sour to the taste, and owe their acidity to acid potassium oxalate with a little tartaric acid. They quite lose this taste in drying. They are refrigerant and diuretic, and may be used advantageously as an article of diet in scurvy. For this purpose they are prepared in the form of salad. The juice of the leaves forms with water an agreeable acidulous drink, sometimes used in fevers. Taken very largely, the leaves are said to have produced poisonous effects. (See *Wood's Quarterly Retrospect*, i. 109.) *R. scutatus*, L., of Europe, Northern Africa, Asia Minor, and the Caucasus, also ranks among the sorrels (*French sorrel*).

Of the proper docks, the roots of *R. Patientia*, L., and *R. alpinus*, L., European plants, and of *R. aquaticus*, *R. acutus*, and *R. sanguineus*, L., belonging both to Europe and to the United States, may be employed indiscriminately with those of the *R. crispus*, L., which was formerly recognized by the U. S. Pharmacopœia. *R. britannicus*, L., and *R. obtusifolius*, L., were formerly official. *R. Hydrolapathum*, Hudson, which is the *R. aquaticus* of the old Dublin Pharmacopœia, is thought to be the *Herba Britannica* of the ancients, celebrated for the cure of scurvy and diseases of the

skin. The docks are herbaceous plants with perennial roots. The flowers are in terminal or axillary panicles. Some of the species are diœcious; but the *R. crispus* has perfect flowers.

Dock root, from whatever species derived, has an astringent, bitter taste, with little or no odor. It readily yields its virtues to water by decoction. The root of *R. crispus* was officially described as "from 20 to 30 Cm. long, about 10 to 15 Mm. thick, somewhat fusiform, fleshy, nearly simple, annulate above, deeply wrinkled below; externally rusty brown, internally whitish, with fine, straight, interrupted, reddish medullary rays, and a rather thick bark; fracture short; odor slight, peculiar; taste bitter and astringent." *U. S.* 1890. According to Riegel, the root of *R. obtusifolius* contains resin, extractive matter resembling tannin, starch, mucilage, albumen, lignin, sulphur, and various salts, among which are calcium phosphate and different acetates and malates. (*J. P. C.*, 3e sér., i. 410.) The leaves of most of the species are edible when young, and are occasionally used as spinach. They are somewhat laxative, and form an excellent diet in scorbutic cases. The roots are used to dye a yellow color. According to J. H. Salisbury (*N. Y. Journ. Med.*, March, 1855), the petioles of the leaves contain nearly one per cent. of oxalic acid; the cortical part of the root, which is the most active, yielded, on analysis, starch, a little sugar, albuminous matter, gummy matter, bitter extractive, tannic acid of the kind which gives green precipitates with the salts of iron, lignin, and various salts. The root yields its virtues to water and to alcohol, but is injured by long boiling. Dock root is astringent, gently tonic, and has been supposed to have alterative properties, making it useful in skin diseases and even syphilis. From the root of *R. nepalensis*, Wall., which is largely used in Madras as an astringent for medicinal purposes and for dyeing, O. Hesse has separated three crystalline substances to which he gives the names of *rumicin*, *nepalin*, and *nepodin*. (*P. J.*, lvi.; also *Proc. A. Ph. A.*, 1896, 551.) *R. aquaticus* and *R. britannicus* are the most astringent. The roots of some species unite a laxative with the tonic and astringent property, resembling rhubarb somewhat in their operation. Such are those of *R. crispus* and *R. obtusifolius;* and *R. alpinus*, L., has in some parts of Europe the name of *mountain rhubarb*. This resemblance is not singular, as the two genera belong to the same natural family. Dock root is given in powder or in decoction. Two ounces (62 Gm.) of the fresh root bruised, or one ounce (31 Gm.) of the dried, may be boiled in a pint (480 Cc.) of water, of which two fluidounces (60 Cc.) may be given at a *dose*, and repeated as the stomach will bear it. George G. Flemyng (*L. L.*, i. 1896) reported the death of two sisters, aged respectively five and six and a half years, preceded by symptoms of oxalic acid poisoning as the result of the ingestion of sorrel leaves.

Fluidextract of Rumex (*Fluidextract of Yellow Dock*).—"Rumex, in No. 40 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *three hundred and fifty cubic centimeters* [or 11 fluidounces, 400 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Rumex is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the fluidextract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890. The *dose* is a fluidrachm (3.75 Cc.).

Ruta.—Under this name the U. S. Pharmacopœia formerly recognized *Ruta graveolens*, L.; *Common rue; Rue odorante*, Fr.; *Garten-Raute*, G.; *Ruta*, It.; *Ruda*, Sp. (Fam. Rutaceæ.) It is a perennial plant usually two or three feet high, with several shrubby branching stems, which, near the base, are woody and covered with a rough bark, but in their ultimate ramifications are smooth, green, and herbaceous. The leaves are doubly pinnate, glaucous, with obovate, sessile, obscurely crenate, somewhat thick and fleshy leaflets. The flowers are yellow, and disposed in a terminal branched corymb upon subdividing peduncles. The calyx is persistent, with four or five acute segments; the corolla consists of four or five concave petals, somewhat sinuate at the margin. There are usually ten stamens, but sometimes only eight. The plant is a native of the south of Europe, but cultivated in our gardens. It flowers from June to September. The whole herb is active, and yields its properties to water and alcohol. The leaves have a strong disagreeable odor, especially when rubbed. Their taste is bitter, hot, and acrid. When recent, and in full vigor, they have so much acrimony as to inflame and even blister the skin, if much handled; but the acrimony is diminished by drying. Their virtues depend chiefly on a volatile oil, which is contained in glandular vesicles, apparent over the whole surface of the plant. They contain, also, according to Mähl, chlorophyll, albumen, a nitrogenous substance, extractive, gum, starch or inulin, malic acid, lignin, and, according to Borntträger, a peculiar acid which he calls *rutinic acid*, $C_{25}H_{28}O_{15}$ (or $C_{27}H_{32}O_{16}$, according to later writers). Rutinic acid is the coloring principle of rue, and has been found in various other plants; though, like quercitrin, yielding quercetin and sugar, it has been shown to be distinct. (*J. P. C.*, 1862, 165.)

Rue yields a very small proportion of a yellow or greenish volatile oil, which becomes brown with age. According to Zeller, the product from the fresh herb is 0.28 per cent., that from the seeds about 1 per cent. The oil has the strong unpleasant odor of the plant, and an acrid taste. Kane gives its sp. gr. at 0.837, its boiling point at 230° C. (446° F.). "A neutral reaction. Sp. gr. about 0.880. It is soluble in an equal weight of alcohol." *U. S.* 1880. It consists mainly of an oxidized constituent, which Strecker proved to be *methyl-nonyl-ketone*, $CH_3.CO.C_9H_{19}$; that is, a ketone analogous to acetone, $CH_3.CO.CH_3$. This accounts for its yielding under treatment with oxidizing agents, pelargonic acid, $C_9H_{18}O_2$. The methyl-nonyl-ketone, when pure, is a colorless liquid, fluorescing blue, boiling at 225° C. (437° F.), and crystallizing at about 15° C. (59° F.). When treated with nitric acid it yields, among other products, pelargonic acid. Schimmel & Co. (*Schim. Rep.*, 1892, 31) state that pure oil of

rue consists of 90 per cent. of methyl-nonyl-ketone, and solidifies even at a moderate temperature to a solid, crystalline mass, and has the sp. gr. 0.837.

According to von Soden and Henle, *Algerian oil of rue* differs from the ordinary oil in that it is chiefly composed of *methyl-heptyl-ketone*, with but small quantities of *methyl-nonyl-ketone*. Its specific gravity at 15° C. (59° F.) is 0.842; and it does not solidify at —15° C. (5° F.). (*Ph. Ztg.*, 46.) Frederick B. Power and Frederic H. Lees (*Trans. Chem. Soc.*, 1902) have since published an elaborate investigation of a similar Algerian oil. They find 80 per cent. of the two ketones, methyl-heptyl-ketone and methyl-nonyl-ketone, 10 per cent. of the corresponding carbinols (alcohols), pinene, l-limonene, cineol, methyl salicylate, ethyl valerate, and some free fatty acids.

Rue is said to have been used by the ancients as a condiment. In modern times it has been employed in *hysteria, worms, colic*, and atonic *amenorrhœa* and *menorrhagia*. Its medicinal activity depends upon its volatile oil, which is a powerful local irritant, causing, when applied to the skin persistently, burning, redness, and vesication, and when taken internally in large doses, violent gastric pains and vomiting, great prostration, confusion of mind, convulsive twitching, and in pregnant women, abortion. It has been considerably used in Europe for the production of criminal abortion, in a number of cases with fatal results. In a case of fatal poisoning in a man, reported by G. F. Cooper, there were vomiting, violent tormina and tenesmus, with bloody stools, great abdominal distention, with tenderness and severe strangury. (*Med. Exam.*, N. S., ix. 720.) The *dose* of the oil is from two to five minims (0.12–0.3 Cc.) every two or three hours. The rue itself is sometimes given in the dose of from ten to thirty grains (0.65–2.0 Gm.).

Rye. *Secale cereale*, L. (Fam. Gramineæ.) Syria, Armenia, and the southern provinces of Russia have been severally indicated as the native country of rye. The plant is now cultivated in all temperate latitudes. The grains consist, according to Einhof, of 24.2 per cent. of envelope, 65.6 of flour, and 10.2 of water. The average composition of rye as a cereal may be thus stated: fat, 1.43 per cent.; starch, 61.87 per cent.; sugar (as sucrose), 4.30 per cent.; albumen (insoluble in alcohol), 9.78 per cent.; nitrogenous matter (soluble in alcohol), 5.09 per cent.; cellulose, 3.23 per cent.; mineral matter, 1.85 per cent.; moisture, 12.45 per cent. (Sadtler, *Industrial Organic Chemistry*, 3d ed., p. 169.) *Rye flour* is much used, in the dry state, as an external application to *erysipelatous inflammation* and other eruptive affections, the burning and unpleasant tingling of which it tends to allay, while it absorbs the irritating secretions. In the form of mush it is an excellent laxative article of diet, and, mixed with molasses, it may be given with great advantage in *hemorrhoids* and *prolapsus ani*, connected with *constipation*. Rye carbonized by heat, with exclusion of the air, has been highly recommended as a tooth powder.

Sabadilla. *Cevadilla.*—The dried ripe seeds of *Asagræa officinalis* (Cham. and Schlecht.), Lindl. (*Schœnocaulon officinale*, A. Gray), were recognized by the Br. Pharm. of 1885. At one time cevadilla was generally believed to be derived from *Veratrum Sabadilla*, Retz. Schiede, during his travels in Mexico, ascertained that it was, in part at least, collected from a different plant, of the same family (Liliaceæ), growing upon the eastern declivity of the Mexican Andes. This was considered by Schlechtendal as another species of Veratrum, by Don as a Helonias, and by Lindley as belonging to a new genus which he named Asagræa. Hence it has been variously denominated *Veratrum officinale*, Schlecht. and Cham., *Helonias officinalis*, D. Don, *Asagræa officinalis*, Lindl., and *Schœnocaulon officinale*, A. Gray. It is not probable that *Veratrum Sabadilla*, Retz, yields much, if any, of the seed of commerce; but it would seem that very much of the drug is the product of a plant so different from *Asagræa officinalis* that Ernst of Carácas believes it to be a new species. It differs chiefly in having its leaves broader and more carinate.

Cevadilla seeds usually occur in commerce mixed with the fruit. This consists of three coalescing capsules or follicles, which open above and appear like a single capsule with three cells. It is three or four lines long and a line and a half in thickness, obtuse at the base, light brown or yellowish, smooth; each of the component capsules contains one or two seeds. A resemblance, existing or supposed, between this fruit and that of barley is said to have given rise to the Spanish name cevadilla, which is a diminutive of barley. The seeds are elongated, pointed at each end, flat on one side and convex on the other, somewhat curved, two or three lines long, wrinkled, slightly winged, black or dark brown on the outside, whitish within, hard, inodorous, and of an exceedingly acrid, burning, and durable taste.

Pelletier and Caventou first noted the presence of an alkaloid in cevadilla, which base they called *veratrine;* Meissner in the same year announced the presence of an alkaloid, *sabadilline*, and Couërbe, Merck, and Weigelin all described what they considered as distinct bases; but its exact composition remained unsettled until Wright and Luff (*J. Chem. S.*, 33, 338) found in it three bases: 1. *cevadine*, $C_{32}H_{49}NO_9$ (agreeing with the base described by Merck as veratrine), crystallizing in needles or compact crystals, fusing at 205° C. (401° F.) (202° C. (395.6° F.), according to Merck), insoluble in water, easily soluble in alcohol and ether, and decomposed by hot alcoholic potash into *cevine*, $C_{27}H_{43}NO_8$ ($C_{27}H_{45}NO_9$, Flückiger), and *methyl-crotonic acid* (*cevadic acid* of Pelletier and Caventou), $C_5H_8O_2$; 2. *veratrine*, $C_{37}H_{53}NO_{11}$, obtained from the syrupy mother liquor from which the cevadine has crystallized; it is uncrystallizable, soluble in ether, and decomposed by alcoholic soda into *verine*, $C_{28}H_{45}NO_8$, and dimethyl-protocatechuic acid (*veratric acid* of Merck), $C_7H_4(CH_3)_2O_4$; 3. *cevadilline*, $C_{34}H_{53}NO_8$, obtained after the extraction of the veratrine with ether; it is insoluble in ether, slightly soluble in boiling benzene, and readily soluble in fusel oil, uncrystallizable, and appears to yield methyl-crotonic acid on treatment with alcoholic soda.

The second of these alkaloids, *veratrine*, Flückiger (*Pharm. Chem.*, 2d ed., 1888, 531) considers as isomeric with cevadine, $C_{32}H_{49}NO_9$, and writes the reaction for its decomposition,

$$2C_{32}H_{49}NO_9 + 4H_2O = \underset{\text{Dimethylprotocatechuic acid.}}{C_9H_{10}O_4} + \underset{\text{Veratroine.}}{C_{55}H_{92}N_2O_{16}} + 2H_2O$$

Wright and Luff extract the alkaloids as follows. One hundred parts of sabadilla seeds are exhausted with one part of tartaric acid and alcohol, the alcoholic extract concentrated, freed

from resinous admixture by addition of water, and then treated with sodium hydroxide and ether. The ethereal solution is then shaken up with aqueous tartaric acid solution, and the acid liquid again treated with sodium hydroxide and ether. The ethereal solution is now mixed with ligroin (light petroleum benzin), and allowed to evaporate spontaneously. A syrupy liquid separates out first, and then crystals of cevadine, which are drained off and recrystallized from alcohol. The residual syrupy liquid consists essentially of veratrine and cevadilline. Ten kilogrammes (24 pounds) of seeds yield from sixty to seventy grains of alkaloids, from which eight to nine grains of pure cevadine, five to six grains of veratrine, and two to three grains of crude cevadilline can be isolated.

Merck has since (*M. R.*, Jan. 1891, 3–9) isolated two new alkaloids from cevadilla, which he names *sabadine* and *sabadinine* respectively. The former has the formula $C_{29}H_{51}NO_8$, crystallizes from ether in short needles, and fuses at from 238° to 249° C. (460.4°–464° F.). It dissolves in concentrated sulphuric acid with a yellow color and a green fluorescence, which gradually disappears, while the liquid assumes a blood-red and then violet color. The alkaloid is sternutatory, although in a much less degree than veratrine. The second alkaloid crystallizes from ether in filiform needles, which begin to sinter at 160° C. (320° F.), but show no fixed fusing point. Concentrated sulphuric acid causes a permanent blood-red color. The formula is given as $C_{27}H_{45}NO_8$. The alkaloid is not sternutatory. Cevadilla yields about 0.3 per cent. of veratrine. (See *Veratrina*, p. 1327.)

Cevadilla is an acrid, drastic emeto-cathartic, operating occasionally with great violence, and in overdoses capable of producing fatal effects. Known in Europe as early as 1752, and formerly used to some extent as a tænicide, in *doses* of from five to twenty grains (0.32–1.3 Gm.), it was official solely as the source of veratrine. It is the principal ingredient of the *pulvis Capucinorum*, sometimes used in Europe for the destruction of vermin in the hair.

According to E. Falk, 0.001 Gm. of pure cevadine will paralyze the frog; 0.01 Gm. will cause death from cardiac paralysis in rabbits; 0.02 Gm. per kilogramme produces paralysis, interrupted by tetanic spasms. Cevine was found to be much less poisonous than cevadine, though producing similar symptoms.

Sabbatia. *Centaurée Américaine*, Fr. *Sabbatie*, G.—Of this gentianaceous genus three American species are more or less used in popular medicine as tonics and as antiperiodics. They are, in fact, simple bitters of some activity, and may very well be substituted for the foreign remedies of their class. Their value in intermittent fever is probably simply that of quassia and gentian, only somewhat more feeble. The *S. angularis* (L.), Pursh, or *American centaury*, was formerly recognized by the U. S. Pharmacopœia in its Secondary List. A description of it may be found in the 16th edition of the *U. S. D.* John F. Huneker found in it a small proportion of *erythrocentaurin*, $C_{27}H_{24}O_8$, previously discovered by Méhu, a French chemist, in *Erythræa Centaurium*, Pers., of Europe. Huneker also obtained, from *American centaury*, resin, chlorophyll, fatty matter, gum, albumen, pectin, bitter extractive, traces of volatile oil, an organic acid, red coloring matter, and salts. (*A. J. P.*, 1871, 207.)

In the Southeastern United States, the *Sabbatia Elliottii*, Steud., or *Quinine flower*, and in the Southwestern United States the *Sabbatia campestris*, Nutt., have been employed like the *S. angularis* in the North. They probably contain the same active principle. Of the *S. angularis* and the *S. campestris* the whole plant is used, the *dose* being a drachm (3.9 Gm.), given in the form of fluidextract or in decoction. Of the Quinine flower, the root is employed; *dose* of the fluidextract, one fluidrachm (3.75 Cc.); in intermittent fever to be repeated at short intervals.

Sagapenum.—This gum-resin, formerly highly esteemed, but at present very rarely met with even in Eastern commerce, is the concrete juice of an unknown Persian plant, supposed by some to be one of the species of Ferula (Fam. Umbelliferæ) related to those that yield galbanum. It is in irregular masses, composed of agglutinated fragments, slightly translucent, of a brownish-yellow, olive, or reddish-yellow color externally, paler internally, brittle, of a consistence somewhat resembling that of wax, and often mixed with impurities, especially with seeds more or less entire. An inferior variety is soft, tough, and of uniform consistence. It has an alliaceous odor less disagreeable than that of asafetida, and a hot, nauseous, bitterish taste. It softens and becomes tenacious by the heat of the hand. The effect of time and exposure is to harden and render it darker. It is inflammable, burning with a white flame and much smoke, and leaving a light spongy charcoal. Pure alcohol and water dissolve it partially, diluted alcohol almost entirely. Distilled with water it affords a small quantity of volatile oil, and the water is strongly impregnated with its flavor. According to Tschirch (*Harze und Harzbehälter*, 229), it contains 23.3 per cent. of gum; 19.2 per cent. of essential oil, containing sulphur; and 57.5 per cent. of a resin which is free from sulphur and melts at 74° to 76° C. (165.2°–168.8° F.). The ether soluble resin of sagapenum can be separated by saponification into *umbelliferone* and *sagaresitannol*, $C_{24}H_{27}O_4.OH$. This latter yields on oxidation *oxypicric acid*. The oil is pale yellow, very fluid, lighter than water, and of a disagreeable alliaceous odor. Sagapenum was considered by the older physicians as midway in its medicinal properties between asafetida and galbanum, and was used in *doses* of from ten to thirty grains (0.65–2.0 Gm.) in *amenorrhœa*, *hysteria*, etc.; also externally in plasters as a discutient.

Sago. *Sagou*, Fr. *Sago*, G., It. *Sagu*, Sp. Under this name the U. S. P. formerly recognized the starch obtained from the sago palms. Numerous trees, inhabiting the islands and coasts of the Indian Ocean, contain a farinaceous pith, which is applied to the purposes of nutriment by the natives. Such are *Metroxylon Sagu*, Rottb. (*Sagus lævis*, Blume), *Metroxylon Rumphii* (Willd.), Mart. (*Sagus Rumphii*, Willd.), *Raphia pedunculata*, Beauv. (*Sagus ruffia*, Jacq.), *Arenga saccharifera*, Labill. (*Saguerus Rumphii*, Roxb.), and *Phœnix farinifera*, Roxb., belonging to the family of Palms, and *Cycas circinalis*, L., *Cycas revoluta*, Thunb., and *Zamia lanuginosa*, belonging to the Cycadaceæ. The fruit of the *Cycas circinalis*, according to J. van Donjen, contains a poisonous glucoside, *pakoëine* (*P. J.*, May, 1903); and it is doubtful if any other trees than *Metroxylon Sagu*, *M. Rumphii* and *Arenga saccharifera* contribute to furnish the sago of commerce. Crawford, in his *History of the Indian Archipelago*,

states that it is derived exclusively from *Metroxylon Sagu*, Rottb., but Roxburgh ascribes the granulated sago to *S. lævis*, Jack (which subsequent research shows to be *Metroxylon Sagu*, Rottb.); and one of the finest kinds is said by Hamilton to be produced by *Arenga saccharifera*, Labill. The farinaceous product of the different species of Cycas, sometimes called *Japan Sago*, does not enter into general commerce.

Metroxylon Rumphii (Willd., *Sp. Pl.* iv. 404), Mart.; Carson, *Illust. of Med. Bot.*, ii. 44, pl. 88. *Metroxylon Sagu*, Rottb. (1783); *Bentley and Trimen*, 278.—The *sago palm* is one of the smallest trees of its family. Its height seldom exceeds thirty feet. The trunk is proportionately very thick, quite erect, cylindrical, covered with the remains of the old leafstalks, and surrounded by a beautiful crown of foliage, consisting of numerous, very large, pinnate leaves, extending in all directions from the summit, and curving gracefully downward. The fruit is a roundish nut, covered with an imbricated coat, and containing a single seed.

The tree is a native of the East India islands, growing in the Peninsula of Malacca, Sumatra, Borneo, Celebes, the Moluccas, and a part of New Guinea. It flourishes best in low and moist situations. Before attaining maturity, the stem consists of a shell, usually about two inches thick, filled with an enormous volume of spongy medullary matter like that of elder. This is gradually absorbed after the appearance of fruit, and the stem ultimately becomes hollow. The greatest age of the tree is not more than thirty years. Large quantities of a kind of sugar called *jaggary* are produced from its juice. According to H. von Rosenberg (*Proc. A. Ph. A.*, xxvii. 140), the medullary matter consists mostly of starch when the large leaves have fallen off and the flowers are just taking their place. At this time the tree is felled, and the trunk cut into billets six or seven feet long, which are split in order to facilitate the extraction of the pith. This is obtained in the state of a coarse powder, which is mixed with water in a trough having a sieve at the end. The water, loaded with farina, passes through the sieve, and is received in convenient vessels, where it is allowed to stand till the insoluble matter has subsided. It is then strained off, and the farina which is left may be dried into a kind of meal or moulded into whatever shape may be desired. For the consumption of the natives it is usually formed into cakes of various sizes, which are dried, and extensively sold in the islands. The commercial sago is prepared by forming the meal into a paste with water, and rubbing it into grains. It is produced in the greatest abundance in the Moluccas, but of the finest quality on the eastern coast of Sumatra. The Chinese of Malacca refine it so as to give the grains a fine pearly lustre. Malcolm states that it is also refined in large quantities at Singapore. In this state it is called *pearl sago*, and is in great repute. It is said that five or six hundred pounds of sago are procured from a single tree.

Pearl sago is that which is now generally used. It is in small grains, about the size of a pin head, hard, whitish, of a light brown color, in some instances translucent, inodorous, and with little taste. It may be rendered perfectly white by a solution of chlorinated lime. *Common sago* is in larger and browner grains, of more unequal size, of a duller aspect, and frequently mixed with more or less of a dirty looking powder.

Sago meal is imported into England from the East Indies. It is in the form of a fine amylaceous powder, of a whitish color, with a yellowish or reddish tint, and of somewhat musty odor.

Common sago is insoluble in cold water, but by long boiling unites with that liquid, becoming at first soft and transparent, and ultimately forming a gelatinous solution. Pearl sago is partially dissolved by cold water, probably owing to the heat used in its preparation. Chemically considered, it is a very pure natural starch, as the nitrogenous matter rarely amounts to more than one per cent., and the ash to one-half per cent., the remainder being starch and moisture. Under the microscope the granules of sago meal appear oval or ovate, and often truncated so as to be more or less muller-shaped. Many of them are broken, and in most the surface is irregular or tuberculated. They exhibit upon their surface concentric rings, which are much less distinct than in potato starch. The hilum is circular when perfect, and cracks either with a single slit or a cross, or in a stellate manner. The granules of pearl sago are of the same form, but are all ruptured, and exhibit only indistinct traces of the annular lines, having been altered in the process employed in preparing them. Those of common sago are very similar to the particles of sago meal, except that they are perhaps rather less regular and more broken.

Potato starch is sometimes prepared so as to resemble bleached pearl sago, for which it is sold. But, when examined under the microscope, it exhibits larger granules, which are also more regularly oval or ovate, smoother, less broken, and more distinctly marked with the annular rugæ than are those of sago, and the hilum often cracks with two slightly diverging slits. Sago is now made in the United States from various kinds of starch.

Sago is used exclusively as an easily digestible, non-irritating food. It is given in the liquid state, and in its preparation care should be taken to boil it long in water, and stir it diligently, in order that the grains may be thoroughly dissolved. Should any portion remain undissolved, it should be separated by straining. A tablespoonful to the pint of water is usually sufficient.

Salacetol. *Salicyl-acetol. Salantol.* $C_6H_4(OH)CO.OCH_2CO.CH_3$.—A synthetic product, the ester of salicylic acid and acetylcarbinol, introduced as a substitute for salol, to avoid the elimination of phenol in the system. Crystallizes out of alcohol in needles, fusing at 71° C. (159.8° F.), slightly soluble in cold water and alcohol, readily soluble in ether, chloroform, and petroleum benzin. It may be used when salol is indicated, in *doses* of from thirty to forty-five grains (2.0–3.0 Gm.).

Salactol.—A mixture of the sodium salts of salicylic and lactic acids, said to contain 71.1 per cent. of salicylic acid. A one per cent. solution of salactol in solution of hydrogen dioxide has been used to arrest the growth of diphtheritic membrane.

Salamander Alkaloids.—*Salamander maculosa*, and probably other newts, produce a poisonous secretion from the skin, from which Hoppe-Seyler and Zalesky separated an active body, *salamandarine*. E. S. Faust (*A. E. P. P.*, xliii.) has secured crystalline salts from this body which produce in the lower animals restlessness, excited reflex activity, and convulsions ending in total paralysis. A second alkaloid, *salamandaridine*, was also separated by Faust.

Salep. *Tubera Salep*, P. G. *Salep*, Fr., G. This name is given to the dried tubers of numerous species of the genus *Orchis*, and in India of the genus *Eulophia*. At present the salep of European commerce is prepared chiefly in the Levant, but to some extent in Germany and other parts of Europe. The German salep is said to be more translucent than the Levant.

Salep is in small, oval, irregular, ovoid or oblong tubers, rarely palmate, hard, horny, semitransparent, of a yellowish color, a feeble odor, and a mild mucilaginous taste. It is sometimes kept in the state of powder. In composition and relation to water it is closely analogous to tragacanth, consisting of a substance insoluble but swelling up in cold water (*bassorin*), of another in much smaller proportion, soluble in cold water, and of minute quantities of saline matters. It also occasionally contains a little starch. It is highly nutritive, and may be employed for the same purposes as tapioca, sago, etc. Its mediæval and Oriental reputation as an aphrodisiac is unfounded. On account of its hardness, salep, in its ordinary state, is of difficult pulverization; but the difficulty is removed by macerating it in cold water until it becomes soft, and then rapidly drying it. *Royal salep*, said to be much used as a food in Afghanistan, has been identified by J. E. T. Aitchison as the product of *Allium Macleanii*, Baker. (Fam. Liliaceæ.) (*P. J.*, Sept. 1889.)

Salhypnone. $C_6H_4O(COC_6H_5)COOCH_3$.—A benzoyl-methyl-salicylic ester which occurs in colorless needles melting at 113° C. (235.4° F.), insoluble in water and sparingly soluble in alcohol and ether. It is a mild antiseptic.

Salicylamide. $C_6H_4\begin{cases}OH\\CONH_2\end{cases}$. This compound is prepared by the action of concentrated ammonia upon methyl salicylate. When purified, it occurs in perfectly colorless, thin, transparent plates, melting at 138° C. (280.4° F.), soluble in alcohol, ether, chloroform, and two hundred parts of water. W. B. Nesbitt finds that this substance, when given in toxic dose, paralyzes the motor nerves and centres, also the muscles, and has but little effect upon blood pressure. He believes that it is a safer remedy than salicylic acid, and has the advantage of greater solubility and more prompt action in smaller dose. Also, that it has analgesic and antipyretic properties which correspond. It may be given in *doses* of three grains (0.2 Gm.). The highest amount used was fifteen grains (1.0 Gm.), taken in nine hours. (*T. G.*, Oct. 1891.)

Salicylbromanilide. *Antinervine.*—This was first described as a mixture of bromacetanilide and salicylanilide, but a specimen analyzed by Ritsert was shown to be a mixture of ammonium bromide, salicylic acid, and acetanilide. Salicylbromanilide has been asserted to be a safe antipyretic and antineuralgic by Radlauer of Germany, but C. S. Bradfute (*New England Monthly*, April, 1891) has found it to be a violent depressant of the heart. In *angina pectoris*, with high tension, he obtained relief by its use, but it seems to be a dangerous remedy. *Dose*, from five to ten grains (0.32–0.65 Gm.).

Salifebrin. *Salicylanilide.*—An antipyretic, made by heating together salicylic acid and acetanilide in molecular proportions. It is a colorless permanent powder, insoluble in water, freely soluble in alcohol.

Saliformin. *Formin Salicylate. Hexamethylene-tetramin-salicylate. Urotropin Salicylate.* $(CH_2)_6N_4.C_6H_4(OH)COOH$.—A colorless, crystalline powder, having an acidulous taste, soluble in water and alcohol, used as an antiseptic and for its supposed solvent powers on uric acid deposits. The daily *dose* is from fifteen to thirty grains (1.0–2.0 Gm.).

Saligallol. *Pyrogallol Di-salicylate.*—A resinous solid, soluble in two parts of acetone and fifteen parts of chloroform. Its solution in acetone has been used as an external application in skin diseases.

Saligenin, *Ortho-oxybenzyl alcohol*, $C_6H_4.OH.CH_2OH$, is the decomposition product of the glucoside *salicin*. Under the name of *antiarthrin*, a substance has been introduced into commerce which is said to be a combination product between saligenin and tannin. It readily undergoes decomposition. It has been used in chronic *rheumatism* and *gout* in *doses* of ninety to one hundred and fifty grains (5.8–9.8 Gm.) a day.

Saliphen. *Saliphenin. Salicyl-p-phenetidin.* $C_6H_4(OC_2H_5)NH.C_6H_4(OH)CO$.—This substance is the product of a reaction between salicylic acid and phenetidin in the presence of phosphorus trichloride. It is in colorless crystals, which melt at 139.5° C. (283° F.); is insoluble in water but soluble in boiling alcohol, acetone, ether, chloroform and glacial acetic acid. It possesses slight antifebrile properties.

Salipyrin. *Antipyrine Salicylate. Salazolon.* $C_{11}H_{12}N_2O.C_7H_6O_3$.—Prepared by the action of salicylic acid upon antipyrine, either at 100° C. (212° F.) or in solution. It occurs as a white, coarsely crystalline powder, odorless, with a somewhat sweetish taste. It is readily soluble in alcohol and in benzene, and crystallizes from the former in hexagonal tables with a melting point of 91.5° C. (196.7° F.). According to Guttmann and to Kollmann (*Internat. Klin. Rundsch.*, Sept. 1890; also *M. M. W.*, Nov. 1890), it is an active antipyretic and antirheumatic, which rarely produces toxic symptoms, although an eruption resembling that caused by antipyrine has been noted; the color of the urine is not affected, but tests show the presence of salicylates. Kollmann states that it sometimes causes vomiting, and the daily *dose* should not exceed forty-five grains (3.0 Gm.), and always be less than this in the beginning, as some individuals are intolerant of it. Salipyrin has been used to a considerable extent in all forms of *rheumatic diseases*, in *influenza*, in various *fevers*, in *migraine*, and in the whole class of diseases in which its component constituents have been found to be useful; also locally in *coryza*. Salipyrin has been very highly praised by Beuttner as a sedative antihemorrhagic remedy, in all forms of *metrorrhagia* not dependent upon severe organic disease, in threatened *abortion*, and in *dysmenorrhœa*. The usual *dose* is from seven to fifteen grains (0.45–1.0 Gm.), in capsule or tablet, repeated every three or four hours, but some clinicians prefer a single large *dose* of forty-five grains (3.0 Gm.).

Salitannol. $C_{14}H_{10}O_7$.—A condensation product of salicylic and gallic acids; it is a colorless powder, insoluble in water, ether, chloroform, and benzene, slightly soluble in alcohol, soluble in solutions of caustic alkalies. It is used as a surgical antiseptic.

Salithymol. *Thymol Ester of Salicylic Acid.* $C_6H_3(CH_3)(C_3H_7)O.COC_6H_4(OH)$.—This salt is prepared by acting on molecular quantities of sodium salicylate and thymol sodium with phos-

phorus trichloride. It is a colorless crystalline powder, of sweet taste, insoluble in water, very soluble in alcohol. It is used as an antiseptic. *Dose*, from fifteen to thirty grains (1–2 Gm.).

Salix. *U. S.* 1880.—Most of the species of the large genus Salix are possessed of similar medicinal properties. (For elaborate study of various willow barks see *Wellcome Chemical Research Laboratory Report*, No. 39.) *S. fragilis*, L. (*S. russelliana*, Sm.), which has been introduced into this country from Europe, is said by Sir James Smith to be the most valuable species. *S. purpurea*, L., a European species, is stated by Lindley to be the most bitter, and *S. pentandra*, L., is preferred by Nees von Esenbeck. Many native species are in all probability equally active with the foreign.

Salix alba, L., the species formerly recognized by the U. S. Pharmacopœia, the common European or white willow, is twenty-five or thirty feet in height, with numerous round spreading branches. The exstipulate leaves are alternate, upon short petioles, lanceolate, pointed, acutely serrate with the lower serratures glandular, pubescent on both sides, and silky beneath. The aments are terminal, cylindrical, and elongated, with elliptical-lanceolate, brown, pubescent scales. The stamens are two in number, yellow, and somewhat longer than the scales; the style is short; the stigmas two-parted and thick. The capsule is nearly sessile, ovate, and smooth. The white willow is now very common in this country. It flowers in April and May, and the bark is easily separable throughout the summer. That obtained from the branches rolls up when dried into the form of a quill, from one-twenty-fifth to one-twelfth of an inch in diameter, has a brown, more or less finely warty epidermis, is flexible, fibrous, and of difficult pulverization. The inner surface is brownish white, and smooth, the liber separating in thin layers. Willow bark has a feebly aromatic odor and a peculiar bitter astringent taste. It yields its active properties to water, with which it forms a reddish-brown decoction. Pelletier and Caventou found, among its ingredients, tannin, resin, a bitter yellow coloring matter, a green fatty matter, gum, wax, lignin, and an organic acid combined with magnesia. The proportion of tannin is so considerable that the bark has been used for tanning leather. The characteristic constituent of all species of willow, however, is *salicin*. (See *Salicinum*, p. 1078.) Robert W. Beck (*A. J. P.*, 1891, 581) has determined the relative percentages of salicin and tannin as follows:

	Salicin.	Tannin.
Leaves of *S. lucida*, Muhl.	0.30 per cent.	6.48 per cent.
Bark of *S. lucida*, Muhl.	1.09 " "	3.58 " "
Bark of *S. alba*, L.	0.56 " "	4.26 " "
Bark of *S. nigra*, Marsh.	0.73 " "	3.29 " "

Jowett and Potter made an examination of thirty-three samples of willow and poplar, and found in but one (*Salix discolor*, Muhl.) the related glucoside *salinigrin*, which Jowett had previously discovered in an unknown sample of willow bark. This compound has the formula $C_{13}H_{16}O_7$, and on hydrolysis yields glucose and meta-hydroxybenzaldehyde (*Wellcome Chem. Research Laboratory Report*, No. 28). The bark of the willow is feebly tonic, but it is at present never employed in regular medicine.

Salix nigra, Marsh. *Black Willow. Pussy Willow.*—The younger Michaux states that this is a strong bitter, and according to various eclectic practitioners, its green aments or floral buds are a very active sexual depressant, useful in *spermatorrhœa*, in all forms of *sexual excitement*, and in the nervous disturbances of the menstrual period. From twenty to thirty minims (1.3–1.8 Cc.) of the fluidextract are to be given four times a day.

Salocreol is a preparation containing an ester of the various phenols of beechwood tar. It occurs as a fluid of neutral reaction, oily consistence, brownish color, and is almost completely odorless. It is almost insoluble in water, easily soluble in the various alcohols, ether, or chloroform. It is saponified by the alkalies and alcohols, and on prolonged exposure also by glycerin. In saponified solutions the addition of a trace of ferric chloride produces the violet colors characteristic of phenol and salicylic acid in neutral solutions. It is affirmed that it is readily absorbed by the skin and does not irritate it or stain it permanently. Salocreol has been used with success in the treatment of *rheumatism*, *gout*, *erysipelas*, and various inflammatory conditions of the lymph glands. (*Deutsche Aerzte Ztg.*, 1903, No. 4.)

Salol-Camphor.—When three hundred parts of salol are rubbed with two hundred parts of camphor, and then gently warmed, a liquid is obtained insoluble in water, but miscible with fixed and volatile oils, ether, and alcohol, to which Désesquelle has given the name of *salol-camphor*, and which he recommends as a local anæsthetic.

Salophen.—*Acetylparamidophenol Salicylate*, $C_6H_4\begin{cases}OH\\COOC_6H_4.NH(C_2H_3O)\end{cases}$, is formed by the combination of salicylic acid with acetylparamidophenol, and contains 51 per cent. of salicylic acid. It forms small white crystalline scales melting at 187° C. (368.6° F.), and is almost insoluble in cold water; moderately soluble only in alcohol and ether. In warm alkaline solution it undergoes decomposition into salicylic acid and acetylparamidophenol. According to Siebel (*Th. M.*, Jan. 1892) this reaction takes place in the intestines. The same authority also states that acetylparamidophenol is scarcely toxic, 8 Gm. per kilo being necessary to kill a rabbit. It has been used by various clinicians in all forms of *rheumatic diseases* and is undoubtedly effective, though less certain in its action than are the simple salicylates. It is also used to some extent as an analgesic in the pains of nervous diseases, in *pruritus*, and also as an intestinal antiseptic.

Dose, ten to fifteen grains (0.65–1.0 Gm.); not more than seventy-five grains should be given daily.

Saloquinine. *Salochinin.* $C_6H_4.OH.CO.O.C_{20}H_{23}N_2O$.—*Quinine ester of salicylic acid* occurs in colorless crystals, insoluble in water, freely soluble in alcohol and ether, fusing at 130° C. (266° F.). It is tasteless and is said not to disturb the digestion or to cause tinnitus aurium, although it is very slowly absorbed. It is said to contain 70 per cent. of quinine, and has been used successfully as an antiperiodic, but is reputed to be of special value in the treatment of malarial and other *neuralgias*, also in fulgurant pains, and has also been highly commended in *typhoid* and other *fevers* as an antipyretic. If in a fever it be administered directly after the cold bath, it begins to powerfully impress the system about the time the effect of the immersion is going off. It may be given in the single *dose* of from fifteen to thirty grains (1–2 Gm.), repeated within twenty-four hours in bad cases of *rheumatic* affections.

Salubrol. *Tetra-bromo-methylene-di-antipyrine.* An inodorous powder, made by the action of bromine on methyl-antipyrine. It is non-poisonous, and is used as a local hæmostatic and antiseptic and as a substitute for iodoform.

Salumin. *Aluminum Salicylate.* $(C_6H_4(OH)COO)_6Al_2 + 3H_2O$.—This salt, which is insoluble in water, is made by the interaction of solutions of sodium salicylate and a salt of aluminum; it is a reddish-white powder used in catarrhal affections of the nose and pharynx. A soluble salumin is made by combining ammonia with the insoluble salumin, to form *ammoniated aluminum salicylate,* the formula of which is $(C_6H_4\left\{\begin{matrix}ONH_4\\COO\end{matrix}\right.)_6Al_2 + 2H_2O$. It is used for preparing astringent and antiseptic washes.

Salvia.—Of this labiate genus one species, *S. officinalis,* is recognized by the U. S. P. 8th Rev., the article will be found on p. 1080. Many of the species share the feeble medicinal properties of the official drug. *S. pratensis, S. Æthiopis, S. glutinosa,* and *S. Sclarea,* or *clarry,* have been officially recognized in Europe, but are less agreeable than is *S. officinalis* and are not much used; the leaves of *S. Sclarea* are said to be introduced into wine in order to impart to it a muscadel taste. The infusion of the *Rocky Mountain sage,* probably *S. lanceolata,* W., is affirmed by A. Comstock (*T. G.,* 1887, 660) to be valuable as a diaphoretic in *malarial* and *rheumatic fevers,* taken in the form of hot infusion, and when cold to be distinctly tonic and astringent. The *dose* of fluidextract is half a fluidrachm (1.8 Cc.).

The seeds of various sages contain enough farinaceous and mucilaginous material to make them useful as food. In the Western United States the ordinary sages of the plains are highly esteemed for fattening cattle, which eat their ripened tops freely (these sages must be distinguished from the so-called "sage brushes" of the West, which belong to the genus Artemisia). *Chia* is the seeds of one or more species of salvia largely used in Mexico and Southern Arizona by the natives as food. It is affirmed that the variety known as *Chia pinoli* is yielded by *S. columbaria* (see *Report U. S. Geogr. Surveys, 100th Merid.,* vol. vi. 48). *S. Chia* was described in the Farmacopea Mexicana as a new species, yielding chia, but Mariano Bâscena affirms (*La Naturaleza,* 1881) that the common chia-yielding sage of Mexico is *S. polystachya,* while *Chia azul* is yielded by *S. patens.* Guibourt is probably in error in ascribing chia to S. *hispanica.* The chia seeds are used not only when crushed as food and for the making of mucilaginous poultices, but also for the preparation of a mucilaginous drink, prepared by adding a teaspoonful of the seed to a tumblerful of cold water, allowing it to stand for half an hour, sweetening and flavoring to taste. They are described as follows: "The seed is a small one, about 1-16th inch in length, and 1-24th inch in width; oblong-ovate, somewhat flattish, nearly cylindrical, both ends rounded and slightly tapering; the thinner end has a small, dark line, forming a slight projection, which is the eye of the seed, and this, when exposed to moisture, opens in a star-shaped or scalloped manner, emitting the growing embryo. Below this eye are oil cells. The seed is smooth and glossy, and is surrounded by a transparent epithelium, swelling very largely when in water. The testa is darkish-gray, striated with dark brown lines, running diagonally, and dotted, forming a very beautiful variegated surface; when pressed or crushed under a spatula it bursts at the hilum, exposing the cotyledons and the oil cells, leaving an oily stain upon paper. Internally the testa is dark, grayish-brown, perfectly smooth, glossy, and devoid of the external variegations or striæ. It contains the embryo, with the radical pointing towards the hilum, and a white, mucilaginous substance much resembling unrendered fat." (*A. J. P.,* May, 1882, 227–229.) The European species, *Salvia verticillata,* Willd., *S. Verbenaca,* L., *S. horminum,* L., and *S. viridis,* L., all indigenous to Central or Southern Europe, are also noted for the mucilaginous character of their seeds, and have on this account been employed to remove foreign substances from the eye.

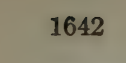
Samadera Bark.—This is the inner bark of a tree belonging to the family of Simarubaceæ, growing in Ceylon. It is intensely bitter, and probably contains quassin. For further particulars, see *P. J.,* 1872, 541.

Sandarach. *Sandaraca. Gum Juniper. Sandaraque,* Fr. *Sandarak,* G.—A resinous substance obtained from the *Callitris quadrivalvis,* Vent. (*Thuja articulata,* Vahl.), an evergreen tree (Fam. Pinaceæ) growing in Northern Africa. It is in small, irregular, roundish oblong grains or tears, of a pale yellow color, sometimes inclining to brown, more or less transparent, dry and brittle, breaking into powder under the teeth, of a faint, agreeable odor increased by warmth, and of a resinous, slightly acrid taste. It melts with heat, diffusing a strong balsamic odor, and easily inflames. It is almost entirely soluble in ordinary alcohol, and entirely so in that liquid when anhydrous, and in ether. Heated oil of turpentine also dissolves the greater part of it, but very slowly. According to Unverdorben, it consists of three resins, varying in their relations to alcohol, ether, and oil of turpentine. The *sandaracin* of Geise, which remains after sandarach has been exposed to the action of ordinary alcohol, is a mixture of two of these resins. Tschirch (*Harze und Harzbehälter,* p. 276) has isolated and described an acid, *sandaracolic acid,* $C_{44}H_{64}O_4(OH)COOH$, making up 85 per cent. of the natural resin and *callitrolic acid,* $C_{64}H_{82}O_5(OH)COOH$, of which 10 per cent. is present. In Australia and Tasmania Callitris trees grow in vast numbers, and produce a sandarach which is almost colorless, having highly refractive power, and a pleasant aromatic odor, becoming dark by age, and sometimes assuming a superficial mealiness. This Australian sandarach softens easily, but does not melt in boiling water, is gritty to the touch, and can scarcely be distinguished from the African drug. (*P. J.,* Jan. 1890.) For an elaborate description of Australian sandarach, see also *A. J. P.,* 1896, 215. Sandarach was formerly given internally, and entered into the composition of various ointments and plasters. At present it is used chiefly as a varnish and as incense; its powder, termed *pounce,* is rubbed upon paper to prevent ink from spreading after letters have been scratched out. A false sandarach has been described by R. Haneke. It resembled the real article, being lemon-yellow in color, transparent, and the tears elongated and rounded at the tips. When chewed it broke into fine powder and stuck to the teeth, while it softened on the water bath and flowed together into a resinous mass. Examination showed it to consist largely of colophony. (*O. Z.,* liv.)

Sanicula. *Sanicula marylandica,* L. *Sanicle. Sanicle,* Fr. *Sanikel,* G.—The root of this in-

digenous umbellifer is popularly known in some parts of the country by the name of *black snake-root.* It is fibrous and of an aromatic taste, and, according to C. I. Houck (*A. J. P.*, vol. xiv. 463), contains a volatile oil and a resin. It has been used in *intermittent fever,* and also in *chorea* by Zabriskie; *dose* of powder to children eight years old half a drachm (2.0 Gm.) three times a day. (*Am. J. M. S.*, N. S., xii. 374.)

Sanoform. *Di-iodo-methyl Salicylate.*



. This substance is obtained by the action of iodine on methyl salicylate (oil of wintergreen). It is a crystalline, colorless, odorless, and tasteless powder, permanent in the light and air, and melting at 110° C. (230° F.), but may be heated up to 200° C. (392° F.) without decomposing. It is soluble in 200 parts of cold or 10 parts of hot alcohol, and readily in ether, chloroform, benzene, and carbon disulphide, but almost insoluble in water or glycerin. It contains 62.7 per cent. of iodine. It forms with caustic alkalies, salts which are sparingly soluble in water.

Sanoform, first introduced as a substitute for iodoform by A. Arnheim, would appear to afford an efficient antiseptic dressing for wounds. As it remains unchanged at high temperatures, it is readily sterilized, while its odorlessness gives it a great advantage over iodoform. Its absorption is extremely slow, as it does not appear in the urine after having been administered hypodermically until twenty-four hours have elapsed, and does not entirely disappear until after fourteen days. It is seemingly, therefore, less poisonous than iodoform. It may be used as a dusting powder or in the manufacture of a 10 per cent. gauze which can be sterilized by heating; or a 1 per cent. solution in collodion, or a 10 per cent. ointment may be employed. It has been employed with satisfaction in ophthalmic surgery by Radziejewski and by Jacobsohn.

Santolina.—A composite plant, *Santolina Chamæcyparissus,* L., is stated to have long been used popularly against the round worm in Scotland. It has been analyzed by T. Maben (*P. J.*, xvi. 301), who finds in it a volatile oil and a considerable percentage of resin, with a bitter principle, which he believes to be an alkaloid and the active principle of the drug. The decoction of the plant may be made by boiling half an ounce in a pint of water for half an hour, straining and making up to a pint. It is given in *doses* of five fluidounces (150 Cc.) to adults and half that quantity to children, repeated for four mornings, and then followed by a brisk cathartic.

Santoninoxime. $C_{15}H_{18}O_2.N.OH$.—This substance was first prepared in 1889 by P. Guici (*Gazz. Chim.*, xix. 367) by digesting at nearly 80° C. (176° F.) for three days five parts of santonin, four parts of hydroxylamine hydrochloride, fifty parts of strong alcohol, and four parts of precipitated calcium carbonate. It crystallizes in white silky needles, melts at about 217° C. (422.6° F.), is very slightly soluble in hot water, and turns the plane of polarized light to the left. Coppola states that this substance is a safe and reliable substitute for santonin, to be given in *doses* about three times as large.

Sapindus.—Various tropical plants belonging to this genus of the Sapindaceæ contain saponin, and are largely used for cleaning purposes. Thus, in India are employed the pulp of the fruit of *Sapindus Mukorossi,* Gaertn. (*S. detergens,* Roxb.), the capsules of *S. trifoliatus,* L. (*S. emarginatus,* Vahl., *S. laurifolius,* Vahl.), and in South America the oil and seed vessels of *S. Saponaria,* L. (*P. J.*, 1871, 585.) For the properties of saponin, see *Saponaria officinalis,* below.

Sapium. *Sapium sebiferum* (L.), Roxb. (*Croton sebiferus,* L., *Stillingia sebifera,* Michx.) *Tallow Tree. Tankawang Fat.*—This is a species of the family Euphorbiaceæ, cultivated in the Chinese provinces of Kiangse, Kiang-sou, and Chih-kiang for the sake of the fatty matters extracted from the nuts by methods detailed in *A. J. P.*, 1872, 264. (See *P. J.*, June, 1872.) The "tallow" occurs in hard, brittle, opaque, white, tasteless, and odorless masses of about eighty pounds' weight. It is said to be nearly pure stearin. The oil is largely used for lighting purposes. The remnants of the nut are employed as fuel and as manure. (See also *P. J.*, 1883, 401, and *Ibid.*, 1887, 901.)

Sapolan.—This is a brownish-black ointment, consisting of two and one-half parts of naphtha, one and one-half parts lanolin, and 3 to 4 per cent. anhydrous soap; used as a stimulant ointment in various skin diseases.

Saponaria. *Saponaria officinalis,* L. *Soapwort. Saponaire, Savonnière,* Fr. *Seifenwurzel,* G. (Fam. Caryophyllaceæ.)—A perennial herbaceous plant, growing wild in this country in the vicinity of cultivation, but introduced from Europe. It is commonly known by the vulgar name of *bouncing bet.* It is one or two feet high, with smooth, lanceolate leaves, and clusters of conspicuous whitish or slightly purplish flowers, which appear in July and August. The root and leaves are employed. They are inodorous, and of a taste at first bitterish and slightly sweetish, afterwards somewhat pungent, continuing long, and leaving a slight sense of numbness on the tongue. They impart to water the property of forming a lather when agitated, like a solution of soap, whence the name of the plant was derived. This property, as well as the medicinal virtues of the plant, resides in *saponin,* $C_{32}H_{54}O_{18}$. This principle constitutes, according to Bucholz, its discoverer, 34 per cent. of the dried root, which contains also a considerable quantity of gum and a little bassorin, resin, and altered extractive, besides lignin and water. Saponin is obtained, though not absolutely pure, by treating the aqueous extract with alcohol and evaporating. When thoroughly purified (see *A. J. P.*, 1884, 274), it is a very white, amorphous, inodorous powder, which excites sneezing when inhaled by the nostrils, has a pungent, disagreeable taste, and is poisonous. It is soluble in water and official alcohol, but is insoluble in anhydrous alcohol, ether, and the volatile oils. Although a glucoside, according to Lautenbach (*Journ. Nerv. and Ment. Dis.*, 1879, 433), it unites with sulphuric acid to form long acicular crystals. Its aqueous solution froths when agitated. It is decomposed by dilute acids, though with some difficulty, into *sapogenin,* $C_{14}H_{22}O_2$, and sugar, or, according to Schiaparelli (*A. J. P.*, 1884, 275), into *saponetin,* $C_{40}H_{66}O_{15}$, and sugar, according to the reaction:

$$2C_{32}H_{54}O_{18} + 3H_2O = C_{40}H_{66}O_{15} + 4C_6H_{12}O_6$$

Stütz (*Ann. Ch. Ph.*, 218, 250) studied the saponin from *Quillaja Saponaria,* Mol., and, after purifying his preparation and making a series of acetyl derivatives therefrom, was led to give the formula $C_{19}H_{30}O_{10}$ to saponin. It has been found in many other plants, among them some species of Silene, Dianthus,

and Lychnis, in *Vaccaria vulgaris*, Host., and in *Agrostemma Githago*, L., all these belonging to the fam. Caryophyllaceæ. (*J. P. C.*, 3e sér., x. 339; also *P. J.*, 1871, 585; *Australian Journ. Pharm.*, 1887.) Serious poisonings by the mixture of the seeds of *Agrostemma Githago* with wheat have been reported. (*D. M. W.*, 1903.) According to Augustine Henry, there are at least eleven species of trees whose products are used in China for washing purposes and probably contain saponin, which is also found to the extent of 10 per cent. in the seeds of the Chinese tea oil tree, and is left in such large proportion in the refuse after the extraction of the oil that the "tea seed cake" is used as a fish poison. (*Am. Drug.*, 1896.) In California the *Indian Soap Root*, *Chlorogallum pomeridianum* (Ker.), Kunth., is much used for washing clothes; it probably contains saponin. The fruits of various species of Sapindus are also rich in saponin and are used as detergents accordingly. In diluted form saponin is irritant to all tissues, and when concentrated it kills by its local action both muscular and nervous tissue. As was first discovered by H. Köhler, when injected into the leg of the frog in minute quantity it produces not only motor weakness but a rapid loss of sensibility, so that reflex movements can no longer be caused by irritating the foot. The paralysis seems to affect especially the peripheral nerve endings, since irritation of the nerve trunk, although incapable of causing contraction of the muscles supplied by it, elicits pain cries and other evidences of sensibility. Muscles with which saponin comes in contact become unexcitable and pass into a condition resembling post mortem rigidity. According to Köhler, this occurs without change in the microscopic structure, but Przybyszewski found that in the neighborhood of the injection where the saponin was abundant the muscles underwent structural changes similar to those of myositis. In the frog saponin produces not only local symptoms, but after a time wide-spread paralysis, with final arrest of the cardiac movements. Given internally to mammals it causes violent gastro-intestinal irritation, progressive loss of power, disturbance of respiration and circulation, and usually clonic and tonic convulsions, which are probably secondary to the perturbations of the cardiac and respiratory functions. Lohmann (*P. J.*, 73, 477) affirms that chemically pure saponin is not injurious when taken by the stomach. Injected into the circulation in rabbits and dogs, according to the researches of Przybyszewski, it causes fall of the arterial pressure, with great disturbance of the respiration and finally cardiac arrest. According to Köhler, the action of the drug upon the heart is antagonistic to that of digitalin, so that the application of sufficient quantities of saponin to the frog's heart which has been arrested by the local application of digitalin will bring about a return of pulsations, while, on the other hand, digitalin is capable of putting aside cardiac arrest from saponin. As has been shown by Ransom (*D. M. W.*, xxvii.), saponin has a powerfully destructive action upon the red blood corpuscles, due to an extraordinary tendency which it has to unite with their cholesterin. The action of saponin upon the respiratory centres is very great, the injection of large doses being followed by immediate arrest of respiration, the heart continuing to beat for some time. As it exists in agrostemma seeds, saponin has several times caused death in the human species. The symptoms have been headache, vertigo, vomiting, hot skin, rapid feeble pulse, progressive muscular weakness, and finally coma. Following out the experiments of Kobert, Ulenburg and Keppler tried saponin as a local anæsthetic, but found that it was not practically convenient for use; nor were the essays of Kobert with the glucoside as an antipyretic more encouraging. Senega appears to depend upon saponin for whatever expectorant virtues it may possess, and the use of quillaja bark has been strongly urged by Kobert. (See *Quillaja*, p. 1035.) In Germany soap root has been used as a substitute for sarsaparilla in scrofulous, venereal, and cutaneous affections, and also by Andri in the form of inspissated juice, half an ounce a day, in *gonorrhœa*. The *dose* of the decoction is set down at two pints daily. For further information as to the physiological action of saponin, consult Husemann's *Pflanzenstoffe*, second edition, and *S. Jb.*, xxi. 3, 13.

According to Kobert (*Gaz. Méd. de Paris*, xiv. 2, 1883), saponin of commerce is composed chiefly of two substances, *quillaic acid* and *sapotoxin*. For method of preparation, see *T. G.*, vol. ii. 540. The quillaic acid is said to be extraordinarily poisonous, three-one-thousandths of a grain for each pound of body weight injected into the veins of a cat being sufficient to cause death, although thirty grains administered by the mouth are safely borne.

Sappan.—The heart wood of *Cæsalpinia Sappan*, L. Under the name of *patang*, sappan wood is largely used as a dye in India, and has long been employed in the British India Medical Service as a substitute for logwood. It is officially characterized as occurring in hard, heavy sections of variable size, or in the form of chips, of a fine orange-red color. A transverse section exhibits well marked concentric rings, numerous narrow medullary rays, and large vessels which are readily seen with a lens. It is cut with difficulty transversely, but is easily split longitudinally, showing distinctly the grain due to the medullary rays. The wood has no odor, and only a slightly astringent taste. It communicates a red color to alcohol (90 per cent.) and to water; this color becomes a carmine red, and not purple, upon the addition of solution of potassium hydroxide (distinction from logwood). According to the investigations of Bolley, sappan wood contains *brasilin*, $C_{16}H_{14}O_5$, identical with that of Brazil wood. Internally it is used in India as an astringent in the treatment of *diarrhœa*. The Br. Add. recognizes a *decoction* (*Decoctum Sappan*, Br. Add.), one ounce with seventy grains (4.5 Gm.) of cinnamon bark to the pint; *dose*, from one-half to two fluidounces (15–60 Cc.).

Saprol. *Disinfection Oil.*—A mixture of crude cresols, containing pyridine bases and hydrocarbons, used for disinfecting purposes. As it is inflammable, care should be exercised in its use.

Sarcocolla. *Sarcocolle*, Fr. *Fleischleimgummi*, *Fischleimgummi*, G.—A peculiar vegetable product, exuding spontaneously from various species of the genus Penæa (Fam. Penæaceæ), small shrubs growing at the Cape of Good Hope, in Ethiopia, Arabia, etc. It is in the form of small, roundish, irregular grains, sometimes agglutinated in masses, friable, opaque or semi-transparent, of a yellowish or brownish-red color, inodorous unless heated, when they have an agreeable odor, and of a peculiar, bitter, sweetish, and acrid taste. Sarcocolla, according to Pelletier, consists of 65.3 per cent. of a peculiar substance, considered by Thomson as holding an intermediate place be-

tween gum and sugar, and called *sarcocollin*, $C_{13}H_{23}O_6$, 4.6 of gum, 3.3 of a gelatinous matter having some analogy with bassorin, and 26.8 of lignin, etc. It is said to be purgative, but at the same time to produce serious inconvenience by its acrid properties. The Arabian physicians used it internally, and by the ancients it was employed as an external application to wounds and ulcers, under the idea that it possessed the property of agglutinating the flesh, whence its name.

Sarracenia. *Side-saddle Plant. Fly Trap. Pitcher Plant. Huntsman's Cup. Water Cup. Sarracenie*, Fr., G.—According to E. P. Porcher, the roots of *Sarracenia flava*, L., and *S. variolaris*, Michx., have long been used in the Southern United States in *dyspepsia*, and are tonic, laxative, and diuretic. Sheppard found them to contain lignin, coloring matter, resin, an acid salt of lime, and probably an alkaloid. Stan. Martin asserts that he has found in the root,—1, an alkaloid which he proposes to name *sarracenine;* 2, a resin; 3, a yellow coloring principle (probably identical with Schmidt's *sarracenic acid*); 4, extractive; 5, substances which constitute the framework of plants. Sarracenine is white, soluble in alcohol and ether, combines with acids to form salts, and with sulphuric acid forms handsome needles, which are bitter, and communicate this taste to its menstrua. (*Ann. Thér.*, 1866, 73.) E. Schmidt, however, found no alkaloid, but discovered *sarracenic acid.* (*A. J. P.*, 1872, 213.) *Dose*, of tincture (two ounces in one pint), a fluidrachm (3.75 Cc.); of fluidextract, from ten to twenty minims (0.6–1.3 Cc.).

Sassy Bark. *Mancona Bark. Saucy Bark. Ecorce de Mançoine*, Fr. *Manconarinde*, G.—This bark is interesting chiefly from its employment by the natives of Western Africa as an ordeal in their trials for witchcraft or sorcery. (For details, see *P. J.*, lxv. 2.) This bark was first studied by C. A. Santos (*A. J. P.*, 1849, xxi. 97), and subsequently by Procter (*Ibid.*, xxiii. 301; xxiv. 195), who proposed the name of *Erythrophleum judiciale* for the tree yielding it. The tree had, however, been previously described under two specific names, having been noted in Hooker's *Niger Flora* (p. 329) as the *Erythrophleum guineense* of Don, and being also the *Fillæa suaveolens* of Guillemin and Perottet's *Flora of Senegal.* It is a large tree with spreading branches, doubly pinnated leaves, flowers in spike-like racemes, and leguminous fruit. The bark is in pieces more or less curved, with or without epidermis, in the former case somewhat fissured externally, of a dull red color diversified by whitish spots, brittle, presenting when cut transversely numerous fawn-colored spots surrounded by reddish-brown tissue, nearly inodorous, and of an astringent taste.[1] Gallois and Hardy obtained the poisonous principle *erythrophleine* by making an alcoholic extract of the bark, exhausting this with water, evaporating, rendering this extract alkaline with ammonia, and treating with acetic ether. The alkaloid is a colorless, crystalline solid, soluble in water, acetic ether, alcohol, and amyl alcohol, insoluble in chloroform, benzin, and ether. In contact with sulphuric acid and black manganese oxide, a violet color (less intense than that produced with strychnine) is developed. Harnack and Zabrocki (*A. E. P. P.*, xv. 404) also prepared *erythrophleine*, and by the action of hydrochloric acid upon it obtained an acid they call *erythrophleic acid*, and a volatile alkaloid they call *mançonine.* The bark yields its virtues to water.

According to the observations of Savage, made in Africa (*Charleston Med. Journ.*, 1859), sassy bark produces in the natives a feeling of constriction in the fauces, attended by prickling, and followed by numbness, with, after a toxic dose, stricture across the brow, severe pain in the head, coma, and death. The physiological action of erythrophleine has been studied by various observers, especially by E. Harnack and R. D. Zabrocki, Gallois and Hardy, and Lauder Brunton, with results which are fairly concordant. It has a pronounced action upon the circulation, causing a slow strong pulse, with a rise in the arterial pressure; phenomena which are certainly in great part due to the direct action upon the ganglionic structure or muscular fibre of the heart itself, but which are also seemingly in part produced by a stimulating influence upon the muscle fibres or nerves in the walls of the arterioles. The action, therefore, of erythrophleine would seem to be very close to that of the digitalis principles. Purging was also noted as the result of an increased peristalsis, thought to be due to the local action of the poison. Vomiting is believed by Lauder Brunton to be the result of an influence upon the nerve centres, because it occurs when the alkaloid is given hypodermically. In fatal poisoning in the lower animals, convulsions are pronounced, and the respiration is also markedly affected. In 1888 L. Lewin asserted erythrophleine to be a powerful local anæsthetic, whose action is more pronounced than that of cocaine. His paper gave rise to an extraordinary controversy, the outcome of which appears to be that, although the alkaloid is possessed of not very active anæsthetic powers, it is for various reasons practically not useful. (See 17th edition, *U. S. D.*, p. 1739.) A solution of the strength of one-tenth of one per cent. is used as an application to the cornea.

Germain Sée asserts (*Méd. Mod.*, Dec. 1891) that, although sassy bark does not act well upon the heart, it gives great relief in *dyspnœa*, the number of respirations being lessened and the inspirations being extraordinarily increased in depth. He gave of the alkaloid from 1-40th to 1-30th of a grain (0.0016–0.002 Gm.); of the extract, from ¼ to ½ of a grain (0.016–0.021 Gm.).

Satureia. *Satureia hortensis*, L. *Summer Savory. S. Montana*, L. *Winter Savory. Sarriette*, Fr. *Saturei, Bohnenkraut*, G.—Annual labiate plants resembling thyme in odor and flavor, growing spontaneously in the south of Europe, and cultivated in our gardens as culinary herbs.

Saururus. *Saururus cernuus*, L. *Lizard's Tail.* (Fam. Saururaceæ.)—D. L. Phares of Newtonia, Miss., considers this indigenous swamp plant "laxative, antispasmodic, sedative, and slightly astringent;" useful in irritation of the kidneys, bladder, prostate, and urinary passages generally. The *dose* of the strong infusion was, with the plant either fresh or dried, from one to four fluidounces (30–120 Cc.) every fifteen or thirty minutes, or three or four times a day. (*A. J. P.*, 1867, 468.)

Saxifraga.—Garreau and Machelast have isolated from *S. crassifolia*, L. and other species of

[1] A comprehensive description of sassy bark is given in the *Commentar zur oesterreichischen Pharmacopœia*, 1880, by Vogel; while in the *Résumé de la Matière Médicale et Toxicologique Coloniale*, by Corre and Lejuanne, the plant, fruit, seeds, etc., are carefully illustrated.

this genus a crystallizable bitter substance, *bergenin*. It is obtained by boiling the stems of the plants with absolute alcohol, after the tannin has been removed by ether. It crystallizes in alcohol, has a bitter taste, melts at 140° C. (284° F.), and burns up completely at 300° C. (572° F.). It is soluble in 167 parts of 90 per cent. alcohol and in 830 parts of water, but is more soluble in these liquids at a boiling temperature; it is faintly acid to litmus, and is not changed by treatment with dilute sulphuric or hydrochloric acid, but by diluted nitric acid is converted into oxalic acid. Concentrated sulphuric acid decomposes it. Its formula is given as $C_6H_3O_3.H_2O$. Bergenin is asserted to be intermediate in its action between salicylic acid and quinine. (*A. Pharm.*, 1881, 293.) The rhizome of *Saxifraga ligulata*, Wall., which is used in India in *dysentery*, has been found by David Hooper to contain about 16 per cent. of gallic and tannic acids, but no other active principles. (*P. J.*, Aug. 1888.)

Schinus. *Schinus molle*, L. (Fam. Anacardiaceæ.)—The *pepper tree* of South America yields a berry the size of a pea, having a flavor similar to a mixture of pepper and fennel. It has been introduced as a shade tree in Southern California. (*A. J. P.*, 1896, 215.) Schimmel & Co. examined the volatile oil distilled from the berries; it had the sp. gr. 0.850, the odor of phellandrene, and was soluble in alcohol. (*Ph. Rev.*, 1897, 114.) It has been used successfully in *gonorrhœa* as a substitute for cubeb. The leaves, bark, and gum resin have been employed medicinally. (See *A. J. P.*, 1866, 1885, 1890; also *P. J.*, 1887.)

Schleich's Anæsthetic Mixture.—In 1895 Schleich proposed the use of an anæsthetic mixture based upon the theory that the ideal anæsthetic should have a boiling point as near as possible to the temperature of the human body, so that elimination should take place from the lungs as rapidly as possible, with consequent immediate awakening from unconsciousness. Schleich's mixtures, three in number, are,—

Mixture No. 1.—Boiling point, 100.4° F. Chloroform, 45 Cc.; petroleum ether, 15 Cc.; ether, 180 Cc.

Mixture No. 2.—Boiling point, 104° F. Chloroform, 45 Cc.; petroleum ether, 15 Cc.; ether, 150 Cc.

Mixture No. 3.—Boiling point, 107.6° F. Chloroform, 30 Cc.; petroleum ether, 15 Cc.; ether, 80 Cc.

Of these mixtures No. 1 is the most evanescent and produces the briefest anæsthesia, while No. 3 is the most permanent in its action.

The incorrectness of the assertion of Schleich, that *petroleum benzin* is a neutral diluent, has been demonstrated by H. C. Wood, Jr., in a series of experiments (*P. M. J.*, April, 1899), in which he proved that petroleum benzin acts both upon the heart and the vasomotor system as a paralyzant, and that its effect upon the respiratory centre is even more powerful, while its anæsthetic influence is exceedingly feeble. It would appear, therefore, that the use of Schleich's mixture is attended by more danger than is that of either chloroform or ether, a conclusion which seems to be borne out by the analysis of about one thousand reported cases made by him.

Scolopendrium. *Scolopendrium Scolopodendrium* (L.), Karst. *Asplenium Scolopendrium*, L. *Phyllitis Scolopendrium* (L.), Newman. *Hart's Tongue.*—The fronds of this fern, which is indigenous both in Europe and America, have a sweetish, mucilaginous, and slightly astringent taste, and, when rubbed, a disagreeable oily odor. They were used as a deobstruent in visceral affections, as an astringent in *hemorrhages* and fluxes, and as a demulcent in pectoral complaints.

Scrophularia. *Scrophularia nodosa*, L. *Figwort. Scrofula Plant. Scrofulaire*, Fr. *Kropfwurz, Knotenwurz*, G. (Fam. Scrophulariaceæ.) Its leaves have when fresh a rank fetid odor, and a bitter, somewhat acrid taste; but these properties are diminished by drying. Water extracts their virtues, forming a reddish infusion, which is blackened by ferric sulphate. For histological study of root, see *P. J.*, 1896. Walz has obtained from it two proximate principles, which he names respectively *scrophularin* and *scrophularosmin*. (Mayer, *A. J. P.*, 1863, 295.) Figwort leaves were formerly considered tonic, diuretic, diaphoretic, discutient, anthelmintic, etc.; useful in *scrofula* and as a local application in *hemorrhoids*. Van de Moer (*P. J.*, 1896) affirms that the seeds are toxic, belonging to the digitalis group.

Sedatin, *Para-valerylphenetidin*, is made by the action of phenetidin hydrochloride upon sodium valerate; it occurs in fine crystals. It is soluble in hot alcohol, sparingly soluble in ether, chloroform, and petroleum benzin. It is said to act like antipyrine.

Sedum. *Sedum acre*, L. *Biting Stonecrop. Wall Pepper. Small Houseleek. Mossy Stonecrop. Joubarbe âcre, Poivre des Murailles*, Fr. *Mauerpfeffer, Steinkraut*, G. (Fam. Crassulaceæ.) This European plant has escaped to some extent from the gardens and grows wild in New England. It causes vomiting and purging, and applied to the skin produces inflammation and vesication. The fresh herb and the expressed juice have been used as an antiscorbutic, emetic, cathartic, and diuretic, and have been applied locally to old *ulcers, warts*, and other excrescences. Other species are less acrid, and are even eaten as salad in some parts of Europe. Such are *Sedum rupestre*, L., and *S. album*, L. *S. Telephium*, L., was formerly employed externally to cicatrize wounds, and internally as an astringent in *dysentery* and *hæmoptysis*, and is still esteemed by the common people in France as a vulnerary. Ernst Mylius found in 100 parts of *Sedum acre* 2.2 parts of a soft, not acid resin, 12.80 parts of uncrystallizable sugar, and 12.40 parts of a soft acid resin, besides an alkaloid and inert substance. (*J. P. C.*, 4e sér., xvii. 81.)

Selenium. Se = 78.6.—This widely distributed element, discovered by Berzelius in 1817, belongs to the sulphur group, and its compounds occur in nature associated with sulphur compounds. It is most conveniently extracted from the lead chamber deposits of the sulphuric acid works. The physiological actions of the compounds of this metal have not been widely studied, but Chabrié and Sépicque (*C. R. A. S.*, cx.) have shown that *selenous acid* is an irritant poison. According to Merck, a solution of selenous acid (0.5 per 100) is a valuable reagent for detecting alkaloids (*M. R.*, 1900).

Semecarpus. *Semecarpus venenosa*, the *Tschongott Tree.*—The highly poisonous bark of this tree, which is a native of the Caroline Islands, is, according to Thoms and Mannich (*Ph. Ztg.*, 1902), due to the presence of *cardol* (*anacardic acid*).

Sempervivum. *Sempervivum tectorum*, L. *Common Houseleek. Grande Joubarbe*, Fr. *Haus-*

wurz, Hauslauch, Dachwurz, G. (Fam. Crassulaceæ.)—In Europe the bruised recent leaves of this plant are employed as a cooling application to burns and other external inflammations. The juice is said to cure *warts.*

Senecio.—Various species of this composite genus have been domestically used in the treatment of *amenorrhœa* both in Europe and America, and their value has been confirmed by various practitioners. (See *P. J.*, Dec. 1897.) The species specially used have been *Senecio vulgaris,* L., *Common Groundsel, Seneçon,* Fr., *Kreutzkraut, Jacobskraut,* G.; an annual European plant introduced into this country and growing in cultivated grounds, and the North American species, *S. aureus,* L., or *ragwort.* The fluidextract is especially used in the *dose* of one fluidrachm (3.75 Cc.) three to six times a day.

In *S. vulgaris,* and in lesser amount also in *S. jacobœa,* A. Grandval and H. Lajoux (*Union Médicale du Nord-est,* xix. 1895) have found two alkaloids, *senecionine,* $C_{18}H_{26}NO_6$, which is slightly, and *senecine,* which is readily soluble in ether. According to Wiet, senecionine is a paralyzant of the peripheral motor and sensory nerves, while Bunch has found that the alcoholic extract of *Senecio jacobœa* is capable of producing a rise of the arterial pressure due to contraction of the arterioles, followed, if the dose has been large enough, by arterial dilatation with fall of pressure (*B. M. J.*, 2, 1900, 212). *Senecin* of the eclectic practitioners is made by precipitating the tincture with water and is not therefore a pure active principle.

The rhizomes of the Mexican species, *Senecio grayanus,* Hemsl., and *S. cerviariæfolius,* Hemsl., constitute *maturin,* the plants being known as *matarique, maturin,* or *guereña.* They produce rise of temperature, dilatation of the pupil, and violent tetanic spasms. Henckel states that they contain a glucoside resembling digitalin. (*A. J. P.*, Jan. 1891; also *Nouv. Rem.*, 1888, and *P. J.*, March, 1889.)

Septoform is a condensation product of formaldehyde with members of the terpene, naphthalene, and phenol groups, prominent among which is *dioxynaphthylmethane* $(C_{10}H_7O)_2.CH_2$. This preparation is offered in the form of a soap and also of an aqueous solution. It is said to be free from irritant properties and to be so strongly germicidal that a 1 per cent. solution will kill the cholera vibrio in five minutes, and the 3 per cent. solution the pus organism in three minutes. It has been chiefly used in veterinary practice, and for the disinfection of the hands (a 3 per cent. solution), or of instruments (5 to 10 per cent. solution). (*Th. M.*, xvi.)

Sesamum. *Sesamum indicum,* L. (Fam. Pedaliaceæ.)—The *benne* plant of our Southern States is annual, with a branching stem four or five feet high, and bearing opposite, petiolate leaves, varying considerably in their shape. Those on the upper part of the plant are ovate-lanceolate, irregularly serrate, and pointed, those near the base three-lobed and sometimes ternate, and lobed leaves are not uncommon at all distances from the ground. The flowers are reddish-white, and stand solitarily upon short peduncles in the axils of the leaves. The fruit is an oblong capsule, with small, oval, yellowish seeds.

There are some ten or twelve species referred to the genus Sesamum, the majority of which are natives of Africa. In India one or two species occur wild, one of these, *Sesamum indicum,* L. (*S. orientale,* L.), has been cultivated from time immemorial in various parts of Asia and Africa. From the latter continent it is supposed that seeds were brought by the negroes to the United States, where, as well as in the West Indies, it is now cultivated to a considerable extent. The plant above described will grow as far north as Philadelphia. The seeds are employed as food by the negroes, who parch them over the fire, boil them in broths, make them into puddings, and prepare them in various other modes. By expression they yield a fixed oil, which was introduced into the Pharmacopœia at the revision of 1880. Berjot obtained from the seeds 53 per cent. of oil by means of carbon disulphide.

Benne Leaves.—These abound in a gummy matter, which they readily impart to water, forming a rich, bland mucilage, much used in the Southern States as a drink in various complaints to which demulcents are applicable, as in *cholera infantum, diarrhœa, dysentery, catarrh, acute cystitis, strangury,* etc. The remedy has attracted attention also in the North, and has been employed with favorable results in Philadelphia. One or two fresh leaves of full size, stirred about in half a pint of cool water, will soon render it sufficiently viscid. With dried leaves hot water is used. The leaves also serve for the preparation of emollient cataplasms.

Sethia. *Sethia acuminata,* Arn.—The juice of this Ceylon plant or the powdered leaves—*dose,* fifteen grains (1.0 Gm.)—are affirmed to be an efficient vermifuge. (*P. J.*, April 7, 1883.)

Sida. *Sida rhombifolia,* L.—*Queensland hemp* (Fam. Malvaceæ), *jelly leaf,* is largely used in Australia as a demulcent. It contains a large quantity of mucilage. *Sida paniculata,* L. (*S. floribunda,* H. B. K.), of Peru, which also contains a large quantity of mucilage, is said by Martinet to be a very active vermifuge, owing its powers, probably, to the extremely minute but very resisting spines which cover its leaves, the part used.

Siegesbeckia. *Siegesbeckia orientalis,* L. (Fam. Compositæ.)—This plant is used in the Mauritius Islands in *syphilis, leprosy,* and various skin diseases. A white, crystalline principle, *darutyne,* has been discovered in it by M. L. Auffray. (*P. J.*, vol. xvi. 1047; also *B. M. J.*, June 25, 1887.)

Sienna. *Terra di Sienna.*—An argillaceous mineral, compact, of a fine texture, very light, smooth, and glossy, of a yellowish-brown or coffee color, leaving a dull orange trace when moistened and drawn over paper. By calcination it assumes a reddish-brown color, and is then called *burnt sienna.* In both the raw and burnt states it is used in painting. The best sienna is brought from Italy, but an inferior kind is found in England.

Silene. *Silene virginica,* L. (Fam. Caryophyllaceæ.) *Catchfly. Wild Pink.*—The wild pink of West Virginia and the Carolinas was considered by the Indians poisonous and by Barton an anthelmintic.

Silex, Pulverized. *Silex Contritus,* Lond *Silicic Acid.*—For mechanical purposes, in the making of aromatic waters, etc., the London Pharmacopœia formerly recognized under the name of *Silex Contritus* powdered quartz; but at present powdered purified talc, paper pulp and magnesium carbonate are employed. For details, see 17th edition, *U. S. D.*, p. 1741.

Pulverized silex is a harsh, white, tasteless powder, insoluble in water and most other solvents.

Its sp. gr. is 2.66. In composition it is a *silicic oxide*, SiO_2. *Silicon* is an electro-negative element, which has been obtained in two allotropic states, called amorphous and crystalline silicon; the first corresponding to amorphous carbon and the second to crystallized carbon or the diamond, except that it is steel-gray in color. The second variety is hard enough to scratch glass but not topaz and has the sp. gr. 2.49. It is now made on a large scale as a product of the electric furnace, being used as a deoxidizing agent in the casting of some metals. Pure *silica* is easily prepared by acidulating commercial solution of sodium silicate with hydrochloric acid, heating and evaporating, and washing the precipitated silica.

Silphium. *Silphium laciniatum*, L. *Polar Plant.* (Fam. Compositæ.)—The *rosin weed*, or *compass plant*, of Ohio, yields an oleoresin, which is said to be used in making chewing gum. (*A. J. P.*, 1881, 487.)

Silver Acetate. *Argenti Acetas.* $AgC_2H_3O_2$. This salt occurs in white crystals freely soluble in hot water. It has been introduced by Zweifel (*Centralbl. f. Gynækologie*, 1900, No. 51) as a substitute for silver nitrate in the treatment of *ophthalmia* of new-born infants. He asserts that the one per cent. solution is in these cases much more effective than the older salt.

Silver Ammonio-chloride. *Argenti Ammonii-chloridum. Argentum Chlorato-ammoniatum.*—This substance is formed by saturating solution of ammonia, by the aid of heat, with silver chloride and allowing the liquid to cool in a stoppered bottle. It crystallizes in cubes. Silver ammonio-chloride has been used in the treatment of *chorea*, *epilepsy*, and *syphilis*, and as an anthelmintic, in *doses* of from one-twelfth to one and a half grains (0.005–0.1 Gm.). It is probably of little value.

Silver Chloride. *Argenti Chloridum.* AgCl. This is readily prepared by adding a solution of sodium chloride to one of silver nitrate, as long as it produces a precipitate. As first thrown down, it is a white, curdy substance, but it soon becomes discolored when exposed to the light. It is decomposed by solutions of the caustic alkalies, which convert it into oxide, but not by their carbonates. After the formation of the oxide in this way, the addition of sugar reduces it, and revives the silver. (Levol.) Silver chloride has been used in *syphilis*, *epilepsy*, *chronic dysentery* and *diarrhœa*, and other diseases in which silver nitrate has been given. The *dose* is from one to three grains or more (0.065–0.2 Gm.), four or five times a day.

Silver Citrate. *Argenti Citras. Itrol.* $Ag_3C_6H_5O_7$.—A dry, odorless powder, soluble with difficulty in water. This salt is recommended by Credé as an antiseptic powder which may be dusted over a wound without producing irritation, or it may be injected subcutaneously into the surrounding tissue. It has been very highly recommended by O. Werler (*Derm. Zeit.*, Bd. cxi.) as intensely poisonous to the organism of *gonorrhœa*, and non-irritant to the urethral mucous membrane, and as further having the power of penetrating deeply into this membrane. The patient is to inject in the usual manner, four times a day, a solution of a strength varying from 1 in 4000 to 1 in 8000. As the itrol solution is immediately decomposed in contact with organic material, it is essential that the syringe and vessels used be kept absolutely clean. Even in *acute gonorrhœa* it is said that no burning or disagreeable sensations are caused. Werler also commends it as a remedy in the treatment of chronic *cystitis*. Tilger and other surgeons have commended the remedy in the treatment of all forms of infected mucous membrane in saturated solution (1 in 3800).

Silver Fluoride. *Argenti Fluoridum.* AgF. Lazzaro claims for this preparation great antiseptic power, but there seems to be but little clinical or experimental evidence as to its value.

Silver Iodide. *Argenti Iodidum. U. S.* 1890. AgI = 233.02.—This salt may be readily prepared by adding a solution of potassium iodide to one of silver nitrate, and washing and drying the precipitate, which should be kept in dark amber-colored vials, protected from light. This iodide is said to have three allotropic forms and a point of maximum density at about 116° C. (240.8° F.) (see paper by G. F. Rodwell, in *Chem. News*, xx. 288; xxi. 14). The U. S. Pharmacopœia, 1890, describes it as "a heavy, amorphous, light yellowish powder, unaltered by light, if pure, but generally becoming somewhat greenish-yellow, and having neither odor nor taste. Insoluble in water, alcohol, diluted acids, or in solution of ammonium carbonate, but soluble in about 2500 parts of stronger ammonia water. It is also dissolved by an aqueous solution of potassium cyanide, and by a concentrated solution of potassium iodide, and the resulting solutions yield a black precipitate with hydrogen sulphide test-solution or ammonium sulphide test-solution. When heated to about 400° C. (752° F.), the salt melts to a dark red liquid, which, on cooling, congeals to a soft, yellow, slightly transparent mass. When mixed with ammonia water, it turns white, but regains its yellowish color upon being washed with water. If a small quantity of chlorine water be agitated with an excess of the salt, the filtrate acquires a bark blue color on the addition of starch test-solution. If 0.5 Gm. of the salt be digested for five minutes with 10 Cc. of a cold 15-per-cent. solution of ammonium carbonate, the filtrate, when supersaturated with nitric acid, should not be rendered more than faintly opalescent (absence of *chloride*). On digesting a portion of the salt—which has been found to be free from chloride, or from which the latter has been completely removed by repeated digestion with ammonium carbonate—for five minutes with 10 Cc. of ammonia water, and supersaturating the filtrate with nitric acid, only a slight opalescence, but no yellowish-white precipitate, should be produced (absence of *bromide*)." *U. S.* 1890. Silver iodide has been given in *doses* of one or two grains (0.065–0.13 Gm.) three times a day, in *epilepsy* and other chronic nervous diseases, but is devoid of value.

Silver Lactate. *Argenti Lactas. Actol.* $AgC_3H_5O_3$.—Silver lactate was introduced by Credé as a surgical germicide. It is affirmed that its injection renders an infected wound rapidly aseptic without much irritation. It is soluble in 15 parts of water, and may be used in very strong, even saturated, solution. D. A. Tilger finds that the application of the pure powder to the curetted infected sore causes only moderate burning pain of short duration and acts most happily. (*M. M. W.*, 1897.) Its therapeutic properties seem to be purely local, since E. Marx found that after injection of very large doses of it into animals it does not prevent the development of pathogenetic germs. It is almost certainly decomposed at the point of injection, but, unlike corrosive sublimate, it does not form an insoluble compound when brought in contact with tissues, and so is able to

find its way through these tissues. Fifteen grains (1 Gm.) of it have been given hypodermically without more serious symptoms than some burning pain at the point of injection. According to Marx, a remarkable rise of temperature follows the use of it in very large doses. Actol has been used to a considerable extent in dentistry, decayed or decaying pulp being washed with a solution of the strength of 1 in 2000 and then dusted with itrol.

Silver Orthophosphate. *Argenti Phosphas.* $Ag_3(PO_4)$.—This substance is prepared by dissolving silver in concentrated orthophosphoric acid; the vitreous mass which results while still melted is dissolved in water acidulated with phosphoric acid, yielding a permanent solution. Spretzka (*Rév. Med. Pharm.*, 5, 292) asserts that it is a valuable remedy in *gonorrhœa*. The injection should contain 0.025 to 0.05 per cent. of the salt, increasing gradually to 0.25 or even 0.5 per cent.

Silver Phenolsulphonate. *Argenti Phenolsulphonas. Silver Sulphocarbolate. Silberol.* $C_6H_4(OH)SO_3Ag$.—A crystalline powder containing 28 per cent. of metallic silver, soluble in water; proved to undergo spontaneous decomposition, but said to be more permanent than itrol. Originally introduced by Zanardi as having the antiseptic properties without the corrosive action of silver nitrate, silberol has been employed by various practitioners in the treatment of *gonorrhœa* and *ophthalmic inflammations*, and as a germicide in ocular surgery. It is asserted that a 2 per cent. solution is well borne as an antiseptic after operations upon the eye; also that when it is used as a substitute for silver nitrate silberol must be employed in twice as concentrated solution.

Silver Protalbin. *Largin.*—This is a compound of silver and protalbin, which occurs as a whitish powder, soluble in water to the extent of 10.5 per cent., freely soluble in glycerin, blood serum, and peptone solution. Not precipitated by chlorides nor yet by albumin, and containing 11.1 per cent. of silver. In brown bottles it keeps unchanged indefinitely. Owing to the fact that it does not coagulate albumin its penetrating powers when brought in contact with the mucous membrane are very great, and it is claimed by many German clinicians that as a specific germicide in the treatment of *gonorrhœal affections* it is pre-eminent. In male gonorrhœa the strength of the injection should be one-fourth of one per cent., gradually increased up to two per cent. After the disappearance of the gonococci the treatment should be continued with the aid of astringents, and finally injections should be made with one-fourth to one-half per cent. of largin. In women the parts may be irrigated with from a one-half to one per cent. solution, after which a 5 per cent. largin bougie may be held in position by a cotton plug for fifteen minutes and the part again irrigated with a 5 per cent. solution of largin. This should be repeated daily for one week; subsequently every second or third day only. Largin is also largely used in the treatment of infectious *conjunctivitis* and catarrhal *corneal ulcers* in the form of gelatin tablets containing one per cent.

Silver Quinaseptolate. *Argenti Quinaseptolas. Argentol.* $C_9H_5N.OHSO_3Ag$.—This substance is a yellow powder, sparingly soluble in water, which was introduced into medicine by Credé on account of its readily splitting up into oxyquinoline and metallic silver. Both septic matters and intestinal juices are said to produce this change. It has been employed either as a dusting powder or in the form of spray, or injection, 1 in 300 to 1000, in *chancres, gonorrhœas*, and various other surgical infections. C. Cipriani asserts that it is a valuable intestinal antiseptic of which 15 grains (1 Gm.) may be given safely in the twenty-four hours if necessary. It is said also to be an active non-irritant antiseptic with marked hemostatic properties.

Silver, Soluble. *Argentum Solubile. Argentum Colloidale. Collargol. Soluble Silver. Colloidal Silver.*—Several allotropic modifications of silver were discovered by Carey Lea in 1891. One of these has been introduced into medicine. "Soluble Silver," so called, can be prepared by taking a mixture of 30 Gm. ferrous sulphate dissolved in 100 Cc. of water and 36 Gm. of crystallized sodium citrate dissolved in 140 Cc. of water and pouring this mixture with stirring into 100 Cc. of a 10 per cent. silver nitrate solution. After allowing the precipitate to settle, the supernatant liquid is poured off, the precipitate dissolved in water, and again precipitated with absolute alcohol. When dried, the colloidal silver is a bluish or green-colored mass, which dissolves in water with a deep red color, but is precipitated from its solution by the addition of salt solutions. It contains 97.2 per cent. silver. Chassevant and Posternak find the collargol of commerce does not contain more than eighty-seven per cent. of silver, the rest being albuminous matter. (*C. R. S. B.*, 1903, lv.) Used in the preparation of *Unguentum Credé*. Soluble silver was originally employed by Credé as a non-poisonous germicide, to be used as internal medication in various affections such as septicæmia, diphtheria, tuberculosis. At first he administered it by inunctions, forty-five grains (3 Gm.) at one time for the adult, but later gave eighty grains to five drachms (5.2–20 Gm.) of the 1 per cent. solution hypodermically or intravenously. The harmlessness of these intravenous injections has been confirmed by Müller, who also affirms that in septic diseases collargol may be given with as much trust as antitoxin in diphtheria. The value of the remedy is, however, very doubtful; the experiments of George Brunner have shown that collargol is precipitated by gelatin bouillon; that it is not soluble in blood serum, although it remains dissolved if the solution of it be mixed with the serum; that the germicidal properties of it are very feeble, twelve hours contact with the one per cent. solution of it being required to kill most pathogenetic bacteria; that when given subcutaneously or intravenously it has no apparent effect upon animals, and that granules of silver can be found later at the places of injection,—finally, that whether given with infectious matter or injected after such material, it has no influence over the processes of the resulting infection or upon the bactericidal power of the blood. The chills and other constitutional disturbances which were formerly produced (but at present are not) by the intravenous injections of collargol were probably due to the presence of impurities in the solutions used, and the whole drift of evidence is to show that collargol probably never circulates in the blood, and that it is physiologically inert.

Silver Thiohydrocarburo-sulphonate. *Argenti Thiohydrocarburo-sulphonas. Ichthargan.* This compound of ichthyol-sulphonic acid and silver is a brown amorphous stable powder, freely

soluble in water, glycerin and diluted alcohol, insoluble in alcohol, ether, and chloroform. Its aqueous solution blackens with exposure to light, and in concentrated solution it is precipitated by sodium chloride and by albumin, the albuminous precipitate being redissolved by an excess of albumin. It is said to contain about 30 per cent. of silver and 15 per cent. of sulphur, and to be very much more destructive to gonorrhœal, pyogenic, diphtheritic, and typhoid germs than is either colloidal silver or protargol. In *gonorrhœa* and all syphilitic *ulcerations, ozæna, infected phlegmons, infected wounds,* diseases of the *throat* and *nose, eczema,* acute and chronic *conjunctivitis,* and other local diseases it is largely used.

The strength of the ichthargan solution varies in *gonorrhœa* from 1 in 500 to 1 in 3000 for injections; from 1 in 2000 to 1 in 5000 for irrigation; 1 to 3 per cent. in instillations. In the *gonorrhœa of women* most excellent results are said to follow packing the vagina with tampons saturated with a solution of 1 to 5 parts of ichthargan, 5 of water, and 100 of glycerin; a 5 to 10 per cent. ointment may also be employed. In *chancroids* the powder of ichthargan, full strength or diluted, may be used. In *trachoma, gonorrhœal,* and other *infective conjunctivitis,* the 1 to 3 per cent. solution may be applied with a brush; 1 in 1000 used as a wash. In *eczema, ulcerations, phlegmons,* and in *lymphangitis,* the ointment varying from 1 to 15 per cent. is advised, well rubbed into the adjacent healthy skin, previously thoroughly cleansed, and also applied directly to the affected surface, if it be exposed. Ichthargan has also been administered internally with asserted excellent results for the relief of *gastritis* and especially of *gastric ulcer. Dose,* one-twentieth to one-eighth of a grain (0.003–0.008 Gm.) in half a fluidounce (15 Cc.) of water, on an empty stomach. Intravenously, ichthargan has been used experimentally in various septic diseases, such as septic *endocarditis, septicæmia,* etc. It is stated that injections of 0.01 to 0.02 Gm. per kilo (one-sixth to one-third grain per two and a half pounds) may be given without risk. At present there is no sufficient evidence of the value of this treatment.

Silver Vitellin. *Argentic Vitellin. Argyrol.* This substance is said to be produced by extracting gliadin from wheat, treating it in an autoclave with dilute hydrochloric acid under pressure, and obtaining thereby a white granular precipitate which is said to be of the nature of a vitellin, and then combining this with silver, the resulting product being a dark brown powder containing 30 per cent. of metal. Silver vitellin is so soluble that one ounce may be dissolved in three drachms of water. The solution does not precipitate albumin or sodium chloride, and has therefore very marked penetrative properties. It has been used in *gonorrhœa,* and found unirritating and effective in a one per cent. solution. The 50 per cent. solution is stated to be equal in germicidal powers to the 25 per cent. solution of silver nitrate, but according to Marshall and Neave (*J. A. M. A.*, Sept. 15, 1906) it has no bactericidal properties.

In injections the strength of the solution should usually be one to five per cent., although on occasion stronger solutions are usually well borne. For irrigation, solutions of the strength of 1 in 2000 to 1 in 500 are employed. Even the stronger solutions are said not to produce unpleasant symptoms.

Simaruba.—Under this name the U. S. P. formerly recognized the bark of the root of *S. amara,* Aublet (*S. officinalis,* DC., *Quassia Simaruba,* L.). *Ecorce de simarouba,* Fr. *Simarubarinde, Ruhrrinde,* G. *Corteccia di Simaruba,* It. *Corteza de Simaruba,* Sp. (Fam. Simarubaceæ.) This is a tree of considerable height, having alternate branches, with a bark which in the old tree is black and somewhat furrowed, in the young is smooth, gray, and marked here and there with broad yellow spots.

It is a native of French Guiana and the Islands of Dominica, Martinique, St. Lucia, St. Vincent and Barbados, in the West Indies. A closely related species, having, however, diœcious instead of monœcious flowers, flourishes in Jamaica, San Domingo, Bahama Islands, Panama, and Guatemala, extending even to Florida. It is called in Jamaica *mountain damson,* and is known to botanists as *S. glauca,* DC. (*Quassia glauca,* Spreng., *S. officinalis,* Macf., not DC.). The two species have probably identical medicinal properties. The bark of the root is the part employed, the wood being nearly tasteless and inert. The middle bark contains much resin. A decoction of the bark and leaves of *S. versicolor,* St.-Hil. (*Cortex Paraibæ*), is employed in Brazil as an antidote for snakebites and in the treatment of *syphilis* and *tape worm;* the powder is used against vermin.

Simaruba bark is in long pieces, some inches in breadth, folded lengthwise, light, flexible, tenacious, very fibrous, externally of a light brownish-yellow color, rough, warty, and marked with transverse ridges, internally of a pale yellow. It is without odor, and of a bitter taste. It readily imparts its virtues, at ordinary temperatures, to water and alcohol. The infusion is at least equally bitter with the decoction, which becomes turbid as it cools. Its constituents, according to Morin, are a bitter principle identical with *quassin,* $C_{10}H_{12}O_3$, a resinous matter, a volatile oil having the odor of benzoin, malic acid, gallic acid in very minute proportion, an ammoniacal salt, calcium malate and oxalate, some mineral salts, ferric oxide, silica, ulmin, and lignin. Simaruba possesses the same tonic properties as other simple bitters. In large doses it is said to purge and vomit. On account of its difficult pulverization, it is seldom given in substance. The best mode of administration is by infusion. The *dose* is from twenty grains to a drachm (1.3–3.9 Gm.).

Simulo.—The dried fruit of one of the *Capparisco rriaceæ* has been highly recommended by reputable clinicians as a palliative in *epilepsy;* also in *chorea.* (See *T. G.*, 1888, 1889; and *Th. M.*, Aug. 1888.)

Sirolin.—A preparation of beech tar containing a large proportion of guaiacol. It has been used in the same class of pulmonic diseases as creosote. The adult *dose* is one fluidrachm (3.75 Cc.).

Sisymbrium. *Sisymbrium officinale* (L.), Scop. (*Erysimum officinale,* L.) *Hedge Mustard. Herbe aux chantres, Tortelle,* Fr. *Wildersenf, Hederich,* G. (Fam. Cruciferæ.)—This annual, growing in Europe and the United States, is said to be diuretic and expectorant, and has been recommended in chronic *coughs, hoarseness,* and ulceration of the mouth and fauces. The juice of the plant may be used mixed with honey or sugar, or the seeds may be taken in substance. *Sisymbrium Sophia,* L. (*Sophia Sophia* (L.), Brit.), or the *flax weed,* was formerly official. It is of a pungent odor when rubbed, and of an acrid,

biting taste. W. Zopf attributes its poisonous qualities to a volatile alkaloid. (*Zeit. f. Nat. Pharm. Central.*, 1894, 494.) The herb has been used externally in indolent ulcers, and the seeds internally in worms, calculous complaints, etc. *Diplotaxis muralis*, DC. (*Sisymbrium murale*, L.), has been used in France in *scurvy*, *scrofula*, and other cachectic affections, especially associated, in the form of a syrup, with potassium iodide. (*Ann. Thér.*, 1863, 126.) Grazing sheep are said to be killed in Southern France by feeding on *Diplotaxis tenuifolia*, DC., and human poisoning has occurred. George Heyl has separated a toxic and apparently uncrystallizable alkaloid (*Ap. Ztg.*, May 30, 1900).

Sium.—*Sium cicutæfolium*, Gmel. (*Sium latifolium* of American authors, not of Linné), which grows in British America and the United States, particularly along the water courses of the valleys of the Pacific slope, and is the *hemlock water parsnip* of this country, is positively asserted to be poisonous. A. R. Porter and N. Rogers (*A. J. P.*, 1876, 348, 483) found in it an active resinous body, toxic to animals. *S. Sisarum*, L., or *skirret*, a plant of Chinese origin, cultivated in Europe, has a sweetish, somewhat aromatic root; it is employed as a salad, and is supposed to be a useful diet in chest complaints.

Skimmia. *Skimmia japonica*, Thunb. *Miramashikimi.*—From this rutaceous plant, which is cultivated in its native country on account of the beauty of its flowers and berries, Eykman separated a glucoside, *skimmin*, and a decomposition product, *skimmetin*. (*Abhandl. d. Tokyo Daigaku.*, No. 10, Tokyo, 1883.) J. Honda (*A. E. P. P.*, Oct. 1904), however, finds that the activity of the plant depends upon the presence of the crystalline alkaloid, *skimmianin*. It is a muscle poison, producing no primary excitement in the muscle, but an increasing paralysis, the influence of the alkaloid extending to involuntary muscles, such as the heart, so that in mammals arterial pressure is progressively decreased.

Skin Varnishes.—Unna has devised a series of preparations for forming thin coverings on the skin. We reproduce the most important formulas.

Bassorin Varnish.—The pure bassorin basis is obtained, according to Elliot, by passing tragacanth mucilage (15 to 100) through a filter heated by steam, evaporating, and mixing with glycerin. A similar basis may be prepared by stirring 5 parts powdered salep with 95 parts cold water until a smooth mucilage is obtained, then heating for half an hour on the steam bath. The salep basis contains less bassorin, but more starch.

Casein Varnish.—The casein obtained by coagulating skimmed milk with rennet at a temperature of from 35° to 40° C. (95°–104° F.) is washed and dried until it forms a yellowish-white sandy powder soluble in alkaline solution. In preparing this varnish the casein is dissolved by means of borax. For 20 parts casein 2.5 parts borax and 77.5 parts water furnish a rapidly drying uniform covering material. The alkaline characters of the borax are masked by the casein. Admixtures of heavy pulverulent substances readily settle out of this basis, and it is requisite to distribute them by shaking. A varnish of casein and glycerin is prepared by dissolving the casein in 3 or 3.5 parts of ammonia water, adding a quantity of glycerin equal in weight to the casein, and heating to drive off the ammonia. The resulting mass mixed with twice its weight of boiling water gives an excellent permanent emulsion.

Amber Varnish.—Made by dissolving a mixture of amber and turpentine in alcohol. It must not be used as a vehicle for the application of zinc oxide.

Castor Oil and *Shellac Varnish.*—With 1 part shellac, 1½ parts castor oil, and 3 parts alcohol, a varnish is obtained which forms a good flexible covering easily removed by alcohol.

Canada Balsam and *Collodion Varnish.*—Sixteen parts collodion with 1 part Canada balsam furnish a material suitable for the application of pyrogallol, and it can be easily removed by alcohol.

Castor Oil and *Collodion Varnish.*—Eight parts collodion and 1 part castor oil.

Lead Ricinoleate Varnish.—One part lead oxide heated with 1½ parts castor oil to saponification, and mixed with 2 parts absolute alcohol, gives a good skin varnish.

Chrysarobin Amber Varnish.—One part chrysarobin and 20 parts amber dissolved in turpentine.

Pyrogallol Shellac Varnish.—One part pyrogallol, 1 part castor oil, 5 parts shellac, and 15 parts absolute alcohol.

Salicylic Acid, Canada Balsam, and *Collodion Varnish.*—One part Canada balsam, 10 parts collodion, and 3 parts salicylic acid.

Zinc Oxide, Castor Oil, and *Collodion Varnish.* Two parts zinc oxide, 2 parts castor oil, and 16 parts collodion.

Zinc and *Lead Ricinoleate Varnish.*—Five parts lead ricinoleate, 8 parts zinc oxide, 8 parts absolute alcohol, and, lastly, 1 part each of collodion and ether.

Ichthyol Borax Casein Varnish.—Five parts sodium ichthyolate and 15 parts borax casein varnish.

Sulphur Glycerin Casein Varnish.—Five parts sulphur and 15 parts glycerin and casein varnish.

Zinc Oxide Salepbassorin Varnish.—Two parts zinc oxide and 18 parts salepbassorin varnish.

Zinc Ichthyol Tragacanth Bassorin Varnish. One part sodium ichthyolate, 2 parts zinc oxide, and 17 parts tragacanth bassorin varnish.

Smalt. *Smalts. Azure.*—When the impure cobaltic oxide, obtained by roasting the native arsenide of that metal, is heated with sand and potassium hydroxide, the mixture melts, and a beautiful blue glass results, which, when reduced to powder, forms smalt or azure. It is used chiefly in painting, and for coloring glass and porcelain.

Sodium and Silver Thiosulphate. *Sodii et Argenti Thiosulphas.*—This double salt may be prepared by dissolving freshly precipitated silver oxide in a solution of sodium thiosulphate and evaporating the solution. It is in the form of minute crystals of the formula $2Na_2S_2O_3 + Ag_2S_2O_3$, very soluble in water, but insoluble in alcohol, and possessing a sweet taste. Its solution, protected from the light, undergoes no change, and, when quite pure, does not discolor the skin or linen. Delioux states that this salt acts locally like silver nitrate, but more mildly: for *gonorrhœa*, one or two parts in two hundred of water.

Sodium Boro-Salicylate. *Sodii Boro-salicylas.* This is made by heating 125 parts of boric acid, 320 parts of sodium salicylate, and 700 parts of water in a flask until a syrupy liquid is produced; this solidifies on cooling, yielding a white product. It dissolves in water. It is used as an antiseptic and preservative.

Sodium Caseinate. *Sodii Caseinas. Nutrose. Casein-natrium*, G.—A combination of casein and

sodium hydroxide, just enough of the alkali being used to dissolve the freshly precipitated casein. The solution is evaporated *in vacuo*, the dry residue powdered, thoroughly washed with alcohol, and then with ether and dried. A white amorphous powder, with little odor or taste, insoluble in alcohol and ether, slightly so in cold water but readily soluble in hot water. It is considered to be a valuable food in intestinal and digestive disturbances, also in *anæmia* and *scrofula*.

Sodium Eosinate (*Tetrabromo-fluorescein-sodium*). $C_{20}H_6O_5Br_4Na_2$.—A brownish-red powder which freely dissolves in water and alcohol, containing about 40 per cent. of bromine. It has been tried in *epilepsy* by Bourneville and Chapotin, who found that it caused such unpleasant secondary symptoms that its use had to be discontinued.

Sodium Ethylate. *Sodii Ethylas. Ethylate of Sodium. Caustic Alcohol.* C_2H_5ONa.—This preparation was introduced by B. W. Richardson of England, as a caustic. He makes it by adding sodium in small pieces gradually to absolute alcohol, kept at a temperature of 10° C. (50° F.); hydrogen is evolved, and when, owing to the formation of the ethylate, the reaction slackens, the liquid is to be carefully heated to 37.7° C. (100° F.). Sodium is then cautiously added until the reaction ceases; the liquid is cooled to 10° C. (50° F.), and the same quantity of absolute alcohol added as was used in the beginning. (*P. J.*, 1878, 485.) Sodium ethylate is a white powder, frequently having a brownish tinge, dissolving in water with a hissing sound, having the property of splitting into alcohol and sodium hydroxide upon contact with even a small quantity of water or moist living tissue:

$$C_2H_5ONa + H_2O = C_2H_5OH + NaOH$$

Sodium ethylate does not appear to be of any value as an internal remedy. When, however, it comes in contact with moist tissue, owing to the liberation of its sodium, it acts as a very speedy and powerful caustic. It should always be used in alcoholic solution, and applied by means of a glass rod. It is said to cause very little pain, and has been specially employed for the destruction of *nævi*. (*L. L.*, Nov. 1878.) Richardson states that it should always be kept in glass-stoppered bottles, in a cold place, as he has known it to explode when placed in warm situations. Gamberini and Monari (*R. T.*, 1892) assert that the 20 per cent. liniment made with olive oil, well rubbed in daily, will usually cure *psoriasis* in twenty days, and that the 10 per cent. aqueous solution is very valuable in the treatment of *lupus erythematosus*, applied after curetting.

Sodium Formate. *Sodii Formas. Ameisensaures Natrium*, G. $HCO_2Na + H_2O$.—Prepared by neutralizing formic acid with sodium carbonate. It occurs in colorless rhombic prisms, which are inodorous, and have a saline, bitter taste. Sodium formate is very deliquescent and dissolves freely in water.

Sodium Glycerophosphate. *Sodii Glycerophosphas.* $C_3H_7O_3PO_3Na_2 + H_2O$.—Made by neutralizing glycerophosphoric acid with sodium carbonate. Commercially it occurs as a 75 per cent. solution having a light yellow color. It is used as a nervine and tonic in *doses* of from three to five grains (0.2–0.32 Gm.), and in the treatment of deficient nerve nutrition, *neurasthenia*, convalescence from *influenza*, *exophthalmic goitre*, *lumbago*, and Addison's disease, it may be administered, in hypodermic injection, in doses of three to four grains (0.2–0.26 Gm.) daily.

Sodium Lygosinate is said to be obtained from *diorthocoumarketone*, which was introduced into medicine under the name of *lygosin*, a ruby-red salt readily soluble in water. According to the experiments of Fabinyi (*S. Jb.*, Bd. 271, 179), this substance acts antipyretically upon the rabbit and has very feeble germicidal powers.

Sodium Methylarsenate. *Sodii Methylarsenas.—Arrhenal*, $OAsCH_3O_2Na_2 + 5H_2O$, is obtained by the action of methyl iodide upon sodium arsenite in the presence of excess of alkali. It occurs in colorless crystals, which are easily soluble in water. This substance contains about 27.3 per cent. of metallic arsenic, corresponding to 36 per cent. of arsenic trioxide, but is said to be non-poisonous in *doses* of 3 grains (0.2 Gm.), it should nevertheless be given with caution. It has been used in *tubereulosis*, *malaria*, *anæmia*, and other conditions for which arsenic is employed, but is probably of very little therapeutic value.

Sodium Naphthol. *Naphthol Sodium.—β-Naphthol sodium* (*microcidine*), a white powder easily soluble in water, used as a non-caustic, non-poisonous antiseptic, said to be much stronger than phenol.

Sodium Nitroferrocyanide. *Sodium Nitroprusside. Sodii Nitroferrocyanidum.* $Na_2Fe(CN)_5NO$.—This is one of the interesting series of salts, discovered by Playfair, called *nitroprussides*, which are produced, for the most part, by saturating *nitroferrocyanic acid*, formed by the action of nitric acid on potassium ferrocyanide, with different bases. The sodium salt is best obtained by the process of A. Overbeck, as follows: Dissolve four parts of powdered potassium ferrocyanide, contained in a flask, in five and a half parts of commercial nitric acid, diluted with an equal weight of water. After the action is completed, which generally occupies about ten minutes and is accompanied by a copious evolution of gases, heat the resulting coffee-brown liquid in a water bath, until a drop of it gives a dingy green instead of a blue precipitate with a solution of ferrous sulphate. Then allow the liquid to cool; whereupon the larger part of the potassium nitrate generated will be deposited in crystals. Pour off the green mother liquor from these, and separate the remaining potassium nitrate by repeated concentrations. Next, neutralize the liquid, while heated in a water bath, with sodium carbonate, taking care to add the carbonate so long as a pure blue precipitate is produced. Lastly, filter the solution, and set it aside for the formation of crystals, which must be washed with water, and dried between blotting paper. The salt is in the form of large, ruby-colored, prismatic crystals, resembling those of potassium ferricyanide. It is soluble in two and a half parts of cold water, and in less quantity of hot water. Its solution, exposed to sunshine, is decomposed, with evolution of nitric oxide gas, and deposition of Prussian blue, at the same time acquiring a green color. Sodium nitroprusside, as well as the other soluble nitroprussides, is a most delicate test for alkaline sulphides, with which it strikes a violet color.

Sodium Oleate. *Sodii Oleas. Eunatrol.*—Sodium oleate may be made by dissolving 10 parts of sodium hydroxide in alcohol and adding the solution to 100 parts of oleic acid and carefully evaporating the soap which is formed to dryness. It is a whitish mass or a white powder, dissolving freely in water and alcohol. According to F. Blum (*Der*

ärtzl. Praktiker, 1897), it has a very powerful action upon the liver, making it very useful in cases of *gall stones* and chronic *hepatic torpor*. *Dose*, from thirty to eighty grains (2–5.2 Gm.) daily in capsules.

Sodium Paracresotate. *Sodii Paracresotas.* $C_6H_3(OH)CH_3CO_2Na$.—This salt is recommended as an internal antiseptic; it is prepared by heating creosol-sodium with carbonic acid, and occurs in colorless and odorless crystals of bitter taste, insoluble in cold water, but soluble in warm water. In the *diarrhœa* of children it is given in *doses* of from five to forty-five grains (0.32–3.0 Gm.).

Sodium Peroxide. *Sodii Peroxidum.*—Vernon Harcourt has shown that this peroxide is readily decomposed by water, with production of sodium hydroxide, oxygen, and hydrogen dioxide. The reaction takes place in the cold, and the yield of oxygen is about that of the theoretical requirement, viz., one atom of oxygen for every molecule of sodium peroxide decomposed. Unna's sodium peroxide soap consists of 3 parts of liquid petrolatum, 7 parts of completely dried soap, and 2.5, 5 or 10 per cent. of powdered sodium peroxide. It is adapted to impart to a pale and excessively cornified facial skin pitted with comedones a healthy rosy color and a softened surface. It has also been used in *rosacea pustulosa* with asserted benefit.

Sodium Phenolsulpho-ricinate. *Sodii Phenolo-sulpho-ricinas* (25 per cent.).—This phenol compound has been highly recommended as a local application in *laryngeal tuberculosis* and *papilloma;* also in *ozæna.* In the latter disease the pituitary membrane and the nasal ducts are first cleansed and subjected to vigorous daily frictions with the aid of a sound padded with wadding steeped in a solution of sodium phenol-sulphoricinate (1 to 2 or 3 parts of water.)

Sodium Selenite. *Sodii Selenis.* Na_2SeO_3.—A white powder which freely dissolves in water. The aqueous 2 per cent. solution of *sodium selenite* stains bacteria red by the precipitate of *metallic selenium*, and has been highly recommended for the purposes of microscopic staining.

Sodium Silicate. *Sodii Silicas. Soluble Glass.* Na_2SiO_3, or frequently $Na_2Si_4O_9$.—Sodium silicate is made by fusing one part of silica, fine sand, or powdered flint, and two parts of dried sodium carbonate, mixed in powder, in an earthenware crucible, and pouring out the fused mass on a stone slab to cool. This is pulverized, and treated with boiling water, to dissolve the soluble part. The solution is filtered and concentrated, so as to form crystals on cooling. These are then purified by dissolving them in water heated to 37.7° C. (100° F.), filtering the solution, and concentrating it so that it may recrystallize. The commercial solution of sodium silicate usually contains about 20 per cent. of silica and 10 per cent. of soda. It is employed in fixing fresco colors by the process of stereochromy, as a cement in the manufacture of artificial stone, and as an addition to soaps, constituting the so-called *silicate soaps.* As long ago as 1872, Dumas, Rabuteau, Papillon, Picot, Champouillon, and other French writers asserted that sodium silicate was an antiseptic, valuable in the treatment of chronic *urethritis*, *vaginitis*, etc., and P. Coreman has shown that pathogenetic germs are killed in one hour by its solution. (*La Presse Méd.*, 1897.) R. Löwenhaupt, however, asserts that when pure it is not antiseptic, any powers which it may seem to have being dependent upon the presence of free alkali in it, and certainly as a practical remedy it has failed to come into use.

Under the name of *Liquor Sodii Silicatis* the U. S. Pharm. 1890 formerly recognized the solution of sodium silicate, describing it as "a semi-transparent, almost colorless, or yellowish, or pale greenish-yellow, viscid liquid, odorless, having a sharp, saline, and alkaline taste, and an alkaline reaction. Specific gravity, 1.300 to 1.400 at 15° C. (59° F.). A drop of the Solution, when held in a non-luminous flame, imparts to it an intensely yellow color. If a portion of the Solution, largely diluted with water, be supersaturated with nitric acid, a gelatinous or pulverulent, white precipitate of silicic hydrate will be produced." The solution is used solely in the preparation of mechanical dressings by the surgeon.

Sodium Silico-Fluoride. *Sodii Silico-fluoridum.* Na_2SiF_6.—When gaseous SiF_4, generated by the action of sulphuric acid upon fluorspar in the presence of broken glass, is passed into water, hydrogen silico-fluoride, H_2SiF_6, is formed. This acid, when neutralized by sodium hydroxide or carbonate, will yield the sodium salt. It is difficultly soluble in water. It is asserted for the *silico-fluoride of sodium* that its solution, *salufer*, is practically non-toxic and powerfully antiseptic. The powder is a strong irritant or a mild caustic. The solution affects steel instruments. Bokenham, in experiments upon bacteria, found that in order to kill them it was necessary for the solution to be at least as strong as one to seven hundred and fifty parts, and that the drug has toxic properties, 0.05 Gm. of it causing prolonged nausea, great slowing of pulse, and reduction of arterial pressure.

Sodium Stearate. *Sodii Stearas.* $NaC_{16}H_{35}O_2$.—The pencils of this substance, which have been recommended by T. G. Unna for use in *sycosis* and other parasitic skin diseases, are made as follows: Sodium stearate, 6 Gm. (90 gr.); glycerin, 2.5 Gm. (30 min.); alcohol, sufficient to make 100 Gm. (4 fl. oz.). The affected part should be rubbed with the pencil five or six times daily.

Sodium Succinate. *Sodii Succinas.* $Na_2C_4H_4O_4 + 6H_2O$.—White crystals freely dissolving in water. Sodium succinate has been highly commended by Ch. F. Hope for *catarrhal jaundice. Dose*, fifteen to twenty grains (1–1.3 Gm.) every three or four hours.

Sodium Sulphobenzoate. *Sodii Benzosulphonas. Sodium benzosulphonate.* $C_6H_4(NaSO_3)COONa$.—Heckel (*C. R. A. S.* cv. 896) asserts that sodium sulphobenzoate is a non-poisonous antiseptic, superior to phenol, and equal to mercurial solution in the antiseptic treatment of wounds; strength of solution about fifty grains in a quart.

Sodium Sulphomethylate. *Sodii Methylsulphonas. Sodium Methylsulphonate.* $CH_2(OH)SO_3Na + H_2O$.—According to Rabuteau, this salt in 240 grain (15.5 Gm.) *doses* produces catharsis without cramp. (*A. J. P.*, 1880, 220.)

Sodium Sulphoricinoleate. *Oleite.*—This substance may be prepared from castor oil by treating it with sulphuric acid at a low temperature, when a compound of sulphuric and ricinoleic acids is formed. The free sulphuric acid being removed by washing, and any unchanged oil by ether, the resulting sulphoricinoleic acid is then neutralized by sodium hydroxide, the finished product being a transparent, jelly-like liquid, with little odor, having an acrid taste, and soluble in water, alcohol, chloroform, and essential oils.

The solvent powers of oleite upon medicinal substances are said to be extraordinary, there being only a few which will not yield to it to a greater or less degree. According to the experiments of Fred. B. Kilmer (*Proc. A. Ph. A.*, 1890; *P. J.*, xx. 1890), its action upon mucous membranes, healthy and diseased skin, cuts, burns, etc., is highly soothing, and it may be taken internally or freely absorbed through the skin without danger. It would appear, therefore, to afford an excellent basis for ointments; but as productions made with it are very sticky, and often liable to harden, it is commonly best used by rubbing the substance with oleite, and then adding 50 per cent. of fatty base.

Phenol sulphoricinate is made by adding pure phenol to sulphoricinic acid; it is a yellowish liquid employed for tuberculous affections. *Phenol and sodium ricinate*—20 per cent. of phenol and 80 per cent. of sodium sulphoricinate—is used as an antiseptic, and in 20 per cent. aqueous solution to destroy *diphtheritic membrane.*

Sodium Sulphosalicylate. *Sodii Salicylsulphonas.* $C_6H_3(OH)<^{COOH}_{SO_3Na}$. *Sodium Salicylsulphonate.—Salicylsulphonic acid,* made by acting on salicylic acid with sulphuric acid, is partly neutralized with sodium carbonate. It occurs as a white crystalline powder, soluble in twenty-five parts of water, insoluble in alcohol and ether. It is used as a substitute for sodium salicylate.

Sodium Sulphovinate. *Sodium Ethylsulphate.* $C_2H_4(OH)SO_3Na + H_2O$.—This salt occurs as a white granular powder or in hexagonal tabular crystals, according to the method of its preparation. Its taste is cooling and rather aromatic, nearly destitute of bitterness. It is very deliquescent, and is soluble in 0.7 part of water.

When sulphuric acid is added to alcohol the temperature rises at once, and a certain proportion of sulphovinic acid is formed, but, as water is at the same time developed, the reaction is soon arrested by the dilution of the mass. The first practical method of overcoming the difficulty was afforded by the process of Limousin. Nineteen and a half ounces (avoirdupois) each of pure sulphuric acid, sp. gr. 1.715 and of concentrated alcohol, about 96°, are slowly introduced by means of two funnels (one for the alcohol and the other for the acid) into a third funnel arranged in a flask plunged into a freezing mixture or kept in a current of cold water, the flow of the two liquids into the flask being so regulated as to keep the alcohol in excess. The mixture is kept for four to five days at a temperature of from 20° C. (68° F.) to 25° C. (77° F.), then diluted with from nine to ten pints of distilled water, and carefully saturated with somewhat less than forty-eight ounces of pure barium carbonate in solution. When the point of saturation has been attained, the liquid is left to deposit the barium sulphate, and afterwards filtered. The solution of barium sulphovinate so obtained is saturated with between twenty-seven and twenty-nine ounces of pure sodium carbonate dissolved in four litres of distilled water. When no more precipitate is formed by the addition of the alkaline solution, and the liquid is neutral to test paper, the transformation of the barium sulphovinate into sodium sulphovinate is complete. The liquor, decanted and filtered, is evaporated in a water bath until it has the sp. gr. 1.33, and left to crystallize. The drained crystals are dried in an oven.

Various other processes have been proposed. T. L. Phipson (*Chem. News*, 1874, 221; also *A. J. P.*, xlvii. 27) mixes small quantities of concentrated sulphuric acid and alcohol; keeps for from eight to ten hours at a temperature of 37.7° C. (100° F.); cools; adds the mixture drop by drop to about twenty times its volume of cold distilled water, cooling at times; adds chalk to this solution until effervescence ceases; filters, heats the filtrate with a little calcium carbonate for about half an hour; filters while warm, and evaporates at a heat not exceeding 37.7° C. (100° F.) till a permanent saline crust forms on the surface, and sets aside to crystallize. The calcium sulphovinate thus formed is in large brilliant plates, readily converted into a corresponding salt of sodium. Dubois modifies (*J. P. C.*, 1875, 44) the method of Limousin by saturating the first mixture, containing sulphovinic acid, with a concentrated solution of sodium hydroxide in strong alcohol, keeping the mixture constantly cold, and adding the alkaline mixture by small portions. The filtered liquid is evaporated as in the method of Phipson, or, preferably, Dubois precipitates the mixture, diluted with strong alcohol, with sodium carbonate. Limousin's process, as thus modified, appears to be preferable to that of Charles Rice, detailed in *A. J. P.*, 1873, 60. Sodium sulphovinate is said to be a mild although active cathartic. According to Rabuteau, five drachms (19.4 Gm.) of it dissolved in three glasses of water will generally produce in the adult four or five liquid stools without pain. The *dose* for children is from two to three drachms (7.7–11.6 Gm.). The pleasantness of its taste and action would render it a favorite purgative were it not for its high price and the difficulty of preserving it, all of the sulphovinates having a great tendency on exposure to the air to break up into alcohol and a salt of sulphuric acid.

Sodium Tartrate. *Sodii Tartras.* $Na_2C_4H_4O_6.2H_2O$.—This salt, in crystals, has been recommended by Delioux as an agreeable purgative, almost without taste, and acting with a power equal to that of the magnesium sulphate in the dose of ten drachms. The *soda powders*, so much used in the United States, form an extemporaneous sodium tartrate, somewhat aërated with carbon dioxide. A *solution of sodium tartrate* has been used as a substitute for solution of magnesium citrate. It may be made by dissolving six drachms of tartaric acid in two fluidounces of water, and seven and a half drachms of sodium bicarbonate in seven fluidounces of water, mixing the solutions gradually and filtering; the filtrate should be poured into a strong twelve fluidounce bottle and two fluidounces of lemon syrup added slowly, so that it will sink to the bottom of the bottle without mixing very much with the solution; eighty grains of tartaric acid are to be added without agitating the bottle, which is to be corked at once securely and set aside in a cool place. The bottle is to be shaken just before the contents are administered.

Sodium Tellurite. Na_2TeO_3.—*Sodium tellurite* is a white powder sparingly soluble in water. The aqueous 2 per cent. solution of sodium tellurite stains bacteria black by the precipitate of *metallic tellurium*, and has been highly recommended for the purposes of microscopic staining.

Sodium Tetraborate. *Sodii Tetraboras. Antipyonin.*—Sodium tetraborate is made by boiling borax and boric acid in water. It occurs as a fine, white powder, greasy to the touch, freely soluble

in water. This salt is non-poisonous, devoid of caustic action, and markedly antiseptic. It is probably therapeutically equivalent to borax, but has been especially recommended in a 2 to 50 per cent. solution, or blown in as a powder, by Jaenicke and by Kafemann in *acute* and *chronic otorrhœa*. Roland attributes extraordinary effects to its insufflation in *keratitis, conjunctivitis,* and other inflammatory eye conditions.

Sodium Valerate. *Sodii Valerianas. Sodii Valeras.*—This salt was dismissed from the U. S. Pharmacopœia in 1870, and from the British Pharmacopœia in 1898. The British process for its preparation was as follows: "Take of Amylic Alcohol *four fluid ounces* [Imperial measure]; Bichromate of Potassium *nine ounces* [avoirdupois]; Sulphuric Acid *six fluid ounces and a half* [Imp. meas.]; Solution of Soda *a sufficiency;* Water *half a gallon* [Imp. meas.]. Dilute the Sulphuric Acid with ten fluid ounces of the Water, and dissolve the Bichromate of Potassium in the remainder of the Water with the aid of heat. When both liquids are cold, mix them with the Amylic Alcohol in a retort or flask, with occasional brisk agitation, until the temperature of the mixture has fallen to about 32.2° C. (90° F.). Connect with a condenser, and distil until about half a gallon of liquid has passed over. Saturate the distilled liquid accurately with the Solution of Soda, remove any oily fluid which floats on the surface, evaporate till watery vapor ceases to escape, and then raise the heat cautiously so as to liquefy the salt. When the product has cooled and solidified, break it into pieces, and immediately put it into a stoppered bottle." *Br.* 1885.

The above process consists of two steps: first, the artificial formation of valeric acid, and, second, the saturation of this acid with sodium hydroxide. By distilling fusel oil with a mixture of sulphuric acid and potassium dichromate, valeric acid is formed, and passes over with water. The change is effected by the oxidizing agency of the chromic acid of the dichromate, for when the amyl alcohol of the fusel oil loses two atoms of hydrogen by oxidation, and gains one of oxygen, it is converted into valeric acid; thus,

$$C_5H_{12}O + O_2 = C_5H_{10}O_2 + H_2O$$

(See *Potassii Dichromas*, and *Amyl Alcohol*, p. 1381.) The distillate, by exact saturation with the solution of sodium hydroxide, is converted into a solution of sodium valerate, which, by the application of heat until the water is driven off and the residual matter is partially liquefied, furnishes, on cooling, the concrete salt. The small portion of oil that floats on the surface of the solution is amyl valerate, $C_4H_9COOC_5H_{11}$.

Sodium valerate is a deliquescent, very soluble salt, in snow-white masses, having the disagreeable odor of valeric acid, and a taste at first styptic, but afterwards sweetish. When heated to 140.5° C. (285° F.), it fuses without loss of acid, and upon cooling concretes into a white solid. The salt, as formerly official, is in the form produced by fusion. Its formula is C_4H_9COONa. It is little used medicinally, having been originally introduced into the Dublin Pharmacopœia in 1850 for the sole purpose of forming, by double decomposition, iron, quinine, and zinc valerates. *Dose*, as a nervous stimulant, one to five grains (0.065–0.32 Gm.).

Soja. *Soja hispida,* Moench. (*Glycine hispida,* Maxim.) *Soy Bean. Soja* or *Sahuca Bean. Miso.* (Fam. Leguminosæ.)—Meissel and Böcker (*A. J. P.*, 1885, 108) give the composition of soja bean as follows: water, 10 per cent.; soluble casein, 30; albumen, 0.5; insoluble casein, 7; fat, 18; cholesterin, etc., 2; dextrin, 10; starch, 5; cellulose, 5; ash, 5; traces of sugar and an amido compound. Stingl and Morawski (*Monatsschrift für Chemie*, April, 1886) have determined the presence in this bean of a ferment said to be one of the most powerful known in its action upon starch, two-thirds of which it converts into sugar and one-third into dextrin. The amount of starch present in soja bean is so little that bread made from the meal may be used in diabetes. (*A. J. P.*, 1896, 309.)

Solanine.—This alkaloid, which is found in many species of the genus Solanum, is most conveniently obtained from the sprouts of the common potato, by Wackenroder's process, which may be found detailed in the 16th edition of *U. S. D.* Its formula is variously given by different authorities. According to Kletzinsky, it is $C_{42}H_{55}NO_{14}$; according to R. Firbas, it is $C_{52}H_{93}NO_{18}$; and Hilger states that it is $C_{42}H_{87}NO_{15}$. Adrian asserts that it is a glucoside, and by heating with sulphuric or hydrochloric acid it breaks up into glucose and a second base, *solanidine.* This was confirmed by Zwenger and Kind, who give to solanidine the formula $C_{26}H_{41}NO_2$. Cazeneuve and Bretem (*J. P. C.*, 1888, 465) also agree that it is a glucoside and give it the formula $C_{28}H_{47}NO_{10} + 2H_2O$. Solanine is in the form of a white opaque powder, or of delicate acicular crystals, somewhat like those of quinine sulphate, though finer and shorter. It is inodorous, of a bitter taste, fusible at from 112.7° to 115.5° C. (235°–240° F.), decomposing at a slightly higher temperature with an odor of caramel, a sublimate of solanidine forming. It is scarcely soluble in water, soluble in alcohol and ether, and capable of neutralizing the acids. It is distinguished by the deep brown or brownish-yellow color which iodine imparts to its solution, and by its reaction with sulphuric acid, which becomes first reddish-yellow, then purplish-violet, then brown, and, lastly, again colorless, with the deposition of a brown powder. This test is said not to be interfered with by the presence of morphine. (*A. J. P.*, 1873, 484.) The salts which solanine forms with acids are mostly amorphous in character. The oxalate, chromate, and phosphate form crystalline crusts. The acid sulphate is said to be very stable, and is not decomposed by water even on heating, in contradistinction to the neutral salt. It is amorphous and very bitter.

The physiological action of solanine has been studied by several investigators, with not altogether concordant results. Geneuil (*B. G. T.*, tome iii.) finds that it has a depressing influence upon the medulla, spinal cord, and both motor and sensory nerve trunks. In an elaborate investigation, Max Perles (*A. E. P. P.*, Leipzig, 1889, xxvi.) has determined that solanine acts as a powerful poison upon all forms of living protoplasm. When mixed with the blood outside of the body it causes rapid coagulation with alteration of the blood corpuscles. In the frog it produces a centric paralysis, with later paralysis of the heart. When injected intravenously it causes in mammals violent dyspnœa, with cramp, arrest of respiration, and the presence of thrombi in the blood vessels. Toxic doses given by the mouth produce excitement, with tremors, fibrillary contractions, cramp followed by central paralysis, collapse, and death in deep coma, preceded by a fall of temperature which is so great as to be

almost characteristic. Vomiting and diarrhœa were frequently observed, and after death inflammation of the gastro-intestinal mucous membranes, and also a parenchymatous and even hemorrhagic nephritis. During life the urine was albuminous, containing casts, and not rarely was dark red from hæmoglobin, or sometimes methæmoglobin. According to Capparoni, minute doses of solanine, while diminishing the rapidity of the heart's action, increase at the same time the arterial pressure.

In the researches of Max Perles, the action of *solanidine* was very similar to that of solanine, the chief difference between the two being that solanine is a violent local irritant, while solanidine seems free from local irritant properties. The two poisons are stated to belong physiologically to the sapotoxin group.

Solanine has been used by Geneuil, Capparoni, Vulpian, and others with asserted good results in *asthma*, to relieve the *cough* of *bronchitis*, to quiet the irritation of *cystitis* in the old, and for the relief of *gastralgia*, *pruritus*, *sciatica*, and other neuralgic or rheumatic pains. Capparoni (*B. G. T.*, May, 1888) affirms that it is an excellent analgesic, calming *ataxic* pains, and that it is even capable of controlling the *tremors* of lateral *sclerosis*.

Solanine has, however, been tried by various clinicians without results favorable to its use in practical medicine. (Consult *B. and F. Med.-Chir. Rev.*, July, 1854, Am. edition, p. 189; *A. G. M.*, March, 1859, p. 360; *B. G. T.*, July 15, 1887.) The *dose* of solanine, as given by different writers, varies. Fronmüller has seen as much as 0.5 gramme (7.5 grains) taken without producing anything more serious than marked malaise, general weakness, giddiness, and sleep. Clarus gives the medium *dose* for adults as one-tenth to one-sixth grain (0.006–0.01 Gm.) of the acetate, and has seen six grains (0.4 Gm.) of the same salt produce general cephalic distress, with occipital pain, dyspnœa, increase of the frequency and loss of the force of the pulse, followed after some hours by sudden vomiting, diarrhœa, great weakness, and marked dyspnœa. Capparoni administered from three and three-fourths to four and one-half grains (0.25–0.30 Gm.) during the twenty-four hours in divided doses. It is probable that much of the solanine that has been used by investigators has been impure, and it would hardly be safe to begin with the pure alkaloid in the dose of more than one-fourth of a grain (0.016 Gm.), increasing the dose *pro re nata*. Cases of poisoning by potatoes in poor condition have been reported in Germany (*A. E. P. P.*, xxxvi.). The symptoms have been vomiting and diarrhœa with abdominal pain, headache, giddiness, and pronounced fever (102.2° F.); it is probable, however, that these manifestations were due to decomposition products rather than to solanine.

Solanum.—The genus Solanum contains a number of species which are possessed of active physiological properties, and some of which have been used to a considerable extent in medicine.

S. aculeatissimum, Jacq., known as *Apple of Sodom*, is indigenous to Brazil; the fruit yields traces of *solanine*.

S. bacciferum, of Jamaica, yields the so-called *Susumber berries*, which are habitually used as fruit by the natives, but Manners has recorded in the *Ed. M. J.*, 1867, fatal poisoning by these berries, death being preceded by dilated pupils and collapse. It is probable, however, that the berries were not true susumber berries but were the product of some other species of solanum.

S. carolinense, L. *Horse Nettle. Sand Brier. Poisonous Potato. Apple of Sodom.*—A coarse perennial weed which grows in waste sandy ground in the United States as far west as Iowa and as far south as Florida, and yields an orange-yellow berry which is said to be the most active part of the plant. For study of microscopic structure, see *A. J. P.*, vol. lxix. It has been examined by G. A. Krauss (*A. J. P.*, 1890, 601, and 1891, 65 and 216) and Harry Kahn (*A. J. P.*, 1891, 126). Krauss found two active principles corresponding probably to *solanine*, $C_{42}H_{75}NO_{15}$, and *solanidine*, $C_{41}H_{71}NO_2$, together with a characteristic organic acid to which he gives the name *solanic acid*. J. U. Lloyd believes that the alkaloid in this plant is not identical with solanine, and proposes to call it *solnine*. (*A. J. P.*, 1894, 61, and 1897, 76, 89, 108.) E. Q. Thornton (*T. G.*, xii. 1896) finds that in frogs this solanum produces stupor with tetanic spasms, not prevented by section of the cord. It is said to have long been used by the negroes of the South in the treatment of the so-called falling sickness, and in 1889 it was recommended by J. L. Napier as of value in epilepsy.

S. carolinense has been largely used in public and private practice for the relief of *epilepsy* by H. C. Wood, who has found that, although when given by itself its usefulness is very limited, as an adjuvant to the bromides it lessens the size of the doses necessary to keep the convulsions in check. Not less than a fluidrachm (3.75 Cc.) of the fluidextract should be given three times a day. No unpleasant effects have ever been produced by it.

S. Chenopodium.—In this plant, which is a native of Queensland, C. E. Sage has found the alkaloid *solanine*. According to E. B. Ormerod the plant is very useful in the treatment of *dysentery*. (*P. J.*, lxviii. 1902.)

S. Dulcamara, L. *Stipites Dulcamaræ. Tiges de Douce-amère* (*de Morelle grimpante*), *Douce amère*, Fr. *Bittersüss, Bittersüss-Stengel, Alpranken*, G. *Dulcamara*, It., Sp.—The young branches of this species were recognized in the U. S. Pharmacopœia of 1890 under the names of *Dulcamara* or *Bittersweet*. *S. Dulcamara* is a climbing shrub with a woody branching stem and purplish, cymose flowers, with lemon-yellow anthers. The bright scarlet berries remain after the falling of the leaves. The plant is common to Europe and North America, and in the United States grows from New England to Ohio. All portions of the plant are very active. Fatal results from the eating of the berries by a child have been recorded (*P. J.*, 1861). For medicinal purposes the plant should be gathered in the autumn after the fall of the leaf, and the extreme twigs should be selected. That grown in high and dry situations is said to be the best.

The dried twigs are of various lengths, cylindrical, about as thick as a goose quill, externally wrinkled, and of a grayish-ash color, consisting of a thin bark, an interior ligneous portion, and a central pith. They are inodorous, though the stalk in the recent state emits, when bruised, a peculiar, rather nauseous odor. Their taste, which is at first bitter and afterwards sweetish, has given origin to the name of the plant. "About 5 Mm., or less, thick, cylindrical, somewhat angular, longitudinally striate, more or less warty, usually hollow in the center, cut into

short sections. The thin bark is externally pale greenish, or light greenish-brown, marked with alternate leaf-scars, and internally green; the greenish or yellowish wood forms one or two concentric rings. Odor slight; taste bitter, afterwards sweet." *U. S.* 1890. Boiling water extracts all their virtues. These are supposed to depend, at least in part, upon the alkaloid *solanine*, which was originally discovered in 1821 by Desfosses of Besançon, in the berries of *Solanum nigrum*, L. Winckler (1841) first observed that the alkaloid of dulcamara stems can be obtained only in an amorphous state, and that it behaves to platinic and mercuric chlorides differently from the solanine of potatoes. Moitessier (1856) confirmed this observation, and obtained only amorphous salts of the solanine of bittersweet. Wittstein (1852) supposed another alkaloid, *dulcamarine*, to be present, but Geissler (1875) showed that this substance was a glucoside, and not an alkaloid, yielding on decomposition with dilute acids *dulcamaretin* and sugar. He assigned the formula $C_{22}H_{34}O_{10}$ to dulcamarine, and $C_{16}H_{26}O_6$ to dulcamaretin. (Flückiger, *Pharmacographia*, 2d ed. p. 451.) (For account of *solanine* see previous article.) Besides solanine, the stalks of *S. Dulcamara* contain, according to Pfaff, a peculiar principle to which he gave the name of *picroglycion*, indicative of the taste, at once bitter and sweet, which it is said to possess. This was obtained by Blitz, in the following manner: The aqueous extract was treated with alcohol, the tincture evaporated, the residue dissolved in water, the solution precipitated with lead subacetate, the excess of this salt decomposed by hydrogen sulphide, the liquor then evaporated to dryness, and the residue treated with acetic ether, which yielded the principle in small isolated crystals by spontaneous evaporation. Pfaff found also in dulcamara, gummy extractive, gluten, green wax, resin, benzoic acid, starch, lignin, and various salts of lime. Frederick Davis (*Y. B. P.*, 1902) found the two alkaloids, *solanine* and *solanidine*, the glucoside *solanein*, and the bitter principle *dulcamarin*, in fresh specimens of the plant.

Dulcamara possesses feeble narcotic properties, with the power of increasing the secretions, particularly those of the kidneys and skin. George B. Wood observed, when the system was under its influence, a dark purplish color of the face and hands, and at the same time considerable languor of the circulation. In overdoses it produces nausea, vomiting, faintness, vertigo, and convulsive muscular movements. A man took from three to four quarts of a decoction made from a peck of the stalks, and was attacked with pain in the joints, numbness of the limbs, dryness of the mouth, and palsy of the tongue, with consciousness unimpaired, the pulse quiet, but small and rather hard, and the skin cool; followed by recovery. (*London Med. Gaz.*, 1850.)

Anaphrodisiac properties have been attributed to dulcamara, and it has also been employed with alleged benefit in chronic *rheumatism*. But its chief use has been in the treatment of scaly cutaneous eruptions, such as *lepra*, *psoriasis*, and *pityriasis*. It has been usually administered in the form of a decoction, but the fluidextract, which was official in the U. S. Pharmacopœia of 1890, affords the best form of administration (see below.) Dulcamara may be given in *doses* of from 30 grains to a drachm (2–3.9 Gm.).

Extractum Dulcamaræ Fluidum. U. S. 1890. *Fluid Extract of Dulcamara.*—" Dulcamara, in No. 60 powder, *one thousand grammes* [or 35 ounces av., 120 grains]; Diluted Alcohol, *a sufficient quantity*, to make *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]. Moisten the powder with *four hundred cubic centimeters* [or 13 fluidounces, 252 minims] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Dulcamara is exhausted. Reserve the first *eight hundred cubic centimeters* [or 27 fluidounces, 24 minims] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one thousand cubic centimeters* [or 33 fluidounces, 6½ fluidrachms]." *U. S.* 1890.

The foregoing formula differs from that of the U. S. P. 1870 in the absence of glycerin. This fluidextract of dulcamara is a rather thick, dark brown liquid. The *dose* is from thirty minims to a fluidrachm (1.8–3.75 Cc.), three or four times a day, which is gradually increased if necessary.

D. Freire has obtained from the fruit of *S. grandiflorum*, or wolf fruit, of Brazil, an energetic toxic alkaloid, *grandiflorine* (*C. R. A. S.*, cv.).

S. Jacquinii, Willd., is used in India as a diaphoretic and expectorant.

S. Lycopersicon, L. (*Lycopersicon Lycopersicon* (L.), Karst., *L. esculentum*, Mill.), formerly the *Love Apple*, now the *Tomato Plant*.—The tomato is believed by many practitioners to be an injurious article of diet to gouty persons on account of the great acidity of the juice, an acidity which T. D. McElhenie has demonstrated to be due at least in part to citric, malic, and oxalic acids (*A. J. P.*, 1872). Solanine is said not to be present in the juice but has been found by George W. Kennedy (*P. J.*, 1873) in the herbaceous part of the plant. It probably also exists in the seeds (*A. J. P.*, xxxiv.).

S. nigrum, L. *Black* or *Garden Nightshade. Duscle. Hound's Berry. Morelle.*—This is an annual plant, widely distributed in the United States from Texas to Nova Scotia. The leaves have been used in medicine in the treatment of *scrofulous dyscrasias*, and are said to produce diaphoresis when in overdose; also nausea, purging, and nervous disturbance. The poisonous properties commonly attributed to this plant are, however, to be doubted, since Dunal of Montpellier, states, as the result of numerous experiments, that the berries are not poisonous to man or the inferior animals; and the leaves are said to be consumed in large quantities in the Isles of France and Bourbon as it is in the Hawaiian Islands by the natives as food, having been previously boiled in water. In the latter case the active principle of the plant may have been extracted by decoction. Introduced by importers under the name of *jurubeba*, this plant was examined by Kobert and found to contain an active principle, and to be inert. According to Peckoldt, however (*Ph. Rund.*, 1889), true jurubeba is *Solanum insidiosum*, Mart., from which the results would have been more favorable. It is used in Brazil in *gonorrhœa* and *syphilis*

S. Pseudocapsicum, L., or *Jerusalem Cherry*, yields a fruit whose resemblance to the common cherry is said to have led to its being eaten by children with fatal results.

S. rostratum, Dunal. *Sand Bur. Beaked Nightshade. Bull Nettle.*—This plant, which grows on the prairies from Nebraska to Mexico, and is noteworthy as having been the original food of the Colorado beetle or potato bug, has yielded to W. S. Amos an alkaloid (*Notes on N. R.*, iv.). Narcotic properties have been attributed to the leaves, stalks and unripe berries of *S. tuberosum*, L., or common white potato, and the extract has been used in various diseases. Worsham of Philadelphia, found the extract, in the quantity of nearly one hundred grains, to cause no sensible effect. (*Phila. Journ. of the Med. and Phys. Sciences*, vi. 22.) It is probable that the properties of the plant vary with the stage of growth, or with the place and circumstances of culture, as is indicated by the researches of C. Haaf, who found solanine in old potatoes which had begun to germinate, in the proportion of 0.16 in 500 parts, and in very young potatoes, deprived of their coating, precisely the same quantity. Fully ripe potatoes, which had not begun to sprout, gave a negative result. (*N. R. Pharm.*, 1864, p. 559.) Solanine has also been found in the germs of potatoes by Julius Otto, and a case is recorded of death in a girl of fourteen, from eating the unripe fruit of the potato (*B. M. J.*, Sept. 3, 1859). The prominent symptoms were partial stupor, speechlessness, jactitation, hurried breathing, lividness of the skin, cold sweats, very frequent and feeble pulse, and a constant spitting through the closed teeth of viscid frothy phlegm.

Solidago. *Golden-rod. Verge d'Or*, Fr. *Goldruthe*, G.—There are very numerous species of this composite genus in the United States. Of these *S. odora*, Ait., was formerly official. *S. Virgaurea*, L., which is common to the United States and Europe, was formerly directed by the Dublin College. It is aromatic, astringent, in hot infusion diaphoretic, and is asserted to be diuretic. (*Rev. Gén. de Clin. et de Thérap.*, 1889.) For a study of the flowers of *S. bicolor*, L., by Adam Conrath, see *A. J. P.*, 1873, 253. For an analysis of *S. rugosa*, Mill., see *A. J. P.*, 1893, 122.

Solphinol.—A white, odorless, crystalline powder, consisting chiefly of boric acid, borax, and alkaline sulphites. It is soluble in ten parts of water and twenty parts of glycerin. It is used as a surgical antiseptic.

Soluble Mercury of Hahnemann. $NH_2(Hg_2)NO_3$.—This is prepared by adding, drop by drop, a diluted solution of ammonia to an equally diluted solution of mercurous nitrate, until the precipitate begins to be paler than at first. It is a black powder. When it has a gray color, the fact shows that too much ammonia has been employed in its precipitation. In this case $NH_2(Hg_2)NO_3$ yields $NH_2(Hg)NO_3 + Hg$. This preparation was included in the old French Codex. It has been used in *syphilitic* diseases.

Solution of Chlorinated Potassa. *Liquor Potassæ Chlorinatæ. Chlorure de Potasse*, Fr. *Chlorkalilösung*, G. *Javelle's Water. Eau de Javelle.*—This is prepared from potassium carbonate precisely as the solution of chlorinated soda is from sodium carbonate, and has an analogous composition. (See *Liquor Sodæ Chlorinatæ*, p. 736.) It is employed for taking out fruit stains, etc., from linen.

Solution of Dialyzed Iron. *Liquor Ferri Dialysatus. Liquor Ferri Oxychlorati*, P. G.—*Dialyzed Solution of Iron* was formerly recognized by the Br. Ph., but was dismissed at the last revision. It is made by treating a solution of ferric chloride with ammonia, whereby ferric hydroxide is precipitated, which by agitation is dissolved, placing the thick liquid in a dialyzer, and suspending this in water, which is to be constantly renewed so long as any traces of hydrochloric acid are found in it. The following process has been used in the United States: To one hundred parts of solution of ferric chloride, sp. gr. 1.26, thirty-five parts of ammonia water, sp. gr. 0.923, may be gradually added. The precipitate which almost immediately forms is redissolved, and the solution introduced into the dialyzer, which is then suspended upon the water, contained in a suitable vessel. When this ceases to produce a precipitate with silver nitrate, or to show an acid reaction, it is assayed by evaporating 10 Cc. to dryness on a water bath, to ascertain the amount of ferric oxychloride in solution; then the final solution is diluted so that it shall contain 10 per cent. of dry oxychloride.

Dialyzed iron is a solution of *ferric oxychloride* in water. Although the amount of chlorine present is very small, it is not correct to speak of it as a solution of ferric oxide. Its composition may vary from $Fe_2Cl_6.12Fe_2O_3$ to $Fe_2Cl_6.95Fe_2O_3$ (Graham), and solutions which contain a large quantity of oxide in proportion to chloride are less stable and more prone to gelatinize. Solutions containing a large proportion of chloride may be evaporated to dryness, if care be used, without the residue becoming insoluble. The solution is of a transparent reddish-brown color, free from the usual astringent, styptic taste of iron preparations. It mixes in all proportions with distilled water, alcohol, syrup, and glycerin, but water containing any saline impurity is apt to cause precipitation. When gelatinization occurs, agitation with a small quantity of solution of ferric chloride will usually restore it to fluidity, care being observed not to add an excess. Contact with the alkalies should be avoided, even in minute quantity; indeed, it is best administered without addition of any kind, or simply diluted with distilled water.

The British Pharmacopœia formerly directed that its specific gravity should be 1.047, and "100 grains should afford a precipitate with a solution of ammonia which, washed, dried and ignited, weighs five grains." E. B. Shuttleworth (*Can. Pharm. Journ.*, Dec. 1877) recommends a solution which has the sp. gr. 1.040 and yielding 5 per cent. of residue when well dried on a water bath, as the best for medicinal use. The specific gravity test can be relied upon, if the solution does not give a precipitate with silver nitrate or become of a blackish-blue color upon treatment with tannin, showing the absence of ferric chloride. (See also *N. R.*, 1879, 46, for a new process by F. Schneider, from *S. W. P.*, 1878, 409.) There is good reason for believing that much of the so-called dialyzed iron found in commerce is made by adding freshly precipitated ferric hydroxide to solution of ferric chloride until it ceases to be dissolved, and then filtering the solution. (Scheffer, *A. J. P.*, March, 1878.) *Ferrum catalyticum*, or *catalytic iron*, used on the Continent, is probably made in this way.

Solution of dialyzed iron has been very highly praised as a ferruginous tonic free from astrin-

gency, which can be given in enormous doses without producing headache or gastro-intestinal irritation. It is evident, however, that a preparation which will not pass through animal membrane cannot be absorbed; in fact, dialyzed iron is precipitated in the stomach and intestines as a ferric oxide, which is very slowly absorbed. Dialyzed iron is, therefore, not an eligible preparation. It is capable of acting as an antidote to arsenic by virtue of the readiness with which it yields hydrated ferric oxide, but it is safer to depend upon the official antidote, ferric hydroxide with magnesium oxide (see p. 506). *Dose*, from one-half to one fluidrachm (1.3–3.75 Cc.).

Solution of Magnesium Bisulphite. *Liquor Magnesii Bisulphitis.*—George Archibald, having found that magnesium bisulphite is capable of arresting the butyric acid fermentation, proposed a solution of it as a remedy in *heartburn*. He prepared it by treating the magnesium carbonate with sulphurous acid, adding to an ounce of water sixteen grains of the sulphite thus formed, and passing sulphurous acid gas through the mixture until a clear solution is obtained. (*P. J.*, 3d series, ii. 502.)

Solutol.—An alkaline solution of sodium cresol in an excess of cresol. It is a transparent brownish liquid, miscible with water, and is used for disinfecting purposes.

Solveol.—A solution of sodium-cresylate in cresol. It is less caustic than solutol, is nearly odorless, of a neutral reaction, and miscible with water. It is used as a surgical antiseptic, for dressings, and in spray apparatus.

Somatose.—This is an artificially digested meat albumin containing 51.6 per cent. of deutero and 13.4 per cent. of hetero-albuminoses, 5 per cent. of peptone, 1 per cent. of moisture, and 5 per cent. of nutrient salts. A yellowish, odorless, and almost tasteless powder.

Iron Somatose is a similar preparation containing 2 per cent. of iron in combination.

Milk Somatose is a soluble nutrient prepared by the same digestive process from casein, containing 5 per cent. of tannin. It is a light yellowish powder, readily soluble in water.

Somnal. $C_7H_{12}Cl_3O_3N$.—This is said to be a solution of hydrated chloral and urethane in alcohol. Tcheremshansky, in a physiological study, has found that it acts upon the nerve centres and upon the circulation almost exactly as does chloral, it being, however, a little less depressing to the heart. Myers (*N. Y. Med. Rec.*, 1892) has reached similar conclusions.

Somnal, therefore, appears to be physiologically equivalent to a mixture of hydrated chloral and urethane, and it does not seem to be clear that it possesses any advantage over the older remedies. It may be given in *doses* of from one-half to one fluidrachm (1.8–3.75 Cc.), although much larger quantities have been occasionally prescribed by some clinicians.

Somnoform.—A proprietary anæsthetic said to contain ethyl chloride 60 per cent., methyl chloride 35 per cent., ethyl bromide 5 per cent. (For a study of its physiological action, see *B. M. J.*, 1903, 1.)

Somnos. $(CCl_3.CH<^{OH}_{O})_3, C_3H_5$.—It is formed by the interaction of anhydrous chloral and glycerol, which react like chloral and alcohol in the formation of chloral alcoholate. The commercial preparation is an alcoholic solution of the compound.

Somnos is used as a hypnotic, the claim made for it that it is free from the depressant effects of chloral does not appear to be sustained.

Dose, of the commercial solution, one fluidrachm (3.75 Cc.).

Sonchus. *Sonchus oleraceus*, L. *Sow Thistle.* (Fam. Compositæ.)—The brownish gum left after the evaporation of the juice of this plant is said to be a powerful hydragogue cathartic, in *doses* of from two to four grains (0.13–0.26 Gm.). Combined with aromatics or belladonna, it may be used instead of elaterium in *dropsy*. (*Med. Bull.*, July, 1888.)

Soot. *Fuligo Ligni.*—This well-known substance has a peculiar odor, and a bitter, empyreumatic, and disagreeable taste. Its composition varies according to the source and conditions of its formation. When obtained by the combustion of resinous materials it may contain oily distillation products soluble in ether; when obtained by the combustion of wood it may contain pyroligneous (acetic) acid and products peculiar to wood tar, such as creosote, guaiacol, and phenols. Of course mineral substances from the ash of the wood may also be present.

Soot was formerly official with the Edinburgh College, and the Scotch physicians prescribed it as a tonic and antispasmodic. It has also been employed as an external remedy in skin diseases. (See *Révue Méd.*, June, 1834; *B. G. T.*, Mars, 1834; also 14th ed. *U. S. D.*) A few shovelfuls of it, thrown into privies or drains, effectually destroy their foul exhalations.

Sophora. *S. secundiflora* (Cav.), DC. (*S. speciosa*, Benth.) *Coral Bean.*—From the poisonous seeds of this leguminous Texan tree H. C. Wood obtained a volatile liquid alkaloid (*sophorine*) whose chloride is crystalline (see *A. J. P.*, 1878), and which, according to P. C. Plugge, is identical with cytisine. This same alkaloid probably exists in many species of the genus, as Parsons found a liquid alkaloid in *S. sericea*, Nutt., *crazy-weed*, which grows in Colorado and Mexico (*Rep. Commissioner of Agricult.*, 1879, and *N. R.*, 1881, 67; see also reports of an investigation by Kalteyer and Neil, *A. J. P.*, 1866, 465), and Greshoff (*P. J.*, xxii.) one in *S. tomentosa*, L. Plugge, however (*A. Pharm.*, 1895), affirms that *matrine*, the alkaloid discovered by Nagai in *S. angustifolia*, is distinct from cytisine.

Sorbus. *Sorbus Aucuparia*, L. (*Pyrus Aucuparia*, Gaertn.) *Mountain Ash. Sorbes*, Fr. *Ebercsche, Vogelbeere*, G. (Fam. Rosaceæ.)—A small European tree, whose fruit contains a peculiar kind of sugar called *sorbinose*, $C_6H_{12}O_6$, isomeric with levulose. It reduces Fehling's solution, but is not fermentable with yeast. Hofmann has also discovered two new acids, which he designates as *sorbic* and *parasorbic acids*, $C_6H_8O_2$. Sorbic acid forms colorless needle-like crystals fusing at 134.5° C. (274° F.), while parasorbic acid is a lactone-like body, which, on heating with concentrated acids or solid alkali, changes into sorbic acid. M. J. Boussingault has found in it a crystalline saccharine principle, *sorbitol*, isomeric with mannitol, melting, when anhydrous, at from 110° to 111° C. (230°–231.8° F.), when hydrated, at 102° C. (215.6° F.). Its formula is $C_6H_{14}O_6$. It does not undergo the vinous fermentation. (*P. J.*, 1872, 28.) The fruit has been used in *scurvy*, and, in infusion, as a remedy in *hemorrhoids* and *strangury*. All parts of the tree are astringent, and may be employed in tanning and dyeing black. *S. americana*, Marsh. (*Pyrus americana*, DC.),

or *American Mountain Ash*, probably has similar virtues to the European species. Edwin Johanson found the fruit to yield from 4.92 to 6.6 per cent. of malic acid. (*Ph. Z. R.*, i. 1882.)

Sorghum.—*Sorghum*, or *Chinese Sugar cane*, is yielded, according to Hoekel, by a number of varieties of *Andropogon arundinaceus*, Scop. (*Sorghum vulgare*, Pers., *A. Sorghum*, Brot.). Some of the varieties indigenous in India, China, and other parts of the East have within recent years been introduced into Europe and the United States. It has come largely into cultivation in the United States, owing in great part to the efforts of the Department of Agriculture, whose numerous publications upon the subject may be consulted by any one desirous of information.

Sozal. $(C_6H_4(OH)SO_3)_3Al$. *Aluminum Paraphenolsulphonate.*—This is obtained by dissolving aluminum hydrate in paraphenolsulphonic acid, or by double decomposition of aluminum sulphate and barium paraphenolsulphonate. It occurs in crystalline grains having a weak phenol odor, but strongly astringent taste; easily soluble in water, glycerin, and alcohol, forming permanent solutions. It has been used as an antiseptic in place of iodoform. (*Ph. Ztg.*, 1892.)

Soziodolic Acid. *Soziodol. Diiodparaphenolsulphonic Acid.* $C_6H_2I_2(SO_3H)OH$.—This is a white glistening powder, odorless, of slightly acid taste, slightly soluble in cold water, more easily in hot water. It is decomposed on heating to 200° C. (392° F.), giving off violet vapors. It contains about 53 per cent. of iodine. It can be recognized by heating, or by adding sulphuric acid to it in hot solution, when iodine separates. Ferric chloride imparts a dark violet color to the aqueous solution; silver nitrate throws down a white precipitate of silver soziodol completely soluble in diluted nitric or sulphuric acid. For an outline of the process of manufacture, see *Squibb's Ephem.*, Feb. 1893. Soziodol is used as a local remedy, resembling somewhat iodoform in its range of usefulness. According to Langaard, 2 per cent. is sufficient to kill bacteria of pus; for wounds, a 10 per cent. mixture with powdered talc is advocated. Lassar praises it in *eczema*, *herpes tonsurans*, *impetigo*, etc.; it has also been much used in *otitis* and *rhinitis*. Langaard has found that fifteen grain doses have no appreciable effect upon rabbits, and Bufalini gave twenty-two grains a day in *phthisis* without unpleasant effect. The following salts have been used.

Sodium soziodol, readily soluble; used in all cases where aqueous solutions are employed. *Potassium soziodol*, sparingly soluble; a desiccant indicated in *eczema*. It is usually employed with talc in the proportion of 1:5 or 1:6. *Zinc soziodol*, a local irritant in solutions of from 1 : 20 to 1 : 50; a caustic in a solution of 1 : 5. *Mercury soziodol*, a caustic, even in a solution of 1:10. Miller affirms that its solution of 2½ in 100 kills the acarus of *scabies* in twenty-four minutes.

Sozolic Acid. *Acidum Sozolicum. Orthophenolsulphonic Acid.* $C_6H_4(SO_3H)OH$.—Ortho and paraphenolsulphonic acids are both formed when phenol is dissolved in concentrated sulphuric acid; at medium temperatures the former is far more abundant, but it readily passes into the para compound on the application of heat. Sozolic acid has a very faint odor of phenol. It is readily soluble in water, alcohol, and glycerin, and is used so diluted as to contain from 3 to 10 per cent. of the active principle. The orthophenolsulphonic acid in 33⅓ per cent. solution has received the trade name of *aseptol*. The ortho acid changes on heating into the isomeric paraphenolsulphonic acid, and this change takes place even in the aqueous solution of the former, a fact which should be remembered in the preparation of aseptol solutions.

E. Riegler (*W. M. Bl.*, xviii. 1895) proposes aseptol as a test for albumin in urine. One part in 20,000 causes coagulation; the precipitate with albumin does not disappear with heat. The solutions of albuminose and peptones are also precipitated, but the precipitates of these disappear with heat. The solution of aseptol undergoes decomposition when exposed to light.

Schiff and Beilstein asserted that phenolsulphonic acid acts like tannic and gallic acids, precipitating albumen and alkaloids, and being capable of replacing gallic acid in the making of leather and in pharmacy. There is, however, no sufficient reason for believing that the substance can be used in medicine in the place of the vegetable acids named. It has also been asserted that phenolsulphonic acid is a more powerful antiseptic than phenol, having the great advantage of being nearly odorless, non-irritating, non-poisonous, and miscible with water in all proportions, therefore to be especially valuable in abdominal and ophthalmological surgery. That it is free from poisonous properties is not probable, and in a careful series of comparative experiments, F. A. Tucker (*Notes on New Remedies*, 1892) found that it had not more than one-third the antiseptic power of phenol.

Spartium. *Spartium junceum*, L. *Spanish Broom.* (Fam. Leguminosæ.)—A small shrub, indigenous in the south of Europe, and cultivated in our gardens as an ornamental plant. The flowers are large, yellow, and of an agreeable odor. Spanish broom in its medicinal properties closely resembles Scoparius, but appears to be from five to six times more active, 6 Gm. of the dried plant, given in infusion, having produced very violent poisoning; serious results have been produced by the substitution of the Spanish for the true broom. The dried flowers are readily differentiated, those of the *true broom* having a small, bell-shaped calyx with two unequal lobes, the upper of which is bidentate, the lower minutely tridentate, and the style always rolled, while in *Spartium junceum* the calyx is deeply cleft to the base on one side only, and the style is deeply rolled.

The symptoms produced by overdoses are vomiting and purging, with renal irritation. The seeds have been used to a considerable extent in *dropsy* in *doses* of from ten to fifteen grains (0.65–1.0 Gm.) three times a day in the form of tincture.

Sphacelotoxin. *Spasmotin. Spasmotoxin.* $C_{20}H_{21}O_9$.—A crystalline yellow powder isolated by Jacoby from ergot. (*Amer. Therap.*, 1894, 295.) It is insoluble in water, in diluted acids, and in petroleum benzin; soluble in ether, alcohol, and benzene. It forms salts with alkalies, the sodium salt being recommended for hypodermic injections. It is asserted that sphacelotoxin is the active constituent of ergot. The *dose* is from one-thirtieth to one-twelfth of a grain (0.002–0.005 Gm.), but doses up to one grain (0.065 Gm.) have been given without danger.

Sphæranthus. *Sphæranthus indicus*, L. (Fam. Compositæ.)—An Indian plant, which is used as a general tonic, deobstruent, alterative, and aphrodisiac, under the names of *Mundi*, *Gorakhmundi*, *Murmuria*, and *Kottakkarandai*. Dymock has found it in a deep cherry-colored essential oil.

Spider Poisons.—The popular belief that certain spiders have the power of poisoning small animals, and even man, has received confirmation, and an active principle, *arachnolysin*, has been separated by Sachs and found to have a powerful hæmolytic action upon the blood of rabbits and cats, but not to affect dogs and guinea pigs (see Kobert, *Giftspinnen*, 1901; *S. Jb.*, Bd. 274, 178).

Spilanthes. *Spilanthes Acmella*, Murr. (*S. oleracea*, L.) *Para Cress. Cresson de Para*, Fr. *Parakresse*, G. (Fam. Compositæ.)—A plant of India, used as a masticatory for *toothache;* when chewed it produces a copious salivation. (*A. J. P.*, xliv. 323.)

Spiræa.—Many if not all of the species of this genus contain a colorless volatile oil, very similar to the oil of gaultheria, but composed mainly of salicylic aldehyde, with only smaller amounts of methyl salicylate. The species which have been submitted to actual analysis are the *Spiræa Ulmaria*, L. (*Filipendula Ulmaria*, Maxim., *Ulmaria palustris*, Moench.),—*Queen of the Meadow*, or *Meadow-sweet*,—a European plant which has been introduced into this country; also the European species *S. lobata*, Jacq., and the species *S. Filipendula*, L. (*Filipendula vulgaris*, Moench.), which grows in Southern Europe and Northern Africa. A yellow, crystalline powder of a bitter taste, insoluble in water, slightly so in alcohol, readily soluble in ether, and having an acid reaction. *Spiræaic acid* (now recognized as salicylic acid) (*J. Pr. Chem.*, xix.) was separated from the flowers of *S. Ulmaria* by Löwig and Weidmann, and has been found by Rochebrune in the flowers of *S. Filipendula*, L.

The roots of probably most of the species contain tannic acid, gallic acid, and when fresh some of the volatile oils. (*A. J. P.*, 1887.) The root of *Spiræa tomentosa*, L. (*Hardhack, Steeplebush*, or *Whitecap*), was formerly recognized in the U. S. Pharmacopœia. It is an indigenous shrub, two or three feet high, with numerous simple, erect, round, downy, and purplish stems, furnished with alternate leaves, closely set upon very short footstalks. The leaves are ovate-lanceolate, unequally serrate, somewhat pointed at both ends, dark green on their upper surface, whitish and tomentose beneath. The flowers are disposed in terminal, compound, crowded spikes or racemes.

The flowers of the Spiræa possess to a very feeble extent the medicinal virtues of salicylic acid, and have been used as diuretic and tonic in the form of decoction. The roots are astringent, and have been used in the treatment of *diarrhœa* in *doses* of from five to twenty grains (0.32–1.3 Gm.) of the aqueous extract repeated *pro re nata*.

Splenic Extract.—Led by the spontaneous recovery of a severe case of exophthalmic goitre during an attack of abscess of the spleen, and the well-known relations between diseases of the spleen and myxœdema, H. C. Wood tried the splenic extract in various cases of *exophthalmic goitre* with sufficient results to make further clinical investigation incumbent upon the profession. The experiments of Oliver and Schäfer show that the intravenous injection of the splenic extract produces in the dog a primary fall and a secondary rise of the arterial pressure; beyond this we have no definite knowledge of the physiological action of the extract. It has been used by A. C. Clark with apparent beneficial results in a number of cases of *insanity* connected with nervous exhaustion. He states that it increases the activity of the skin, usually increases the appetite, and has no effect upon the bowels, the urine, or the blood. In the practice of H. C. Wood a disadvantage has been the tendency of the extract to produce nausea, or, if used hypodermically in the form of the glycerin extract, to cause abscesses. In teaspoonful doses the glycerin extract (40 per cent.) has in some cases provoked violent gastric distress. *Dose*, of the glycerin extract, from ten to twenty minims (0.6–1.3 Cc.) three times a day; *dose*, of the solid extract, from three to five grains (0.2–0.32 Gm.), in capsules.

Sponge. *Spongia. Spongia officinalis. Eponge*, Fr. *Schwamm. Badeschwamm*, G.—The sponge is "a flexible, fixed, torpid, polymorphous animal, composed either of reticulate fibres or masses of small spires interwoven together, and clothed with a gelatinous flesh, full of small mouths on its surface, by which it absorbs and ejects water." Various genera are described, but the sponges used in commerce are said all to belong to the genus *Spongia*. Sponges inhabit the bottom of the sea, where they are fixed to rocks or other solid bodies, and are most abundant within the tropics. They are collected chiefly in the Mediterranean and Red Seas, and in those of the East and West Indies. When collected they are enveloped in a gelatinous coating, which forms part of the animal. For details of fishery and preparation, see *P. J.*, xx. Large quantities of the coarser kinds are imported from the Bahamas, but the finest and most esteemed are brought from the Mediterranean, especially from the coast of Syria. Recently the cultivation of sponges has been undertaken on an extensive scale. Small fragments are cut under water from the live sponge, and fixed upon a sandy bottom by means of skewers. In three years they will have grown sufficiently to be marketable.

Sponge, as found in commerce, is in yellowish-brown masses of various shapes and sizes, light, porous, elastic, and composed of fine, flexible, tenacious fibres, interwoven in the form of cells and meshes. It usually contains numerous minute fragments of coral or stone, or small shells, from which it must be freed before it can be used for ordinary purposes. Sponge is prepared by macerating it for several days in cold water, beating it in order to break up the concretions which it contains, and dissolving what cannot thus be separated of the calcareous matter by hydrochloric acid diluted with thirty parts of water. By this process it is rendered perfectly soft, and fit for surgical use. It may be bleached by steeping it in water impregnated with sulphurous acid, or by exposure in a moist state to the action of chlorine. It is stated that sponges which have been soaked in pus and infectious matters will recover their primitive condition by soaking in a 4 per cent. solution of potassium permanganate, then in a 25 per cent. solution of official sulphurous acid, and finally thorough washing in an abundance of water. (*A. J. P.*, xliv. 355.) When intended for surgical purposes, the softest, finest, and most elastic sponges should be selected; for forming *burnt sponge* the coarser will answer equally well. According to Hatchett, the chemical constituents of sponge are gelatin, coagulated albumin, common salt, and calcium carbonate. Magnesia, silica, iron, sulphur, and phosphorus have been detected in it, as also iodine and bromine, combined with sodium and potassium. From the experiments of Croockewit, it would appear that sponge is closely analogous to, if not identical with, the *fibroïn* and *sericin*

of silk, differing from it only in containing iodine, sulphur, and phosphorus. (*Ann. Ch. Ph.*, xlviii. 43.) Schlossberger, however, has shown that it is distinct, in its very slight solubility in ammoniacal solution of copper hydroxide and in its yielding leucine and glycocoll when treated with diluted sulphuric acid, while sericin yields under similar treatment tyrosine and serin. He names the principle *spongin*.

Sponges are used for mechanical purposes only. *Sponge tent* is employed for dilating sinuses. This is prepared by dipping sponge into melted wax, compressing it between two flat surfaces till the wax hardens, and then cutting it into pieces of a proper form and size. By the heat of the body the wax becomes soft, and the sponge, expanding by the imbibition of moisture, gradually dilates the wound or sinus in which it may be placed. When a conical sponge tent of uniform calibre is required, as for dilating the uterine cavity, a better plan is to cut the sponge into a conical shape while fresh and compress when moist, by winding it carefully with a fine tightly drawn cord, removing the cord when perfectly dry, and dipping the tent into melted wax, so as to get a thick coating. For other modes of preparing sponge tent, as well as of saturating the sponge at the same time with substances calculated to make a remedial impression—as phenol, alum, lead acetate, etc., see *A. J. P.*, 1868, 410; 1869, 446.

Spongia Usta, *Burnt Sponge,* was formerly official (*Spongia Usta,* U. S. 1850), but is no longer used in medicine. For method of preparation, analysis, and therapeutic properties, see 16th edition, *U. S. D.*

Statice. *Statice caroliniana,* Walt. (*S. Limonium* (L.), Gray. *Limonium carolinianum* (Walt.), Britt.) *Marsh Rosemary. Ink Root. Sea Lavender. Romarin des Marais, Lavande triste,* Fr. *Strandnelke,* G. (Fam. Plumbaginaceæ.)—It is an indigenous maritime plant with a perennial root, sending up annually tufts of leaves, which are obovate or cuneiform, entire, obtuse, mucronate, smooth, and on long footstalks.

Marsh rosemary grows in the salt marshes along the sea coast from New England to Florida, and flowers in August and September. The root, which was formerly in the Secondary List of the U. S. Pharmacopœia, is large, spindle-shaped, or branched, fleshy, compact, rough, and of a purplish brown color. It is bitter and extremely astringent, but odorless. It contains tannic acid (12.4 per cent.), volatile oil, resin, and other substances (*A. J. P.*, xiv. 116). Statice is powerfully astringent, and in some parts of the United States, particularly in New England, is much employed, especially as a local application, in decoction, to aphthous and ulcerative affections of the mouth and fauces.

In Brazil and Buenos Ayres the roots of *S. brasiliensis,* Boiss., are employed under the name of *Buaycura* or *Guaycura.* (*P. J.*, 1878, ix. 466.) For a description of the physical and chemical characteristics of the root, see *P. J.*, vol. xv. 86. In Russia and Spain the very large roots of *S. latifolia,* Sm., are used for tanning, and in Morocco the roots of *S. mucronata,* L., are stated to be employed, under the name of *safrifa,* as a nervine.

Steresol.—An antiseptic varnish made by dissolving purified gum lac 270 parts, benzoin 10 parts, balsam of Tolu 10 parts, phenol in crystals 100 parts, oil of cinnamon 6 parts, saccharin 6 parts, in sufficient alcohol to make 1000 parts. It permits of asepsis of mucous surfaces, and is adapted for use where it is impossible to apply bandages.

Sterisol. *Steriosol.*—According to Aufrecht, this liquid contains formaldehyde, sodium chloride, potassium phosphate, sugar of milk, and water. It is used as an antiseptic.

Stipa.—According to Gillespie (*B. M. J.*, Oct. 1898), a number of species of this genus of grasses are actively poisonous, and have caused death in horses and other domestic animals. Of such character especially are *Stipa viridula,* Trin., *Stipa inebrians,* Hance, and *Stipa sibirica,* Lam., of the Russian steppes. A few experiments made with *Stipa viridula,* Trin., indicated that it acts powerfully upon the brain and spinal cord.

Stipa Vasevi, Scribner.—According to Vernon Bailey this grass, which grows on the mountains of California, is a very active narcotic, producing in animals, which graze upon it, sleep lasting for a week or longer.

Stovaine. *Amylene AB. Hydrochloride.* (*Hydrochloride of benzoyl ethylmethyl-aminopropanol.*)—This substance, belonging to the group of amino-alcohols, was first brought before the French Academy of Medicine, March 24, 1904, by Billon, whose results have been confirmed by Lapersonne (*Recueil d'Ophtalmologie,* May, 1904). It crystallizes in small, brilliant scales, melting at 175° C. (347° F.), and is very soluble in water. It shows most of the reactions of cocaine, which is also a benzoyl derivative. It is affirmed to have very much less toxicity than cocaine. The solution when placed in the eye causes a rapid anæsthesia, with abolition of the palpebral reflexes, mild injection of the conjunctiva, and slight myosis. These symptoms usually pass off in from three to ten minutes, but when the applications are repeated two or three times at an interval of one minute profound anæsthesia, lasting from twenty to twenty-five minutes, is produced.

According to Lapersonne, stovaine as a local anæsthetic is inferior to cocaine for application to the conjunctiva, but contrarily is superior to cocaine for subcutaneous and subconjunctival use; and frequently, especially in ocular instillation, advantage is obtained by the use of a mixture of two parts of stovaine to one part of cocaine. The solutions used by Lapersonne were for instillation, 4 per cent.; for subconjunctival injection, 1 per cent.

Strontium Lactate. *Strontii Lactas, U. S.* 1890. $Sr(C_3H_5O_3)_2.3H_2O = 317.32$.—This salt may be prepared by the process of Thumann, who takes a certain quantity of finely powdered strontium nitrate which is thoroughly washed on a funnel, closed with absorbent cotton, with strong alcohol; after drying, 44.84 Gm. of the strontium nitrate are dissolved in 1 liter of water and 10 Gm. of diluted sulphuric acid added, when all the barium present will be precipitated, together with a small quantity of strontium. The filtrate is treated with an excess of pure sodium carbonate (about 60 Gm. dissolved in 1 liter of water); the precipitated strontium carbonate is washed on a filter to free it from sodium carbonate and sodium nitrate. To the strontium carbonate, contained in a tared beaker, are added 36 Gm. of absolute lactic acid diluted with 200 Cc. of water, and the mixture heated until solution is effected; then sufficient water is added to make the solution weigh 551 Gm., which will then represent 10 per cent. of pure anhydrous strontium lactate. If the salt be desired, the solution may be evaporated, and

the residue granulated. This was officially described as "a white, granular powder, or crystalline nodules, odorless, and having a slightly bitter, saline taste; permanent in the air. Soluble in about 4 parts of water at 15° C. (59° F.), and in less than 0.5 part of boiling water. The solution saturated at a boiling heat remains liquid for many hours, even after being cooled to 0° C. (32° F.). Soluble in alcohol. When heated to 110° C. (230° F.), the salt loses its water (16.9 per cent.). At a higher temperature it first fuses, then is decomposed, giving off inflammable vapors, and leaves a residue of strontium carbonate and carbon, which, on the addition of hydrochloric acid, effervesces and communicates an intense, red color to a non-luminous flame. The aqueous solution (1 in 20) is slightly acid to litmus paper. With calcium sulphate test-solution the solution slowly forms a white precipitate of strontium sulphate, insoluble in diluted acids. The same reaction occurs more quickly with diluted sulphuric acid, potassium sulphate test-solution, or other soluble sulphates. With potassium chromate test-solution it forms a yellow precipitate of strontium chromate, soluble in acetic acid. With ammonium carbonate test-solution, or sodium carbonate test-solution, it forms a white precipitate of strontium carbonate, soluble, with effervescence, in acetic acid. If to 5 Cc. of the solution (1 in 20) 1 Cc. of sulphuric acid be added, and then 1 Cc. of potassium permanganate decinormal volumetric solution, the red color will rapidly disappear, while the mixture will effervesce and give off the odor of aldehyde. If 1 Gm. of the salt be dissolved in 19 Cc. of water, it should form a perfectly clear, colorless solution, leaving no insoluble residue (absence of *carbonate*, *oxalate*, etc.). The aqueous solution should not be affected by hydrogen sulphide test-solution, either before or after acidulation with a drop of hydrochloric acid (absence of *arsenic*, *lead*, etc.); nor by ammonium sulphide test-solution (absence of *iron*, *aluminum*, etc.). No turbidity should be produced in the solution by potassium dichromate test-solution (absence of *barium*). If 0.5 Cc. of silver nitrate test-solution be added to 5 Cc. of the aqueous solution (1 in 20), not more than a slight opalescence should be perceptible (limit of *chloride*, etc.). If 0.5 Gm. of the salt be placed upon a watch-glass, and 1 Cc. of sulphuric acid be carefully poured upon it, no effervescence should occur (absence of *carbonate*, *oxalate*, etc.); nor should any penetrating odor be perceptible, even after gentle heating (absence of *butyrate*, *propionate*, etc.); nor should the acid assume, within ten minutes, a deeper color than a pale straw-yellow (limit of *readily carbonizable*, *organic impurities*). If 1.33 Gm. of the salt, rendered anhydrous, before being weighed, by carefully drying at 110° C. (230° F.), be ignited, until most of the carbon has disappeared, and then distributed in 10 Cc. of water, it should require, for complete neutralization, not less than 9.9 Cc. of normal sulphuric acid (corresponding to at least 98.6 per cent. of the pure salt), methyl-orange being used as indicator." *U. S.* 1890.

Uses.—Strontium lactate was originally brought forward by J. V. Laborde, who found it to have a distinct diuretic action. His researches led to clinical studies of the drug by Germain Sée, Paul, Dujardin-Beaumetz, and others. It is asserted that strontium lactate is an extremely successful remedy in the treatment of *nephritis* and chronic *albuminuria*, the urine being increased, the albumin lessened or entirely removed, and the general nutrition improved. It is stated that the action of this lactate upon the excretion of albumin is especially marked in epithelial and parenchymatous nephritis, but is much less pronounced in interstitial nephritis, and is not present when albuminuria is due to pulmonary congestion; also that it is not necessarily accompanied by an increased flow of urine, and is the result of an influence upon the tissues of the kidneys. Upon the intestinal canal the lactate is asserted to exert a very favorable influence. Strontium lactate has also been tried with alleged good results in the treatment of *rheumatism* and *gout*, it being affirmed that it increases the nitrogenous elimination and causes disappearance of the urates. *Dose*, from ten to thirty grains (0.65–2.0 Gm.) three times a day in solution.

Strontium Sulphide. *Strontii Sulphidum.* SrS. This substance has been used to some extent as a depilatory, in accordance with the following method: A powder of 2 parts strontium sulphide, 3 parts of zinc oxide, and 3 parts of powdered starch, kept dry until used, is formed into a paste with warm water and allowed to remain upon the surface from which the hair is to be removed from one to five minutes, being taken off so soon as pronounced pain or any evidences of caustic action are perceptible. The surface should then be gently but firmly scraped with a blunt edge like that of a paper knife, washed well with warm water, and treated with an emollient.

Strychnine Arsenate. *Strychninæ Arsenas.* J. Russell praises this salt highly as a prompt means of getting the conjoint effects of its constituents; he employs its solution (1 in 250) hypodermically, and states the first *dose* as one-sixty-fourth of a grain, increased to one-fifteenth (0.001–0.004 Gm.). (*W. M. Bl.*, Sept. 1886.)

Strychnos Potatorum, L. *Chilbinj. Clearing Nuts. Indian Gum Nuts.* (Fam. Loganiaceæ.)—The nuts of this species of Strychnos are very largely used in some parts of India for clearing muddy water, and are stated to have found their way into American commerce. (*A. J. P.*, 1871.) The fruit is also employed by the native practitioners of Hindostan, under the name of *nirmali*, as an emetic and in *dysentery*. They do not contain strychnine. In clearing water, one of the dried nuts is rubbed hard for a short time around the inside of the earthen water pot; on settling, the water is left pure and tasteless. The seeds contain a large quantity of an albuminous principle, upon which their virtues probably depend. The tree, which grows to a very large size, produces a shining, black, one-seeded berry (that of the nux vomica being many-seeded). The seeds are described (*P. J.*, 1871, 44) as broadly lenticular, about half an inch in diameter and a quarter of an inch in thickness, of a dirty whitish-gray color, and covered with a thick coating of delicate appressed hairs. These are so small that the seed to the naked eye looks mealy. Under the microscope the hairs are seen to be agglutinated in bundles of from three to six, and to consist each of a single pointed cylindrical cell.

Stylophorum. *Stylophorum diphyllum* (Michx.), Nuttall. (Fam. Papaveraceæ.)—According to E. Schmidt, the root of this American plant contains *chelidonine*, with a second alkaloid closely related to, if not identical with, *chelerythrine*. (*A. J. P.*, 1888.)

Stylosanthes. *Stylosanthes biflora* (L.), B. S. P. (*S. elatior*, Swz.) (Fam. Leguminosæ.) It is asserted that this American plant has the power of relieving abdominal uterine pains during the latter months of gestation, and is also a uterine tonic during parturition. *Dose*, of the fluid-extract, from ten to twenty minims (0.6–1.3 Cc.) three times a day.

Subcutin.—This compound of paraphenolsulphuric acid with paramido-benzoic acid has been brought forward by Ritsert as non-toxic, distinctly germicidal, and locally anæsthetic. It is a white crystalline powder, soluble to the extent of 1 per cent. in cold water, and two and one-half per cent. in tepid water. For hypodermic use to this solution is added about 1 per cent. of ordinary salt. It is stated that it is especially adapted to the production of infiltration anæsthesia.

Sublamine. *Hydrargyri Sulphas Æthylenediaminata.*—This substance is a white powder, soluble in water, composed of three molecules of mercuric sulphate and eight molecules of ethylenediamine, and contains about 43 per cent. of mercury. It was originally brought forward as a non-irritant germicide of exceptional penetrative power, and especially useful for the purpose of disinfecting the hands and skin; used in solution varying from 1 to 1000 up to 1 to 200. It has also been highly commended in 1 to 300 for sterilizing suture silk by boiling.

Sublamine has also been employed to some extent for the hypodermic administration of mercury; one and seven-tenths parts of it are equivalent in the mercurial to one part of the bichloride, but it is affirmed by Schuftan, when given hypodermically, to be more active than corrosive sublimate, probably because it does not coagulate albumin.

Sublimo-Phenol. *Phenolated Mercuric Chloride. Chloro-phenolate of Mercury.*—Colorless crystals produced by precipitation when solutions of mercuric chloride and potassium phenolate are mixed. It is easily soluble in fused phenol or boiling aqueous or alcoholic solutions of phenol. It is used in antiseptic surgery.

Succinic Acid. *Acidum Succinicum. Sal Succini Volatile. Acide succinique*, Fr. *Bernsteinsaure*, G. $H_2C_4H_4O_4$.—This acid is obtained by distilling amber. The product is an aqueous solution of succinic acid, associated with empyreumatic oil. (See *Amber* and *Oil of Amber*, page 1378.) By filtering the liquor the solution of the impure acid passes through, while the oil is absorbed by the paper. The acid may be purified by boiling the solution with nitric acid, diluted with twice its bulk of water, and then evaporating to crystallize: should the crystals not be colorless, the treatment with nitric acid must be repeated until they are so. Succinic acid is made artificially by the action of nitric acid on the fatty acids, and may be produced in a great many ways from various substances. Thus, it is invariably formed in small amount in the alcoholic fermentation of sugar. Desaignes obtained it more advantageously from calcium malate subjected to fermentation excited by casein. The malate was converted into calcium succinate, which was then decomposed by sulphuric acid, so as to yield succinic acid. For the details of the process for obtaining succinic acid from calcium malate, see the paper of E. J. Kohl, in *A. J. P.*, vol. xxvii. July. Succinic acid, when pure, is in white, transparent crystals, having no odor and a somewhat acrid taste. It dissolves in five times its weight of cold and twice its weight of boiling water. It is less soluble in alcohol, and very sparingly so in ether. Nitric acid is without action on it. It melts at 182° C. (359.6° F.), and boils without alteration at 235° C. (455° F.). It sublimes, however, at a much lower temperature. According to Wackenroder, it is sometimes adulterated with tartaric acid soaked in oil of amber. Succinic acid, though formerly official, is at present seldom used in medicine. It has been ascertained to be a product of vital action, having been detected by Heintz in the colorless liquid found in hydatid cysts of the liver. (See *J. P. C.*, Sept. 1850.) One of its salts, *ammonium succinate*, $(NH_4)_2C_4H_4O_4$, made by supersaturating succinic acid with ammonia, evaporating and crystallizing, has been used with great alleged success in *delirium tremens*. This salt is occasionally used as a precipitant of ferric oxide.

For a description of *sodium succinate*, see page 1652.

Sucramine.—This substance, which has been exploited in France as a new sweetening agent, is said to be simply the ammonium salt of saccharin.

Sulfosote. *Potassium creosotic-sulphonate*, or a mixture of *guaiacol- and cresol-sulphonates of potassium.*—Under its proprietary name, sulfosote is supplied in the form of a syrup, of which the *dose* is said to be, for the adult, three fluidrachms (11.25 Cc.). It has been used in various forms of pulmonic disease for the treatment of which creosote is advisable.

Sulphaldehyde is made by the action of hydrogen sulphide upon acetaldehyde in aqueous solution. An oil is obtained which solidifies at low temperatures. According to Lusini (*Nouv. Rem.*, 1890), this substance acts on the lower animals as a powerful hypnotic.

Sulphaminol. $C_6H_4<^{S_2}_{NH}>C_6H_3.OH$. *Thio-oxydiphenylamine.*—This compound is made by the action of sulphur upon the salt of metaoxydiphenylamine. It is a pale yellow powder free from odor and taste, readily soluble in alkalies, more difficultly so in alkaline carbonates, quite insoluble in water. When heated it turns brown, and melts at 155° C. (311° F.). It is asserted that this substance is harmless (see a paper by Kobert, *Journ. de Méd.*, Sept. 1890), and that when taken internally it is split up in the organism into oxydiphenylamine and sulphuric acid compounds. It has been used as a substitute for iodoform, having the advantage of being odorless. Various compound solutions of it have been employed as local applications to the mucous membranes of the nose and larynx, such as *sulphaminol menthol, s. creosote, s. guaiacol, s. eucalyptol.* Internally, it has been given in *doses* of from four to five grains (0.26–0.32 Gm.); externally, it may be used in powder or oily solutions.

Sulphites, Bisulphites, Thiosulphates.—These salts were introduced into medicine because of their extraordinary hostility, through their acid ingredient, to the lower forms, whether of vegetable or animal life. Microscopic plants and animals cannot exist in the presence of sulphurous acid, and, as its salts are easily decomposed, with the liberation of the acid, they are capable of exercising the same destructive influence. In parasitic diseases, such as *scabies, porrigo, prurigo senilis*, different forms of *ringworm, pityriasis versicolor*, the *sore mouth* or *thrush of infants*, etc., the local use of these remedies is often very

efficient. In cases of *fermentative dyspepsia* the sulphites may be of value in checking the changes of the food. At one time it was supposed that they would be of value as germicides in *zymotic disease*, but theory indicates that unless given in poisonous doses they could have no influence upon disease germs in the system, and clinical experience has abundantly shown that they are valueless in infectious diseases.

Of the *sulphites*, those which have been employed are *sodium*, *potassium*, *ammonium*, *magnesium*, and *calcium sulphites*. *Sodium sulphite* is official. (See page 1157.)

Ammonium sulphite may be prepared by passing sulphurous acid to saturation into a solution of ammonium carbonate, and evaporating the solution rapidly, avoiding as far as possible exposure to the air. The sulphites of magnesium and calcium whose carbonates are insoluble may be prepared more advantageously by double decomposition, but calcium sulphite may be prepared by using lime water for the saturation of the sulphurous acid. Whenever evaporation is employed, it should be carefully conducted so as not to drive off the acid, and with as little exposure to the air as possible, as the sulphites in solution are strongly disposed to pass into sulphates. Even in the solid state they slowly undergo the same change, and should therefore be kept, as far as can be conveniently done, excluded from the air. The sulphites in general have a mild sulphurous taste, and on exposure to heat, or with the addition of an acid, emit the characteristic odor of sulphurous acid. They are distinguishable from the *thiosulphates* or *hyposulphites* by not depositing sulphur on the addition of diluted sulphuric acid to their solutions. As the efficiency of the sulphites is ascribable to their acid, they may be used indiscriminately, one being preferred to another according to solubility, or other property affecting the convenience of exhibition.

Sodium, *magnesium*, and *potassium sulphites* have been fully described, and the remarks in reference to their therapeutical application may be considered as applicable to the others. *Ammonium sulphite*, $(NH_4)_2SO_3$, has an acrid sulphurous taste, at first deliquesces in the air, and afterwards dries, gradually being converted into the sulphate by the absorption of oxygen. It is soluble in its weight of cold, and in less than its weight of boiling water. It decrepitates with heat, losing a part of its ammonia, and then sublimes as an acid sulphite. *Calcium sulphite*, $CaSO_3$, is a white powder, and distinguished by its difficult solubility, requiring 800 parts of water for solution. An excess of acid renders it more soluble, and from its hot saturated solution it is deposited, on cooling the liquid, in hexagonal needles.

The influence of these salts on the system in health is feeble. Six drachms have been taken in twenty-four hours, without injury. When taken internally, they are absorbed, and partly eliminated unchanged with the urine, partly changed by the absorption of oxygen into sulphates, as happens on exposure out of the body, the urine at first containing a sulphite, and after twenty-four hours a sulphate. From the largest doses of the sulphites only a laxative effect and an increased secretion of the urine are obtained. Their long-continued use is said to prove injurious, by inducing debility and anæmia. From fifteen grains to a drachm (1.0–3.9 Gm.) may be given, so repeated as to amount to from two drachms to an ounce in twenty-four hours. As almost all acids decompose the sulphites, they should not be administered with any acid substance. Should the bowels be disturbed, a little of some opiate may be given. For external use, one part of the salt employed may be dissolved in from five to ten parts of water.

Acid Sulphites (*Bisulphites*).—These are quite as efficient as the sulphites, probably more so, in consequence of their relatively greater proportion of acid. They might be and probably are used indiscriminately with the sulphites, as, in the preparation of the latter by the direct union of their constituents, the sulphurous acid may readily be used in excess, and thus give rise to the bisulphite. Indeed, Berzelius states that the salt formed by passing sulphurous acid through a solution of sodium carbonate until the liquid shall sensibly redden litmus paper, is really sodium bisulphite, and that the sulphite may be prepared by adding to this salt a quantity of soda equal to that already contained in it. The bisulphites generally may be prepared by passing sulphurous acid in excess through the alkaline solution, or through the solution of a sulphite already formed. (See also *P. J.*, 1872, 844.) They may be distinguished from the sulphites by their strong odor of sulphurous acid and by the fact that they are neutral or faintly acid to test paper, while the latter salts have a feeble alkaline reaction. They may be given for the same purposes and in the same dose and by the same method of administration as the sulphites. Some years since (*P. J.*, 1867), W. Lascelles Scott called attention to the *calcium bisulphite* as a very valuable preservative; but his statements have not led to the practical use of the drug.

Thiosulphates (*Hyposulphites* or *Sulpho-sulphates*).—These may be considered as absolutely identical for therapeutic purposes with the sulphites, as, when they undergo decomposition, sulphurous acid is eliminated. The hyposulphites consist of bases combined with an acid, which, in the free state, would be $H_2S_2O_3$, but which, when liberated, separates into sulphurous acid and sulphur. They are prepared by boiling a sulphite or bisulphite in solution with sulphur, as in the example of sodium thiosulphate,

$$2Na_2SO_3 + S_2 = 2Na_2S_2O_3$$

or are made on a larger scale by passing sulphur dioxide into the calcium sulphide liquor of the alkali waste, whereby calcium thiosulphate is formed. This may then be changed into the sodium salt by the action of sodium sulphate, yielding sodium thiosulphate and calcium sulphate. The chief advantage possessed by the thiosulphates or hyposulphites is that they are less disposed than the sulphites to change into sulphates by the absorption of oxygen. They may be recognized by the deposition of sulphur when an acid is added to their solutions. They are freely soluble in water, even the calcium and magnesium thiosulphates. They may be used for the same purposes and in the same doses as the sulphites, and administered in the same way.

Sulphoricinic Acid.—This is made by the action of from 30 to 40 per cent. sulphuric acid upon castor oil at a temperature not exceeding 50° C. (122° F.), care being taken to avoid the evolution of sulphur dioxide. On the addition of water, sulphoricinic acid with unchanged oil separates in an oily layer from the aqueous solution of acid below. This substance is a powerful local irritant. Berlioz states that the acid and its soluble salts are actively antiseptic and deodorizant; useful as

a local application in *ozæna* and other affections. (*S. M.*, March 11, 1891.) *Sodium sulphoricinate*, $C_{18}H_{33}O_2OSO_3$, forms a brown liquid, miscible with water and alcohol, with a feebly alkaline reaction. It has the power of dissolving powerful antiseptic substances as phosphorus, iodine, phenol, resorcinol, naphthalene, and other substances making strongly antiseptic solutions. Of these preparations the only one of importance is the *phenol sodium-sulphoricinicum*, often incorrectly known as *phenol sulphoricinicum*.

Phenolum Natrio-sulphoricinicum (*phenol sulphoricinate*) is a yellowish syrupy liquid, containing 20 per cent. of phenol and 80 per cent. of sodium sulphoricinate. The liquid itself mixes in all proportions with water, and has been especially commended as a local application in various *diseases of the skin* and in *tubercular* and other *ulcerations of the mucous membranes*. First recommended by T. Heryng (*Th. M.*, 1896) as a local caustic application to *papilloma* and *ulcers* in the nasal and laryngeal passages, or diluted in various forms of chronic inflammation of the mucous membrane of the nose and larynx. These statements have been confirmed by various laryngologists. Prezedborski finds it of very great service both in *rhinitis atrophica* and *hypertrophica*. Berlioz (*B. G. T.*, 1890) especially recommends it in *diphtheria*. The 20 per cent. aqueous solution is to be applied locally to the throat four times a day and once or twice in the night. (*S. M.*, 1892.) *Naphthol sulphoricinate, salol sulphoricinate,* and *creosote sulphoricinate* have also been made and used as local agents.

Sulphosalicylic Acid. *Salicyl-sulphonic Acid.* $C_6H_3SO_3H.OH.COOH$.—Made by acting upon salicylic acid with strong sulphuric acid. It is in the form of white acicular crystals, soluble in water and alcohol. Sulphosalicylic acid is used, like sodium salicylate, in rheumatism, but its chief value lies in its use as a reagent to detect the presence of proteids of all kinds. Egg-albumin (1 in 12,500) can be detected by this reagent, forming a dense white precipitate which is not redissolved on boiling. It is used to detect albumin, peptones, globulins and fibrin. Albumoses and peptones redissolve when boiled but again separate on cooling.

Sweet Pellitory.—The root of *Tanacetum umbelliferum*, Boiss. (Fam. Compositæ), of India, according to David Hooper, contains pyrethrine in minute proportions with fat and wax, an organic acid which is a pigment, glucose, and inulin. (*P. J.*, xxi. 1890.)

Swietenia. *Swietenia febrifuga*, Roxb. (*Soymida febrifuga*, Juss.) *Rohun Bark.* (Fam. Meliaceæ.)—The bark of this East Indian tree is said to be much used as an antiperiodic in half drachm (2 Gm.) *doses*.

Swietenia Mahogoni, Jacq., or *mahogany tree*, which grows in the West Indies and other parts of tropical America, has also a bitter, astringent bark, containing catechin (*Bull. Soc. Chim. Paris*, xxiv. 118). The bark of *S. senegalensis*, Desv. (*Khaya senegalensis*, A. Juss.), *Juribali bark*, is used on the coast of Africa in the cure of *intermittents*, and Caventou extracted an alkaloid from it. (*Am. J. M. S.*, N. S., xx. 168.)

Sycose.—This name has been applied to saccharin and also to preparations of saccharin. (See *Benzosulphinidum*, p. 234.)

Symphorol. *Symphoral. Sodium, Lithium,* or *Strontium Caffeine-sulphonates.*—The name symphorol is applied to either of the salts above mentioned. They are colorless, odorless, bitter powders. The sodium salt is used as a diuretic, the lithium salt in *gout* and *rheumatism*, and the strontium salt in *Bright's disease*.

Symphytum. *Symphytum officinale*, L. *Comfrey. Radix Symphiti. Radix Consolidæ Majoris. Consoude*, Fr. *Schwarzwurz, Beinwurz*, G.—A perennial European plant often cultivated. Its root is spindle-shaped, branched, often more than an inch thick and a foot long, externally smooth and blackish, internally white, fleshy, and juicy. By drying it becomes wrinkled, of a firm, horny consistence, and of a dark color within. It is almost inodorous, and has a mucilaginous, feebly astringent taste. It contains mucilage in great abundance (according to Lewis, more than althæa root) and a little tannin. It was formerly highly esteemed as a vulnerary. Its virtues are those of a demulcent, like marshmallow, and it is used domestically in *chronic catarrhs, consumption*, and other lung diseases.

Symplocos. *Symplocos racemosa*, Roxb. (Fam. Styraceæ.)—The bark of this East Indian tree is said to be a mild astringent, and especially useful in *menorrhagia*. (*P. J.*, Sept. 24, 1881.)

Synanthrose. *Lævulin.* $C_6H_{10}O_5$.—This is a carbohydrate, isomeric with inulin, discovered by O. Popp in *Helianthus tuberosus*, L. (Fam. Compositæ.) For details, see Tollens, *Kohlenhydrate*, 198.

Syringa. *Syringa vulgaris*, L. *Common Lilac.* (Fam. Oleaceæ.)—The leaves and fruit of this common garden plant have a bitter and somewhat acrid taste, and have been used as tonics and antiperiodics. Petroz and Robinet found in the fruit a sweet and a bitter principle. The latter was afterwards obtained pure by Meillet, who gave it the name of *lilacin*, and by Bernays, who called it *syringin*. It has been investigated by Kromayer (*A. Pharm.* (2), 113, 19), who established its glucosidal character, gave it the formula $C_{17}H_{24}O_9 + H_2O$, and showed its identity with the *ligustrin* of Polex. It forms long white stellate needles, which are tasteless, easily soluble in hot water and alcohol, insoluble in ether. The crystals become anhydrous at 115° C. (239° F.), and fuse at 212° C. (413.6° F.). On heating with dilute acids it breaks up into *syringenin*, $C_{11}H_{14}O_4$, and a fermentable glucose. The *syringenin* (which has been recognized as *oxymethyl coniferin*) is a light rose-red amorphous mass, soluble in alcohol, insoluble in water and ether.

Syrup of Ferrous Bromide. Syrupus Ferri Bromidi, U. S. 1880. *Syrup of Bromide of Iron.* "A syrupy liquid containing 10 per cent. of Ferrous Bromide. Iron, in the form of fine wire, and cut into small pieces, *thirty parts* [or one and a half ounces av.]; Bromine, *seventy-five parts* [or nine fluidrachms]; Sugar, in coarse powder, *six hundred parts* [or twenty-eight ounces av.]; Distilled Water, *a sufficient quantity*, to make *one thousand parts* [or about two pints]. Introduce the Iron into a flask of thin glass of suitable capacity, add to it *two hundred parts* [or nine fluidounces] of Distilled Water and afterwards the Bromine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color and has lost the odor of Bromine. Place the Sugar in a porcelain capsule and filter the solution of bromide of iron into the Sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand-bath, and, having strained the Syrup through linen into a tared bottle, add

enough Distilled Water to make the product weigh *one thousand parts* [or measure two pints]. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place not accessible to daylight." *U. S.* 1880. Although this syrup is not so sensitive to the oxidizing action of the air as syrup of ferrous iodide, it is preferable to filter the solution into hot syrup instead of into sugar in an open capsule. It is "a transparent, pale green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium it yields a blue precipitate. If a little carbon disulphide be added to the Syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a yellow or brown color. It should not deposit a sediment on keeping, and should not tinge gelatinized starch yellow (absence of free bromine). 5.39 Gm. of the Syrup should require for complete precipitation 50 Cc. of the volumetric solution of nitrate of silver (corresponding to 10 per cent. of ferrous bromide)." *U. S.* 1880. Ferrous bromide has been recommended as a sedative chalybeate tonic, and has been especially praised by Jacob Da Costa in *chorea*. In an extended trial of it by H. C. Wood, it failed entirely to be of service. It is not an eligible chalybeate. *Dose*, of the syrup, from one-half to one fluidrachm (1.8–3.75 Cc.), equal to about four to eight grains of the bromide.

Tacamahac. *Tacamahaca.*—The resinous substance commonly known by this name is supposed to be derived from *Bursera tomentosa*, Triana (*Fagara octandra*, L., *Elaphrium tomentosum*, Jacq., *Amyris tomentosa*, Spreng.), a tree of considerable size, of the fam. Burseraceæ, growing in the island of Curaçoa and in Venezuela. The juice exudes spontaneously, and hardens on exposure. As brought into the market, it is in irregularly shaped pieces of various sizes, some not larger than a mustard seed, others as much as an inch or two in diameter. The color is usually light yellowish or reddish-brown, but in the larger masses is more or less diversified. The pieces are in general translucent, though frequently covered with powder upon their surface, so as to render them apparently opaque. They are heavier than water, brittle, and pulverizable, yielding a pale yellow powder. Their odor is resinous and agreeable, their taste bitter, balsamic, and somewhat acrid. Exposed to heat, they melt and exhale a stronger odor. Tacamahac is partially soluble in alcohol, and completely so in ether and the fixed oils. It consists of resin with a little volatile oil.

Another variety is obtained from the East Indies, and called *tacamahaca orientale*, or *tacamahaca in testis*. It is supposed to be derived from *Calophyllum Inophyllum*, L., and comes into the market in gourd shells covered with rush leaves. It is of a pale yellow color inclining to green, slightly translucent, soft, and adhesive, of an agreeable odor, and an aromatic bitterish taste. It is at present very rare in commerce. The tree which yields this resin produces a drupe, about as large as a plum, from the seeds of which 50 per cent. of a greenish-yellow fixed oil is obtained by expression, which is used in India for lamps, and as a local application in the *itch*. (*J. P. C.*, 1861, 23.) Guibourt describes several other varieties of tacamahac, which, however, are little known. Among them is a soft, adhesive, dark green oleoresin (*J. P. C.*, 3e sér., xxiv. 396), said to be procured from the *Calophyllum Tacamahaca*, Willd., growing in the islands of Réunion and Madagascar. (See also Pennetier, *Matières Premières*, 642.)

Tacamahac was formerly highly esteemed as an internal remedy, but is now used only in ointments and plasters. Its properties are analogous to those of the turpentines. It is sometimes used as incense.

Tachia. *Tachia guyanensis.*—The root of this tree (Fam. Gentianaceæ) is used under the name of *Caferana*, in Brazil, as an antiperiodic and tonic. According to Peckoldt it contains an organic crystalline substance, *caferanine*. (See *Merck's Bericht*, 1889; also *Ber. d. Chem. Ges.*, 1899, No. 7.)

Taka Diastase.—This ferment is formed by the action of a fungus (*Moyashi; Aspergillus oryzæ*, Cohn., *Eurotium oryzæ*, Ahlburg; for description, see *A. J. P.*, 1898, 137) upon steamed rice, and is used in Japan, where it is known by the name of *koji*, in the preparation of the national intoxicating beverage *sake*. It has also been employed to act upon maize in the making of whisky. It is a yellowish-white, highly hygroscopic powder, almost tasteless, freely soluble in water. It is capable, under proper conditions, of converting one hundred times its weight of starch in ten minutes into glucose. Its action resembles very closely that of saliva; according to the experiments of Julius Friedenwald (*N. Y. M. J.*, 1897), it not only aids in the digestion of the starches, but serves the other function of the saliva in stimulating the gastric secretion, and thereby promoting the proteid digestion. It would seem, therefore, to be especially indicated as an artificial digestant in cases in which there is a deficiency of saliva.

There is much clinical evidence on record as to its value in all cases in which there is loss of power of digesting starches, and the correctness of Armstrong's assertion (*Liverpool Med.-Chir. Journ.*, 1897), that it is especially valuable in gouty persons in whom the starch digestion is often feeble, would seem to be well founded. In Friedenwald's experiments with test breakfasts it was found not to affect normal gastric digestion, and to be of very little value in pure *nervous dyspepsia*. In cases of *gastric catarrh*, with subacidity, it appeared to have a tendency to increase the acidity of the gastric juices and to promote the digestion of starches. Its greatest applicability, however, was found to be in cases of hyperacidity, in which it is stated to diminish the excess of acid and increase gastric peristalsis. It should be given in the middle of the meal, in *doses* of from five to ten grains (0.32–0.65 Gm.), in capsules; or, after the meal, in slightly alkaline solution.

Tanacetum. *U. S.* 1890. *Tansy.*—Under this name the U. S. Pharmacopœia formerly recognized the tops and leaves of the *Tanacetum vulgare*, L., a perennial herbaceous plant rising two or three feet in height, which is cultivated in our gardens, although growing wild in the roads and in old fields. It was originally introduced from Europe. It is in flower from July to September.

Tansy was officially described as follows: "Leaves about 15 Cm. [six inches] long; bipinnatifid, the segments oblong, obtuse, serrate or incised, smooth, dark green, and glandular; flower-heads corymbose, with an imbricated involucre, a convex, naked receptacle, and numerous yellow, tubular florets." *U. S.* 1890. The odor is strong, peculiar, and fragrant, but much diminished by drying; the taste is warm, bitter, somewhat acrid,

and aromatic. These properties are imparted to water and alcohol. According to Leppig (*In. Dis.*, Dorpat, 1882), both the flowers and the leaves contain the following constituents: *tanacetin*, tannic acid (*tanacetum-tannic acid*), traces of gallic acid, volatile oil, a wax-like substance, albuminoids, tartaric, citric, and malic acids, traces of oxalic acid, a lævogyrate sugar, resin, metarabic acid, pararabin, and woody fibre. Of these the most important are the bitter principle *tanacetin*, to which Leppig gives the formula $C_{11}H_{16}O_4$, a compound first discovered by Homolle (1845), the tannic acid, to which he gives the formula $C_{23}H_{29}O_{31}$, and the volatile oil, of which the flowers yielded 1.49 per cent. and the leaves 0.66 per cent. The *tanacetic acid* of Peschier he considers to be impure malic acid, an opinion shared by Husemann. (*Pflanzenstoffe*, 2d ed., 1884, p. 1531.) The bitter principle tanacetin forms a very hygroscopic, brownish, amorphous mass, easily soluble in alcohol and in water, insoluble in ether. It possesses a taste at first characteristically bitter like willow bark, and then cooling and caustic. The essential oil was investigated by Bruylants (*Ber. d. Chem. Ges.*, xi. 449), according to whom it consisted of a terpene, $C_{10}H_{16}$, boiling at from 155° to 160° C. (311°–320° F.), of which 1 per cent. only is present, an aldehyde, $C_{10}H_{16}O$, boiling at from 195° to 196° C. (383°–384.8° F.), of which 70 per cent. was obtained, and an alcohol (borneol), $C_{10}H_{18}O$, boiling at from 203° to 205° C. (397.4–401° F.), of which 26 per cent. was present. Semmler (*Ber. d. Chem. Ges.*, xxv. 3343, 3352, 3513) has specially investigated the constituent boiling at 195° C. (383° F.), and having the composition $C_{10}H_{16}O$. He finds it to be not an aldehyde, but a ketone, and calls it *tanacetone*. It is identical with the ketone found in sage oil, wormwood oil, and thuja oil. As it was first identified in this last-named oil by Wallach, and named by him *thujone*, this name is now applied to it to the exclusion of the other. (See also *Schim. Rep.*, April, 1893, and April, 1897; and Gildemeister and Hoffmann, *Aetherische Oele*).

Tansy adds to the medicinal properties of the aromatic bitters those of an irritant narcotic. It has been recommended in *intermittents*, *hysteria*, and *amenorrhœa*, but in this country is little employed in regular practice. The seeds are said to be most effectual as a vermifuge. The *dose* of the powder is from thirty grains to a drachm (2.0–3.9 Gm.) two or three times a day; but the infusion is more frequently administered. Tansy has been used to a considerable extent as a domestic abortifacient, but is not only very uncertain but also very dangerous in its action, and has in various cases produced death. The symptoms caused by it have been abdominal pain, vomiting, violent epileptic convulsions often followed by profound coma, dilated pupils, great disturbances of respiration, frequent and feeble pulse, and death, which has been said to be from heart failure, but is probably the outcome of a paralytic asphyxia. The minimum fatal dose can scarcely be considered to have been positively ascertained, but a fluidrachm (3.75 Cc.) of the oil is said to have caused death, although recovery in one case occurred after taking half a fluidounce. Tansy tea has also caused death. (For cases, see *Am. J. M. S.*, xvi., xxiii., xxiv.; *J. P. C.*, April, 1870; also H. C. Wood's *Therapeutics*.) Post-mortems have been reported in which no inflammation of the gastro-intestinal mucous membranes could be discovered.

Tanghinia. *Ordeal Bean of Madagascar.—Tanghinia venenifera*, Poir. (*Cerbera Tanghin*, Hook.) (Fam. Apocynaceæ), has been investigated, and, according to C. E. Quinquaud, is both a respiratory and a cardiac poison. (*C. R. A. S.*, cl. 534. See also *T. G.*, vol. ii. 610.) The active principle, *tanghinin*, occurs in colorless lustrous scales, efflorescing in the air, having a bitter and sharp taste, soluble in alcohol, ether, and acetic acid.

Tang-kui or **Man-mu.**—Under these names from time immemorial there has been used in China as an emmenagogue the root of an araliaceous plant, the fluidextract of which has been placed upon the market by Merck under the name of *eumenol*. It has been recommended by various clinicians in the treatment of *dysmenorrhœa* and *amenorrhœa*, given in *doses* of one to two fluidrachms (3.75–7.5 Cc.) three times a day during the menstrual week. Bufalini, having searched in vain for an active alkaloid, believes that the activity of the substance depends upon an ethereal oil.

Tannalbin. *Tannin Albuminate.*—This compound, suggested by Gottlieb, is made by adding to ten parts of a 10 per cent. solution of albumin, six and a half parts of a 10 per cent. solution of tannin; the precipitate is collected, washed, pressed, and dried by exposure to heat (about 110° C., 230° F.) for six hours. It contains about one-half its weight of tannin. It is a light brown powder, insoluble in water and in the gastric juice, tasteless, odorless, and not at all irritant to the mucous membranes. As an astringent it is very feeble, but, as the tannic acid is probably liberated in the intestines, it is a valuable remedy in the treatment of *chronic diarrhœa* dependent upon intestinal relaxation, and has even been used with asserted satisfaction when there were intestinal catarrh and ulceration. It does not disturb the digestion, indeed, has been highly commended in *gastric catarrh* with excessive secretion of mucus. It has also been found useful in *chronic albuminuria*, especially in lessening the amount of albumin in the urine. *Dose*, from fifteen to thirty grains (1–2 Gm.), three to six times a day, in capsule or powder.

Tannalum. *Tannal. Basic Aluminum Tannate.* $Al(OH)_2(C_{14}H_9O_9) + 5H_2O$.—This is a brownish-yellow powder, insoluble in water, which has been especially commended by Heymann as a mild, astringent, non-irritant substance, to be used as a dusting powder or by insufflation in diseases of the nasal and laryngeal mucous membranes. By the action of tartaric acid it becomes converted into the so-called *soluble tannal*, $Al(C_4H_4O_6)(C_{14}H_9O_9) + 3H_2O$, also used locally.

Tannigen. *Diacetyl Tannic Acid.* $C_{14}H_8(CO\,CH_3)_2O_9$.—This compound, which is prepared by the action of acetic anhydride or acetyl chloride upon tannin, is the diacetic ester of tannic acid. It is a yellowish-gray, tasteless and odorless, slightly hygroscopic powder, which can be heated to 180° C. (356° F.), without alteration; insoluble in cold water, readily soluble in alcohol, dissolving in diluted solution of sodium phosphate, soda, or borax, with the production of a yellowish-brown color. It has been used as a mild astringent in chronic *diarrhœas*, especially in such as often accompany *phthisis*, and as a local application by insufflation in chronic *rhinitis* and *laryngitis*. *Dose*, from ten to fifteen grains (0.65–1.0 Gm.) three or four times a day, in capsules; to children it may be given spread on bread and butter.

Tannochrom is found in commerce as a gray insoluble powder containing fifty per cent. of a compound of chromium bitannate and resorcinol; a fifty per cent. solution is also used which is miscible with water, alcohol and glycerin. The powder is used in the treatment of *eczema* and other skin diseases, and the liquid in one-fourth to one-half per cent. solution in *gonorrhœa*.

Tannocol. *Gelatin-tannate.*—This is a tasteless, odorless powder, containing about 50 per cent. of tannic acid, having the same therapeutic properties and applications as tannalbin. It is claimed by Rosenheim that it is superior to that substance in being cheaper, of greater constancy of constitution, and less apt to be affected by the gastric juices. In the intestines it is decomposed by the alkaline secretions and tannic acid is liberated. *Dose*, fifteen to thirty grains (1–2 Gm.).

Tannoform. *Methylene Ditannin.* $CH_2(C_{14}H_9O_9)_2$.—A new class of bodies has been prepared by Merck which are termed tannoforms, and which consist of combinations between the various characteristic tannins and formaldehyde. These bodies are formed by adding a solution of formaldehyde gas to a purified plant extract containing the plant tannin in the presence of hydrochloric acid. The further nomenclature of the tannoforms depends upon the name of the plant from which the particular tannin is derived.

The condensation product of gallotannic acid and formaldehyde, which is termed simply tannoform, is made by dissolving five grammes of tannin in about fifteen kilogrammes of hot water, adding three kilogrammes of 30 per cent. formaldehyde, and then adding concentrated hydrochloric acid until no further precipitate is thrown down. This requires about twelve to fifteen kilogrammes of acid. The precipitate is then washed with water and dried at a low temperature.

Tannoform occurs as a light pinkish-white powder which decomposes at about 230° C. (446° F.). It is dissolved by alcohol and is insoluble in all the usual organic solvents; but is soluble in diluted ammonia, sodium or potassium hydroxide solutions, giving a brownish-red solution, from which it is again precipitated upon the addition of an acid. When warmed with concentrated sulphuric acid it dissolves with a brown color, turning on further heating to green, and then to blue. This green or blue solution gives a blue color with alcohol, which on standing some time turns to a wine-red, and on dilution with soda solution to a grass-green color. It has been chiefly used as a local remedy in the treatment of *eczema, bed sores, local hyperidroses, chancres*, etc. Von Oefele recommends it especially in *pruritus vaginæ*. Tannoform has also been commended as an external remedy in various affections of the skin with discharges, and in excessive sweating. In cases of night sweats the trunk should be bathed with alcohol and then a powder consisting of one part of tannoform and two parts of talc, should be well rubbed into the skin. In *hyperidrosis of the feet* it is stated that if for eight days, at bedtime, after a foot bath, powder of tannoform and talc (1 to 2) be well rubbed into the feet and between the toes, a most pronounced effect will be produced and will last for many weeks. It may be used as a dusting powder, or often with advantage mixed with starch.

It is stated that tannoform is decomposed in the intestines by the pancreatic juices, and acts as an astringent through its tannic acid, and as an antiseptic through its formaldehyde. It has been used with alleged good result in acute and chronic *enteritis* and other forms of *diarrhœa*, in *doses* of from five to fifteen grains (0.32–1.0 Gm.), in capsule, from three to six times a day.

Tannoguaiaform is a compound of tannic acid, guaiacol and formaldehyde. It is odorless and tasteless and has been recommended as an intestinal astringent and antiseptic particularly suited to the treatment of intestinal tuberculosis, as it probably liberates formaldehyde in the intestines. Care should be used in prescribing it. *Dose*, eight to fifteen grains (0.5–1.0 Gm.).

Tannon.—*Tannopin*, $(CH_2)_6N_4(C_{14}H_{10}O_9)_3$, is a condensation product of tannin and hexamethylenetetramine. It is a light brown, tasteless and odorless, non-hygroscopic powder, insoluble in water, weak acids, spirit, and ether, but dissolving slowly in dilute alkaline solution. It has been used by Schreiber (*D. M. W.*, 1897) in *diarrhœa* in *doses* of fifteen grains (1.0 Gm.) from three to four times a day.

Tapioca.—Under this name the U. S. P. formerly recognized the fecula obtained from *Manihot Manihot* (L.), Lyons (*Jatropha Manihot*, L., *Janipha Manihot*, H. B. K., *Manihot utilissima*, Pohl, *B. & T.* 235), the *cassava* plant or *manioc* of the West Indies, the *mandioca* or *tapioca* of Brazil. It is a shrub belonging to the Euphorbiaceæ, about six or eight feet high, with a very large, white, fleshy, tuberous root, which often weighs thirty pounds. The stem is round, jointed, and furnished at its upper part with alternate petiolate leaves, deeply divided into three, five, or seven oval-lanceolate, very acute lobes, which are somewhat wavy upon their borders, deep green on their upper surface, glaucous and whitish beneath. The flowers are in axillary racemes.

The manihot plant is a native of South America, and is cultivated extensively in the West Indies, Brazil, and other parts of tropical America, and in Liberia, for the sake of its root, which is much employed as an article of food. It can also be grown successfully in Florida and other Southern States. (See *Forty-fourth Bulletin U. S. Dept. Agriculture.*) The plant is propagated by cuttings. It is of quick growth, and the root arrives at perfection in about eight months. There are two chief varieties, but it is said that in Brazil as many as thirty different forms of the plant are recognized by cultivators. The root of the *sweet* cassava may be eaten with impunity; that of the *bitter*, which is the most extensively cultivated, abounds in an acrid, milky juice, which renders it highly poisonous if eaten in the recent state. Henry and Boutron Chalard affirm that the bitter cassava contains hydrocyanic acid (*J. P. C.*, xxii. 119), but Peckoldt claims that its poisonous effects are due to *manihotoxine* (*Ph. Rund.*, iv. 1890). Both varieties contain a large proportion of starch. The root is prepared for use by washing, scraping, and grating or grinding it into a pulp, which, in the bitter variety, is submitted to pressure so as to separate the deleterious juice. It is dried, and in the state of meal or powder is made into bread, cakes, or puddings. As the poisonous principle is volatile, the portion which may have remained in the meal is entirely dissipated by the heat employed in cooking. The preparation denominated tapioca among us is obtained from the expressed juice. This, upon standing, deposits a powder, which, after repeated washings with cold water, is nearly pure starch. It is dried by exposure to heat, which renders it partially soluble in cold water, and

enables it to assume its characteristic consistence. When dried without heat, it is pulverulent, and closely resembles the fecula of arrow root. In Demerara, as we are told by Pagot, the manioc juice, after having been deprived of injurious properties by boiling, is used as a sauce. (*P. J.*, 1873.)

The preparation of tapioca in Malacca is thus described by James Collins: The fresh root-stocks are thoroughly washed in tubs in a constant stream of water by scantily clad Chinese, and then peeled like turnips; they are then sliced in one machine and pulped in another, the pulp being removed in cane baskets to large wooden frames, with calico bottoms; a powerful stream of water is allowed to fall upon the pulp, a sifting motion being communicated to the strainer; as the starch is washed out, it is received into inclined troughs, and, while in a state of suspension, run into settling vats. There it is stirred and washed, and, while moist, it is removed to the drying room. Two kinds of tapioca are prepared. The flour is made by heating slightly by fires placed underneath; it is constantly stirred, and turned over with iron shovels, to prevent agglutination and insure equal drying. Granular tapioca is made as follows. A long range of quallies, or small, shallow iron pans, are slightly tilted forward on ledges of brickwork, and heated with a wood fire. Each operator has a quallie and fire to himself. Taking a quantity of damp starch, he stirs it round and round with an iron shovel, and the heat is sufficient to cause the tapioca to become agglutinated together in small masses, and coated with dextrin. The drying is done with great skill, and with an open fire. (*C. D.*, 1884.) Tapioca is also made at present on a large scale in Malacca with steam apparatus.

Tapioca is in irregular, hard, white, rough grains, possessing little taste, partially soluble in cold water, and affording a fine blue color when iodine is added to its filtered solution. The partial solubility in cold water is owing to the rupture of the starch granules by heat. Examined under the microscope, the granules appear partly broken, partly entire. The latter are muller-shaped, about the two-thousandth of an inch in diameter, more uniform in size than the granules of most other varieties of fecula, with a distinct hilum, which is surrounded by rings, and cracks in a stellate manner. *Tapioca meal*, called sometimes *Brazilian arrow root*, and by the French *moussache*, is the fecula dried without heat. Its granules are identical with those already described. Being nutritious, and at the same time easy of digestion and destitute of irritating properties, tapioca forms an excellent diet for the sick and convalescent. It is prepared for use by boiling it in water. Lemon juice and sugar are usually grateful additions, and in *low states of disease* or cases of *debility* it may be impregnated with wine and nutmeg or other aromatic.

A factitious tapioca is found in commerce, consisting of very small, smooth, spherical grains, and supposed to be prepared from potato starch. It is sold under the name of *pearl tapioca*.

Cassaripe is the thickened gum obtained from the root of the bitter cassava, which is said to be innocuous and so actively antiseptic as to be habitually used in Brazil for the preservation of meat. According to S. D. Risley (*Phila. Med. Journ.*, 1899), the 10 per cent. ointment of cassaripe is useful in *suppurating conjunctivitis* and *ulcers* of the *cornea*, applied with gentle massage three or four times a day.

Taxus. *Taxus baccata*, L. *Common European Yew Tree. If commun*, Fr. *Eibe*, G. (Fam. Coniferæ.)—The fruit of this handsome evergreen appears to be a deadly poison. In a fatal case the child was found semi-comatose, with convulsions, a cold and clammy skin, difficult respirations, dilated pupils, and making attempts at vomiting. The poison is probably in the seeds. (See 16th edition, *U. S. D.*; also James Thompson, *L. L.*, 1868, 530. For fatal cases in adults, see *M. T. G.*, 1870, ii.; also *L. L.*, 1870, 471; also *P. J.*, viii. 361.) W. Marmé obtained from yew seeds and leaves an alkaloid, $C_{37}H_{51}NO_{10}$, to which the name of *taxine* has been given. It was a white, poisonous, crystalline powder, only slightly soluble in water, easily soluble in ether, alcohol, chloroform, benzene, and carbon disulphide, but not in petroleum benzin. It fused at 80° C. (176° F.). With concentrated sulphuric acid it gave a red color, but dissolved without color in nitric and phosphoric acids. (*A. J. P.*, 1876, 353.) For Vreven's method of isolating taxine, see *P. J.*, 1896, 215. Amato and Capparelli (*Gazz. Chim.*, x. 349) prepared from the leaves a volatile alkaloid, which was soluble in cold sulphuric acid with yellow color, becoming red on heating. They also isolated a nitrogenous crystalline and colorless principle, fusing at from 86° to 87° C. (186.8°–188.6° F.), soluble in alcohol, insoluble in water, named *milossin*.

Tayuya.—The root of the *Dermophylla pendulina*, Manso (Fam. Cucurbitaceæ), is used in Brazil, under the name of *tayuya*, in *syphilis*, etc. (*N. R.*, 1877, 234); also, under the same name, the root of the *Trianosperma ficifolia*, Mart. (*Cayapoina martiana*, Cogn.), also of the fam. Cucurbitaceæ (*P. J.*, x. 667), and probably various other roots. In *T. ficifolia* two alkaloids, *trianospermine* and *trianospermitine*, and a bitter principle, *tayuyin*, have been found by Peckoldt (*P. J.*, x. 667), and in *T. dermophylla* a green resin, bitter extractive, and tannic acid were found by the same investigator. (*B. G. T.*, lxxxiv., xci. See also *Proc. A. Ph. A.*, xxiv.)

Tea. *Thé*, Fr. *Thee*, G.—The plant which furnishes tea—*Thea chinensis*, L. (*Camellia theifera*, Griff., *C. Thea*, Link)—is an evergreen shrub belonging to the fam. Ternstrœmiaceæ. It is usually from four to eight feet high, though capable, in a favorable situation, of attaining the height of thirty feet. It has numerous alternate branches, furnished with elliptical-oblong or lanceolate, pointed leaves, which are serrate except at the base, smooth on both sides, green, shining, marked with one rib and many transverse veins, and supported alternately upon short footstalks. They are two or three inches long, and from half an inch to an inch in breadth. The flowers are either solitary or supported, two or three together, at the axils of the leaves. They are of considerable size, not unlike those of the myrtle in appearance, consisting of a short green calyx with five or six lobes, of a corolla with from four to nine large unequal snow-white petals, of numerous stamens with yellow anthers and connected at their base, and of a pistil with a three-parted style. The fruit is a three-celled and three-seeded capsule. It has not been certainly determined whether more than one species of the tea plant exists. Linnæus admitted two species—*T. Bohea* and *T. viridis*—differing in the number of their petals; but this ground of distinction is untenable, as the petals are known to vary very much in the same plant. Hayne makes three species—*T. stricta*, *T. Bohea*, and *T. viridis*—which are distinguished severally by the

shape of their leaves and fruit and the direction of the footstalk. De Candolle admits but one species, with two varieties,—the *viridis* or green tea, with "lanceolate flat leaves, three times as long as they are broad," and the *Bohea*, with "elliptical-oblong, subrugose leaves, twice as long as broad." Lindley recognizes the two Linnæan species, distinguishing them by the leaves, which in *T. viridis* are acuminate, and emarginate at the apex, and in *T. Bohea* are smaller, flatter, darker green, with small serratures, and terminate gradually in a point, but are not at all acuminate or emarginate. (*Flora Medica*, 120.)

The tea plant is a native of China and Japan, and is cultivated in both countries, but most abundantly in the former. In Japan it forms hedge rows around the rice and corn fields; in China, whence immense quantities of tea are exported, whole fields are devoted to its culture. It is propagated from the seeds, which are planted in holes at certain distances, six or eight seeds being placed in each hole, in order to secure the growth of one. In three years the plant yields leaves for collection, and in six attains the height of a man. When from seven to ten years old, it is cut down, in order that the numerous shoots which issue from the stump may afford a larger product of the leaves. These are picked separately by hand. Three harvests, according to Kaempfer, are usually made during the year: the first at the end of February, the second at the beginning of April, and the third in June. As the youngest leaves are the best, the product of the first collection is most valuable, while that of the third, consisting of the oldest leaves, is comparatively little esteemed. Sometimes only one or two harvests are made: but care is always taken to assort the leaves according to their age, and thus originate numerous commercial varieties of tea. The character of the plant, dependent upon the soil, situation, climate, and culture, has also a great influence upon the value of the leaves. It is said that the best tea is procured from the shrubs which grow upon the sides of steep hills with a southern exposure. Though the plant grows both about Pekin in the north and Canton in the south of China, it is said to attain greater perfection in the intermediate country, in the neighborhood of Nankin, for instance, where the climate is neither so cold as in the first-mentioned vicinity nor so hot as in the second. Some of the commercial varieties have their origin in this cause, and it is highly probable, though the fact has not been certainly proved, that difference in species may be another source of diversity. After having been gathered, the leaves are dried by artificial heat in shallow iron pans, from which they are removed while still hot, and rolled with the fingers, or in the palm of the hand, so as to be brought into the form in which they are found in commerce. For further particulars as to the cultivation of tea, see *P. J.*, 1871, 386. The odor of the tea leaves themselves is very slight, and it is customary to mix with them the flowers of certain aromatic plants, as those of the orange, different species of jasmine, the rose, *Osmanthus fragrans*, Lour. (*Olea fragrans*, Thunb.), of the Oleaceæ, and *Camellia Sasanqua* (Thunb.?), in order to render them pleasant to the smell. The flowers are afterwards separated by sifting or otherwise. (See *P. J.*, xv. 112.) Under the name of *flowers of tea* was at one time sold a waste product consisting of the hair of young leaves, but recently the flowers themselves have been used to make a beverage (*P. J.*, 71, p. 453). The cultivation of tea has been successfully introduced into Brazil and into the British possessions in India. Samples of Himalaya tea, chemically examined by T. Zoeller, were found to be equal to the best Chinese product, containing at least 5 per cent. of theine and 5.38 per cent. of nitrogen. (*P. J.*, 1871, 162.) Attempts have been made, under the auspices of the government, to introduce tea culture into the United States.

(An elaborate article on tea, with methods of cultivation, etc., by Wm. B. Marshall, U. S. Nat. Museum, will be found in *A. J. P.*, 1903, p. 79.)

Bush Tea and *Honig Thee*, used at Cape Colony, South Africa, as a substitute for tea, are the dried leaves and tops of several species of *Cyclopia*, among which are *C. subternata*, Vog., *C. latifolia*, DC., *C. genistoides*, Vent., and *C. sessiliflora*, Eckl. and Zeyh. (Fam. Leguminosæ). According to the analysis of Henry G. Greenish, they do not contain theine, but a glucosidal body, *cyclopin*, $C_{25}H_{28}O_{13}$. (*P. J.*, xi. 549.)

The gross imports of tea into the United States for the year ending June 30, 1904, amounted to 112,905,541 lbs., valued at $18,229,310. In 1886, England imported 145,000,000 lbs. of tea from China, and 81,000,000 lbs. from India. Numerous varieties exist in commerce, differing in the shape communicated by rolling, in color, in flavor, or in strength; but they may be all arranged in the two divisions of *green* and *black teas*, which, at least in their extremes, differ so much in properties that it is difficult to conceive that they are derived from the same species.

Under the name of *tea oil* there has appeared in the London markets a Chinese fixed oil said to be derived from *Camellia drupifera*, Lour. (*C. oleifera*, Wall.), a detailed description of which, with tests, may be found in the *P. J.*, vol. xvi. 634. A similar oil is prepared in Japan from the seeds of *Camellia japonica*, L. (*Ibid.*, 637, 764.)

Properties.—Green tea is characterized by a dark green color, sometimes inclining more or less to blue or brown. It has a peculiar, refreshing, somewhat aromatic odor, and an astringent, slightly pungent, and agreeably bitterish taste. Its infusion has a pale greenish-yellow color, with the odor and taste of the leaves. According to Warington, who examined numerous varieties of tea carefully, both by the microscope and chemical tests, many of the green teas imported into Great Britain owe their color to a powdery coating, consisting of calcium sulphate and Prussian blue; others to a mixture of these with a yellowish vegetable substance; and others, again, to calcium sulphate alone. (*P. J.*, iv. 37.) *Black tea* is distinguished by a dark brown color. It is usually less firmly rolled and lighter than the green, and contains the petioles of the plant mingled with the leaves. Its odor is fainter, and of a somewhat different character, though still fragrant. Its taste, like that of green tea, is astringent and bitterish, but is less pungent, and to many persons less agreeable. To hot water it imparts a brown color, with its sensible properties of taste and odor. These vary exceedingly in degree in the different varieties, and some black teas are almost wholly destitute of aromatic or agreeable flavor. According to Blyth, green tea is prepared from young leaves which are roasted over a wood fire within an hour or two after being gathered; while the black tea leaves, on the other hand, are allowed to lie in heaps for ten or twelve hours after they have been plucked, during which

time they undergo a sort of fermentation; the leaves then pass through certain processes, and are slowly dried over charcoal fires. (Wynter Blyth, *Foods, Composition and Analysis*, 1903.) A sophisticated tea is largely exported from China, consisting of powdered tea mixed with sand and other earth, and agglutinated with gum; that which is to pass for black being colored with plumbago, and the green with the coating above referred to. On analysis, these teas were found to afford from 35 to 45 per cent. of ashes, while the genuine yields only 5 per cent. A very full account of the adulteration of tea and the methods for the detection of the same may be found in Allen, *Com. Org. Anal.*, 2d edition.

The analyses below[1] by Y. Kozai (*Bulletin No. 7, Imperial College of Agriculture*, Japan) have a special value, owing to the author's knowledge of tea manufacture. Unusual precautions were taken in sampling the leaves, to insure strictly parallel specimens being taken. The figures refer to the moisture-free leaves in each case.

Rochleder found also a peculiar acid, which he calls *boheic acid*, $C_7H_{10}O_6$. According to Stenhouse, the tannin of tea, though always accompanied by a little gallic acid, differs essentially from that of galls; not being, like it, a glucoside, but yielding, under the influence of sulphuric acid, a dark brown substance, almost insoluble in water. (See *A. J. P.*, 1862, 254.) For article on the methods of analysis of tea and a series of analyses of different varieties, see *A. J. P.*, 1887, 626. The volatile oil is citron-yellow, lighter than water, has a strong odor of the tea plant, solidifies easily by cold, and resinifies on exposure to air. It is probably one of the principles upon which depend the effects of tea upon the nervous system. Hence old teas are less energetic than the recently imported; and it is said that the fresh leaves have often produced dangerous effects in China. Nevertheless, the tannic acid is not without influence upon the system; and it is not improbable that the extractive contributes to the peculiar influence of this valuable product. Of these active ingredients, the volatile oil, tannic acid, and extractive are found most largely, according to the analysis of Mulder, in the green tea. *Theine*, $C_8H_{10}N_4O_2$, is a crystallizable principle discovered by Oudry. It was afterwards proved by Jobst to have the same composition as caffeine (trimethyl xanthine). (See *Coffee*, *Ilex*, *Kola Nuts*, and *Guarana*, page 605.) According to Mulder, it exists in tea combined with tannic acid. Theine has a feebly bitter taste; is, in the state of crystals, soluble in 46 parts of water, 53 of alcohol, and slightly soluble in ether; melts at about 236.8° C. (458.3° F.), and at 178° C. (352.4° F.) sublimes in white vapors, which condense in minute needles. From its aqueous solution the following reagents precipitate it; phospho-molybdic acid, yellow precipitate; iodine with potassium iodide, dirty brown precipitate; platinum chloride, yellow hair-like crystals insoluble in cold hydrochloric acid, slowly separating; auric and mercuric chlorides and silver nitrate also give precipitates. Infusion of galls causes a deposit of theine tannate, which is again, however, dissolved by heating the water. Kossel discovered in 1888 a related principle, *theophylline* (*dimethylxanthine*), but only in very small amounts. It is now made synthetically and has been introduced into medicine. (See *Theocine*).

The proportion of theine found in tea varies considerably, the general range being from three to four per cent. India and Ceylon tea usually contain slightly more than four per cent.

Tea is astringent and gently excitant, and exerts a decided influence over the nervous system, evinced by the feelings of comfort and even exhilaration which it produces, and the unnatural wakefulness to which it gives rise when taken in unusual quantities or by those unaccustomed to its use. It is almost exclusively used as a beverage. Taken moderately, and by healthy individuals, it may be considered as perfectly harmless; but long continued in excessive quantity it is capable of inducing unpleasant nervous and dyspeptic symptoms. Green tea is decidedly more injurious in these respects than black, and should be avoided by dyspeptic individuals, and by those whose nervous systems are peculiarly excitable. As a medicine, tea may sometimes be given advantageously in *diarrhœa*, and a strong infusion will often be found to relieve *nervous headache*. An extract is made from it in China which is said to be useful in fevers. (See *Fluidextractum Camelliæ*, National Formulary.)

Tegmin.—Under this name a surgical dressing has been recommended; it is an emulsion made from yellow wax, one part; acacia, two parts; water, three parts; it also contains 5 per cent. of zinc oxide and a little wool fat. It is used as a protective and vehicle for skin remedies.

Telfairia Pedata, Hook. (*Joliffa africana*, Delile.)—The seeds of this East African plant yield a deep yellow fragrant oil, of specific gravity 0.918, containing *telfairic acid*. (*Chem. Zeit. R.*, xxiv. 24.)

Tellurium. (Te. Atomic weight, 126.6.)—The first physiological investigations as to the action of tellurium were made by Hansen (*Chem. Gaz.*, 1854), who found that the *potassium tellurate* produces in dogs vomiting, with stupor, and that in the dose of one grain three times a day it causes in man cardiac oppression, nausea, some salivation, with a pronounced garlic-like odor of the breath. These investigations have been extended and confirmed by William J. Gies (*M. A.*, June, 1901), who found that in doses of one-third of a grain per kilogramme sodium tellurate caused in the dog vomiting, diarrhœa, uncon-

[1] Analyses of Tea (percentage composition).

	Unprepared Leaves.	Green Tea.	Black Tea.
Caffeine or Theine	3.30	3.20	3.30
Ether Extract	6.49	5.52	5.82
Hot-water Extract	50.97	53.74	47.23
Tannin (as Gallotannic Acid)	12.91	10.64	4.89
Other Nitrogen Free Extract	27.86	31.43	35.39
Crude Protein	37.33	37.43	38.90
Crude Fibre	10.44	10.06	10.07
Ash	4.97	4.92	4.93
Albuminoid Nitrogen	4.11	3.94	4.11
Caffeine Nitrogen	0.96	0.93	0.96
Amido-nitrogen	0.91	1.13	1.16
Total Nitrogen	5.97	5.99	6.22

sciousness, paralysis, convulsions, and death, with pronounced inflammatory changes in the intestines and kidneys similar to those seen after arsenic. Characteristic was the pigmentation of all parts of the body by metallic tellurium. During life the brown or greenish discoloration of urine and the very pronounced garlicky odor of the breath were almost diagnostic. The continuous administration of minute doses had no effect upon metabolism, but if the amount ingested was increased, gastro-intestinal irritation with restlessness soon appeared. Tellurium was found in the fæces, urine, breath, and skin secretions. In man drowsiness, nausea, and constipation seemed to result from the remedy, given in doses up to half a grain. There was also a marked anhidrotic action, even in healthy men, appearing fifteen minutes to one hour after the ingestion of the dose. Potassium tellurate is an efficient remedy for the arrest of *colliquative sweating*, but the pronounced alliaceous odor which it imparts to the breath, and even to the perspiration, greatly interferes with its use. *Dose* of potassium or sodium tellurate, one-sixth to one-half of a grain (0.01–0.032 Gm.).

Tephrosia. *Cracca virginiana*, L. (*T. virginiana*, Pers.) *Turkey Pea. Wild Pea. Catgut. Goat's Rue. Hoary Pea. Devil's Shoestring. Tephrosie*, Fr., G. (Fam. Leguminosæ.)—Several species of Cracca are employed in different parts of the world, though unknown in general commerce. They are leguminous plants, shrubby or herbaceous, with leaves unequally pinnate, and flowers in axillary or terminal racemes. They are generally possessed of cathartic properties, their leaves or roots being employed. Plugge (*Proc. A. Ph. A.*, 1897, 560) examined the root of *T. macropoda* and found a poisonous active principle, not identical with cytisine. *Cracca virginiana*, L., grows in most parts of the Eastern United States. It is a foot or two high, with pubescent stems and leaves and handsome terminal flowers. (See Griffith's *Med. Bot.*, 237.) The roots, which are slender, long, and matted, are tonic and aperient, and are said to have been used by the Indians as a vermifuge, given in the form of decoction.

Terpinol.—This is not a simple body, but a mixture of terpenes with variable proportions of an alcohol, *terpineol*, $C_{10}H_{17}OH$. It forms a colorless oily substance with a hyacinthine odor; it is produced by boiling terpin with diluted mineral acids. It is insoluble in water, but readily soluble in alcohol and ether. Terpinol has been used in chronic *bronchial catarrh*, and is especially commended by Lazarus when there is much irritation of the membrane with scanty secretion. Janowsky states that it is a valuable remedy in *hæmoptysis*. The *dose* is three to five minims (0.2–0.3 Cc.) at intervals of from one to four hours, administered in capsules.

Terraline. *Terroline.*—A liquid proprietary petroleum product, odorless and tasteless, used internally in emulsions, in the *dose* of from one to two fluidrachms (3.75–7.5 Cc.). See *Petrolatum Liquidum*, page 924.

Testa Præparata. *Prepared Oyster-shell. Magistère de Coquilles (d'écailles) d'Huîtres*, Fr. *Präparirte Austerschalen*, G.—"Take of Oyster-shell *a convenient quantity*. Free the Oyster-shell from extraneous matter, wash it with boiling water, and, having reduced it to a fine powder, treat this in the manner directed for Prepared Chalk." *U. S.* 1870. Prepared oyster-shell differs from prepared chalk in containing animal matter, which, being very intimately blended with calcium carbonate, is supposed by some physicians to render the preparation more acceptable to a delicate stomach. It is given as an antacid in *diarrhœa*, in the *dose* of from ten to forty grains (0.65–2.6 Gm.) or more, frequently repeated. A preparation was introduced into use in this country, under the name of *Castillon's powders*, consisting of sago, salep, and tragacanth, each, in powder, *a drachm*, prepared oyster-shell *a scruple*, and sufficient cochineal to give color to the mixture. A drachm of this is boiled in a pint of milk, and the decoction used *ad libitum* as a diet in chronic bowel affections.

Tetragastris. *Tetragastris panamensis* (Engl.). *Hedwigia balsamifera* (Engl.). *Bois Cochon*, or *Sucrier de Montagne*, Fr. (Fam. Burseraceæ.) This native of the Antilles has been examined by Gaucher, Combemale, and Marestang (*France Méd.*, October, 1888), who find in it an alkaloid and a resin. The extract of the root and stems produces in the guinea pig rapid and considerable lowering of temperature, progressive paralysis, general convulsions, dilatation of the pupils, respiratory irregularity, and cardiac paresis. The alkaloid was found to be a convulsive agent, acting upon the spinal cord. The resin, which seemed much more active than the alkaloid, acted as a paralyzant.

Tetranthera.—From the bark of the lauraceous plant, *T. citrata* (*T. Brawa*, Bl., *T. intermedia*, Bl.), J. D. Filippo has extracted an alkaloid, *lauro-tetanine*. (See *A. Pharm.*, 1898, 601.)

Teucrium. *Teucrium Chamædrys*, L. *Germander. Chamædrys. Petit Chêne*, Fr. *Edlar, Gamanderlein, Frauenbiss*, G.—A small European labiate, which has been employed as a mild corroborant in *uterine, rheumatic, gouty*, and *scrofulous affections*, and *intermittent fevers*. Germander was an ingredient in the *Portland powder*, noted as a remedy in gout. This powder, according to the original prescription, consisted of equal parts of the roots of *Aristolochia rotunda*, L., and *Gentiana lutea*, L., of the tops and leaves of *Teucrium Chamædrys*, L., and *Erythræa Centaurium* (L.), Pers., and of the leaves of *Ajuga Chamæpitys*, Schreb., or *ground pine*. The *dose* was a drachm every morning before breakfast for three months, then forty grains for three months, afterwards half a drachm for six months, and finally half a drachm every other day for a year. (Parr.) Two other species of Teucrium have been used in medicine,—*T. Marum*, L., *cat thyme*, or *Syrian herb mastich*, indigenous in the south of Europe, and *T. Scordium*, L., or *water germander*, growing in the higher latitudes of the same continent. The former is a warm, stimulating, aromatic bitter, and has been recommended in *hysteria, amenorrhœa*, and *nervous debility;* the latter has the odor of garlic, and a bitter, somewhat pungent taste, and was formerly highly esteemed as a corroborant in *low forms of disease;* but neither of them is now much employed. *T. Marum* is an errhine, and was formerly an ingredient of the *Pulvis Asari Compositus*. The *dose* of either of the three species is about half a drachm (2.0 Gm.). A plant said to have been used advantageously in *cholera* in the Levant, a specimen of which was sent to Paris, proved to be *Teucrium Polium*, L. (*J. P. C.*, xv. 352.) Moorhof (*Ph. Cent.*, 1893, 89) prepared a purified liquid extract from *T. Scordium*, and named it *teucrin*, which he recommends in the treatment of fungoid diseases and abscesses.

Tfol is an argillaceous earth, containing free gelatinous silica, which is largely used in Northern Africa as a substitute for soap. It has been strongly recommended by Lahache for the purpose of emulsifying tar oil and for disinfecting purposes.

Thalictrum.—It appears probable that many species of this genus (Fam. Ranunculaceæ) have active medicinal or toxic properties. In 1879 Henriot and Doassans asserted that they had separated from the roots of the *Thalictrum macrocarpum*, Gren., a crystalline yellow substance, having very pronounced toxic principles, analogous to those of curare; and subsequently stated (*C. R. S. B.*, 1880) that this substance really consists of two principles,—an alkaloid, *thalictrine*, obtained in the form of prismatic needles, insoluble in water, soluble in alcohol, forming crystalline salts with acids, and *macrocarpin*, a yellow crystalline body, soluble in water, representing the coloring principle of thalictrum. Subsequently *berberine* was found by Doassans and Mousset in *Thalictrum flavum*, L., *Fen Rue* or *Monk's Rhubarb*, macrocarpin being, according to this authority, very closely allied to berberine, but differing in that its color is not affected by ammonia. Rochebrune (*Toxicolog. Africaine*, i.) has found both thalictrine and macrocarpin in the roots of *Thalictrum glaucum*, Desf., of Spain. Thalictrine he states to be a very active cardiac poison, producing loss of power, convulsive movements, irregularity and depression of the heart's beat, and finally death in some cases in convulsions. According to Rochebrune, thalictrine also exists in the African species *Thalictrum rhynchocarpum*, Q. Dillon and A. Rich.

Thalline. *Tetrahydroparaquinanisol* or *Tetrahydroparamethyloxyquinoline.* $C_9H_6H_4N(OCH_3)$. The term anisol is applied to the methyl ether of phenol, and it is therefore methyloxybenzene. Skraup's synthesis of quinoline, C_9H_7N, was effected by heating aniline or amidobenzene with nitrobenzene, glycerin, and sulphuric acid. By taking instead paramidoanisol, paranitroanisol, glycerin, and sulphuric acid, Skraup obtained paraquinanisol, $C_9H_6N(OCH_3)$. This is then treated with tin and hydrochloric acid, when it takes up four atoms of hydrogen and becomes $C_9H_6H_4N(OCH_3)$. The name thalline was given to this base because of the deep green color produced by ferric chloride and other oxidizing agents. The base thalline is obtained in well-formed rhombic crystals, which fuse at 40° C. (104° F.), and recrystallize on cooling. It shows a neutral reaction and has a characteristic aromatic odor resembling that of coumarin. It is soluble in water, alcohol, and ether.

Thalline sulphate is a white crystalline powder which loses its two molecules of water of crystallization at 100° C. (212° F) and melts at 110° C. (230° F.). It is soluble in five times its weight of cold water and freely soluble in boiling water, soluble in 100 parts of alcohol. Both solutions turn brownish on exposure to air and light. The odor of the sulphate recalls that of anisol. *Thalline tartrate* is a white crystalline powder, fusing at 155° C. (311° F.), and possessing a coumarin-like odor. It is soluble in ten parts of water and hardly soluble in alcohol. Its aqueous solution has an acid reaction.

Thalline tartrate and sulphate are medicinally equivalent. They are powerful antipyretics, acting also, when in sufficient dose, as depressants both upon the vasomotor system and upon the heart, and, according to A. Robin, checking tissue waste in the body, and having a very marked tendency to attack the red blood corpuscles. These salts have been used in practical medicine, in *doses* of from four to eight grains (0.26–0.5 Gm.), but are so prone to produce disagreeable symptoms, such as marked cyanosis, vomiting, diarrhœa, albuminuria, etc., that their employment has been abandoned. According to Kreis, in from 4 to 4½ per cent. solution they are active germicides, and the frequent use of urethral injections of the 1 to 2 per cent. solution has been found very useful in *chronic gonorrhœa.* Moncorvo states that thalline is an active hæmostatic.

Thallium. (Tl. Atomic weight, 202.6.)—This metal, discovered by spectrum analysis, has been found to prevail widely in nature. The credit of its discovery by Crookes in 1861 has been disputed by Lamy. Although the absorption of the salts of thallium appears to be slow they are certainly distributed everywhere, their presence having been recognized by Lamy by the green spectroscopic line in all the tissues of poisoned animals. Small doses may be tolerated for a short time, but according to William Marmé have a cumulative effect, so that after the continued use of the poison the appetite is impaired, intestinal pain is felt, and vomiting occurs, with diarrhœa, hemorrhage, salivation, and emaciation. General debility, embarrassed respiration, weakness of the circulation, disordered muscular action, as tremors and want of co-ordination are added to the other symptoms, and, when the poisoning becomes general, conjunctivitis, with free secretion of mucus, is a frequent symptom. After death, small effusions of blood and infiltration of the lungs are observed, as are also intense congestion of the bowels, copious pericardial effusion, and ecchymoses on the heart's surface. Cases of poisoning in man have been extremely few, but in a physician who took for experimental purposes from two to four grains (0.13–0.26 Gm.) in a week, and a month later the same amount in similar manner, no symptoms followed the first lot taken except numbness of the toes and finger tips. The second dose produced diarrhœa, increased numbness of the feet and hands, extending to the body, with pains, muscular weakness, and tenderness over the nerve trunks, especially in the lower extremities. As both lead and arsenic, however, were found in the urine of this patient, some doubt must exist how far the symptoms were really due to thallium. (Ballard, *Reports Boston City Hospital*, 1902.) That thallium, however, can produce widespread general neuritis is strongly indicated by the violent pains, especially of the legs, which have been noted by Lamy, by Combemale, and other observers, and also by the muscular atrophy which appears to be pronounced in chronic poisoning by the drug in the lower animals. Curci indeed claims that thallium is exclusively a muscle poison, and as long ago as 1874 Rabuteau recorded that after death from thallium the muscles did not respond to irritation. (See *Ed. M. J.*, 1874.)

A symptom which was produced in the lower animals by Buschke and by Bettmann, and has been reported in various cases as occurring in man, is loss of hair. Thus, Guinard, in 1898, found that the taking of nine pills of 0.05 Gm. each of the thallium acetate was followed by pronounced alopecia. Pozzi and Courtade assert that in some cases thallium causes swelling of the gums with a blue line at the junction with the teeth, but

this symptom seems not to have been noticed by other observers. In 1898 Combemale claimed that in *doses* of one and a half grains (0.096 Gm.), given at bedtime, thallium acetate is a valuable remedy in the *colliquative sweats* of phthisis; that it is effective has been proved by Huchard and others; but in many cases it has produced severe peripheral pains, loss of hair, abdominal disturbance, and other very disagreeable symptoms.

Thanatol. *Guæthol. Ajacol. Pyro-catechin-mono-ethyl-ether.* $C_6H_4<^{OC_2H_5\,(1)}_{OH\quad(2)}$. This is an oily liquid, homologous with guaiacol, and having similar medicinal properties. See page 1507.

Thapsia. *T. Garganica*, L. *Thapsie, Faux Fenouil*, Fr. *Thapsie*, G.—An umbelliferous plant, growing in Southeastern Europe, and well known to the ancients, named from the isle of Thapsos, where it was obtained. Theophrastus speaks of its root as emetic and purgative. After long neglect this plant has obtained a foothold in the French Codex, which recognizes a *Resina Thapsiæ* prepared by exhausting the bark of the root with alcohol and evaporating to a soft extract. From this extract the Codex further directs that an *Emplastrum Thapsiæ* shall be so prepared as to contain 7 per cent. of the resin combined with yellow wax, turpentine, and colophony. The bark of the root and the resin are both objects of commerce. The bark is described by Stanislaus Martin as almost always doubly quilled, unless where altogether in small fragments, exteriorly rugose with the epidermis here and there detached in patches larger or smaller, and of a deep brown color, interiorly smooth and whitish, and of a fibrous fracture. The size of the pieces varies, the largest not exceeding twenty-four inches in length and an inch in circumference. At the point where the root is attached to the stem there is often adherent a ligneous fibre about an inch long, and over the whole surface there are found but few radicles. It is said that great care is necessary, in removing the root from the bales, not to be injured by the powder which escapes, and which causes itching and swellings of the face and hands. By submitting thapsia to the successive action of alcohol and ether Pressoir obtained two resins. Sulphuric acid colored that soluble in alcohol scarlet, that soluble in ether blue. (*J. P. C.*, 4e sér., xi. 328.) Canzoneri finds that the ethereal extract is an amber-colored syrupy resin possessing vesicating properties. From it he has obtained two acids, *octoic* or *caprylic* acid, and *thapsic* acid, besides a neutral non-nitrogenous vesicating substance. (See *A. J. P.*, vol. xiv. 325.) Cazenave objects to the plaster prepared from the resin, and kept in masses, as it deteriorates by time. He proposes the following method of preparing a plaster extemporaneously when wanted. Dissolve the resin in alcohol, and with the aid of a brush spread it on a suitable recipient, which may be ordinary plaster, waxed taffetas, or simply gummed paper. A single layer is sufficient for the purpose of an active revulsion, but the effect may be increased at pleasure by increasing the number of layers. (*J. P. C.*, 1868, 29.) The French thapsia plaster is an exceedingly active counter-irritant, producing much inflammation of the skin with an eczematous eruption and intolerable itching, and, if the application be maintained, finally an ulcerated and suppurated surface, which on healing leaves behind it pronounced scars. The therapeutic action of the plaster is that of a severe counter-irritant.

The resin from the root of *Thapsia Sylphium*, St.-Laz., an Algerian plant, which most botanists believe to be a simple variety of *T. Garganica*, L., is, according to Herlaut, more active than that of the official plant. (*Proc. A. Ph. A.*, xxvi. 250.) Heckel and Schlagdenhauffen (*N. R.*, June and July, 1887) find in the root of *Thapsia villosa*, L., a vesicant resin, which acts more slowly and gently than does that of *T. Garganica*.

Theobromine - acetyl - methylene - salicylate. *Diurazin.*—This is said to be a condensation product containing 30 per cent. of theobromine, 55 per cent. of salicylic acid, and 6 per cent. of formaldehyde, and has been recommended as a diuretic in *dropsy* in *doses* of six grains (0.4 Gm.).

Thermin. *Tetrahydro-β-naphthylamine Hydrochloride.* $C_{10}H_7.H_4.NH_2.HCl$.—The tetrahydro addition compound is formed when metallic sodium is caused to act upon naphthylamine in boiling amyl alcohol solution. The hydrochloride has been brought forward by Filehne of Breslau, as a local mydriatic of extraordinary power. It is asserted that in from 1 to 5 per cent. solution it dilates the pupil more widely than does atropine.

Thermodin. *Acetyl para-ethoxy-phenyl-urethane.* $C_6H_4(OC_2H_5)N(COCH_3)COOC_2H_5$.—A derivative of urethane in the form of a colorless, crystalline powder, fusing at from 86° to 88° C. (186.8°–190.4° F.), insoluble in water. It is used as an antipyretic in *doses* of from five to fifteen grains (0.32–1.0 Gm.).

Thermol. *Acetyl-salicyl-phenetidin.* $C_{17}H_{17}NO_4$.—This substance, proposed by S. Lewis Summers, is a white, crystalline, odorless, tasteless powder, which is claimed to be a harmless and active antipyretic and analgesic, and as such has been used to a considerable extent in *typhoid fever, neuralgia, dysmenorrhœa, migraine*, etc.; also, as an antispasmodic in *whooping cough*. *Dose*, three to fifteen grains (0.2–1.0 Gm.).

Thevetia. *Yccotli.*—Inhabiting the damp, hot valleys of the Mexican Cordilleras is a large tree belonging to the Apocynaceæ, whose fruits are known by the natives as *huesos ó codos de fraile*, or *friar's elbow bones*, and are used as a topical application in *hemorrhoids*. The tree is the *Thevetia Yccotli*, DC. (A. DeC., *Prodromus*, viii. 343.) In the seeds Herrera found a glucoside, *thevetin*. (*A. J. P.*, 1877, 145.) Closely allied to *T. Yccotli* is *T. nereifolia*, Juss. (*Prodromus*, viii. 343), a tree which probably grows also in Mexico, but has been found by botanists chiefly, if not solely, in the West Indian Islands, Colombia, Peru, and others parts of South America. De Vrij very many years ago discovered in its seeds a glucoside which was closely studied by Blas. (*Neues Jahrb. f. Pharmacie*, Bd. xxxiv. 1854, 1.) He gave it the name of *thevetin*, and the formula $C_{54}H_{84}O_{24}$, and believed it to be identical with *cerberin*, previously found by Oudemann in *Cerbera Odallam*, Ham., also an apocynaceous plant. Plugge (*A. Pharm.*, 1893, 10) has made a very thorough study of the cerberin from *Cerbera Odallam*, Gaertner, and finds that it is not identical with either tanghinin or thevetin. With the former it is isomeric, showing the same percentage composition, but has different crystalline form and melting point.—cerberin 192° C. (377.6° F.), tanghinin 182° C. (359.6° F.). From thevetin it

differs not only in composition, but in the nature of the decomposition products. Cerberin, $C_{27}H_{40}O_8$, is decomposed into *cerberetin*, $C_{19}H_{26}O_4$, a citron-yellow amorphous powder melting at 85.5° C. (186° F.), and glucose, while thevetin, $C_{54}H_{84}O_{24}$, is split into *theveresin*, $C_{48}H_{70}O_{17}$, a white powder, and glucose.

Merck (*Jahresb. für* 1892, 57) has described a glucoside *cerberin* to which he gives the formula $C_{25}H_{38}O_{12}$. He states that it was obtained from a Mexican plant, probably *Thevetia Yccotli*. Whether this glucoside is identical with the thevetin of Blas cannot be definitely stated. Blas found that the thevetin of De Vrij boiled in diluted sulphuric acid splits into glucose and *theveresin*, which has the formula $C_{48}H_{70}O_{17}$. Thevetin occurs in minute crystals, odorless, of bitter taste, slightly soluble in cold water (twelve parts), freely so in boiling water, diluted and strong alcohol, acetic acid, insoluble in ether. Its most characteristic reaction appears to be its dissolving in concentrated sulphuric acid, with the production of a reddish-brown color, changing to a cherry-red, and after some hours to a violet color. In commerce it occurs as a yellowish-white, amorphous bitter powder, easily soluble in water and alcohol. Theveresin is only slightly soluble in boiling water. These substances are active poisons. A number of cases of poisoning by the seeds of the East Indian thevetia have occurred; the symptoms have been repeated vomiting, a slow, very feeble pulse, delirium, convulsive movements, and coma. The physiological action of the thevetin from *T. nereifolia* has been investigated chiefly by König. (*A. E. P. P.*, Bd. v. 228.)

David Cerna finds that the glucoside of *T. Yccotli* (*P. M. T.*, ix. 396) with sulphuric acid affords a clear greenish-yellow solution gradually passing to brown and brownish violet, and finally becoming a permanent cherry-brown color, which changes on the addition of potassium bicarbonate to an emerald-green; also that it is in moderate doses stimulant both to the circulation and respiration, but finally paralyzes the heart muscle and the respiratory apparatus; that it causes cerebral convulsions and spinal paralysis, abolishing sensation and reflex activity before voluntary movement by an influence upon the sensory nerves or spinal tract. Zotos N. Zotos (*In. Dis.*, Dorpat, 1892) states that *cerberin* belongs physiologically to the digitalin group.

Thialdine. $C_6H_{13}NS_2$.—This substance, obtained when hydrogen sulphide acts upon aldehyde-ammonia in aqueous solution, forms crystals melting at 43° C. (109.4° F.), which are but slightly soluble in water, more easily in alcohol. It has been investigated by Lusini, who found it a general paralyzing agent, acting powerfully upon the heart, which it arrests in diastole; while *carbothialdine*, $C_5H_{10}N_2S_2$, formed by the action of carbon disulphide in alcoholic solution upon aldehyde-ammonia, acts as a tetanizing agent and does not affect the heart. (See *Nouv. Rem.*, Nov. 1890.)

Thigenol.—This proposed substitute for ichthyol is said to be the sodium salt of a sulphonic acid of a synthetic sulphur oil, and has been used in 20 per cent. ointment for the treatment of *dermatitis*, *prurigo*, and other diseases of the skin. (*K. T. W.*, 1902, No. 6.)

Thilanin.—This substance is said to be made by the action of sulphur upon lanolin. It is of the consistence of lanolin, of a brownish color and peculiar odor. It is said not to be irritating, and has been used without dilution with asserted excellent results in *chronic eczema* and other *skin eruptions* in which uncombined sulphur has been employed.

Thiocol. *Potassium Guaiacol Sulphonate.* $C_6H_3\begin{cases}OH\\OCH_3\\SO_3K\end{cases}$. This is a fine white powder, having a taste at first bitter and afterwards sweetish; readily soluble in water; containing about 60 per cent. of guaiacol. It is pleasant to the taste and not irritant to the gastric or other mucous membranes. Its freedom from odor, ready absorption and non-irritant action on the mucous membrane are among its recommendations that have been reported by its introducers. The original commendation of it by C. Schwartz (*K. T. W.*, 1898), in *tuberculosis*, *chronic bronchitis* and *intestinal catarrh*, has been confirmed by various clinicians. Forty-five grains (3.0 Gm.) of it may be given during the day, increased to one hundred grains (6.5 Gm.) a day.

Thiol.—This is a thin, dark brown, neutral liquid, with an odor somewhat like that of Russia leather, having a specific gravity of from 1.082 to 1.089; its aqueous solution is transparent, froths when shaken, and is not precipitated by strong alcohol; it is also feebly soluble in glycerin. On evaporation, liquid thiol yields about 40 per cent. of dried thiol. It is prepared from paraffin oils of from 0.89 to 0.90 sp. gr., which are treated with sulphur at high temperatures. The unsaturated hydrocarbons (olefins, etc.) are alone attacked, and these are then extracted by suitable solvents from the saturated hydrocarbons. They are then acted upon by concentrated sulphuric acid at low temperatures, and the thiol separated out by the addition of ice. It may then be evaporated *in vacuo* to either *thiolum liquidum* or *thiolum siccum*. It is asserted that thiol possesses the remedial properties of ichthyol, and is superior on account of being odorless. It has been used in *eczema*, *syphilitic* and other *superficial ulcerations*, *acute infiltration of joints*, *sprains*, *contusions*, *erysipelas*, etc., precisely as has ichthyol. The liquid is used in the form of a solution or ointment; the dried thiol is sometimes employed as a powder. In *rheumatism* thiol has been given internally in *doses* of from five to ten minims (0.3–0.6 Cc.), or the dried preparation in *doses* of from one to two grains (0.065–0.13 Gm.).

Thiolinic Acid.—This is a darkish green extract-like mass, having the odor of mustard, which has been called *sulphurated linseed oil*. It is insoluble in water; soluble in alcohol. Its alkaline combinations, especially with the sodium salts, have been recommended as substitutes for thiol and ichthyol.

Thiophene (C_4H_4S) was recognized by Victor Meyer in 1883 as being an invariable accompaniment of benzene as produced from coal tar, and because of the similarity of properties adhering very closely to it through all reactions. It can be separated by shaking up the benzene with one-tenth of its bulk of concentrated sulphuric acid until the addition of a little isatine no longer produces a blue color (indophenin reaction). Thiophene is a colorless, mobile oil, of faint odor, and boils at 84° C. (183.2° F.). Just as benzene is accompanied in coal tar by toluene, xylene, and higher homologues, so thiophene is accompanied by *thiotolene* (*methyl-thio-*

phene), $C_4H_3S.CH_3$, and *thioxene* (*dimethyl-thiophene*), $C_4H_2S.(CH_3)_2$. Thiophene and its homologues yield a large number of brilliant dye colors analogous to those derived from benzene. It was first physiologically tested by A. Heffter (*A. G. P.*, 39, 420), who found that it appeared in the urine, and lessened the elimination of sulphuric acid in the urine. E. Spiegler (*Th. M.*, Feb. 1892) has employed in *skin diseases*—1, *Sodium thiophene sulphonate*, $C_4H_3S—NaSO_3$; 2, *Thiophenediiodide*, $C_4H_2I_2S$. The first of these compounds is a white crystalline powder, containing 33 per cent. of sulphur, having a feeble, disagreeable odor. It was found in the form of an ointment to act very well in *prurigo* with *eczema*. Thiophenediiodide occurs in tabular crystals, melting at 40.5° C. (105° F.), having a characteristic, not disagreeable odor, insoluble in water, but very feebly soluble in ether, chloroform, and warm alcohol, soluble with difficulty in cold alcohol; containing 75.5 per cent. of iodine and 9.5 per cent. of sulphur. It was found to be antiseptic and is one of the compounds suggested as a substitute for iodoform.

Thioresorcin. $C_6H_4(OS)_2$.—A yellowish-gray powder, insoluble in water, made by fusing together one molecule of resorcinol and two molecules of sulphur. It has been recommended as a substitute for iodoform, but has given rise to unpleasant symptoms.

Thiosapol.—Soap containing from 5 to 10 per cent. of sulphur in combination, used in treating skin diseases.

Thiosinamin. *Allyl-sulpho-urea. Allylsulphocarbamide.* $CS\begin{cases}NH_2\\NH(C_3H_5)\end{cases}$. This occurs in colorless monoclinic or rhombic crystals, of a bitter taste and feeble garlic-like odor. It is moderately soluble in water, very soluble in alcohol and ether. It possesses no bactericidal properties, and in the doses in which it has been used seems to exert no influence whatever upon the general system, except upon the blood making organs. Several hours after its injection the leucocytes in the blood are greatly diminished in number, falling, according to Hebra, in some cases from 14,000 to 4000. This condition lasts, however, but a short time, and is followed by a pronounced hyperleucocytosis. During the latter period a very pronounced destruction and absorption of exudates and of cicatricial and other poorly nourished tissues occur.

It was introduced originally into medicine by Von Hebra (*Internat. klin. Rundschau*, Sept. 1892) in the treatment of lupus and old cicatrices, and has been used by many clinicians in the treatment of *lupus*, *chronic glandular inflammations*, *keloid*, *urethral strictures*, *corneal opacities* and *sclerotic conditions of the ear* with consequent deafness. Unna has also employed it locally in the form of the 5 to 20 per cent. soap or plaster in *fibrous tumors*, *keloid*, *leprous*, and *syphilitic* lesions, and in *smallpox* scars. Its local application may be continued for some hours and is said not to produce irritation or pain. It has been given by the mouth in capsules in *doses* of one-half to three grains (0.032–0.2 Gm.), or hypodermically in one to four grains (0.065–0.26 Gm.), in a 10 to 15 per cent. alcoholic solution preferably administered in the intrascapular or gluteal region. Considerable pain is produced by the injection. In superficial diseases injections may well be made in the neighborhood of the lesion. According to K. Lange, thiosinamin is toxic in overdose. Hebra used the 15 per cent. alcoholic solution injected into the back in such quantity that the patient receives from four and one-half to seven grains (0.32–0.45 Gm.) of the thiosinamin, repeating the injection every third or fourth day. A solution may be made by dissolving 10 parts in 100 parts of a sterile mixture of water and glycerin, which keeps well and is non-irritant. As a full *dose*, twelve or fifteen minims (0.7–0.9 Cc.) of this solution may be injected into a muscle every third day.

Thiuret. $C_8H_7N_3S_2$.—A sulphurated compound made by the oxidation of *phenyl-dithiobiuret;* it is a bulky, inodorous, crystalline powder, insoluble in water, soluble in alcohol and ether, easily decomposed by alkaline solutions with liberation of sulphur. It is used as a substitute for iodoform.

Thuja. *U. S.* 1880. *Arbor Vitæ.—Thuja occidentalis*, L. (Fam. Coniferæ), is specifically characterized by the peculiarities of the leaves, the pointless cone-scales, and the broad wings extending all around the seeds. It attains a height of fifty feet and a diameter of three feet, but is usually much smaller, and grows in swampy grounds from Pennsylvania northward and westward, often forming extensive "cedar swamps." In Canada and the extreme northern parts of the United States it is commonly called *white cedar*, a name sometimes applied to *Chamæcyparis thyoides* (L.), B. S. P. (*Cupressus thyoides*, L.), which latter is more properly called *Southern white cedar*. The wood is reddish, soft, fine-grained, and very durable. The leaves, or small twigs invested with the leaves, are the parts used. They have an agreeable balsamic odor, especially when rubbed, and a strong, balsamic, camphoraceous, bitter taste, and are flattish, two-edged, with the scale-like leaves appressed and closely imbricate in four rows, rhombic-ovate, obtusely pointed, with a roundish gland upon the back. A. Kawalier of Vienna, found in them volatile oil, a bitter principle called *pinipicrin*, $C_{22}H_{36}O_{11}$, found also in *Pinus sylvestris*, sugar, gelatinous matter, a variety of wax, resin, and tannic acid; also a peculiar crystallizable coloring principle, *thujin*, to which he gives the formula $C_{20}H_{22}O_{12}$. It is of a citron-yellow color and an astringent taste, soluble in alcohol, inflammable, and when its alcoholic solution is heated with diluted hydrochloric or sulphuric acid it splits up into glucose and *thujigenin*,

$$C_{20}H_{22}O_{12} + H_2O = C_6H_{12}O_6 + C_{14}H_{12}O_7$$

and by continuing the reaction another molecule of water is taken up by the latter and *thujetin*, $C_{14}H_{14}O_8$, is formed. Thujetin is possibly identical with quercetin. When thujin is heated with barium hydroxide, instead of thujetin is obtained another product, *thujetic acid*, $C_{28}H_{22}O_{13}$. The same chemist determined that the tannic acid of this plant is identical with *pinitannic acid*, which he had previously obtained from the leaves of *Pinus sylvestris*, L. (See, for details, *Chem. Gaz.*, Nos. 392, 393, 1859.) According to Hübschmann, the leaves and twigs of *Thuja occidentalis* yield also 1 per cent. of an essential oil of sharp, camphor-like taste, sp. gr. 0.925, boiling point from 190° to 206° C. (374°–402.8° F.), and easily soluble in alcohol. According to *Schim. Rep.*, April, 1897, thuja oil contains *pinene*, *fenchone*, *thujone*, and probably *carvone*.

Oil of White Cedar.—F. K. Bailey reports the case of a girl, aged fifteen, who took sixteen drops of the oil of white cedar, and directly after-

wards fell unconscious, with clonic spasms followed by epileptiform convulsions lasting at intervals for several hours. Long-continued irritation of the stomach resulted. (*N. R.*, 1872.)

In the form of decoction, thuja has been used in *intermittent fever*, and, according to Schoepf, in *coughs, fevers, scurvy*, and *rheumatism*, and as an emmenagogue. Made into an ointment with lard or other animal fat, the leaves are said to form a useful local application in rheumatic complaints. A yellowish-green volatile oil, which may be obtained from the leaves by distillation, has been used with success in *worms*. According to Hildebrand both *fenchone* and thujone act as stimulants to the heart muscle (*A. E. P. P.*, Bd. 48). The *dose* of the fluidextract is a fluidrachm (3.75 Cc.) from three to six times a day.

Thymacetin. $C_6H_2(CH_3)C_3H_7\begin{cases}OC_2H_5\\NH(C_2H_3O).\end{cases}$ This is a white crystalline powder, slightly soluble in water, having the same chemical relation to thymol that phenacetin has to phenol. It should show, therefore, the general characters of phenacetin with the antiseptic character of thymol. According to Jolly (*Cb. G. T.*, Feb. 1892), it is a very valuable analgesic and hypnotic. *Dose*, from three to fifteen grains (0.2–1.0 Gm.), best given in capsules.

Thymoform. $2[C_6H_3(CH_3)(C_2H_7)O].CH_2$.—It is made by heating 100 parts of thymol with 100 parts of a 40 per cent. solution of formaldehyde and gradually stirring in 100 parts of concentrated hydrochloric acid. It is in the form of a yellowish, tasteless powder, having a faint odor of thymol. It is readily soluble in alcohol, ether, chloroform and olive oil, but insoluble in water, petroleum benzin and glycerin. It is used as an antiseptic dusting powder.

Thymol Urethane. *Thymoli Carbonas. Thymolcarbonic Ether.*—J. F. Pohl, by the same process by which guaiacol is converted into guaiacol carbonate, has produced from thymol a nearly tasteless, colorless, crystalline compound of neutral reaction, fusing at 49° C. (120.2° F.). It is slightly soluble in water, but is decomposed by the alkaline juices of the intestine, thymol being liberated. It is claimed that this substance is as effective as thymol against the *anchylostoma*, and, owing to its not dissolving in the stomach, is much less apt to produce disagreeable symptoms. (*A. J. P.*, March, 1901, 143.) *Dose*, for adult, thirty grains (2 Gm.) three times a day for four days, followed by brisk purgation.

Thymus Gland.—The close connection which exists between the development of the body and the thymus gland would suggest the use of the extract in *rickets* and other diseases which occur especially during the developmental stage of life, and are accompanied by marked failure of nutrition. We know, however, of no studies made upon the subject. Without any apparent guiding principle the extract of the thymus has been used to a considerable extent in the treatment of *exophthalmic goitre*. The results appear to warrant the conclusion that the thymus gland possesses no specific action in that disease. That the thymus body has some activity seems to be indicated by the experiments of Svehla, who found that its intravenous injection produces a marked fall of blood pressure which he believes to be the outcome of vasomotor paralysis, and that large doses cause dyspnœa and collapse, ending in death. *Dose*, of extract, from three to five grains (0.2–0.32 Gm.) in capsules.

Tilia. *Linden Tree.*—The dried flowers of *Tilia europœa*, L., and of other species of Tilia (Fam. Tiliaceæ) are official in the German Pharmacopœia under the head of *Flores Tiliæ*. The flowers contain a colorless, fragrant, volatile oil. The bark has been said to contain a neutral body, *tiliadin*, and a glucoside *tiliacin*. (See *A. J. P.*, 1890; *P. J.*, 66, 105.) The infusion is used as a household remedy to relieve hysteria and indigestion.

Timbo.—This name is applied in Brazil to various sapindaceous plants, used as fish poisons. Among these is *Serjania curassavica*, Radlk. (*Paullinia pinnata*, L.), in which Stanislaus Martin (*B. G. T.*, xcii.) has found an alkaloid, *timbonine;* F. Pfaff has obtained from a timbo of unknown origin two alkaloids, *timboin* and *anhydrotimboin*, also an oily compound, *timbol*. (*A. J. P.*, Nov. 1891.)

Tin. (Sn. At. wt., 118.1.) *Stannum. Etain*, Fr. *Zinn*, G.—This was recognized in the old Edinburgh and Dublin Pharmacopœias, and in the U. S. of 1850, but is no longer official. It has, however, too long ranked among recognized remedies to be passed without notice. Tin is one of the metals which have been known from the earliest ages. It exists generally as an oxide (*tin stone* and *wood tin*), rarely as a sulphide (*tin pyrites*), and is by no means generally diffused. It is found in England, Spain, Germany, Bohemia, and Hungary, in Europe, and sparingly in some parts of the United States; in the island of Banca and the Peninsula of Malacca in Asia; in Bolivia, and at Durango in Mexico. The mines of Banca furnish the purest tin. The metal is extracted from the native oxide. When this occurs in its purest state, in detached roundish grains, called *stream tin*, the reduction is effected by heating with charcoal. When the common oxide, called *mine tin*, is reduced, it requires to be freed, by pounding and washing, from the adhering gangue, after which it is roasted to drive off sulphur, arsenic, and antimony, and finally reduced in furnaces by means of stone coal. The metal, as thus obtained, is called *block tin*, and is not pure. The purest kind of tin known in commerce is called *grain tin*. The world's production of tin in 1903 is given as 93,893 tons. The importations of block tin into the United States for the year 1903 amounted to 44,028½ short tons, valued at $23,618,802, while the importations of tin and terne plate, which in 1889 amounted to 331,311 long tons, valued at $21,726,707, in 1903 had diminished to 47,360 tons, valued at $2,999,252.

Tin is a malleable, rather soft metal, of a silver-white color. It may be beaten out into thin leaves, called *tin foil*. It undergoes a superficial tarnish in the air. Its taste is slight, and when rubbed it exhales a peculiar odor. Its ductility and tenacity are small; when bent to and fro, it emits a crackling noise, which is characteristic. Its sp. gr. is 7.29, melting point 235° C. (455° F.), and it volatilizes at a white heat. It forms two oxides. The *stannous oxide*, SnO, is of a grayish-black color. When perfectly pure it has, according to Roth, a red color. *Stannic oxide*, SnO_2, or *dioxide*, forms two hydrates, both being acids,—*stannic acid*, $SnO_2.H_2O$, and *metastannic acid*, $Sn_5O_{10}.5H_2O$, or $(H_2SnO_3)_5$.

The tin of commerce is often impure, being contaminated with other metals, introduced by

fraud or present in consequence of the mode of extraction from the ore. A high specific gravity is an indication of impurity. When its color has a bluish or grayish cast, the presence of copper, lead, iron, or antimony may be suspected. Arsenic renders it whiter, but at the same time harder, and lead, copper, and iron cause it to become brittle. Pure tin is converted by nitric acid into a white powder (*metastannic acid*), without being dissolved. Boiled with hydrochloric acid, it forms a solution which gives a white precipitate with potassium ferrocyanide. A blue precipitate with this test indicates iron, a brown one copper, and a violet-blue one both iron and copper. If lead be present, a precipitate will be produced by magnesium sulphate. The Malacca and Banca tin and the English grain tin are the purest kinds found in commerce. Banca tin, from analyses by Mulder, appears to be particularly pure, containing only one-twenty-fifth of one per cent. of foreign metals. Block tin and the metal obtained from Germany are usually of inferior quality.

Tin enters into the composition of bronze, bell metal, pewter, and plumber's solder. It is used also in making tin plate, which is sheet iron coated with tin, in making tin amalgam for silvering looking glasses, and in forming the *solution of stannous chloride* (*bichloride of tin*), a combination essential for the dyer's use. It is employed in fabricating various vessels and instruments useful in domestic economy and the arts. Being unaffected by weak acids, it forms a good material for vessels intended for boiling operations in pharmacy. A *false tin foil* is considerably used at present, made by coating lead with tin, and then rolling it out into thin sheets. As tin foil is employed for enclosing medicinal powders and perishable articles of food and medicine, care should be taken not to use this substituted preparation.

Stanni Pulvis. *Powder of Tin.*—For directions for making, see 16th edition *U. S. D.* Powder of tin was used as a mechanical anthelmintic, but has very properly gone out of vogue. The *dose* is half an ounce, mixed with molasses, given for several successive mornings, and then followed by a brisk cathartic purge. In the *J. P. C.*, 4e sér., xix. 78, is reported a death believed to have been caused by tin. Pattengo (*A. E. P. P.*, xvii., 1886) confirms the old statement of Orfila that the metal is of no therapeutic value. Three-fourths of a grain of the chloride intravenously injected into a dog suffice to cause trembling, Cheyne-Stokes respiration, opisthotonos, and death. Stannous chloride, or chloride of tin, is a violent irritant and mild caustic. Chemically pure tin, given internally, is probably not absorbed. (See 16th edition *U. S. D.*)

Tinospora. *Br. Add.*—"The dried stem of *Tinospora cordifolia*, Miers (Fam. Menispermaceæ), collected in the hot season." *Br. Add.* Tinospora has long been used in India as a medicine and in the preparation of a starch known as *gilœ-ka-sat* or as *palo*. It is said to be a tonic, antiperiodic, and a diuretic. Flückiger obtained from it traces of an alkaloid and a bitter glucoside The Br. Add. recognizes an *infusion* (*Infusum Tinosporæ*, Br. Add., two ounces to the pint), *dose*, one-half to one fluidounce (15–30 Cc.); a *tincture* (*Tinctura Tinosporæ*, Br. Add., four ounces to the pint), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.); and a *concentrated solution* (*Liquor Tinosporæ Concentratus*, Br. Add.), *dose*, one-half to one fluidrachm (1.8–3.75 Cc.). *Tinospora crispa*, Miers, which is abundant in the Philippines, is used freely by the natives under the name of *makabuhay* (that is, "You may live") as a panacea especially valuable in *general debility*, in chronic *rheumatism*, and in *malarial fevers*. It may be prepared in the same way and given in the same doses as *Tinospora cordifolia*.

Tissa. *Tissa rubra* (L.), Brit.—*Arenaria rubra*, L., is a native of Malta, Sicily, and Algiers, and has long been used as a popular remedy in diseases of the bladder. It was shown by F. Vigier (*J. P. C.*, 1879, ii. p. 371) to contain a resinous aromatic substance which is probably its active principle. It is strongly recommended by Bertherand in *calculous diseases* and acute and chronic cystitis. The aqueous extract may be given in *doses* of thirty grains (2.0 Gm.); or the fluidextract, *dose*, a fluidrachm (3.75 Cc.), three or four times a day.

Tobacco. *Tabacum. U. S.* 1890. *Nicotiana Tabacum*, L.—An annual plant with a large fibrous root, and an erect, round, hairy, viscid stem, which branches near the top, and rises from three to six feet in height. The leaves are numerous, alternate, sessile, and somewhat decurrent, very large, ovate-lanceolate, pointed, entire, slightly viscid, of a pale green color, and are the part employed. The seeds, examined by F. M. Brandt, yielded no narcotic principle, though a protein-like substance contained in them was thought by its decomposition to produce nicotine (*Neues Jahrb. für Pharm.*, xxi. 42). William Procter also failed to find nicotine in the seeds. (*Proc. A. Ph. A.*, 1858, 296.)

There is good reason to believe that this plant is a native of tropical America, where it was found by the Spaniards upon their arrival. It is at present cultivated in most parts of the world, and nowhere more abundantly than within the limits of the United States. Virginia is, perhaps, the region most celebrated for its culture. The young shoots, produced from seeds thickly sown in beds, are transplanted into the fields during the month of May, and set in rows with an interval of three or four feet between the plants. Through the whole period of its growth the crop requires constant attention. The development of the leaves is promoted by removing the top of each plant and thus preventing it from running into flower and seed. The harvest is in August. The ripe plants, having been cut off above their roots, are dried under cover, and then stripped of their leaves, which are tied in bundles and packed in hogsheads. While hung up in the drying houses, they undergo a curing process, consisting in exposure to a considerable degree of heat, through which they become moist, or, in other words, are said to sweat, after which they are dried for packing.

Two varieties of this species are mentioned by authors, one with narrow, the other with broad leaves; but they do not differ materially in properties. Great diversity in the quality of tobacco is produced by difference of soil and mode of cultivation, and several varieties are recognized in commerce. Other species also of Nicotiana are said to be cultivated, especially *N. rustica*, L., which is said to have been the first introduced into Europe, and is thought to have been cultivated by the aborigines of this country, as it is naturalized near the borders of some of our small Northern lakes. The *N. quadrivalvis* of Pursh affords tobacco to the Indians of the Missouri and Columbia Rivers; and *N. fruticosa*, a native of China, was probably cultivated in Asia before the discovery

of this continent by Columbus. The latter species is said by John Le Conte to be that from which the best Cuba tobacco is obtained.[1] (*A. J. P.*, 1859.) Besides these there are *N. Persica*, L., cultivated in Persia; *N. repanda*, Willd., cultivated in Central and Southern North America; *N. Bigelovii*, Wats., of North America; and certain cultivated forms of *N. Tabacum*, L., which have been given by some authors specific rank.

The total annual production of tobacco throughout the world at present is estimated at 1,000,000 tons, of which Asia furnishes 350,000, America 300,000, Europe 250,000, and the rest of the world 100,000 tons. (*Zeit. für Angew. Chem.*, 1905, p. 1623.)

Tobacco, as it occurs in commerce, is of a yellowish-brown color, a strong narcotic penetrating odor which is wanting in the fresh leaves, and a bitter, nauseous, and acrid taste. These properties are imparted to water and alcohol. They are injured by long boiling, and the extract is, therefore, relatively feeble. An elaborate analysis of tobacco was made by Vauquelin, who discovered in it among other ingredients, an acrid, volatile, colorless liquid, slightly soluble in water, very soluble in alcohol, and supposed to be the active principle. It was separated by a complicated process, of which, however, the most important step was the distillation of tobacco juice with potassium hydroxide. In the results of this distillation Vauquelin recognized alkaline properties, which he ascribed to ammonia, but which were, in part at least, dependent upon the acrid principle above mentioned. To this principle the name of *nicotine* was given; but its alkalinity was not ascertained till a subsequent period. Another substance was obtained by Hermbstädt by simply distilling water from tobacco and allowing the liquid to stand for several days. A white crystalline matter rose to the surface, which upon being removed was found to have the odor of tobacco, and to resemble it in effects. It was fusible, volatilizable, similar to the nicotine of Vauquelin in solubility, and without alkaline or acid properties. It was called *nicotianin* by Hermbstädt, and appears to partake of the nature of volatile oils. Flückiger, who made a study of this nicotianin, is of the opinion that it is simply a fatty acid contaminated with a little volatile oil. (*Pharmacographia*, 2d ed., p. 468.) According to Landerer, it occurs only in dried tobacco leaves. It forms white crystalline scales of a delicate tobacco-like odor, a bitter taste, and a neutral reaction. It is only slightly soluble in water, soluble in ether and alcohol. According to an analysis of Barral (*C. R. A. S.*, 21, p. 1376), it has the formula $C_{23}H_{32}N_2O_3$. Barral states, moreover, that when distilled with strong solution of potassium hydroxide it yields nicotine.

Two German chemists, Posselt and Reimann, subsequently analyzed tobacco, and ascertained the alkaline nature of its active principle, which, however, neither they nor Vauquelin obtained in a state of purity. The nicotine obtained by Vauquelin and by Posselt and Reimann was a colorless, volatile liquid, and, as subsequently ascertained by Henry and Boutron, was in fact an aqueous solution of the alkaline principle in connection with ammonia. It was reserved for these chemists to obtain nicotine in a state of purity. It exists in tobacco combined with an acid in excess, and in this state is not volatile. It is easily extracted from tobacco by means of alcohol or water as a malate, from which the alkaloid can be separated by shaking it with caustic lye and ether. The ether is then expelled by warming the liquid, which finally has to be mixed with slaked lime and distilled in a stream of hydrogen, when the nicotine begins to come over at about 200° C. (392° F.). The percentage of nicotine in tobacco varies considerably,—from 1.62 per cent. in Havana tobacco and 2 per cent. in Maryland tobacco to 6 per cent. in Virginia tobacco and 8 per cent. in Kentucky tobacco. For a mode of estimating the proportion of nicotine in tobacco, see *P. J.*, Dec. 1873, 442.[2] For an analysis of the ashes of Virginia tobacco, by McD. Irby of New Orleans, and J. A. Cabell of Virginia, see *Chem. News* (Sept. 4, 1874, 117).

Nicotine. (*Nicotina* or *Nicotia.*)—This is a colorless or nearly colorless fluid, of the sp. gr. 1.027, boiling at 247° C. (476.6° F.), and not solidifying at —10° C. (14° F.); having a faint odor when cold; of an exceedingly acrid, burning taste, even when largely diluted; entirely volatilizable, and, in the state of vapor, very irritant to the nostrils, with an odor recalling that of tobacco; inflammable; very soluble in water, alcohol, ether, the fixed oils, and oil of turpentine; strongly alkaline in its reaction, and capable of forming crystallizable salts with the acids. These salts are deliquescent, having a burning and acrid taste, and, like the salts of ammonia, lose a portion of their base by heat. Its formula is $C_{10}H_{14}N_2$, and it is recognized as a *hexahydrodipyridyl*, $C_{10}H_8(H_6)N_2$. While nicotine has not been prepared synthetically as yet, two isomeric bases, *isonicotine* and *nicotidine*, have been prepared. On treatment with oxidizing agents, nicotine yields *nicotinic* or *β-pyridinecarboxylic acid*, $C_5H_4N.COOH$. In its action on the animal system it is one of the most virulent poisons known. A drop of it, in the state of concentrated solution, is sufficient to destroy a dog, and small birds perish at the approach of a tube containing it. Tannin forms with it a compound of but slight solubility, and might be employed as an antidote. Nicotine exists in tobacco in small proportion; it has been found in the seeds, and, in very small proportion, in the root. There can be little doubt that tobacco owes its activity to this alkaloid, which has also been criminally employed as a poison. (*N. Y. Jour. of Med.*, N. S., ix.) Nicotine has the remarkable property of resisting decomposition amid the decaying tissues of the body, and was detected by Orfila in the bodies of animals destroyed by it two or three months after their death. Mayer concluded from his experiments that nicotine is the active principle in all parts of the plant both before and after curing. (*Proc. A. Ph. A.*, 1865.)

[1] There is reason for believing that the official species is a more exclusive source of the commercial tobacco than is indicated by the text, and also in the *Pharmacographia*, where it is stated that *N. rustica* furnishes *East India Tobacco* and the kinds known as *Latakia* and *Turkish Tobacco*, *N. Persica* the tobacco of Shiraz, and *N. repanda* a much valued Havana tobacco. Latakia tobacco seems, however, to be the product of the official plant, and Senator Vidal asserts that *N. repanda* is not found in Cuba, *N. Tabacum* being the only species there cultivated. (*P. J.*, viii. 710.) Again, the Persian and Turkish tobacco sold under the name of *tumbeki* of commerce, which has been variously attributed to *N. Persica* and to *N. rustica*, is in all probability the product of *N. Tabacum*. (*Kew Bulletin*, April, 1891.)

[2] For Liecke's and Schloesing's methods of estimating nicotine, see 17th edition *U. S. D.*, p. 1346. For Kosutany's method, see *Zeit. An. Chem.*, 1893, 277.

Pictet and Rotch (*A. J. P.*, 1902, p. 292) have isolated three new alkaloids from tobacco. The first of these is a liquid boiling at 266° to 267° C. (510.8°–512.6° F.), to which the name *nicoteïne*, and the formula $C_{10}H_{12}N_2$, has been given; the second *nicotelline*, $C_{10}H_8N_2$, has a boiling point of over 306° C. (583° F.), and is solid at ordinary temperatures, crystallizing from alcohol in white prismatic needles, and the third is very volatile, found admixed with nicotine, and has not as yet been satisfactorily studied.

Vohl and Eulenberg (*P. J.*, Jan. 1872, p. 567) made an interesting analysis of tobacco smoke. The smoke analyzed was from strong tobacco, containing 4 per cent. of nicotine. Notwithstanding this large proportion of nicotine, none of it was found in the smoke, the authors differing in their results from most previous observers. The subject has been reinvestigated by R. Kissling (*Ding. Polyt. Journ.*, 244, 64), who has shown that Vohl's conclusion as to the non-existence of nicotine in tobacco smoke is due to that chemist having overlooked the fact that the alkaloid is decomposed by warm potassium hydroxide, a reaction which has not met with general recognition.

When cigars were smoked, certain gases were given off, which, when collected and examined, proved to be oxygen, nitrogen, carbon dioxide, and marsh gas. The smoke was drawn first through a potassium hydroxide solution to collect acids, and then through diluted sulphuric acid to collect bases. With the alkaline solution, an oily substance appeared on the surface, having an almost intolerable odor of tobacco smoke, and from this was obtained, by distillation at a gradually increasing temperature, at first a liquid and oily product, and, at the temperature of 300° C. (572° F.), a substance which on cooling became a laminated mass. This, on being repeatedly crystallized from ether, assumed the appearance of pearly white scales, melting between 94° and 95° C. (201.2° and 203° F.), and of a higher boiling point than mercury. From these characters, as well as its percentage composition, this substance appears to be identical with the hydrocarbon ($C_{19}H_{18}$) discovered by Kraut. The oily distillate before this, having been purified by repeated treatment with potassium hydroxide and sulphuric acid, had a sp. gr. 0.8 to 0.87, and from its percentage composition (92 or 93 C and 8 or 7 H) appears to be a mixture of different hydrocarbons belonging to the benzene or some analogous series. The potassium hydroxide solution, after the separation of the oils yielded, under appropriate treatment, a large amount of gas, consisting of carbon dioxide and hydrogen cyanide and sulphide; consequently the statement that tobacco smoke contains no cyanogen is a mistake. Upon a distillation of the potassium hydroxide solution after the addition of sulphuric acid, several acids were found in the distillate,—viz., acetic, propionic, butyric, and valeric, with a portion of creosote, more doubtfully caproic, caprylic, and succinic acids. Only the sulphuric acid solution now remained for examination. From this, which had become dark-colored and thick on standing, a *dark brown resin* was separated. By treatment with potassium hydroxide, ammoniacal vapors escaped, and a *brown oil* with the odor of tobacco smoke floated on the surface. From the residuary liquid, after distillation, saturation with potassium hydroxide, and redistillation, vapors escaped which proved to be ammonium chloride. After further treatment, for which we refer to the original, the oily residue was divided by fractional distillation, and the whole series of picoline bases, analogous to the aniline bases, were obtained. The identities of the following were determined by their boiling point, percentage composition, and the composition of the double platinum salt: *pyridine*, C_5H_5N, boiling point 115° to 116° C. (239°–240.8° F.); *picoline*, C_6H_7N, boiling point 134° to 135° C. (273.2°–275° F.); *lutidine*, C_7H_9N, boiling point 155° C. (311° F.); *collidine*, $C_8H_{11}N$, boiling point 171.5° C. (341° F.) (isomeric with xylidine); *parvoline*, $C_9H_{13}N$, boiling point 187° to 188° C. (368.6°–370.4° F.) (isomeric with cumudine); *coridine*, $C_{10}H_{15}N$, boiling point 211° C. (411.8° F.); *rubidine*, $C_{11}H_{17}N$; and probably *viridine*, $C_{12}H_{19}N$, boiling point 251° C. (483.8° F.). No trace of *nicotine* was to be found. The authors experimented physiologically with only a mixture of those boiling below 160° C. (320° F.), and of those boiling between 160° and 250° C. (320° and 482° F.), and these were found, like nicotine, to cause contraction of the pupil, dyspnœa, general convulsions, and death.

Thoms (*A. J. P.*, 1900, p. 227) has reported upon the composition of tobacco smoke, confirming most of the statements made above. He, however, obtained distinct quantities of phenols and a small quantity of furfurol. In cigars from which the nicotine had been removed, no pyridine was found in the smoke.

When distilled at a temperature above that of boiling water, tobacco affords an empyreumatic oil, which Brodie proved to be a most virulent poison. It was official in the U. S. P. 1870, under the name of *Oleum Tabaci: Oil of Tobacco.* A single drop, injected into the rectum of a cat, occasioned death in about five minutes, and double the quantity, administered in the same manner to a dog, was followed by the same result. This oil is of a dark brown color and an acrid taste, and has a very disagreeable odor exactly resembling that of tobacco pipes which have been much used. It has been stated to contain nicotine. (*Ann. Ch. Phys.*, 3e sér., ix. 465.)

It is quite certain that tobacco leaves undergo considerable chemical changes during the processes of curing and preparation for use. Thus, the characteristic odor of ordinary tobacco is entirely different from that of the fresh leaves, and must be owing to the generation of a new volatile principle. It has also been asserted that the proportion of nicotine in prepared tobacco is greater than in the fresh. It has even been made a question whether nicotine exists at all in the fresh growing leaves; but this question has been experimentally decided in the affirmative by Procter (*Proc. A. Ph. A.*, 1858, p. 300), and Mayer of New York, has experimentally determined that the nicotine exists as largely in the plant before as after curing; indeed, he believes that it is somewhat diminished in the process, probably in part if not altogether by volatilization. (*Ibid.*, 1865.)

The distinguishing character of tobacco, as given in the Br. Pharm. 1885, is that when distilled with solution of potassium hydroxide it yields an alkaline fluid having the peculiar odor of nicotine and giving precipitates with platinic chloride and tincture of galls.

Medicinal Properties and Uses.—Tobacco is a powerful sedative poison, which is locally irritant. Snuffed up the nostrils, it excites violent sneezing and a copious secretion of mucus; chewed, it irritates the mucous membrane of the

mouth and increases the flow of saliva; when injected into the rectum, it sometimes operates as a cathartic;[1] and the alkaloid nicotine injected into the cellular tissue of animals evidently produces much pain. Moderately taken, it quiets restlessness, calms mental and corporeal inquietude, and produces a state of general languor or repose which has great charms for those habituated to the impression. In larger quantities, it gives rise to confusion of the head, vertigo, stupor, faintness, nausea, vomiting, and general depression of the nervous and circulatory functions, which, if increased, eventuates in alarming and even fatal prostration. The symptoms of its excessive action are severe retching, with the most distressing and continued nausea, great feebleness of pulse, coolness of the skin, fainting, and sometimes convulsions. We are singularly deficient in exact knowledge as to how these various symptoms are produced. In accordance with the experimental evidence at hand, the convulsions are spinal; and it seems well determined that the paralysis is due to a depressant action upon the motor nerve trunks, which immediately after death are found to be inexcitable. How the circulatory phenomena are brought about is not clear, but it would appear that the heart muscle is not itself directly affected, as Benham found that the direct application of the poison to the viscus does not arrest its pulsations.

The use of tobacco was adopted by the Spaniards from the American Indians. In the year 1560 it was introduced into France by the ambassador of that country at the court of Lisbon, whose name—Nicot—has been perpetuated in the generic title of the plant. Sir Walter Raleigh is said to have introduced the practice of smoking into England. In the various modes of smoking, chewing, and snuffing, the drug is now largely consumed in every country on the globe. It must have properties peculiarly adapted to the propensities of our nature to have thus surmounted the first repugnance to its odor and taste and to have become the passion of so many millions. When employed in excess, it enfeebles digestion, produces emaciation and general debility, and lays the foundation of serious nervous disorders. The most common of these is undoubtedly the disturbance of the innervation of the heart, with consequent palpitations and cardiac distress. Amaurosis and even color blindness are occasionally produced, and even insanity has been ascribed to chronic tobacco poisoning. In many cases of "nervous break-down" attributed to overwork, the excessive use of tobacco has centainly been an important etiological factor. In the form of snuff, tobacco is sometimes so much contaminated with lead, in consequence of being kept in leaden boxes, as to produce the poisonous effects of that metal. In different kinds of snuff Vogel found from 0.014 to 1.025 per cent. of lead. (See *A. J. P.*, 1864, p. 422.)

Formerly much used as a relaxant, tobacco has been superseded by safer and more efficacious remedies, so that it is at present never employed in medicine, unless it be internally in *chronic asthma* and locally in *hemorrhoids* and in various spasmodic or painful affections. It should always be borne in mind that its active principle is absorbed readily by the skin, and that serious or even fatal poisoning may result from its too free application to the surface of the body. A case of death is on record, occurring in a child eight years old, in consequence of the application of the expressed juice of the leaves to the head, for the cure of *tinea capitis*. Death has also been produced by the inhalation of the smoke.

From five to six grains (0.32–0.4 Gm.) of powdered tobacco will generally act as an emetic; but the remedy ought never to be used for such purpose.

Toddalia. *Br. Add.*—"The dried root-bark of *Toddalia aculeata*, Pers." (Fam. Rutaceæ.) This climbing shrub, known also as *Lopez root*, growing in the subtropical Himalayas and Ceylon, is a tonic stomachic, containing a resin and a volatile oil, which may be readily obtained from the leaves by distillation. This oil has the odor of citron peel, and a bitter aromatic taste. The British Addendum recognizes an *infusion* (*Infusum Toddaliæ*, Br. Add., two ounces to a pint), *dose*, one to two fluidounces (30–60 Cc.); also a *concentrated solution* (*Liquor Toddaliæ Concentratus*, Br. Add.), *dose*, from one-half to one fluidrachm (1.8–3.75 Cc.).

Tolypyrine. *Tolyantipyrin. Paratolyl-dimethyl-pyrazolon.* $C_6H_4CH_3N{<}^{N.CH_3.C.CH_3}_{CO.CH}$

This compound occurs in colorless crystals soluble in water and alcohol, insoluble in ether, and is used like antipyrine as an antipyretic in *doses* of from eight to thirty grains (0.5–2.0 Gm.).

Tonga.—Tonga is a composition of unknown barks compounded by the natives of the Feejee Islands for medicinal purposes. The plants from which this remedy is derived are believed to be *Premna taitensis*, Schan. (Fam. Verbenaceæ), and *Epipremnum mirabile*, Schott. (*Rhaphidophora vitiensis*, Schott.) (Fam. Araceæ). (*A. J. P.*, 1881, 439.) It was introduced to the notice of the medical profession by Sydney Ringer and Wm. Murrell of London, as a remedy for *neuralgia*. (*L. L.*, ii. 1880.) The natives are said to steep the bundle as prepared by them for twenty minutes in half a tumblerful of cold water, and then, squeezing it dry, drink the infusion, preserving the bundle in a dry place for further use. A fluidextract has been put upon the market, and evidence of its value brought forward, but we have known a fluidrachm of this extract given every two hours for two days without obvious effect; the *dose* usually recommended is half a fluidrachm (1.8 Cc.).

Tonka Bean. *Fève Tonka*, Fr. *Tonka-bohnen*, G.—The seed of *Dipteryx odorata* of Willd., the *Coumarouna odorata* of Aublet, a large tree growing in Guiana. The fruit is an oblong-ovate pod, enclosing a single seed, from an inch to an inch and a half long, from two to four lines broad, usually somewhat compressed, with a dark brown, wrinkled, shining, thin, and brittle skin, and a light brown oily kernel. The seed has a strong, agreeable, aromatic odor, and a bitterish, aromatic taste. Its active constituent is a crystallizable, odorous substance, called *coumarin* or *cumarin*, $C_9H_6O_2$, by Guibourt. It is the anhydride of *coumaric acid*, $C_9H_8O_3$. It is capable of sublimation; but, to obtain it in crystals in this way, a low temperature is necessary. (Waddington, *P. J.*, 1868, 410.) This substance is sometimes found in a crystalline state, between the two lobes of the kernel Coumarin appears

[1] *Enema Tabaci, Br.* 1867. *Enema of Tobacco.* This preparation, though no longer official, is still occasionally used: "Take of Leaf Tobacco *twenty grains;* Boiling Water *eight fluidounces.* Infuse in a covered vessel, for half an hour, and strain." *Br.* The whole quantity to be given at once.

to be a widely spread substance which has been found in many species of plants, notably in species of *Melilotus* (Fam. Leguminosæ) and *Trilisa odoratissima* (Walt.), Cass. (*Liatris odoratissima*, Willd.) (Fam. Compositæ), a plant sometimes used to protect woollens from moths. (*A. J. P.*, 1859, 556; also 1899, 133; see also *Chem. Gaz.*, 1852; *D. C.*, Nov. 1887.) Gössmann obtains coumarin in the following manner. The beans, cut finely, are heated for a long time with an equal bulk of alcohol of specific gravity 0.863, nearly to boiling, and, the tincture being decanted, the residue is treated in the same manner. The tinctures are mixed, the alcohol distilled off until turbidness appears, when four times the bulk of water is added, which precipitates coumarin and fatty matter. The precipitate is then heated to boiling, and the liquid passed through a moistened filter. The fatty matter remains on the filter, and the hot solution which passes deposits the coumarin on cooling. More may be obtained by concentrating the liquid, and may be purified by animal charcoal. One pound of the beans yielded 108 grains of coumarin. (*Ibid.*, 1856, 211.) Coumarin has been prepared synthetically by heating salicylic aldehyde with sodium acetate and acetic anhydride, whereby *acetocoumaric acid* is formed, which decomposes further into acetic acid and coumarin. It has also been obtained by the action of phenol upon malic acid. Tonka bean is used to adulterate tincture and extract of vanilla and to flavor snuff, being either mixed with it in the state of powder or put entire into the snuff box. Coumarin adulterated with acetanilide has been found in the market. (*Schim. Rep.*, 1893, 67.) Köhler (*Cb. M. W.*, 1875, 869, 881) finds that coumarin is a decided narcotic, and is at first stimulant, afterwards paralyzant to the heart. (See also C. Levaditi, *Centrlb. f. allgem. Path.*, xii. 1901.) The fluidextract of the bean has been used with asserted advantage in *whooping cough* in *doses* equivalent to from five to eight grains (0.32–0.5 Gm. for children five years old. (*A. J. P.*, 1869, 27.)

Tormentilla. *Rhizoma Tormentillæ*, P. G. *Tormentille*, Fr. *Tormentillwurzel*, G. *Tormentilla*, It. *Tormentila*, Sp.—Various species of the rosaceous genus *Potentilla* have been employed in medicine. (See *A. J. P.*, 1875, 109.) It is asserted (*Ibid.*) that our common *P. canadensis*, L., is a valuable sudorific and diuretic.

Potentilla Tormentilla, Neck. (*Tormentilla erecta*, L., *T. officinalis*, Curt.)—The tormentil, or *septfoil*, which was formerly in the Secondary List of the U. S. Pharmacopœia, is a small perennial plant of Europe. All parts of the plant are astringent, especially the root, which is the part employed. The root of tormentil is cylindrical and rounded, rather larger above than at the lower extremity, an inch or two in length, about as thick as the finger, knotty, sometimes contorted, brown or blackish externally, and reddish within. It has a slight aromatic odor and a very astringent taste. Tannin is an abundant constituent. There is also a red coloring principle, soluble in alcohol, but insoluble in water. Besides these ingredients Meissner found resin, cerin, myricin, gummy extractive, gum, extractive, lignin, water, and a trace of volatile oil. Tormentil has since been chemically examined by Rembold, who obtained tormentilla red by boiling the tannin of the root (*tormentiltannic acid*, $C_{26}H_{22}O_{11}$) with sulphuric acid. It has the same composition as rhatany red, and yields the same products of decomposition when fused with potassium hydroxide. He also obtained *kinovic acid*, $C_{24}H_{38}O_4$, from the root by boiling it with milk of lime, adding hydrochloric acid to the decoction, boiling the precipitate with solution of barium hydroxide, decomposing again by hydrochloric acid, dissolving the precipitate in alcohol, decolorizing with animal charcoal, filtering, concentrating, and crystallizing. Small quantities of *ellagic acid*, $C_{14}H_6O_8$, were also noted by him. (*A. J. P.*, 1868, 311; from *Ann. Chem.*, cxliv. 5.) The root is said to be used for tanning leather in the Orkneys and Western Islands of Scotland, and for staining leather red by the Laplanders. Tormentil is a simple and powerful astringent, applicable to all cases of disease in which this class of medicines is indicated. It may be given in substance, decoction, or extract. The *dose* of the powder is from thirty grains to a drachm (2.0–3.9 Gm.).

Toxicodendron capense, Thunb. (*Hyœnanche globosa*, Lam., *H. capense*, Peis.) (Fam. Euphorbiaceæ.)—The fruits of this South American species are said to be used for the poisoning of hyenas. They have been investigated by Arthur Baron von Engelhardt (*Kobert's Arbeiten*, 1892), who finds in them a chemically neutral, bitter principle, *hyananchin*, which is a powerful poison, resembling in its physiological action strychnine, from which, however, it differs in that it powerfully affects the cerebrum. The convulsions which it produces are of central origin, the poison having no action upon the nerve trunks or the muscles.

Toxylon. *Toxylon pomiferum*, Raf. (*Maclura aurantiaca*, Nutt.) (Fam. Moraceæ.) *Osage Orange.*—The bark of the root of this tree, which is indigenous in the Southern United States, is said to be considerably used in making a yellow dye. Alex. King has found in it *moric* and *moritannic acids*. (*A. J. P.*, xlvi. 257.)

Tragoponic Acid.—This was found by Rademaker and Fisher in the seeds of *Tragopogon porrifolius, L.* (Fam. Compositæ.) *Salsify*, more commonly known as *oyster plant*, is the plant which furnishes the edible root. (See *Nat. Drug.*, July 23, 1886, 47.)

Traumatol. *Iodocresine. Iodocresol.* $C_6H_3I.(CH_3)OH$.—This occurs as a purplish-red or yellow powder; it is obtained by acting on cresol with iodine, and is used as a substitute for iodoform.

Tribromallyl. *Tribromhydrinum.*—This is a colorless liquid, having a specific gravity of 2.436, freely soluble in ether. It has been recommended by De Fleury for *hysteria, asthma*, and similar nervous affections, in the *dose* of five drops in capsules from two to four times a day.

Tribromphenol. $C_6H_2Br_3.OH$.—Tribromphenol is prepared by shaking a solution of phenol with bromine water. It occurs in the form of soft, white, colorless needles, melting at 95° C. (203° F.), and subliming undecomposed at a higher temperature. It is soluble in alcohol, ether, and chloroform, and soluble with difficulty in glycerin, liquefied phenol, water, and weak alcohol. In caustic alkaline solutions it is readily soluble, and from them it is separated unaltered by acids.

Tribromphenol has been strongly recommended by Grimm for use in *antiseptic surgery*. He finds that a gauze containing a 2 per cent. solution of the compound, when saturated with blood

serum or urine, will remain perfectly odorless for fourteen days, and that a half per cent. solution of it will kill the bacteria of putrefaction in an hour.

Tribromphenol-Bismuth. *Xeroform.* $(C_6H_2Br_3O)_2BiOH + Bi_2O_3$.—This is a yellowish-green, insoluble, almost odorless and tasteless powder, which, according to its manufacturer, is a chemical combination of equal amounts of bismuth and tribromphenol, containing about 50 per cent. of bismuth oxide. It has been especially recommended by Hueppe (*B. K. W.*, 1893) as a specific in *cholera*, and has been used as an intestinal antiseptic in acute and chronic *enteritis* and in various functional and organic diseases of the alimentary canal.

Xeroform has also been recommended by E. Heuss (*Th. M.*, April, 1896) as a local antiseptic remedy for surgical use, especially valuable in the treatment of *burns, infected wounds, ulcers*, and other conditions for which iodoform is commonly employed. It does not alter under the influence of light, and since it is not decomposed by a temperature of 120° C. (255° F.), can be readily sterilized.

Dose, eight to fifteen grains (0.5–1.0 Gm.).

Tribromphenol Bromide. $C_6H_2Br_3OBr$.—E. W. Lewis finds (*Proc. Chem. Soc.*) that the melting point usually attributed to this substance 47.8° C. (118° F.), is much too low, and that it may be raised to 148° to 149° F. (64.4°–65° C.) by recrystallizing the compound from ethyl acetate; moreover, while, as usually stated, the substance of low melting point gives off bromine on heating at about 125° F. (51.7° C.), the purified material begins to lose bromine before melting at about 145° F. (62.8° C.). Tribromphenol bromide is made by adding 2 to 4 Gm. of phenol dissolved in water to bromine water containing 19 Gm. of bromine. After each addition of phenol the bottle is vigorously shaken, and when all of the phenol is added the mixture is set aside in a dark place for three days; the precipitate is then collected, drained on a porous earthenware tile and dried over sulphuric acid; the precipitate is then dissolved in warm ethyl acetate and the solution on cooling deposits the crystals. The crystals of tribromphenol bromide belong to the orthorhombic system. It forms citron-yellow scales which are insoluble in water, ether, cold alcohol, and alkalies. On boiling with alcohol it is decomposed and tribromphenol results.

Triferrin, or *paranucleinate of iron*, contains about 22 per cent. of iron as well as 2½ per cent. of organically combined phosphorus and is prepared from casein of cow's milk by digestion and precipitation by means of ferric salts. Triferrin is freely and completely soluble in a weak solution of sodium hydroxide, but it is insoluble in diluted hydrochloric acid having the acid strength of normal gastric juice. *Dose*, five grains (0.32 Gm.).

Trigonella. *T. Fœnum-græcum*, L. *Fenugreek. Semen Fœnugræci*, P. G. *Bockshornsamen*, G. A European annual leguminous plant cultivated in France and Germany for its seeds. These are oblong-cylindrical, somewhat compressed, obliquely truncated at each extremity, one or two lines in length, brownish yellow externally, yellow internally, and marked with an oblique furrow running half their length. They have a strong peculiar odor, and an oily, bitterish, farinaceous taste, and contain fixed and volatile oils, mucilage, bitter extractive, and a yellow coloring substance. E. Jahns (*Ber. d. Chem. Ges.*, xviii. 2518-2523) has obtained *choline*, $C_5H_{15}NO_2$, and *trigonelline*, $C_7H_7NO_2$. The yield of the former was 0.05 per cent., and of the latter 0.13 per cent. Trigonelline is isomeric and probably identical with pyridine-betaine. By heating trigonelline with concentrated solution of potassium hydroxide, a distillate is obtained which appears to contain pyridine. An ounce of the seeds, boiled in a pint of water, renders it thick and slimy. They yield the whole of their odor and taste to alcohol. On the continent of Europe they are employed in the preparation of emollient cataplasms, enemata, ointments, and plasters. They are never used internally for human beings, but the ground seeds are used to an enormous extent in the manufacture of cattle powders or condition powders.

Trillium, *Beth Root. Birth Root. Wake Robin. Trillium*, Fr., G.—The indigenous species, *T. erectum*, L., is said to have been employed by the aborigines, and also used by the early settlers; it still has some vogue under the name of *beth root* as an astringent and tonic expectorant; also in *hemorrhages* and to hasten *parturition*, and as a local irritant in *skin diseases*. *Dose*, of powdered root, a drachm (3.9 Gm.) three times a day. E. S. Wayne found in it a substance supposed to be saponin. It is said also to contain volatile oil and tannic acid. D. J. Prendergast believes that the *Trillium erectum*, L., contains a glucoside similar to convallamarin. (*Am. Drug.*, Nov. 1887.) For details, see 16th edition *U. S. D.* Vivian I. Reid (*A. J. P.*, 1892, 67) found a small quantity of fixed oil, saponin to the extent of 4.86 per cent., and an acid crystalline principle which is colored purplish-brown by sulphuric acid, and light green with sulphuric acid and potassium dichromate.

Trimethylamine. *Propylamine. Secaline. Triméthylamine*, Fr. *Trimethylamin*, G.—Wertheim in 1850 prepared from narcotine a substance having the formula C_3H_9N, and gave it the name *metacetamine*. In the same year Anderson prepared from codeine, and Hofmann from methyl compounds, substances having the same formula, giving them respectively the names of propylamine and trimethylamine. Other chemists have obtained similarly constituted principles from cod liver oil, ergot, herring pickle, putrid calf's blood, etc., and have even found them in saline combination in the flowers of *Cratægus Oxyacantha*, L., *Sorbus Aucuparia*, L., and one or more species of Chenopodium. Under the name of propylamine some of these principles were introduced into medicine by Awenarius of St. Petersburg, and met for a time with considerable favor; so that several processes for preparing propylamine were published before the 13th edition *U. S. D.* Since that time it has been very clearly shown that these various substances, although containing the same number of atoms, have them differently arranged, are consequently possessed of diverse properties, and are hence only isomeric. The material obtained from herring pickle and other sources and sold as propylamine is indeed not propylamine at all, but a more or less impure solution of trimethylamine; it is, in truth, doubtful whether propylamine has ever been procured from a natural source or made in any other way than by treating propyl iodide with ammonia. Both principles are derived ammonias or *amines*, but propylamine is a primary compound ammonia (monamine), and trimethylamine is a tertiary compound ammonia (triamine). In the first body the nitrogen

is combined with two atoms of hydrogen and one propyl group, C_3H_7, in the second with three methyl groups, $(CH_3)_3$.

Propyl, C_3H_7, H, H $\}$ N = C_3H_9N, Propylamine.

Methyl, CH_3, CH_3, CH_3 $\}$ N = C_3H_9N, Trimethylamine.

The physical differences are very marked. Thus propylamine boils at 49° C. (120.2° F.), trimethylamine at 9.3° C. (48.7° F.). The commercial propylamine contains other ammonia compounds besides trimethylamine, the latter substance indeed being sometimes present in very small quantity. Trimethylamine is made on a large scale at present by the destructive distillation of the "vinasses," or residues of beet root molasses. For other processes, see 16th edition *U. S. D.*, p. 1944.

Brieger has shown that choline, neuridine, and trimethylamine are among the early products of albuminoid decomposition in the human cadaver, and are then followed by other and more poisonous bodies of the ptomaine class.

The best form of trimethylamine for use is probably the hydrochloride, which may be prepared in a state of purity as a very deliquescent salt, crystallizing in long needles. To form the chloride naturally the distillatory products in Perret's process may be received into hydrochloric acid and separated from any ammonium chloride by means of absolute alcohol. *Commercial propylamine—i.e.*, impure solution of trimethylamine—is a colorless transparent liquid, of a characteristic odor, usually attended by some pungency, which may possibly be ascribed to the ammonia frequently mixed with it. It is soluble in water and alcohol, has a strong alkaline reaction, and forms crystallizable salts with the acids. If the end of a glass rod, previously dipped into hydrochloric acid, be held over the open mouth of a vial containing it, a white cloud of the chloride will be seen, as in the case of ammonia. *Pure propylamine* is said to be a perfectly clear, strongly refractive fluid, with the odor of ammonia; a boiling point of 49° C. (120.2° F.); a sp. gr. at 20° C. (67° F.) of 0.7186; inflammable; miscible with water. With hydrochloric acid it makes a deliquescent salt, soluble in alcohol, forming with platinum chloride a double salt, which crystallizes in large, dark, golden-yellow clino-rhombic plates, somewhat soluble in hot water and alcohol. *Pure trimethylamine* is a gas at ordinary temperatures.

Locally applied, trimethylamine acts as a powerful irritant or, if in sufficient concentration, even as a mild caustic. According to Laborde, in its physiological action it resembles the ammonium chloride or carbonate, though differing in not causing convulsions in animals fatally poisoned with it. (*M. T. G.*, 1874, 241.) The chloride was found to act in the same way as the trimethylamine, but to be scarcely more than half as powerful. Combemale and Brunelle have found that the drug is a powerful stimulant to the salivary gland. Given to man, trimethylamine acts chiefly as a violent gastro-intestinal irritant, the dose of half a drachm of the commercial article, even if freely diluted, usually producing distinct effects upon the stomach and the intestines. It has been found to act as a depressant to the circulation, but Laborde affirms that unless given in such dose as to produce serious results from its local action, it increases both in man and animals the arterial pressure. In 1854 it was brought forward by Awenarius of St. Petersburg, Russia, as a specific in *rheumatism*, and by other Continental physicians some confirmation of the original statements was afforded. Extensive trial made with the remedy in Philadelphia and elsewhere this side of the Atlantic soon led to its abandonment, and at present the remedy has passed entirely out of vogue. Awenarius prescribed a mixture of twenty-five drops of propylamine with six fluidounces of distilled water, flavored if necessary with sugar and oil of peppermint; of this he gave a tablespoonful every three hours, taking care that the drug was pure and freshly prepared. (*Ann. Thér.*, 1859.) In France, where the chloride was preferred, the following was a favorite formula: Trimethylamine chloride ten grammes, tincture of orange peel twenty-eight grammes, syrup nine hundred and seventy grammes. A tablespoonful contains about three and one-half grains. The *dose* of trimethylamine chloride is from eight to fifteen grains (0.5–1.0 Gm.).

Triosteum. *T. perfoliatum*, L. *Horse Gentian. Bastard Ipecac. Tinker's Weed. Fever Root. Feverwort. Wild Ipecac. Racine de Trioste*, Fr. *Dreisteinwurzel*, G. (Fam. Caprifoliaceæ.)—This plant is found in most parts of the Eastern United States, preferring a limestone soil and shady situations. The rhizome or root, the part used, is horizontal, long, about three-quarters of an inch in diameter, thicker and tuberculated near the origin of the stem, of a yellowish or brownish color externally, whitish within, and furnished with fibres which may be considered as branches of the main root. When dry it is brittle and easily pulverized. On microscopic examination, numerous crystals of calcium oxalate are to be seen. It has a sickening odor, and a bitter, nauseous taste. It is said to contain an alkaloid which Andree believed to be identical with emetine, but which Hartwich has shown to be different. It yields its active properties to both water and alcohol. Triosteum is cathartic, and in large doses emetic, and perhaps diuretic. The bark of the root may be given in *doses* of twenty to thirty grains (1.3–2.0 Gm.), or the extract in half the quantity. For uses, see *A. J. P.*, 1891, 326.

Triphenin. *Propionyl-phenetidin.* $C_6H_4.C_2H_5O.NH.(CH_3.CH_2.CO)$.—A homologue of phenacetin made by boiling a mixture of paraphenetidin with propionic acid; it forms colorless, odorless crystals, fusing at 120° C., of feebly bitter taste, soluble in 2000 parts of water.

Triphenin has been used to a very limited extent as an antipyretic in *typhoid fever, pneumonia*, and other acute affections, and also as an analgesic for nervous pains. Its range of action is precisely that of phenacetin. It is stated that it acts promptly, mildly, and without untoward secondary effects. *Dose*, eight to fifteen grains (0.5–1.0 Gm.).

Tripoli. *Terra Tripolitana.*—An earthy mineral, of a whitish, yellowish, or pale straw color, sometimes inclining to red or brown, usually friable, often adhesive to the tongue, and presenting the aspect of argillaceous earth, though differing from clay by the roughness and hardness of its particles, and by not forming a paste with water. The *Venice tripoli* is said to come from Corfu. Tripoli is sometimes artificially prepared by calcining certain argillites. It is used for cleaning and polishing metals.

Trompatila.—This is the stem and branches of *Bouvardia triphylla*, Salisb. (Fam. Rubiaceæ), a Mexican plant used by the natives for *hydrophobia*. (*A. J. P.*, 1874, 51.)

Tulipine.—An alkaloid extracted from the garden tulip. It is said to be a cardiac poison, with remarkable sialagogue properties. (*Nouv. Rem.*, 1886.) Under the name of *chielin* there has been put upon the market a brownish thick extract-like substance of an agreeable odor, easily soluble in water, said to be derived from the bulb of the tulip and to be non-poisonous. It has been highly recommended by H. Heyman as a soothing application in various forms of inflammatory skin diseases. (*D. M. W.*, August, 1902.)

Tumenol.—A dark brown or brownish-black liquid, of a syrupy consistence, which is made from bituminous shale oils. These are agitated with sodium hydroxide solution to remove phenols and then with sulphuric acid to remove pyridine and other bases. The oil is then treated with fuming sulphuric acid. The dark syrupy liquid which separates is washed with water and dissolved in sodium hydroxide. From this solution ether extracts *tumenol oil*. Hydrochloric acid, on the other hand, if added to the sodium hydroxide solution, throws down *tumenol-sulphonic acid*. A mixture of these two substances constitutes *tumenol venale*, a soft, resinous, odorless mass. A. Neisser (*D. M. W.*, 1891) highly commends tumenol as a local application in *eczema*, and as having extraordinary powers over the itching of *prurigo, parasitic dermatitis*, and other *skin affections*. He uses a lotion made with equal parts of ether, rectified spirit, and water or glycerin, and 10 per cent. of tumenol.

Turpeth. *Turpethum, Br. Add.*—"The dried root and stem of *Ipomœa Turpethum*, R. Br." (*Operculina Turpethum* (L.), Peter.) (Fam. Convolvulaceæ.) This plant, which grows throughout India and Ceylon, has long been used not only in India, but also to some extent by the Arabs and in Europe. According to Mérat and De Lens, the root itself formerly came into commerce, but at present turpeth "consists of the root and stem of the plant cut into short lengths, usually from one-half to two inches (one and a quarter to five centimetres) in diameter; the central woody portion is often removed by splitting the bark on one side. The exterior surface has a twisted rope-like or columnar appearance due to deep longitudinal furrows, and is of a dull gray color; a transverse section shows a porous central column surrounded by a broad cortical portion, the section is of a pale yellowish-white color, the cortex sometimes being darker. The fracture is short in the cortex and fibrous in the central portion. The drug has a faint odor and a nauseous taste, which is perceptible only after it has been some time in the mouth." *Br. Add.*

Boutron-Chalard found in turpeth root, resin, a fatty substance, volatile oil, albumen, starch, a yellow coloring matter, lignin, salts, and ferric oxide. (*J. P. C.*, viii. 121.) The root contains 10 per cent. of resin. (Andouard, *Ann. Thér.*, 1866, 118.) According to Spirgatis this resin is a glucoside, *turpethin*, $C_{76}H_{128}O_{36}$, like that of other Convolvulaceæ, insoluble in ether, but soluble in alcohol, to which it imparts a brown color not removable by animal charcoal. To obtain it pure, the alcoholic solution is concentrated; the resin precipitated by, and afterwards boiled with, water, then dried, reduced to powder, digested with ether, and finally redissolved by absolute alcohol and thrown down by ether. After being treated several times in this way, it is obtained in the state of a brownish resin, yielding on pulverization a gray powder, which strongly irritates the mucous membrane of the nostrils and mouth, and is fusible at 182.2° C. (360° F.). It is inflammable, burning with a smoky flame and emitting irritant vapors. With strong bases it acts like jalapin, takes up water, and is transformed into a soluble acid, *turpethic acid*, $C_{34}H_{60}O_{18}$, while with dilute acids it is decomposed into *turpetholic acid*, $C_{16}H_{32}O_4$, and glucose. (*J. P. C.*, 4e sér., i. 236.) Turpeth root is purgative, somewhat less powerful than jalap, and rather slow in its action. From one to three drachms (3.9–11.6 Gm.) may be given in decoction and from fifteen grains to a drachm (1–3.9 Gm.) in powder. (Mérat and De Lens.) Andouard (*Ann. Thér.*, 1866) states that the *resin of turpeth* is an active purge in *doses* of seven or eight grains (0.45–0.5 Gm.).

Tussilago. *Tussilago Farfara*, L. *Coltsfoot. Folia Farfaræ*, P. G. *Tussilage, Pas d'âne*, Fr. *Huflattig, Rosshuf*, G. (Fam. Compositæ.)—Coltsfoot is a perennial herb, with a creeping root, which early in the spring sends up several leafless, erect, simple, unifloral scapes or flower-stems, five or six inches high and bearing appressed scale-like bracts of a brownish-pink color. The flower, which stands singly at the end of the scape, is large, yellow, compound, with hermaphrodite florets in the disk, and pistillate, fertile florets in the ray. The latter are numerous, linear, and twice the length of the former. The leaves do not make their appearance until after the flowers. They are radical, petiolate, large, cordate, angular, toothed at the margin, bright green upon their upper surface, white and downy beneath. The plant grows spontaneously both in Europe and North America. In this country it is found upon the banks of streams from Nova Scotia and New Brunswick south to New York and west to Minnesota. It flowers in April and June. The whole of it is employed, but the leaves most so. They should be gathered after their full expansion, but before they have attained their greatest magnitude. The flowers have an agreeable odor, which they retain after desiccation. The dried root and leaves are inodorous, but have a rough, bitterish, mucilaginous taste. Boiling water extracts their virtues. C. S. Bondurant (*A. J. P.*, 1887, 340) examined coltsfoot chemically. He found evidences of a bitter glucoside. Coltsfoot exercises little sensible influence upon the human system. It is, however, demulcent, and is sometimes used in *chronic coughs, consumption*, and other *affections of the lungs*. The expectorant properties which it was formerly thought to possess are not obvious. The leaves were smoked by the ancients in *pulmonary complaints*, and in Germany they are said to be substituted for tobacco. Cullen used the fresh juice in *scrofula*, several ounces daily. The decoction made by boiling one troyounce in one pint of water is commonly given in teacupful doses.

Tussol. *Antipyrine Mandelate* (*Phenyl-glycolate*). $C_{11}H_{12}N_2O.C_6H_5CH(OH)COOH$.—It forms a white powder, fusing at 52° to 53° C. (125.6°–127.4° F.), is soluble in water, and is recommended in the treatment of *whooping cough* in the following *doses:* for children under one year, from three-fourths to one and a half grains (0.048–0.096 Gm.); from two to four years, four to six grains (0.26–0.4 Gm.).

Tutty. *Tutia. Impure Oxide of Zinc.*—This oxide is formed during the smelting of lead ores containing zinc. It is deposited in the chimneys of the furnaces, in the form of incrustations, moderately hard and heavy, and studded over with small protuberances of a brownish color on the outside and yellowish within. As it occurs in commerce, the pieces occasionally present a bluish cast, from the presence of small particles of metallic zinc. Sometimes a spurious substance is sold for tutty, consisting of a mixture of blue clay and copper filings, made into a paste with water and dried on an iron rod. It is distinguished from the genuine tutty by its diffusing in water and exhaling an earthy odor, and by its greater friability. Tutty is used solely as an external desiccant. To fit it for medicinal use it must be reduced to fine powder, which is dusted over the affected part, or applied in the form of an ointment.

Tylophora Leaves. *Tylophoræ Folia. Br. Add.* (Fam. Asclepiadaceæ.)—The dried leaves of *Tylophora asthmatica* (L.), Wight and Arnott. (*Tylophora fasciculata*, Ham.), are used in certain parts of India as a poison for vermin, and have been used with fatal results as a poison. *Tylophora asthmatica*, which grows in Bengal, Burmah, and Ceylon, has been known in Indian medicine since 1780, and has been largely used in both the civil and the military medical service of Madras. It is officially described as "petiolate, entire, from two to five inches (five to twelve and a half centimetres) long and from three-quarters of an inch to two and one-half inches (eighteen to sixty-five millimetres) broad, lanceolate-ovate or ovate or subrotund in outline, somewhat cordate at the base, abruptly acuminate; rather leathery in texture, glabrous on the upper surface, and finely downy on the lower; of a brownish-green color, which is paler on the lower surface. Odor slightly aromatic; almost devoid of taste." *Br. Add.*

David Hooper has separated from this drug an alkaloid, *tylophorine*, soluble in ether and alcohol, but scarcely so in water; forming crystalline salts, and striking with nitric acid a purplish red color, with Fröhde's reagents a deep sap-green, and with potassium dichromate and sulphuric acid a dirty violet. Tylophora resembles in its activity ipecac, and is used as a substitute for that drug in *bronchitis* and in *dysentery*. In *doses* of from 20 to 30 grains (1.3–2.0 Gm.) it is used as an emetic. The expectorant *dose* is from one-half to two grains (0.032–0.13 Gm.).

Ulex. *Ulex europæus*, L. (Fam. Leguminosæ), is the common *furze*, *gorse*, or *whin* so conspicuous in the waste places and by the roadsides of Great Britain, from its spiny branches and bright yellow flowers situated on the spines, either solitary or in pairs. In the seeds of this plant, A. W. Gerrard has found an alkaloid, *ulexine*. In 1890 Kobert (*D. M. W.*, 1890), as the result of an elaborate physiological study, came to the conclusion that ulexine and cytisine are identical. The suggestion has given rise to a considerable chemico-physiological discussion, a brief abstract of which may be found in *P. J.*, Feb. 1891. Kobert found indications of a second alkaloid in ulex. Partheil (*A. Pharm.*, 1892, 448; 1894, 486) and Plugge (*A. Pharm.*, 1894, 444) are in accord as to the identity of ulexine and cytisine. Ulexine has been used in cardiac *dropsy*. *Dose*, from one-fifteenth to one-twentieth of a grain (0.004–0.003 Gm.).

Ulmaren is the name given by Bourcet to a mixture of the salicylic acid esters of the higher aliphatic alcohols. It has been stated to contain 75 per cent. of salicylic acid. Ulmaren is described as a heavy, pale yellowish-red, refractive, neutral, or weakly acid liquid, of pleasant, faint odor recalling salol, and burning taste. Its sp. gr. at 15° C. (59° F.) is 1.06; and its boiling point lies between 237° C. and 242° C. (458.6°–467.6° F.). It crystallizes from an equal volume of petroleum benzin, and is almost insoluble in water, but is soluble in alcohol, ether, and chloroform. Animal experimentation (*Th. M.*, 1903, xvii.) showed that in moderate doses it is well taken, but if given in large doses by the mouth causes in the dog vomiting and purging, and in the rabbit a dose of 0.07 Gm. per kilogramme intraperitoneally injected, caused death from asphyxia. It is recommended to be used as an external application in *rheumatic* and *neuralgic* diseases, as well as in *gout*, either to be painted on the part and covered with waxed paper or used in the form of an ointment made up with lanolin, in which case it should be present in the proportion of 30 per cent. After epidermatic application the salicylic acid reaction may be demonstrated in the urine in three hours and lasts for three days. It is affirmed to have marked analgesic, antipyretic and antirheumatic powers (*B. G. T.*, June, 1903). *Dose*, fifteen to forty-five grains (1–3 Gm.); externally thirty to sixty grains (2–3.9 Gm.).

Ultramarine. *Outremer*, Fr. *Ultramarin*, G. This fine blue pigment was formerly obtained from *lapis lazuli*, or *lazulite*, a mineral of Siberia. It is now prepared artificially on a very large scale. In preparing it, a mixture of soft clay with sodium sulphate, charcoal, caustic soda, and sulphur is heated in crucibles. In this way a colorless compound is first produced, termed white ultramarine. This, however, soon becomes of a green color. The green ultramarine thus obtained, which is also used as a color, is then mixed with sulphur and heated. The sulphur takes fire and is allowed to burn in the air, when the product becomes of a fine blue color. (*Roscoe and Schorlemmer*, vol. ii. 459.) It is thought to be a compound of aluminum and sodium silicates with sodium polysulphide, although the sulphur present is retained in two conditions, part being deposited when ultramarine is treated with acids and part escaping as hydrogen sulphide.

Umbellularia. *Umbellularia californica* (Arn.), Nutt. *California Laurel. Spice Tree.* (Fam. Lauraceæ.)—The leaves of this California tree are employed in *neuralgic headaches*, and in *intestinal colic* and *atonic diarrhœa*; also externally as a mild counter-irritant. Stillman and O'Neill (*N. R.*, 1883) obtained from the seeds a new acid, *umbellulic acid*. The leaves are said also to contain about 4 per cent. of a volatile oil, having a specific gravity of 0.936, a warm camphoraceous taste, and a strong pungent odor. Burse has separated from the oil by fractional distillation *umbillol*, an oil having the formula $C_8H_{12}O$, which dissolves in concentrated sulphuric acid with red color, and is narcotic (*Ap. Ztg.*, xi.). According to Schimmel & Co. (*Schim. Rep.*, April, 1897), it also contained *cineol*, $C_{10}H_{18}O$. It is probable that the volatile oil is a strong local anæsthetic, as it has been found to act rapidly when brought in contact with exposed pulp or sensitive dentine. The fluidextract has been used in *doses* of from ten to thirty minims (0.6–1.8 Cc.).

Umber. *Terra Umbra.*—A mineral of a fine compact texture, light, dry to the touch, shining when rubbed by the nail, and of a fine pale brown color, which changes to a peculiar beautiful deep brown by heat. According to Klaproth, it contains 13 parts of silica, 5 of alumina, 48 of ferric oxide, 20 of manganese, and 14 of water in 100. *Burnt umber,* as well as the mineral in its unaltered state, is used in painting. The umber of commerce is said to be brought chiefly from the island of Cyprus.

Uranium.—Atomic weight, 236.7. The salts of the metal uranium are violent poisons, producing not only severe gastro-enteritis and nephritis, but also acting specifically on the hæmoglobin of the blood, affecting its oxygenating powers. (See *P. J.*, Sept. 1890.) They have been carefully investigated by Jacob Woroschilsky (*Arbeiten d. Pharm. Inst.*, Dorpat, v. 1890), who finds that they are violent poisons, though acting slowly, especially when given subcutaneously, small toxic doses producing death almost as rapidly as larger ones. In the lower animals, 1 milligramme of the oxide per kilogramme will produce an intense parenchymatous nephritis, followed by violent inflammation of the intestines. There is marked elevation of the blood pressure and widespread degeneration of the tissues, especially of the blood vessels. In mild cases of poisoning a transient glycosuria is a primary symptom. The uranium nitrate has been affirmed by West to be useful in *diabetes mellitus* (Kronpetzy prefers the acetate), in *doses* of one to two grains (0.065–0.13 Gm.), three times a day, increased to twenty grains (1.3 Gm.) a day. They have been used on the principle of *similia similibus curantur* in renal diseases. Augermayer affirms that the salts of uranium are highly toxic, half a milligramme per kilogramme of body weight being sufficient to cause death. (*Ph. J.*, Oct. 30, 1897, 378.)

Urasol. *Acetyl-methylene-disalicylic Acid.* $CH_2(C_6H_3{<}^{OC_2H_3O}_{COOH})_2$. This substance, introduced into medicine by S. Lewis Summers, is said to be formed from about 75 per cent. of salicylic acid, 16 per cent. of acetic acid, and 8 per cent. of formaldehyde. It occurs as a yellowish-white powder, insoluble in water, soluble in ether and alcohol. It has been used in *doses* of five to eight grains (0.32–0.5 Gm.), given in capsules, in *muscular rheumatism,* irregular *gout,* and as a germicide in *cystitis* and other inflammations of the genito-urinary tract.

Urea. $CO(NH_2)_2$. *Carbamide. Urée,* Fr. *Harnstoff,* G.—For an account of the physical and chemical properties of urea, the reader is referred to treatises upon physiology. Urea has been employed in practical medicine as a hydragogue diuretic in the treatment of *dropsies* and as a tonic alterative in *phthisis* (*L. L.*, December, 1901). *Dose,* ten grains (0.65 Gm.) every six hours; increase *pro re nata.*

Thio-urea is a substance in which one atom of oxygen in a molecule of urea is replaced by an atom of sulphur, $CS{<}^{NH_2}_{NH_2}$. According to Paul Binet (*Rev. Méd. de la Suisse Rom.*, 1893), it is a very active poison, paralyzing the nerve centres, but leaving intact the peripheral nerves and the muscles.

Urechites. *Urechites suberecta,* Jacq. *Savannah Flower. Yellow-flowered Nightshade.*—This is an apocynaceous plant, which grows abundantly in the West Indian Islands, and is said to be used in Jamaica by the negroes as a poison. The symptoms which it produces are violent vomiting and purging, with convulsions. J. J. Bowrey (*J. Chem. S.*, June, 1878) has isolated from it two glucosides, *urechitin* and *urechitoxin,* having respectively the formula $C_{28}H_{42}O_8$ and $C_{13}H_{20}O_5$. Isaac Ott (*T. G.*, 1880) finds the plant to be a powerful cardiac poison, first increasing and then depressing the arterial pressure, and finally, if the dose be large enough, killing by producing cardiac arrest. The results reached by Ott are in accord with those of Ralph Stockman (*Laborat. Rep., Royal College of Physicians, Edinburgh,* vol. iv., 1892), who finds that both of the glucosides are very active poisons belonging to the digitalis group. On the other hand, Vowinkie came to the conclusion that even small doses of the plant depress the heart, and experiments made upon man by Bowrey show that in large doses the drug produces nausea, vomiting, general depression, great perspiration, and slight slowing of the pulse. Stockman (*Rev. de Clin. et de Thér.*, June 29, 1892) found that the leaves contain a toxic alkaloid, which he calls *urechitine,* $C_{28}H_{42}O_8 + H_2O$, and a glucoside, *urechitonin,* which is less toxic. In Jamaica the drug is said to have been used in the treatment of *intermittent* and other *sthenic fevers.* The *dose* of the fluidextract is from two to ten minims (0.12–0.6 Cc.).

Urginea. *Br. Add. Indian Squill.*—The younger bulbs of *Urginea indica,* Kunth., also the younger bulbs of *Scilla indica,* Baker (*Ledebouria hyacinthina,* Roth), taken soon after the plant has flowered. "The bulbs of Urginea indica are tunicated, consisting of fleshy coats which enclose each other completely; in size varying as much as the common onion; color whitish; taste bitter and acrid. The bulbs of Scilla indica are not tunicated like an onion, but made up of thick fleshy imbricated scales; otherwise, except that they are somewhat smaller, they resemble those of Urginea indica." *Br. Add.*

The bulbs of Indian squill have long been used in India for purposes similar to that for which the official squill is employed in Europe and America, but no sufficient chemical examinations have been made to prove the identity of the Indian and European drugs. The Br. Add. recognizes a *vinegar* (*Acetum Urgineæ,* Br. Add., two and a half ounces to the pint), *dose,* ten to thirty minims (0.6–1.8 Cc.); an *oxymel* (*Oxymel Urgineæ,* Br. Add.), *dose,* one-half to one fluidrachm (1.8–3.75 Cc.); a *pill* of ipecacuanha with urginea (*Pilula Ipecacuanhæ cum Urginea,* Br. Add.); a *compound pill* (*Pilula Urgineæ Composita,* Br. Add.); a *syrup* (*Syrupus Urgineæ,* Br. Add.), *dose,* one-half to one fluidrachm (1.8–3.75 Cc.), and a *tincture* (*Tinctura Urgineæ,* Br. Add., four ounces to the pint), *dose,* five to fifteen minims (0.3–0.9 Cc.).

Uricedin.—Prepared by clarifying lemon juice, and adding for every fifty parts of citric acid in it, twenty parts of sulphuric acid, four parts of 25 per cent. hydrochloric acid, and sufficient sodium carbonate to nearly neutralize the acids. One part of lithium carbonate, neutralized with lemon juice, is then added, and the whole evaporated and granulated. It contains sodium sulphate, chloride, and citrate, with lithium citrate. Used in *gout* and *rheumatism.*

Urisolvin.—A compound of pure urea and acid lithium citrate used as a diuretic and uric acid solvent, in *doses* of three grains (0.2 Gm.), in the form of tablets.

Urobiline. $C_{42}H_{40}N_4O_7$.—This biliary pigment, prepared from urine, occurs as a brown resinous mass soluble in alcohol, ether, chloroform, and alkaline solution. It has been proposed by Th. Roman and G. Delluc as a reagent for zinc. A few drops of a solution of urobiline in chloroform, 2 Cc. of which are mixed with 5 Cc. of absolute alcohol, will make with an alkalized solution containing zinc a green fluorescence.

Uropherin. *Lithium-diuretin. Theobromine-lithium-salicylate.* $C_7H_7N_4O_2Li + C_6H_4(OH)COOLi$. A compound analogous to diuretin, lithium being substituted for sodium. Used as a diuretic in *doses* of fifteen grains (1.0 Gm.). E. Merck has also introduced the benzoate under a corresponding name, uropherin-benzoate.

Ursal.—A compound of urea and salicylic acid, used as a substitute for sodium salicylate.

Urtica. *Ortie brûlante*, Fr. *Brennessel*, G. Various species of this genus are furnished with poisonous stinging hairs. *Urtica gigas* of Australia is said frequently to kill horses, and to produce in man a sting whose impression lasts for months. (*N. R.*, 1875.) It has generally been thought that the virulence of the hairs is due to the presence of free formic acid (*A. J. P.*, xxii.), and David Hooper (*P. J.*, April, 1887) has demonstrated the presence of formic acid, or a substance very closely allied to it, in the hairs of the *Nilgri nettle* (*Girardinia palmata*). Nevertheless, it does not seem probable that formic acid is the poison. G. Haberlandt believes it to be a non-volatile albuminoid, and L. Reuter has obtained from several nettles a glucoside. (*A. J. P.*, Jan. 1890.) Oddi and Lomonaco (*Rif. Med.*, April, 1892) isolated from the common nettle a crystalline alkaloid, and found that in mammals the extract acts powerfully upon the vasomotor system, and in frogs causes centric paralysis with diastolic cardiac arrest.

U. dioica, L., or common nettle, and *U. urens*, L., or dwarf nettle, of America and Europe, have been used in medicine as local irritants, as diuretics (*A. J. P.*, 1866), and especially for the purpose of arresting *uterine hemorrhage*. The fluidextract may be given in *doses* of half a fluidrachm (1.8 Cc.) or a decoction of the strength of an ounce to a pint in teacupful doses.

Ustilago. *U. S.* 1880. *Corn Smut.*—The genus Ustilago belongs to the Ustilaginaceæ, all the members of which generally develop their spores in the ovary or anthers of the host plant, forming a slimy mass, which in maturing becomes a black dust made up of spores. They produce the *smut* in cereals. *Ustilago maydis* (DC.), Tul., is produced on the stems, the pistils (corn grains), and the male inflorescence (tassel) of the Indian corn. It is specifically characterized by its minute spherical spores, having their surface covered with echinulate warts. It is abundant in the United States. Upon the corn the smut appears in masses, varying in size from a cherry to a child's head. These masses are smooth, irregularly globose, or sometimes lobulated, having at first a livid, bluish tint, and then becoming blackish, and finally bursting and emitting the black contents, consisting of innumerable globose very minute spores, each of which is covered with beautiful little pointed processes. In a dried state the masses are blackish and covered with a black powder.

C. H. Cressler found in ustilago an alleged alkaloid, *secaline* (*trimethylamine*, see *Ergota*, p. 447), besides a thick, viscid, fixed oil and a resin soluble in ether but not in alcohol. (*A. J. P.*, 1861, 306.) Rademaker and Fischer (*Nat. Drug.*, 1887, 296) believed that they had discovered a white, bitter alkaloid, *ustilagine*, soluble in ether, while H. B. Parsons decided that the fixed oil contained an acid which he provisionally named *sclerotic acid;* also an amine-like volatile substance extracted by ether. (*N. R.*, March, 1882; also *West. Drug.*, 1894.) A. W. Balch (*Journ. Boston Soc. Med. Sci.*, March, 1901) was not able to find any active substance in the smut.

The belief that corn smut is an abortifacient to the lower animals (*A. J. P.*, Sept. 1861) appears to be without foundation, as in the experiments made by the United States Department of Agriculture in 1898 (*Farmers' Bulletin*, No. 69) no effect was produced by corn smut given to pregnant cows. The experiments of James Mitchell (*T. G.*, ii. 223) that ustilago abolishes sensation, reflex action, and later general motor power in the frog, is contradicted by the results of Balch, who also found that enormous doses of the substance have no effect upon the color of the cock's comb. In *doses* of one to two drachms (3.9–7.7 Gm.) it has been claimed by W. A. N. Dorland that the fluidextract markedly increases the severity and frequency of the uterine pains in human labor. The whole drift of our present evidence is to show that ustilago is probably inert, and it does not seem to be a remedy of any practical value.

Vaccinium. *Vaccinium crassifolium*, Andr. (Fam. Vacciniaceæ.)—The leaves of this American shrub are said to be astringent and diuretic, and capable of replacing uva ursi. *Dose*, of the fluidextract, from a half to one fluidrachm (1.8–3.75 Cc.).

Valeric Acid. *Valerianic Acid. Acidum Valericum. Acidum Valerianicum.* $C_4H_9.COOH$. Mol. wt., 101.31. *Acide valérianique, Acide valérique*, Fr. *Valeriansaure, Baldriansaure*, G. *Acido valerianico*, It., Sp.

In the 1860 U. S. revision this acid was transferred from the Preparations to the Materia Medica list; in that of 1880 it was dropped entirely. Valeric Acid is "a colorless liquid, of an oily consistence, a penetrating, disagreeable odor, and caustic taste; and of the sp. gr. 0.935." *U. S.* 1870.

"Take of Valerianate of Soda, in coarse powder, *eight troyounces;* Sulphuric Acid, Water, each, *a sufficient quantity*. To the Valerianate of Soda add, first, three fluidounces of Water, and then three troyounces and a half of Sulphuric Acid. Mix them thoroughly, and from the mixture, after standing, separate the oily acid liquid which rises to the surface. Agitate this repeatedly with small portions of Sulphuric Acid until its specific gravity is reduced below 0.950. Then introduce it into a retort, and distil nearly to dryness, rejecting the distillate so long as it has a specific gravity above 0.940, and keeping the remainder for use. The rejected portion of the distillate, after agitation with Sulphuric Acid, may be returned to the retort during the progress of the distillation." *U. S.* 1870.

The object of this process is merely to procure valeric acid in a state adapted for the preparation of ammonium valerate. The sulphuric acid, uniting with the sodium of the sodium valerate, separates the valeric acid, which rises to the surface with the appearance of an oil. In this state it is still mixed with water, and, as the pure acid is wanted, the direction is given to agitate it with sulphuric acid, which deprives it

of the excess of water. It is now distilled in order to separate any sulphuric acid and water that may be mixed with it. Musgiller of Brooklyn, N. Y., stated that the acid cannot be obtained by the process of 1860 of a sp. gr. as low as 0.933 with ordinary sulphuric acid, and suggested that 0.935 be adopted as the official standard, as acid of this strength is equally well adapted for the preparation of the valerates, for which alone it is used. This suggestion, as to the sp. gr., was adopted at the revision of the U. S. Pharmacopœia of 1870. Musgiller proposed some modifications of the process which appear to be judicious. (See *A. J. P.*, 1869, 83; also *Proc. A. Ph. A.*, 1868.)

For modes of preparing valeric acid from the oil and roots of valerian, the reader is referred to the article on Valerian in this work. It is prepared also from amyl alcohol by reaction with a mixture of potassium dichromate and sulphuric acid, as the first step in the preparation of sodium valerate.

Valeric acid (originally valerianic acid) received its name from having been found in the oil distilled from the root of *Valeriana officinalis*, L. (Fam. Valerianaceæ). It was first obtained in 1817 by Chevreul from the oil of the dolphin, and received the name of *delphinic acid*, which, however, upon the discovery of its identity with the acid afterwards obtained by Pentz from valerian, was superseded by its present title. It has been obtained also from the bark and fruit of *Viburnum Opulus*, L., and other species of Viburnum (Fam. Caprifoliaceæ), the sap wood of the European elder (*Sambucus nigra*, L.) (Fam. Caprifoliaceæ), the root of *Angelica Archangelica*, L. (*Archangelica officinalis*, Hoffm.) (Fam. Umbelliferæ), and from various organic products of the vegetable and animal kingdom.

Properties.—Valeric acid is a colorless liquid, of an oily consistence, a repulsive odor, resembling, however, that of valerian, and a pungent, sour, acrid, disagreeable taste. Its sp. gr. is variously given from 0.946 at 0° C. to 0.931 at 20° C. (Beilstein, *Org. Chem.*, i. 406.) As stated in the U. S. P. 1870, it is 0.935. It remains liquid at 8° below zero (F.), and boils at 174° C. (345.2° F.). (Trommsdorff.) It is soluble in thirty parts of cold water, and when agitated with water takes up about 20 per cent., without losing its oily consistence, and rises to the surface of the liquid. Alcohol and ether mix with it in all proportions. It is very soluble in strong acetic acid, and dissolves camphor and some resins. (Trommsdorff.) It forms salts with the alkalies, and reddens litmus paper strongly, but the blue color gradually returns in a warm place. Its composition is represented by $C_5H_{10}O_2$, and it is a mixture of two isomeric acids (*isovaleric acid* and optically active valeric acid). This is true as well of the valeric acid that is obtained from the *Valeriana officinalis*, L., the *Angelica Archangelica*, L., and that which results from the oxidation of the amyl alcohol of fermentation with the aid of chromic acid. The strong acid readily unites with a molecule of water to form a hydrated acid, $C_5H_{10}O_2 + H_2O$. This compound, formerly known as the *trihydrate*, has a sp. gr. 0.945, and boils at a lower temperature than the strong acid. It has a much milder taste than the pure acid, and is at the same time somewhat saccharine. The U. S. P. 1870 gave the following tests of the official acid: "A solution of Valerianic Acid, in fifty parts of hot water, saturated with hydrated carbonate of zinc, yields a liquid, which, when filtered and evaporated to ten parts and cooled, affords white pearly crystals of valerianate of zinc. The mother-water, drained from these crystals, should not yield, by further evaporation and cooling, a salt crystallizing in six-sided tables, and very soluble in water. When the Acid is added to a concentrated solution of acetate of copper, the transparency of the solution is not disturbed." The former of the last two tests indicates the absence of acetic, the latter of butyric acid. The acid distilled from the oil or root of valerian has been employed in *nervous affections*, and possesses properties similar to those of valerian. According to Landerer, the acid artificially produced does not operate therapeutically so satisfactorily as the native product. The *dose* would probably be about the same as that of the oil of valerian, given in sweetened water.

Valeridin. *Valerydin. Sedatin. Iso-valeryl-p-phenetidin.* $C_6H_4 \begin{cases} NHCOC_4H_9 \\ OC_2H_5 \end{cases}$. This substance occurs as white, glistening needles, which are readily soluble in alcohol or chloroform, difficultly soluble in ether, and almost insoluble in water. It is obtained by heating isovaleric acid with p-phenetidin. C. Erdmann (*Ph. Ztg.*, xliii.) commends this substance in *doses* of from eight to fifteen grains (0.5–1.0 Gm.) a day, as a succedaneum for valeric acid, and as being very serviceable in *migraine, neuralgia,* and *hysteria.*

Validol. *Menthol Valerate,* $C_{10}H_{19}.O.CO.C_4H_9$. Validol is a clear, colorless liquid, of a mild, pleasant odor, and slightly bitter taste, said to contain 30 per cent. of menthol combined chemically with 70 per cent. of valeric acid. It was originally proposed by Schwersenski (*Th. M.*, 1897) as being locally non-irritant and affording a means of exhibiting menthol; for its local action in *pruritus, gastralgia, coryza,* various mucous inflammations, and as an antispasmodic in *migraine, neurasthenia, hysteria,* and other neuroses. Other clinicians have commented favorably upon the drug as an antiemetic and stomachic. It is stated to be specially eliminated through the urine, to which it imparts a peculiar odor. *Dose,* five to twenty minims (0.3–1.3 Cc.); locally 10 to 15 per cent. ointment is recommended.

Validolum Camphoratum is a 10 per cent. solution of camphor in validol.

Valonia. *Acorn Cups. Valloné, Vélanède, Gallon,* Fr. *Knoppern, Walonen,* G.—The great cups of the acorns of the *Quercus ægilops,* L. (Fam. Cupuliferæ), a native of Bosnia, contain a very large percentage of tannin. They are extensively exported for dyeing and tanning, and have been employed as an astringent in *diarrhœa.*

Valyl. *Valeric Acid Diethylamide.*—*Valyl,* $C_4H_9.CO.N(C_2H_5)_2$, occurs as a colorless liquid having a characteristic odor and burning taste, and boiling at 210° C. (410° F.). According to Kionka (*D. M. W.*, xxvii. 1901), valyl produces cerebral excitement, attended with convulsions probably of cerebral origin, as there is no increased reflex activity. It is said primarily to increase the blood pressure and to have little action upon the heart or respiration. It is somewhat irritant, but may be given in four per cent. aqueous solution, and has been used as a substitute for valerian in *hysterical* and allied *neuroses. Dose,* four to fifteen grains (0.26–1.0 Gm.) three times a day, preferably administered with an equal amount of tallow in gelatin capsules.

Vanadic Acid. *Acidum Vanadicum.* (*Meta-vanadic Acid,* HVO_3.)—Forms golden-yellow scales, which are only slightly soluble. According to

Le Blond and C. David, vanadic acid is actively antiseptic, and very useful in solutions for the skin, 0.05 in 1000; for gynæcological use, 0.17 in 1000. *Oxydasin* is said to be a solution, 0.5 in 1000. (*B. G. T.*, 145.)

Sodii Metavanadas. Sodium Vanadate. $NaVO_3$. This is a yellowish-white powder, freely soluble in hot water.

Ferri Vanadas. Iron vanadate.—A dark, grayish-brown powder, almost insoluble in water.

Lithii Vanadas. Lithium Vanadate. $LiVO_3 + H_2O$.—A yellowish-white crystalline powder, freely soluble in water.

In the arts vanadic acid is used in various oxidizing processes as a carrier of oxygen, effecting by its presence the more efficient action of other oxidants, as in the aniline black formation, where a small amount of ammonium vanadate is capable of taking the place of large amounts of chlorates and similar oxidizing agents. It is also used in vanadium inks.

Vanadic acid and its soluble salts have been shown (*Lyons Méd.*, 1899) to be actively poisonous, 0.017 gramme per kilo given to the rabbit intravenously producing rapid death. When given to man in overdose they produce gastro-intestinal irritation, but it is alleged that in minute dose they increase the elimination of urea, stimulate nutrition, and act favorably in *anæmia, chlorosis, chronic rheumatism*, and *tuberculosis*. The *dose* of the acid is given as from $\frac{1}{125}$ to $\frac{1}{64}$ grain (0.0005–0.001 Gm.); but the sodium salt is much less irritant, and therefore preferable; *dose*, one-sixty-fourth to one-twenty-fifth of a grain (0.001–0.0026 Gm.), administered in dilute solution three times a day. The lithium vanadate has been specially commended by some practitioners in *gout*, and the iron salt in *anæmia*. The *dose* of the latter is the same as that of the sodium salt.

Vanadium.—(Atomic weight, 50.8.) Vanadium has been studied physiologically in the form of the salts of *vanadic acid*, especially in the *metavanadate of sodium*. The vanadates are well known to act as carriers of oxygen in many chemical reactions. It has been affirmed that vanadic acid readily yields its oxygen and as readily receives oxygen from other substances, so that in the blood it is first converted into *hypovanadic acid* and then by the oxyhæmoglobin is changed into *hypervanadic acid*. The salts of vanadic acid are said to produce in the lower animals vomiting, profuse diarrhœa, disturbances of respiration, tonic and clonic convulsions, loss of sensibility, and cardiac depression.

Therapeutically, the vanadium compounds have been used by Laran, and by Lyonnet, Martz, and Martin. It is claimed that in proper doses they increase the appetite and have a tendency to increase weight, are antihidrotic and useful in *tuberculosis, chlorosis*, and other diseases. *Dose*, of the acid, from one-half to one milligramme (1-128th to 1-64th grain), given in solution in the course of twenty-four hours. (For literature, see Schmidt's *Jahrbücher*, Bd. 265, 229.)

Vandellia. *Vandellia diffusa*, L. (Fam. Scrophulariaceæ.)—This is an herb of Paraguay, said to be used by the natives as an emetic. (*P. J.*, 1872, 849.)

Vasogen. *Vaselinum Oxygenatum.*—This is a feebly alkaline, yellow-brown fluid, of a peculiar but not disagreeable odor and taste, which readily emulsifies with water. It is said to be "oxygenated vaseline or petrolatum," and again that "it contains about 25 per cent. of olein, saponified with anhydrous ammonia, and mixed with vaseline and vaseline oil." Vasogen serves as a vehicle for ointments whose active ingredients, it is said, are absorbed with great rapidity from the skin. There have been offered camphor vasogen, 33½ per cent.; iodine vasogen, from 3 to 10 per cent.; menthol vasogen, 2 per cent., and the list might be extended almost indefinitely. There does not seem to be any reason for supposing that the vasogen ointments are really superior to ointments made with vaseline.

Venetian Red. *Bolus Veneta.*—A dull red ochrey substance used in painting.

Verbascum. *Verbascum Thapsus*, L. *Mullein. Flores Verbasci*, P. G. *Bouillon blanc, Molène*, Fr. *Wollkraut, Königskerze*, G. (Fam. Scrophulariaceæ.)—The ordinary mullein weed is too well known to need description. As remedial agents both leaves and flowers have been employed. They have a very slight odor, and a mucilaginous, herbaceous, bitterish, feeble taste. Mullein leaves are demulcent and emollient, and are thought to possess anodyne properties, which render them useful in pectoral complaints. On the continent of Europe, an infusion of the flowers, strained in order to separate the rough hairs, is considerably used in mild *catarrhs*. An oil, produced by saturating olive oil with mullein flowers, during prolonged exposure to the sun, is used as a local application in Germany for *piles* and other *mucous membrane inflammations*. The mullein oils sold in pharmacies are of this nature, or some of them alcoholic tinctures. The dried leaves are sometimes smoked to relieve irritation of the respiratory mucous membranes; fomentations with mullein leaves also have some repute as anodynes. Internally, the decoction (an ounce to the pint, flowering tips) may be taken in the quantity of from four to six fluidounces.

According to L. Rosenthal (*P. J.*, July, 1902), the seeds of *Verbascum sinuatum*, which are used in Greece as a fish poison, contain 6.13 per cent. of saponin. Traces of the same substance were found in the fruits of *V. phlomoides*, L., and *V. thapsiforme*, Schrad.

Verditer.—Two preparations of copper, employed as pigments, are known by this name in commerce, and are distinguished by the epithets of blue and green. *Blue verditer* is prepared in London from the solution of copper nitrate obtained in precipitating silver by copper. According to Gray, this solution is poured while hot upon whiting (calcium carbonate), and the mixture stirred every day till the liquor loses its color, when it is decanted, and fresh portions added till the proper color is obtained. By a process for procuring this pigment, invented by Pelletier, the solution of copper nitrate is decomposed by quicklime, and the precipitate, after being washed, is incorporated intimately with another portion of quicklime. By the former process, a copper carbonate is obtained; by the latter, a mixture of copper and calcium hydroxides. *Green verditer* is prepared by precipitating a solution of copper nitrate by chalk or a white marl, and consists of copper carbonate mixed with an excess of the calcareous carbonate.

Vernonia. *Vernonia anthelmintica*, Willd. (Fam. Compositæ.)—This is an East Indian plant, whose black, bitter, and nauseous seeds have a high reputation in Ceylon as an anthelmintic in *doses* of sixty grains (3.9 Gm.). (*P. J.*, April, 1883; also *Ph. Rev.*, 1896, 274.)

Veronal. *Diethylmalonyl Urea. Diethyl Barbituric Acid.* $C_2H_5>C<{}^{CO.NH}_{CO.NH}>CO$.

Colorless crystals with a melting point of 191° C. (375.8° F.), slightly bitter in taste, soluble in 145 parts of water at ordinary temperature and in 12 parts of boiling water. Originally introduced as an hypnotic by Fischer and von Mering, veronal has been favorably reported upon by a number of clinicians as producing a sleep which usually develops in fifteen to twenty minutes and continues for many hours, its action being more sure and more continuing than that of trional. It is affirmed to act even when there is pain, and to be well borne in cases of pulmonic and cardiac disease. In the *insomnia* of the *psychoses* it is favorably reported upon. Concerning its general physiological action we have little knowledge, but C. Trautmann (*Ther. Geg.*, 1903) affirms as the result of experimental studies that it lessens nitrogenous elimination. Various authorities claim that it leaves no after effects, but Jolly, Rosenfeld, and Würth, have noticed after its administration, malaise, headache, and giddiness, and even disturbances of speech,—chiefly when given in very large doses. Analgesic powers have been attributed to it by some clinicians and denied by others. Ordinary *dose*, fifteen to twenty grains (1.0–1.3 Gm.); in mild cases, four to five grains (0.26–0.32 Gm.), and when there is much excitement much larger doses are well borne. Walter Berant has given as high as one hundred and twenty grains (7.7 Gm.) in twenty-four hours.

Veronica. *Veronica officinalis*, L. *Speedwell. Véronique mâle*, Fr. *Ehrenpreis*, G. (Fam. Scrophulariaceæ.)—Several species of Veronica, common to Europe and this country, have been medicinally employed. Of these, *V. officinalis*, L., and *V. Beccabunga*, L., or *brooklime*, are the most conspicuous. *V. officinalis* has a bitterish, warm, and somewhat astringent taste. Enz found in it a bitter principle soluble in water and alcohol, but scarcely so in ether, and precipitated by the salts of lead, but not by tannic acid; an acrid principle; red coloring matter; a variety of tannic acid producing a green color with ferric salts, a crystallizable fatty acid, with malic, tartaric, citric, acetic, and lactic acids; mannite; a soft, dark green, bitter resin. Mayer of New York, found evidences of an alkaloid and of a saponaceous principle. (*A. J. P.*, 1863, 209.) The plant has been considered diaphoretic, diuretic, expectorant, tonic, etc., and was formerly employed in *pectoral* and *nephritic complaints*, *hemorrhages*, *diseases of the skin*, and in the treatment of *wounds*. *V. Beccabunga* was used in the fresh state as a blood purifier and in *scurvy*.

Vieirine.—This substance is obtained from the bark of the *Remijia Vellozii*, DC. (Fam. Rubiaceæ), of Brazil. It is used in Brazil in *doses* of from one to four grains (0.065–0.26 Gm.) repeated *pro re nata*, as a tonic and as an antiperiodic in place of quinine.

Vienna Paste. *Potassa Cum Calce. U. S.* 1890. *Potassa with Lime.*

"Potassa, *five hundred grammes* [or 17 ounces av., 279 grains]; Lime, *five hundred grammes* [or 17 ounces av., 279 grains], to make *one thousand* grammes [or 35 ounces av., 120 grains]. Rub them together, in a warm iron mortar, so as to form a powder, and keep it in a well-stoppered bottle." *U. S.* 1890.

"A grayish-white powder, deliquescent, having a strongly alkaline reaction, and responding to the tests for calcium and potassium. It should be soluble in diluted hydrochloric acid without leaving more than a small residue." *U. S.* 1890. It should not effervesce on the addition of an acid. It is prepared for use by being made up into a paste with a little alcohol. The paste is applied for ten or fifteen minutes to the part to be cauterized, exactly as with potassium hydroxide, than which escharotic it is more manageable, being slower in its operation, and less deliquescent. Filhos has improved this caustic by forming it into sticks. To prepare it thus, the potassium hydroxide is perfectly fused in an iron spoon, and one-third of its weight of quicklime is added in divided portions, the whole being stirred with an iron rod. The fused mass is then run into lead tubes, closed at one end, about three inches long, and from a quarter to half an inch in diameter in the clear. The sticks are kept, still enclosed in the lead tubes with the open end downward, in thick glass tubes, containing some powdered quicklime, and closed with a cork, between which and the stick some cotton is put to steady the caustic. When employed, as much of the caustic is uncovered at the end by scraping off the lead, as it is proposed to use.

Vinca.—Under this name are included *V. major*, L., *Greater Periwinkle*, and *V. minor*, L., *Lesser Periwinkle* (Fam. Apocynaceæ). It is said to be very useful in arresting *menorrhagic* and other *hemorrhages*. (*P. J.*, 1871, 961; *Ibid.*, 1873, 963; also *A. J. P.*, 1872.)

Vincetoxicum. *V. officinale*, Moench. *Cynanchum Vincetoxicum*, Pers. *Asclepias Vincetoxicum*, L. *White Swallow-wort. Vincetoxicum. Asclépiade, Dompte-venin, Hirundinaire*, Fr. *Schwalbenwurz, Giftwende*, G.—A perennial, herbaceous European plant, the root of which was formerly esteemed a counterpoison, and hence the botanical name. It has a bitterish, acrid taste, and, when fresh, a disagreeable odor, which is diminished by drying. Taken internally, especially in the recent state, it excites vomiting, and is capable, in larger quantities, of producing dangerous if not fatal inflammation of the stomach. Feneulle found in the root a principle analogous to emetin. It has been used in skin diseases and scrofula.

Vinegar. *Acetum.*—Vinegar is produced by the acetous fermentation in infusions of mixed malted and unmalted grain, or in various fruit juices. Any substance which is capable of undergoing the alcohol fermentation is further liable, under the influence of a microscopic plant, *Mycoderma aceti*, and exposure to the air at a temperature between 24° C. (75° F.) and 35° C. (95° F.), to undergo further change with oxidation, which converts the alcohol into acetic acid. Practically for success there should not be more than 12 per cent. of alcohol in the original fluid. The mycoderm may exist as a pellicle composed of extremely small cells (micrococci) in contiguous rows, or finally enveloped in a glue-like mass, or it may be in the form of rod-like cells (bacilli) more or less dispersed through the fluid.

In the quick *German process* for making vinegar a mixture of one part of 80 per cent. alcohol, four or six parts of water, and one-thousandth of honey or extract of malt, at a temperature of 24° C. (75° F.) to 35° C. (95° F.), is allowed to percolate through beech shavings, previously steeped in vinegar, and contained in a deep oaken tub, in which is a wooden diaphragm perforated with numerous small holes, loosely filled with

packthread about six inches long. It is essential to the success of the process that a current of air shall pass through the tub. In order to establish this current, eight equidistant holes are pierced near the bottom of the tub, forming a horizontal row, and four glass tubes are inserted vertically in the diaphragm, of sufficient length to project above and below it. The air enters by the holes below, and passes out by the tubes. Although the air is necessary for the furnishing of oxygen, acetification consisting chiefly in the oxidation of the alcohol, the beech shavings and similar articles chiefly aid in the process by affording surface upon which the mycoderms can grow. During the process the temperature rises to 37° C. (100° F.) or 40° C. (104° F.), and remains nearly stationary while the process is going on favorably. The liquid is drawn off by a discharge pipe near the bottom, and must be passed three or four times through the tub before the acetification is completed, which generally occupies from twenty-four to thirty-six hours. According to Wimmer, pieces of purified charcoal, about the size of a walnut, may be advantageously substituted for the beech shavings in the process.

In 1862, Pasteur substituted for the German process the sowing of the mycoderm upon the surface of a mixture of wine and vinegar, or of water, alcohol (2 per cent.), and acetic acid (1 per cent.), adding alcohol daily in small quantities after about half that contained in the original liquid had been converted into acetic acid, until a vinegar of sufficient strength was produced. The *French process* was improved in 1869 by Laugier, and it was subsequently further elaborated by Emanuel Wurm. (For details, see *P. J.*, xi. 133.)

In England, vinegar is made from the infusion of malt. The fermented wort is caused to fall in a shower upon a mass of fagots of birch twigs occupying the upper part of a large vat, and, after trickling down to the bottom, is pumped up repeatedly to the top, to be again allowed to fall, until the acetification is completed. This mode of oxidizing the alcohol in the fermented wort has the advantage of rendering insoluble certain glutinous and albuminous principles, which, if not removed, would cause a muddiness in the vinegar and make it liable to spoil.

In the United States, vinegar is largely made by the German method of oxidizing very diluted alcohol, and is called *spirit vinegar;* it is often prepared from cider—*cider vinegar.* The cider is placed in barrels (with their bung holes open) which are exposed during the summer to the heat of the sun. The acetification is completed in the course of about two years. The progress of the fermentation, however, must be watched, and as soon as perfect vinegar is formed, it should be racked off into clean barrels. Without this precaution, the acetous fermentation would run into the putrefactive, and the vinegar be spoiled. Cider vinegar contains no aldehyde. It contains malic acid, and therefore yields a precipitate with lead acetate. The want of such a precipitate indicates that the alleged cider vinegar is a manufactured substitute, although a fictitious article might yield a similar precipitate.

Vinegar may be clarified, without impairing its aroma, by throwing about a tumblerful of boiling milk into from fifty to sixty gallons of the liquid, and stirring the mixture. This operation also makes red vinegar pale.

The series of changes which occur during the *acetous fermentation* is called *acetification.* During its progress there is a disengagement of heat; the liquor absorbs oxygen and becomes turbid; filaments form, and upon the completion of the fermentation, form a pultaceous mass, leaving a clear liquor containing the acetic acid. The explanation of Liebig is that the alcohol loses two atoms of hydrogen as the first effect of oxidation, and becomes aldehyde, and this, by the absorption of one atom of oxygen, becomes acetic acid ($C_2H_3O.OH$). Thus the conversion of alcohol into acetic acid consists in, first, the removal of two atoms of hydrogen, and afterwards the addition of one atom of oxygen. The following equations represent this change:

$$C_2H_6O + O = C_2H_4O + H_2O$$
$$C_2H_4O + O = C_2H_4O_2$$

Aldehyde is a colorless, inflammable, ethereal liquid, having a pungent taste and odor. Its density is 0.79. It absorbs oxygen gradually, and is thus converted into acetic acid, as just stated. Its property of absorbing oxygen gives it a reducing power like that possessed by glucose. Hence it responds to Fehling's test for that substance (PART III). It is characterized by its forming a crystalline compound with ammonia, and also with alkaline bisulphites; it is polymerized by the action of acids and some other reagents, and thus yields *paraldehyde* ($(C_2H_4O)_3$, a liquid boiling at 124° C. (255° F.). The name aldehyde alludes to its relation to alcohol, *al*cohol *dehyd*rogenated. Its aqueous solution is decomposed by potassium hydroxide with formation of *aldehyde resin.* This is a soft, light brown mass, which, heated to 100° C. (212° F.), gives off a nauseous soapy odor.

Properties.—Vinegar, when good, is of an agreeable, penetrating odor, and a pleasant acid taste. According to Magnes-Lahens, wine vinegar always contains a little aldehyde. The better sorts of vinegar have a grateful aroma, probably due to the presence of an ethereal substance, perhaps acetic ether. The color of vinegar varies from pale yellow to deep red. When long kept, especially if exposed to the air, it becomes ropy, acquires an unpleasant odor, putrefies, and loses its acidity.

The essential ingredients of vinegar are acetic acid and water; but, besides these, it contains various other substances, derived from the particular vinous liquor from which it may have been prepared. Among these may be mentioned coloring matter, gum, starch, gluten, sugar, a little alcohol, and frequently malic and tartaric acids, with a minute proportion of alkaline and earthy salts. Vinegar should be devoid of lead and copper and of free sulphuric acid, as shown by its not being discolored by hydrogen sulphide, and yielding no precipitate when boiled with a solution of calcium chloride, and of such a strength that a fluidounce would require, for neutralization, not less than thirty-five grains of potassium bicarbonate. After neutralization it should be free from acrid taste, indicating the absence of acrid substances, the taste of which may have been concealed by that of the acetic acid.

MALT VINEGAR (*Acetum Britannicum*) has a brown color, and a sp. gr. from 1.006 to 1.019. The strongest kind, called *proof vinegar*, contains from 4.6 to 5 per cent. of acetic acid. That of British manufacture usually contains sulphuric acid, which the manufacturer is allowed by law to add in a proportion not exceeding one part in a thousand; but if the vinegar be properly made it does not require to be thus protected.

Vinegar is "a liquid of a brown color and peculiar odor. Specific gravity 1.017 to 1.019. 445.4 grains by weight (1 fluidounce) of it require about 402 grain-measures of the volumetric solution of soda for their neutralization, corresponding to 5.41 per cent. of real acetic acid, $HC_2H_3O_2$. If ten minims of solution of chloride of barium be added to a fluidounce of the vinegar, and the precipitate, if any, be separated by filtration, a further addition of the test should give no precipitate. Sulphuretted hydrogen causes no change of color." *Br.* 1885.

Wine Vinegar (*Acetum Gallicum*) is nearly one-sixth stronger than pure malt vinegar. It is of two sorts, the white and the red, according as it has been prepared from white or from red wine. *White wine vinegar* is usually preferred. *Red wine vinegar* may be deprived of its color, and rendered limpid, by being passed through animal charcoal.

Distilled Vinegar (*Acetum Destillatum; Vinaigre distillé, Oxéolat simple*, Fr.; *Destillirter Essig*, G.) was official in the U. S. Pharmacopœia 1870, and was prepared by obtaining seven pints of distillate from eight pints of vinegar placed in a glass retort, the one pint left in the retort retaining the fixed impurities, salts, etc. One hundred grains should saturate not less than seven and six-tenths grains of potassium bicarbonate. It should be wholly volatilizable by heat, yield no precipitate with lead acetate or silver nitrate, nor change color upon the addition of hydrogen sulphide or ammonia. If silver be digested with it and hydrochloric acid afterwards added, no precipitate should be produced.

Adulterations.—The principal foreign substances which vinegar is liable to contain are sulphuric and sulphurous acids, certain acrid substances, and copper and lead, derived from improper vessels used in its manufacture. Tin has been found in it after standing a short time in tin vessels. Hydrochloric and nitric acids are but rarely present.

Barium chloride is not a suitable test for the presence of free sulphuric acid, as it will cause a precipitate with sulphates, which are often found in vinegar when no free sulphuric acid is present. The evaporation of a sample of vinegar in contact with a piece of white sugar or on white paper will often show the presence of free sulphuric acid by the charring which ensues. A very simple method, discovered by A. Ashby, of detecting free mineral acids in vinegar is mentioned by Allen (*Com. Org. Anal.*, 2d ed., i. 392). A solution of logwood is prepared from boiling water and fresh logwood chips. Separate drops of this solution are spotted on the surface of a flat porcelain dish and evaporated to dryness over a water bath. To each spot a drop of the suspected sample (concentrated first if desirable) is added, and the heating continued until it has evaporated. If the vinegar be pure the residue will be found to have a bright yellow color, but in the presence of a very small proportion of mineral acid the residue assumes a red color. The acrid substances usually introduced into vinegar are red pepper, long pepper, pellitory, grains of paradise, and mustard seed. These may be detected by evaporating the vinegar to an extract, which will have an acrid, biting taste, if any one of these substances be present. By far the most dangerous impurities in vinegar are copper and lead. The former may be detected by a brownish precipitate on the addition of potassium ferrocyanide to the concentrated vinegar; the latter, by a blackish precipitate with hydrogen sulphide, and a yellow one with potassium iodide. Pure vinegar is not discolored by hydrogen sulphide. According to Chevallier, wine vinegar which has been strengthened with acetic acid from wood sometimes contains a minute proportion of arsenic, which is probably derived from arseniferous sulphuric acid, employed in preparing the acetic acid. (For an examination of samples of commercial vinegar by F. G. Ryan, see *A. J. P.*, 1899, p. 71.)

Vinegar has feeble antiscorbutic properties, but is at present used as a medicine only for its local astringent properties, and in the form of an enema diluted with three times its bulk of water to kill *seat worms*. In the *dermatitis* produced by exposure to the sun, made into a paste with glycerin, bismuth, and starch, it is very effective. In *hæmatemesis* one ounce to a tumbler of water often acts very advantageously, and may be taken freely. At one time vinegar was largely used in pharmacy as a menstruum, but on account of its tendency to undergo decomposition it has been replaced by diluted acetic acid in both the American and British Pharmacopœias.

Vioform. $C_9H_4ICl(OH)N$.—*Iodochloroxyquinoline* was introduced as a substitute for iodoform in surgery. According to the researches of E. Tavel, it is less toxic than iodoform, especially when brought in local contact with wounds, and is also more actively germicidal than is iodoform. Locally it is not at all irritant. (See *S. Jb.*, Bd. 267, p. 133; Bd. 272, p. 163.)

Viola. *Violet.*—The genus *Viola* (Fam. Violaceæ) includes numerous species, many, perhaps all of which are possessed of analogous medicinal properties. *Viola tricolor*, L., the *Heart's-ease, Pansy*, or *Johnny-jump-up* of the gardens, was formerly recognized by the U. S. Pharmacopœia; while *V. odorata*, L., and *V. pedata*, L., have held places in both the British and the United States Pharmacopœias.

V. odorata, L. (*Violette, Violette odorante*, Fr.; *Wohlriechendes Veilchen, Veilchen*, G.; *Violetta*, It.; *Violeta*, Sp.), the common violet of Europe, resembles very closely the American blue violet, *V. cucullata*, Ait., from which, however, it is at once distinguished by its delicious fragrance. It is the *sweet blue violet* of our gardens. *V. pedata*, L., is an indigenous stemless violet, characterized by its large blue or variegated beardless flowers, and its deeply three to five-divided, pointed pedate leaves.

The flowers of *V. odorata* yield their odor and their slightly bitter taste to boiling water. Their infusion affords a very delicate test for acids and alkalies, being reddened by the former and rendered green by the latter. Their odor is destroyed by desiccation, and the degree to which they retain their fine color depends upon the care used in collecting and drying them. They should be gathered before being fully blown, deprived of their calyx, and rapidly dried, either in a heated room or by exposing them to a current of very dry air. The flowers of other species are often mingled with them, and, if of the same color, are equally useful as a chemical test.

In the root, leaves, flowers, and seeds of *Viola odorata*, Boullay discovered an alkaloid, *violine*, allied to emetine, but possessing distinct properties. It is white, soluble in alcohol, scarcely soluble in water, and forms salts with the acids. It exists in the plant combined with malic acid. Orfila asserts that it is exceedingly active and even

poisonous. It is probably found in other species of Viola. Mandelin (*Jahresb.*, 1883) obtained a glucoside analogous to quercitrin, which he names *viola-quercitrin*. It crystallizes out of hot water in fine yellow needles. When boiled with diluted acids, it is decomposed into *quercetin*, *isodulcite* and a fermentable glucose,

$$C_{27}H_{30}O_{16} + 3H_2O = C_6H_{14}O_6 + C_6H_{12}O_6 + C_{15}H_{10}O_7$$

he also obtained salicylic acid from several species of Viola. (*A. J. P.*, 1882, 10.)

The herbaceous parts of various species of violets are mucilaginous, emollient, and slightly laxative, and have been used in *pectoral*, *nephritic*, and *cutaneous diseases*. In Europe a syrup prepared from the fresh flowers of *Viola odorata* is employed as an addition to demulcent drinks, and as a laxative for infants. The root, which has a bitter, nauseous, slightly acrid taste, acts in the *dose* of from thirty grains to a drachm (2.0–3.9 Gm.) as an emetic and cathartic. It is probable that the same property is possessed by the roots of all the violets, as it is known to be by several species of *Ionidium*, which belongs to the same family. The existence in small proportion of the emetic principle in the leaves and flowers accounts for their expectorant properties.

Virginia Creeper. *Parthenocissus quinquefolia* (L.), Planch. *Ampelopsis quinquefolia*, Michx. (*Vitis quinquefolia*, Lam., also *V. hederacea*, Willd.) *American Ivy. Vigne vierge*, Fr. *Wilder Wein, Amerikanischer Epheu*, G.—The bark twigs of this indigenous woody creeper of the fam. Vitaceæ have been used by the eclectics as an alterative, tonic, and expectorant. They contain tartaric acid and potassium and calcium tartrates, albumen, sugar, pyrocatechin, and some other principles. McCall employed the bark collected late in the fall in *dropsy*, with asserted very good results. (*Penins. and Independ. Med. Journ.*, June, 1858.) In two cases of poisoning reported by Bernays, the symptoms were violent vomiting and purging, collapse, and deep sleep, with dilated pupils. (*P. J.*, vii.)

Viscum. *Viscum album*, L. *Mistletoe. Gui de Chêne, Gillon*, Fr. *Mistel*, G. (Fam. Loranthaceæ.) A European evergreen parasitic shrub, growing on various trees, particularly the apple and other fruit trees, and forming a pendent bush from two to five feet in diameter. The plant is famous in the history of Druidical superstition. In the religious rites of the Druids, the mistletoe of the oak was employed, and hence was afterwards preferred when the plant came to be used as a remedy; but it is in fact identical in all respects with those which grow upon other trees. (*P. J.*, 1897, 289.) The fresh bark and leaves have a peculiar, disagreeable odor, and a nauseous, sweetish, slightly acrid and bitterish taste. *Viscin*, which forms the glutinous constituent in the berries, leaves, and stalks of the mistletoe, is the principal constituent of *birdlime*. Crude viscin may be obtained by kneading the finely bruised mistletoe bark with water, as long as anything is dissolved, and removing the ligneous impurities mechanically. A purer product may be obtained by boiling the crude product in strong alcohol, macerating the residue with ether, evaporating the ethereal extracts, purifying these extracts by kneading first with alcohol and then with water. The formula $C_{20}H_{48}O_8$ ($C_{20}H_{32} + 8H_2O$) has been given to it by Reinsch. Pawlevsky (*Bull. Soc. Chim.* (2), 34, 348) obtained from mistletoe a crystallizable acid, slightly soluble in water, insoluble in alcohol and ether, fusing at from 101° to 103° C. (213.8°–217.4° F.), to which he gave the formula $CH_3O_3.OH$. The berries, which are white, and about the size of a pea, abound in the peculiar viscid principle, and are sometimes used in the preparation of birdlime, of which this principle is the basis. Mistletoe is said to be productive of vomiting and purging when largely taken. The berries caused in a child three years old vomiting and prostration, coma, a fixed and somewhat contracted pupil, and convulsive movements. (*Ann. Thér.*, 1859, 36.) A fatal case is recorded. (*M. T. G.*, 1867, 26.) The plant was formerly looked upon as a powerful nervine, but it is now out of use. The leaves and wood were given in the *dose* of a drachm (3.9 Gm.) in substance. According to P. Riehl (*D. M. W.*, xxvi. 1900), viscin affords an excellent basis for the making of applications to the skin, a benzene viscin solution mixed with starch affording an excellent plaster mass.

The *American Mistletoe* is the *Phoradendron flavescens*, Nuttall (*Viscum flavescens*, Pursh). It is probably the plant reported as growing upon the elm, by which several children were poisoned. (Henry Dye, *Memphis Med. Recorder*, iv. 344.) The prominent symptoms were vomiting and great thirst followed by frequent discharges of bloody mucus from the bowels, with tenesmus. One of the children was found in a collapsed state, in which death took place. Dye states also that, in other instances, as he had been informed, children had eaten the *berries* without any ill effect. W. H. Long, confirmed by Lee Payne (*North Carolina Med. Journ.*, vol. vii. 253) asserts (*New Rem.*, ii. 31) that the American mistletoe is a very certain oxytocic, and very efficacious in arresting post-partum and other varieties of *uterine hemorrhage*. He gives a fluidrachm (3.75 Cc.) of the fluidextract every twenty minutes in labor until the effect is produced; every four to six hours in *menorrhagia*.

Vitellus. *U. S.* 1890. *Yolk of Egg.*—"The yolk of the egg of *Gallus Bankiva*, var. *domestica* Temminck (class *Aves*; order *Gallinæ*)." *U. S.* 1890.

The yolk of egg was made official in 1890 because of its use in the glycerite of yolk of egg.

Glyceritum Vitelli. *U. S.* 1890. *Glycerite of Yolk of Egg. Glyconin.*

"Fresh Yolk of Egg, *forty-five grammes* [or 1 ounce av., 257 grains]; Glycerin, *fifty-five grammes* [or 1 ounce av., 411 grains], to make *one hundred grammes* [or 3 ounces av., 231 grains]. Rub the Yolk of Egg, in a mortar, with the Glycerin, gradually added, until they are thoroughly mixed. Then transfer the mixture to a bottle." *U. S.* 1890.

Under the name of *Glyconin* there has been employed in France for many years, both for medicinal purposes and for those of the toilet, an emulsion made of glycerin and the yolk of egg. When these two substances are rubbed together, they unite to form a very intimate mixture, which does not separate. It has the consistence of honey, and forms an opaque emulsion with water. It may be preserved almost indefinitely. The usual proportions of the ingredients are four parts of the yolk of egg and five parts of pure glycerin. It has been repeatedly recommended as a basis for cod liver oil and other emulsions. (See also papers by Close in *Proc. A. Ph. A.*, 1884 and 1886.) It is itself not medicinal.

Vulcanite.—For cases of poisoning by *artificial gum* made of vulcanite colored with vermilion, see *Med. Press and Circular*, Dec. 1874.

Warburg's Tincture.—This famous remedy, at first a proprietary medicine, afterwards by the voluntary act of its inventor had its formula revealed. There is so much testimony as to its extraordinary virtues in the severe *remittent* and *pernicious malarial fevers* of India that its powers can scarcely be questioned. After the bowels of the patient in the acutest stage of the disorder have been freely opened, a half ounce of the tincture is given undiluted, all drink being withheld, and at the end of three hours a second half ounce is given in a similar manner. Soon after the second dose a violent, aromatic perspiration comes on, and the fever is usually broken. The remedy is also commended in *collapse* without organic disease. The formula given by Warburg is as follows: Socotrine aloes 1 lb.; rhubarb, angelica fruit, confection of Damocratis, each 4 oz. troy; elecampane, saffron, fennel, prepared chalk, each 2 oz. troy; gentian, zedoary, cubebs, myrrh, camphor, agaric, each, 1 oz. troy. Digest the whole with 500 oz. proof spirit in a water bath for 12 hours, express, add 10 oz. sulphate of quinia, dissolve by the aid of a water bath, cool, and filter.

It is evident that Warburg's Tincture contains various substances which are inert, but the practical difficulty is to determine as to what its extraordinary valuable anti-malarial powers are really due. The formula of Hager—quinine sulphate 1 part, spirit of camphor, 2 parts, elixir proprietatis (P. G.) 22 parts, alcohol 16 parts—does not seem to us to at all represent the tincture. The formula used in the U. S. army, with asserted excellent results in Cuba, has the advantage of yielding a product in tablets, which is as follows: Aqueous extract aloes, 224 grains; rhubarb, 448 grains; angelica seed, 448 grains; elecampane, 224 grains; saffron (Spanish), 224 grains; fennel, 224 grains; gentian, 112 grains; zedoary root, 112 grains; cubeb, 112 grains; myrrh, 112 grains; white agaric, 112 grains; camphor, 112 grains; quinine sulphate, 1280 grains. Exhaust with eight pints of diluted alcohol, or divide into 1024 tablets.

The confection of Damocratis [1] is in the original formula in such small amount that it is hardly possible that it could have any effect. If it be omitted the formula can be very readily followed, and it seems to us that the apothecary should use the original formula with this single alteration when Warburg's Tincture is called for. (See also *Tinctura Antiperiodica*, National Formulary.)

Dose, one to four fluidrachms (3.75–15.0 Cc.).

Whiting.—This is essentially the same as prepared chalk, being made by the pulverization and elutriation of crude chalk. It is used as a coarse paint, and for various purposes in the arts, for which calcium carbonate is requisite. *Paris white* is a variety of the same material.

Winter's Bark. WINTERA. The bark of *Drimys Winteri*, Forst. *Cortex Winteranus. Ecorce de Winter, Cannelle de Magellan*, Fr. *Winter's Zimmt*, G. (Fam. Magnoliaceæ.)—For description of tree, see *U. S. D.*, 16th edition. The tree is a native of the southern parts of South America, growing along the Strait of Magellan, and extending as far north as Chile. According to Martius, it is found also in Brazil. The bark

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[1] *Confectio Damocratis* (*Mithridatium*) is a combination of thirty aromatic substances mostly obsolete, formerly official in the London Pharmacopœia. We are indebted to Robert Fletcher, of the Surgeon-General's office, for the following formula, taken from the London Pharmacopœia of 1677, p. 100. It is, of course, useless as a pharmaceutical preparation.

MITHRIDATIUM.

℞

Myrrhæ Arabicæ,
Croci,
Agarici,
Zingiberis,
Cinnamomi,
Spicæ Nardi (Indian Nard or Spikenard),
Thuris (G. Olibanum),
Sem. Thlaspios (water cress seeds), ana drachmas decem.
Seseleos (*Laserpitium Siler*—heartwort, sermountain),
Opobalsami seu Olei Nucis Moschatæ per expressionem,
Junci odorati (Camel's hay, sweet rush, a dried plant from Turkey),
Stœchados Arabicæ (French lavender),
Costi veri (root of Costus verus or dulcis),
Galbani,
Terebinthinæ Cypriæ (Chian),
Piperis longi,
Castorei,
Succi Hypocistidos (from Cytinus, a parasitic plant in France),
Styracis Calamitæ (Gum S.),
Opopanacis,
Fol. Malabathri recentium, seu, ejus defectu, Macis, ana unciam unam.
Casiæ ligneæ veræ,
Polii montani (Teucrium creticum—Poleymountain of Candy),
Piperis albi,
Scordii (Teucrium Scordium—water germander),
Sem. Dauci Cretici (Athamantis creticus—Candy carrot),
Carpobalsami vel Cubebarum (Bals. Mecca, or cubeb),
Trochisch. Cypheos,
Bdellii, ana drach. septem.
Nardi Celticæ purgatæ (Valeriana celtica),
Gummi Arabici,
Sem. Petroselini Macedonici,
Opii,
Cardamomi minoris,
Sem. Fœniculi,
Gentianæ,
Flo. rosar. rubrarum,
Dictamni Cretensis, ana drachmas quinque.
Sem. Anisi,
Asari (A. europæum, Asarabacca),
Acori, seu Calami Aromatici,
Ireos,
Phu majoris (Valeriana Phu, major—or ordinary Valerian),
Sagapeni, ana drachmas tres.
Mei Athamantici (Æthusa Meum),
Acaciæ,
Ventrium Scincorum (Lizards),
Summitatum Hyperici (Hypericum perforatum—St. John's Wort), ana drachmas duas semis.
Vini Canarini optimi quantum sufficit ad solutionem gummi, et succorum, nempe circiter uncias viginti-sex.
Mellis deinde despumati triplum ad omnia, præter vinum.
Fiat Electuarium secundum artem.

TROCHISCI CYPHEOS PRO MITHRIDATIO.

℞

Pulpæ Uvarum passarum pinguium, à cortice et acinis probè mundatæ,
Terebinthinæ Cypriæ,—ana uncias tres.
Myrrhæ,
Scœnanthûs (Juncus odoratus), ana unciam unam et semis.
Cinnamomi, unciam dimidiam.
Calami Aromatici, drachmas tres.
Rad. Cyperi rotundi.
——Spicæ Nardi Indicæ,
Casiæ ligneæ,
Baccarum Juniperi,
Bdellii unguinosi,
Aspalathi, sive Ligni Aloes, ana drachmas duas semis.
Croci, drachmam unam.
Mellis optimi despumati, q. s.
Vini Canarini momentum.
Myrrha et Bdellium terantur in mortario cum Vino, ad crassitudinem liquidi mellis. Addatur mox Terebinthina, dein pulpa Passularum, tum Pulveres; Omnia demum excipiantur melle despumato optimè cocto, cogantûrque in Massam, ex qua fiant Trochisci.

Pharmacopœia Coll. Reg. Londini, 1677, 125.

The first form of Warburg's Tincture contained a small quantity of *Mithridate;* formula therefore added.

of the tree was brought to England, in the latter part of the sixteenth century, by Captain Winter, who attended Drake on his voyage round the world, and while in the Strait had learned its aromatic and medicinal properties. Since this period, from time to time various barks have appeared in European commerce as Winter's bark, although not any that was the genuine bark. Among those in the London market was at one time the bark of *Cinnamodendron corticosum*, Miers. (Fam. Canellaceæ), of Jamaica, which is pungent like true Winter's bark, but is of a much paler brown color, and resembles canella bark except in the absence of the chalky-white inner surface. Recently this bark has been replaced by the bark of *Croton Malambo*, Karst. (Fam. Euphorbiaceæ), which resembles in color and thickness the bark of the Cinnamodendron, but has a bitter taste and a calamus-like flavor. The following is the description of a specimen which came into the possession of George B. Wood many years since. It corresponds closely with Guibourt's description of commercial Winter's bark. It is in quilled pieces, usually a foot in length and an inch or more in diameter, appearing as if scraped or rubbed on the outside, where the color is pale yellowish or reddish gray, with red elliptical spots. On the inside the color is that of cinnamon, though often blackish. The pieces are sometimes flat and very large. The bark is two or three lines in thickness, hard and compact, and when broken exhibits on the exterior part of the fracture a grayish color, which insensibly passes into reddish or yellowish towards the interior. The powder resembles in color that of Peruvian bark. The odor is aromatic, the taste spicy, pungent, and even burning. P. N. Arata and F. Canzoneri describe a bark which they assert to be genuine Winter's bark from the Strait of Magellan. It was in the form of deeply furrowed, curled-up fragments with an earthy fracture, exhibiting, when in small pieces, an internal reddish-brown coloration. When fresh it had a bitter and pungent taste and an agreeable odor, recalling both turpentine and cloves. The sun-dried bark yielded: water (at 110°), 13.713 per cent.; ash, 3.338 per cent.; soluble in ether, 3.841 per cent.; in alcohol, 6.465 per cent.; in water, 13.981 per cent.; ligneous matter, 49.200 per cent. The ethereal solution contained a peculiar essence, fatty compounds, resins, and waxy matter; the alcoholic extract contained reddish uncrystallizable resins. The *volatile oil* was isolated by distilling the bark with water, exhausting the distillate with petroleum, and distilling off the solvent. The crude oil, amounting to 0.64 per cent. of the weight of the bark employed, was a mixture of several substances. *Winterene*, $C_{15}H_{24}$, is the essential oil separated from this by fractional distillation. It passes over between 260° and 265° C. (500°–509° F.); specific gravity at 13° C. (55.4° F.) = 0.93437. Index of refraction = 1.4931; specific rotatory power at 16° C. (60.8° F.) $[x] = +11.2$. It is readily oxidized on exposure to the air, becoming yellow. The formula $C_{25}H_{40}$ was calculated from the ultimate analysis and vapor density, but the authors consider that the ready oxidizability of winterene and its analogy to similar essences point rather to the formula $C_{15}H_{24}$, which would place it in the group of sesquiterpenes, such as cedrene, cubebene, etc., the boiling points of which are between 250° and 268° C. (482°–514.4° F.). (*P. J.*, June 14, 1890.) The presence of tannic acid and ferric oxide, according to Henry, serves to distinguish Winter's bark from *Canella alba*, with which it has often been confounded. The bark above described as commercial Winter's bark is destitute of both tannic acid and ferric oxide, and cannot therefore be the bark examined by Henry.[1]

The bark of the *Drimys granatensis*, L. f. (now regarded as identical with *D. Winteri*, Forst.), has been imported into London under the name of *Merida coto*, and it has been stated that it contains *cotoin*. It occurs in short pieces of a yellowish-gray color, traversed longitudinally by hard cellular layers, which distinguish it at once from coto and paracoto bark. Its odor resembles that of true coto, but is more feeble. A careful chemical study of it by O. Hesse (*P. J.*, vol. lv.) shows that it contains no cotoin, but a crystalline substance, $C_{13}H_{14}O_4$, to which the name of *drimin* was given. From the leaves Hesse obtained a wax alcohol, *drimol*, $C_{28}H_{58}O_2$. As *Drimys granatensis*, L. f., is recognized as *D. Winteri*, Forst., it is plain that Merida coto must be looked upon as a form of Winter's bark coming from Venezuela.

Medicinal Properties and Uses.—Winter's bark is a stimulant aromatic tonic, and was employed by Winter as a remedy for *scurvy*. It may be used in half-drachm (2.0 Gm.) *doses* for similar purposes with cinnamon or canella alba, but is scarcely known in the medical practice of this country. *Drimys chilensis* of De Candolle, growing in Chile, yields a bark having similar properties (Carson, *A. J. P.*, xix. 81); also *D. aromatica*, F. Muell., of Australia (*P. J.*, xxi.).

Wistaria. *Wistaria chinensis*, DC. (*Kraunhia chinensis.*) (Fam. Leguminosæ.)—Ottow (*P. J.*, Oct. 1886) has obtained from this ornamental leguminous creeper a crystalline poisonous glucoside, *wistarin*.

Withania. *Withania coagulans*, Dun. (*Puneeria coagulans*, Stock.) *Vegetable Rennet.* (Fam. Solanaceæ.)—This shrub, common in Afghanistan and Northern India, has the property of coagulating milk, and has been used for preparing a vegetable rennet ferment for making cheese. Sheridan Lea found upon examination that the substance which possesses the coagulating power is a ferment closely resembling animal rennet. The active principle is soluble in glycerin, and can be extracted from the seeds by this solvent; the extract possesses strong coagulating powers even in small amounts. Alcohol precipitates the ferment body from its solutions, and the precipitate, after washing with alcohol, may be dissolved again without having lost its coagulating powers. The active principle of the seeds will cause the coagulation of milk when present in very small quantities, the addition of more of the ferment simply increasing the rapidity of the change. The coagulation is not due to the formation of acid by the ferment. If some of the active extract be made neutral or alkaline, and added to neutral milk, a normal clot is formed, and the reaction of the clot remains neutral or faintly alkaline. The clot formed by the action of the ferment is a true clot, resembling in appearance and properties that

[1] For Guibourt's description of true Winter's bark, written in 1850, see 17th edition *U. S. D.* Guibourt also describes the barks of two other species of Drimys, those of *D. mexicana* and *D. granatensis*, growing respectively in Mexico and Colombia, both of which have considerable resemblance to the preceding. (Tome iii. 681, 682.)

formed by animal rennet, and is not a mere precipitate. Lea prepared an active extract, applicable for cheese making purposes, by grinding the dry seeds very finely in a mill, and extracting them for twenty-four hours with such a volume of 5 per cent. sodium chloride solution that the mass is still fluid after the absorption of water by the fragments of the seeds as they swell up. From this mass the fluid part may be readily separated by using a centrifugal machine (such as is used in sugar refining), and it can then be easily filtered through filter paper; without the centrifugal machine the separation of the fluid from the residue of the seeds is tedious and imperfect; forty grammes of the seeds treated as above, with 150 Cc. of 5 per cent. sodium chloride solution, gave an extract of which 0.25 Cc. clotted 20 Cc. of milk in twenty-five minutes, and 0.1 Ce. clotted a similar portion of milk in one hour. When added in these proportions the curd formed is quite white. The presence of the coloring matter is, however, perhaps on the whole unimportant, since even if a larger quantity of the ferment extract is added in order to obtain a very rapid coagulation, the coloring matter is obtained chiefly in the whey, the curd being white; by adding sufficient common salt to make the percentage up to 15 per cent., and alcohol up to 4 per cent., the preparation would retain its activity very well. (*P. J.*, 1884, 606.)

Woorari. *Woorara. Woorali. Urari. Curare.* This powerful South American arrow poison was first brought to Europe by the celebrated traveller Waterton; it was in the form of a thick syrup, but as it now occurs in commerce it is a blackish extract, brittle, somewhat resinoid in appearance, encrusting the sides of gourds or little rude earthenware jars, into which it has almost certainly been poured in a liquid state. The drug varies much in strength. It has been variously described. According to the researches of Planchon (*P. J.*, xi. 491), there are really four distinct varieties of curare. 1. That from the Upper Amazon, obtained from the *Strychnos castelnæana*, Wedd., and possibly from *S. Yapurensis*, G. Planch. 2. That from the Upper Orinoco, extending towards the Rio Negro, yielded by *S. Gubleri*, G. Planch.; this is the variety spoken of by Humboldt. 3. That of British Guiana, obtained from *S. toxifera*,[1] Schomb., associated with *S. pedunculata*, Benth. (*S. schomburghkiana*, Klotzsch), and *S. cogens*, Benth. 4. That of French Guiana, made out of *S. crevauxiana*, Baill. (*S. Crevauxii*, G. Planch.). If this classification be correct, it is very important to distinguish the varieties of the woorari; this at present cannot be done. H. C. Wood has received, however, two distinct wooraris, one said to come from the Upper Amazon, therefore No. 1 of Planchon, and the other believed to come from the Orinoco. They are distinguished by the former being free from and the latter full of ants, evidently put in while the poison was liquid. The preparation of woorari has been witnessed by various travellers and variously described. (See *P. J.*, xvi. 502; *B. F. M. R.*, Oct. 1865; *P. J.*, x. 1881.) It usually consists in making a decoction and finally extract of various plants, including the active Strychnos. Jobert asserts that the Tecuma Indians use, besides *S. castelnæana*, Weddell, *Cocculus toxiferus* and an arum (*Taya*), which he found to be very poisonous. According to Kobert (*Ph. Ztg.*, June, 1885), *Malouetia nitida*, Spruce (Fam. Apocynaceæ), or *Guachamaca*, a plant which is abundant in the Orinoco and Rio Negro districts, enters largely into the composition of curare. The alkaloid, *guachamacine*, isolated by T. Schiffer in 1883, is very closely allied to, if it be not identical with, curarine, in both its chemical and its physiological activity. It is entirely possible that the varieties of woorari vary in their alkaloid and their physiological properties. Allied, it may be, to the third variety of woorari are the arrow poisons brought by W. S. W. Ruschenberger from Colombia, and studied by W. A. Hammond and S. Weir Mitchell. (*Am. J. M. S.*, July, 1859.) *Corroval* was in dark brown lumps, having the appearance of a vegetable extract, and of an intensely bitter and persistent taste. Under the microscope it presented the appearance of vegetable remains, but nothing animal. It yielded its active properties to water and alcohol, and was found to depend for its activity upon a peculiar alkaloid, *corrovaline*. In a few minutes after the introduction of the poison through a wound, paralytic phenomena became obvious, and the animal soon died, without preliminary spasm or convulsions. But the heart, instead of continuing to act after apparent death, had entirely ceased to beat, and had quite lost its irritability, so that it could not be excited by galvanism. They inferred that the action of the poison is directly and primarily on the heart, possibly through the ganglia contained in its tissue. There was no evidence whatever, either chemical or physiological, of the presence of strychnine in the poison. *Vao* or *bao* was a vegetable extract containing corrovaline, and apparently only a diluted or adulterated corroval. In 1893 Joseph Tillie obtained arrows from New Granada the poison on which affected chiefly the muscles, and it would seem, therefore, that under the name of woorari are used in South America arrow poisons much more allied to strophanthus in their physiological activity than to the true wooraris, which do not attack the voluntary or involuntary muscles. To such poisons the name of *corroval* should at present be applied. The term curare has in itself no specific meaning, since, according to Whiteford, it is simply the Indian word for *poison*. It is plain that the poisons coming from South America under the name of woorari are various, although in appearance the same, and that at present, therefore, woorari can hardly be used in practical medicine.

In 1898 Boehm classified the curares of the markets as *Tubocurare*, originating from the Amazon, preserved in hollow bamboo canes, and said to contain about 9 to 11 per cent. of *tubocurarine* as its poisonous constituent; *Gourd curare*, derived from *Strychnos toxifera*, very rarely met with, and having curarine and a second alkaloid soluble in ether for its active principle; *Jor curare*, obtained from *Strychnos castelnæana*, also exceedingly rare in the European markets, containing three alkaloids,—*protocurine*, having a feeble curare action; the non-poisonous *protocuridine*; and *protocurarine*, which is more actively poisonous than is curarine (*Ph. Ztg.*, xlii. 41).

The attempts first made to isolate the poisonous principle of woorari were without satisfactory re-

[1] The bark of the *Strychnos toxifera* has been chemically examined by Villiers, who finds that its purified extract resembles in its chemical and physiological relations ordinary curarine. He was not able, however, to obtain the pure alkaloid. (*J. P. C.*, fifth series, vol. xi.)

sults. Heintz succeeded in obtaining the poison in an exceedingly concentrated form, but not entirely separated from other principles. (*Am. Med. Gaz.*, vii. 6.) In 1828 Boussingault and Roulin separated a substance which they regarded as an alkaloid, but which neither they nor other chemists obtained in a crystalline state. Pure concentrated sulphuric acid gives with the curare alkaloids a very durable, magnificent blue color, which is not the case with strychnine. With potassium dichromate the same acid develops the same violet color as with strychnine, but much more persistent. Concentrated nitric acid renders it purple. By these tests curare may be readily detected in the fluids of animals poisoned with it. (*J. P. C.*, 4e sér., ii. 296.) Within the last few years R. Boehm has finally isolated the two bases, *curarine* (also called *tubo-curarine* from its source in the curare packed in bamboo tubes), $C_{19}H_{21}NO_4$, and *curine*, $C_{18}H_{19}NO_3$. The free tubo-curarine forms an amorphous brown-red mass. Boehm (*Ber. d. Chem. Ges.*, xx. 143) states that curine exists in many specimens of curare; it may also be obtained from the aqueous extract of curare. It is much less poisonous than the accompanying curarine. Curine is a crystalline powder fusing at 161° C. (321.8° F.), slightly soluble in cold water, freely soluble in alcohol, chloroform, and dilute acids. It forms a voluminous white precipitate with metaphosphoric acid.

Woorari is one of those poisons whose active principle passes through animal membranes with difficulty, and hence when given by the stomach or rectum it acts very slowly, and in some cases elimination may proceed so rapidly that no marked influence is exerted, because not enough of the alkaloid is in the blood at any one time. There is also some reason for believing that the alkaloid is destroyed in the liver. When injected into a vein, or introduced by the hypodermic needle or the poisoned arrow into the cellular tissue, it acts with great promptness. The symptoms caused are progressive loss of muscular power, the animal growing weaker and weaker, the respirations becoming more and more feeble, until death by asphyxia results. Not rarely there are marked muscular twitchings, or even convulsive movements, which Vulpian asserts (*Leçons Subs. Toxiq.*, 1881, 202) are not due to the asphyxia, because they are not prevented by artificial respiration. They are probably of centric origin, since Tillie (*A. E. P. P.*, xxvii.) has shown that the drug first excites the spinal cord, although such action is masked by the paralysis of the motor nerves. The heart usually continues beating after cessation of breathing, and only very large doses of the poison affect early the arterial pressure. It has indeed very little action upon the cardiac or vasomotor apparatus unless the dose be very large, when the blood pressure sinks from depression of the peripheral vasomotor nerves (Tillie), the cardiac fibres of the vagi also suffer (Dogiel and Nikolski). The failure of muscular power and loss of reflex activity are not due to any influence upon the nerve centres or the muscles, but to paralysis of the motor nerves; it is probable, as Vulpian believes, that it is the extreme peripheral endings of these which first suffer. At a certain stage of the poisoning, response occurs in the tributary muscle when a nerve is galvanized, although reflex and voluntary impulses are unable to force a passage to the muscles. The sensory, vasomotor, and inhibitory nerves are not affected unless by enormous doses. Couty and De Lacuda have brought forward some evidence to show that the muscles do not escape as absolutely as has been believed. (*Schwalbe's Jahresb.*, 1881, 203.) Death has generally been attributed to paralysis of the respiratory nerves, but Dogiel and Nikolski are of the opinion that death is due to the respiratory centres being paralyzed.

Glycosuria has been frequently noticed as the result of woorari poisoning in animals. According to the experiments of K. Morishima, in frogs poisoned either with curarine or protocurarine it is only an occasional phenomenon. It is apparently not connected with the amount of glycogen in the liver or in the muscles (*A. E. P. P.*, xlii. 1899). In regard to action upon the bodily temperature the evidence is somewhat contradictory. Bernard noticed an extraordinary rise, but, according to more recent observations, the temperature of the central portions of the body falls, while that of the extremities, and sometimes even of the lower rectum, rises. Voisin and Liouville divide the effects on the human subject into two classes, according to their severity. The milder symptoms are chiefly exhibited in the circulatory system. The pulse is increased in force and frequency, the respiration is rendered somewhat more frequent, the temperature is slightly elevated, perspirations sometimes occur, and the urine is augmented in quantity, is remarkably light-colored, and contains glucose. From larger quantities of the poison violent febrile phenomena occur, commencing with the characteristic symptoms of a severe chill. There are shivering, chattering of the teeth, sensations of severe cold, cutis anserina, startings, and general trembling, with small and rapid pulse, anxiety, sighing, etc. The power of the lower extremities rapidly diminishes or quite ceases, coordination of motion is disturbed, and sometimes the patient is unable to move the legs. Thirst, headache, insomnia, and sometimes diuresis, are added to the other symptoms. The first coldness is followed by a hot skin, frequent and full pulse, redness of the surface, injected conjunctiva, and a profuse sweat. The paralysis of the lower extremities continues generally for a few minutes, at most for an hour; but care was taken to arrest the action of the poison by compressing the vessels above the point of insertion. The fever continues longer; sometimes, when the dose is large, for five or six days, gradually diminishing. The elimination of the poison by the kidneys appears to cease in about twenty-four hours. In cases of poisoning from the injection of woorari, a ligature around the limb between the place of injection and the heart, the free exhibition of diluents and evacuants, and artificial respiration when required, are the measures recommended. (*Ed. M. J.*, 1867, 667.)

As a remedy curare has very little value, even in *tetanus, hydrophobia*, and other severe *convulsive affections;* it will undoubtedly quiet the spasm, but does not have any direct curative influence upon the disease, which is due to an irritation of the centres and not of the nerve trunks. According to the elaborate experiments of Du Cazal (*A. G. M.*, Sept. 1869), from one-fourteenth to one-seventh of a grain (0.005–0.01 Gm.) daily were borne by a dog without inconvenience; at the dose of ten milligrammes the characteristic phenomena began to show themselves, but disappeared in a few hours; with fourteen milligrammes the animal perished. For man the doses administered by subcutaneous injection were from one-sixth to

three-fourths of a grain (0.01–0.05 Gm.). From these quantities, the appearance of glucose in the urine proved the presence of the poison in the system, and some slight characteristic symptoms, as dizziness, headache, vertigo, general lassitude, have appeared, but without any serious disturbance of the locomotor apparatus. Jousset and Bellesme prepare an infusion in the proportion of one part of the medicine to ten parts of boiling water, and after filtration, inject subcutaneously, at short intervals, a quantity of the infusion equivalent to half a centigramme (about one-thirteenth of a grain), to be increased or diminished according to its effects. (*Ann. Thér.*, 1866, 37.)

According to Bernard, *curarine* is at least twenty times as strong as curare, and should be given in proportionate dose. According to the experiments of Joseph Tillie, *curine* has no influence upon the motor nerves, but acts both in the frog and in the mammal upon the heart, belonging physiologically to the digitalis group. Boehm states that the presence of curine in curare can be recognized by the white precipitate made by metaphosphoric acid.

Wrightia. *Wrightia zeylanica*, R. Br. *Wrightia antidysenterica*, R. Br. *Nerium antidysentericum*, L. (Fam. Apocynaceæ.)—Under the names of *Conessi bark*, *Tellicherri bark*, and *Codaga pala*, a spongy, rusty-colored, bitter bark of this apocynaceous tree was formerly used in Europe as a remedy in *dysentery* and *diarrhœa*, and is said still to be largely employed by the native practitioners of India. Stenhouse obtained from the seeds, besides a fixed oil which they contain in large quantity, a peculiar bitter principle, called by him *wrightine*, which, though uncrystallizable and forming uncrystallizable compounds with the acids, has claims to be ranked with the alkaloids. (See *P. J.*, 1864, 493.) Hains had previously obtained the same alkaloid, and described it under the name of *conessine*. (*P. J.* (2), vi. 432.) The alkaloid conessine is now a commercial product prepared by Merck, and the formula $C_{12}H_{20}N$ is given it. It occurs in delicate white interlaced masses of crystals, melting at 121° C. (249.8° F.), sparingly soluble in water, readily so in alcohol. A small quantity rubbed with a few drops of concentrated sulphuric acid affords on the addition of nitric acid a golden and finally orange-yellow color. We are not aware that the medicinal properties of this have been investigated.

A species of the allied genus *Holarrhena* (*H. africana*, DC.), is stated by German missionaries to be used in parts of tropical Africa in *dysentery*. Polstorff and Schirmer (*Ber. d. Chem. Ges.*, 1886, 78) prepared the alkaloid both from *Holarrhena africana* and from *Wrightia zeylanica*, finding it to be identical in the two cases. They gave it the formula $C_{12}H_{20}N$, and state that it is a light white powder, melting at 121.5° C. (251° F.), sparingly soluble in water, freely soluble in alcohol, ether, chloroform, and benzene. When oxidized by iodic acid in sulphuric acid solution, conessine is changed to *oxyconessine*, $C_{12}H_{20}NO$.

Wurrus.—Under the name of *Vars*, *Wars*, or *Wurrus*, a powder somewhat similar to kamala has been used as an anthelmintic in Southern Arabia, and exported into commerce from Aden. It is believed to be the product of *Hemingia grahamiana* (*P. J.*, Sept. 1887). It is composed of cylindrical or subconical grains, 170 to 200 Mm. long by 70 to 100 broad, with oblong resin cells arranged perpendicularly in three or four tiers.

Xanthin Compounds.—The organic radical xanthin, or *dioxypurin*, yields the following compounds which are interesting therapeutically:

(1) Trimethylxanthin (caffeine), $C_5O_2N_4H(CH_3)_3$.

(2) Three isomeric *dimethylxanthins*: $C_5O_2N_4H_2(CH_3)_2$.

1:7 Dimethylxanthin, paraxanthin.

1:3 Dimethylxanthin, theophylline (theocine).

3:7 Dimethylxanthin, theobromine.

All three of the dimethylxanthins are said to surpass the trimethyl compound as diuretics. Of the xanthin compounds caffeine and theobromine have elsewhere been considered. *Paraxanthin* is not a commercial drug, but according to Dreser-Elberfeld it is an active diuretic.

Theophylline. Theocine.—Theophylline was first isolated from tea leaves by Kossel, but in such minute quantities that it was not a commercial product until the discovery by Traube that it could be produced by synthesis, resulting in its being put upon the market under the name of *theocine*. It is a crystalline substance soluble in 179 parts of water at 18° C. (64.4° F.), in 85 parts at 37° C. (98.6° F.).

Theocine was first brought forward by Minkowski as a very active diuretic, and has been reported upon by a number of German clinicians. It is said to be about as poisonous as caffeine, but distinctly more active than is either caffeine or theobromine as a diuretic. It has been used in both *cardiac* and *renal diseases* with success. It sometimes causes gastric irritation and in some cases severe vomiting, also headache and general malaise have been reported. The system usually, in a short time, becomes accustomed to its use, so that it fails after a time to produce any therapeutic effect. Its maximum action is commonly apparent the second or third day of its ingestion. *Dose*, 7.5 to 18 grains (0.5–1.2 Gm.) may be given in divided doses every twenty-four hours.

Xanthium.—Guichard believes that he has found an alkaloid in the *X. speciosum*. (*P. J.*, vii. 249.) In the *Xanthium Strumarium*, L., *Cocklebur* or *Clotbur*, which is common both in Europe and in America, A. Zander believes that he has found a glucoside, *xanthostrumarin*. M. V. Cheatham thinks that there is a second active principle. (See *A. J. P.*, vol. xi. 271, vol. xiv. 134.) Clotbur is stated to be an active styptic, both local and general. *Dose*, of the fluidextract, from one to two fluidrachms (3.75–7.5 Cc.).

Xanthorrhiza. *Yellow-root. Shrub Yellow-root. Xanthorrhiza apiifolia*, L'Herit. (*X. tinctoria*, Woodhouse).—This is a ranunculaceous shrub, two or three feet in height, with a horizontal root, which sends off numerous suckers. The stem is simple, rather thicker than a goose quill, with a smooth bark and bright yellow wood. The leaves, which stand thickly at the upper part of the stem, are compound, consisting of several ovate-lanceolate, acute, doubly serrate leaflets, sessile upon a long petiole, which embraces the stem at its base. The flowers are small, purple, and disposed in long, drooping, divided racemes, placed immediately below the first leaves. The yellow-root grows in the interior of the Southern and in the Western States. Nuttall found it abundant on the banks of the Ohio. It flowers in April. The root was formerly in the Secondary List of the U. S. Pharmacopœia, but the bark of the stem possesses the same virtues. The root is from three inches to a foot or more in length, and about half an inch in thickness near the stem. It shrinks somewhat in

drying, and, as found in commerce, is in slender pieces of various lengths, diminishing from three or four lines in thickness to the dimensions of a knitting needle, wrinkled longitudinally, with a light yellowish-brown, easily separable epidermis, a thick, hard, bright yellow woody portion, and a very slender central pith. It is inodorous, and of a simple but extremely bitter taste. It imparts its color and taste to water. The infusion is not affected by ferric salts. J. Dyson Perrins found *berberine* in it. (*P. J.*, May, 1862.) Samuel S. Jones believed that he had proved the existence in the drug of a second alkaloid. (*A. J. P.*, vol. xvi. 1861.) Xanthorrhiza possesses properties closely analogous to those of calumba, quassia, and other simple tonic bitters, and may be used for the same purposes and in the same manner. Woodhouse employed it in the *dose* of forty grains (2.6 Gm.).

Xanthorrhœa Resins. *Gum Acaroides. Gum Acroides.*—Yellow and reddish resinous substances, the products of different species of Xanthorrhœa (Fam. Liliaceæ), have been introduced into England from Australia. They are obtained by spontaneous exudation from the stems of the plants, which are usually shrubs. The *yellow variety* (from *X. media*, R. Br., syn. *X. hastilis*, *X. resinosa*, Sm.) is in tears, in flattish pieces having on one side the mark of the stem, or in masses of various size and irregular shape. It has a reddish-yellow color, resembling gamboge when broken, and when heated emits a fragrant odor like that of Tolu balsam. It contains resin, cinnamic and benzoic acids, and a trace of volatile oil, and may therefore be ranked among the balsams. When heated with nitric acid, it yields a large product of picric acid. In medicinal properties it is said to bear a close resemblance to storax and the balsam of Tolu. A tincture, made in the proportion of two ounces to a pint of alcohol, may be given in the *dose* of one or two fluidrachms. The *red variety* (from *X. australis*, R. Br.) resembles dragon's blood in color, and appears to be analogous to the other variety in properties. (See *A. J. P.*, 1881; also *A. J. P.*, vol. xv., and *D. C.*, 1895, 83.) These resins have been introduced as a shellac substitute in varnish making.

Xylene. *Xylol. Xylène*, Fr. *Xylol*, G. $C_6H_4(CH_3)_2$.—There are three isomeric hydrocarbons of this name, the ortho-, meta-, and para-xylene respectively, all contained in coal tar. A mixture of them was first extracted from naphtha by Hugo Müller, and was brought forward by Zuelzer as a specific in *small pox*, but is useless. (*P. J.*, 1872, 623.) It is largely used as a solvent by microscopists.

Yeast. *Cerevisiæ Fermentum. Beer Yeast.*—The ferment obtained in brewing beer, and produced by *Saccharomyces* (*Torula*, Turpin) *cerevisiæ*, Meyen, was dismissed from the U. S. Pharmacopœia in 1880, from the British in 1898. Two well-marked varieties of the *Saccharomyces cerevisiæ* have been recognized. The one is the most active at the ordinary temperature (16°–20° C., 60.8°–68° F.), and carries through its fermentative work in from three to four days; the other works at a lower temperature (6°–8° C., 42.8°–46.4° F.), and the fermentation is much slower. The first placed in a saccharine liquid is carried by the carbon dioxide which it liberates to the surface of the liquid, where it continues its activity; it is, therefore, known as a *surface* or *top yeast*. The second, on the contrary, is not carried up, and rests during its entire activity on the bottom of the fermenting vessel, and is hence called a *bottom yeast*. Two quite distinct methods of beer brewing are practised, depending upon the use of the one or the other of these varieties of yeast. (For fuller information as to the nature of yeast and its conditions of culture and activity, see Sadtler's *Industrial Organic Chemistry*, Philadelphia, 3d ed., 1900, 185 *et seq.*)

Yeast is a flocculent, frothy, somewhat viscid semi-fluid, of a dirty yellowish color, a sour vinous odor, and a bitter taste. Exposed to a moderate heat it loses its liquid portion, becomes dry, hard, and brittle, and may in this state be preserved for a long time, though with the loss of much of its peculiar power. *Yeast cakes* are made by putting yeast into sacks, washing it with water, then submitting it to pressure, and ultimately drying it (*Ibid.*, 225); *compressed yeast*, the undried product, is now largely used.

Yeast is insoluble in alcohol or water. Its ultimate composition, according to Schlossberger (*Ann. Ch. Ph.*, 51, 199), is carbon 49.9 per cent., hydrogen 6.6 per cent., nitrogen 12.1 per cent., and oxygen 31.4 per cent. Its proximate constituents are albuminoids, cellulose, fats, and resinous substances.

The chief function of yeast is the inducing of the vinous fermentation, in which are produced alcohol and carbon dioxide, and various other substances in smaller or larger proportions. Pasteur has shown that while from 94 to 95 per cent. of the sugar decomposes into ethyl alcohol and carbon dioxide, the other 5 or 6 per cent. decomposes by secondary reactions, yielding glycerin from 2.5 to 3.6 per cent. and succinic acid from 0.4 to 0.7 per cent. The higher homologues of ethyl alcohol are also produced in small amount, forming fusel oil or raw spirit.

The activity of yeast is due to the presence of a microscopic fungus, first discovered in it by Leuwenhoek in 1680. As originally announced by Thénard in 1803, this yeast plant is ordinarily the cause of the alcoholic fermentation. It consists of numerous cells, irregular, roundish, or cylindrical in shape, separate, jointed into rows, or budding one from the other. It is most probable that the yeast plant is the mycelium, or early vegetative stage, of more than one species of mucor or mould; and some authorities recognize various species of the yeast fungus. The name *Torula cerevisiæ* was first given to the yeast plant, which was subsequently called *Mycoderma vini;* Reess, in his elaborate work (*Alkoholsgährungspilze*, Leipsic, 1870), made a distinct genus of it, *Saccharomyces*, including many species.

According to Albert Buchner and Rapp, a dried yeast which retains its activity on keeping is obtained as follows: The yeast is freed from water as much as possible by expression, immersed in acetone and rubbed through a sieve. The acetone is decanted, renewed, again decanted, and the residue collected by the aid of a suction filter, then treated with ether for three minutes, and this removed in the same way, after which the yeast is spread out to dry, the drying being completed at a temperature of 45° C. (113° F.). Dried yeast, so obtained, is an almost white powder. (*Ph. Centralh.*, 1903, 36.)

According to Casagrandi, *Saccharomyces ruber*, previously discovered by Demme, produces a *red yeast* which ferments glucose very readily, developing a red pigment. This saccharomyces was found pathogenic to various animals, and when

put into milk so modified that liquid as to convert it into a pronounced intestinal irritant. (*P. J.*, Jan. 1898.) A number of yeasts are used in China and Java whose fundamental plants are different from those of the European yeast. See *P. J.*, vol. xlvii.

As a stimulant in *typhoid, hectic,* and other low *fevers,* yeast was formerly employed to a considerable extent, as much as a pint of it being taken within the twenty-four hours. This use of it did not rest upon any scientific basis and has altogether ceased. On the other hand, the employment of yeast in the treatment of various infections has recently received great support from the experiments of Landau (*D. M. W.*, 1899, 11), of Gelli (*Corriere Sanitario,* 1899, 46) of Hallion and Carrion, of Nobécourt (*S. M.*, 1901), of Durand (*Lyons Méd.,* 1902), and of others, which experiments demonstrate that yeast has active germicidal properties. It is now employed as a local remedy in various *infectious inflammations,* and has been especially commended in the treatment of *gonorrhœa of the female,* the yeast being injected so as to fill the vagina and retained in place for some hours by means of a plug. The application should at first be made every other day; subsequently at longer intervals. There is further much testimony to show that yeast exerts, even when given internally, a germicidal action; it has long been used in *furunculosis,* and recently has been highly commended in *purpura, cholera, dysentery,* and other conditions of the alimentary canal dependent upon the presence of organisms. From two to four ounces of it may be taken three or four times a day. Locally it may be applied *ad libitum. Dried yeast* has been much used in France internally under the name of *levurine,* and it is probable that the ordinary *yeast cake* of American bakers may well be substituted for yeast.

Yohimbine.—This is an alkaloid which is obtained from the bark of *Corynanthe Yohimbi* (Schumann, *Notizblatt der Bot. Gart. in Museum zu Berlin,* No. 25, Bd. 3), a rubiaceous tree growing in the Southern Cameroons district in Africa. The bark is stated to be 8 to 10 Mm. thick, with an external corky layer of a gray-brown color covered with isolated lichens. It shows numerous longitudinal and transverse fissures like some old specimens of cinchona bark. The transverse fracture is of a uniform yellowish-brown color, and presents short, soft fibres like rough velvet.

The alkaloid has been obtained in white needles melting at 234° C. (453.2° F.), and having the composition $C_{22}H_{30}N_2O_4$.

It was originally investigated by Oberwarth and Loewy (*V. A. P. A.*, vol. 153, and *B. K. W.*, No. 42, 1900), who found it to be in animals and also in man a very active excitant to the sexual organs and functions. On the other hand, Kravkoff, as the result of experiments upon the lower animals and upon man, concluded that it has no aphrodisiac effects and frequently produces nausea, salivation, irritability, and other disagreeable results. It has been used, however, by numerous clinicians in *neurasthenic impotence,* with reports which are generally favorable to its influence. (For literature, see *M. R.*, 1901, 1902.) It is said to be of no value when the impotence depends upon organic nerve trouble, and to be harmful when it is caused by chronic inflammatory disease of the sexual organs or of the prostate gland. *Dose,* of the hydrochloride, 0.005 Gm. (1-12th grain), either in tablet or solution, three or four times a day. Yohimbine has also been employed in a 1 per cent. solution hypodermically.

Zedoary. *Radix Zedoariæ. Rhizoma Zedoariæ,* P. G. *Zedoaire,* Fr. *Zitterwurzel,* G.—There are two kinds of zedoary, the long and the round, distinguished by the old official titles of *radix zedoariæ longæ* and *radix zedoariæ rotundæ;* the former produced by *Curcuma aromatica,* Salisb. (*C. Zedoaria,* Roxb.), the latter, as some suppose, by *Kæmpferia rotunda,* L., but, according to others, by the *Curcuma Zedoaria,* Rosc. (*C. Zerumbet,* Roxb.), all of the fam. Scitaminaceæ. Both kinds come from the East Indies. The *long zedoary* is in slices, from a inch and a half to three inches in length, and from half an inch to an inch thick, obtuse at the extremities and exhibiting the remains of the radical fibres. The *round* is also usually in slices, which are the sections of a roundish root, ending in a point beneath, and divided longitudinally into two parts, each of which is flat on one side, convex on the other, and heart-shaped in its outline. Sometimes the root of the latter variety is entire, and sometimes in quarters instead of halves. It is marked with circular rings on the convex surface, and, like the former, with small projecting points which are the remains of radical fibres. Both are grayish white on the outside, yellowish brown within, hard, compact, of an agreeable aromatic odor, and a bitterish, pungent, camphorous taste. The round, however, is less spicy than the long. They yield a volatile oil, when distilled with water, and contain a pungent soft resin and bitter extractive. Zedoary is a warm, stimulating aromatic, useful in flatulent colic and debility of the digestive organs. It is not now employed, as it produces no effects which cannot be as well or better obtained from ginger. The *dose* is from ten grains to half a drachm (0.65–2.0 Gm.).

Zerechtit. *Tschuking. Landtia Schimperi,* Benth. and Hook. (*Ubiæa Schimperi,* J. Gay, *Arctotis Schimperi,* O. Kze.)—The leaves, flowers and fruit of an Abyssinian composite. (See *Proc. A. Ph. A.*, xxvi. 228.)

Zerumbet. *Cassumuniar.*—Under these names an East India root was formerly used, having some analogy in sensible and medicinal properties to ginger, and ascribed to the *Zingiber Zerumbet* of Roscoe. Some consider the cassumuniar as a distinct root, and refer it to the *Zingiber Cassumuniar* of Roxburgh. The difference of opinion is of little importance, as neither of the roots is to be found in the markets. By some authors the zerumbet has been erroneously confounded with the round zedoary. Geiger describes it as in pieces of the size of a fig or larger, externally grayish brown and wrinkled, internally yellowish, hard and tough, of a biting, aromatic taste, and a spicy odor.

Zinc and Potassium Cyanide. *Zinci et Potassii Cyanidum.* $K_2Zn(CN)_4$.—Made by adding zinc cyanide to solution of potassium cyanide, evaporating and crystallizing. The salt possesses a sweet and metallic taste and is used for the same purposes as zinc cyanide in from ⅛ to ½ grain (0.008–0.032 Gm.) *doses.*

Zinc Borate. *Zinci Boras.* $ZnB_4O_7 + 7H_2O$. Prepared by mixing an aqueous solution of zinc sulphate (1 in 10) with one of borax (1 in 25), and collecting the precipitate. Used as an antiseptic dusting powder.

Zinc Cyanide. *Zinci Cyanidum.* $ZnCy_2$.—This cyanide is precipitated as a white insoluble

powder, by adding cautiously, until it ceases to produce a precipitate, a recently filtered solution of potassium cyanide to a solution of zinc sulphate. It is used in Germany as a substitute for hydrocyanic acid, and is said to be anthelmintic. It has been recommended by Lashkevich in cardiac neuroses in *doses* of from one-tenth to one-eighth grain (0.006–0.008 Gm.) three times a day. It has been employed in *epilepsy, chorea,* and *neuralgia,* in several *painful affections of the stomach,* and in the *colics* attendant on *difficult menstruation.* The *dose* is a quarter of a grain (0.016 Gm.), gradually increased to a grain and a half (0.096 Gm.), given in mixture. It is official in the French Codex.

Zinc Ferrocyanide. *Zinci Ferrocyanidum.* $Zn_2FeCy_6 + 3H_2O$.—Formed by double decomposition between hot solutions of potassium ferrocyanide and zinc sulphate. It is precipitated as a white powder. It has similar medicinal properties to those of the cyanide, and is used in the same diseases. The *dose* is from one to four grains (0.065–0.26 Gm.), given in pill. (See *Zinc Cyanide,* p. 1701.)

Zinc Lactate. *Zinci Lactas.* $Zn(C_3H_5O_3)_2 + 3H_2O$.—This salt is used by Herpin in *doses* of two grains (0.13 Gm.), three times a day, gradually increased to ten grains (0.65 Gm.) a day, as a substitute for zinc oxide in *epilepsy.* For its physical properties and methods of preparation see 16th edition *U. S. D.*

Zinc Permanganate. *Zinci Permanganas. Zinkpermanganat, Uebermangansaures Zink, G.* $Zn(MnO_4)_2 + 6H_2O$.—Made by precipitating barium permanganate with zinc sulphate, using exact molecular proportions. It forms almost black deliquescent crystals, giving off oxygen even more readily than potassium permanganate. It is used as an astringent and antiseptic application

Zinc Phosphate. *Zinci Phosphas. Trizincic Orthophosphate.* $Zn_3P_2O_8 + 2H_2O$.—Barnes of London, has brought forward this salt of zinc as having special advantages over other salts of the same metal in the treatment of *nervous diseases,* peculiarly useful in the *insanity* occurring in the convalescence from fevers, in which he associates it with quinine, and in *epilepsy* attended by *disorder of the uterine functions.* Zinc phosphate may be prepared by the mutual reaction of zinc sulphate and an alkaline phosphate. Zinc phosphate is a white powder, insoluble in water but soluble in acids.

Zinc Phosphide. *Zinci Phosphidum. U. S.* 1890. $Zn_3P_2 = 256.24$.

According to Hager, zinc phosphide was first prepared by Marggraf in 1740. It was formerly made by fusing, in a bath of iron filings, 74 parts of pure zinc, and adding gradually, in small pieces, 26 parts of dry phosphorus. This process gives good results only in small quantities (10 to 20 Gm.). A more recent process is to pass vapors of phosphorus in a current of dry hydrogen over fused zinc. The product is a spongy, gray mass, of metallic appearance, containing rhomboidal crystals, and when powdered resembling somewhat reduced iron. The particles of metallic zinc should be separated. Its sp. gr. is 4.72. "Zinc phosphide should be kept in small, glass-stoppered vials." *U. S.* 1890.

It is thus described in the U. S. Pharmacopœia of 1890: "A gritty powder of a dark gray color, or crystalline fragments of a dark, metallic lustre, and having a faint odor and taste of phosphorus. In contact with the air it slowly emits phosphorous vapor. Insoluble in water or alcohol. Soluble in diluted hydrochloric or sulphuric acid with evolution of hydrogen phosphide. When strongly heated, with exclusion of air, it melts and finally sublimes. When heated in air, it becomes oxidized to zinc phosphate. If 0.5 Gm. of Zinc Phosphide be dissolved in 15 Cc. of diluted hydrochloric acid, heat being applied to expel all of the hydrogen phosphide gas, a clear solution should result, leaving no residue (absence of *insoluble impurities*). A portion of this solution should yield a pure white precipitate with potassium ferrocyanide test-solution (absence of *iron* or *copper*); or with ammonium sulphide test-solution (absence of *lead* or *copper*). If another portion of this solution be mixed with an equal volume of hydrogen sulphide test-solution, no color or turbidity should appear (absence of *arsenic, cadmium, lead, copper,* etc.)." For a method of assay of zinc phosphide, see *N. R.,* June, 1879.

It has been proved by direct experiment upon animals, as well as by clinical experience, that zinc phosphide affects the system physiologically and therapeutically in exactly the same manner as does phosphorus, and it is employed in medicine as a substitute for that element. Theoretically, each grain of the phosphide contains nearly a quarter of a grain of phosphorus. It is asserted in the journals to have been administered in doses of one or even two grains; but of the pure salt such amounts would be extremely dangerous; the commencing *dose* is one-twentieth of a grain (0.003 Gm.).

Zinc Salicylate. *Zinci Salicylas. Zinksalicylat,* G. $Zn(C_6H_4.OH.COO)_2 + H_2O$.—Made by boiling together molecular proportions of sodium salicylate and zinc sulphate, cooling, washing the crystals and recrystallizing from hot water. In the form of long satiny needle-like crystals, having a sweet but astringent and bitter taste. It is soluble in about 20 parts of cold water. Zinc salicylate is an astringent and antiseptic, a solution (1 to 5 grains in one fluidounce) is used in *ophthalmia* and *gonorrhœa.*

Zinc Subgallate. *Zinci Subgallas.*—An odorless powder containing 44 per cent. of zinc oxide and 56 per cent. of gallic acid. Internally it is used in intestinal disorders as an antiferment in *doses* of from one-half to four grains (0.032–0.26 Gm.). Externally it has been used in skin diseases.

Zinc Sulphite. *Zinci Sulphis.* $ZnSO_3 + 2H_2O$. Made by precipitating a solution of zinc sulphate with sodium sulphite, collecting, washing and drying the precipitate. A white crystalline powder, soluble in about 600 parts of water.

Zizyphus. *Zizyphus sativa,* Gaertn. (*Z. vulgaris,* Lamarck.) *Jujube,* Fr. *Brustbeeren, Judendornbeeren,* G.—A shrub,, or small tree, of the fam. Rhamnaceæ, growing on the shores of the Mediterranean, and cultivated in Italy, Spain, and the south of France. The fruit is the part used. This consists of oval drupes, of the size of a large olive, with a thin, coriaceous, red or reddish-brown skin, a yellowish, sweet, acidulous pulp, and an oblong, pointed stone in the centre. These have the name of *jujubæ.* By drying, their pulp becomes softer and sweeter, and acquires a vinous taste, evincing the commencement of fermentation. They are nutritive and demulcent, and are used in the form of decoction in *pectoral complaints. Jujube paste* consists properly of gum arabic and sugar, dissolved in a decoction of this fruit, and evaporated to the proper consistence. As a de-

mulcent it is in no respect superior to a paste made with gum arabic and sugar alone, and the preparation formerly sold in this country under the name contains in fact none of the fruit. The fruits of two other species, *Z. Lotus*, Lam., growing in the north of Africa, and *Z. Jujuba*, Lam., a native of the East Indies, possess properties similar to those of the *Z. sativa*, and are used as food by the inhabitants of the countries where they grow. The *Zizyphus Jujuba* is stated by Bosisto (*A. J. P.*, 1886) to be one of the main sources of stick-lac, from which shellac is manufactured.

Zygadenus.—This is a liliaceous genus, found in the United States, some members of which are believed to be poisonous. H. S. Goodell affirms that he has seen violent convulsions produced by the juice of *Z. venenosus*, Watson. According to Watson, among the northern tribes of Indians the bulb of this species is said to be very poisonous, and is known as the *Death Camass*.

Zymoidin.—A powder said to be composed of zinc oxide, bismuth oxide, aluminum oxide, iodine, boric acid, carbolic acid, gallic acid, salicylic acid, quinine, and other ingredients. It is used as an antiseptic and dusting powder.

PART III

SECTION I

In this division are included the subjects formerly embraced in the Appendix of this work, with the addition of the official tests and various tables, some of which are introduced for the first time in this Dispensatory, and the National Formulary in abstract.

Tests, Reagents, Test Solutions, and Volumetric Solutions.

U. S. P. Eighth Decennial Revision.

The constant reference to tests in the previous pages, and the adoption of volumetric test solutions in the U. S. Pharmacopœias of 1880 and 1890, and the British Pharmacopœia (1898), necessitate the insertion of the official reagents and solutions used in the quantitative and qualitative tests. Great care should be used, in preparing these tests and selecting the reagents, to see that they come fully up to the official requirements, as the whole value of the test depends upon the purity of the reagent and the accuracy with which the solution has been made.

INTRODUCTORY.

Official Substances as Reagents.—Some official substances (chemicals, chemical solutions, etc.) are sufficiently pure to be used as reagents, if they comply with the tests of purity prescribed by the Pharmacopœia. Latin official names are not used as titles in the following list, the English name being preferred. In the case of non-official substances, the presence of certain impurities, though immaterial for their use as medicines, renders their employment as reagents unsuitable. Whenever a greater degree of purity is required than is provided for by the text of the Pharmacopœia, it will be specially mentioned in the following lists.

Abbreviations and Signs Used:

T.S. = Test Solution.

V.S. = Volumetric Solution.

$\frac{N}{1}$ = Normal (see under "Volumetric Solutions," page 1715).

$\frac{N}{2}$ = Half-normal; $\frac{N}{10}$ = Tenth-normal; $\frac{N}{50}$ = Fiftieth-normal; $\frac{N}{100}$ = Hundredth-normal.

$\frac{2N}{1}$ = Double-normal (sometimes written: 2N).

Keeping of Reagents.—Reagents should be kept in bottles made of glass free from lead and arsenic, and not subject to corrosion by acids and alkalies.

The bottles should be closed by well-ground glass or rubber stoppers. Ground glass stoppers of bottles containing alkali hydroxides, ammonium sulphide, ammonia water, and other substances of alkaline reaction rapidly attacking ground glass surfaces, should be coated with a thin film of petrolatum.

Reagents easily affected by light, such as hydrogen sulphide T.S., ammonium sulphide T.S., chlorine water, silver nitrate T.S., etc., should be kept in bottles made of dark amber-colored glass.

NOTE.—As some of the following test solutions are in certain cases directed to be used in definite quantities in place of the regular volumetric solutions, it is important that they should always be prepared of the *exact strength prescribed.*

TESTS, REAGENTS, AND TEST SOLUTIONS.

NOTE.—The reagents are arranged in alphabetical order. The test solutions are usually mentioned in connection with the principal chemical or other substance from which they are prepared. The volumetric solutions will be found on page 1715.

Whenever *water* is required or mentioned as a solvent in the tests given in the Pharmacopœia, or in the preparation of any reagent, it is understood that *distilled water* shall be used.

1. Absolute Alcohol.—Ethyl Alcohol, C_2H_5OH.—Use the official absolute alcohol [*Alcohol Absolutum*, U. S. P.], which should be neutral to litmus T.S.

2. Acetic Acid, $HC_2H_3O_2$.—Use the official acetic acid [*Acidum Aceticum*, U. S. P.].

3. Albumin Test Solution.—Carefully separate the white of a hen's egg (which should be fresh) from the yolk, shake it thoroughly with 100 Cc. of water, and filter. This solution should be freshly made when required.

4. Alcohol.—Ethyl Alcohol, C_2H_5OH.—Use the official alcohol [*Alcohol*, U. S. P.]. Alcohol of lower strength is prepared as follows:

Alcohol, 90 per cent.—Mix 51 Cc. of alcohol [*Alcohol*, U. S. P.] with 3 Cc. of distilled water. The specific gravity of the mixture should be 0.826 at 25° C. (77° F.), corresponding to 90 per cent., by volume, of absolute alcohol.

5. Alcohol, 80 per cent.—Mix 45.5 Cc. of alcohol [*Alcohol*, U. S. P.] with 9.5 Cc. of distilled water. The specific gravity of the mixture should be 0.856 at 25° C. (77° F.), corresponding to 80 per cent., by volume, of absolute alcohol.

6. Alcohol, 70 per cent.—Mix 38.6 Cc. of alcohol [*Alcohol*, U. S. P.] with 15 Cc. of distilled water. The specific gravity of the mixture should be 0.882 at 25° C. (77° F.), corresponding to 70 per cent., by volume, of absolute alcohol.

7. Ammonia Water, NH_4OH.—Use the official ammonia water [*Aqua Ammoniæ*, U. S. P.].

8. Ammonium Carbonate Test Solution.—Dissolve 20 Gm. of ammonium carbonate, $NH_4HCO_3.NH_4NH_2CO_2$ [*Ammonii Carbonas*, U. S. P.], in a mixture of 20 Cc. of ammonia water and 70 Cc. of water, and add sufficient water to measure 100 Cc.

9. Ammonium Chloride Test Solution.—Dissolve 10 Gm. of ammonium chloride, NH_4Cl [*Ammonii Chloridum*, U. S. P.], in sufficient water to measure 100 Cc.

10. Ammonium Molybdate Test Solution.—Dissolve 15 Gm. of finely powdered ammonium molybdate, $(NH_4)_6Mo_7O_{24} + 4H_2O$, in 100 Cc. of distilled water, adding sufficient ammonia water, if necessary, to effect solution. Then gradually pour the liquid into 100 Cc. of nitric acid (sp. gr. 1.403 at 25° C. [77° F.]). The resulting solution, after being subjected to gentle heat for about two hours, should be decanted from any yellow sediment which may be deposited.

Alternative Method.

Solution No. 1.

Molybdic Acid, H_2MoO_4	10 Gm.
Ammonia Water (10 per cent.)	42 Cc.

Solution No. 2.

Nitric Acid (sp. gr. 1.403), Water, of each	63 Cc.

Pour Solution No. 1 into Solution No. 2 gradually, shaking repeatedly. After being subjected to a gentle heat for about two hours, the solution should be decanted from any yellow sediment which may be deposited.

Preserve the test solution in the dark, and, if a sediment should form in it after some days, carefully decant the clear solution from it.

11. Ammonium Oxalate Test Solution.—Dissolve 4 Gm. of pure crystallized ammonium oxalate, $(NH_4)_2C_2O_4 + H_2O$, in sufficient water to measure 100 Cc. Or, dissolve 4 Gm. of pure oxalic acid (see No. 73) in 100 Cc. of water, add 15 Cc. of ammonia water, boil to expel excess of ammonia, and dilute with water to 113 Cc.

On evaporating a portion of the test solution, and igniting the residue, it should be completely volatilized (absence of *fixed impurities*). The precipitate produced by the addition of silver nitrate T.S., or by barium chloride T.S., should dissolve without residue upon the addition of nitric acid (absence of *chlorides* and *sulphates*).

12. Ammonium Sulphate, $(NH_4)_2SO_4$.—This salt should respond to the following tests of purity: Three grammes should leave no appreciable residue upon ignition (absence of *fixed impurities*). The aqueous solution of the salt (1 in 10) should not respond to the Time-Limit Test for Heavy Metals (see No. 121). Another portion of this solution should not become turbid upon the addition of nitric acid and silver nitrate T.S. (absence of *chlorides*). Another portion of this solution should not be colored red upon the addition of 2 drops of hydrochloric acid and 1 drop of ferric chloride T.S. (absence of *sulphocyanate*). This salt may be prepared by neutralizing pure sulphuric acid, which has been diluted with an equal volume of water, with ammonia water, evaporating and crystallizing. During the evaporation, the solution should be tested from time to time with litmus paper, adding more ammonia if necessary to keep the liquid alkaline.

13. Ammonium Sulphide Test Solution.—Saturate 3 parts of pure ammonia water with hydrogen sulphide, prepared as directed (No. 47), and add to the solution (which now contains ammonium hydrogen sulphide, NH_4HS) 2 parts of ammonia water, which converts the greater portion of the ammonium hydrogen sulphide into ammonium sulphide, $(NH_4)_2S$. The solution should be perfectly clear and colorless, and should leave no residue on evaporation. It should not be rendered turbid either by magnesium sulphate T.S. (absence of *free ammonia*), or by calcium chloride T.S. (absence of *ammonium carbonate*). It should be protected against air and light by being kept in small, dark amber-colored bottles, in a cool, dark place. As soon as a notable deposit of sulphur has made its appearance in the solution, it should be rejected.

Ammonium polysulphide test solution is occasionally required. It is a yellow liquid, made by dissolving a small quantity of pure sulphur in the preceding colorless ammonium sulphide test solution.

14. Amyl Alcohol, $C_5H_{11}OH$.—A colorless, oily liquid having a penetrating characteristic odor, boiling at 131° C. (267.8° F.); soluble in 40 parts of water at 25° C. (77° F.); miscible with alcohol, ether, chloroform, carbon disulphide, petroleum benzin, benzene, and fixed and volatile oils.

15. Aniline (Phenylamine), $C_6H_5NH_2$.—When freshly distilled, aniline is a colorless, strongly refractive, oily liquid having a peculiar aromatic odor and a pungent, burning taste. Upon exposure to the light and air, it rapidly assumes a reddish-brown color. Specific gravity 1.0214 at 25° C. (77° F.). Aniline should distil over completely between 183° and 184° C. (361.4° and 363.2° F.). It is soluble in alcohol, ether, and the fixed and volatile oils. With acids, it forms soluble crystalline salts. When added to a solution of calcium or sodium hypochlorite a blue or purple color is produced.

16. Arsenic Test, Bettendorf's.—To a solution of the prescribed quantity of the substance to be tested in 5 Cc. of pure concentrated hydrochloric acid contained in a clean test-tube, 5 Cc. of a saturated solution of freshly prepared stannous chloride in pure concentrated hydrochloric acid (see No. 46) are added, and, after being heated for fifteen minutes while immersed in a bath of boiling water, the tube is allowed to stand for one hour. If arsenic be present in non-permissible amount, a brownish tint will become manifest when the tube is placed over a white surface and the solution viewed from above, comparison being made with a mixture of 5 Cc. each of pure concentrated hydrochloric acid and a saturated solution of stannous chloride, prepared under like conditions.

NOTE.—It is absolutely necessary that the solution of stannous chloride be freshly prepared, and that sulphates, sulphites, sulphides, and salts of mercury, gold, and selenium be absent from the reagents and the chemicals being tested.

17. Arsenic Test, Modified Gutzeit's.—The efficiency of this test depends upon a strict adherence to the conditions described below.

REAGENTS.

Zinc.—This should be in a granulated or fine mossy condition and free from arsenic, sulphur, and phosphorus, and should not contain more than 0.05 per cent. of iron. It should otherwise respond to all the tests given under Zinc [*Zincum*, U. S. P.].

Hydrochloric Acid (8 per cent.).—Mix 22.5 Cc. of hydrochloric acid [*Acidum Hydrochloricum*, U. S. P.] with water sufficient to measure 100 Cc.

Mercuric Chloride Test-Paper.—By means of a glass rod, transfer a drop of a saturated alcoholic solution of mercuric chloride to the centre of a piece of white filter-paper (preferably the kind used for quantitative analysis) of about 4 Cm. diameter; after drying, this paper is to be twice successively moistened with the reagent and dried. It is not necessary to moisten the paper with alcohol or the reagent while using it.

Lead Acetate Test-Gauze.—A piece of cheese cloth, about 1 decimeter square, when required for use, is thoroughly impregnated with lead acetate T.S., and the excess of fluid removed by pressure.

TEST-FLASK.

Select a flask of the capacity of about 60 to 75 Cc., with a neck of about 5 to 6 Cm. in length, and about 1 Cm. in diameter.

PREPARATION OF THE CHEMICAL TO BE TESTED.

To 5 Cc. of the aqueous solution of the chemical (1 in 10) or to a solution in 5 Cc. of water of the residue remaining after undergoing special treatment, 1 Cc. of a mixture of equal volumes of sulphuric acid and water is added, followed by 10 Cc. of a freshly prepared saturated solution of sulphurous acid. This liquid, contained in a small beaker, is heated upon a bath of boiling water until it is free from excess of sulphurous acid and has been reduced to 5 Cc. in volume.

THE TEST.

Before applying this test for the presence of arsenic in chemicals, in order to establish the freedom of the reagents from arsenic, sulphur, and phosphorus, or any interfering contaminations, a preliminary blank test should be made as follows: Into the flask are introduced 2 Gm. of zinc, 20 Cc. of the hydrochloric acid (see above), and 5 Cc. of water, and into the lower end of the neck of the flask is inserted a small wad of clean dry gauze, and then the lead acetate test-gauze, pressed with sufficient firmness to retain its place. About 1 Cm. space should be allowed above the gauze; the lip of the flask, after careful cleansing, is securely covered by folding over it the mercuric chloride test-paper. The reaction is allowed to proceed until the greater portion of the zinc has dissolved, which may require from one-half to two hours, when, if no trace of a yellow to orange-colored deposit is distinguishable upon the inner surface of the test-paper cap, the reagents are proved to be sufficiently pure, and a direct test may be applied at once. If a black stain is produced, sulphur compounds are present in the zinc or reagents, and this indicates unfitness for use. While the blank test is being carried out, another flask should be charged in a like manner with 2 Gm. of zinc and 20 Cc. of the hydrochloric acid (see above), followed by the 5 Cc. of the solution of the chemical (1 in 10) to be tested, which has undergone reduction as directed (under *Preparation of the Chemical to be tested*); the wad of clean dry gauze followed by the lead acetate test-gauze is then introduced, and after cleansing the lip of the flask the mercuric chloride cap is folded over the top. After the evolution of hydrogen has continued for at least one-half hour, and most of the zinc has dissolved, the inner side of the mercuric chloride test-cap is examined to detect the presence of a yellow stain.

The presence of arsenic much in excess of the permissible limit (1 in 100,000) is manifested by the formation of a distinct yellow to orange spot, according to the quantity present. Antimony produces a dark gray to brownish-black coloration. The production of a black stain indicates the presence of sulphur compounds (as sulphurous acid or sulphides), also possibly antimony. If the former be present, a simultaneous blackening of the lead acetate gauze will be observed. If such be the case, the operation, as directed under *Preparation of the Chemical to be tested*, must be repeated upon a fresh portion of the sample, using greater precautions for the complete removal of the sulphurous acid.

In testing such phosphorus compounds as hypophosphorous acid and the hypophosphites, special care should be observed to completely oxidize the sample as directed, otherwise a yellow stain, similar to that caused by arsenic, may be produced through the evolution of hydrogen phosphide.

Compounds containing antimony are tested for arsenic by Bettendorf's Test.

18. Barium Carbonate.—Purified barium carbonate, $BaCO_3$, is prepared by dissolving 12 parts of purified, crystallized barium chloride in 30 parts of boiling water, then adding 5 parts of ammonium carbonate, followed by 5 parts of ammonia water; finally washing the precipitate thoroughly and drying.

19. Barium Chloride Test Solution.—Prepared from purified, crystallized barium chloride, $BaCl_2 + 2H_2O$. The aqueous solution of the salt should be perfectly neutral and should not respond to

the Time-Limit Test for Heavy Metals (see No. 121). The aqueous solution, after being precipitated by diluted sulphuric acid in slight excess, yields a filtrate which should not leave any permanent residue when evaporated and heated on platinum-foil (absence of *other fixed bases*). Diluted alcohol, after remaining in contact with it for several hours, should, upon ignition, show a pure yellowish-green flame free from red (absence of *traces of strontium*). To prepare the *test solution*, dissolve 10 Gm. of the salt in sufficient water to measure 100 Cc.

20. Barium Hydroxide Test Solution.—A saturated solution of crystallized barium hydroxide, $Ba(OH)_2 + 8H_2O$, in water. This solution rapidly absorbs carbon dioxide from the air. It should be freshly prepared when required for use.

21. Barium Nitrate Test Solution.—Prepared from pure barium nitrate, $Ba(NO_3)_2$. This salt should respond to the same tests as barium chloride (see No. 19). In addition, its aqueous solution, when slightly acidulated with nitric acid, should not be rendered turbid by silver nitrate T.S. (absence of *chloride*). To prepare the *test solution*, dissolve 10 Gm. of the salt in sufficient water to make 100 Cc.

22. Benzin, or **Petroleum Benzin.**—Use the official purified petroleum benzin [*Benzinum Purificatum*, U. S. P.].

23. Benzene, or **Benzole.**—Benzene, C_6H_6, is a colorless, transparent liquid of a peculiar, aromatic odor, sp. gr. 0.871 at 25° C. (77° F.), congealing at 5.2° C. (41.3° F.), and boiling at 80.4° C. (176.7° F.). It is insoluble in water, but soluble in 4 parts of alcohol, and in ether. When equal volumes of benzene and concentrated sulphuric acid are mixed, the latter should not become colored. On shaking 2 Cc. of benzene with 0.5 Cc. of sulphuric acid and 1 drop of fuming nitric acid, no green or blue tint should be produced (absence of *thiophene*).

24. Brazil-Wood Test Solution.—See under *Indicators* (No. 125).

25. Bromine Test Solution (Bromine Water).—An aqueous solution of bromine, Br [*Bromum*, U. S. P.], prepared by dissolving 1 Cc. of bromine in sufficient water to measure 100 Cc.

26. Calcium Chloride Test Solution.—Dissolve 10 Gm. of crystallized calcium chloride, $CaCl_2 + 6H_2O$, in sufficient water to measure 100 Cc.

27. Calcium Hydroxide Test Solution (Lime Water), $Ca(OH)_2$.—Use the official lime water [*Liquor Calcis*, U. S. P.].

28. Calcium Sulphate Test Solution.—Introduce pulverized transparent crystals of native gypsum (selenite), $CaSO_4 + 2H_2O$, into a bottle nearly filled with water, agitate at intervals for twelve hours, and decant the clear, saturated solution when required. One part of gypsum requires, at 25° C. (77° F.), 378 parts of water for solution.

29. Carbon Disulphide, CS_2.—Use the official carbon disulphide [*Carbonei Disulphidum*, U. S. P.].

30. Chlorine Test Solution (Chlorine Water).—Use the official chlorine water [*Liquor Chlori Compositus*, U. S. P.]. Since it deteriorates by keeping, it should be freshly prepared when required for use.

31. Chloroform, $CHCl_3$.—Use the official chloroform [*Chloroformum*, U. S. P.]. It should be strictly neutral to moistened litmus paper.

32. Cobaltous Nitrate Test Solution.—The crystallized commercial salt, $Co(NO_3)_2 + 6H_2O$, is sufficiently pure, if, after it is dissolved in water, and the cobalt completely precipitated by ammonium sulphide T.S., the filtrate leaves no residue after evaporating and igniting. To prepare the *test solution*, dissolve 1 Gm. of the salt in 10 Cc. of water.

33. Cochineal Test Solution.—See under *Indicators* (No. 126).

34. Copper, Metallic, Cu, in the form of wire, foil, or turnings.

35. Cupric Ammonium Sulphate Test Solution.—A solution of cupri-tetrammonium sulphate, $CuSO_4 + 4NH_3 + H_2O$. To copper sulphate T.S. add ammonia water, until the precipitate first formed is nearly, but not completely, redissolved; then filter. This solution should be freshly made when required.

36. Cupric Sulphate Test Solution.—Dissolve 10 Gm. of cupric sulphate, $CuSO_4 + 5H_2O$ [*Cupri Sulphas*, U. S. P.], in sufficient water to measure 100 Cc.

37. Cupric Tartrate Test Solution.—See Volumetric Solutions (No. 133).

38. Diphenylamine Test Solution.—Prepared from diphenylamine, $(C_6H_5)_2NH$, which is in the form of grayish-white or colorless crystals, of a peculiar, aromatic odor, melting at 54° C. (129.2° F.), slightly soluble in water, more soluble in acids. It is used either in the dry state, or in solution in diluted sulphuric acid, as a test for nitric acid (in sulphuric acid, water, etc.), or for chlorine (in hydrochloric acid). To test a solution for the presence of nitric acid, a small portion of it is mixed with 1 or 2 drops of diphenylamine T.S., and then concentrated sulphuric acid, free from compounds of nitrogen, is poured in so as to form a layer beneath the solution. The presence of nitric acid is shown by a deep blue color at the zone of contact. A similar reaction is also produced by the presence of hypochlorites, chlorates, chromium trioxide, ferric salts, and similar oxidizing agents. The *test solution* is prepared by dissolving 0.1 Gm. of diphenylamine in 50 Cc. of sulphuric acid. The solution should be colorless.

39. Ether, $(C_2H_5)_2O$.—Use the official ether [*Æther*, U. S. P.]. It should be strictly neutral to moistened litmus paper.

40. Ferric Ammonium Sulphate Test Solution.—Dissolve 10 Gm. of ferric ammonium sulphate, $FeNH_4(SO_4)_2 + 12H_2O$ [*Ferri et Ammonii Sulphas*, U. S. P.], in sufficient water to measure 100 Cc.

41. Ferric Chloride Test Solution.—Dissolve 10 Gm. of ferric chloride [*Ferri Chloridum*, U. S. P.] in sufficient water to measure 100 Cc.

42. Ferrous Sulphate Test Solution.—Dissolve a clear crystal of ferrous sulphate, $FeSO_4 + 7H_2O$ [*Ferri Sulphas*, U. S. P.], in about 10 parts of water which has been previously boiled to expel air. This solution should be freshly prepared immediately before use.

43. Ferrous Sulphide, FeS.—A heavy solid, in the form of black or brownish-black irregular masses, or fused into sticks, soluble in diluted sulphuric or diluted hydrochloric acid, with copious evolution of hydrogen sulphide.

44. Gelatin Test Solution.—Dissolve 1 Gm. of purified gelatin [*Gelatinum*, U. S. P.] in 50 Cc. of water, with the aid of a gentle heat, and filter if necessary. This solution should be freshly made when wanted for use.

45. Gold Chloride Test Solution.—The commercial gold chloride, usually prepared by dissolving gold in nitro-hydrochloric acid and carefully evaporating to dryness, consists chiefly of chlorauric acid, $HAuCl_4 + 4H_2O$, which is converted into neutral auric chloride, $AuCl_3$, by fusing it at a temperature not exceeding 150° C. (302° F.), moistening the residue (now consisting of auric and aurous chloride) with enough hot water to produce a syrupy liquid (whereby the aurous chloride is decomposed into auric chloride and metallic gold), and then pouring off the clear liquid from the precipitate. To prepare the *test solution*, mix the liquid finally obtained in the before-mentioned process with 20 volumes of water. Or, dissolve 1 Gm. of dry auric chloride in 30 Cc. of water.

46. Hydrochloric Acid, Pure, for Tests, HCl.—In addition to the tests prescribed for this acid [*Acidum Hydrochloricum*, U. S. P.], it is required to conform to the following more rigorous tests, before it can be employed as a reagent: The addition of 1 Cc. of barium chloride T.S. to 1 Cc. of the acid diluted with 9 Cc. of water should cause no turbidity within twenty-four hours (absence of *sulphuric acid*). A crystal of diphenylamine dropped into the acid should not turn blue (absence of *free chlorine*).

47. Hydrogen Sulphide, H_2S.—A gas generated by treating ferrous sulphide with diluted sulphuric acid, and washing the gas as directed under the Test Solution (No. 48).

48. Hydrogen Sulphide Test Solution (Hydrosulphuric Acid).—A saturated, aqueous solution of hydrogen sulphide. To prepare about 1000 Cc. of the solution, treat 20 Gm. of ferrous sulphide, in a suitable apparatus, with a mixture of 20 Cc. of sulphuric acid (U. S. P.), and 250 Cc. of water, pass the gas through a drying-tube filled with granulated calcium chloride, then from this through a tube of about 8 millimeters diameter and 40 centimeters in length, which contains about 5 Gm. of coarsely pulverized iodine mixed with spun glass (glass wool), and finally through a wash-bottle which contains a small quantity of potassium iodide T.S. The gas thus purified is conducted nearly to the bottom of a bottle of the capacity of about 1500 Cc., containing 1000 Cc. of cold water. The bottle should be shaken occasionally to facilitate the solution of the gas. When it is no longer absorbed, transfer the solution to small, dark amber-colored bottles, to be filled nearly to the top; pass a stream of hydrogen sulphide for a few minutes through each, and then at once stopper them tightly, and preserve them afterwards in a cool and dark place. Before any of the solution is used, it should be ascertained that it retains a strong odor of hydrogen sulphide, and that, when it is added to an equal volume of ferric chloride T.S., a copious precipitate of sulphur is formed at once.

49. Indicators.—See special list, page 1714.

50. Indigo Test Solution.—Dissolve 1 Gm. of commercial indigo-carmine, which is the sodium or potassium salt of indigo-disulphonic acid, $H_2C_{16}H_8N_2O_2(SO_3)_2$, in 150 Cc. of water.

51. Iodine Absorption Value of Fats and Oils.—The iodine value or number of a fat or an oil is a figure which indicates the percentage of iodine absorbed under certain conditions. It is determined as follows: To a solution of 0.3 Gm.[1] of the fat or oil in 10 Cc. of chloroform contained in a glass-stoppered bottle of 250 Cc. capacity, add 25 Cc. of a mixture of equal volumes of alcoholic iodine T.S., and alcoholic mercuric chloride T.S., both of which have been measured from a burette. After having been securely stoppered, the bottle is set aside in a cool place, protected from the light, for a period of four[2] hours. After this time, the mixture must still possess a brown color; if it does not, a further measured portion of the mixture of the two reagents should be added, and the mixture be again set aside. Finally, 20 Cc. of potassium iodide T.S. are added, followed by 50 Cc. of water, and tenth-normal sodium thiosulphate V.S. is then added in small successive portions, shaking thoroughly after each addition until the color of the mixture is discharged. The number of Cc. of the sodium thiosulphate V.S. consumed is noted. At the same time that this test is carried out, a blank experiment is made in which exactly the same quantities of chloroform, iodine T.S., and mercuric chloride T.S. are mixed, and after standing for four or more hours, the free iodine is estimated by titration with tenth-normal sodium thiosulphate V.S. as directed above. The number of Cc. of the thiosulphate V.S. consumed is noted, and from this is deducted the number of Cc. of the thiosulphate V.S. which was consumed in the test; the difference multiplied by 12.59, and this product divided by 3,[3] gives the iodine value of the fat or oil.

52. Iodine Test Solution.—For preparing the ordinary test solution (as a reagent for starch, alcohol by iodoform test, etc.), iodine, I, fulfilling the requirements of the Pharmacopœia [*Iodum*, U. S. P.], is sufficiently pure. Dissolve 1 Gm. of iodine and 3 Gm. of potassium iodide in 50 Cc. of water.

For use in volumetric analysis, or in other cases where the ordinary impurities present in official iodine are objectionable, *Purified Iodine* must be employed (see No. 137).

53. Iodine Test Solution, Alcoholic.—Dissolve 25 Gm. of iodine [*Iodum*, U. S. P.] in 500 Cc. of alcohol. This solution is employed in the determination of the iodine absorption value of fats and oils (No. 51).

54. Iron, Metallic, Fe.—Bright and perfectly clean iron in the form of wire, sheet, filings, or electrolytically reduced to powder, according to the uses to be made of it. For making solutions of pure iron salts, fine, thin, bright wire (so-called florist's or piano wire) should be used. For detecting copper, bright pieces of sheet iron or steel knitting-needles are used.

[1] 0.15 to 0.2 Gm. for linseed oil and 0.8 Gm. for oil of theobroma and similar fats.

[2] Sixteen hours are required for accuracy in the case of linseed oil.

[3] When the quantity of the fat or oil used is not 0.3 Gm., then the product is not divided by 3, but by the figure corresponding to the quantity taken; thus, for linseed oil, 0.15 Gm. would be divided by 1.5.

55. Lead Acetate Test Solution.—Dissolve 10 Gm. of clear, transparent crystals of lead acetate, $Pb(C_2H_3O_2)_2 + 3H_2O$ [*Plumbi Acetas*, U. S. P.], free from adhering lead carbonate, in sufficient water to measure 100 Cc. Preserve the solution in well-stoppered bottles.

56. Lead Acetate Test Solution, Basic.—Use the official solution of lead subacetate [*Liquor Plumbi Subacetatis*, U. S. P.].

57. Litmus Paper and **Test Solution.**—See under *Indicators* (No. 129).

58. Magnesia Mixture.—Dissolve 10 Gm. of magnesium sulphate, $MgSO_4 + 7H_2O$ [*Magnesii Sulphas*, U. S. P.], and 20 Gm. of ammonium chloride, NH_4Cl [*Ammonii Chloridum*, U. S. P.], in 80 Cc. of water, add 42 Cc. of ammonia water [*Aqua Ammoniæ*, U. S. P.], set the mixture aside for a few days in a well-stoppered vessel, and filter. If not perfectly clear, the solution should always be filtered before using.

59. Magnesium Sulphate Test Solution.—Dissolve 10 Gm. of magnesium sulphate, $MgSO_4 + 7H_2O$ [*Magnesii Sulphas*, U. S. P.], in sufficient water to measure 100 Cc.

60. Mercuric Chloride Test Solution.—Dissolve 5 Gm. of mercuric chloride, $HgCl_2$ [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in sufficient water to measure 100 Cc.

61. Mercuric Chloride Test Solution, Alcoholic.—Dissolve 30 Gm. of mercuric chloride, $HgCl_2$ [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in 500 Cc. of alcohol. This solution is employed in the determination of the iodine absorption value of fats and oils (No. 51).

62. Mercuric Nitrate Test Solution, $Hg(NO_3)_2 + 4H_2O$.—Use the official solution of mercuric nitrate [*Liquor Hydrargyri Nitratis*, U. S. P.].

63. Mercuric Potassium Iodide Test Solution (*Mayer's Reagent*).—Dissolve 1.344 Gm. of mercuric chloride, $HgCl_2$ [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in 60 Cc. of water, and 5 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in 10 Cc. of water. Mix the two solutions, and then add sufficient water to make the mixture measure 100 Cc.

64. Mercuric Potassium Iodide Test Solution, Alkaline (*Nessler's Reagent*).—Dissolve 10 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in 10 Cc. of water, and add gradually, in portions, a saturated aqueous solution of mercuric chloride [*Hydrargyri Chloridum Corrosivum*, U. S. P.], with constant agitation, until a slight red precipitate remains undissolved; to this mixture add 30 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.] and, when solution has taken place, 1 Cc. more of the saturated aqueous solution of mercuric chloride. Dilute this solution with water until it measures 200 Cc. Allow the precipitate to subside, and draw off the clear fluid.

Note.—2 Cc. of this reagent, when added to 50 Cc. of water containing 0.05 milligramme of ammonia, should produce at once a yellowish-brown coloration.

65. Mercurous Nitrate Test Solution.—Into a porcelain evaporating dish introduce 10 Gm. of pure mercury with 5 Cc. of pure nitric acid and 5 Cc. of distilled water, and set it aside for 24 hours in a cool, dark room. Separate and drain the crystals ($2HgNO_3 + H_2O$), and dissolve them in 100 Cc. of water. Preserve the solution in a dark, amber-colored bottle, into which a small quantity of mercury has been introduced.

66. Metals, Time-Limit Test for Heavy.—See No. 121.

67. Modified Gutzeit's Test.—See No. 17.

68. Methyl Alcohol, CH_3OH.—Rectified, purified wood-alcohol, having a specific gravity of about 0.812 at 25° C. (77° F.), and free from pyroligneous odor. Used for the identification of salicylic acid.

69. Methyl-Orange Test Solution.—See under *Indicators* (No. 130).

70. Naphthylamine Acetate Test Solution.—Boil 0.1 Gm. of alpha-naphthylamine acetate ($C_{10}H_7NH_2.HC_2H_3O_2$) in 20 Cc. of distilled water, filter through cotton, and mix the filtrate with 180 Cc. of diluted acetic acid (10 per cent. absolute acid). Only freshly distilled water should be employed in preparing this reagent, which must be kept in well-stoppered bottles, protected from the light.

71. Nitric Acid, HNO_3.—Use the official nitric acid [*Acidum Nitricum*, U. S. P.].

72. Nitric Acid, Fuming.—Use the commercial red fuming acid, if it is of the specific gravity 1.437 at 25° C. (77° F.). It should be carefully kept in glass-stoppered bottles, in a cool place.

73. Oxalic Acid, Pure, $H_2C_2O_4 + 2H_2O$.—*Pure Oxalic Acid* is in the form of colorless, transparent, clino-rhombic crystals; 10 Gm. on ignition upon platinum foil should leave no residue. One part of the acid is completely soluble in 12 parts of water at 25° C. (77° F.). For the preparation of test and volumetric solutions, commercial oxalic acid should be purified as follows:

To 1 part of the Acid add 10 parts of cold water, and shake until the latter is saturated. Filter off the solution from the undissolved crystals, evaporate the filtrate to about three-fourths of its volume, and set it aside so that the fixed salts which it contains may crystallize out. Carefully decant the liquid from the crystals, concentrate it by evaporation, and set it aside to crystallize, stirring occasionally to prevent the formation of large crystals which might enclose moisture. Drain the crystals in a funnel, dry them carefully on blotting paper, and preserve them in well-stoppered bottles.

74. Oxalic Acid Test Solution.—Dissolve 10 Gm. of pure oxalic acid, $H_2C_2O_4 + 2H_2O$, in sufficient distilled water to measure 100 Cc.

75. Palladous Chloride Test Solution.—Dissolve 0.5 Gm. of palladous chloride, $PdCl_2$, in sufficient water to measure 10 Cc. Preserve in a glass-stoppered bottle.

76. Phenolphthalein Test Solution.—See under *Indicators* (No. 131).

77. Picric Acid Test Solution.—Dissolve 1 Gm. of pure, distinctly crystalline picric acid (trinitrophenol), $C_6H_2(NO_2)_3OH$, in 100 Cc. of water, cool the solution and filter, if necessary.

78. Platinic Chloride Test Solution.—Dissolve 2.6 Gm. of chloroplatinic acid, $H_2PtCl_6 + 6H_2O$, in 20 Cc. of water. On evaporating a small portion of the solution to dryness and igniting the residue, pure metallic platinum should remain, which should yield nothing soluble in nitric acid.

79. Potassio-Mercuric Iodide Test Solution.—See No. 63.

80. Potassium Bitartrate, $KHC_4H_4O_6$.—The purification of potassium bitartrate [*Potassii Bitartras*, U. S. P.], to render it suitable for standardizing volumetric solutions of potassium and sodium hydroxide, is carried out as follows: To 100 Gm. of the salt contained in a beaker, is added a mixture of 85 Cc. of water and 25 Cc. of diluted hydrochloric acid; the covered beaker is then placed upon a bath of boiling water and the mixture digested, with occasional stirring, for three hours. After quickly cooling, the solution is drained off from the precipitate, which is washed by affusion and decantation with two successive portions of 100 Cc. each of water; after collecting the precipitate upon a plain filter, the washing with cold water is continued until the filtrate, after adding a few drops of nitric acid, ceases to become opalescent upon the addition of silver nitrate T.S. The precipitate of potassium bitartrate is then dissolved in the smallest possible volume of boiling water (about 1500 Cc.), filtered, and the filtrate, while being rapidly cooled, is constantly stirred. When the mixture is cold, the crystalline precipitate is collected upon a plain filter, washed with 300 Cc. of cold water, and, after thoroughly draining, dried at 120° C. (248° F.) until of constant weight. It should be kept in dry, securely stoppered bottles.

Purified potassium bitartrate is employed for standardizing normal and tenth-normal potassium or sodium hydroxide V.S.

81. Potassium Bromate, $KBrO_3$.—White cubical crystals or granular crystalline powder, having a pungent, saline taste. Soluble in 15.5 parts of water at 25° C. (77° F.), and in 2 parts of boiling water; slightly soluble in alcohol. The aqueous solution has a neutral reaction, and upon the addition of diluted sulphuric acid no yellow color should at once be produced. When heated to 350° C. (662° F.), the salt undergoes decomposition with the evolution of oxygen. Potassium Bromate should not be triturated or heated with organic or easily oxidizable substances. The addition of nitric acid or sulphuric acid to the salt causes decomposition with the evolution of bromine. If 0.1 Gm. of Potassium Bromate, dried at 100° C. (212° F.), and 2 Gm. of potassium iodide be dissolved in about 25 Cc. of water contained in a glass-stoppered bottle (of about 100 Cc. capacity), and, after the addition of 5 Cc. of hydrochloric acid, the bottle be securely stoppered and set aside for ten minutes, not less than 36.1 Cc. of tenth-normal sodium thiosulphate V.S. should be required to discharge the color, corresponding to 99.8 per cent. of pure Potassium Bromate.

82. Potassium Carbonate Test Solution.—Dissolve 10 Gm. of anhydrous potassium carbonate, K_2CO_3, prepared by heating potassium carbonate [*Potassii Carbonas*, U. S. P.] to 130° C. (266° F.), in sufficient water to measure 100 Cc.

83. Potassium Chromate Test Solution.—Dissolve 10 Gm. of yellow potassium chromate, K_2CrO_4, in sufficient water to measure 100 Cc. On adding silver nitrate T.S. to a few drops of the solution diluted with a little distilled water, a red precipitate is produced which should be completely soluble in nitric acid (absence of *chloride*). Another portion of the solution, mixed with an equal volume of diluted hydrochloric acid, should yield no precipitate with barium chloride T.S. (absence of *sulphate*). Another portion of the solution should not become turbid upon the addition of ammonia water or ammonium oxalate T.S. (absence of *alkaline earths*). A solution of 0.1 Gm. of the salt in 20 Cc. of water should not become red upon the addition of a few drops of phenolphthalein T.S. (limit of *free alkalies*).

84. Potassium Cyanide Test Solution.—Dissolve 1 Gm. of potassium cyanide, KCN [*Potassii Cyanidum*, U. S. P.], in sufficient water to measure 10 Cc. This solution should be freshly prepared when required.

85. Potassium Dichromate, Pure, $K_2Cr_2O_7$.—In addition to the tests prescribed for this salt in the text of the Pharmacopœia, it is required to conform to more rigorous tests before it can be used in the preparation of the tenth-normal volumetric solution. In a solution of 0.5 Gm. of the salt in 10 Cc. of water rendered acid by 0.5 Cc. of nitric acid, no turbidity should be produced by barium chloride T.S. (absence of *sulphates*).

To 10 Cc. of the aqueous solution of the salt (1 in 20), the addition of 1 Cc. of ammonia water, followed by 1 Cc. of ammonium oxalate T.S., should produce no turbidity (absence of *calcium*).

If to a solution of 0.5 Gm. of the salt in 20 Cc. of water, sufficient sulphurous acid be added to impart a strong odor of the reagent, and the mixture be boiled for about three minutes and cooled, the addition of 1 Cc. of nitric acid and a few drops of silver nitrate V.S. should produce no turbidity (absence of *chlorides*).

Potassium dichromate which fails to meet all of the above requirements may be purified by recrystallization, the hot, saturated aqueous solution of the salt being rapidly cooled with agitation. The granular crystals, after being collected on a plain filter and washed with sufficient *cold* water to remove the mother liquor, are thoroughly drained and then dried at 120° C. (248° F.). This recrystallization should be repeated until the salt responds to all of the above tests for purity.

86. Potassium Dichromate Test Solution.—Dissolve 10 Gm. of pure potassium dichromate (No. 85) in sufficient water to measure 100 Cc.

87. Potassium Ferricyanide Test Solution.—Dissolve 1 part of potassium ferricyanide, $K_3Fe(CN)_6$, in about 10 parts of water. This solution should be freshly made when required, as it undergoes decomposition with formation of ferrocyanide on standing. A freshly prepared aqueous solution, when mixed with some ferric chloride T.S. which has been well diluted with water, should show a brown tint, free from turbidity or a shade of green. Potassium Ferricyanide should respond to the tests for the absence of sulphates and chlorides as described under Potassium Ferrocyanide (No. 88).

88. Potassium Ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$.—In the form of large, soft, transparent, yellow, four-sided, monoclinic tabular crystals, odorless, and having a mild, saline taste. Slightly efflorescent on exposure to dry air.

Soluble in three parts of water at 25° C. (77° F.), and in 2 parts of boiling water; insoluble in alcohol. The aqueous solution is neutral to litmus paper. No effervescence should be caused by the addition of diluted sulphuric acid to a concentrated solution of the salt (absence of *carbonate*).

The aqueous solution (1 in 20), acidulated with hydrochloric acid, should, upon the addition of barium chloride T.S., remain clear (absence of *sulphate*). If a mixture of 0.5 Gm. of the salt with 1.5 Gm. of pure potassium nitrate and 0.5 Gm. of pure anhydrous sodium carbonate be heated to redness in a porcelain crucible, the residue dissolved in water, and the filtered solution supersaturated with nitric acid, no turbidity should be produced upon the addition of silver nitrate T.S. (absence of *chloride*). The precipitate produced in the aqueous solution, acidulated with nitric acid, by silver nitrate T.S. should be of a pure white color, without a tinge of red (absence of *ferricyanide*).

89. Potassium Ferrocyanide Test Solution.—Dissolve 10 Gm. of potassium ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$, in sufficient water to measure 100 Cc.

90. Potassium Hydroxide Test Solution.—Use the official solution of potassium hydroxide, KOH [*Liquor Potassii Hydroxidi*, U. S. P.].

91. Potassium Hydroxide Test Solution, Alcoholic.—Use the half-normal alcoholic potassium hydroxide V.S. (Nos. 99 and 144).

92. Potassium Iodide Test Solution.—Dissolve 20 Gm. of potassium iodide, KI [*Potassii Iodidum*, U. S. P.], in sufficient water to measure 100 Cc., and keep the solution in dark amber-colored, well-stoppered bottles. The solution should be frequently renewed.

93. Potassium Nitrate, KNO_3.—The dry salt [*Potassii Nitras*, U. S. P.], responding to the tests of purity required by the Pharmacopœia. It should also be free from chlorides and sulphates.

94. Potassium Permanganate Test Solution, $KMnO_4$.—Use No. 145.

95. Potassium Sulphate Test Solution.—Dissolve 1 Gm. of potassium sulphate, K_2SO_4, in sufficient water to measure 100 Cc.

96. Potassium Sulphocyanate, KSCN.—Colorless, prismatic crystals, of cooling, saline taste, and hygroscopic in moist air. Readily soluble in less than its own weight of water; soluble in 10 parts of absolute alcohol.

The aqueous solution of the salt (1 in 20) should not become turbid within five minutes upon the addition of barium chloride T.S. (limit of *sulphate*).

The aqueous solution (1 in 20), after the addition of 1 Cc. of diluted hydrochloric acid, should remain colorless (absence of *iron*), and should not respond to the Time-Limit Test for Heavy Metals (No. 121).

97. Potassium Sulphocyanate Test Solution.—Use the tenth-normal volumetric solution (No. 146).

98. Resins, etc., Acid Number for.—Dissolve 1 Gm. of the resinous substance in alcohol, add a few drops of phenolphthalein T.S., and titrate with normal potassium hydroxide V.S.; the amount of potassium hydroxide consumed (expressed in milligrammes) is termed the Acid Number. The reaction is often more distinct if an excess of normal potassium hydroxide V.S. be used and the solution titrated back with normal acid V.S.

99. Saponification Value of Fats and Oils.—The determination of the saponification value is conducted as follows: Weigh out accurately, in a flask holding 150 to 200 Cc., 1.5 to 2 Gm. of the purified and filtered fat. Next run into the flask, with a burette, 25 Cc. of alcoholic potassium hydroxide T.S. (see No. 144). While exactly 25 Cc. is not indispensable, in comparative tests precisely the same amount must be used, allowing the burette to drain in exactly the same way in each test. Then place a small funnel in the flask and heat it on a water-bath containing boiling water, for half an hour, so that the alcohol is simmering, frequently imparting a rotatory motion to the contents of the flask. Then add 1 Cc. of phenolphthalein T.S., and titrate back the excess of potassium hydroxide with half-normal hydrochloric acid V.S. A blank test is made at the same time, using the alcoholic potassium hydroxide T.S. alone; the difference in the number of cubic centimeters of half-normal hydrochloric acid V.S. consumed by the blank test and the real test, multiplied by 27.87, and divided by the weight in grammes of the fat or oil, will give the saponification equivalent of the sample tested.

100. Silver Ammonium Nitrate Test Solution.—Dissolve 1 Gm. of silver nitrate, $AgNO_3$ [*Argenti Nitras*, U. S. P.], in 20 Cc. of water, and add ammonia water, drop by drop, until the precipitate first produced is almost, but not entirely, redissolved. Filter the solution, and preserve it in dark amber-colored and well-stoppered bottles.

101. Silver Nitrate Test Solution, $AgNO_3$.—For ordinary purposes, use the tenth-normal volumetric solution (see No. 147).

102. Silver Sulphate Test Solution.—Dissolve 1 Gm. of silver nitrate [*Argenti Nitras*, U. S. P.] in 0.5 Cc. of warm water, and add 1.5 Cc. of pure, concentrated sulphuric acid. On cooling, small transparent crystals of silver sulphate, Ag_2SO_4, separate. Carefully pour off the acid liquid, wash the crystals repeatedly, by decantation, with cold water, transfer them to a bottle, add 100 Cc. of water, and agitate so as to produce a saturated solution. For use, decant a sufficient quantity of the latter.

103. Sodium Acetate Test Solution.—Dissolve 10 Gm. of sodium acetate, $NaC_2H_3O_2 + 3H_2O$ [*Sodii Acetas*, U. S. P.], in sufficient water to measure 100 Cc.

104. Sodium Bitartrate Test Solution, $NaHC_4H_4O_6 + H_2O$.—To a solution of 3.5 Gm. of tartaric acid [*Acidum Tartaricum*, U. S. P.] in about 80 Cc. of boiling water, add gradually, in small portions, monohydrated sodium carbonate [*Sodii Carbonas Monohydratus*, U. S. P.] until the solution has a neutral reaction; to this liquid is now added 3.5 Gm. of tartaric acid, and after filtering and cooling, sufficient water is added to the solution to measure 100 Cc. This solution should be freshly prepared when required.

105. Sodium Carbonate.—The monohydrated salt, $Na_2CO_3 + H_2O$, conforming to the tests prescribed by the Pharmacopœia [*Sodii Carbonas Monohydratus*], but absolutely free from chloride and sulphate.

106. Sodium Carbonate Test Solution.—Dissolve 10 Gm. of monohydrated sodium carbonate, $Na_2CO_3 + H_2O$ [*Sodii Carbonas Monohydratus*, U. S. P.], in sufficient water to measure 100 Cc.

107. Sodium Cobaltic Nitrite Test Solution, $Co_2(NO_2)_6.6NaNO_2 + H_2O$.—Dissolve 4 Gm. of cobaltous nitrate, $Co(NO_3)_2 + 6H_2O$, and 10 Gm. of sodium nitrite, $NaNO_2$, in about 50 Cc. of water, add 2 Cc. of acetic acid [*Acidum Aceticum*, U. S. P.], and dilute with sufficient water to measure 100 Cc. A few drops of acetic acid should be added to the solution from time to time. The reagent should not be kept longer than three months.

108. Sodium Hydroxide Test Solution, NaOH.—Use the official solution of sodium hydroxide [*Liquor Sodii Hydroxidi*, U. S. P.].

109. Sodium Nitrite, $NaNO_2$.—The purest commercial salt, either granulated or in the form of sticks, is sufficiently pure.

110. Sodium Nitroprusside Test Solution.—Dissolve 1 part of sodium nitroprusside, $Na_2Fe(NO)(CN)_5 + 2H_2O$, in 19 parts of water immediately before using.

111. Sodium Phosphate Test Solution.—Dissolve 10 Gm. of sodium phosphate, $Na_2HPO_4 + 12H_2O$ [*Sodii Phosphas*, U. S. P.], in sufficient water to measure 100 Cc.

112. Sodium Tartrate Test Solution, $Na_2C_4H_4O_6 + 2H_2O$.—To a solution of 6.5 Gm. of tartaric acid [*Acidum Tartaricum*, U. S. P.] in about 80 Cc. of boiling water, add gradually, in small portions, monohydrated sodium carbonate [*Sodii Carbonas Monohydratus*, U. S. P.] until the solution has a neutral reaction; after filtering and cooling, add sufficient water to measure 100 Cc. This solution should be freshly prepared when required.

113. Sodium Thiosulphate, $Na_2S_2O_3 + 5H_2O$.—In addition to the tests prescribed for this salt in the text of the Pharmacopœia [*Sodii Thiosulphas*], it is required to conform to the following more rigorous tests before it can be used in preparing the standard volumetric solution. If to a solution of the salt (1 in 20) in distilled water, iodine T.S. be added, drop by drop, until it retains a faint but permanent brown color, no turbidity should be produced upon the addition of barium chloride T.S. (absence of *sulphates* and *sulphites*). The addition of 1 drop of phenolphthalein T.S. to the aqueous solution of the salt (1 in 10) should produce not more than a very faint rose-tint (absence of *free alkalies*). The aqueous solution of the salt (1 in 20) should not become cloudy upon the addition of ammonium oxalate T.S. (absence of *calcium salts*).

114. Sodium Thiosulphate Test Solution.—Use the tenth-normal volumetric solution (No. 151).

115. Stannous Chloride Test Solution.—Heat pure tin (see No. 122), in the form of foil or granules, with concentrated hydrochloric acid, taking care that the metal be in excess. When the acid is saturated, crystals of stannous chloride, $SnCl_2 + 2H_2O$, begin to form. Remove and drain these, dissolve them in 10 parts of water, and preserve the solution in well-stoppered bottles, into each of which a fragment of pure tin, or a piece of pure tin-foil, has previously been introduced.

For Bettendorf's test (see No. 16), pure concentrated hydrochloric acid (which responds to the U. S. P. tests of purity) is saturated with the *freshly prepared* crystals.

116. Starch Test Solution.—Triturate 1 Gm. of starch [*Amylum*, U. S. P.] with 10 Cc. of cold water, and then add sufficient boiling water, with constant stirring, to make about 200 Cc. of a thin, translucent fluid. This solution should be freshly prepared and filtered when required for use.

117. Sulphanilic Acid Test Solution.—Dissolve 0.5 Gm. of sulphanilic acid, $C_6H_4(NH_2).(SO_3H)$ (para-amidobenzenesulphonic acid), in 150 Cc. of diluted acetic acid (10 percent absolute acetic acid). Only freshly distilled water should be employed in preparing the diluted acetic acid.

This reagent should be kept in well-stoppered bottles.

118. Sulphuric Acid, Pure, for Tests, H_2SO_4.—The sulphuric acid of the Pharmacopœia, which has a specific gravity of 1.826 at 25° C. (77° F.), will answer as a reagent for most purposes, provided it is of the required degree of purity. But when "concentrated" sulphuric acid is specially directed in a test, it is intended that the strongest obtainable pure acid, of a specific gravity of not less than 1.834 at 25° C. (77° F.), be employed.

In addition to the tests prescribed for this acid in the text of the Pharmacopœia, it is required to conform to the following more rigorous tests before it can be employed as a reagent. If 1 Cc. of diphenylamine T.S. (see No. 38) be carefully poured, as a separate layer, upon 5 Cc. of sulphuric acid, contained in a test-tube, no distinct blue color should appear in the zone of contact (absence of *nitric acid*).

119. Tannic Acid Test Solution.—Dissolve 1 Gm. of tannic acid, $HC_{14}H_9O_9$ [*Acidum Tannicum*, U. S. P.], in 1 Cc. of alcohol, and add sufficient water to measure 10 Cc.

120. Tartaric Acid Test Solution.—Dissolve 1 part of tartaric acid, $H_2C_4H_4O_6$ [*Acidum Tartaricum*, U. S. P.], in 3 parts of water. Since fungous growths rapidly destroy the solution of tartaric acid, it should be prepared only as wanted.

121. Time-Limit Test for Heavy Metals.—This test is to be used to detect the presence of undesirable metallic impurities in official chemical substances or their solutions; these should not respond affirmatively within the stated time.

Ten Cc. of a solution of the substance in distilled water (1 in 20), contained in a test-tube of about 40 Cc. capacity, is acidulated with 1 Cc. of diluted hydrochloric acid (unless otherwise directed), warmed to about 50° C. (122° F.), and an equal volume of freshly prepared hydrogen sulphide T.S. added, and the mixture allowed to stand, in the well-stoppered test-tube, in a warm place, at 35° C. (95° F.) for at least half an hour. At the end of this time any coloration or turbidity is carefully noted, ammonia water is added in excess, and the solution again examined for a coloration or turbidity.

Before the addition of the ammonia water, the mixture should still possess the odor of hydrogen sulphide; if not, it should be thoroughly saturated with the gas and again set aside for half an hour.

Any change in the color of the solution which is being tested should be noted by comparison with the same volume of the hydrogen sulphide T.S. (which has been likewise acidulated), when viewed by reflected light while held against a white surface.

Antimony yields, upon the addition of hydrogen sulphide T.S. to highly diluted solutions, a pale yellow to orange color, or, to more concentrated solutions, an orange precipitate, which is soluble in test

solutions of potassium hydroxide and ammonium sulphide, as well as in strong hydrochloric acid. The precipitate is insoluble in test solution of ammonium carbonate. The addition of ammonia water to the highly diluted hydrogen sulphide solution of antimony slightly intensifies the coloration.

Arsenic yields, upon the addition of hydrogen sulphide T.S. to highly diluted solutions, a pale yellow color, or, to more concentrated solutions, a yellow precipitate, which is soluble in test solutions of potassium hydroxide, ammonium sulphide, and ammonium carbonate, but is reprecipitated upon the addition of hydrochloric acid, insoluble in excess. The addition of ammonia water to the highly diluted hydrogen sulphide solution of arsenic slightly intensifies the yellow color.

Cadmium in very dilute solutions gives, with hydrogen sulphide T.S. or ammonium sulphide T.S., a pale yellow color; it yields in more concentrated solutions (not excessively acid) a yellow precipitate, which is insoluble in cold diluted hydrochloric acid, potassium hydroxide T.S., or ammonium sulphide T.S. (distinction from *arsenic*), and in solution of potassium cyanide. This precipitate is soluble in nitric and hydrochloric acids and in hot diluted hydrochloric and sulphuric acids.

Copper yields, upon the addition of hydrogen sulphide T.S. to highly diluted solutions, a pale brown color, or, to more concentrated solutions, a brownish-black precipitate, which is insoluble in diluted hydrochloric acid and test solution of potassium hydroxide, and is but very slightly soluble in test solution of ammonium sulphide. The precipitate is soluble in warm diluted nitric acid and also in solution of potassium or sodium cyanide. The addition of ammonia water to the highly diluted hydrogen sulphide solution containing copper slightly intensifies the coloration.

Iron.—Acidified solutions of ferrous iron do not react with hydrogen sulphide T.S., but yield a dark coloration or black precipitate with ammonium sulphide T.S., or upon the addition of ammonia water to the hydrogen sulphide mixture. This latter precipitate is soluble in cold diluted hydrochloric acid.

Acidified solutions of ferric iron yield a white turbidity or precipitate of sulphur upon the addition of hydrogen sulphide T.S., but a dark coloration or black precipitate with ammonium sulphide T.S., or upon the addition of ammonia water to the hydrogen sulphide mixture. This precipitate is readily soluble in acetic and inorganic acids.

Lead yields, upon the addition of hydrogen sulphide T.S. or ammonium sulphide T.S. to highly diluted solutions, a pale brown coloration, or, to more concentrated solutions, a black precipitate, which is insoluble in diluted hydrochloric acid, and also in test solutions of potassium hydroxide and ammonium sulphide.

Zinc yields, with ammonium sulphide T.S., and with hydrogen sulphide T.S., either in neutral solution, or after acidulation with acetic acid (in the absence of free mineral acids), a white turbidity in highly diluted solutions, but with concentrated solutions a white precipitate soluble in hydrochloric acid and insoluble in acetic acid.

122. Tin.—Pure metallic tin, Sn, in the granulated or mossy condition. Its solution in hydrochloric acid should give no precipitate with potassium sulphate T.S. (absence of *lead*), and, when tested by the Modified Gutzeit's Test (No. 17), replacing the zinc by tin, the diluted hydrochloric acid by hydrochloric acid U. S. P., and adding 1 drop of platinic chloride T.S., the mercuric chloride cap should not become colored within the time required for the solution of the metal (absence of *arsenic*).

123. Turmeric Paper and Tincture.—See under *Indicators* (No. 132).

124. Zinc.—Pure metallic zinc, Zn [*Zincum*, U. S. P.]. See also Modified Gutzeit's Test (No. 17).

INDICATORS FOR ACIDIMETRY, ALKALIMETRY, etc.

NOTE.—Each test solution used as *indicator* should be examined as soon as prepared, and afterwards from time to time, as to its neutrality. If necessary, it should be brought, by the cautious addition of highly diluted sulphuric acid, or of a very dilute solution of an alkali, to such a point that, when a few drops of it are added to 25 Cc. of water, a few drops of a hundredth-normal acid or alkali V.S., respectively, will distinctly develop the appropriate tints.

Since many of the colored test solutions are injured by exposure to light, it is best to preserve them in dark amber-colored vials. Papers prepared with them should be kept in dark bottles or paper boxes.

125. Brazil-Wood Test Solution.—Boil 50 Gm. of finely cut Brazil-wood [the heart-wood of *Peltophorum dubium* (Sprengel), Britton, Fam. *Leguminosæ*] with 100 Cc. of water during half an hour, replacing the water from time to time. Allow the mixture to cool, strain, wash the contents of the strainer with water until 100 Cc. of strained liquid are obtained, add 25 Cc. of alcohol, and filter. Care should be taken to exclude ammoniacal vapors while filtering. This solution is turned purplish-red by alkalies, and yellow by acids.

126. Cochineal Test Solution.—Macerate 1 Gm. of unbroken cochineal [*Coccus*, U. S. P.], during four days, with 20 Cc. of alcohol and 60 Cc. of water. Then filter. The color of this test solution is turned *violet* by alkalies, and *yellowish-red* by acids. Cochineal T.S. is useful in titrating alkaloids, inorganic acids, ammonia, the alkalies, and alkaline earths. The presence of salts of iron, alumina, or copper should be avoided. This indicator is useless for titrating organic acids.

127. Hematoxylin Test Solution.—Dissolve 0.2 Gm. of hematoxylin [a crystalline substance derived from *Hæmatoxylon*, U. S. P.] in 100 Cc. of alcohol. Use about 5 drops for each titration. This indicator assumes a *yellow* to *orange* color in acid solutions, and a *violet* to *purple* color in alkaline solutions. The titration is complete when the change in color remains permanent upon the addition of one drop of the volumetric solution after stirring the liquid.

128. Iodeosin Test Solution.—Dissolve 0.1 Gm. of iodeosin, $C_{20}H_8I_4O_5$ (*tetraiodofluorescein*), in 100 Cc. of alcohol. This indicator becomes *colorless* in acid solutions, changing to *pink* in alkaline solutions. Dilute the solution to be titrated in a 200 Cc. flask with distilled water to about 100 Cc., add 20 Cc. of ether and 5 drops of the iodeosin T.S., cork, and shake well. Then add the volumetric alkali solution gradually, shaking well after each addition. The titration is complete when the lower aqueous solution retains a faint *pink* color after shaking thoroughly. For assaying alkaloidal residues, dissolve

the latter in a measured excess of volumetric acid solution, and transfer the acid solution to a 200 Cc. flask, washing the container well with water until the contents of the flask measure about 100 Cc. Then proceed as above.

129. Litmus Paper and Test Solution.—Exhaust powdered litmus with three separate and successive portions (representing about 4 times its weight) of boiling alcohol (which removes the undesirable color erythrolitmin), each extraction lasting for about one hour. After draining off the alcohol, digest the residue with about an equal weight of cold water and filter. (This blue solution, which contains some alkali, after being acidulated, may be used to make red litmus paper.) Finally, extract the residue with about 5 times its weight of boiling water, and, after thoroughly cooling, filter. The addition of 1 drop of tenth-normal acid or alkali V.S. to 50 Cc. of water containing 5 drops of the indicator should produce a distinct change in color. Preserve the filtrate, as *test solution*, in wide-mouthed bottles stoppered with loose plugs of cotton so as to exclude dust but admit air. The blue color of litmus test solution is changed by acids to *red*, and this red color by the addition of alkalies is restored to *blue*.

Litmus Paper, Blue.—Impregnate with the test solution just described strips of white, unsized paper, free from wood-pulp, but not too porous, and dry them by suspending them on lines of clean twine, in an atmosphere free from acid or ammoniacal vapors.

Litmus Paper, Red.—Prepare this with the same kind of paper and in the same manner as described in the preceding paragraph. Add to the test solution used to impregnate the paper just sufficient of a highly diluted solution of hydrochloric acid to impart to it a faint red tint.

Neither blue nor red litmus paper should have a very intense color.

Preserve the test-paper in bottles, so as to exclude dust and acid or ammoniacal vapors.

130. Methyl-Orange Test Solution.—Dissolve 1 Gm. of methyl-orange, $NaC_{14}H_{14}N_3SO_3$ (the sodium or ammonium salt of dimethylamidoazobenzene sulphonic acid; also known as helianthin, tropæolin D, or Poirrier's Orange 3 P), in 1000 Cc. of water. Add to it, carefully, with constant stirring, tenth-normal sulphuric acid V.S., in drops, until the liquid turns red and just ceases to be transparent. Then filter.

To distinguish methyl-orange from other orange colors of this class, which are unfit for use as indicators, it should respond to the following tests:

Methyl-orange should be completely soluble in distilled water, and the test solution should be of an orange-yellow color, free from a brownish tint. No precipitate should form in this solution upon the addition of an alkali.

The addition of hydrochloric acid to a hot, concentrated solution of methyl-orange should produce a crystalline precipitate, composed of lustrous plates having a violet reflection and free from brown tint.

The addition of calcium chloride or barium chloride T.S. should produce no precipitate.

A few drops of gold chloride T.S. should produce a red coloration, free from either a violet or green tint.

Excessive quantities of this indicator should be avoided in titrating; from 1 to 3 drops are sufficient for a volume of from 50 to 100 Cc., or just enough is added to impart a faint tint to the solution, which if neutral should change to a red or yellow respectively upon the addition of 2 drops of a tenth-normal acid or alkali V.S.

Methyl-orange is suitable for titrating inorganic acids, alkalies, alkali carbonates or bicarbonates, also certain alkaloids, as morphine and quinine. It is not to be employed in titrating organic acids, nor in alcoholic or boiling solutions.

This indicator gives a *yellow* color with alkalies and *red* with acids.

131. Phenolphthalein Test Solution.—Dissolve 1 Gm. of phenolphthalein ($C_{20}H_{14}O_4$) in 50 Cc. of alcohol and dilute to 100 Cc. with water. About 3 drops are sufficient for 50 Cc. of the solution to be titrated; it gives a *red* color with alkali hydroxides or carbonates, while acids render the solution *colorless*. Phenolphthalein may be employed in hot titrations. It is not suitable as an indicator for ammonia, but is largely used for organic acids, alkali hydroxides, and for carbonates and bicarbonates in boiling solutions.

Phenolphthalein Paper is prepared by impregnating white, unsized paper with the test solution and drying it.

132. Turmeric Tincture.—Digest any convenient quantity of ground turmeric root (from *Curcuma longa*, Linné, Fam. *Zingiberaceæ*) repeatedly with small quantities of water and discard the liquids. Then digest the dried residue for several days with six times its weight of alcohol, and filter.

Turmeric Paper.—Impregnate white, unsized paper with the tincture, and dry it. The tincture, as well as the paper, turns *brown* with alkalies, and the original *yellow* color is restored by acids, with the exception of boric acid, which, even in the presence of hydrochloric acid, turns the color to reddish-brown, and this is changed to bluish-black by ammonia.

VOLUMETRIC SOLUTIONS.

NOTE.—It is absolutely necessary that the measuring vessels employed in the operations of volumetric analysis, consisting of burettes, flasks, mixing cylinders, pipettes, etc., should agree among themselves accurately in their graduation at the standard temperature selected. It is immaterial what standard temperature has been selected for the graduation of the vessels.

All volumetric solutions must be prepared at the standard temperature of 25° C. (77° F.), and the solutions must be used in the titrations at a temperature not below 21° C. (69.8° F.), nor above 29° C. (84.2° F.).

All bottles in which volumetric solutions are to be kept, as well as the burettes or pipettes in which they are to be measured, should, prior to use, be thoroughly rinsed with distilled water, then with two or three small portions of the solution that they are to contain. When not in use, burettes should be kept filled with distilled water.

Normal volumetric solutions $\left(\frac{N}{1}\right)$ are those which contain in one liter, in any stated reaction, the chemical equivalent of one gramme of hydrogen. If the molecule of the reagent is univalent, one liter

will contain the weight in grammes equal to the molecular weight of the reagent; if bivalent, a weight in grammes equal to one-half its molecular weight; if trivalent, a weight in grammes equal to one-third its molecular weight.

Thus, hydrochloric acid, HCl = 36.18, having but one H atom replaceable by a basic element, has 36.18 Gm. of absolute HCl in 1000 Cc. of the normal volumetric solution; while sulphuric acid, H_2SO_4 = 97.35, having two replaceable H atoms, contains only one-half this number, or 48.675 grammes of absolute H_2SO_4 in 1000 Cc. of its normal solution. Potassium hydroxide, KOH = 55.74, has but one K to replace one H in acids, hence its normal solution contains 55.74 grammes of pure KOH in one liter. Again, one molecule of potassium dichromate in oxidation liberates *three* atoms of oxygen which are capable of oxidizing *six* atoms of ferrous to ferric iron. Therefore, each molecule of the dichromate, yielding *three* atoms of oxygen, is equivalent to *six* atoms of hydrogen. Hence, the normal solution should contain $\frac{292.28}{6}$ or 48.713 Gm. in 1000 Cc. Two molecules of potassium permanganate, $2KMnO_4$ = 313.96, in oxidation, give off five atoms of O, which are equivalent to ten atoms of H; hence its normal solution should contain $\frac{313.96}{10}$ or 31.396 Gm. in 1000 Cc.

Solutions containing in 1000 Cc. one-tenth of the quantity of the active reagent in the normal solution are called tenth-normal $\left(\frac{N}{10}\right)$; those containing one-hundredth, hundredth-normal $\left(\frac{N}{100}\right)$; one-fiftieth, fiftieth-normal $\left(\frac{N}{50}\right)$; those containing twice the amount, double-normal $\left(\frac{2N}{1}\right)$; half the amount, half-normal $\left(\frac{N}{2}\right)$.

Solutions containing quantities of the active reagent having *no* simple relation to the molecular weight are called empirical.

In the majority of the assays it has been directed that an integral quantity (1, 2, 5, or 10 Gm.) of the substance which is to be tested be weighed, dissolved in water, and made up to a definite volume, then an aliquot portion (representing the fractional weight of the substance required) is measured off for titration. Fractional parts of a Cc. may be measured by means of a 1 Cc. pipette graduated in one-tenth or one-twentieth divisions.

Use of Empirical Solutions.—All standard volumetric solutions deteriorate in time, some very slowly, others rapidly, especially when not properly preserved. To restore the titer of such solutions (that is, to make them exactly normal, tenth-, or hundredth-normal, as the case may be) each time they are to be used, involves an unnecessary waste of time. If one accurately standardized solution be always available, it is not necessary that the other volumetric solutions employed in conjunction with it be diluted to exactly correspond, Cc. for Cc., so long as the *exact* ratio is known.

The percentage strength of any empirical solution as compared with a standard volumetric solution is ascertained by experiment, then the number of Cc. of the empirical solution consumed in the titration of the substance is multiplied by its percentage strength, which result represents the equivalent volume of the true standard solution.

Example.—One gramme of a sample of potassium carbonate required for neutralization 22 Cc. of an empirical solution of hydrochloric acid. In a trial experiment, 16 Cc. of this weak solution were required to neutralize 10 Cc. of a standard normal potassium hydroxide V.S. The former is therefore of 62.5 per cent. strength (for 16 : 10 :: 100 : x. $x = 62.5$), hence the 22 Cc. of empirical solution consumed represent 13.75 Cc. (62.5 per cent. of 22) of standard normal hydrochloric acid V.S. Then if 1 Cc. of $\frac{N}{1}$ hydrochloric acid V.S. = 0.068635 Gm. of potassium carbonate, 13.75 Cc. would be equivalent to 13.75×0.068635, or 0.9436+ Gm. of carbonate.

133. Alkaline Cupric Tartrate Volumetric Solution.

[Fehling's Solution.]

A. The Copper Solution.—Dissolve 34.67 (34.6663) Gm. of carefully selected, small crystals of pure cupric sulphate [*Cupri Sulphas*, U. S. P.], showing no trace of efflorescence or of adhering moisture, in a sufficient quantity of water to make the solution measure, at 25° C. (77° F.), exactly 500 Cc.

Keep this solution in small, well-stoppered bottles.

B. The Alkaline Tartrate Solution.—Dissolve 173 Gm. of crystallized potassium and sodium tartrate [*Potassii et Sodii Tartras*, U. S. P.], and 75 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.], in a sufficient quantity of water to make the solution measure, at 25° C. (77° F.), exactly 500 Cc.

Keep the solution in small, rubber-stoppered bottles.

For use, mix exactly equal volumes of the two solutions at the time required.

One Cubic Centimeter of the mixed solution is the equivalent of:

	Gramme.
Cupric Sulphate, crystallized, $CuSO_4 + 5H_2O$	0.03467
Cupric Tartrate, $CuC_4H_4O_6 + 3H_2O$	0.03688
Cane Sugar (Inverted)	0.00475
Glucose, anhydrous, $C_6H_{12}O_6$	0.00500
Milk Sugar, anhydrous, $C_{12}H_{22}O_{11}$	0.00678

134. Tenth-Normal Bromine Volumetric Solution.

[Koppeschaar's Solution.]

Br = 79.36. 7.936 Gm. in 1000 Cc.

Dissolve 3.2 Gm. of potassium bromate (No. 81) and 50 Gm. of potassium bromide in sufficient water to measure, at or near 25° C. (77° F.), 900 Cc. Transfer 20 Cc. of this solution, by means of a pipette, into a bottle having a capacity of about 250 Cc., and provided with a glass stopper; add 75 Cc. of water and 5 Cc. of pure hydrochloric acid, and immediately insert the stopper. Shake the bottle a few times,

then remove the stopper just sufficiently to quickly introduce 5 Cc. of potassium iodide T.S., taking care that no bromine vapors escape, and immediately stopper the bottle. Agitate the bottle thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water so that the washings flow into the bottle, and then add from a burette tenth-normal sodium thiosulphate V.S. until the brown iodine tint is just discharged. Note the number of Cc. of the sodium thiosulphate V.S. thus consumed, and then dilute the bromine solution so that equal volumes of it and of tenth-normal sodium thiosulphate V.S. will exactly correspond to each other under the conditions mentioned above.

EXAMPLE.—Assuming that the 20 Cc. of the bromine solution have required 25.2 Cc. of the sodium thiosulphate V.S. to completely discharge the iodine tint, then each 20 Cc. of the bromine solution must be diluted to 25.2 Cc. Thus, if 850 Cc. of the solution remain, it must be diluted with water to measure 1071 Cc.

After the solution is thus diluted, a new trial should be made in the manner above described, in which 25 Cc. of the tenth-normal sodium thiosulphate V.S. should just discharge the tint of the iodine liberated by the bromine set free from 25 Cc. of the standard bromine solution.

Keep the solution in dark amber-colored, glass-stoppered bottles.

One Cubic Centimeter of Tenth-Normal Bromine V.S. is the equivalent of:

	Gramme.
Bromine, Br	0.007936
Phenol, C_6H_5OH	0.001556

135. Normal Hydrochloric Acid Volumetric Solution.

$HCl = 36.18$. 36.18 Gm. in 1000 Cc.

Mix 130 Cc. of hydrochloric acid of specific gravity 1.158 with sufficient water to measure 1000 Cc.

Of this liquid (which is still too concentrated) carefully measure, from a burette, 10 Cc. into a flask or porcelain dish, and after diluting with about double its volume of water, add 2 drops of methyl-orange T.S., then gradually add, from a burette, a *freshly standardized* normal potassium hydroxide V.S., until the red tint of the solution changes, after vigorous shaking, to a permanent pale yellow. Note the number of Cc. of potassium hydroxide V.S. consumed, and then dilute the acid solution so that equal volumes of this and of the normal potassium hydroxide V.S. neutralize each other at 25° C. (77° F.).

EXAMPLE.—Assuming that 10 Cc. of the acid solution first prepared required exactly 11 Cc. of normal potassium hydroxide V.S., each 10 Cc. of the former must be diluted to 11 Cc., or the whole of the remaining acid solution in the same proportion at 25° C. (77° F.). Thus, if 950 Cc. should remain, 95 Cc. of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of normal potassium hydroxide V.S. If necessary, a new adjustment should then be made to render the correspondence perfect at 25° C. (77° F.).

One Cubic Centimeter of Normal Hydrochloric Acid V.S. is the equivalent of:

	Gramme.
Hydrochloric Acid, absolute, HCl	0.03618

NOTE.—Normal hydrochloric acid is in every respect equivalent in neutralizing power to normal sulphuric acid (see No. 152), and may be employed, except in special cases, for the same purposes. However, preference is generally given to the normal sulphuric acid V.S.

136. Half-Normal Hydrochloric Acid Volumetric Solution.

$HCl = 36.18$. 18.09 Gm. in 1000 Cc.

Dilute 500 Cc. of normal hydrochloric acid V.S. with sufficient distilled water to measure exactly 1000 Cc. at 25° C. (77° F.).

One Cubic Centimeter of Half-Normal Hydrochloric Acid V.S. is the equivalent of:

	Gramme.
Hydrochloric Acid, absolute, HCl	0.01809
Benzaldehyde, C_7H_6O	0.0526
Cinnamic Aldehyde, C_9H_8O	0.0333
Citral, $C_{10}H_{16}O$	0.03802
Potassium Acetate, $KC_2H_3O_2$ (after ignition)	0.04872
Potassium Bicarbonate, $KHCO_3$	0.049705
Potassium Bitartrate, $KHC_4H_4O_6$ (after ignition)	0.09339
Potassium Carbonate, anhydrous, K_2CO_3	0.034318
Potassium Citrate, cryst., $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.05368
Potassium Hydroxide, KOH	0.02787
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.070045
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.06755
Sodium Benzoate, $NaC_7H_5O_2$ (after ignition)	0.071505
Sodium Bicarbonate, $NaHCO_3$	0.041715
Sodium Carbonate, anhydrous, Na_2CO_3	0.026328
Sodium Carbonate, monohydrated, $Na_2CO_3 + H_2O$	0.030798
Sodium Citrate, $2Na_3C_6H_5O_7 + 11H_2O$ (after ignition)	0.0591
Sodium Hydroxide, NaOH	0.01988
Sodium Salicylate, $NaC_7H_5O_3$ (after ignition)	0.079445

137. Tenth-Normal Iodine Volumetric Solution.

I = 125.9. 12.59 Gm. in 1000 Cc.

Tenth-normal iodine V.S. may be prepared according to either of the following methods:

I. Dissolve 12.59 Gm. of pure iodine (see below) in a solution of 18 Gm. of potassium iodide in 300 Cc. of water. Then add sufficient water to make the solution measure, at 25° C. (77° F.), exactly 1000 Cc. Unless freshly prepared, its strength should always be determined anew at the time it is used. Transfer the solution to glass-stoppered vials.

Preparation of Pure Iodine.—Heat powdered iodine [*Iodum*, U. S. P.] in a porcelain dish placed over a bath of boiling water for twenty minutes, and stir it constantly with a glass rod, so that adhering moisture, cyanogen iodide, and most of the iodine bromide and iodine chloride, if present, may be vaporized. Then transfer the iodine to a porcelain or other non-metallic mortar, and triturate it with about 5 per cent. of its weight of dry potassium iodide, so as to decompose any remaining iodine bromide and iodine chloride. Then return the mass to the dish, cover it with a glass funnel, and heat the dish carefully on a sand-bath. Detach the sublimed, pure iodine, and, after pulverizing and drying for twenty-four hours over calcium chloride, keep it in well-stoppered bottles, in a cool place.

II. Tenth-normal iodine V.S. may also be prepared as follows:

Dissolve about 14 Gm. of iodine [*Iodum*, U. S. P.] in a solution of 18 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in about 300 Cc. of water, diluting finally to 1000 Cc. Of this solution (which is too concentrated), carefully measure from a burette 10 Cc. into a flask, then add gradually and cautiously, from a burette, tenth-normal sodium thiosulphate V.S. (shaking constantly) until the color of the solution is discharged. Note the number of Cc. of the sodium thiosulphate V.S. consumed, and then dilute the iodine solution so that any known volume of the latter will require for decolorization exactly the same volume of the tenth-normal sodium thiosulphate V.S.

EXAMPLE.—Assuming that 10 Cc. of the iodine solution required 10.8 Cc. of the tenth-normal sodium thiosulphate V.S. for decolorization, then each 10 Cc. of the former must be diluted to 10.8 Cc., or each 100 Cc. of the iodine solution to 108 Cc. at 25° C. (77° F.). After the solution is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the tenth-normal iodine V.S. should require exactly 50 Cc. of the tenth-normal sodium thiosulphate V.S. for complete decolorization. If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-Normal Iodine V.S. is the equivalent of:

	Gramme.
Iodine, I	0.01259
Arsenic, As	0.00372
Arsenic Trioxide (Arsenous acid), As_2O_3	0.004911
Iron, Fe	0.002775
Potassium Sulphite, crystallized, $K_2SO_3 + 2H_2O$	0.009648
Sodium Bisulphite, $NaHSO_3$	0.005168
Sodium Thiosulphate (Hyposulphite), crystals, $Na_2S_2O_3 + 5H_2O$	0.024646
Sodium Sulphite, crystallized, $Na_2SO_3 + 7H_2O$	0.012520
Sulphur Dioxide, SO_2	0.003180
Antimony and Potassium Tartrate, crystallized, $2K(SbO)C_4H_4O_6 + H_2O$	0.016495

138. Tenth-Normal Oxalic Acid Volumetric Solution.

$H_2C_2O_4 + 2H_2O$ = 125.10. 6.255 Gm. in 1000 Cc.

Dissolve 6.4 Gm. of pure oxalic acid (see No. 73) in sufficient water to measure 1000 Cc.

Into a flask, accurately measure, from a burette, 10 Cc. of a *freshly standardized* tenth-normal potassium hydroxide V.S., dilute with about 20 Cc. of water, add 3 to 5 drops of phenolphthalein T.S. and heat to boiling. From a burette gradually add the oxalic acid solution (which is still too concentrated) until the red tint of the alkali solution fails to reappear after vigorous shaking and boiling. Note the number of Cc. of the oxalic acid solution consumed, and then dilute it so that equal volumes of this and of the tenth-normal potassium hydroxide V.S. neutralize each other at 25° C. (77° F.). It deteriorates on standing.

EXAMPLE.—Assuming that the 10 Cc. of the tenth-normal potassium hydroxide V.S. required exactly 9.5 Cc. of the oxalic acid solution, then each 9.5 Cc. of the latter must be diluted to 10 Cc., or the whole of the remaining acid solution in the same proportion at 25° C. (77° F.). Thus, if 950 Cc. of the oxalic acid solution should remain, 50 Cc. of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of tenth-normal potassium hydroxide V.S. should require for neutralization exactly 50 Cc. of the oxalic acid solution at 25° C. (77° F.). If necessary, a new adjustment should then be made to render the correspondence perfect.

NOTE.—Tenth-normal oxalic acid V.S. is in every respect equivalent in neutralizing power to any other tenth-normal acid V.S. with either litmus or phenolphthalein T.S. as indicator. Its most important use is in standardizing tenth-normal potassium permanganate V.S.

One Cubic Centimeter of Tenth-Normal Oxalic Acid V.S. is the equivalent of:

	Gramme.
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006255
Ammonia Gas, NH_3	0.001693
Calcium Hydroxide, $Ca(OH)_2$	0.003678
Lead Subacetate, $Pb_2O(C_2H_3O_2)_2$	0.0135935
Manganese Dioxide, precipitated, MnO_2	0.004318
Potassium Hydroxide, KOH	0.005574
Potassium Permanganate, $KMnO_4$	0.0031396
Sodium Hydroxide, NaOH	0.003976

139. Tenth-Normal Potassium Dichromate Volumetric Solution.

$K_2Cr_2O_7 = 292.28$. 4.8713 Gm. in 1000 Cc.

Dissolve 4.8713 Gm. of pure potassium dichromate, which has been pulverized and dried at 120° C. (248° F.) (see Reagent No. 85), in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

When used with phenolphthalein as indicator, to neutralize alkalies, the volumetric solution of potassium dichromate is tenth-normal when it contains 14.614 Gm. in 1000 Cc. It is then the exact equivalent of any tenth-normal acid V.S., each Cc. being equivalent to the amounts of alkalies quoted under such acids.

When used as an oxidizing agent to convert ferrous into ferric salts, or to liberate iodine from potassium iodide, the solution just mentioned (containing 14.614 Gm. in 1000 Cc.) has the effect of a $\frac{3N}{10}$ volumetric solution, and a solution of one-third of this strength, containing 4.8713 Gm. in 1000 Cc., has the value of a tenth-normal solution, and is the equivalent of an equal volume of tenth-normal potassium permanganate V.S., or, in the case of iodine liberated from potassium iodide, it is the equivalent of an equal volume of tenth-normal sodium thiosulphate V.S. For titrating iron in *ferrous* compounds, it is used in the following manner. Introduce the aqueous solution of the ferrous salt into a flask, and, if it is not already acid, render it so with sulphuric acid. Now add, gradually, tenth-normal potassium dichromate V.S. from a burette, with agitation, until a drop taken out upon a white surface no longer becomes blue when mixed with a drop of freshly prepared potassium ferricyanide T.S.

Tenth-normal potassium dichromate V.S. may also be used, in conjunction with potassium iodide (from which it liberates iodine) and sulphuric acid, for adjusting the titer of sodium thiosulphate V.S. and thus that of the iodine V.S.

One Cubic Centimeter of Tenth-Normal Potassium Dichromate V.S. is the equivalent of:

	Gramme.
Potassium Dichromate, $K_2Cr_2O_7$	0.0048713
Iron, Fe, in ferrous compounds	0.00555
Ferrous Carbonate, $FeCO_3$	0.011505
Ferrous Sulphate, anhydrous, $FeSO_4$	0.015085
Ferrous Sulphate, crystallized, $FeSO_4 + 7H_2O$	0.027601
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.017767
Sodium Thiosulphate, $Na_2S_2O_3 + 5H_2O$	0.024646

140. Normal Potassium Hydroxide Volumetric Solution.

$KOH = 55.74$. 55.74 Gm. in 1000 Cc.

Dissolve 75 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.], in sufficient water to measure about 1050 Cc., and fill a burette with a portion of this liquid.

Into a flask of the capacity of about 300 Cc., introduce 9.339 Gm. of potassium bitartrate, which has been purified and dried as directed under No. 80, and 160 Cc. of distilled water. Boil the liquid until solution has taken place, add from 3 to 5 drops of phenolphthalein T.S., followed by the cautious addition, from a burette, of the potassium hydroxide solution, frequently agitating the flask, boiling, and, toward the end of the operation, reducing the flow to drops until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the potassium hydroxide solution consumed, and then dilute the remainder of the solution so that exactly 50 Cc. of the diluted liquid at 25° C. (77° F.) shall be required to neutralize the 9.339 Gm. of potassium bitartrate used.

Example.—Assuming that 40 Cc. of the stronger solution of potassium hydroxide first prepared had been consumed in the trial, then each 40 Cc. must be diluted to 50 Cc., or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 1000 Cc. should be still remaining, this must be diluted with water to 1250 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the diluted solution should exactly neutralize 9.339 Gm. of potassium bitartrate at 25° C. (77° F.). If necessary, a new adjustment should then be made to render the correspondence perfect.

Note.—Solutions of caustic alkalies absorb carbon dioxide from the atmosphere, and thereby change their titer when used with litmus T.S., or phenolphthalein T.S., as indicator (methyl-orange T.S. is not affected by the presence of carbonic acid). Hence the volumetric solutions should be preserved in bottles provided with well-fitting rubber stoppers, or, better still, these should be provided with tubes filled with soda-lime (a mixture of caustic soda and lime) ; the tubes pass through a perforation in the rubber stoppers, and thus absorb the carbon dioxide and prevent its access to the solution. If the solution is kept in a burette for any length of time, the same provision with a soda-lime tube should be observed.

In place of potassium hydroxide V.S., sodium hydroxide V.S. (see No. 150) may be used, in the same manner and in the same quantity. Potassium hydroxide V.S., however, is preferable, since it foams less, and attacks glass more slowly.

One Cubic Centimeter of Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.05574
Acetic Acid, absolute, $HC_2H_3O_2$	0.05958
Ammonia Gas, NH_3	0.01693
Ammonium Chloride, NH_4Cl	0.05311
Boric Acid, H_3BO_3	0.06154
Citric Acid, crystallized, $H_3C_6H_5O_7 + H_2O$	0.06950
Hydriodic Acid, absolute, HI	0.12690
Hydrobromic Acid, absolute, HBr	0.08036
Hydrochloric Acid, absolute, HCl	0.03618
Hypophosphorous Acid, HPH_2O_2	0.06553

One Cubic Centimeter of Normal Potassium Hydroxide V.S. is the equivalent of:—(Continued.)

	Gramme.
Lactic Acid, absolute, $HC_3H_5O_3$	0.08937
Nitric Acid, absolute, HNO_3	0.06257
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.06255
Phosphoric Acid, H_3PO_4 (to form K_2HPO_4; with phenolphthalein)	0.048645
Potassium Dichromate, $K_2Cr_2O_7$	0.14614
Sodium Hydroxide, NaOH	0.03976
Sulphuric Acid, absolute, H_2SO_4	0.048675
Tartaric Acid, crystallized, $H_2C_4H_4O_6$	0.07446
Trichloracetic Acid, CCl_3COOH	0.16212

141. Tenth-Normal Potassium Hydroxide Volumetric Solution.

KOH = 55.74. 5.574 Gm. in 1000 Cc.

Dilute 100 Cc. of freshly standardized normal potassium hydroxide V.S. with sufficient distilled water to measure, at 25° C. (77° F.), exactly 1000 Cc.

This solution may also be prepared and standardized directly with potassium bitartrate, as directed under normal potassium hydroxide V.S., employing for this purpose 0.9339 Gm. of the former and a solution of about 7.5 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.] in 1000 Cc. of distilled water. Fifty Cc. of the prepared tenth-normal solution at 25° C. (77° F.) should exactly neutralize 0.9339 Gm. of potassium bitartrate (No. 80).

NOTE.—The same precautions should be taken for protecting this solution from carbon dioxide of the air as are directed under normal potassium hydroxide V.S.

One Cubic Centimeter of Tenth-Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.005574
Sulphuric Acid, absolute, H_2SO_4	0.0048675

142. Fiftieth-Normal Potassium Hydroxide Volumetric Solution.

KOH = 55.74. 1.1148 Gm. in 1000 Cc.

Dilute 20 Cc. of a freshly standardized normal or 200 Cc. of tenth-normal potassium hydroxide V.S. with sufficient distilled water to measure, at 25° C. (77° F.), exactly 1000 Cc. This standard solution is employed in conjunction with the tenth-normal sulphuric acid V.S. in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin T.S. as indicators.

NOTE.—The same precautions should be taken for protecting this solution from carbon dioxide of the air as are directed under normal potassium hydroxide V.S. It should be renewed at frequent intervals.

One Cubic Centimeter of Fiftieth-Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.0011148
Sulphuric Acid, absolute, H_2SO_4	0.0009735
Aconitine, $C_{34}H_{47}NO_{11}$	0.012811
Atropine, $C_{17}H_{23}NO_3$	0.005741
Cinchonidine, $C_{19}H_{22}N_2O$	0.005841
Cinchonine, $C_{19}H_{22}N_2O$	0.005841
Combined Alkaloids of Cinchona bark	0.006139
Combined Alkaloids of Ipecac	0.004768
Cocaine, $C_{17}H_{21}NO_4$	0.006018
Coniine, $C_8H_{17}N$	0.002524
Hydrastine, $C_{21}H_{21}NO_6$	0.007606
Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.006018
Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.005661
Physostigmine, $C_{15}H_{21}N_3O_2$	0.005464
Pilocarpine, $C_{11}H_{16}N_2O_2$	0.004133
Quinine, $C_{20}H_{24}N_2O_2$	0.006436
Strychnine, $C_{21}H_{22}N_2O_2$	0.006635

143. Hundredth-Normal Potassium Hydroxide Volumetric Solution.

KOH = 55.74. 0.5574 Gm. in 1000 Cc.

Dilute 10 Cc. of normal or 100 Cc. of tenth-normal potassium hydroxide V.S. with sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc. The solution must be frequently renewed.

One Cubic Centimeter of Hundredth-Normal Potassium Hydroxide V.S. is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.0005574
Sulphuric Acid, absolute, H_2SO_4	0.00048675

144. Half-Normal Alcoholic Potassium Hydroxide Volumetric Solution.

KOH = 55.74. 27.87 Gm. in 1000 Cc.

Dissolve about 40 Gm. of potassium hydroxide [*Potassii Hydroxidum*, U. S. P.], which has been broken into small pieces, in about 20 Cc. of water, and add sufficient alcohol [*Alcohol*, U. S. P.], to measure 1000 Cc. After setting aside in a well-stoppered bottle for one day, the clear supernatant solution should be quickly decanted into a bottle provided with a well-fitted rubber stopper.

Into a flask of the capacity of about 300 Cc., introduce 1.8678 Gm. of potassium bitartrate, which has been purified and dried, as directed under No. 80, and about 100 Cc. of distilled water. Heat the solution to the boiling point, add 5 drops of phenolphthalein T.S., followed by the cautious addition, from a burette, of the potassium hydroxide solution, frequently agitating the flask, boiling, and, toward the end of the operation, reducing the flow to drops until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the alcoholic potassium hydroxide solution consumed, and then dilute the remainder of the solution with alcohol so that exactly 20 Cc. of the diluted liquid shall be required to neutralize the 1.8678 Gm. of potassium bitartrate used.

EXAMPLE.—Assuming that 12.5 Cc. of the stronger alcoholic solution of potassium hydroxide first prepared had been consumed in the trial, then each 12.5 Cc. must be diluted with alcohol to 20 Cc., or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 980 Cc. should remain, this must be diluted with alcohol to measure 1568 Cc.

Half-Normal Alcoholic Potassium Hydroxide V.S. may also be prepared as follows: Of the above described concentrated alcoholic potassium hydroxide solution, carefully measure, from a burette, 20 Cc. into a flask, and, after diluting with about 50 Cc. of water, add about 5 drops of phenolphthalein T.S., heat to a boiling temperature, and add, from a burette, half-normal hydrochloric acid V.S., frequently agitating the flask, and, toward the end of the operation, reducing the flow to drops until the red color is just discharged. Note the number of Cc. of the half-normal hydrochloric acid V.S. consumed, and then dilute the remainder of the solution with alcohol so that equal volumes of this and of the half-normal hydrochloric acid V.S. neutralize each other at 25° C. (77° F.).

Should half-normal hydrochloric acid V.S. not be available, standardization can be carried out in the same manner with *normal* hydrochloric acid V.S., two volumes of the alcoholic potassium hydroxide being made to correspond with one volume of the standard acid.

NOTE.—This solution should be kept in bottles provided with a well-fitted rubber stopper and protected from the light. Owing to the readiness with which this standard solution loses its titer, blank tests should be performed whenever it is employed in titrations.

One Cubic Centimeter of Half-Normal Alcoholic Potassium Hydroxide V.S. is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.02787
Borneol, $C_{10}H_{18}O$	0.07649
Bornyl Acetate, $C_{10}H_{17}O.C_2H_3O$	0.09734
Menthol, $C_{10}H_{20}O$	0.07749
Menthyl Acetate, $C_{10}H_{19}O.C_2H_3O$	0.09834
Santalol, $C_{15}H_{26}O$	0.11026

145. Tenth-Normal Potassium Permanganate Volumetric Solution.

$2KMnO_4 = 313.96$. 3.1396 Gm.[1] in 1000 Cc.

Introduce about 3.3 Gm. of pure, crystallized potassium permanganate [*Potassii Permanganas*, U. S. P.] into a flask, add 1000 Cc. of distilled water, and boil for about five minutes. Close the flask with a plug of purified cotton, and set aside for at least two days, so that suspended matter may deposit. After the lapse of this time, pour off the clear portion of the solution into a glass-stoppered bottle.

The water to be employed for diluting this solution (which is still too concentrated) should be prepared as directed under Distilled Water [*Aqua Destillata*, U. S. P.], adding, however, about 1 Gm. of potassium permanganate to the water in the retort before beginning the distillation.

I. Introduce into a flask 10 Cc. of an accurately standardized tenth-normal oxalic acid V.S., add 1 Cc. of pure, concentrated sulphuric acid, and before this mixture cools, gradually add, from a burette provided with a glass stop-cock, small quantities of the permanganate solution to be standardized, shaking the flask after each addition and reducing the flow to drops toward the end of the operation. When the last drop of the permanganate solution added is no longer decolorized, but imparts a pinkish tint to the liquid, which remains permanent for one-half minute, note the number of Cc. consumed, and then dilute the trial permanganate solution with the specially prepared distilled water so that it will correspond, volume for volume, at 25° C. (77° F.), with the tenth-normal oxalic acid V.S. (note example under II.).

II. Tenth-normal potassium permanganate V.S. may also be standardized as follows:

To a solution of about 1 Gm. of potassium iodide [*Potassii Iodidum*, U.S.P.], in 10 Cc. of diluted sulphuric acid, contained in a flask, add, from a burette provided with a glass stop-cock, 20 Cc. of the potassium permanganate solution to be standardized; then dilute the mixture at once with about 200 Cc. of distilled water. An accurately standardized tenth-normal sodium thiosulphate V.S. is then slowly added from a burette, while the mixture is vigorously shaken, until the color is discharged. Note the number of Cc. of the latter consumed, then dilute the permanganate solution so that equal volumes of the two solutions correspond to each other under the same conditions at 25° C. (77° F.).

EXAMPLE.—Assuming that 25 Cc. of the tenth-normal sodium thiosulphate V.S. were required to decolorize the liberated iodine of the mixture, then each 20 Cc. of the potassium permanganate solution must be diluted with the specially prepared distilled water to 25 Cc., or the whole of the remaining solution in the same proportion. Thus, if 920 Cc. remain, it should be diluted to measure 1150 Cc. at 25° C. (77° F.).

After the potassium permanganate solution is thus diluted, a new trial should be made in the manner above described, in which 20 Cc. of this solution should require exactly 20 Cc. of the tenth-normal sodium thiosulphate V.S. to decolorize the mixture. If necessary, a new adjustment should be made to render the correspondence perfect.

NOTE.—When potassium permanganate V.S. is to be prepared for immediate use, this may be done as follows: Dissolve about 3.3 Gm. of pure, crystallized potassium permanganate in 1000 Cc. of recently

[1] The exact quantity is never weighed, but the solution is adjusted directly by oxalic acid or indirectly with sodium thiosulphate.

boiled and cooled pure water. This is then standardized by either of the above methods and diluted accordingly with recently boiled and cooled pure water. Potassium permanganate V.S. made by this method without the preliminary boiling and standing deteriorates readily, hence should be verified each time it is used.

Potassium permanganate V.S. should be kept in well-closed glass-stoppered bottles, and only burettes provided with glass stop-cocks should be employed in titrating with it. Even when properly prepared and preserved, this solution should be restandardized frequently.

One Cubic Centimeter of Tenth-Normal Potassium Permanganate V.S. is the equivalent of:

	Gramme.
Potassium Permanganate, $KMnO_4$	0.0031396
Calcium Oxide, CaO (as oxalate)	0.002784
Iron, Fe, in ferrous compounds	0.005550
Ferrous Carbonate, $FeCO_3$	0.011505
Ferrous Oxide, FeO	0.007138
Ferrous Sulphate, anhydrous, $FeSO_4$	0.015085
Ferrous Sulphate, crystals, $FeSO_4 + 7H_2O$	0.027601
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.017767
Hydrogen Dioxide, H_2O_2	0.001688
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006255
Oxygen, O	0.000794
Sodium Nitrite, $NaNO_2$	0.0034285

146. Tenth-Normal Potassium Sulphocyanate Volumetric Solution.

[Volhard's Solution.]

$KSCN = 96.53$. 9.653 Gm. in 1000 Cc.

Dissolve 10 Gm. of crystals of pure potassium sulphocyanate (No. 96) in 1000 Cc. of water.

This solution is too concentrated, and has to be adjusted so as to correspond in strength exactly with tenth-normal silver nitrate V.S. For this purpose, introduce into a flask 10 Cc. of tenth-normal silver nitrate V.S., 3 Cc. of ferric ammonium sulphate T.S., and 3 Cc. of nitric acid (free from nitrous compounds), and dilute the liquid with about 100 Cc. of distilled water. To this mixture add, from a burette, in small portions at a time, the sulphocyanate solution. At first, a white precipitate of silver sulphocyanate appears, then, every drop falling from the burette is surrounded by a deep brownish-red color produced by ferric sulphocyanate, which disappears on vigorous shaking of the flask as long as any of the silver nitrate remains unchanged. When all the silver has been converted into sulphocyanate, a single additional drop of the potassium sulphocyanate solution produces a brownish-red color which no longer disappears on shaking, but communicates a perceptible pale reddish-brown tint to the contents of the flask. Note the number of Cc. of the potassium sulphocyanate solution used, and dilute the whole of the remaining solution so that equal volumes of this and of the tenth-normal silver nitrate V.S., at 25° C. (77° F.), will be required to produce the permanent reddish-brown tint. (The same depth of pale reddish brown tint to which the volumetric solution is adjusted must be attained when the solution is used for volumetric assays.)

After the dilution, a new trial should be made, in which 50 Cc. of tenth-normal silver nitrate V.S., 5 Cc. of ferric ammonium sulphate T.S., 5 Cc. of nitric acid, and 200 Cc. of water are used, and there should be required exactly 50 Cc. of the potassium sulphocyanate solution, at 25° C. (77° F.), to produce the same depth of a permanent pale reddish-brown tint.

If necessary, a new adjustment should be made, to render the correspondence perfect.

One Cubic Centimeter of Tenth-Normal Potassium Sulphocyanate V.S. is the equivalent of:

	Gramme.
Potassium Sulphocyanate, KSCN	0.009653
Silver, Ag	0.010712
Silver Nitrate, $AgNO_3$	0.016869

147. Tenth-Normal Silver Nitrate Volumetric Solution.

$AgNO_3 = 168.69$. 16.869 Gm. in 1000 Cc.

Dissolve 16.869 Gm. of silver nitrate [*Argenti Nitras*, U. S. P.] which, previous to weighing, has been pulverized and dried in a covered porcelain crucible in an air-bath at 130° C. (266° F.) for one hour, in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

Keep the solution in dark amber-colored, glass-stoppered vials, carefully protected from dust and sunlight.

Note.—Titration by tenth-normal silver nitrate V.S. may be conducted in various ways, adapted to the special preparation to be tested:

a. The titration of soluble chlorides and bromides.—To the solution of an accurately weighed quantity of the salt, contained in either a porcelain dish or a flask placed on a white surface, sufficient potassium chromate T.S. is added to impart a yellow tint, then the tenth-normal silver nitrate V.S. is slowly added from a burette, stirring or agitating constantly until the mixture acquires a permanent red tint, due to the formation of red silver chromate. This method is only suitable for *neutral* solutions.

b. The titration of free hydrobromic, hydrochloric, and hydriodic acids or their salts in acid solution, known as the Volhard or Thiocyanate (Sulphocyanate) method of residual titration.—An accurately measured excess of tenth-normal silver nitrate V.S. is added to the solution of the halogen acid or its salt, and then acidified with pure nitric acid, and the indicator (ferric ammonium sulphate T.S.) added; then the uncombined excess of the silver nitrate V.S. is determined by titrating back with tenth-normal potassium sulphocyanate V.S., the end-reaction being the formation of a permanent pale reddish-brown tint (due to

ferric sulphocyanate). The volume of the silver nitrate V.S. originally added, less that of the potassium sulphocyanate V.S. consumed, will give the number of Cc. of the former which were required for the precipitation of the halogen. The quantity of nitric acid added should be sufficient to remove the yellow color produced by the addition of the indicator.

c. Titration till the first appearance of a permanent precipitate.—This method is applicable in the estimation of the alkali cyanides and hydrocyanic acid. When the solution is used by this method it is fifth-normal instead of tenth-normal solution.

One Cubic Centimeter of Tenth-Normal Silver Nitrate V.S. is the equivalent of:

	Gramme.
Silver Nitrate, $AgNO_3$	0.016869
Allyl Iso-thiocyanate, $CS.NC_3H_5$	0.00492
Ammonium Bromide, NH_4Br	0.009729
Ammonium Chloride, NH_4Cl	0.005311
Ammonium Iodide, NH_4I	0.014383
Bromine, Br	0.007936
Calcium Bromide, $CaBr_2$	0.009926
Chlorine, Cl	0.003518
Ferrous Bromide, anhydrous, $FeBr_2$	0.010711
Ferrous Iodide, FeI_2	0.015365
Hydriodic Acid, HI	0.012690
Hydrobromic Acid, HBr	0.008036
Hydrochloric Acid, HCl	0.003618
Hydrocyanic Acid, HCN, to first formation of precipitate	0.005368
Hydrocyanic Acid, HCN, potassium chromate as indicator	0.002684
Iodine, I	0.012590
Lithium Bromide, LiBr	0.008634
Potassium Bromide, KBr	0.011822
Potassium Chloride, KCl	0.007404
Potassium Cyanide, KCN, to first formation of precipitate	0.012940
Potassium Iodide, KI	0.016476
Potassium Sulphocyanate, KSCN	0.009653
Sodium Bromide, NaBr	0.010224
Sodium Chloride, NaCl	0.005806
Sodium Iodide, NaI	0.014878
Strontium Bromide, $SrBr_2 + 6H_2O$	0.017647
Strontium Iodide, $SrI_2 + 6H_2O$	0.022301
Zinc Bromide, $ZnBr_2$	0.011181
Zinc Chloride, $ZnCl_2$	0.006763
Zinc Iodide, ZnI_2	0.015835

148. Tenth-Normal Sodium Chloride Volumetric Solution.

$NaCl = 58.06$. 5.806 Gm. in 1000 Cc.

Dissolve 5.806 Gm. of pure sodium chloride (see below) in sufficient water to measure, at 25° C. (77° F.), exactly 1000 Cc.

Pure Sodium Chloride may be prepared by passing a current of dry hydrochloric acid gas into a saturated aqueous solution of the purest commercial sodium chloride, collecting the crystalline precipitate on a filter, washing with a little pure concentrated hydrochloric acid, draining, pulverizing, and igniting it gently in a crucible heated to low redness, to expel all traces of free acid. Care should be taken to avoid fusion.

One Cubic Centimeter of Tenth-Normal Sodium Chloride V.S. is the equivalent of:

	Gramme.
Sodium Chloride, NaCl	0.005806
Silver, Ag	0.010712
Silver Nitrate, $AgNO_3$	0.016869
Silver Oxide, Ag_2O	0.011506

149. Double-Normal Sodium Hydroxide Volumetric Solution.

$NaOH = 39.76$. 79.52 Gm. in 1000 Cc.

Dissolve 90 Gm. of sodium hydroxide [*Sodii Hydroxidum*, U. S. P.] in sufficient water to measure about 1000 Cc.

For the standardization of this approximate solution of sodium hydroxide proceed as directed under normal potassium hydroxide V.S. (see No. 140); 25 Cc. of the volumetric solution, at 25° C. (77° F.), should exactly neutralize 9.339 Gm. of pure potassium bitartrate (see No. 80).

NOTE.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide V.S. (see No. 140).

150. Normal Sodium Hydroxide Volumetric Solution.

$NaOH = 39.76$. 39.76 Gm. in 1000 Cc.

Dissolve 54 Gm. of sodium hydroxide [*Sodii Hydroxidum*, U. S. P.] in sufficient water to measure about 1050 Cc., and fill a burette with a portion of this liquid.

For the standardization of this approximate solution of sodium hydroxide, proceed as directed under normal potassium hydroxide V.S. (see No. 140); 50 Cc. of the volumetric solution, at 25° C. (77° F.), must exactly neutralize 9.339 Gm. of pure potassium bitartrate.

NOTE.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide V.S. (see No. 140).

This solution may be employed in place of the normal potassium hydroxide V.S. (see No. 140), volume for volume.

One Cubic Centimeter of Normal Sodium Hydroxide V.S. is the equivalent of:

	Gramme.
Sodium Hydroxide, NaOH	0.03976
Boric Acid, H_3BO_3	0.06154
Formaldehyde, CH_2O	0.02979
Trichloracetic Acid, $HC_2Cl_3O_2$	0.16212

151. Tenth-Normal Sodium Thiosulphate Volumetric Solution.

$Na_2S_2O_3 + 5H_2O = 246.46$. 24.646 Gm. in 1000 Cc.

Dissolve 30 Gm. of sodium thiosulphate (see No. 113) in sufficient distilled water to measure 1000 Cc. This trial solution, which is too concentrated, is standardized as follows:

To a solution of about 1 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in 10 Cc. of diluted sulphuric acid contained in a flask of about 500 Cc. capacity, add slowly, from a burette, 20 Cc. of tenth-normal potassium dichromate V.S., shaking after each addition. Place a watch-glass on the mouth of the flask and allow it to stand for five minutes, then dilute the solution with about 250 Cc. of distilled water, add some starch T.S., and then, from a burette, the trial solution of sodium thiosulphate, in small portions at a time, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the blue color of the mixture changes to a light green; note the number of Cc. of the trial sodium thiosulphate solution consumed. Then dilute the sodium thiosulphate solution so that equal volumes of it and the tenth-normal potassium dichromate V.S. will exactly correspond to each other under the above conditions, at 25° C. (77° F.).

EXAMPLE.—Assuming that 16 Cc. of the trial sodium thiosulphate solution were required to decolorize the liberated iodine of the mixture, then each 16 Cc. of this solution must be diluted to 20 Cc. so that it will correspond in volume to the tenth-normal potassium dichromate V.S. added, or the whole of the remaining solution in the same proportion at 25° C. (77° F.). Thus, if 984 Cc. of the sodium thiosulphate solution are remaining, this should be diluted to measure 1230 Cc. After the sodium thiosulphate solution is thus diluted, a new trial should be made in the manner above described, in which exactly 20 Cc. of this solution should be required to decolorize the iodine liberated by 20 Cc. of the tenth-normal dichromate V.S. If necessary, a new adjustment should be made to render the correspondence perfect.

Keep the solution in glass-stoppered bottles, carefully protected from dust.

NOTE.—When this solution is to be used, fill a burette with it, place the liquid to be tested either for the free iodine it already contains, or for that which it liberates from an excess of potassium iodide added to it, in a flask, and gradually add small portions of the solution from the burette, shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the color is discharged.

One Cubic Centimeter of Tenth-Normal Sodium Thiosulphate V.S. is the equivalent of:

	Gramme.
Sodium Thiosulphate (Hyposulphite), $Na_2S_2O_3 + 5H_2O$	0.024646
Bromine, Br	0.007936
Chlorine, Cl	0.003518
Chromium Trioxide, CrO_3	0.003311
Iodine, I	0.01259
Iron, Fe, in ferric salts	0.00555
Potassium Bromate, $KBrO_3$	0.002764

152. Normal Sulphuric Acid Volumetric Solution.

$H_2SO_4 = 97.35$. 48.675 Gm. in 1000 Cc.

Carefully mix 30 Cc. of pure, concentrated sulphuric acid, of specific gravity 1.826 at 25° C. (77° F.), with sufficient water to measure about 1050 Cc., and allow the liquid to cool to 25° C. (77° F.). Measure from a burette 10 Cc. of this liquid (which is yet too concentrated) into a flask, add 2 drops of methyl-orange T.S., and afterwards, from a burette, a freshly standardized normal potassium hydroxide V.S., shaking after each addition, and, toward the end of the operation, reducing the flow to drops, until the red tint of the solution changes to a permanent pale yellow after thorough shaking. Note the number of Cc. of normal potassium hydroxide V.S. consumed. Then dilute the sulphuric acid solution so that equal volumes of this and of normal potassium hydroxide V.S., at 25° C. (77° F.), exactly neutralize each other.

EXAMPLE.—Assuming that 10 Cc. of the acid solution first prepared had required exactly 11.2 Cc. of normal potassium hydroxide V.S., each 10 Cc. of the former must be diluted to 11.2 Cc., or each 1000 Cc. to 1120 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of normal potassium hydroxide V.S., at 25° C. (77° F.). If necessary, a new adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.048675
Ammonia Gas, NH_3	0.01693
Ammonium Carbonate, $(NH_4)_2CO_3$	0.047705
Ammonium Carbonate [U. S. P.], $NH_4HCO_3.NH_4NH_2CO_2$	0.052003
Calcium Hydroxide, $Ca(OH)_2$	0.03678

One Cubic Centimeter of Normal Sulphuric Acid V.S. is the equivalent of:—(Continued.)

	Gramme.
Lead Acetate, crystallized, $Pb(C_2H_3O_2)_2 + 3H_2O$	0.188075
Lead Subacetate, assumed as $Pb_2O(C_2H_3O_2)_2$	0.135935
Lithium Carbonate, Li_2CO_3	0.036755
Magnesium Carbonate, $(MgCO_3)_4(MgOH)_2 + 5H_2O$	0.048226
Magnesium Oxide, MgO	0.02003
Potassium Acetate, $KC_2H_3O_2$ (after ignition)	0.09744
Potassium Bicarbonate, $KHCO_3$	0.09941
Potassium Bitartrate, $KHC_4H_4O_6$ (after ignition)	0.18678
Potassium Carbonate, anhydrous, K_2CO_3	0.068635
Potassium Citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.10736
Potassium Hydroxide, KOH	0.05574
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.14009
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.13510
Sodium Benzoate, $NaC_7H_5O_2$ (after ignition)	0.14301
Sodium Bicarbonate, $NaHCO_3$	0.08343
Sodium Borate, crystallized, $Na_2B_4O_7 + 10H_2O$	0.18966
Sodium Hydroxide, NaOH	0.03976
Sodium Salicylate, $NaC_7H_5O_3$ (after ignition)	0.15889
Zinc Oxide, ZnO	0.04039

153. Half-Normal Sulphuric Acid Volumetric Solution.

$H_2SO_4 = 97.35$. 24.3375 Gm. in 1000 Cc.

Dilute 500 Cc. of normal sulphuric acid with sufficient water to measure 1000 Cc. at 25° C. (77° F.).

This standard solution is chiefly employed in the titration of the organic salts of sodium and potassium in conjunction with methyl-orange as indicator. For this purpose a special experiment should be made in which an accurately measured volume of 10 Cc. of normal potassium hydroxide V.S. should, after adding 2 drops of methyl-orange T.S., require exactly 20 Cc. of the half-normal sulphuric acid V.S. for neutralization.

If necessary, an adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Half-Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.0243375
Ammonia Gas, NH_3 (Spirit of Ammonia)	0.008465
Potassium Acetate, $KC_2H_3O_2$ (after ignition)	0.04872
Potassium Bicarbonate, $KHCO_3$	0.049705
Potassium Bitartrate, $KHC_4H_4O_6$ (after ignition)	0.09339
Potassium Citrate, anhydrous, $K_3C_6H_5O_7$ (after ignition)	0.0507
Potassium Citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (after ignition)	0.05368
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (after ignition)	0.070045
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (after ignition)	0.06755
Sodium Benzoate, $NaC_7H_5O_2$ (after ignition)	0.07150
Sodium Carbonate, anhydrous, Na_2CO_3	0.026327
Sodium Carbonate, monohydrated, $Na_2CO_3 + H_2O$	0.030797
Sodium Citrate, $2Na_3C_6H_5O_7 + 11H_2O$ (after ignition)	0.0591
Sodium Salicylate, $NaC_7H_5O_3$ (after ignition)	0.079445

154. Tenth-Normal Sulphuric Acid Volumetric Solution.

$H_2SO_4 = 97.35$. 4.8675 Gm. in 1000 Cc.

Dilute 100 Cc. of normal sulphuric acid with sufficient water to measure 1000 Cc. at 25° C. (77° F.).

This standard solution is employed in conjunction with the fiftieth-normal potassium hydroxide V.S. in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin T.S. as an indicator. For this purpose a special experiment should be made, in which an accurately measured volume of 10 Cc. of the tenth-normal sulphuric acid, after adding 1 Cc. of hematoxylin T.S. (or a sufficient quantity of the indicator to be employed), should require 50 Cc. of the fiftieth-normal potassium hydroxide V.S. for complete neutralization, at 25° C. (77° F.). If necessary, an adjustment should be made to render the correspondence perfect.

One Cubic Centimeter of Tenth-Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.0048675
Potassium Hydroxide, KOH	0.005574
Aconitine, $C_{34}H_{47}NO_{11}$	0.06406
Atropine, $C_{17}H_{23}NO_3$	0.02870
Brucine, $C_{23}H_{26}N_2O_4$	0.03913
Calcium Hydroxide, $Ca(OH)_2$	0.003678
Cephaëline, $C_{14}H_{19}NO_2$	0.02314
Cinchonidine, $C_{19}H_{22}N_2O$	0.02920
Cinchonine, $C_{19}H_{22}N_2O$	0.02920
Combined Alkaloids of Cinchona	0.03069
Combined Alkaloids of Ipecac	0.02384

One Cubic Centimeter of Tenth-Normal Sulphuric Acid V.S. is the equivalent of:—(Continued.)

	Gramme.
Cocaine, $C_{17}H_{21}NO_4$	0.03009
Coniine, $C_8H_{17}N$	0.01262
Emetine, $C_{15}H_{21}NO_2$	0.02453
Hydrastine, $C_{21}H_{21}NO_6$	0.03803
Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.03009
Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.02830
Physostigmine, $C_{15}H_{21}N_3O_2$	0.02732
Pilocarpine, $C_{11}H_{16}N_2O_2$	0.02066
Quinine, $C_{20}H_{24}N_2O_2$	0.03218
Strychnine, $C_{21}H_{22}N_2O_2$	0.03317

155. Fiftieth-Normal Sulphuric Acid Volumetric Solution.

$H_2SO_4 = 97.35$. 0.9735 Gm. in 1000 Cc.

Dilute 20 Cc. of normal sulphuric acid V.S., or 200 Cc. of tenth-normal sulphuric acid V.S., with sufficient distilled water to measure, at 25° C. (77° F.), 1000 Cc. This standard solution may be employed in the titration of alkaloids, with hematoxylin, cochineal, or iodeosin T.S. as an indicator.

One Cubic Centimeter of Fiftieth-Normal Sulphuric Acid V.S. is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.0009735
Aconitine, $C_{34}H_{47}NO_{11}$	0.012811
Atropine, $C_{17}H_{23}NO_3$	0.005741
Cinchonidine, $C_{19}H_{22}N_2O$	0.005841
Cinchonine, $C_{19}H_{22}N_2O$	0.005841
Combined Alkaloids of Cinchona	0.006139
Combined Alkaloids of Ipecac	0.004768
Cocaine, $C_{17}H_{21}NO_4$	0.006018
Coniine, $C_8H_{17}N$	0.002524
Hydrastine, $C_{21}H_{21}NO_6$	0.007606
Morphine, crystallized, $C_{17}H_{19}NO_3 + H_2O$	0.006018
Morphine, anhydrous, $C_{17}H_{19}NO_3$	0.005661
Physostigmine, $C_{15}H_{21}N_3O_2$	0.005464
Pilocarpine, $C_{11}H_{16}N_2O_2$	0.004133
Quinine, $C_{20}H_{24}N_2O_2$	0.006436
Strychnine, $C_{21}H_{22}N_2O_2$	0.006635

GASOMETRIC ESTIMATIONS.

(U. S. P. 8TH REV.)

In certain cases the United States Pharmacopœia (8th Rev.) directs the strength of a product or chemical substance to be determined by the volume of gas (nitrogen dioxide) given off during a definite reaction. This volume is to be determined by the nitrometer in the following manner:

Arrange a nitrometer consisting of a measuring tube (graduated for at least 50 Cc.) connected by stout rubber tubing with an open equilibrium tube (both tubes, preferably, provided with a globular expansion near the lower end) in such a manner, by suitable clamps attached to a stand, that either tube may be readily and quickly clamped at a higher or lower level. The stop-cock of the measuring tube having been opened, and the open equilibrium tube having been raised to a higher level, pour into the latter a saturated aqueous solution of sodium chloride, until the measuring tube, including the bore of the stop-cock, is completely filled. Then close the latter and fix the equilibrium tube at a low level. Having ascertained that the stop-cock is closed air-tight, and having, if necessary, wiped out the graduated tube of the nitrometer, introduce into it the prescribed quantity of the liquid to be tested, and allow this to flow slowly into the measuring tube, being careful not to admit any air. Follow it by the prescribed quantities of the several reagents (potassium iodide T.S., and normal sulphuric acid V.S.). When the reaction, which takes place at once, moderates, remove the measuring tube from its clamp, and, being careful to hold it constantly so that the liquid contained in it stands at a higher level than that in the equilibrium tube, shake its contents, without permitting any gas to pass into the open tube. When the reaction has completely ceased, restore the tube to its fastening, and allow the apparatus and contents to acquire the ordinary temperature of the room, which is assumed to be at or about 25° C. (77° F.). Then adjust the two tubes so that the liquid columns are at exactly the same level, and read off the volume of gas in the measuring tube. Multiply this figure by the weight of the substance, which is the equivalent of 1 Cc. of nitrogen dioxide (see No. 156, page 1727). The result will be the weight of the pure substance (nitrite) contained in the amount taken for the assay.

For pharmacopœial purposes the determination will be sufficiently exact if the evolved gas be measured at or near 25° C. (77° F.).

Since temperature and barometric pressure materially affect the volume of the gas, the following correction factors must be used to obtain reasonably exact results when the temperature and pressure are not nearly normal. The barometer correction is important at any locality more than 250 meters above sea-level:

Factors for Temperature Corrections.
(Normal Temperature, 25° C.)

Temperature.	Factor.	Temperature.	Factor.	Temperature.	Factor.
15° C.	1.035	22° C.	1.010	29° C.	0.987
16° C.	1.031	23° C.	1.007	30° C.	0.983
17° C.	1.028	24° C.	1.003	31° C.	0.980
18° C.	1.024	25° C.	1.000	32° C.	0.977
19° C.	1.021	26° C.	0.997	33° C.	0.974
20° C.	1.017	27° C.	0.993	34° C.	0.971
21° C.	1.014	28° C.	0.990	35° C.	0.968

EXAMPLE.—Assuming that the volume of gas read off was 44.5 Cc. at 32° C. (89.6° F.), and it is desired to ascertain the corresponding volume at 25° C. (77° F.), barometric pressure not being taken into consideration, then the 44.5 Cc. must be reduced in the proportion of 1 to 0.977 (see temperature correction factors above), or 44.5 must be multiplied by 0.977. The result will be 43.48 (43.4765) Cc. as the equivalent volume of gas at 25° C. (77° F.).

Factors for Correction for Barometric Pressure.
(Normal Barometer, 760 Mm.)

Barometer Reading.		Factor.	Barometer Reading.		Factor.
Mm.	Inches.		Mm.	Inches.	
790	31.10	1.039	660	25.98	0.868
780	30.71	1.026	650	25.59	0.855
770	30.31	1.013	640	25.20	0.842
760	29.92	1.000	630	24.80	0.829
750	29.53	0.987	620	24.41	0.816
740	29.13	0.974	610	24.02	0.803
730	28.74	0.961	600	23.62	0.789
720	28.35	0.947	590	23.23	0.776
710	27.95	0.934	580	22.83	0.763
700	27.56	0.921	570	22.44	0.750
690	27.17	0.907	560	22.05	0.737
680	26.77	0.895	550	21.65	0.724
670	26.38	0.882			

EXAMPLE.—Assuming that the volume of gas read off was 43.48 (43.4765) Cc. at 590 Mm. barometric pressure, and it is desired to ascertain the corresponding volume at normal barometric pressure (760 Mm.), temperature not being taken into consideration, then the 43.48 Cc. must be reduced in the proportion of 1 to 0.776 (see barometric correction factors above), or 43.48 must be multiplied by 0.776. The result will be 33.74 Cc. as the equivalent volume of gas at normal barometric pressure.

156. Estimation of Nitrogen Dioxide.

NO = 29.81 ; 1 Liter { at 0° C. and 760 Mm. = 1.3396 Gm.
at 25° C. and 760 Mm. = 1.2272 Gm.

One Cubic Centimeter of Nitrogen Dioxide is the equivalent of:

	At 0° C. and 760 Mm. Gramme.	At 25° C. and 760 Mm. Gramme.
Nitrogen Dioxide, NO = 29.81	0.0013396	0.0012272
Amyl Nitrite, $C_5H_{11}NO_2$ = 116.24	0.0052234	0.0047851
Ethyl Nitrite, $C_2H_5NO_2$ = 74.51	0.0033482	0.0030673
Sodium Nitrite, $NaNO_2$ = 68.57	0.0030813	0.0028227

ALKALOIDAL ASSAY BY IMMISCIBLE SOLVENTS.

(U. S. P. 8TH REV.)

Nearly all alkaloids are practically insoluble in water, but they are soluble in alcohol, chloroform, ether, amyl alcohol, benzene, petroleum benzin, or mixtures of several of these. The salts of these alkaloids, however, are soluble in water, but practically insoluble in the above-mentioned solvents. The process of assay by immiscible solvents, which is generally known as the "shaking out" process, is based on this property of alkaloids, and it is carried out by treating liquid extracts that have been freed from alcohol, with an immiscible solvent in the presence of an excess of alkali. This liberates the alkaloid, and, on becoming free, if not so previously, it is dissolved by the immiscible solvent. This solution is then separated, transferred to another container, and shaken with an excess of acid largely diluted with water. The acid combining with the free alkaloid forms a salt, which now leaves the immiscible solvent and is found in the aqueous solution. This process is sometimes repeated, in case the alkaloidal solution is still colored. The apparatus used in this operation of shaking out is termed a "separator," and consists of an oval or pear-shaped glass vessel, with an opening at the top supplied with a well-ground glass stopper, and an outlet tube at the bottom, provided with an accurately fitting glass stop-cock. The solvents directed to be used in the U. S. P. (8th Rev.) are alcohol, chloroform, ether, and various mixtures of these containing at least 75 parts of ether in 100 parts of solvent by volume. In the case of chloroform, the solvent will collect at the bottom of the separator, and can be drawn off, but the ethereal or ether-chloroform mixture will form the upper portion of the liquid in the separator, and the

aqueous layer must first be drawn off into a suitable vessel, and the ethereal layer then transferred to another vessel. It is not necessary or desirable to shake the mixture of immiscible solvent and water violently, for a rotation of the separator or a gentle shaking for about a minute will answer all purposes. At times, an emulsion of the water and the solvent is formed, especially if the shaking is too violent, and in order to separate this, it is advisable to proceed as follows: If the solvent is heavier than the water, add more of the former, a little water, and a slight amount of alcohol; if the solvent is lighter than the water, add sufficient saturated sodium chloride solution or crystals of sodium chloride. A safe procedure to avoid the forming of emulsions is to invert the separator several times, and then to at once begin rotating to keep the solvents well mixed. To insure a complete extraction of the alkaloid, it is desirable to treat the liquid three times with the immiscible solvent, and this is to be followed by a rinsing of the empty separator with repeated small portions of the same solvent. The separator should not be filled to more than two-thirds of its capacity at any time, and if its contents should become heated by the neutralization of acid by alkali, or *vice versa*, it should be cooled to the temperature of the room, before opening the stopper, by immersing it in running water. The final operation must always be the collection of the free alkaloid by the use of a portion of the immiscible solvent, drawing this off into a beaker, rinsing with small portions of the solvent to prevent possible loss. The beaker is then placed on a water-bath and gently heated, to remove the solvent by evaporation, leaving the alkaloids in the beaker in the dry form, and usually in the condition of a resinous or varnish-like mass. It is then either weighed as such or dissolved in volumetric acid solution, delivered in measured quantity from a burette, and the excess of the acid titrated with volumetric alkali solution with the use of an indicator. Should the final residual alkaloids still be slightly colored, it is preferable to employ iodeosin as the indicator, as the alkaloidal solution contains ether and the ethereal layer retains in solution coloring matter or impurity which may be present. If the alkaloids are not colored, hematoxylin or cochineal may safely be used.

The quantity of alkaloid is found by multiplying the number of cubic centimeters of volumetric acid consumed by a constant factor, depending upon the molecular weight of the individual alkaloid. These factors will be found on page 1725, under Tenth-Normal Sulphuric Acid V.S. (No. 154), and are used throughout the text without explanation. The factor in each case represents the weight in grammes of the alkaloid required to neutralize 1 Cc. of volumetric acid.

DETERMINATION OF THE OPTICAL ROTATION OF ORGANIC SUBSTANCES.

(U. S. P. 8TH REV.)

Many organic substances either liquid by nature or in solution in suitable solvents, when examined in a specially constructed polarizing apparatus or polaristrobometer, exhibit the property of circular polarization, or, in other words, are capable of rotating the plane of polarization of a ray of light either to the right or to the left. Such substances are termed "optically active," and when rotating to the right are designated as "dextro-rotatory" or "dextrogyrate," and when rotating to the left, as "lævo-rotatory" or "lævogyrate." Substances which do not possess this property of optical rotation are termed "optically inactive."

Among the substances recognized by the U. S. P. (8th Rev.), there are several, particularly certain essential or volatile oils, and related bodies, for which the determination of the angle of rotation of a ray of polarized light, or, in some cases, the proof of their optical inactivity, affords the most simple and positive evidence of their identity or purity.

The instruments used for this purpose vary somewhat in their construction. Those which are most generally adapted for the examination of the substances mentioned above are the Polaristrobometer of Wild, in which the optical activity of the substance is manifested by the appearance or disappearance of dark, parallel stripes, or the so-called "half-shadow" instrument of Laurent, in which the two sides of the field of vision are capable of becoming unequally illuminated. Both of the instruments permit the angle of rotation to be read off in degrees or fractions of a degree of a circle.

These optical determinations are best made in a dark room, and by means of homogeneous or monochromatic light, the latter being obtained by introducing into a non-luminous flame, on a loop of platinum wire, a small bead of fused sodium chloride. The light thus radiated corresponds with the line D of the solar spectrum.

Since the deviation of the plane of polarization either to the right or to the left of the zero point is directly proportional to the length of the column of liquid, it is important that the observations should be made with tubes of a definite length, such as 100, 50, or 25 Mm. The selection of the length of the tube to be employed is, however, usually dependent upon the depth of color of the liquid and the extent of its optical rotation.

The rotatory power of an optically active, liquid substance, observed with sodium light, and referred to the ideal density 1, and in a tube having a length of 1 decimeter (100 Mm.), is designated as its *specific rotatory power*. This is usually expressed by the term $[a]_D$. Since, however, not only the density of an optically active liquid, but also its rotation, is influenced by the temperature, the specific rotation varies with the latter. In stating the specific rotation it is, therefore, necessary to indicate at what temperature the rotation and the density of the liquid have been determined. But for the same temperature the specific rotation of a pure, optically active liquid is always a constant number. The temperature used in the text of the U. S. P. (8th Rev.) is 25° C. (77° F.).

For calculating the specific rotatory power of an optically active liquid substance, or solution of an optically active solid, the following formulas are of general application:

I. For liquid substances $$[a]_D = \frac{100 \times a}{L \times d}$$

II. For solutions of solids $$[a]_D = \frac{10000 \times a}{L \times p \times d}$$

or $$[a]_D = \frac{10000 \times a}{L \times c}$$

For calculating these formulas the determination of the following factors is necessary:

a = the angle of rotation of the liquid or solid observed with sodium light.
L = the length of the tube in millimeters.
d = the density or specific gravity of the active liquid.
p = the amount of active substance in 100 parts by weight of the solution.
c = the number of grammes of active substance in 100 cubic centimeters of the solution.

ARTICLES EMPLOYED IN CHEMICAL TESTING AND TEST-SOLUTIONS OF THE BRITISH PHARMACOPŒIA.

The British test-solutions here given are used for determining the character of particular substances, whether isolated or in composition; thus enabling us to ascertain the identity of medicines, their purity or impurity, and the character of the foreign ingredients, which may be mixed with them accidentally, or with a view to adulteration.

Acetic Acid.—"The Acetic Acid of the British Pharmacopœia." *Br.*

Acetic Acid, Glacial.—"The Glacial Acetic Acid of the British Pharmacopœia." *Br.*

Albumen.—"The liquid white, separated from the yolk, of the egg of Gallus Bankiva, *var.* domesticus, *Temminck.*" *Br.*

Alcohol, Absolute.—"The Absolute Alcohol of the British Pharmacopœia." *Br.*

Alcohol (90 per cent.). **Alcohol** (70 per cent.).—"The Alcohol (90 per cent.) and Alcohol (70 per cent.) of the British Pharmacopœia." *Br.*

Alum.—"The Alum of the British Pharmacopœia." *Br.*

Ammonium Molybdate.—"A nearly white crystalline salt, $(NH_4)_2MoO_4$." *Br.*

Ammonium Oxalate.—"Colorless crystals, $(COONH_4)_2,H_2O$, prepared by neutralizing oxalic acid with solution of ammonia." *Br.*

Ammonium Thiocyanate.—"A crystalline salt, NH_4SCN." *Br.*

Amylic Alcohol.—"A liquid consisting principally of iso-primary amylic alcohol, $(CH_3)_2$: $CH.CH_2.CH_2OH$. It may be prepared by shaking commercial fusel oil with a saturated solution of common salt, separating the oily layer, submitting it to distillation, and collecting and reserving the portion which distils between 257° and 289° F. (125° and 142.8° C.)." *Br.*

Barium Chloride.—"Colorless crystals, $BaCl_2,2H_2O$. Its solution should not give a precipitate with solution of ammonium hydrosulphide, and no residue should remain after adding excess of diluted sulphuric acid, filtering, and evaporating the filtrate to dryness in a platinum dish. Barium nitrate, $Ba2NO_3$, or barium acetate, $(CH_3COO)_2Ba$, may be used in place of barium chloride, but each must respond to the foregoing tests." *Br.*

Barium Hydroxide.—"Colorless crystals, $Ba(OH)_2,8H_2O$, prepared by mixing concentrated solutions of barium chloride and sodium hydroxide. The precipitate is purified by recrystallization from water. It should be entirely soluble in water, the resulting solution should give no precipitate with solution of ammonium hydrosulphide, and a very slight residue should remain after adding excess of diluted sulphuric acid, filtering, and evaporating the filtrate to dryness in a platinum dish." *Br.*

Benzol.—"The Benzol of the British Pharmacopœia." *Br.*

Benzolated Amylic Alcohol.—"Benzol, 3 parts by volume; Amylic Alcohol, 1 part by volume. Mix; decant from any deposited water." *Br.*

Bismuth Oxynitrate.—"The Bismuth Oxynitrate of the British Pharmacopœia." *Br.*

Borax.—"The Borax, $Na_2B_4O_7,10H_2O$, of the British Pharmacopœia." *Br.*

Bromine.—"The Bromine of commerce." *Br.*

Cadmium Iodide.—"The pure crystals, CdI_2, of commerce." *Br.*

Calcium Carbonate.—"The pure white marble, or calc-spar, of commerce." *Br.*

Calcium Hydroxide.—"The Calcium Hydroxide of the British Pharmacopœia." *Br.*

Calcium Oxide.—"The Lime of the British Pharmacopœia." *Br.*

Calcium Sulphate.—"Pure native calcium sulphate, $CaSO_42H_2O$." *Br.*

Carbon Bisulphide.—"The Carbon Bisulphide of the British Pharmacopœia." *Br.*

Chloroform.—"The Chloroform of the British Pharmacopœia." *Br.*

Citric Acid.—"The Citric Acid of the British Pharmacopœia." *Br.*

Collodion.—"The Collodion of the British Pharmacopœia." *Br.*

Copper.—"The metal in foil, wire, or turnings." *Br.*

Copper Oxyacetate.—"The pure copper oxyacetate, or verdigris, of commerce." *Br.*

Copper Sulphate.—"The Copper Sulphate of the British Pharmacopœia." *Br.*

Ether.—"The Ether of the British Pharmacopœia." *Br.*

Ferric Chloride.—"The pure anhydrous ferric chloride of commerce." *Br.*

Ferrous Sulphate.—"The Ferrous Sulphate of the British Pharmacopœia." *Br.*

Glycerin.—"The Glycerin of the British Pharmacopœia." *Br.*

Hydrochloric Acid.—"The Hydrochloric Acid of the British Pharmacopœia." *Br.*

Hydrochloric Acid, Diluted.—"The Diluted Hydrochloric Acid of the British Pharmacopœia." *Br.*

Hydrochloric Acid, Gaseous.—"The dry gas, HCl, prepared by the interaction of sulphuric acid and common salt." *Br.*

Hydrogen Sulphide.—Synonym—*Sulphuretted Hydrogen.* "A gas prepared by the action of hydrochloric acid on ferrous sulphide. It will be sufficiently pure after passing through two wash-bottles each containing water. A solution of the gas in water may also be employed, but only if it smells strongly of the gas and yields an abundant black precipitate with solution of lead subacetate." *Br.*

Indigo.—"A blue pigment prepared from various species of Indigofera, *Linn.*" *Br.*

Iron.—"The Iron of the British Pharmacopœia." *Br.*

Isinglass.—"The swimming bladder, or sound, of various species of Acipenser, *Linn.*, prepared and cut into shreds." *Br.*

Lead Acetate.—"The Lead Acetate of the British Pharmacopœia." *Br.*

Lead Peroxide.—"The pure lead peroxide, PbO_2, of commerce." *Br.*

Lime.—"The Lime of the British Pharmacopœia." *Br.*

Litmus.—"A blue pigment prepared from various species of Roccella, *DC.* Litmus is used in several forms. For example, Solution of Litmus [page 1733]; Blue Litmus Paper, made by impregnating unglazed white paper with a solution of litmus; and Red Litmus Paper, made by impregnating the paper with the solution reddened by the previous addition of a very minute quantity of sulphuric acid. Litmus may also be employed in the solid form." *Br.*

Manganese Peroxide.—"The powdered native peroxide, MnO_2, pyrolusite." *Br.*

Methyl-Orange.—"Methyl-orange, $NaO.SO_2.C_6H_4N : N.C_6H_4N(CH_3)_2$, or helianthin, is prepared by the combination of diazobenzenesulphonic acid and dimethylaniline in an alkaline solution. Its warm aqueous solution should give no precipitate with an alkali or with solution of calcium chloride, but an orange-yellow precipitate with solution of lead subacetate." *Br.*

Microcosmic Salt.—"The salt, $NaNH_4HPO_4,4H_2O$, of commerce." *Br.*

Milk of Lime.—"Lime, 100 grammes; Distilled water, 200 cubic centimetres. Mix." *Br.*

Morphinated Water.—"Prepared by digesting pure morphine in Chloroform Water for seven days at a temperature of 60° F. (15.5° C.), with occasional agitation, so as to obtain a saturated solution of the alkaloid, and filtering from the undissolved morphine." *Br.*

Morphine.—"The precipitate obtained on adding solution of ammonia, in slight excess, to a solution of a pure morphine salt in water, the precipitate being washed with water until free from ammonium salt." *Br.*

Mucilage of Gum Acacia.—"The Mucilage of Gum Acacia of the British Pharmacopœia." *Br.*

Mucilage of Starch.—"Triturate 1 gramme of Starch with a small quantity of Distilled Water to form a smooth paste; add more Distilled Water, gradually, to produce 50 cubic centimetres of mixture; boil for a few minutes, constantly stirring; cool. Mucilage of Starch should be recently prepared." *Br.*

Nitric Acid.—"The Nitric Acid of the British Pharmacopœia." *Br.*

Nitric Acid, Diluted.—"The Diluted Nitric Acid of the British Pharmacopœia." *Br.*

Nitric Acid, Fuming.—"Nitric Acid of specific gravity 1.5." *Br.*

Oil of Turpentine.—"The Oil of Turpentine of the British Pharmacopœia." *Br.*

Olive Oil.—"The Olive Oil of the British Pharmacopœia." *Br.*

Petroleum Spirit.—Synonym—*Petroleum Ether.* "A colorless, very volatile, and highly inflammable liquid obtained from petroleum, and consisting of a mixture of the lower members of the paraffin series of hydrocarbons. Boiling point 122° to 140° F. (50° to 60° C.). Specific gravity 0.670 to 0.700." *Br.*

Phenol.—"The Phenol of the British Pharmacopœia." *Br.*

Phenol-Phthalein.—"A crystalline substance produced by interaction of phenol and phthalic anhydride. $C\begin{cases} C_6H_4.OH \\ C_6H_4.OH \\ C_6H_4.CO \\ O\text{——}! \end{cases}$" *Br.*

Picric Acid.—"Trinitrophenol, $C_6H_2(NO_2)_3OH$, obtained by the action of nitric acid on phenol." *Br.*

Potassium Bichromate.—"The Potassium Bichromate of the British Pharmacopœia." *Br.*

Potassium Chlorate.—"The Potassium Chlorate of the British Pharmacopœia." *Br.*

Potassium Chromate.—"The pure, neutral, yellow crystals, K_2CrO_4, of commerce." *Br.*

Potassium Cyanide.—"The commercial salt, containing at least 90 per cent. of potassium cyanide, KCN." *Br.*

Potassium Ferricyanide.—"The red crystalline salt, $K_6Fe_2C_{12}N_{12}$. Its aqueous solution should give no precipitate or blue coloration with a dilute solution of a pure ferric salt." *Br.*

Potassium Ferrocyanide.—"The yellow crystalline salt, $K_4FeC_6N_6,3H_2O$, prepared by fusing together potassium carbonate, nitrogenous organic matter, and iron." *Br.*

Potassium Hydrogen Sulphite.—Synonym—*Acid Potassium Sulphite.* "The commercial salt, $KHSO_3$." *Br.*

Potassium Hydroxide.—"The Caustic Potash of the British Pharmacopœia." *Br.*

Potassium Iodide.—"The Potassium Iodide of the British Pharmacopœia." *Br.*

Potassium Permanganate.—"The Potassium Permanganate of the British Pharmacopœia." *Br.*

Potassium Sulphate.—"The Potassium Sulphate of the British Pharmacopœia." *Br.*

Powdered Talc.—"A natural magnesium silicate, powdered, and purified by boiling with diluted hydrochloric acid, washing with distilled water until neutral to litmus, and drying." *Br.*

Sodium Acetate.—"The pure commercial salt, $CH_3COONa,3H_2O$." *Br.*

Sodium Arsenate.—"The Sodium Arsenate of the British Pharmacopœia." *Br.*

Sodium Bicarbonate.—"The Sodium Bicarbonate of the British Pharmacopœia." *Br.*

Sodium Carbonate.—"The Sodium Carbonate of the British Pharmacopœia." *Br.*

Sodium Chloride.—"The Sodium Chloride of the British Pharmacopœia." *Br.*

Sodium Hydrogen Sulphite.—Synonym—*Acid Sodium Sulphite.* "The commercial salt, $NaHSO_3$." *Br.*

Sodium Hydroxide.—"The sodium hydroxide, sodium hydrate, or 'caustic soda,' of commerce, occurs in hard grayish-white rods or cakes, deliquescent, very alkaline and corrosive. It affords the reactions characteristic of sodium. It usually contains as impurities alumina, carbonates, chlorides, phosphates, silicates, and sulphates. A clear solution of caustic soda may be used, instead of a solution of Purified Sodium Hydroxide, in all analytical operations in which the foregoing impurities would not vitiate the result. Purified Sodium Hydroxide may be obtained by dissolving caustic soda in ethylic alcohol, filtering the solution, evaporating it to dryness in a silver dish, occasionally adding distilled water during the evaporation. The residue is Purified Sodium Hydroxide. It should yield no characteristic reaction with the tests for phosphates or sulphates, and not more than the slightest reactions with the tests for carbonates. It is not quite free from alumina. Pure Sodium Hydroxide may be prepared by the interaction of pure barium hydroxide and sodium sulphate, or by the interaction of pure sodium and water. A solution of Pure Sodium Hydroxide is required only in testing for small quantities of aluminium." *Br.*

Sodium Nitrite.—"The Sodium Nitrite of the British Pharmacopœia." *Br.*

Sodium Potassium Tartrate.—"The Sodium Potassium Tartrate of the British Pharmacopœia." *Br.*

Sodium Sulphate.—"The Sodium Sulphate of the British Pharmacopœia." *Br.*

Sodium Sulphite.—"The Sodium Sulphite of the British Pharmacopœia." *Br.*

Sodium Thiosulphate.—Synonym—*Sodium Hyposulphite.* "The crystalline salt, $Na_2S_2O_3,5H_2O$. 2.4644 grammes should decolorize 100 cubic centimetres of the volumetric solution of iodine." *Br.*

Sulphur.—"The Sublimed Sulphur of the British Pharmacopœia." *Br.*

Sulphuric Acid.—"The Sulphuric Acid of the British Pharmacopœia." *Br.*

Sulphuric Acid, Diluted.—"The Diluted Sulphuric Acid of the British Pharmacopœia." *Br.*

Tartaric Acid.—"The Tartaric Acid of the British Pharmacopœia." *Br.*

Test Papers.—"See 'Litmus' and 'Turmeric.'" *Br.*

Tin.—"Tin, granulated by letting drops of it in the molten state fall into water. It should yield no reactions with the tests for lead, copper, iron, or zinc." *Br.*

Turmeric.—"The dried rhizome of Curcuma longa, *Linn.* Turmeric is commonly used in the form of tincture prepared from the bruised rhizome, in the proportion of 1 gramme to 6 cubic centimetres of Alcohol (90 per cent.) by the process of maceration or in the form of paper prepared by steeping unglazed white paper in the tincture and drying." *Br.*

Uranium Nitrate.—"The crystals of pure uranium nitrate of commerce." *Br.*

Water.—"The Distilled Water of the British Pharmacopœia." *Br.*

Zinc.—"The laminated or granulated metal. It should be entirely dissolved by diluted hydrochloric acid. The solution should yield no characteristic reaction with the tests for lead, copper, cadmium, arsenium, tin, and iron." *Br.*

TEST-SOLUTIONS. Br.

Solution of Albumen.—"Albumen, 2 cubic centimetres; Distilled Water, 8 cubic centimetres, or a sufficient quantity. Mix by trituration in a mortar, and filter through clean tow first moistened with Distilled Water. Solution of Albumen must be recently prepared. The strength of the Solution may be adjusted to suit particular requirements." *Br.*

Solution of Ammonia.—"The Solution of Ammonia of the British Pharmacopœia." *Br.*

Solution of Ammonia, Strong.—"The Strong Solution of Ammonia of the British Pharmacopœia." *Br.*

Solution of Ammonium Acetate.—"The Solution of Ammonium Acetate of the British Pharmacopœia." *Br.*

Solution of Ammonium Carbonate.—"Ammonium Carbonate, in small pieces, 10 grammes; Solution of Ammonia, 15 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Ammonium Chloride.—"Ammonium Chloride, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Ammonium Chloride (Nessler's).—"Ammonium Chloride, 3.15 grammes; Distilled Water, recently boiled, and free from ammonia, sufficient to produce 1000 cubic centimetres. Dissolve." *Br.*

Solution of Ammonium Citrate.—"The Solution of Ammonium Citrate of the British Pharmacopœia." *Br.*

Solution of Ammonium Hydrosulphide.—"Saturate one hundred and twenty cubic centimetres of Solution of Ammonia with washed Hydrogen Sulphide; add eighty cubic centimetres of Solution of Ammonia. The Solution should be freshly prepared." *Br.*

Solution of Ammonium Molybdate.—"Ammonium Molybdate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Ammonium Oxalate.—"Ammonium Oxalate, 5 grammes; Distilled Water, warm, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Ammonium Thiocyanate.—"Ammonium Thiocyanate, 5 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Auric Chloride.—"Pure Gold of commerce, in leaf, 1 gramme; Nitric Acid, 1.5 cubic centimetres; Hydrochloric Acid, 7 cubic centimetres; Distilled Water, a sufficient quantity. Place the Gold in a flask with the Nitric Acid and six cubic centimetres of the Hydrochloric Acid, first mixed with four cubic centimetres of the Distilled Water, and digest until it is dissolved. Add one cubic centimetre of Hydrochloric Acid. Evaporate in a basin at a temperature not exceeding 212° F. (100° C.) until acid vapors cease to be given off. Dissolve the auric chloride thus obtained in fifty cubic centimetres of Distilled Water." *Br.*

Solution of Barium Chloride.—"Barium Chloride, in crystals, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Barium Hydroxide.—"Barium Hydroxide, 10 grammes; Distilled Water, recently boiled, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Boric Acid.—"Boric Acid, 5 grammes; Alcohol (90 per cent.), sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Bromine.—"Bromine, 1 cubic centimetre; Distilled Water, sufficient to produce 150 cubic centimetres. Place the Bromine in a bottle furnished with a well-fitting stopper, and pour in the Distilled Water; shake several times. Keep the Solution in a dark place." *Br.*

Solution of Cadmium Iodide.—"Cadmium Iodide, 5 grammes; Distilled Water, sufficient to produce 100 cubic centimetres. Dissolve and filter." *Br.*

Solution of Calcium Chloride.—"Calcium Chloride, fused, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Calcium Sulphate.—"Calcium Sulphate, 2.5 grammes; Distilled Water, 200 cubic centimetres. Rub the Calcium Sulphate in a porcelain mortar for a few minutes with twenty cubic centimetres of the Distilled Water; shake the mixture thus obtained with the rest of the Distilled Water; set aside; filter." *Br.*

Solution of Chlorinated Soda.—"The Solution of Chlorinated Soda of the British Pharmacopœia." *Br.*

Solution of Chlorine.—"Produced by saturating Distilled Water with chlorine. The chlorine may be obtained by the interaction of Hydrochloric Acid and Manganese Peroxide, and should be purified by passing through a small quantity of water contained in a wash-bottle. The solution should be recently prepared." *Br.*

Solution of Chromic Acid.—"The Solution of Chromic Acid of the British Pharmacopœia." *Br.*

Solution of Copper Acetate.—"Copper Oxyacetate, in fine powder, 20 grammes; Acetic Acid, 40 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Dilute the Acetic Acid with twenty cubic centimetres of the Distilled Water; digest the Copper Oxyacetate in the mixture at a temperature not exceeding 212° F. (100° C.), with repeated stirring; continue heating until a dry residue is obtained. Digest the product in one hundred and sixty cubic centimetres of Boiling Distilled Water; make up the required volume with Distilled Water; filter." *Br.*

Solution of Copper Ammonio-Sulphate.—"Copper Sulphate, in crystals, 10 grammes; Solution of Ammonia, a sufficient quantity; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve the Copper Sulphate in one hundred and sixty cubic centimetres of the Distilled Water, and cautiously add the Solution of Ammonia to the liquid until the precipitate first formed is nearly dissolved; filter the product; finally make up the required volume with Distilled Water. A concentrated solution may be prepared by using a smaller quantity of distilled water." *Br.*

Solution of Copper Sulphate.—"Copper Sulphate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve, and filter if necessary." *Br.*

Solution of Ferric Chloride.—"See 'Test-Solution of Ferric Chloride' [page 1734]." *Br.*

Solution of Ferric Sulphate.—"The Solution of Ferric Sulphate of the British Pharmacopœia." *Br.*

Solution of Ferrous Sulphate.—"Ferrous Sulphate, 4 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter. The Solution of Ferrous Sulphate should be recently prepared." *Br.*

Solution of Hydrogen Peroxide.—"The Solution of Hydrogen Peroxide of the British Pharmacopœia." *Br.*

Solution of Indigo Sulphate.—"Indigo, dry and in fine powder, 0.2 gramme; Sulphuric Acid, 200 cubic centimetres. Mix the Indigo with two cubic centimetres of the Sulphuric Acid in a small test-tube, and heat in boiling water for an hour; pour the product into the remainder of the acid; shake the mixture; decant the clear liquid." *Br.*

Solution of Iodine.—"The Volumetric Solution of Iodine [page 1738]." *Br.*

Solution of Isinglass.—"Isinglass, in shreds, 4 grammes; Distilled Water, warm, sufficient to produce 200 cubic centimetres. Mix, and digest for half an hour on a water-bath with repeated shaking, and filter through clean moistened tow. Solution of Isinglass must be recently prepared." *Br.*

Solution of Lead Acetate.—"Lead Acetate, 20 grammes; Distilled Water, recently boiled, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Lead Subacetate.—"The Strong Solution of Lead Subacetate of the British Pharmacopœia; or the same, more or less diluted." *Br.*

Solution of Lime.—Synonym—*Solution of Calcium Hydroxide.* "The Solution of Lime of the British Pharmacopœia." *Br.*

Solution of Litmus.—"Litmus, in powder, 20 grammes; Alcohol (90 per cent.), 200 cubic centimetres; Distilled Water, 200 cubic centimetres. Boil the Litmus with eighty cubic centimetres of the Alcohol for one hour; pour away the clear liquid; repeat this operation with sixty cubic centimetres of the Alcohol; and a third time with the remainder of the Alcohol. Digest the washed Litmus in the Distilled Water, and filter." *Br.*

Solution of Magnesium Ammonio-Sulphate.—"Magnesium Sulphate, 20 grammes; Ammonium Chloride, 40 grammes; Solution of Ammonia, 84 cubic centimetres; Distilled Water, 160 cubic centimetres. Dissolve the Magnesium Sulphate and Ammonium Chloride in the Distilled Water; add the Solution of Ammonia, and set the mixture aside for a few days in a well-closed bottle; decant and filter." *Br.*

Solution of Magnesium Sulphate.—"Magnesium Sulphate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Mercuric Chloride.—"See 'Test-Solution of Mercuric Chloride' [page 1734]." *Br.*

Solution of Mercurous Nitrate.—"Mercury, 2 grammes; Nitric Acid, 1 cubic centimetre; Distilled Water, a sufficient quantity. To the Mercury, in a small dish, add one cubic centimetre of Distilled Water and the Nitric Acid, and set the whole aside for twenty-four hours in a cool dark place; drain the resulting crystals; dissolve them in two hundred cubic centimetres of Distilled Water." *Br.*

Solution of Methyl Orange.—"Methyl Orange, 0.4 gramme; Alcohol (90 per cent.), 50 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve." *Br.*

Solution of Phenol-Phthalein.—"Phenol-phthalein, 0.4 gramme; Alcohol (90 per cent.), 120 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve. The Solution should be colorless." *Br.*

Solution of Picric Acid.—"Picric Acid, 1 gramme; Distilled Water, sufficient to produce 150 cubic centimetres. Dissolve." *Br.*

Solution of Platinic Chloride.—"Platinum foil of commerce, 10 grammes; Hydrochloric Acid, 60 cubic centimetres; Nitric Acid, 10 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Heat the Platinum foil with the Hydrochloric Acid to about 176° F. (80° C.); add the Nitric Acid very gradually; evaporate the solution to dryness on a water-bath; moisten the residue with a few drops of Hydrochloric Acid; again evaporate to dryness; dissolve the residue in sufficient Distilled Water to produce two hundred cubic centimetres of the Solution." *Br.*

Solution of Potassio-Cupric Tartrate.—Synonym—*Fehling's Solution.*

"No. 1. Copper Sulphate, in crystals, 34.64 grammes; Sulphuric Acid, 0.5 cubic centimetre; Distilled Water, sufficient to produce 500 cubic centimetres. Dissolve.

No. 2. Sodium Potassium Tartrate, 176 grammes; Sodium Hydroxide, 77 grammes; Distilled Water, sufficient to produce 500 cubic centimetres. Dissolve. Mix equal volumes of the solutions No. 1 and No. 2 at the time of using." *Br.*

Solution of Potassio-Mercuric Iodide.—Synonym—*Nessler's Reagent.* "Potassium Iodide, 7 grammes; Mercuric Chloride, a sufficient quantity; Sodium Hydroxide, 24 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve the Potassium Iodide and two and a half grammes of Mercuric Chloride in one hundred and sixty cubic centimetres of Distilled Water; to this liquid add a cold saturated aqueous solution of Mercuric Chloride, with constant stirring, until a slight red precipitate remains; add the Sodium Hydroxide; when the latter has dissolved add a little more of the aqueous solution of Mercuric Chloride, and make up to the required volume with Distilled Water." *Br.*

Solution of Potassium Acetate.—"Potassium Acetate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Acid Tartrate.—"Digest excess of Acid Potassium Tartrate in Distilled Water; filter." *Br.*

Solution of Potassium Carbonate.—"Potassium Carbonate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Chromate.—"Potassium Chromate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Cyanide.—"Potassium Cyanide, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Ferricyanide.—"Potassium Ferricyanide, in crystals, 10 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter. This Solution should be freshly prepared." *Br.*

Solution of Potassium Ferrocyanide.—"Potassium Ferrocyanide, in crystals, 10 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Hydroxide.—"The Solution of Potash of the British Pharmacopœia." *Br.*

Solution of Potassium Hydroxide, Alcoholic.—"Potassium Hydroxide, 20 grammes; Alcohol (90 per cent.), sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Iodide.—"Potassium Iodide, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Potassium Permanganate.—"The Solution of Potassium Permanganate of the British Pharmacopœia." *Br.*

Solution of Pyroxylin.—"The Collodion of the British Pharmacopœia." *Br.*

Solution of Silver Ammonio-Nitrate.—"Silver Nitrate, in crystals, 5 grammes; Solution of Ammonia, 10 cubic centimetres, or a sufficient quantity; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve the Silver Nitrate in one hundred and sixty cubic centimetres of the Distilled Water, and cautiously add the Solution of Ammonia to the liquid until the precipitate first formed is nearly dissolved; set aside; decant; finally make up to the required volume with Distilled Water." *Br.*

Solution of Silver Nitrate.—"Silver Nitrate, 10 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve." *Br.*

Solution of Sodium Acetate.—"Sodium Acetate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Sodium Carbonate.—"Sodium Carbonate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Sodium Hydroxide.—"Purified Sodium Hydroxide, 40 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Sodium Phosphate.—"Sodium Phosphate, in crystals, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Sodium Sulphate.—"Sodium Sulphate, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

Solution of Stannous Chloride.—"Tin, granulated, 40 grammes; Hydrochloric Acid, 120 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Dilute the Acid in a flask with forty cubic centimetres of the Distilled Water, and, having added the Tin, apply heat gently until gas ceases to be evolved; make up to the required volume with Distilled Water, allowing the undissolved Tin to remain in the Solution." *Br.*

Solution of Sulphurous Acid.—"The Sulphurous Acid of the British Pharmacopœia." *Br.*

Solution of Tannic Acid. "Tannic Acid, 20 grammes; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve. Solution of Tannic Acid should be freshly prepared." *Br.*

Solution of Tartarated Antimony. "Tartarated Antimony, 10 grammes; Distilled Water, boiling, sufficient to produce 200 cubic centimetres. Dissolve and filter. Solution of Tartarated Antimony should be freshly prepared." *Br.*

Solution of Tartaric Acid.—"Tartaric Acid, in crystals, 25 grammes; Alcohol (90 per cent.), 50 cubic centimetres; Distilled Water, sufficient to produce 200 cubic centimetres. Dissolve the Tartaric Acid in one hundred and thirty cubic centimetres of the Distilled Water; add the Alcohol; make up to the required volume with Distilled Water." *Br.*

Solution of Uranium Nitrate.—"Uranium Nitrate, 10 grammes; Distilled Water, sufficient to produce 200 cubic centimetres." *Br.*

Test-Solution of Ferric Chloride.—"Dissolve 10 grammes of commercial anhydrous Ferric Chloride in sufficient Distilled Water to produce 200 cubic centimetres of solution. Filter if necessary." *Br.*

Test-Solution of Mercuric Chloride.—"Mercuric Chloride, 10 grammes; Distilled Water, boiling, sufficient to produce 200 cubic centimetres. Dissolve and filter." *Br.*

TESTS FOR SUBSTANCES MENTIONED IN THE TEXT OF THE BRITISH PHARMACOPŒIA.

Acetates.—"Neutral acetates are decomposed by heat, yielding vapors which possess a characteristic acetous odor. Hydrogen acetate and ethyl acetate have characteristic odors. Acetates when warmed with sulphuric acid yield vapors of hydrogen acetate; or, when warmed with sulphuric acid and a small quantity of alcohol (90 per cent.), yield ethyl acetate. Test-solution of ferric chloride affords a deep red coloration with neutral or faintly acid acetates, and the resulting liquid on boiling yields a reddish-brown precipitate. On adding hydrochloric acid the red solution turns yellow. On adding test-solution of mercuric chloride the red color is not discharged (distinction from thiocyanates). Dry acetates heated with (a very minute proportion of) arsenious anhydride yield (the highly poisonous) cacodyl oxide, recognizable by its characteristic smell." *Br.*

Aluminium.—"Solution of ammonia or solution of ammonium hydrosulphide affords a white gelatinous precipitate, soluble in hydrochloric acid, in acetic acid, and in solution of potassium hydroxide or solution of sodium hydroxide, but nearly insoluble in solution of ammonia and in solutions of ammonium salts, and quite insoluble when the solutions are boiled. Solution of ammonium oxalate causes no precipitate." *Br.*

Ammonium Salts.—"Ammonium salts volatilize when strongly heated, generally without residue. When heated with solution of potassium hydroxide, or with solution of sodium hydroxide, ammonium salts evolve ammonia, recognizable by its odor. Solution of platinic chloride affords with ammonium salts acidulated with hydrochloric acid a yellow crystalline precipitate, especially in the presence of alcohol. On ignition, this precipitate leaves a residue of platinum only. A concentrated solution of tartaric acid produces in concentrated solutions of ammonium salts a white crystalline precipitate, especially in the presence of much alcohol. Solution of potassio-mercuric iodide affords a brown precipitate, or a reddish-brown coloration, or, in excessively dilute solutions of ammonium salts, a yellowish tinge." *Br.*

Antimony.—"Hydrogen sulphide yields, in slightly acid solutions, an orange-colored precipitate, soluble in solution of potassium hydroxide, in ammonium hydrosulphide, and in the strongest hydrochloric acid with evolution of hydrogen sulphide, but almost insoluble in solution of the official Ammonium Carbonate and in solution of potassium hydrogen sulphite. Hydrogen, generated by the interaction

of zinc and diluted sulphuric acid, partially converts antimony compounds into hydrogen antimonide. A cold porcelain tile held in the flame of this gas acquires a dark metallic deposit, which is not appreciably dissolved by solution of chlorinated soda. The gas, when passed into solution of silver nitrate, causes a black precipitate containing antimony and silver, and on the cautious addition of solution of ammonia the supernatant liquid yields no yellow precipitate. If one end of a strip or rod of zinc be allowed to rest on a platinum capsule containing the acidulated antimony solution, the other end being in the liquid, hydrogen antimonide is not evolved, but the antimony is precipitated on the platinum as a black, adherent, non-granular stain, insoluble in hydrochloric acid. Copper foil precipitates antimony from solutions, and the antimony may be volatilized by heat, condensing as a white amorphous sublimate of oxides of antimony near to the copper." *Br.*

Arsenium.—"Hydrogen sulphide affords in solutions containing hydrochloric acid a yellow precipitate, soluble in solution of potassium hydroxide, potassium carbonate, ammonium hydrosulphide, and potassium hydrogen sulphite, and in solution of the official Ammonium Carbonate, but reprecipitated on addition of hydrochloric acid. The precipitate is insoluble in the strongest hydrochloric acid.

Nascent hydrogen, generated by the interaction of zinc and diluted sulphuric acid, converts arsenium compounds into hydrogen arsenide. A cold porcelain tile held in the flame of this gas acquires a dark metallic deposit, which is readily dissolved by solution of chlorinated soda. The gas, when passed into excess of solution of silver nitrate, causes a black precipitate of silver, and the cautious addition of solution of ammonia to the supernatant liquid causes a yellow precipitate. Hydrogen, generated by the interaction of zinc and solution of potassium hydroxide or sodium hydroxide, converts arsenium compounds into hydrogen arsenide. This gas gives a black stain to filtering paper soaked with solution of silver nitrate and placed as a cap over the tube in which the test is being performed. Hydrogen antimonide is not evolved from antimony compounds under similar circumstances. The operation should be performed in an atmosphere which is free from hydrogen sulphide. Stannous chloride dissolved in a large excess of hydrochloric acid gives on boiling with a solution containing arsenium a brownish-black precipitate. Bright copper foil precipitates arsenium from solutions acidulated by hydrochloric acid, and the arsenium may be volatilized by heat in an open tube, when it condenses, at some distance from the copper, as a white sublimate of characteristic octahedral crystals. *Arsenites.*—Solutions of arsenites yield a yellow precipitate with solution of silver ammonio-nitrate. *Arsenates.*—Solutions of arsenates yield a reddish-chocolate precipitate with solution of silver ammonio-nitrate. Solution of magnesium ammonio-sulphate affords a white crystalline precipitate." *Br.*

Bismuth.—"Hydrogen sulphide affords a brownish-black precipitate, insoluble in solution of potassium hydroxide, of potassium cyanide, in diluted hydrochloric acid, and in ammonium hydrosulphide, but decomposed and dissolved by boiling nitric acid. Solution of potassium hydroxide, sodium hydroxide, or ammonia, except in the presence of citrates, yields a white precipitate insoluble in excess of the precipitant. Dilute solution of sodium chloride in large excess gives in solutions which are not too acid a white precipitate, insoluble in tartaric acid. Solution of potassium chromate gives a yellow precipitate, soluble in dilute nitric acid, insoluble in solution of potassium hydroxide. Stannous chloride dissolved in a concentrated solution of potassium hydroxide gives a black precipitate when added in excess to a solution containing bismuth. Diluted sulphuric acid does not precipitate bismuth salts." *Br.*

Bromates.—"From bromates solution of sulphurous acid liberates bromine, recognizable by its odor and appearance. After ignition with charcoal bromates are converted into bromides, and the latter yield their characteristic reactions." *Br.*

Bromides or Hydrobromides.—"Solution of silver nitrate gives a yellowish curdy precipitate, readily soluble in solution of potassium cyanide, somewhat soluble in strong but almost insoluble in weak solution of ammonia, and insoluble in nitric acid. Solution of sodium nitrite with the addition of diluted hydrochloric acid does not liberate bromine from a bromide. Solution of chlorine liberates bromine soluble in two or three drops of carbon bisulphide or of chloroform, and forming a reddish solution. Bromine is liberated when a bromide is heated with sulphuric acid and manganese peroxide, lead peroxide, or potassium bichromate, the vapor giving an orange-yellow color to filter-paper soaked in mucilage of starch. In testing for bromides in the presence of iodides, all iodine should first be removed by boiling the aqueous solution with excess of lead peroxide." *Br.*

Cadmium.—"Hydrogen sulphide yields a yellow precipitate, insoluble in cold dilute hydrochloric acid, in solutions of ammonium hydrosulphide, of potassium hydroxide, and of potassium cyanide, but soluble in nitric acid, in hot diluted hydrochloric acid, and in hot diluted sulphuric acid. Solution of potassium hydroxide and solution of sodium hydroxide afford white precipitates insoluble in excess. Solution of ammonia gives a white precipitate readily soluble in excess." *Br.*

Calcium.—"Solution of ammonium carbonate yields a white precipitate, which, after boiling well and setting aside the mixture, is insoluble in solution of ammonium chloride. Solution of ammonium oxalate gives a white precipitate, soluble in hydrochloric acid, but insoluble in acetic acid. Solution of potassium chromate gives no precipitate." *Br.*

Carbonates and Bicarbonates.—"Dilute acids cause an effervescence of carbonic anhydride, which is odorless, and causes a white precipitate in solution of lime, or in solution of barium hydroxide. Soluble carbonates afford a brownish-red precipitate with test-solution of mercuric chloride, bicarbonates a whitish precipitate; the former yield a white precipitate with a cold solution of magnesium sulphate, the latter do not." *Br.*

Chlorides or Hydrochlorides.—"Solution of silver nitrate affords a white curdy precipitate, soluble in solution of ammonia or solution of potassium cyanide, but insoluble in nitric acid. A solid chloride or hydrochloride, when subjected to distillation with sulphuric acid and potassium bichromate, yields a reddish-brown distillate, which is decomposed by water. The resulting solution when nearly neutralized gives a yellow precipitate with solution of lead acetate or solution of barium chloride, and a mixed red and white precipitate with solution of silver nitrate, of which the red portion is dissolved by nitric acid,

and both portions by solution of ammonia. Heated with manganese peroxide and sulphuric acid, chlorides or hydrochlorides yield chlorine, recognizable by its odor and by giving a blue color with solution of potassium iodide and mucilage of starch." *Br.*

Citrates.—"Citrates become charred when heated. Solution of calcium chloride added in excess affords, when boiled with a neutral solution of a citrate, a white precipitate, insoluble in solution of potassium hydroxide, but soluble in solution of ammonium chloride and in solutions of alkaline citrates. Solution of silver nitrate causes in solutions of neutral citrates a white precipitate soluble in solution of ammonia. A mirror is not formed on the sides of the tube when the ammoniacal solution is warmed (distinction from tartrates)." *Br.*

Copper.—"Hydrogen sulphide or solution of ammonium hydrosulphide yields in solutions which are not strongly acid a brownish-black precipitate, insoluble in diluted hydrochloric acid and in solution of potassium hydroxide, almost insoluble in solution of ammonium hydrosulphide, but decomposed and dissolved by boiling nitric acid, and when freshly precipitated soluble in solution of potassium cyanide. Solution of potassium hydroxide gives a bulky light blue precipitate which becomes brownish black on boiling. The light blue precipitate is soluble in a very large excess of a concentrated solution of potassium hydroxide, forming a blue solution. In the presence of soluble tartrates or citrates the light blue precipitate dissolves at once in the solution of potassium hydroxide, yielding a blue liquid which is not affected on boiling. Dextrose and other sugars act similarly, but the resulting solution, on warming, affords a yellowish-red to bright red precipitate. In the presence of non-volatile organic acids solution of potassium hydroxide produces no precipitate, but on the addition of the reagent the solution becomes deep blue. Solution of ammonia or of ammonium carbonate added in small quantity to a neutral solution of a copper salt gives a greenish-blue precipitate which readily dissolves in excess of solution of ammonia, forming a deep blue solution. This blue coloration is perceptible in highly dilute solutions. Solution of potassium ferrocyanide gives a reddish-brown precipitate, or in very dilute solutions a reddish-brown coloration, unaffected by dilute acids but decomposed by solution of potassium hydroxide. Metallic iron receives a reddish coating of copper when placed in a solution of a copper salt." *Br.*

Cyanides.—"Solution of silver nitrate affords a white curdy precipitate, soluble in solution of potassium cyanide, in solution of ammonia, and in boiling concentrated nitric acid. If to a soluble cyanide be added a few drops of a mixed solution of ferrous and ferric salts, then of solution of sodium hydroxide, and lastly excess of hydrochloric acid, a precipitate of Prussian blue results. Insoluble cyanides decompose when heated, evolving cyanogen, which burns with a characteristic peach-colored flame." *Br.*

Hydrobromides.—See "Bromides," page 1735.

Hydrochlorides.—See "Chlorides," page 1735.

Iodates.—"Solution of silver nitrate gives a white crystalline precipitate, sparingly soluble in water and in dilute nitric acid, but readily dissolved by solution of ammonia. Solution of sulphurous acid when added to the ammoniacal solution gives a pale yellow precipitate. A mixed solution of potassium iodide and tartaric acid in a solution of an iodate yields iodine, which affords a blue color with mucilage of starch. Solution of barium chloride gives a white precipitate nearly insoluble in water and soluble with difficulty in diluted nitric acid. On the addition of mucilage of starch and solution of sulphurous acid a blue color is produced." *Br.*

Iodides.—"Solution of silver nitrate affords a curdy yellow precipitate, insoluble in nitric acid and almost insoluble in solution of ammonia, but soluble in solution of potassium cyanide. Solution of mercurous nitrate produces a green precipitate, insoluble in diluted nitric acid, soluble in solution of potassium iodide. Test-solution of mercuric chloride yields a scarlet precipitate, slightly soluble in excess of this reagent, and very soluble in solution of potassium iodide. Solution of lead acetate causes a yellow precipitate, soluble in diluted nitric acid and soluble in boiling water. From the latter solution the precipitate separates in golden crystalline scales as the solution cools. Solution of copper sulphate, mixed with the solution of ferrous sulphate or of sulphurous acid, affords a whitish precipitate, soluble in solution of ammonia, sparingly soluble in hydrochloric acid. A small quantity of solution of chlorine or bromine, or a solution of sodium nitrite and diluted hydrochloric acid, liberates iodine. A very minute quantity of free iodine produces an intense blue coloration with mucilage of starch. If liquid containing free iodine be shaken with carbon bisulphide, the iodine is dissolved by the carbon bisulphide and communicates a violet color to it." *Br.*

Iron.—"Reactions common to Ferrous and Ferric salts: Solution of ammonium hydrosulphide yields, in neutral solutions, a black precipitate soluble in cold diluted hydrochloric acid with evolution of hydrogen sulphide. Solution of potassium ferrocyanide gives a blue precipitate, or a white precipitate rapidly turning blue, insoluble in dilute hydrochloric acid, decomposed by solution of potassium hydroxide or by solution of sodium hydroxide.

Reactions characteristic of Ferrous salts: Hydrogen sulphide causes no precipitate in a slightly acid solution. Solution of potassium ferricyanide affords a dark blue precipitate, insoluble in dilute hydrochloric acid, decomposed by solution of potassium hydroxide or solution of sodium hydroxide. (Ferric salts give a reddish-brown coloration but no precipitate with this reagent.) Ferrous salts mixed with solution of potassium or sodium hydroxide give a dull green precipitate.

Reactions characteristic of Ferric salts: Hydrogen sulphide gives a white precipitate of sulphur. Solution of ammonium thiocyanate produces a blood-red coloration, which is discharged on the addition of test-solution of mercuric chloride. Solution of tannic acid yields a bluish-black coloration or precipitate with ferric salts, and, more slowly, with ferrous salts. Solution of potassium, sodium, or ammonium hydroxide causes a reddish-brown precipitate, soluble in solution of citric or tartaric acid, and not formed in the presence of citrates and tartrates." *Br.*

Lead.—"Hydrochloric acid affords, except in very weak solutions, a white precipitate soluble in boiling water. The aqueous solution as it cools deposits the lead chloride in the crystalline form. Hydrogen sulphide in not very strongly acid solutions yields a black precipitate insoluble in dilute hydrochloric acid, solution of potassium hydroxide, and solution of ammonium hydrosulphide. It is decom-

posed by boiling with diluted nitric acid, being partly converted into soluble lead nitrate and partly into white insoluble lead sulphate and sulphur. Diluted sulphuric acid causes a white precipitate almost insoluble in water, and still less soluble in dilute sulphuric acid and in alcohol, but soluble in solution of ammonium acetate. Solution of potassium chromate produces a yellow precipitate readily soluble in solution of potassium hydroxide, in strong, hot nitric acid, sparingly soluble in diluted nitric acid, insoluble in acetic acid. Solution of potassium hydroxide gives a white precipitate soluble in excess of the reagent, but insoluble in solution of ammonia." *Br.*

Magnesium.—"Solution of ammonium carbonate, in the presence of solution of ammonium chloride, affords no precipitate. Solution of sodium phosphate, or solution of sodium arsenate, in the presence of ammonium salts and solution of ammonia, yields a white crystalline precipitate. Solution of potassium, sodium, ammonium, barium, or calcium hydroxide causes a white precipitate, insoluble in excess of the reagent, but soluble in solution of ammonium chloride." *Br.*

Mercury.—"Reactions common to Mercurous and Mercuric salts: Hydrogen sulphide yields a black precipitate, insoluble in solution of ammonium hydrosulphide and in boiling diluted nitric acid. Copper foil immersed in a solution free from excess of nitric acid becomes coated with a deposit of mercury which on rubbing becomes bright, and from which the mercury may be volatilized by heat and obtained in globules. Solution of stannous chloride reduces mercuric salts, first to mercurous salts and then to metallic mercury.

Reactions characteristic of Mercurous salts: Hydrochloric acid affords a white precipitate insoluble in water, which is blackened by solution of ammonia. Solution of potassium or sodium hydroxide produces a black precipitate of mercurous oxide, and solution of ammonia a black precipitate of a mercurous-amido salt. Solution of potassium iodide gives a green precipitate soluble in excess of the precipitant.

Reactions characteristic of Mercuric salts: Solution of ammonia affords a white precipitate. Solutions of potassium or sodium hydroxide yield a yellow precipitate of mercuric oxide. Solution of potassium iodide produces a scarlet precipitate, soluble in excess of the precipitant, and in a considerable excess of the solution of the mercuric salt." *Br.*

Nitrates.—"Ferrous sulphate and sulphuric acid, when added to a solution of a nitrate in such a way that the acid forms a stratum below the aqueous solution, cause a purple or brown coloration at the junction of the two liquids. Nitrates liberate red fumes when warmed with sulphuric acid and copper. Nitrates discharge the color of solution of indigo sulphate containing excess of sulphuric acid, especially if the mixture is warmed." *Br.*

Nitrites.—"On the addition, to a solution of a nitrite, of a few drops of diluted sulphuric acid, solution of potassium iodide, and mucilage of starch, a blue color is produced. Diluted sulphuric acid affords red fumes. Solution of ferrous sulphate and acetic acid yield a deep brown color." *Br.*

Oxalates.—"Solution of calcium chloride affords a white precipitate, soluble in hydrochloric acid, but insoluble in acetic acid. Solution of silver nitrate yields a white precipitate, soluble in solution of ammonia and in diluted nitric acid. Most oxalates are on ignition converted into carbonates. Oxalates do not char when heated with sulphuric acid, but yield carbonic oxide and carbonic anhydride." *Br.*

Phosphates (Ortho-).—"Solution of silver ammonio-nitrate yields in solution of ortho-phosphates a light yellow precipitate readily soluble in solution of ammonia and in cold dilute nitric acid. Test-solution of ferric chloride, in the presence of ammonium acetate or other acetate, yields a whitish precipitate, insoluble in acetic acid. Solution of magnesium ammonio-sulphate affords a white crystalline precipitate. Excess of solution of ammonium molybdate, containing much nitric acid, produces, on warming, a yellow precipitate." *Br.*

Potassium.—"Solution of platinic chloride affords with moderately strong solutions of potassium chloride (or with other potassium salts if hydrochloric acid be present) a yellow crystalline precipitate, which, upon ignition, leaves a residue of potassium chloride and platinum. Potassium compounds moistened with hydrochloric acid communicate a violet coloration when introduced, on platinum wire, into the flame of a spirit lamp or Bunsen burner." *Br.*

Selenium and Tellurium.—"Selenium and Tellurium may occur in compounds of bismuth. To detect these elements, dissolve the compound in nitric acid, add solution of sodium chloride or ammonium chloride, and dilute freely with water. The filtrate from the precipitated oxychloride, mixed with excess of sodium sulphite, should give no precipitate or coloration even after twelve hours." *Br.*

Silica.—"Silica, after exposure to a red heat, is insoluble in acids, and is not dissolved in a bead of microcosmic salt when heated to fusion in the blow-pipe flame. The result of its fusion with alkalies is soluble in water, the solution yielding a gelatinous precipitate on the addition of hydrochloric acid." *Br.*

Silver.—"Hydrochloric acid and other chlorides afford a white curdy precipitate, soluble in solution of ammonia, but insoluble in nitric acid. Solution of potassium chromate, in the absence of chlorides, bromides, and iodides, affords a red precipitate." *Br.*

Sodium.—"Sodium compounds, moistened with hydrochloric acid, communicate a yellow coloration when introduced, on platinum wire, into the flame of a spirit lamp or Bunsen burner." *Br.*

Starch.—"When starch is boiled with water, the mixture, on cooling, affords a deep blue coloration on the addition of solution of iodine. When boiled for some minutes with water acidulated with hydrochloric acid, and then made alkaline with sodium hydroxide, a red precipitate is formed on further boiling after the addition of solution of potassio-cupric tartrate. The varieties of starch may be distinguished by their microscopical characters." *Br.*

Sulphates.—"Solution of barium chloride affords a white precipitate insoluble in hydrochloric acid." *Br.*

Sulphides.—"The official sulphides, hydrosulphides, and sulphurated compounds evolve hydrogen sulphide when boiled with strong hydrochloric acid. Sulphonal and thiocyanates do not evolve hydrogen

sulphide when treated in this way. If fused with sodium carbonate, mixed with a small proportion of potassium nitrate, they afford a mass which, when dissolved in water, responds to the tests for sulphates." *Br.*

Sulphites.—"Hydrochloric acid liberates sulphurous anhydride, a colorless gas with a pungent smell of burning sulphur. Hydrochloric acid and zinc being added, hydrogen sulphide, recognizable by its odor, is liberated. Sulphites decolorize solution of iodine." *Br.*

Tartrates.—"Tartrates become charred when heated. Solution of calcium chloride added in excess to a solution of a neutral tartrate affords a white granular precipitate, soluble, when fresh, in cold, moderately concentrated solution of potassium hydroxide, from which it is precipitated on boiling. It is also soluble in tartaric acid. Solution of silver nitrate yields a white precipitate, soluble in solution of ammonia and in nitric acid. The ammoniacal solution is reduced on heating, and deposits metallic silver as a mirror on the sides of the test-tube. A concentrated solution of potassium acetate gives a white precipitate in moderately concentrated solutions when acidulated with acetic acid and well stirred, and especially on the addition of alcohol (90 per cent.). If to the solution of tartaric acid in water, or of a tartrate acidulated with acetic acid, be added a drop of solution of ferrous sulphate, then a few drops of solution of hydrogen peroxide, and finally an excess of solution of potassium hydroxide, a purple or violet color will be produced." *Br.*

Tellurium.—See "Selenium," page 1737.

Thiosulphates.—"Hydrochloric acid gives a yellow precipitate and liberates sulphurous anhydride, recognizable by its odor. Hydrochloric acid and zinc liberate hydrogen sulphide. Thiosulphates decolorize solution of iodine." *Br.*

Tin.—"Metallic zinc placed in a solution of any tin salt acidulated with hydrochloric acid precipitates the whole of the tin in metallic scales or as a gray sponge. The metal, separated from the liquid, is soluble in boiling concentrated hydrochloric acid, and the solution, which contains stannous chloride, gives with test-solution of mercuric chloride a white precipitate of calomel, which becomes gray from separation of metallic mercury, if excess of tin salt is present." *Br.*

Zinc.—"Solution of ammonium hydrosulphide yields with neutral, and hydrogen sulphide with alkaline, solutions a white precipitate, soluble in hydrochloric acid, but insoluble in acetic acid. Solution of potassium hydroxide or of ammonia affords a white precipitate, soluble in excess of either reagent. Solution of potassium ferrocyanide produces a white precipitate, insoluble in diluted hydrochloric acid." *Br.*

TEST-SOLUTIONS FOR VOLUMETRIC ESTIMATIONS. Br.

"The following apparatus is required in the preparation and use of these solutions. 1. A glass flask which, when filled to a mark on the neck, contains 1000 grammes of distilled water at 60° F. (15.5° C.). This flask is described as the 'one-litre flask,' and is used in ordinary analytical operations to measure 1000 cubic centimetres, as it is customary for the sake of convenience to make the measurement of liquids with metric apparatus which has thus been graduated at 60° F. (15.5° C.). 2. A graduated cylindrical jar which, when filled to the zero mark at 60° F. (15.5° C.), contains 1000 grammes of distilled water, and is divided into 100 equal parts, each of which is taken as corresponding to 10 cubic centimetres. 3. A burette. A graduated tube which, when filled to the zero mark at 60° F. (15.5° C.), holds, within the graduated portion, 50 grammes of distilled water; the graduated portion is divided into 50 equal parts, each of which is taken as corresponding to 1 cubic centimetre, and each such division is subdivided into 10 equal parts. A standard Litre contains 1 kilogramme (1000 grammes) of distilled water at the temperature of maximum density (39.2° F. or 4° C.), and at the barometric pressure of 760 millimetres of mercury. One-thousandth part of a standard Litre (one millilitre) is, strictly speaking, equivalent to 1.00016 cubic centimetres, or one cubic centimetre to 0.99984 millilitre. Any litre-measure or other piece of volumetric apparatus not actually marked '60° F.' or '15.5° C.' is to be taken as having reference to the standard Litre graduated at 39.2° F. or 4° C. Volumetric solutions, before being used, should be shaken, in order that they may be throughout of uniform strength. They should also be preserved in stoppered bottles." *Br.*

Volumetric Solution of Iodine.—(Iodine, I = 125.9.) "Iodine, 12.59 grammes; Potassium Iodide, 18 grammes; Distilled Water, a sufficient quantity. The Iodine should be pure. It may be obtained pure by mixing the official 'Iodum' with one-fourth of its weight of dry potassium iodide, resubliming, and leaving the resulting crystals for a few hours under a glass shade placed over a dish containing concentrated sulphuric acid. Put the Iodine and the Potassium Iodide (which should be pure), with about 20 cubic centimetres of Distilled Water, into the one-litre flask; gently agitate until solution is complete; then dilute the solution with Distilled Water until it measures 1000 cubic centimetres. The strength of this Solution should be verified by the aid of pure arsenious anhydride, pure barium thiosulphate, or other suitable substance, and the Solution (a) be either strengthened or diluted, so that 1000 cubic centimetres shall contain exactly 12.59 grammes of iodine; or (b) have its actual strength noted, so that calculations may be made accordingly when the Solution is used." *Br.*

Volumetric Solution of Potassium Bichromate.—(Potassium Bichromate, $K_2Cr_2O_7 = 292.3$.) "Potassium Bichromate, 4.87 grammes; Distilled Water, a sufficient quantity. Put the Potassium Bichromate into the one-litre flask; dissolve it in about half a litre of Distilled Water; dilute the solution with Distilled Water until it has the exact bulk of 1000 cubic centimetres. 100 cubic centimetres of this solution yield 0.0794 gramme of oxygen, and are therefore capable of converting 0.556 gramme of iron from the ferrous to the ferric state. The strength of this Solution should be verified by the aid of pure ferrous ammonium sulphate, or other trustworthy substance, and the Solution (a) be either strengthened or diluted, so that 1000 cubic centimetres shall contain exactly 4.87 grammes of potassium bichromate; or (b) have its actual strength noted, so that calculations may be made accordingly when the Solution is used." *Br.*

Volumetric Solution of Silver Nitrate.—(Silver Nitrate, $AgNO_3 = 168.69$.) "Silver Nitrate, 16.869 grammes; Distilled Water, a sufficient quantity. Put the Silver Nitrate into the one-litre flask;

dissolve it in about half a litre of Distilled Water; dilute the solution with Distilled Water until it has the exact bulk of 1000 cubic centimetres. The Solution should be kept in an opaque stoppered bottle. The strength of this Solution should be verified by the aid of pure sodium chloride or solution of pure hydrochloric acid of known strength, and the Solution (a) be either strengthened or diluted, so that 1000 cubic centimetres shall contain exactly 16.869 grammes of silver nitrate; or (b) have its actual strength noted, so that calculations may be made accordingly when the Solution is used." *Br.*

Volumetric Solution of Sodium Hydroxide.—(Sodium Hydroxide, NaOH = 39.76.) "Purified Sodium Hydroxide, 42 grammes; Distilled Water, a sufficient quantity. Dissolve the Purified Sodium Hydroxide in 1000 cubic centimetres of Distilled Water. Fill a burette with the solution of sodium hydroxide, and cautiously drop this into 100 cubic centimetres of the volumetric solution of sulphuric acid until the acid is exactly neutralized as indicated by litmus. Note the number of cubic centimetres (n) of the solution of sodium hydroxide used, and having then introduced 800 cubic centimetres of it into a graduated jar, augment this quantity by the addition of water, until it becomes $800 \times 100 \div n$ cubic centimetres. 1000 cubic centimetres then contain exactly 39.76 grammes of sodium hydroxide. A decinormal volumetric solution of sodium hydroxide may be prepared by adding, to 100 cubic centimetres of the above volumetric solution, sufficient Distilled Water to produce 1000 cubic centimetres. Alcoholic solutions, normal and decinormal.—Alcohol (90 per cent.) may, when necessary, be used as the solvent. An equivalent proportion of potassium hydroxide, KOH = 55.71, may in certain cases be employed in the place of sodium hydroxide." *Br.*

Volumetric Solution of Sodium Thiosulphate.—(Sodium Thiosulphate, crystallized, $Na_2S_2O_3,5H_2O$ = 246.44.) "Sodium Thiosulphate, in crystals, 28 grammes; Distilled Water, a sufficient quantity. Dissolve the Sodium Thiosulphate in 1000 cubic centimetres of Distilled Water. Fill a burette with this solution, and drop it cautiously into 100 cubic centimetres of the volumetric solution of iodine, until only a faint brown or yellow color remains. Add mucilage of starch and continue the addition of the thiosulphate solution until the blue color is discharged. Note the number of cubic centimetres (n) required to produce this effect; then put 800 cubic centimetres of the same solution into a graduated jar, and augment this quantity by the addition of Distilled Water until it amounts to $800 \times 100 \div n$ cubic centimetres. 1000 cubic centimetres then contain exactly 24.644 grammes of sodium thiosulphate." *Br.*

Volumetric Solution of Sulphuric Acid.—(Sulphuric Acid, H_2SO_4 = 97.34.) "Sulphuric Acid, 50 grammes; Distilled Water, a sufficient quantity. Dilute the Sulphuric Acid with 900 cubic centimetres of Distilled Water; cool. Prepare a small quantity of sodium carbonate by heating pure sodium bicarbonate to redness in a platinum crucible for a quarter of an hour. Make a solution of 1.053 grammes of the sodium carbonate, and add to it from a burette the solution of sulphuric acid until exact neutrality is obtained, taking care to boil off the carbonic anhydride. Note the number of cubic centimetres used (n); then put 900 cubic centimetres of the solution of sulphuric acid into a graduated jar, and augment this quantity by the addition of Distilled Water until it amounts to $900 \times 20 \div n$ cubic centimetres. 1000 cubic centimetres then contain exactly 48.67 grammes of sulphuric acid. A decinormal volumetric solution of sulphuric acid may be prepared by adding, to 100 cubic centimetres of the above volumetric solution, sufficient Distilled Water to produce 1000 cubic centimetres." *Br.*

INDICATORS OF THE TERMINATION OF REACTIONS IN VOLUMETRIC ESTIMATIONS.

Mucilage of Starch.—"It gives an intensely blue color with iodine, at ordinary temperatures." *Br.*

Solution of Litmus.—"It gives a red color with acids and a blue color with alkalies. It is not distinctly reddened by boric acid. It is reddened by moist carbonic anhydride; hence, when estimating a carbonate with a volumetric solution of an acid, the termination of the reaction is indicated by the neutral tint of the litmus after the liquid under examination has been well boiled." *Br.*

Solution of Methyl Orange.—"It gives a pink color with mineral acids and a faint yellow color with alkalies. It is a trustworthy indicator of excess of ammonia. It is not reddened by moist carbonic anhydride or boric acid." *Br.*

Solution of Neutral Potassium Chromate.—"It gives a red precipitate with silver nitrate, but not while any soluble chloride, bromide, or iodide is present." *Br.*

Solution of Phenol-Phthalein.—"It gives a red color with alkalies, which is discharged by acids. It is the most trustworthy indicator of excess of organic acids. It does not accurately indicate the point of neutralization of ammonia with an acid. For the latter, Tincture of Cochineal is an appropriate indicator." *Br.*

Solution of Potassium Ferricyanide.—"It gives an intensely blue precipitate or coloration with ferrous salts, but none with ferric salts." *Br.*

ART OF PRESCRIBING MEDICINES.

The art of prescribing medicines, *i.e.*, of adapting them to the treatment of individual cases, is one of prime importance, which, however, can scarcely with propriety be fully discussed in a work like the present. As explanatory of our own text, and as affording some guidance to the young practitioner, and also, to the apothecary in interpreting prescriptions, we offer a few remarks, with practical examples.

1. Dose of Medicines.—In this work a minimum and a maximum dose for adults are usually given for each article. In interpreting these doses the practitioner should remember that it is rarely proper to begin with the amount stated as maximum, whilst, on the other hand, the minimum dose will only in exceptional cases produce the full physiological effect of the remedy. When a powerful remedy is being used, and a decided effect is desired, it is best to commence with the smaller dose and to increase cautiously. There are various circumstances modifying the dose which demand attention.

Age.—The young require a smaller dose than those of maturity; and the old, though their systems are, perhaps, less susceptible to the action of medicines than those of the middle-aged, cannot bear an equally forcible impression from depressing remedies.

The following rule of Young is almost universally adopted.

"For children under twelve years, the doses of most medicines must be diminished in the proportion of the age to the age increased by twelve; thus, at two years to $\frac{1}{7}$; viz., $\frac{2}{2+12}=\frac{1}{7}$. At twenty-one the full dose may be given."

To the above rule some exceptions are offered in particular medicines. Thus, purgatives, diaphoretics, and diuretics must usually be given to children in larger, and narcotics in smaller, doses than those called for by Young's rule. A babe six months old will often not be affected by one-fourth the adult dose of castor oil, or one-sixth the dose of calomel, but will not bear well more than one twenty-fifth the dose of opium.

Sex, Temperament, and Idiosyncrasy.—Females usually require somewhat smaller doses than males, and persons of sanguine temperament than the phlegmatic. Constitutional peculiarities, called idiosyncrasies, often exist in individuals, rendering them more than usually susceptible or unsusceptible to the action of certain remedies, the dose of which must be modified accordingly. Thus, in some persons a grain or two of calomel will excite salivation, while in others scarcely any quantity which can be safely administered will produce this effect. Sometimes, moreover, a medicine operates on an individual in a manner wholly different from its ordinary mode. In all such cases experience is the only sure guide, and when a physician is called to a patient, not before known, careful inquiries should always be made.

Habit.—Generally speaking, the susceptibility to the action of medicines is diminished by their frequent and continued use, and, in order to maintain a given impression, the quantity must be regularly increased. This is especially true in regard to the narcotics, which are sometimes borne in enormous doses by those habituated to their use. It is a good practical rule in prescribing, when circumstances demand the continuance, for a considerable length of time, of some particular effect, to vary the medicine, and employ successively several with the same general powers, so as not too rapidly to exhaust the susceptibility to the action of any individual remedy. A patient accustomed to one narcotic is usually found blunted towards other cognate medicines.

2. Mode of administering Medicines.—This has reference both to the combination of medicines with one another, and to the form in which they are exhibited.

Simplicity in prescription is always desirable. Remedies should never be mixed together without a definite purpose. Those exceedingly complex prescriptions, formerly so much in vogue, of which the ingredients were so numerous as to render altogether impossible a reasonable estimate of their bearing on each other, or of their effects on disease, have been generally abandoned by modern practitioners. The only ground upon which any of them can be justifiably retained is that, by very frequent trials, through a long course of years, and in various states of disease, their influence on the system may have been fully ascertained, so that they may be considered rather in the light of a single remedy than a compound of many. A brief enunciation of a few general principles in regard to the art of combination may be useful.

Remedies of the same general character may be given in connection, in order to increase their energy, or to render their action more certain. It has been well ascertained that substances thus combined will often act vigorously, when, severally, they would produce comparatively little effect, and it sometimes happens that, while their activity is augmented, they are rendered less irritating, as in the case of the drastic cathartics.

Different medicines are very often mixed together, in order to meet different and coexisting indications, without any reference to the influence which they may reciprocally exert on each other. Thus, in the same patient we not unfrequently meet with debility of stomach and constipation of the bowels, connected with derangement of the hepatic function. To answer the indications presented by these morbid conditions, we may properly combine, in the same dose, a tonic, cathartic, and mercurial alterative. For similar reasons we often unite tonics, purgatives, and emmenagogues, anodynes and diaphoretics, emetics and cathartics, antacids, astringents, and tonics.

Medicines acting differently in certain respects are combined to modify each other's powers, or to gain strength at some especial point where their actions overlap. In this way seemingly new powers are sometimes developed, and those previously existing are greatly increased. Examples of such a result are afforded in the official powder of ipecacuanha and opium, which acts as a diaphoretic beyond the capabilities of either of its constituents. The effects of one medicine are, in numerous instances, increased by the influence of another in augmenting the natural susceptibility of the system to its action. Thus, bitters enable cathartics to operate in smaller doses; purgatives awaken the dormant susceptibility to the action of mercury. In some instances, the action of one medicine is promoted by that of another apparently of a nature wholly opposite. Thus, when calomel and opium are given in colic, the purgative operation of the former is facilitated by the relaxation of intestinal spasm produced by the latter. Medicines in addition to the effects for which they are administered, very frequently produce disagreeable symptoms, which may be moderated or altogether prevented by combination with other medicines, and this object may usually be accomplished without in the least degree interfering with the remedial influence desired. Thus, the griping produced by cathartics, and the nausea by these and various other medicines, may be often corrected by the simultaneous use of aromatics. To cover the disagreeable taste or odor of certain medicines, and to afford a convenient vehicle for their administration, are also important objects of combination, as upon these circumstances often depend the acceptability of the medicine to the stomach, and even the possibility of inducing the patient to swallow it. Substances should be preferred as vehicles which are calculated to render the medicine acceptable to the palate and stomach, and in other ways to correct its disagreeable effects; as syrups for powders, the aromatic waters for medicines given in the form of mixture, and carbonic-acid water for the neutral salts.

But, in the mixing of medicines, care should be taken that they are neither chemically nor physiologically incompatible; in other words, that they are not such as will react on each other so as to produce new and unexpected combinations, nor such as will exert contrary and opposite effects upon the system. Thus, when the operation of an acid is desired, an alkali should not be given at the same time, as they unite to form a third substance entirely different from either; nor should a soluble salt of lime, barium, or lead be given with sulphuric acid or a soluble sulphate, as decomposition would ensue, with the production of an inert compound. So, also, in relation to physiological incompatibility, diaphoretics and

diuretics should not, as a general rule, be united with a view to their respective effects, as these are to a certain extent incompatible, one being diminished by whatever has a tendency to increase the other. There are cases, however, in which we may advantageously combine medicines with a view to their chemical reaction, as in the instance of the effervescing draught, and circumstances sometimes call for the union of remedies apparently opposite, as in the case of colic before alluded to, in which opium may be advantageously combined with purgatives. Still, such combinations should never be formed unless with a full understanding of their effects.

The *form in which medicines are exhibited* is often an object of considerable importance. By variation in this respect, according to the nature of the medicine, the taste of the patient, or the condition of the stomach, we are frequently enabled to secure the favorable operation of remedies, which, without such attention, might prove useless or injurious. Medicines may be given in the solid state, as in the form of powder, pill, troche, or electuary; in the state of mixture, in which a solid is suspended in a liquid, or one liquid is mechanically mixed with another in which it is insoluble; or in the state of solution, under which may be included the various forms of infusion, decoction, tincture, fluidextract, wine, vinegar, syrup, honey, and oxymel.

In writing extemporaneous prescriptions, neatness, order, and precision should always be observed; as independently of the pleasing moral effect, a positive practical advantage results in the greater accuracy which the habit of attending to them gives to the prescriber, and the comparative certainty which they afford that his directions will be strictly complied with. As a general rule, when medicines are combined in prescription, the most important should come first in order, next the adjuvant or corrigent, and lastly the vehicle. Sometimes, however, it is important to indicate to the pharmacist the succession in which the subtances should be combined, and this may render convenient a deviation from the order above mentioned. The physician should always be careful either to write out the full name of the medicine, or to employ such abbreviations as cannot be misunderstood. Fatal mistakes have been occasioned by a neglect of this precaution. The following table and formulas explain and illustrate the signs, abbreviations, and methods habitually used in prescribing.

Table of Signs and Abbreviations.

℞	Recipe.	Take.	Collyr.	Collyrium.	An eye-water.
āā	Ana.	Of each.	Cong.	Congius vel congii.	A gallon or gallons.
℔	Libra vel libræ.	A pound or pounds.	Decoct.	Decoctum.	A decoction.
℥	Uncia vel unciæ.	An ounce or ounces.	Ft.	Fiat.	Make.
ʒ	Drachma vel drachmæ.	A drachm or drachms.	Garg.	Gargarysma.	A gargle.
			Gm.	Gramme or gram.	15.5 grains.
℈	Scrupulus vel scrupuli.	A scruple or scruples.	Gr.	Granum vel grana.	A grain or grains.
			Gtt.	Gutta vel guttæ.	A drop or drops.
O	Octarius vel octarii.	A pint or pints.	Haust.	Haustus.	A draught.
f℥	Fluiduncia vel fluiduncіæ.	A fluidounce or fluidounces.	Infus.	Infusum.	An infusion.
			M.	Misce.	Mix.
fʒ	Fluidrachma vel fluidrachmæ.	A fluidrachm or fluidrachms.	Mass.	Massa.	A mass.
			Mist.	Mistura.	A mixture.
♏	Minimum vel minima.	A minim or minims.	Pil.	Pilula vel pilulæ.	A pill or pills.
			Pulv.	Pulvis vel pulveres.	A powder or powders.
Cc.	Cubic centimeter.	About 16 minims.			
Chart.	Chartula vel chartulæ.	A small paper or papers.	Q. S.	Quantum sufficit.	A sufficient quantity.
Coch.	Cochlear vel cochlearia.	A spoonful or spoonfuls.	S.	Signa.	Write.
			Ss.	Semis.	A half.

Examples of Common Extemporaneous Prescriptions.

Powders.

℞ Zinci Sulphatis
Pulveris Ipecacuanhæ, āā, gr. xx.
Fiat pulvis.
S. To be taken in a wineglassful of sweetened water.

An active emetic to be used in narcotic and other forms of poisoning.

℞ Pulveris Jalapæ gr. x.
Potassii Bitartratis ʒ ii.
Misce.
S. To be taken in syrup or molasses.

A hydragogue cathartic, used in dropsy, in scrofulous inflammation of the joints and when it is necessary to induce watery stools.

℞ Sulphuris ʒ i.
Potassii Bitartratis ʒ ii.
Misce.
S. To be taken in syrup or molasses.

A laxative used for hemorrhoids and cutaneous diseases.

℞ Pulveris Rhei gr. x.
Magnesiæ ʒss.
Fiat pulvis.
S. To be taken in syrup or molasses.

A laxative and antacid, used in diarrhœa, dyspepsia, etc.

℞ Potassii Nitratis ʒ i.
Antimonii et Potassii Tartratis gr. i.
Hydrargyri Chloridi Mitis gr. vi.
Fiat pulvis, in chartulas sex dividendus.
S. One to be taken every two hours in syrup or molasses.

A refrigerant, diaphoretic, and alterative, used in bilious fevers; usually called *nitrous powders.*

℞ Pulveris Calumbæ
Pulveris Zingiberis āā, ʒ i.
Fiat pulvis, in chartulas sex dividendus.
S. One to be taken three times a day in syrup or molasses.

A tonic, used in dyspepsia.

Pills.

℞ Pulveris Aloes
Pulveris Rhei āā, ʒss.
Olei Caryophylli gtt. x.
Saponis gr. xx.
Misce, et cum aquâ fiat massa in pilulas viginti dividenda.
S. Two or three to be taken daily, at bedtime or before a meal.
An excellent laxative in habitual constipation.

℞ Pulveris Aloes
Extracti Quassiæ āā, ʒi.
Olei Anisi ♏x.
Syrupi q. s.
Misce, et fiat massa in pilulas triginta dividenda.
S. Two to be taken once, twice, or three times a day.
A laxative, tonic, and carminative, useful in dyspepsia.

℞ Pulveris Scillæ gr. xx.
Hydrargyri Chloridi Mitis gr. x.
Pulveris Acaciæ,
Syrupi āā, q. s.
Misce, et fiat massa in pilulas decem dividenda.
S. One to be taken twice or three times a day.
A diuretic and alterative, much used in dropsy, especially when complicated with organic visceral disease.

℞ Plumbi Acetatis gr. xii.
Pulveris Opii gr. i.
Pulveris Acaciæ
Syrupi, āā, q. s. ut fiat massa in pilulas sex dividenda.
S. One every two, three, or four hours.
An astringent much employed in hæmoptysis and uterine hemorrhage.

Mixtures.

℞ Magnesiæ ʒi.
Syrupi f ʒi.
Tere simul, et affunde
Aquæ Acidi Carbonici f ʒiv.
Fiat haustus.
S. To be taken at a draught, the mixture being well shaken.
An agreeable magnesia mixture.

℞ Mannæ ʒi.
Fœniculi contusi ʒi.
Aquæ bullientis f ʒiv.
Fiat infusum et cola; dein adjice.
Magnesii Carbonatis ʒii.
Ft. mist.
S. One-third to be taken every three or four hours till it operates.

℞ Olei Ricini f ʒiss.
Tincturæ Opii ♏xxx.
Pulveris Acaciæ
Sacchari āā, ʒii.
Aquæ Menthæ Viridis f ʒiv.
Acaciam et saccharum cum paululo aquæ menthæ tere; dein oleum adjice, et iterum tere; denique aquam reliquam paulatim infunde, et omnia misce.
S. A tablespoonful to be taken every hour or two hours till it operates.
Used as a gentle laxative in dysentery and diarrhœa. It is usually known by the name of *oleaginous mixture.*

℞ Acidi Nitrosi f ʒi.
Tincturæ Opii gtt. xl.
Aquæ Camphoræ f ʒviii.
Misce.
S. One-fourth to be taken every three or four hours.
Hope's camphor mixture, used in dysentery, diarrhœa, and cholera.

Effervescing Draught.

℞ Potassii Carbonatis ʒii.
Aquæ f ʒiv.
Solve.
Or,
℞ Potassii Bicarbonatis ʒiii.
Aquæ f ʒiv.
Solve.
S. Add a tablespoonful of the solution to the same quantity of lemon or lime juice, previously mixed with a tablespoonful of water; and give the mixture in the state of effervescence, every hour or two hours.
An excellent diaphoretic and anti-emetic in fever with nausea or vomiting. If morphine is needed, it should be dissolved in the lemon juice. It is precipitated from alkaline solutions.

Solutions.

℞ Magnesii Sulphatis ʒi.
Syrupi Limonis f ʒi.
Aquæ Acidi Carbonici f ʒvi.
Misce.
S. To be taken at a draught.
An agreeable mode of administering magnesium sulphate.

℞ Quininæ Sulphatis gr. xii.
Acidi Sulphurici Aromatici gtt. xxiv.
Syrupi f ʒss.
Aquæ Menthæ Piperitæ f ʒi.
Misce.
S. A teaspoonful to be taken every hour or two hours.
A good mode of administering sulphate of quinine in solution.

Infusions.

℞ Sennæ ʒiii.
Magnesii Sulphatis
Mannæ āā, ʒss.
Fœniculi ʒi.
Aquæ bullientis Oss.
Macera per horam in vase leviter clauso, et cola.
S. A teacupful to be taken every four or five hours till it operates.
An excellent purgative in febrile complaints.

℞ Calumbæ contusæ
Zingiberis contusi āā, ʒss.
Sennæ ʒii.
Aquæ bullientis Oi.
Macera per horam in vase leviter clauso, et cola.
S. A wineglassful to be taken morning, noon, and night, or less frequently if it operates too much.
An excellent remedy in dyspepsia with constipation and flatulence.

METRIC PRESCRIPTIONS.

Of late years, since the more general use of the metric system, prescriptions written according to this method have been frequently employed, especially in sections of our country inhabited by those who are accustomed to use the system, which is now almost exclusively employed in Europe. For an explanation of its principles the reader is referred to the article on weights and measures, page 1745. Two distinct methods are in vogue in the United States, called respectively *gravimetric* and *volumetric;* in the *gravimetric* plan, which is almost exclusively used abroad, no *measures* of capacity are employed, weights being alone used, the unit of weight, the *gramme,* and its subdivisions constituting the sole weights. This method is objected to by many, who are habituated to the usual American practice of measuring instead of weighing liquids, and the *volumetric* method, in which liquids are measured, is preferred, the unit of measure selected being the *cubic centimeter* (abbreviated Cc., and sometimes called *fluigramme*), which is equivalent to a gramme of water at 4° C. One of the principal arguments in favor of the volumetric method is that no plan has yet been devised by which the patient can take the dose by weight; teaspoons, tablespoons, or graduated glasses are used altogether for administering liquid medicines, and it would be an almost impracticable task for the practitioner to bear constantly in mind the difference in specific gravity between chloroform, ether, glycerin, syrups, water, and other liquids, yet this would be absolutely necessary in order to secure accurate dosage if the gravimetric method were adopted; and in addition the pharmacist would be compelled to weigh the liquids in compounding prescriptions, a troublesome innovation, or to calculate the corresponding volume of each liquid if graduated measures were used. Arabic numerals are exclusively employed in metric formulæ, arranged in a column opposite the names of the ingredients of the prescription; this custom should never be deviated from, as it is one of the means of recognizing metric prescriptions. The following examples will illustrate the various forms of metric prescriptions in general use, but it is very important that but *one* of these forms should be adopted and *adhered to* if the merits of the system are to be fully realized. We decidedly prefer form Number 1.

PILLS.

Form Number 1.

	Gramma.
℞ Pulv. Aloes	2
Pulv. Rhei	1.5
Olei Caryophylli	.6
Saponis	1.25

Make twenty pills.

The advantages of the decimal line are that the decimal dot is abolished with its dangerous complications, for a spot or a fly-speck on the prescription paper may increase or decrease the quantity of an ingredient *ten times,* and the use of the decimal line is familiar to all who use a dollar and cents column.

Form Number 2.

℞ Pulv. Aloes	2.
Pulv. Rhei	1.5
Olei Caryophylli	.6
Saponis	1.25

Make twenty pills.

This form is used frequently, because of the familiarity with the arithmetical method of using a dot to denote a decimal fraction, and where metric prescriptions are altogether in use, as in Continental Europe, there is no necessity for indicating the denomination, gramme being always understood.

Form Number 3.

℞ Pulv. Aloes	2	Gm.
Pulv. Rhei	1.5	Gm.
Olei Caryophylli	.6	Gm.
Saponis	1.25	Gm.

Make twenty pills.

This form is an improvement on Number 2, and would be far superior to it for use in this country, where prescriptions written in the old systems will long continue to be used; for next to writing out in full the word *gramme,* the indication of the unusual quantity by underscoring will prevent its being mistaken for *grain.*

LIQUIDS.

Form Number 1.

(*Volumetric.*)

	Gm. / Cc.
℞ Magnesiæ Sulph.	30
Acid. Sulph. Dil.	6
Syrup. Limonis	30
Aquæ	180

Make a draught.

Form Number 2.

(*Gravimetric.*)

℞ Magnesiæ Sulph.	30.
Acid. Sulph. Dil.	.6
Syrup. Limonis	30.
Aquæ	180.

Make a draught.

Form Number 3.

(*Volumetric.*)

℞ Magnesiæ Sulph.	30	Gm.
Acid. Sulph. Dil.	.6	Cc.
Syrup. Limonis	30	Cc.
Aquæ	180	Cc.

Make a draught.

TABLES OF WEIGHTS AND MEASURES.

APOTHECARIES' WEIGHT. *U. S.*

Pound.		Troyounces.		Drachms.		Scruples.		Troy Grains.
℔ 1	=	12	=	96	=	288	=	5760
		℥ 1	=	8	=	24	=	480
				ʒ 1	=	3	=	60
						℈ 1	=	gr. 20

The Imperial Standard Troy weight, at present recognized by the British laws, corresponds with the Apothecaries' weight in pounds, ounces, and grains; but differs from it in the division of the ounce, which, according to the former scale, contains twenty pennyweights, each weighing twenty-four grains.

AVOIRDUPOIS WEIGHT. *Br.*

Pound.		Ounces.		Drachms.		Troy Grains.
℔ 1	=	16	=	256	=	7000
		oz. 1	=	16	=	437.5
				dr. 1	=	gr. 27.34375

Relative Value of Troy and Avoirdupois Weights.

Pound.		Pounds.		Pound.	Ounces.	Grains.
1 Troy	=	0.822857 Avoirdupois	=	0	13	72.5
1 Avoirdupois	=	1.215277 Troy	=	1	2	280

APOTHECARIES' OR WINE MEASURE. *U. S.*

Gallon.		Pints.		Fluidounces.		Fluidrachms.		Minims.		Cubic Inches.
Cong. 1	=	8	=	128	=	1024	=	61440	=	231
		O 1	=	16	=	128	=	7680	=	28.875
				f℥ 1	=	8	=	480	=	1.8047
						f℈ 1	=	♏ 60	=	.2256

IMPERIAL MEASURE.

Adopted by the British Pharmacopœia.

Gallon.		Pints.		Fluidounces.		Fluidrachms.		Minims.
1	=	8	=	160	=	1280	=	76800
		1	=	20	=	160	=	9600
				1	=	8	=	480
						1	=	60

Relative Value of Apothecaries' and Imperial Measure.

Apothecaries' Measure.		Imperial Measure.			
		Pints.	Fluidounces.	Fluidrachms.	Minims.
1 gallon	=	6	13	2	23
1 pint	=		16	5	18
1 fluidounce	=		1	0	20
1 fluidrachm	=			1	2.5
1 minim	=				1.04

Imperial Measure.		Apothecaries' Measure.				
		Gallon.	Pints.	Fluidounces.	Fluidrachms.	Minims.
1 gallon	=	1	1	9	5	8
1 pint	=		1	3	1	38
1 fluidounce	=				7	41
1 fluidrachm	=					58
1 minim	=					0.96

Relative Value of Weights and Measures in Distilled Water at 25° C. (77° F.).

1. Value of Apothecaries' Weight in Apothecaries' Measure.

				Pints.	Fluidounces.	Fluidrachms.	Minims.
1 pound	=	0.79188319 pint	=	0	12	5	21.6629
1 ounce	=	1.0558489 fluidounces	=	0	1	0	26.8975
1 drachm	=	1.0558489 fluidrachms	=	0	0	1	3.3509
1 scruple	=			0	0	0	21.1170
1 grain	=			0	0	0	1.0558

2. Value of Apothecaries' Measure in Apothecaries' Weight.

				lb	ʒ	ʒ	ə	Gr.		Grains.
1 gallon	=	10.1025000 pounds	=	10	1	1	2	10.4	=	58190.400
1 pint	=	1.2628125 pounds	=	1	3	1	0	13.80	=	7273.8000
1 fluidounce	=	0.94710937 ounce	=	0	0	7	1	14.61	=	454.6125[1]
1 fluidrachm	=	0.94710937 drachm	=	0	0	0	2	16.83	=	56.8266
1 minim	=	0.94710937 grain	=							.9471

3. Value of Avoirdupois Weight in Apothecaries' Measure.

				Pints.	Fluidounces.	Fluidrachms.	Minims.
1 pound	=	0.96235805 pint	=	0	15	3	10.9098
1 ounce	=	0.96235805 fluidounce	=	0	0	7	41.9319

4. Value of Apothecaries' Measure in Avoirdupois Weight.

1 gallon	=	8.312914285 pounds.
1 pint	=	1.039114285 pounds.
1 fluidounce	=	1.039114285 ounces.

5. Value of Imperial Measure in Apothecaries' and Avoirdupois Weights.

Imperial Measure.		Apothecaries' Weight.						Avoirdupois Weight.			Grains.		Cubic Inches.
1 gallon	=	12 lb	1 ℥	6 ʒ	2 ℈	0 gr.	=	10 lb	0 oz.	=	70,000	=	277.27384
1 pint	=	1	6	1	2	10	=	1	4	=	8,750	=	34.65923
1 fluidounce	=			7	0	17.5	=		1	=	437.5	=	1.73296
1 fluidrachm	=				2	14.69	=				54.69	=	0.21662
1 minim	=										.91	=	0.00361

[1] The weight of a fluidounce of water at 25° C. (77° F.) according to the Table of Weight and Volume Relations in the U. S. Pharmacopœia 8th Rev. is 454.6 grains.

In converting the weights of liquids heavier or lighter than water into measures, or conversely, a correction must be made for specific gravity. In converting weights into measures, the calculator may proceed as if the liquid was water, and the obtained measure will be to the true measure *inversely* as the specific gravity. In the converse operation, of turning measures into weights, the same assumption may be made, and the obtained weight will be to the true weight *directly* as the specific gravity.

METRIC WEIGHTS AND MEASURES.

The French *metric* system is based upon the idea of employing, as the unit of all measures, whether of length, capacity, or weight, a uniform unchangeable standard, adopted from nature, the multiples and subdivisions of which should follow in decimal progression. To obtain such a standard, the length of one-fourth part of the terrestrial meridian, extending from the equator to the pole, was ascertained. The ten-millionth part of this arc was chosen as the unit of measures of length, and was denominated *meter*.[1] The cube of the tenth part of the meter was taken as the unit of measures of capacity, and denominated *liter*. The weight of distilled water, at its greatest density, which this cube is capable of containing, was called *kilogramme*, of which the thousandth part was adopted as the unit of weight, under the name of *gramme*. The multiples of these measures, proceeding in the decimal progression, are distinguished by employing the prefixes *deca*,[2] *hecto*, *kilo*, and *myria*, taken from the Greek numerals, and the subdivisions, following the same order, by *deci*, *centi*, *milli*, from the Latin numerals. Since the introduction of this system it has been adopted by the principal nations of Europe, excepting Great Britain, and in many of these its use is compulsory. It is in general use in France, Germany, Austria-Hungary, Italy, Spain, Norway, Sweden, Netherlands, Switzerland, Greece, British India, and South America. It was legalized in Great Britain in 1864, and in the United States by an act of Congress in 1866.

The *meter*, or unit of length,	=	39.3700 inches.	
The *liter*, or unit of capacity,	=	33.813819776 fluidounces.	*U. S.*
The *gramme*, or unit of weight,	=	15.43235639 Troy grains.	

Upon this basis the following tables have been constructed:

Measures of Length.

		English Inches.		Miles.	Rods.	Yards.	Feet.	Inches.
Millimeter (mm.)	=	.03937						
Centimeter (cm.)	=	.39370						
Decimeter (dm.)	=	3.93700						
Meter (M.)	=	39.37000	=	0	0	1	0	3.370
Decameter (Dm.)	=	393.70000	=	0	0	10	2	9.700
Hectometer (Hm.)	=	3937.00000	=	0	0	109	1	1.000
Kilometer (Km.)	=	39370.00000	=	0	198	4	1	10.000
Myriameter (Mm.)	=	393700.00000	=	6	56	2	0	4.000

Measures of Capacity.

		English Cubic Inches.		Apothecaries' Measure.
Milliliter (cc.)	=	.0610233778	=	16.2306 minims.
Centiliter (cl.)	=	.6102337780	=	2.7051 fluidrachms.
Deciliter (dl.)	=	6.1023377800	=	3.3816 fluidounces.
Liter (L.)	=	61.0233778000	=	2.1133 pints.
Decaliter (Dl.)	=	610.2337780000	=	2.6417 gallons.
Hectoliter (Hl.)	=	6102.3377800000		
Kiloliter (Kl.)	=	61023.3778000000		
Myrialiter (Ml.)	=	610233.7780000000		

Measures of Weight.

		Troy Grains.		lb (Troy).	ʒ	ʒ	Gr.
Milligramme (mg.)	=	.0154					
Centigramme (cg.)	=	.1543					
Decigramme (dg.)	=	1.5432					
Gramme (Gm.)	=	15.4323					
Decagramme (Dg.)	=	154.3235	=	0	0	2	34.3
Hectogramme (Hg.)	=	1543.2356	=	0	3	1	43.2
Kilogramme (Kg.)	=	15432.3563	=	2	8	1	12.3
Myriagramme (Mg.)	=	154323.5639	=	26	9	4	3.5

[1] There are two methods of spelling the metric units in common use, one, the original, *metre*, *litre*, *gramme;* in the other, these are spelled *meter*, *liter*, and *gram*. The U. S. Pharmacopœia (8th Rev.) sanctions both methods, which, in our opinion, is unfortunate. *Metre* and *litre* are spelled meter and liter, while the original orthography is retained for *gramme*.

[2] Deca and hecto are sometimes written deka and hekto.

RELATIVE VALUE OF WEIGHTS AND MEASURES.

Value of Avoirdupois Weights and Imperial Measures, in Metrical Weights and Measures, as stated in the British Pharmacopœia.

Avoirdupois Weights.		Metrical Weights.	Imperial Measures.		Metrical Measures.
1 pound	=	453·5925 grammes.	1 gallon	=	4·543487 liters.
1 ounce	=	28·3495 "	1 pint	=	0·567936 "
1 grain	=	0·0648 "	1 fluidounce	=	0·028396 "
			1 fluidrachm	=	0·003549 "
			1 minim	=	0·000059 "

Relative Value of United States and Metric Measures of Length.

Inches.		Centimeters.	Inches.		Centimeters.	Inch.		Millimeters.	Inch.		Millimeters.
12	=	30·50	6	=	15·20	1/32	=	1·00	5/8	=	15·90
11	=	27·90	5	=	12·70	1/12	=	2·11	11/16	=	16·92
10	=	25·40	4	=	10·20	1/8	=	3·20	3/4	=	19·10
9	=	22·90	3	=	7·60	1/4	=	6·40	13/16	=	21·15
8	=	20·30	2	=	5·10	1/3	=	8·46	7/8	=	22·20
7	=	17·80	1	=	2·54	1/2	=	12·70	11/12	=	23·28

Relative Value of Apothecaries' and Metric Fluid Measures.

Minims.		Cubic Centimeters.	Minims.		Cubic Centimeters.	Fluid-ounces.		Cubic Centimeters.	Fluid-ounces.		Cubic Centimeters.
1	=	0·06	25	=	1·54	**1**	=	**30·00**[1]	21	=	621·04
2	=	0·12	**30**	=	**1·85**	2	=	59·14	22	=	650·62
3	=	0·18	35	=	2·15	3	=	88·72	23	=	680·19
4	=	0·24	40	=	2·46	4	=	118·29	24	=	709·76
5	=	0·30	45	=	2·77	5	=	147·87	25	=	739·34
6	=	0·37	50	=	3·08	6	=	177·44	26	=	768·91
7	=	0·43	55	=	3·40	7	=	207·00	27	=	798·50
8	=	0·50	Fluid-drachms.			8	=	236·59	28	=	828·06
9	=	0·55				9	=	266·16	29	=	857·63
10	=	0·61	1	=	**3·70**	10	=	295·73	30	=	887·21
11	=	0·67	1 1/2	=	4·61	11	=	325·31	31	=	916·78
12	=	0·74	1 2/3	=	5·53	12	=	354·88	32	=	946·35
13	=	0·80	1 5/6	=	6·47	13	=	384·45	48	=	1419·00
14	=	0·86	2	=	7·39	14	=	414·00	56	=	1656·00
15	=	0·92	3	=	11·09	15	=	443·06	64	=	1892·00
16	=	1·00	**4**	=	**15·00**	**16**	=	**473·11**	72	=	2128·00
17	=	1·05	5	=	18·48	17	=	502·75	80	=	2365·00
18	=	1·12	6	=	22·18	18	=	532·32	96	=	2839·00
19	=	1·17	7	=	25·87	19	=	561·90	112	=	3312·00
20	=	1·23				20	=	591·47	**128**	=	**3785.00**

[1] The more accurate equivalent is 29·57 Cc.

Relative Value of Metric Fluid and Apothecaries' Measures.

Cubic Centimeters.		Fluid-ounces.	Cubic Centimeters.		Fluid-ounces.	Cubic Centimeters.		Minims.	Cubic Centimeters.		Minims.
1000	=	33·81	400	=	13·52	25	=	405·7	4	=	64·9
900	=	30·43	300	=	10·14	10	=	162·3	3	=	48·7
800	=	27·05	200	=	6·76	9	=	146·1	2	=	32·5
700	=	23·67	100	=	3·38	8	=	129·8	**1**	=	**16·00**[2]
600	=	20·29	75	=	2·53	7	=	113·6	0·50	=	8·1
500	=	16·90	50	=	1·69	6	=	97·4	0·25	=	4·1
473	=	16·00	**30**	=	**1·00**[1]	5	=	81·1	0·06	=	1·0

[1] Or, more exactly, 1·01.

[2] Or, more exactly, 16·23.

Relative Value of Apothecaries' and Metric Weights.

Grains.	Grammes.	Grains.	Grammes.	Grains.	Grammes.	Drachms.	Grammes.
1/100	0·00065	1	0·065	24	1·55	1	3·88
1/64	0·00101	2	0·130	25	1·62	2	7·77
1/60	0·00110	3	0·194	26	1·70	3	11·66
1/50	0·00130	4	0·259	27	1·75	4	15·55
1/48	0·00135	5	0·324	28	1·82	5	19·44
1/40	0·00162	6	0·389	29	1·87	6	23·32
1/36	0·00180	7	0·454	30	1·94	7	27·21
1/32	0·00202	8	0·518	31	2·00	Ounces.	
1/30	0·00220	9	0·583	32	2·10	1	31·10[2]
1/25	0·00270	10	0·648	33	2·16	2	62·20
1/24	0·00274	11	0·713	34	2·20	3	93·31
1/20	0·00324	12	0·775	35	2·25	4	124·41
1/18	0·00360	13	0·842	36	2·30	5	155·51
1/16	0·00405	14	0·907	37	2·40	6	186·62
1/15	0·00432	15	0·972	38	2·46	7	217·72
1/12	0·00540	15·5[1]	1·000	39	2·55	8	248·82
1/10	0.00648	16	1·040	40	2·59	9	279·93
1/8	0·00810	17	1·102	42	2·73	10	311·03
2/15	0·01080	18	1·166	44	2·85	11	342·14
3/16	0·01296	19	1·232	48	3·00	12	373·24
1/6	0·01620	20	1·296	50	3·24	14	435·44
1/5	0·02160	21	1·360	52	3·40	16	497·65
1/4	0·03240	22	1·425	56	3·65	24	746·48
3/4	0·04860	23	1·490	58	3·75	48	1492·96
						100	3110·40

[1] Or, more exactly, 15·432 + gr. = 1 gramme.

[2] Or, more exactly, 31·10349 grammes.

Relative Value of Metric and Apothecaries' Weights.

Grammes.	Grains.	Grammes.	Grains.	Grammes.	Grains.	Grammes.	Grains.
0·0010	1/64	0·065	1·003	1	15·43	100	1543·23
0·0020	1/32	0·100	1·543	2	30·99	125	1929·04
0·0040	1/16	0·130	2·006	3	46·30	150	2314·85
0·0065	1/10	0·150	2·315	4	61·73	175	2700·70
0·0081	1/8	0·180	2·778	5	77·20	450	6944·60
0·0108	1/6	0·200	3·086	6	92·60	550	8487·80
0·0162	1/4	0·300	4·630	7	108·00	650	10031·01
0·0324	1/2	0·500	7·716	8	123·50	750	11574·30
0·0486	3/4	0·700	10·803	9	138·90	850	13117·50
0·0567	7/8	0·900	13·890	10	154·32	1000	15432·35

Relative Value of Avoirdupois and Metric Weights.

Avoir. Ounces.	Grammes.	Avoir. Ounces.	Grammes.	Avoir. Ounces.	Grammes.	Avoir. Pounds.	Grammes.
1/16	1·772	5	141·75	13	368·54	3	1360·78
1/8	3·544	6	170·07	14	396·89	4	1814·37
1/4	7·088	7	198·45	15	425·24	5	2267·96
1/2	14·175	8	226·80	Avoir. Pounds.		6	2721·55
1	28·350	9	255·15	1	453·59	7	3175·14
2	56·700	10	283·50	2	907·18	8	3628·74
3	85·049	11	311·84	2·2	1000·00	9	4082·33
4	113·398	12	340·19			10	4535·92

Relative Value of Metric and Avoirdupois Weights.

Grammes.	Oz.	Gr.	Grammes.	Oz.	Gr.	Grammes.	Oz.	Gr.	Grammes.	Oz.	Gr.
28·35	1		38	1	149	125	4	179	600	21	72
29	1	10	39	1	164	150	5	127	650	22	406
30	1	25	40	1	180	200	7	24	700	24	303
31	1	41	50	1	334	250	8	358	750	26	199
32	1	56	60	2	50	300	10	255	800	28	96
33	1	72	70	2	205	350	12	151	850	29	430
34	1	87	80	2	360	400	14	48	900	31	326
35	1	103	85	3		450	15	382	950	33	223
36	1	118	90	3	76	500	17	279	1000	35	120
37	1	133	100	3	230	550	19	175			

APPROXIMATE MEASUREMENT.

For the sake of convenience, in the absence of proper instruments, we often make use of means of measurement which, though not precise nor uniform, afford results sufficiently accurate for ordinary purposes. Of this kind are certain household implements, of a capacity approaching to uniformity, and corresponding to a certain extent with the regular standard measures. Custom has attached a fixed value to these implements, with which it is proper that the practitioner should be familiar, although their capacity, as they are now made, with the exception of the wineglass, generally somewhat exceeds that at which they were originally and still continue to be estimated. According to the U. S. P. (8th Rev.):

A *tea-cup* is estimated to contain about four fluidounces, or 120 Cc.
A *wineglass* . . . . . two fluidounces, or 60 Cc.
A *tablespoon* (cochlear magnum) . . . half a fluidounce, or 16 Cc.
A *dessertspoon* (cochlear medium) . . two fluidrachms, or 8 Cc.
A *teaspoon* (cochlear parvum) . . . . a fluidrachm, or 4 Cc.
The U. S. D. (19th ed.) prefers to make the equivalents used in this book closer, and have therefore adopted for the tablespoonful 15 Cc., dessertspoonful 7.5 Cc., and teaspoonful 3.75 Cc.

Small quantities of liquid medicines are often administered by *drops*, each of which is usually considered equivalent to a minim, or the sixtieth part of a fluidrachm. The drop of water and of aqueous fluids is, sometimes, about that size; but the same is by no means the case with all medicinal liquids, and the drop even of the same liquid varies much in bulk, according to the circumstances under which it is formed. This is, therefore, an uncertain mode of estimating the quantity of liquids, and should be superseded where minim measures can be had. Certain rules, however, influence the formation of drops, which will enable us to form some notion of their probable relative number, in the same amount of liquid when possessed of the requisite data. Thus, the heavier the liquid, the smaller, other things being equal, is the size of the drops, and the greater their number in a given measure. The drop of chloroform, for example, which is a very heavy liquid, is very small, much smaller than that of alcohol or ether. The greater or less viscidity and greater or less mobility of the liquid have much influence, the former in increasing, the latter in diminishing the size of the drops. The adhesiveness of liquids, which opposes their disposition to leave the surface from which they fall, requires a greater mass to overcome it, and consequently augments the size of the drop. The rapidity of the movement acts in a contrary direction, and the drop from a full bottle should be less than from one more or less emptied. The broader the surface from which they fall, the greater is their size. The drops from a thick-lipped bottle are larger than from one with thin lips.

The results stated in the table on page 1749 were obtained by Stephen L. Talbot. They may be relied on as accurate, and in most cases correspond with the results obtained by Durand and Procter (see *A. J. P.*, i. 169; 1865, p. 389; 1880, p. 337), but should be considered as indicating only the relative number of drops afforded by the several liquids mentioned; for, under other circumstances than those of Talbot's experiments, entirely different results might be obtained as relates to each liquid. The preparations experimented with were those of the U. S. Pharmacopœia of 1870, but the table has been revised to correspond with the preparations of the U. S. P. (8th Rev.)

FRENCH MEASURES.

In reading French medical works, if unacquainted with their customary expressions of measure, we are often left in great uncertainty as to the precise quantity indicated by the names. The following table, translated from the French Codex, will obviate this difficulty. (See Metric Table, page 1745.)

	Grammes.
A coffeespoon (*cuillerée à café*, Fr., *teaspoon*) (Fr. Cod. 1895)	5
A dessertspoon (*cuillerée à dessert*, Fr., *dessertspoon*), 2 coffeespoons, or	10
A common spoon (*cuillerée*, Fr., *tablespoon*), 4 coffeespoons, or	15
A glass (*verre*, Fr.), 10 common spoons	150
A handful (*poignée*, Fr.) of barleyseed (Fr. Cod. 1866)	80
" " " flaxseed	50
" " " flaxseed-meal	150
" " " dried mallow leaves	40
" " " " chicory "	30
A pinch (*pincée*, Fr.) of chamomile flowers	2
" " " arnica "	1
" " " marshmallow "	2
" " " mallows "	1
" " " linden "	2
" " " fruits of anise	2
" " " " fennel	2
A hen's egg, newly laid, has the mean weight of	64
" the white alone	40
" the yellow alone	20
Blanched almonds have the mean weight, each, of	1

TABLE EXHIBITING THE NUMBER OF DROPS IN A FLUIDRACHM OF DIFFERENT LIQUIDS, WITH THE WEIGHT IN GRAINS AND GRAMMES.

Name.	Drops in f℥i (60 m.)	Weight of f℥i	
		in gr.	in Gm.
Acetum Opii	90	61	3.95
Sanguinariæ	78	55½	3.59
Scillæ	68	57	3.69
Acidum Aceticum	108	58	3.75
Aceticum Dilutum	68	55	3.56
Carbolicum	111	59	3.82
Hydrochloricum	70	65	4.21
Hydrochlor. Dilutum	60	56	3.62
Hydrocyanicum Dilutum	60	54	3.49
Lacticum	111	66	4.27
Nitricum	102	77	4.98
Nitricum Dilutum	60	58	3.62
Nitrohydrochloricum	76	66	4.27
Phosphoricum Dilutum	59	57	3.69
Sulphuricum	128	101	6.54
Sulphuricum Aromaticum	146	53	3.43
Sulphuricum Dilutum	60	58½	3.79
Sulphurosum	59	55	3.56
Æther	176	39	2.52
Alcohol	146	44	2.85
Dilutum	137	49	3.17
Aqua	60	55	3.56
Ammoniæ Fortior	66	50	3.24
Destillata	60	53½	3.46
Balsamum Peruvianum	101	60	3.88
Bromum	250	165	10.69
Chloroformum	250	80	5.18
Copaiba	110	51	3.30
Creosotum	122	56½	3.66
Fluidextractum Belladonnæ	156	57	3.69
Buchu	150	47½	3.07
Cimicifugæ	147	48	3.11
Cinchonæ	138	58	3.75
Colchici Radicis	160	57	3.69
Colchici Seminis	158	55	3.56
Conii	137	61	3.95
Digitalis	134	62	4.01
Ergotæ	133	60	3.88
Gelsemii	149	49	3.14
Glycyrrhizæ	133	61	3.95
Hyoscyami	160	59	3.82
Ipecacuanhæ	120	60	3.88
Pareiræ	140	57	3.72
Rhei	158	61	3.95
Sarsaparillæ Compositum	134	60	3.88
Senegæ	137	62	4.01
Serpentariæ	148	47	3.07
Uvæ Ursi	137	60	3.88
Valerianæ	150	49	3.17
Veratri Viridis	150	50	3.24
Zingiberis	142	48	3.11
Glycerinum	67	68	4.40
Hydrargyrum	150	760	49.24
Liquor Acidi Arsenosi	75	56	3.62
Ammonii Acetatis	57	55	3.56
Arseni et Hydrargyri Iodidi	58	55	3.56
Ferri Chloridi	71	72	4.66
Ferri Citratis	71	72	4.66
Ferri Nitratis	59	59	3.82
Ferri Subsulphatis	73	83	5.37
Ferri Tersulphatis	83	72	4.66
Liquor Hydrarg. Nitratis	131	123	7.97
Iodi Compositus	63	59	3.82
Plumbi Subacetatis	74	70	4.53
Potassii Hydroxidi	62	58	3.75
Potassii Arsenitis	57	55	3.56
Sodæ Chlorinatæ	63	62	4.01
Zinci Chloridi	89	88	5.70
Oleoresina Aspidii	130	52	3.36
Capsici	120	51	3.30
Cubebæ	123	52	3.36
Oleum Æthereum	125	50	3.24
Amygdalæ Amaræ	115	55	3.56
Amygdalæ Expres	108	48½	3.14
Anisi	119	54	3.49
Bergamottæ	130	46	2.98
Cari	132	50	3.24
Caryophylli	130	57	3.69
Cinnamomi	126	53½	3.46
Copaibæ	123	49½	3.20
Cubebæ	125	51	3.30
Fœniculi	125	53	3.43
Gaultheriæ	125	62	4.01
Juniperi	148	49	3.17
Lavandulæ	138	52	3.36
Limonis	129	47	3.04
Menthæ Piperitæ	129	50	3.24
Ricini	77	51½	3.33
Rosæ	132	47	3.04
Rosmarini	143	50	3.24
Sassafras	133	58	3.75
Terebinthinæ	136	45½	2.94
Tiglii	104	50	3.24
Spiritus Ætheris Compositus	148	45	2.91
Ætheris Nitrosi	146	47	3.04
Ammoniæ Aromaticus	142	48	3.11
Camphoræ	143	47	3.04
Chloroformi	150	48	3.11
Menthæ Piperitæ	142	47	3.04
Syrupus	65	72	4.66
Acaciæ	44	73	4.73
Ferri Iodidi	65	77	4.98
Scillæ	75	74	4.79
Scillæ Compositus	102	70	4.53
Senegæ	106	70	4.53
Tinctura Aconiti	146	46	2.98
Belladonnæ	137	53	3.43
Benzoini Composita	148	48	3.11
Cantharidis	131	51	3.33
Cinchonæ Composita	140	49	3.17
Digitalis	128	53	3.43
Ferri Chloridi	150	53	3.43
Iodi	148	47	3.04
Nucis Vomicæ	140	44	2.85
Opii	130	53	3.43
Opii Camphorata	130	52	3.36
Opii Deodorati	110	54	3.49
Valerianæ	130	52	3.36
Veratri Viridis	145	46	2.98
Zingiberis	144	46	2.98
Vinum Colchici Radicis	107	55	3.56
Colchici Seminis	111	54	3.49
Opii	100	55	3.56

TABLES SHOWING SPECIFIC GRAVITY CORRESPONDING WITH DEGREES OF HYDROMETERS.

Baumé's hydrometer is still largely employed. In this instrument the specific gravity of distilled water is assumed as the zero of the descending scale in relation to fluids heavier than itself, and as ten on the ascending scale in relation to lighter fluids. In the following tables the specific gravity of liquids is given corresponding with the several degrees of this hydrometer. The first column of specific gravities is taken from the French Codex. The second column is based on the calculations of Huss. The third column was calculated by Henry Pemberton of Philadelphia, in 1851. The figures in this column correspond with the degrees of the hydrometers formerly prepared by W. H. Pile.

FOR LIQUIDS LIGHTER THAN WATER.
(Baumé's hydrometer.)

Degree of hydrometer.	Specific Gravity. By Baumé.			Degree of hydrometer.	Specific Gravity. By Baumé.		
10	1.000	1.0000	1.0000	44	0.809	0.8047	0.8045
11	0.993	0.9930	0.9929	45	0.804	0.8001	0.8000
12	0.986	0.9861	0.9859	46	0.800	0.7956	0.7954
13	0.979	0.9792	0.9790	47	0.795	0.7911	0.7909
14	0.973	0.9724	0.9722	48	0.791	0.7866	0.7865
15	0.966	0.9657	0.9655	49	0.787	0.7821	0.7821
16	0.960	0.9591	0.9589	50	0.783	0.7777	0.7777
17	0.953	0.9526	0.9523	51	0.778	0.7733	0.7734
18	0.947	0.9462	0.9459	52	0.774	0.7689	0.7692
19	0.941	0.9399	0.9395	53	0.770	0.7646	0.7650
20	0.935	0.9336	0.9333	54	0.766	0.7603	0.7608
21	0.929	0.9274	0.9271	55	0.762	0.7560	0.7567
22	0.923	0.9212	0.9210	56	0.758	0.7518	0.7526
23	0.917	0.9151	0.9150	57	0.754	0.7476	0.7486
24	0.911	0.9091	0.9090	58	0.750	0.7435	0.7446
25	0.905	0.9032	0.9032	59	0.746	0.7394	0.7407
26	0.900	0.8974	0.8974	60	0.742	0.7354	0.7368
27	0.894	0.8917	0.8917	61	0.738	0.7314	0.7329
28	0.889	0.8860	0.8860	62	0.735	0.7275	0.7290
29	0.883	0.8804	0.8805	63	0.731	.....	0.7253
30	0.878	0.8748	0.8750	64	0.727	.....	0.7216
31	0.872	0.8693	0.8695	65	0.724	.....	0.7179
32	0.867	0.8638	0.8641	66	0.720	.....	0.7142
33	0.862	0.8584	0.8588	67	0.716	.....	0.7106
34	0.857	0.8531	0.8536	68	0.713	.....	0.7070
35	0.852	0.8479	0.8484	69	0.709	.....	0.7035
36	0.847	0.8428	0.8433	70	0.706	.....	0.7000
37	0.842	0.8378	0.8383	71	0.702	.....	0.6965
38	0.837	0.8329	0.8333	72	0.699	.....	0.6930
39	0.832	0.8281	0.8284	73	0.696	.....	0.6896
40	0.827	0.8233	0.8235	74	0.692	.....	0.6863
41	0.823	0.8186	0.8187	75	0.689	.....	0.6829
42	0.818	0.8139	0.8139	76	0.686	.....	0.6796
43	0.813	0.8093	0.8092	77	0.682	.....	0.6763

The following formulas, furnished by Pile, may prove useful by enabling any one to calculate the sp. gr. corresponding with the several degrees of Baumé's hydrometer, and, conversely, the degree of Baumé corresponding with the sp. gr.

1. *For Liquids lighter than Water.*—The following formulas give the sp. gr. as represented in the first column in the foregoing table; or, the specific gravity being known, give the corresponding degree of Baumé.

$$\frac{144}{B^\circ + 134} = \text{sp. gr.}; \text{ and } \frac{144}{\text{sp. gr.}} - 134 = B^\circ.$$

The following formulas apply to the third column of specific gravities.

$$\frac{140}{B^\circ + 130} = \text{sp. gr.}; \text{ and } \frac{140}{\text{sp. gr.}} - 130 = B^\circ.$$

2. *For Liquids heavier than Water.*—For the first column, $\frac{144}{144 - B^\circ} = \text{sp. gr.}$, and $144 - \frac{144}{\text{sp. gr.}} = B^\circ$; for the third, $\frac{145}{145 - B^\circ} = \text{sp. gr.}$, and $145 - \frac{145}{\text{sp. gr.}} = B^\circ$.

FOR LIQUIDS HEAVIER THAN WATER.

(Baumé's hydrometer.)

Degree of hydrometer.	Specific Gravity. By Baumé.			Degree of hydrometer.	Specific Gravity. By Baumé.		
0	1.000	1.0000	1.0000	38	1.359	1.3559	1.3551
1	1.007	1.0070	1.0069	39	1.372	1.3686	1.3679
2	1.014	1.0141	1.0139	40	1.384	1.3815	1.3809
3	1.022	1.0213	1.0211	41	1.398	1.3947	1.3942
4	1.029	1.0286	1.0283	42	1.412	1.4082	1.4077
5	1.036	1.0360	1.0357	43	1.426	1.4219	1.4215
6	1.044	1.0435	1.0431	44	1.440	1.4359	1.4356
7	1.052	1.0511	1.0507	45	1.454	1.4501	1.4500
8	1.060	1.0588	1.0583	46	1.479	1.4645	1.4646
9	1.067	1.0666	1.0661	47	1.485	1.4792	1.4795
10	1.075	1.0745	1.0740	48	1.501	1.4942	1.4949
11	1.083	1.0825	1.0820	49	1.516	1.5096	1.5104
12	1.091	1.0906	1.0902	50	1.532	1.5253	1.5263
13	1.100	1.0988	1.0984	51	1.549	1.5413	1.5425
14	1.108	1.1071	1.1008	52	1.566	1.5576	1.5591
15	1.116	1.1155	1.1153	53	1.583	1.5742	1.5760
16	1.125	1.1240	1.1240	54	1.601	1.5912	1.5934
17	1.134	1.1326	1.1328	55	1.618	1.6086	1.6111
18	1.143	1.1414	1.1417	56	1.637	1.6264	1.6292
19	1.152	1.1504	1.1507	57	1.656	1.6446	1.6477
20	1.161	1.1596	1.1600	58	1.676	1.6632	1.6666
21	1.171	1.1690	1.1693	59	1.695	1.6823	1.6860
22	1.180	1.1785	1.1788	60	1.715	1.7019	1.7058
23	1.190	1.1882	1.1885	61	1.736	1.7220	1.7261
24	1.199	1.1981	1.1983	62	1.758	1.7427	1.7469
25	1.210	1.2082	1.2083	63	1.779	1.7640	1.7682
26	1.221	1.2184	1.2184	64	1.801	1.7856	1.7901
27	1.231	1.2288	1.2288	65	1.823	1.8082	1.8125
28	1.242	1.2394	1.2393	66	1.847	1.8312	1.8354
29	1.252	1.2502	1.2500	67	1.872	1.8548	1.8589
30	1.261	1.2612	1.2608	68	1.897	1.8790	1.8831
31	1.275	1.2724	1.2719	69	1.921	1.9038	1.9079
32	1.286	1.2838	1.2831	70	1.946	1.9291	1.9333
33	1.298	1.2954	1.2946	71	1.974	1.9548	1.9595
34	1.309	1.3072	1.3063	72	2.002	1.9809	1.9863
35	1.321	1.3190	1.3181	73	2.031	2.0073	2.0139
36	1.334	1.3311	1.3302	74	2.059	2.0340	2.0422
37	1.346	1.3434	1.3425	75	2.087	2.0610	2.0714

Gay-Lussac's centesimal alcoholmeter is applicable only to alcohol. The scale of this instrument is divided into 100 unequal degrees, the zero corresponding to pure water, and 100° to absolute alcohol; and every intermediate degree expresses the percentage of pure alcohol, by measure, contained in the liquors examined. Thus, when the instrument stands at 40° in any alcoholic liquid, it indicates that 100 measures of the liquid contain 40 of pure alcohol and 60 of water. But, as it was graduated for the temperature of 59° of Fahrenheit, the liquors to be tested should be brought to that temperature. *Tralles's centesimal alcoholmeter* is the one used by the U. S. Government in gauging the strength of spirit, and is generally employed in this country by distillers and wholesale dealers in the purchase and sale of alcoholic liquors. The scale of this instrument is, like Gay-Lussac's, divided into 100 unequal parts, each corresponding to the percentage by volume of pure alcohol contained in the liquors examined. As the sp. gr. of water is considered as unity at its temperature of greatest density, 39.8° F., and the degrees of this scale are calculated for 60° F., the zero, corresponding to the density of water, will represent a sp. gr. of .9991.

The table of Tralles on page 1752 gives the percentage of alcohol *by measure* corresponding with the specific gravity. Under the heading of Alcohol tables (see page 1757), a table of the percentage by weight corresponding with the sp. gr. is given. By means of these tables, in connection with the alcoholmeter, every problem that can arise in reference to the strength of spirituous liquors can be solved; and by the appended table, giving the value of Baumé's degrees in those of Tralles, the facility is still further extended.

Sikes's hydrometer is used in Great Britain in the collection of the excise revenue: it is a brass instrument having a spherical bulb, with a weight at the bottom to make it float upright; the stem is divided into twenty parts, and every other division numbered, from 0 to 10. A series of nine weights are furnished with the instrument, numbered from 10 to 90; these are to be added to the weight at the bottom to cause the hydrometer to sink, so that a reading may be had on the graduated scale; this reading added to the number on the weight employed, gives a figure which indicates the strength of the spirit by referring to a table which accompanies the instrument.

Jones's hydrometer is similar to Sikes's, but by many is regarded as an improvement on it.

ALCOHOLMETRICAL TABLE OF TRALLES.

Alcohol in 100 measures of spirit.	Specific gravity at 60° F.	Alcohol in 100 measures of spirit.	Specific gravity at 60° F.	Alcohol in 100 measures of spirit.	Specific gravity at 60° F.	Alcohol in 100 measures of spirit.	Specific gravity at 60° F.
0	.9991	26	.9689	51	.9315	76	.8739
1	.9976	27	.9679	52	.9295	77	.8712
2	.9961	28	.9668	53	.9275	78	.8685
3	.9947	29	.9657	54	.9254	79	.8658
4	.9933	30	.9646	55	.9234	80	.8631
5	.9919	31	.9634	56	.9213	81	.8603
6	.9906	32	.9622	57	.9192	82	.8575
7	.9893	33	.9609	58	.9170	83	.8547
8	.9881	34	.9596	59	.9148	84	.8518
9	.9869	35	.9583	60	.9126	85	.8488
10	.9857	36	.9570	61	.9104	86	.8458
11	.9845	37	.9556	62	.9082	87	.8428
12	.9834	38	.9541	63	.9059	88	.8397
13	.9823	39	.9526	64	.9036	89	.8365
14	.9812	40	.9510	65	.9013	90	.8332
15	.9802	41	.9494	66	.8989	91	.8299
16	.9791	42	.9478	67	.8965	92	.8265
17	.9781	43	.9461	68	.8941	93	.8230
18	.9771	44	.9444	69	.8917	94	.8194
19	.9761	45	.9427	70	.8892	95	.8157
20	.9751	46	.9409	71	.8867	96	.8118
21	.9741	47	.9391	72	.8842	97	.8077
22	.9731	48	.9373	73	.8817	98	.8034
23	.9720	49	.9354	74	.8791	99	.7988
24	.9710	50	.9335	75	.8765	100	.7939
25	.9700						

Table showing the value of the Degrees of Baumé's Hydrometer in those of Tralles's Alcoholmeter.

Baumé.	Tralles.	Baumé.	Tralles.	Baumé.	Tralles.	Baumé.	Tralles.
10.12	.0	20	50.1	30	75.6	40	92.9
11	4.3	21	53.2	31	77.6	41	94.2
12	9.8	22	56.1	32	79.6	42	95.5
13	16.1	23	58.9	33	81.5	43	96.7
14	22.9	24	61.6	34	83.4	44	97.8
15	29.2	25	64.2	35	85.1	45	98.8
16	34.5	26	66.6	36	86.8	46	99.7
17	39.2	27	69.0	37	88.4	46.37	100.0
18	43.1	28	71.3	38	90.0		
19	46.8	29	73.5	39	91.4		

RELATIONS BETWEEN THERMOMETERS.

In *Fahrenheit's* thermometer, the freezing point of water is placed at 32°, and the boiling point at 212°, and the number of intervening degrees is 180.

The *Centigrade* or *Celsius's* thermometer, which is now recognized in the U. S. Pharmacopœia and has been adopted generally by scientists, marks the freezing point *zero*, and the boiling point 100°.

In *Réaumur's* thermometer the freezing point is at *zero*, and the boiling point at 80°.

In *De Lisle's* thermometer, used in Russia, the graduation begins at the boiling point, which is marked *zero*, while the freezing point is placed at 150°.

From the above statement, it is evident that 180 degrees of Fahrenheit are equal to 100° of the Centigrade, 80° of Réaumur, and 150° of De Lisle; or 1 degree of the first is equal to $\frac{5}{9}$ of a degree of the second, $\frac{4}{9}$ of a degree of the third, and $\frac{2}{3}$ of a degree of the last. It is easy, therefore, to convert the degrees of one into the equivalent number of degrees of the other; but in ascertaining the corresponding points upon the different scales, it is necessary to take into consideration their different modes of graduation. Thus, as the zero Fahrenheit is 32° below the point at which that of the Centigrade and of Réaumur is placed, this number must be taken into account in the calculation.

1. If any degree on the *Centigrade* scale, either above or below zero, be multiplied by 1.8 the result will, in either case, be the number of degrees above or below 32°, or the freezing point of *Fahrenheit.*

2. The number of degrees between any point of *Fahrenheit's* scale and 32°, if divided by 1.8, will give the corresponding point on the *Centigrade.*

Table of Thermometric Equivalents.

(U. S. P. 8th Rev.)

Centigrade and Fahrenheit Scales.

Given Centigrade: Sought Fahrenheit:

$$n° \text{ C.} = \frac{9n°}{5} + 32$$

Given Fahrenheit: Sought Centigrade:

$$n° \text{ F.} = \frac{5\,(n° - 32)}{9}$$

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
—40	—40						
—39.4444	—39	—19.4444	—3			15.5556	60
—39	—38.2	—19	—2.2			16	60.8
—38.8889	—38	—18.8889	—2			16.1111	61
—38.3333	—37	—18.3333	—1			16.6667	62
—38	—36.4	—18	—0.4			17	62.6
—37.7778	—36	—17.7778	0			17.2222	63
—37.2222	—35	—17.2222	1			17.7778	64
—37	—34.6	—17	1.4			18	64.4
—36.6667	—34	—16.6667	2			18.3333	65
—36.1111	—33	—16.1111	3			18.8889	66
—36	—32.8	—16	3.2			19	66.2
—35.5556	—32	—15.5556	4			19.4444	67
—35	—31	—15	5			20	68
—34.4444	—30	—14.4444	6	0.5556	33	20.5556	69
—34	—29.2	—14	6.8	1	33.8	21	69.8
—33.8889	—29	—13.8889	7	1.1111	34	21.1111	70
—33.3333	—28	—13.3333	8	1.6667	35	21.6667	71
—33	—27.4	—13	8.6	2	35.6	22	71.6
—32.7778	—27	—12.7778	9	2.2222	36	22.2222	72
—32.2222	—26	—12.2222	10	2.7778	37	22.7778	73
—32	—25.6	—12	10.4	3	37.4	23	73.4
—31.6667	—25	—11.6667	11	3.3333	38	23.3333	74
—31.1111	—24	—11.1111	12	3.8889	39	23.8889	75
—31	—23.8	—11	12.2	4	39.2	24	75.2
—30.5556	—23	—10.5556	13	4.4444	40	24.4444	76
—30	—22	—10	14	5	41	25	77
—29.4444	—21	—9.4444	15	5.5556	42	25.5556	78
—29	—20.2	—9	15.8	6	42.8	26	78.8
—28.8889	—20	—8.8889	16	6.1111	43	26.1111	79
—28.3333	—19	—8.3333	17	6.6667	44	26.6667	80
—28	—18.4	—8	17.6	7	44.6	27	80.6
—27.7778	—18	—7.7778	18	7.2222	45	27.2222	81
—27.2222	—17	—7.2222	19	7.7778	46	27.7778	82
—27	—16.6	—7	19.4	8	46.4	28	82.4
—26.6667	—16	—6.6667	20	8.3333	47	28.3333	83
—26.1111	—15	—6.1111	21	8.8889	48	28.8889	84
—26	—14.8	—6	21.2	9	48.2	29	84.2
—25.5556	—14	—5.5556	22	9.4444	49	29.4444	85
—25	—13	—5	23	10	50	30	86
—24.4444	—12	—4.4444	24	10.5556	51	30.5556	87
—24	—11.2	—4	24.8	11	51.8	31	87.8
—23.8889	—11	—3.8889	25	11.1111	52	31.1111	88
—23.3333	—10	—3.3333	26	11.6667	53	31.6667	89
—23	—9.4	—3	26.6	12	53.6	32	89.6
—22.7778	—9	—2.7778	27	12.2222	54	32.2222	90
—22.2222	—8	—2.2222	28	12.7778	55	32.7778	91
—22	—7.6	—2	28.4	13	55.4	33	91.4
—21.6667	—7	—1.6667	29	13.3333	56	33.3333	92
—21.1111	—6	—1.1111	30	13.8889	57	33.8889	93
—21	—5.8	—1	30.2	14	57.2	34	93.2
—20.5556	—5	—0.5556	31	14.4444	58	34.4444	94
—20	—4	0	32	15	59	35	95

Table of Thermometric Equivalents—*Continued.*

C.°	F.°	C.°	F.	C.°	F.°	C.°	F.°
35.5556	96	60.5556	141	85.5556	186	110.5556	231
36	96.8	61	141.8	86	186.8	111	231.8
36.1111	97	61.1111	142	86.1111	187	111.1111	232
36.6667	98	61.6667	143	86.6667	188	111.6667	233
37	98.6	62	143.6	87	188.6	112	233.6
37.2222	99	62.2222	144	87.2222	189	112.2222	234
37.7778	100	62.7778	145	87.7778	190	112.7778	235
38	100.4	63	145.4	88	190.4	113	235.4
38.3333	101	63.3333	146	88.3333	191	113.3333	236
38.8889	102	63.8889	147	88.8889	192	113.8889	237
39	102.2	64	147.2	89	192.2	114	237.2
39.4444	103	64.4444	148	89.4444	193	114.4444	238
40	104	65	149	90	194	115	239
40.5556	105	65.5556	150	90.5556	195	115.5556	240
41	105.8	66	150.8	91	195.8	116	240.8
41.1111	106	66.1111	151	91.1111	196	116.1111	241
41.6667	107	66.6667	152	91.6667	197	116.6667	242
42	107.6	67	152.6	92	197.6	117	242.6
42.2222	108	67.2222	153	92.2222	198	117.2222	243
42.7778	109	67.7778	154	92.7778	199	117.7778	244
43	109.4	68	154.4	93	199.4	118	244.4
43.3333	110	68.3333	155	93.3333	200	118.3333	245
43.8889	111	68.8889	156	93.8889	201	118.8889	246
44	111.2	69	156.2	94	201.2	119	246.2
44.4444	112	69.4444	157	94.4444	202	119.4444	247
45	113	70	158	95	203	120	248
45.5556	114	70.5556	159	95.5556	204	120.5556	249
46	114.8	71	159.8	96	204.8	121	249.8
46.1111	115	71.1111	160	96.1111	205	121.1111	250
46.6667	116	71.6667	161	96.6667	206	121.6667	251
47	116.6	72	161.6	97	206.6	122	251.6
47.2222	117	72.2222	162	97.2222	207	122.2222	252
47.7778	118	72.7778	163	97.7778	208	122.7778	253
48	118.4	73	163.4	98	208.4	123	253.4
48.3333	119	73.3333	164	98.3333	209	123.3333	254
48.8889	120	73.8889	165	98.8889	210	123.8889	255
49	120.2	74	165.2	99	210.2	124	255.2
49.4444	121	74.4444	166	99.4444	211	124.4444	256
50	122	75	167	100	212	125	257
50.5556	123	75.5556	168	100.5556	213	125.5556	258
51	123.8	76	168.8	101	213.8	126	258.8
51.1111	124	76.1111	169	101.1111	214	126.1111	259
51.6667	125	76.6667	170	101.6667	215	126.6667	260
52	125.6	77	170.6	102	215.6	127	260.6
52.2222	126	77.2222	171	102.2222	216	127.2222	261
52.7778	127	77.7778	172	102.7778	217	127.7778	262
53	127.4	78	172.4	103	217.4	128	262.4
53.3333	128	78.3333	173	103.3333	218	128.3333	263
53.8889	129	78.8889	174	103.8889	219	128.8889	264
54	129.2	79	174.2	104	219.2	129	264.2
54.4444	130	79.4444	175	104.4444	220	129.4444	265
55	131	80	176	105	221	130	266
55.5556	132	80.5556	177	105.5556	222	130.5556	267
56	132.8	81	177.8	106	222.8	131	267.8
56.1111	133	81.1111	178	106.1111	223	131.1111	268
56.6667	134	81.6667	179	106.6667	224	131.6667	269
57	134.6	82	179.6	107	224.6	132	269.6
57.2222	135	82.2222	180	107.2222	225	132.2222	270
57.7778	136	82.7778	181	107.7778	226	132.7778	271
58	136.4	83	181.4	108	226.4	133	271.4
58.3333	137	83.3333	182	108.3333	227	133.3333	272
58.8889	138	83.8889	183	108.8889	228	133.8889	273
59	138.2	84	183.2	109	228.2	134	273.2
59.4444	139	84.4444	184	109.4444	229	134.4444	274
60	140	85	185	110	230	135	275

Table of Thermometric Equivalents—*Continued.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
135.5556	276	160.5556	321	185.5556	366	210.5556	411
136	276.8	161	321.8	186	366.8	211	411.8
136.1111	277	161.1111	322	186.1111	367	211.1111	412
136.6667	278	161.6667	323	186.6667	368	211.6667	413
137	278.6	162	323.6	187	368.6	212	413.6
137.2222	279	162.2222	324	187.2222	369	212.2222	414
137.7778	280	162.7778	325	187.7778	370	212.7778	415
138	280.4	163	325.4	188	370.4	213	415.4
138.3333	281	163.3333	326	188.3333	371	213.3333	416
138.8889	282	163.8889	327	188.8889	372	213.8889	417
139	282.2	164	327.2	189	372.2	214	417.2
139.4444	283	164.4444	328	189.4444	373	214.4444	418
140	284	165	329	190	374	215	419
140.5556	285	165.5556	330	190.5556	375	215.5556	420
141	285.8	166	330.8	191	375.8	216	420.8
141.1111	286	166.1111	331	191.1111	376	216.1111	421
141.6667	287	166.6667	332	191.6667	377	216.6667	422
142	287.6	167	332.6	192	377.6	217	422.6
142.2222	288	167.2222	333	192.2222	378	217.2222	423
142.7778	289	167.7778	334	192.7778	379	217.7778	424
143	289.4	168	334.4	193	379.4	218	424.4
143.3333	290	168.3333	335	193.3333	380	218.3333	425
143.8889	291	168.8889	336	193.8889	381	218.8889	426
144	291.2	169	336.2	194	381.2	219	426.2
144.4444	292	169.4444	337	194.4444	382	219.4444	427
145	293	170	338	195	383	220	428
145.5556	294	170.5556	339	195.5556	384	220.5556	429
146	294.8	171	339.8	196	384.8	221	429.8
146.1111	295	171.1111	340	196.1111	385	221.1111	430
146.6667	296	171.6667	341	196.6667	386	221.6667	431
147	296.6	172	341.6	197	386.6	222	431.6
147.2222	297	172.2222	342	197.2222	387	222.2222	432
147.7778	298	172.7778	343	197.7778	388	222.7778	433
148	298.4	173	343.4	198	388.4	223	433.4
148.3333	299	173.3333	344	198.3333	389	223.3333	434
148.8889	300	173.8889	345	198.8889	390	223.8889	435
149	300.2	174	345.2	199	390.2	224	435.2
149.4444	301	174.4444	346	199.4444	391	224.4444	436
150	302	175	347	200	392	225	437
150.5556	303	175.5556	348	200.5556	393	225.5556	438
151	303.8	176	348.8	201	393.8	226	438.8
151.1111	304	176.1111	349	201.1111	394	226.1111	439
151.6667	305	176.6667	350	201.6667	395	226.6667	440
152	305.6	177	350.6	202	395.6	227	440.6
152.2222	306	177.2222	351	202.2222	396	227.2222	441
152.7778	307	177.7778	352	202.7778	397	227.7778	442
153	307.4	178	352.4	203	397.4	228	442.4
153.3333	308	178.3333	353	203.3333	398	228.3333	443
153.8889	309	178.8889	354	203.8889	399	228.8889	444
154	309.2	179	354.2	204	399.2	229	444.2
154.4444	310	179.4444	355	204.4444	400	229.4444	445
155	311	180	356	205	401	230	446
155.5556	312	180.5556	357	205.5556	402	230.5556	447
156	312.8	181	357.8	206	402.8	231	447.8
156.1111	313	181.1111	358	206.1111	403	231.1111	448
156.6667	314	181.6667	359	206.6667	404	231.6667	449
157	314.6	182	359.6	207	404.6	232	449.6
157.2222	315	182.2222	360	207.2222	405	232.2222	450
157.7778	316	182.7778	361	207.7778	406	232.7778	451
158	316.4	183	361.4	208	406.4	233	451.4
158.3333	317	183.3333	362	208.3333	407	233.3333	452
158.8889	318	183.8889	363	208.8889	408	233.8889	453
159	318.2	184	363.2	209	408.2	234	453.2
159.4444	319	184.4444	364	209.4444	409	234.4444	454
160	320	185	365	210	410	235	455

Table of Thermometric Equivalents—*Continued.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
235.5556	456	260.5556	501	285.5556	546	310.5556	591
236	456.8	261	501.8	286	546.8	311	591.8
236.1111	457	261.1111	502	286.1111	547	311.1111	592
236.6667	458	261.6667	503	286.6667	548	311.6667	593
237	458.6	262	503.6	287	548.6	312	593.6
237.2222	459	262.2222	504	287.2222	549	312.2222	594
237.7778	460	262.7778	505	287.7778	550	312.7778	595
238	460.4	263	505.4	288	550.4	313	595.4
238.3333	461	263.3333	506	288.3333	551	313.3333	596
238.8889	462	263.8889	507	288.8889	552	313.8889	597
239	462.2	264	507.2	289	552.2	314	597.2
239.4444	463	264.4444	508	289.4444	553	314.4444	598
240	464	265	509	290	554	315	599
240.5556	465	265.5556	510	290.5556	555	315.5556	600
241	465.8	266	510.8	291	555.8	316	600.8
241.1111	466	266.1111	511	291.1111	556	316.1111	601
241.6667	467	266.6667	512	291.6667	557	316.6667	602
242	467.6	267	512.6	292	557.6	317	602.6
242.2222	468	267.2222	513	292.2222	558	317.2222	603
242.7778	469	267.7778	514	292.7778	559	317.7778	604
243	469.4	268	514.4	293	559.4	318	604.4
243.3333	470	268.3333	515	293.3333	560	318.3333	605
243.8889	471	268.8889	516	293.8889	561	318.8889	606
244	471.2	269	516.2	294	561.2	319	606.2
244 4444	472	269.4444	517	294.4444	562	319.4444	607
245	473	270	518	295	563	320	608
245.5556	474	270.5556	519	295.5556	564	320.5556	609
246	474.8	271	519.8	296	564.8	321	609.8
246.1111	475	271.1111	520	296.1111	565	321.1111	610
246.6667	476	271.6667	521	296.6667	566	321.6667	611
247	476.6	272	521.6	297	566.6	322	611.6
247.2222	477	272.2222	522	297.2222	567	322.2222	612
247.7778	478	272.7778	523	297.7778	568	322.7778	613
248	478.4	273	523.4	298	568.4	323	613.4
248.3333	479	273.3333	524	298.3333	569	323.3333	614
248.8889	480	273.8889	525	298.8889	570	323.8889	615
249	480.2	274	525.2	299	570.2	324	615.2
249.4444	481	274.4444	526	299.4444	571	324.4444	616
250	482	275	527	300	572	325	617
250.5556	483	275.5556	528	300.5556	573	325.5556	618
251	483.8	276	528.8	301	573.8	326	618.8
251.1111	484	276.1111	529	301.1111	574	326.1111	619
251.6667	485	276.6667	530	301.6667	575	326.6667	620
252	485.6	277	530.6	302	575.6	327	620.6
252.2222	486	277.2222	531	302.2222	576	327.2222	621
252.7778	487	277.7778	532	302.7778	577	327.7778	622
253	487.4	278	532.4	303	577.4	328	622.4
253.3333	488	278.3333	533	303.3333	578	328.3333	623
253.8889	489	278.8889	534	303.8889	579	328.8889	624
254	489.2	279	534.2	304	579.2	329	624.2
254.4444	490	279.4444	535	304.4444	580	329.4444	625
255	491	280	536	305	581	330	626
255.5556	492	280.5556	537	305.5556	582	330.5556	627
256	492.8	281	537.8	306	582.8	331	627.8
256.1111	493	281.1111	538	306.1111	583	331.1111	628
256.6667	494	281.6667	539	306.6667	584	331.6667	629
257	494.6	282	539.6	307	584.6	332	629.6
257.2222	495	282.2222	540	307.2222	585	332.2222	630
257.7778	496	282.7778	541	307.7778	586	332.7778	631
258	496.4	283	541.4	308	586.4	333	631.4
258.3333	497	283.3333	542	308.3333	587	333.3333	632
258.8889	498	283.8889	543	308.8889	588	333.8889	633
259	498.2	284	543.2	309	588.2	334	633.2
259.4444	499	284.4444	544	309.4444	589	334.4444	634
260	500	285	545	310	590	335	635

ALCOHOL TABLES.

List of Abbreviations Used in the Following Tables.

abs. = absolute. dif. = difference. sp. gr. = specific gravity.
alc. = alcohol. frac. = fractional. vol. = volume.
appt. = apparent. gal. = gallon. wt. = weight.
cor. = correction.

Alcohol Table (U. S. P. 8th Rev.)

Per cent. vol. abs. alc.[1]	Sp. gr. 15.6° C.[2] / 15.6° C.	Dif. of appt. sp. gr. for 1° C.[3]	Frac. per cent.[4]	Vol. in gal. of 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	No. of gal. official alc. in 100 lbs. av.[5]	Cor. on foregoing for 0.1 per cent.	Wt. in lbs. av. of 1 gal. U. S.[6]	Per cent. by wt. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Cor. of sp. gr. for 1° C.[3]
1	0.9985	0.00017	0.067	12.024	0.0018	0.127	0.0127	8.3164	1	0.9981	0.00017
2	0.9970	0.00018	0.071	12.043	0.0017	0.254	0.0127	8.3039	2	0.9963	0.00018
3	0.9956	0.00018	0.071	12.060	0.0017	0.381	0.0128	8.2922	3	0.9945	0.00019
4	0.9942	0.00019	0.071	12.077	0.0017	0.509	0.0128	8.2805	4	0.9928	0.00020
5	0.9928	0.00020	0.077	12.094	0.0016	0.637	0.0128	8.2689	5	0.9912	0.00021
6	0.9915	0.00021	0.077	12.109	0.0015	0.765	0.0129	8.2581	6	0.9896	0.00022
7	0.9902	0.00021	0.083	12.125	0.0015	0.894	0.0129	8.2472	7	0.9881	0.00023
8	0.9890	0.00022	0.083	12.140	0.0015	1.023	0.0129	8.2372	8	0.9867	0.00024
9	0.9878	0.00023	0.083	12.155	0.0015	1.152	0.0130	8.2272	9	0.9853	0.00025
10	0.9866	0.00024	0.091	12.170	0.0014	1.282	0.0130	8.2172	10	0.9839	0.00026
11	0.9855	0.00025	0.091	12.183	0.0013	1.412	0.0130	8.2081	11	0.9826	0.00027
12	0.9844	0.00025	0.091	12.197	0.0014	1.542	0.0130	8.1989	12	0.9813	0.00029
13	0.9833	0.00026	0.091	12.210	0.0013	1.672	0.0131	8.1898	13	0.9800	0.00030
14	0.9822	0.00027	0.091	12.224	0.0013	1.803	0.0131	8.1806	14	0.9788	0.00031
15	0.9811	0.00028	0.100	12.238	0.0013	1.934	0.0131	8.1714	15	0.9776	0.00033
16	0.9801	0.00029	0.100	12.250	0.0013	2.065	0.0131	8.1631	16	0.9764	0.00034
17	0.9791	0.00031	0.100	12.263	0.0013	2.196	0.0132	8.1548	17	0.9752	0.00036
18	0.9781	0.00032	0.100	12.275	0.0012	2.328	0.0132	8.1464	18	0.9740	0.00038
19	0.9771	0.00034	0.100	12.288	0.0013	2.460	0.0132	8.1381	19	0.9727	0.00040
20	0.9761	0.00035	0.100	12.300	0.0013	2.592	0.0132	8.1298	20	0.9715	0.00042
21	0.9751	0.00037	0.100	12.313	0.0012	2.724	0.0133	8.1215	21	0.9703	0.00044
22	0.9741	0.00038	0.091	12.326	0.0013	2.857	0.0133	8.1131	22	0.9690	0.00046
23	0.9730	0.00040	0.100	12.340	0.0013	2.990	0.0133	8.1040	23	0.9677	0.00048
24	0.9720	0.00041	0.100	12.352	0.0014	3.123	0.0134	8.0956	24	0.9663	0.00049
25	0.9710	0.00043	0.091	12.365	0.0013	3.257	0.0134	8.0873	25	0.9649	0.00051
26	0.9699	0.00044	0.091	12.379	0.0014	3.391	0.0134	8.0782	26	0.9635	0.00053
27	0.9688	0.00046	0.091	12.393	0.0014	3.525	0.0135	8.0690	27	0.9621	0.00055
28	0.9677	0.00047	0.091	12.407	0.0015	3.660	0.0135	8.0598	28	0.9606	0.00057
29	0.9666	0.00049	0.083	12.421	0.0015	3.795	0.0136	8.0507	29	0.9590	0.00058
30	0.9654	0.00051	0.083	12.437	0.0015	3.931	0.0136	8.0407	30	0.9574	0.00060
31	0.9642	0.00052	0.083	12.452	0.0016	4.067	0.0136	8.0307	31	0.9558	0.00061
32	0.9630	0.00054	0.077	12.468	0.0017	4.203	0.0137	8.0207	32	0.9542	0.00063
33	0.9617	0.00055	0.077	12.485	0.0017	4.340	0.0138	8.0099	33	0.9524	0.00064
34	0.9604	0.00056	0.077	12.502	0.0017	4.478	0.0138	7.9990	34	0.9507	0.00065
35	0.9591	0.00058	0.071	12.518	0.0018	4.616	0.0139	7.9882	35	0.9489	0.00066

[1] Multiply these figures by 1.0535 for the volume per cent. of official alcohol.

[2] Also approximately the weight in kilograms of one liter of the spirit.

[3] Add if the temperature is above, subtract if below, 15.6° C. (60° F.). If the temperature is taken in Fahrenheit degrees, multiply these figures by 0.555.

[4] Corresponding with a difference in apparent specific gravity of 0.0001.

[5] For the volume in pints of 100 lbs. of the spirit, multiply these figures by 8; for the volume in fluidounces, multiply by 128; for the volume in liters, multiply by 3.7854.

For the volume of 100 ounces avoirdupois in gallons, divide the figures of the Table by 16; for the volume in pints, divide by 2; for the volume in fluidounces, multiply by 8.

For the volume of 100 grains in fluidounces, multiply by 0.01829; in minims, by 8.777.

[6] For the weight of one gallon in ounces avoirdupois, multiply these figures by 16; in grains, by 7000; in grammes, by 453.59.

For the weight of one pint in pounds, divide these figures by 8; for the weight of one pint in ounces, multiply by 2; in grains, multiply by 875.

For the weight of one fluidounce in ounces avoirdupois, divide these figures by 8; in grains, multiply by 54.69.

Alcohol Table (U. S. P. 8th Rev.)—*Continued.*

Per cent. vol. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Dif. of appt. sp. gr. for 1° C.	Frac. per cent.	Vol. in gal. of 100 lbs. av.	Cor. on foregoing for 0.1 per cent.	No. of gal. official alc. in 100 lbs. av.	Cor. on foregoing for 0.1 per cent.	Wt. in lbs. av. of 1 gal. U. S.	Per cent by wt. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Cor. of sp. gr. for 1° C.
36	0.9577	0.00059	0.071	12.537	0.0018	4.755	0.0139	7.9765	36	0.9471	0.00067
37	0.9563	0.00060	0.071	12.555	0.0019	4.894	0.0140	7.9649	37	0.9452	0.00067
38	0.9549	0.00062	0.067	12.574	0.0020	5.034	0.0140	7.9532	38	0.9433	0.00068
39	0.9534	0.00063	0.067	12.593	0.0020	5.174	0.0141	7.9407	39	0.9414	0.00069
40	0.9519	0.00064	0.063	12.613	0.0021	5.315	0.0142	7.9282	40	0.9394	0.00070
41	0.9503	0.00065	0.063	12.634	0.0021	5.457	0.0143	7.9149	41	0.9374	0.00070
42	0.9487	0.00066	0.059	12.656	0.0022	5.600	0.0143	7.9016	41.48	0.9364	0.00071
43	0.9470	0.00067	0.059	12.678	0.0023	5.743	0.0144	7.8874	42	0.9353	0.00071
44	0.9453	0.00068	0.059	12.701	0.0023	5.888	0.0145	7.8733	43	0.9332	0.00072
45	0.9436	0.00069	0.059	12.724	0.0024	6.032	0.0146	7.8591	44	0.9311	0.00072
46	0.9419	0.00069	0.056	12.747	0.0024	6.178	0.0146	7.8449	45	0.9290	0.00073
47	0.9401	0.00070	0.053	12.771	0.0025	6.324	0.0147	7.8300	46	0.9269	0.00073
48	0.9382	0.00070	0.053	12.797	0.0026	6.471	0.0148	7.8141	47	0.9247	0.00074
48.95	0.9364	0.00071	0.053	12.822	0.0026	6.612	0.0148	7.7991	48	0.9225	0.00074
49	0.9363	0.00071	0.053	12.823	0.0026	6.620	0.0148	7.7983	49	0.9203	0.00075
50	0.9344	0.00071	0.053	12.849	0.0027	6.768	0.0150	7.7825	50	0.9181	0.00076
51	0.9324	0.00072	0.050	12.877	0.0028	6.919	0.0150	7.7658	51	0.9159	0.00076
52	0.9304	0.00073	0.050	12.905	0.0029	7.069	0.0152	7.7492	52	0.9137	0.00076
53	0.9284	0.00073	0.050	12.932	0.0028	7.221	0.0152	7.7325	53	0.9114	0.00077
54	0.9264	0.00074	0.047	12.960	0.0029	7.373	0.0154	7.7158	54	0.9092	0.00077
55	0.9243	0.00074	0.047	12.990	0.0030	7.527	0.0154	7.6984	55	0.9069	0.00077
56	0.9222	0.00075	0.045	13.019	0.0031	7.681	0.0156	7.6809	56	0.9047	0.00077
57	0.9200	0.00075	0.045	13.051	0.0031	7.837	0.0156	7.6625	57	0.9024	0.00078
58	0.9178	0.00075	0.045	13.082	0.0032	7.993	0.0158	7.6442	58	0.9002	0.00078
59	0.9156	0.00076	0.045	13.113	0.0032	8.151	0.0158	7.6259	59	0.8979	0.00078
60	0.9134	0.00076	0.045	13.145	0.0032	8.309	0.0160	7.6076	60	0.8956	0.00079
61	0.9111	0.00076	0.043	13.178	0.0033	8.469	0.0160	7.5884	61	0.8934	0.00079
62	0.9089	0.00077	0.043	13.210	0.0033	8.628	0.0162	7.5701	62	0.8910	0.00079
63	0.9066	0.00077	0.043	13.243	0.0033	8.790	0.0162	7.5509	63	0.8887	0.00080
64	0.9043	0.00077	0.043	13.277	0.0034	8.952	0.0163	7.5318	64	0.8863	0.00080
65	0.9020	0.00078	0.042	13.311	0.0035	9.115	0.0165	7.5126	65	0.8839	0.00080
66	0.8996	0.00078	0.043	13.346	0.0035	9.280	0.0165	7.4926	66	0.8815	0.00080
67	0.8973	0.00078	0.042	13.381	0.0036	9.445	0.0166	7.4735	67	0.8791	0.00080
68	0.8949	0.00079	0.040	13.417	0.0036	9.611	0.0169	7.4535	68	0.8767	0.00081
69	0.8924	0.00079	0.042	13.454	0.0037	9.780	0.0169	7.4327	69	0.8743	0.00081
70	0.8900	0.00079	0.040	13.490	0.0038	9.948	0.0171	7.4127	70	0.8719	0.00081
71	0.8875	0.00079	0.038	13.528	0.0039	10.119	0.0173	7.3919	71	0.8696	0.00081
72	0.8849	0.00080	0.038	13.568	0.0040	10.292	0.0173	7.3702	72	0.8672	0.00081
73	0.8823	0.00080	0.038	13.608	0.0041	10.465	0.0175	7.3485	73	0.8648	0.00081
74	0.8797	0.00080	0.037	13.648	0.0042	10.640	0.0177	7.3269	74	0.8624	0.00081
75	0.8770	0.00081	0.038	13.690	0.0042	10.817	0.0177	7.3044	75	0.8600	0.00081
76	0.8744	0.00081	0.037	13.731	0.0042	10.994	0.0179	7.2827	76	0.8576	0.00081
77	0.8717	0.00081	0.037	13.774	0.0043	11.173	0.0180	7.2603	77	0.8552	0.00081
78	0.8690	0.00081	0.037	13.816	0.0043	11.353	0.0182	7.2378	78	0.8527	0.00080
79	0.8663	0.00081	0.037	13.859	0.0044	11.535	0.0183	7.2153	79	0.8503	0.00080
80	0.8636	0.00081	0.036	13.903	0.0045	11.718	0.0184	7.1928	80	0.8478	0.00080
81	0.8608	0.00081	0.036	13.948	0.0046	11.902	0.0187	7.1695	81	0.8454	0.00080
82	0.8580	0.00081	0.034	13.994	0.0046	12.089	0.0189	7.1462	82	0.8429	0.00080
83	0.8551	0.00080	0.034	14.041	0.0048	12.278	0.0190	7.1220	83	0.8404	0.00080
84	0.8522	0.00080	0.034	14.089	0.0049	12.468	0.0191	7.0978	84	0.8378	0.00080
85	0.8493	0.00080	0.033	14.137	0.0050	12.659	0.0195	7.0737	85	0.8353	0.00080
86	0.8463	0.00080	0.032	14.187	0.0052	12.854	0.0197	7.0487	86	0.8328	0.00080
87	0.8432	0.00080	0.031	14.239	0.0054	13.051	0.0200	7.0229	87	0.8302	0.00080
88	0.8400	0.00080	0.031	14.293	0.0054	13.251	0.0202	6.9962	88	0.8276	0.00080
89	0.8368	0.00080	0.031	14.348	0.0055	13.453	0.0203	6.9696	89	0.8250	0.00080
90	0.8336	0.00080	0.030	14.403	0.0057	13.656	0.0207	6.9429	90	0.8223	0.00080

Alcohol Table (U. S. P. 8th Rev.)—*Continued.*

Per cent. vol. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Dif. of appt. sp. gr. for 1° C.	Frac. per cent.	Vol. in gal. of 100 lbs. av.	Cor. on foregoing for 0.1 per cent.	No. of gal. official alc. in 100 lbs. av.	Cor. on foregoing for 0.1 per cent.	Wt. in lbs. av. of 1 gal. U. S.	Per cent. by wt. abs. alc.	Sp. gr. 15.6° C. / 15.6° C.	Cor. of sp. gr. for 1° C.
91	0.8303	0.00080	0.029	14.460	0.0060	13.863	0.0210	6.9154	91	0.8196	0.00080
92	0.8269	0.00080	0.028	14.520	0.0063	14.073	0.0215	6.8871	92	0.8168	0.00080
93	0.8233	0.00080	0.027	14.583	0.0067	14.288	0.0219	6.8571	92.3	0.8160	0.00080
94	0.8196	0.00080	0.026	14.649	0.0069	14.507	0.0224	6.8263	93	0.8141	0.00080
94.92	0.8160	0.00080	0.026	14.714	0.0070	14.714	0.0224	6.7963	94	0.8113	0.00080
95	0.8157	0.00080	0.026	14.719	0.0070	14.731	0.0227	6.7938	95	0.8085	0.00080
96	0.8118	0.00080	0.024	14.790	0.0076	14.958	0.0234	6.7614	96	0.8056	0.00080
97	0.8076	0.00080	0.024	14.867	0.0080	15.192	0.0237	6.7264	97	0.8026	0.00080
98	0.8034	0.00080	0.021	14.945	0.0087	15.429	0.0249	6.6914	98	0.7997	0.00080
99	0.7987	0.00080	0.019	15.033	0.0099	15.678	0.0263	6.6523	99	0.7967	0.00080
100	0.7935	0.00080	....	15.131	.....	15.941	.....	6.6089	100	0.7935	0.00080

SPECIFIC GRAVITY OF ALCOHOL AT $\frac{25° C.}{25° C.}$ (U. S. P. 8th Rev.)[1]

Per cent. volume absolute alcohol.[2]	Specific gravity.	Per cent. weight absolute alcohol.	Specific gravity.	Per cent. volume official alcohol.	Specific gravity.
1	0.9985	1	0.9981	1	0.9986
2	0.9970	2	0.9963	2	0.9971
3	0.9955	3	0.9944	3	0.9957
4	0.9940	4	0.9926	4	0.9943
5	0.9926	5	0.9909	5	0.9929
6	0.9912	6	0.9892	6	0.9916
7	0.9898	7	0.9876	7	0.9903
8	0.9885	8	0.9861	8	0.9890
9	0.9872	9	0.9846	9	0.9878
10	0.9860	10	0.9831	10	0.9866
11	0.9848	11	0.9816	11	0.9854
12	0 9836	12	0.9802	12	0.9843
13	0.9825	13	0.9788	13	0.9832
14	0.9813	14	0.9774	14	0.9821
15	0.9801	15	0.9761	15	0.9810
16	0.9790	16	0.9747	16	0.9799
17	0.9778	17	0.9734	17	0.9788
18	0.9767	18	0.9720	18	0.9777
19	0.9756	19	0.9705	19	0.9767
20	0.9744	20	0.9691	20	0.9756
21	0.9733	21	0.9677	21	0.9745
22	0.9721	22	0.9663	22	0.9734
23	0.9709	23	0.9648	23	0.9723
24	0.9697	24	0.9633	24	0.9712
25	0.9685	25	0.9617	25	0.9700
26	0.9673	26	0.9601	26	0.9689
27	0.9660	27	0.9585	27	0.9677
28	0.9648	28	0.9568	28	0.9665
29	0.9635	29	0.9551	29	0.9653
30	0.9622	30	0.9533	30	0.9641
31	0.9608	31	0.9516	31	0.9629
32	0.9594	32	0.9498	32	0.9616
33	0.9580	33	0.9479	33	0.9603
34	0.9566	34	0.9461	34	0.9590
35	0.9552	35	0.9442	35	0.9576
36	0.9537	36	0.9423	36	0.9563
37	0.9521	37	0.9403	37	0.9550
38	0.9506	38	0.9383	38	0.9536
39	0.9490	39	0.9364	39	0.9521

[1] Based upon the figures used in E. R. Squibb's table.

[2] These volume percentages are strictly accurate only at 15.6° C. the standard temperature for alcohol.

Specific Gravity of Alcohol at $\frac{25° C.}{25° C.}$—*Continued.*

Per cent. volume absolute alcohol.	Specific gravity.	Per cent. weight absolute alcohol.	Specific gravity.	Per cent. volume official alcohol.	Specific gravity.
40	0.9474	40	0.9344	40	0.9506
41	0.9457	41	0.9323	41	0.9491
42	0.9440	42	0.9301	42	0.9475
43	0.9422	43	0.9280	43	0.9459
44	0.9404	44	0.9258	44	0.9443
45	0.9386	45	0.9236	45	0.9426
46	0.9368	46	0.9214	46	0.9410
47	0.9350	47	0.9192	47	0.9393
48	0.9331	48	0.9170	48	0.9376
49	0.9311	49	0.9147	49	0.9359
50	0.9291	50	0.9124	50	0.9341
51	0.9271	51	0.9102	51	0.9323
52	0.9250	52	0.9079	52	0.9304
53	0.9230	53	0.9056	53	0.9285
54	0.9209	54	0.9034	54	0.9266
55	0.9187	55	0.9011	55	0.9246
56	0.9165	56	0.8988	56	0.9227
57	0.9143	57	0.8965	57	0.9207
58	0.9121	58	0.8943	58	0.9186
59	0.9099	59	0.8920	59	0.9165
60	0.9077	60	0.8897	60	0.9144
61	0.9054	61	0.8874	61	0 9123
62	0.9031	62	0.8850	62	0.9102
63	0.9008	63	0.8826	63	0.9081
64	0.8984	64	0.8802	64	0.9060
65	0.8961	65	0.8778	65	0.9038
66	0.8937	66	0.8754	66	0.9016
67	0.8913	67	0.8730	67	0.8994
68	0.8889	68	0.8705	68	0.8972
69	0.8864	69	0.8681	69	0.8949
70	0.8840	70	0.8657	70	0.8926
71	0.8814	71	0.8634	71	0.8904
72	0.8788	72	0.8610	72	0.8881
73	0.8762	73	0.8586	73	0.8857
74	0.8736	74	0.8562	74	0.8834
75	0.8709	75	0.8538	75	0.8809
76	0.8682	76	0.8514	76	0.8784
77	0.8655	77	0.8490	77	0.8760
78	0.8628	78	0.8465	78	0.8735
79	0.8601	79	0.8441	79	0.8709
80	0.8574	80	0.8416	80	0.8684
81	0.8546	81	0.8392	81	0.8658
82	0.8518	82	0.8367	82	0.8632
83	0.8489	83	0.8342	83	0.8607
84	0.8460	84	0.8316	84	0.8581
85	0.8431	85	0.8291	85	0.8555
86	0.8401	86	0.8266	86	0.8528
87	0.8370	87	0.8240	87	0.8501
88	0.8338	88	0.8214	88	0.8474
89	0.8306	89	0.8188	89	0.8446
90	0.8274	90	0.8161	90	0.8418
91	0.8241	91	0.8134	91	0.8389
92	0.8207	92	0.8106	92	0.8359
93	0.8171	92.3	0.8098	93	0.8329
94	0.8134	93	0.8079	94	0.8299
94.9	0.8098	94	0.8051	95	0.8269
95	0.8095	95	0.8023	96	0.8237
96	0.8055	96	0.7994	97	0.8204
97	0.8014	97	0.7964	98	0.8170
98	0.7972	98	0.7935	99	0.8135
99	0.7925	99	0.7905	100	0.8098
100	0.7873	100	0.7873		

ALCOHOL.

According to E. R. Squibb.

NOTE.—This table was prepared by E. R. Squibb and introduced into the U. S. Pharmacopœia 1890, it is inserted here because it contains data not found in the official alcohol table U. S. P. 8th Rev., see page 1757.

PART I.—From 0 to 10 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C. = 60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C. = 60° F.	Weight of one pint, at 15⅝° C. = 60° F.	
								Avoirdupois Weight.						
											To the nearest ounce.			
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Under proof. (Brit. Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs.	ozs.	Grs.	lbs.	ozs.	lbs.	In Grammes.	In Grains.
1·0000	0·9986					3779·13	58,320	8	5	132	8	5	333·5	472·39	7290
0·9993	0·9978			99	1	3776·50	58,279	8	5	91	8	5	333·0	472·06	7285
0·9985	0·9970		1	98	2	3773·46	58,232	8	5	44	8	5	332·5	471·68	7279
0·9981	0·9966	1				3771·97	58,209	8	5	22	8	5	332·5	471·49	7276
0·9976	0·9961			97	3	3770·08	58,180	8	4	430	8	5	332·5	471·26	7272
0·9970	0·9953		2		4	3767·82	58,145	8	4	395	8	5	332·0	470·98	7268
0·9968	0·9951			96		3767·04	58,133	8	4	383	8	5	332·0	470·88	7267
0·9965	0·9948	2			5	3765·94	58,116	8	4	366	8	5	332·0	470·74	7264
0·9960	0·9943			95		3764·06	58,087	8	4	337	8	5	332·0	470·51	7261
0·9956	0·9938		3		6	3762·51	58,063	8	4	313	8	5	332·0	470·31	7258
0·9952	0·9934			94		3761·02	58,040	8	4	290	8	5	331·5	470·13	7255
0·9947	0·9927	3			7	3759·14	58,011	8	4	261	8	5	331·5	469·89	7251
0·9944	0·9924			93		3757·97	57,993	8	4	243	8	5	331·5	469·75	7249
0·9942	0·9922		4		8	3757·26	57,982	8	4	232	8	5	331·5	469·66	7248
0·9936	0·9916			92	9	3754·99	57,947	8	4	197	8	4	331·0	469·37	7243
0·9930	0·9909	4	5	91	10	3752·72	57,912	8	4	162	8	4	331·0	469·09	7239
0·9921	0·9900			90	11	3749·29	57,859	8	4	109	8	4	330·5	468·66	7232
0·9914	0·9893	5	6	89	12	3746·63	57,818	8	4	68	8	4	330·5	468·33	7227
0·9906	0·9885			88	13	3743·65	57,772	8	4	22	8	4	330·0	467·95	7221
0·9900	0·9879			87		3741·38	57,737	8	3	424	8	4	330·0	467·67	7217
0·9898	0·9876	6	7		14	3740·60	57,725	8	3	413	8	4	330·0	467·58	7216
0·9892	0·9870			86	15	3738·33	57,690	8	3	377	8	4	329·5	467·29	7211
0·9890	0·9868		8		16	3737·56	57,678	8	3	366	8	4	329·5	467·19	7210
0·9885	0·9863			85		3735·68	57,649	8	3	336	8	4	329·5	466·96	7206
0·9884	0·9862	7			17	3735·29	57,643	8	3	331	8	4	329·5	466·91	7205
0·9878	0·9855		9	84	18	3733·02	57,608	8	3	296	8	4	329·0	466·63	7201
0·9872	0·9849			83	19	3730·82	57,574	8	3	261	8	4	329·0	466·35	7197
0·9869	0·9846	8	10		20	3729·65	57,556	8	3	243	8	4	329·0	466·21	7194
0·9864	0·9841			82	21	3727·77	57,527	8	3	214	8	3	328·5	465·97	7191
0·9857	0·9834			81		3725·12	57,486	8	3	173	8	3	328·5	465·64	7186
0·9855	0·9831	9	11		22	3724·34	57,474	8	3	161	8	3	328·5	465·54	7184
0·9852	0·9828			80	23	3723·24	57,457	8	3	144	8	3	328·5	465·40	7182
0·9845	0·9821			79		3720·58	57,416	8	3	103	8	3	328·0	465·07	7177
0·9841	0·9816	10	12		24	3719·09	57,393	8	3	81	8	3	328·0	464·89	7174

PART II.—From 10 to 25 per cent. of Absolute Alcohol.

0·9838	0·9813			78	25	3717·92	57,375	8	3	62	8	3	328·0	464·74	7172
0·9831	0·9806			77	26	3715·27	57,334	8	3	21	8	3	327·5	464·41	7167
0·9828	0·9801	11	13		27	3714·17	57,317	8	3	5	8	3	327·5	464·27	7165
0·9825	0·9798			76		3713·00	57,299	8	2	424	8	3	327·5	464·13	7162
0·9821	0·9793		14		28	3711·51	57,276	8	2	401	8	3	327·5	463·94	7159
0·9819	0·9791			75		3710·73	57,264	8	2	389	8	3	327·0	463·84	7158
0·9815	0·9787	12	15		29	3709·24	57,241	8	2	366	8	3	327·0	463·65	7155
0·9813	0·9785			74	30	3708·46	57,229	8	2	354	8	3	327·0	463·56	7154
0·9807	0·9779			73	31	3706·19	57,194	8	2	319	8	3	327·0	463·27	7149
0·9802	0·9773	13	16	72	32	3704·32	57,165	8	2	290	8	3	326·5	463·04	7146
0·9794	0·9765			71	33	3701·33	57,119	8	2	244	8	3	326·5	462·67	7140
0·9789	0·9759	14	17	70	34	3699·33	57,089	8	2	214	8	2	326·0	462·42	7136
0·9784	0·9754			69	35	3697·51	57,060	8	2	185	8	2	326·0	462·19	7132
0·9778	0·9746	15	18	68	36	3695·24	57,025	8	2	150	8	2	326·0	461·90	7128
0·9775	0·9743				37	3694·14	57,008	8	2	123	8	2	326·0	461·77	7126

PART II.—From 10 to 25 per cent. of Absolute Alcohol.

(*Continued.*)

Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C. = 60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C. = 60° F.	Weight of one pint, at 15⅝° C. = 60° F.	
								Avoirdupois Weight.						
						In Grammes.	In Grains.	lbs.	ozs.	Grs.	To the nearest ounce.			
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Under proof. (Brit. Excise.)	Of proof spirit. (U. S. Revenue.)						lbs.	ozs.	lbs.	In Grammes.	In Grains.
0·9772	0·9740			67	38	3692·97	56,990	8	2	115	8	2	325·5	461·62	7124
0·9766	0·9733	16	19	66	39	3690·71	56,955	8	2	80	8	2	325·5	461·34	7119
0·9760	0·9726		20	65	40	3688·44	56,920	8	2	45	8	2	325·5	461·05	7115
0·9753	0·9719	17	21	64	41	3685·78	56,879	8	2	4	8	2	325·0	460·72	7110
0·9749	0·9715			63	42	3684·29	56,856	8	1	418	8	2	325·0	460·54	7107
0·9743	0·9709			62	43	3682·02	56,821	8	1	383	8	2	324·5	460·25	7103
0·9741	0·9706	18	22		44	3681·31	56,810	8	1	373	8	2	324·5	460·16	7101
0·9737	0·9702			61	45	3679·76	56,786	8	1	348	8	2	324·5	459·97	7098
0·9732	0·9697			60	46	3677·88	56,757	8	1	319	8	2	324·5	459·73	7095
0·9728	0·9692	19	23	59	47	3676·39	56,734	8	1	297	8	2	324·0	459·55	7092
0·9720	0·9684			58	48	3673·27	56,687	8	1	249	8	2	324·0	459·16	7086
0·9716	0·9678	20	24		49	3671·85	56,664	8	1	227	8	2	324·0	458·98	7083
0·9714	0·9676			57	50	3671·07	56,652	8	1	214	8	1	323·5	458·88	7081
0·9709	0·9668		25	56		3669·19	56,623	8	1	186	8	1	323·5	458·65	7078
0·9704	0·9661	21		55	51	3667·31	56,594	8	1	157	8	1	323·5	458·41	7074
0·9698	0·9655		26	54	52	3665·05	56,559	8	1	122	8	1	323·0	458·13	7070
0·9693	0·9650				53	3663·17	56,530	8	1	92	8	1	323·0	457·90	7066
0·9691	0·9646	22	27	53	54	3662·39	56,518	8	1	81	8	1	323·0	457·80	7065
0·9683	0·9638			52	55	3659·36	56,471	8	1	33	8	1	322·5	457·42	7059
0·9678	0·9631	23	28	51	56	3657·47	56,442	8	1	5	8	1	322·5	457·18	7055
0·9671	0·9624			50	57	3654·81	56,401	8	0	401	8	1	322·5	456·85	7050
0·9665	0·9617	24	29	49	58	3652·54	56,366	8	0	366	8	1	322·0	456·57	7046
0·9658	0·9610			48	59	3649·88	56,325	8	0	325	8	1	322·0	456·24	7041
0·9652	0·9603	25	30	47	60	3647·62	56,290	8	0	290	8	1	321·5	455·95	7036

PART III.—From 25 to 40 per cent. of Absolute Alcohol.

0·9645	0·9597			46	61	3645·02	56,250	8	0	250	8	1	321·5	455·63	7031
0·9643	0·9594		31		62	3644·24	56,238	8	0	238	8	1	321·5	455·53	7030
0·9638	0·9590	26		45	63	3642·37	56,209	8	0	209	8	0	321·0	455·30	7026
0·9631	0·9582		32	44	64	3639·71	56,168	8	0	168	8	0	321·0	454·96	7021
0·9623	0·9574	27		43	65	3636·66	56,121	8	0	121	8	0	320·5	454·58	7015
0·9618	0·9567		33	42	66	3634·79	56,092	8	0	92	8	0	320·5	454·35	7011
0·9609	0·9556	28	34	41	67	3631·42	56,040	8	0	40	8	0	320·0	453·93	7005
0·9602	0·9549			40	68	3628·76	55,999	7	15	436	8	0	320·0	453·59	7000
0·9595	0·9542			39	69	3626·10	55,958	7	15	395	8	0	320·0	453·26	6995
0·9593	0·9538	29	35		70	3625·33	55,946	7	15	383	8	0	319·5	453·17	6993
0·9587	0·9532			38	71	3623·06	55,911	7	15	348	8	0	319·5	452·88	6989
0·9578	0·9521	30	36	37	72	3619·69	55,859	7	15	296	8	0	319·0	452·46	6982
0·9572	0·9515			36	73	3617·42	55,824	7	15	261	8	0	319·0	452·18	6978
0·9565	0·9507		37	35		3614·76	55,783	7	15	220	8	0	319·0	451·84	6973
0·9560	0·9500	31			74	3612·88	55,754	7	15	191	7	15	318·5	451·61	6969
0·9555	0·9495			34	75	3611·03	55,725	7	15	162	7	15	318·5	451·38	6966
0·9550	0·9489		38	33	76	3609·12	55,696	7	15	133	7	15	318·0	451·14	6962
0·9544	0·9482	32			77	3606·86	55,661	7	15	98	7	15	318·0	450·86	6958
0·9539	0·9477			32		3604·91	55,631	7	15	68	7	15	318·0	450·61	6954
0·9535	0·9473		39		78	3603·42	55,608	7	15	45	7	15	318·0	450·43	6951
0·9528	0·9465	33		31	79	3600·76	55,567	7	15	4	7	15	317·5	450·09	6946
0·9519	0·9456		40	30	80	3597·39	55,515	7	14	390	7	15	317·0	449·67	6939
0·9511	0·9446	34		29	81	3594·35	55,468	7	14	343	7	15	317·0	449·29	6933
0·9503	0·9438		41	28	82	3591·30	55,421	7	14	296	7	15	316·5	448·91	6928
0·9495	0·9430			27	83	3588·32	55,375	7	14	250	7	15	316·5	448·54	6922
0·9490	0·9424	35	42		84	3586·44	55,346	7	14	221	7	15	316·0	448·30	6918
0·9485	0·9419			26		3584·56	55,317	7	14	192	7	14	316·0	448·07	6915
0·9475	0·9409			25	85	3580·74	55,258	7	14	133	7	14	316·0	447·59	6907
0·9470	0·9402	36	43		86	3578·86	55,229	7	14	104	7	14	315·5	447·36	6904
0·9465	0·9397			24		3576·98	55,200	7	14	75	7	14	315·5	447·12	6900
0·9455	0·9387			23	87	3573·22	55,142	7	14	17	7	14	315·0	446·65	6893
0·9452	0·9382	37	44		88	3572·06	55,124	7	13	437	7	14	315·0	446·51	6890

PART III.—From 25 to 40 per cent. of Absolute Alcohol.

(Continued.)

Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C. = 60° F.							Weight of 40 gallons to the nearest half pound, at 15⅝° C. = 60° F.	Weight of one pint, at 15⅝° C. = 60° F.	
								Avoirdupois Weight.							
											To the nearest ounce.				
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Under proof. (Brit. Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs.	ozs.	Grs.	lbs.	ozs.	lbs.	In Grammes.	In Grains.
0·9446	0·9376			22	89	3569·79	55,089	7	13	401	7	14	315·0	446·22	6886
0·9434	0·9363	38	45	21	90	3565·25	55,019	7	13	331	7	14	314·5	445·66	6877
0·9426	0·9355			20	91	3562·21	54,972	7	13	284	7	14	314·0	445·28	6871
0·9416	0·9343	39	46	19	92	3558·45	54,914	7	13	226	7	14	314·0	444·81	6864
0·9405	0·9332			18	93	3554·30	54,850	7	13	162	7	13	313·5	444·29	6856
0·9396	0·9323	40	47	17	94	3550·87	54,797	7	13	109	7	13	313·0	443·86	6850
0·9391	0·9318				95	3548·99	54,768	7	13	75	7	13	313·0	443·62	6846

PART IV.—From 40 to 55 per cent. of Absolute Alcohol.

0·9381	0·9307		48	16	96	3545·23	54,710	7	13	22	7	13	312·5	443·15	6839
0·9376	0·9302	41				3543·35	54,681	7	12	431	7	13	312·5	442·92	6835
0·9373	0·9300			15	97	3542·19	54,663	7	12	413	7	13	312·5	442·77	6833
0·9362	0·9288		49	14	98	3538·04	54,599	7	12	349	7	13	312·0	442·25	6825
0·9356	0·9280	42				3535·77	54,564	7	12	314	7	13	312·0	441·97	6820
0·9352	0·9276			13	99	3534·28	54,541	7	12	291	7	13	311·5	441·78	6818
0·9343	0·9267		50	12	100	3530·84	54,488	7	12	238	7	13	311·5	441·35	6811
0·9335	0·9259	43			101	3527·86	54,442	7	12	192	7	12	311·0	440·98	6805
0·9329	0·9253			11		3525·59	54,407	7	12	157	7	12	311·0	440·70	6801
0·9323	0·9246		51		102	3523·33	54,372	7	12	122	7	12	310·5	440·42	6796
0·9318	0·9242			10		3521·45	54,343	7	12	93	7	12	310·5	440·18	6793
0·9314	0·9237	44			103	3519·89	54,319	7	12	69	7	12	310·5	439·99	6790
0·9306	0·9230			9		3516·91	54,273	7	12	23	7	12	310·0	439·61	6784
0·9303	0·9226		52		104	3515·75	54,255	7	12	5	7	12	310·0	439·47	6782
0·9292	0·9214	45		8	105	3511·59	54,191	7	11	379	7	12	309·5	438·95	6774
0·9283	0·9205		53	7	106	3508·16	54,138	7	11	326	7	12	309·5	438·52	6767
0·9270	0·9192	46		6	107	3503·30	54,063	7	11	251	7	12	309·0	437·91	6758
0·9262	0·9184		54	5	108	3500·26	54,016	7	11	204	7	11	308·5	437·53	6752
0·9249	0·9171	47		4	109	3495·33	53,940	7	11	128	7	11	308·0	436·92	6742
0·9242	0·9164		55		110	3492·68	53,899	7	11	87	7	11	308·0	436·58	6737
0·9236	0·9158			3		3490·41	53,864	7	11	51	7	11	308·0	436·30	6733
0·9228	0·9150	48			111	3487·43	53,818	7	11	6	7	11	307·5	435·93	6727
0·9221	0·9143		56	2	112	3484·77	53,777	7	10	402	7	11	307·5	435·60	6722
0·9212	0·9134			1	113	3481·34	53,724	7	10	349	7	11	307·0	435·17	6715
0·9206	0·9128	49		Proof over.		3479·07	53,689	7	10	314	7	11	307·0	434·88	6711
0·9200	0·9122		57		114	3476·80	53,654	7	10	279	7	11	306·5	434·60	6707
0·9189	0·9111			1	115	3472·65	53,590	7	10	215	7	10	306·0	434·08	6699
0·9184	0·9106	50				3470·77	53,561	7	10	186	7	10	306·0	433·85	6695
0·9178	0·9100		58	2	116	3468·51	53,526	7	10	151	7	10	306·0	433·56	6691
0·9168	0·9090				117	3464·75	53,468	7	10	93	7	10	305·5	433·09	6684
0·9160	0·9081	51	59	3	118	3461·70	53,421	7	10	46	7	10	305·0	432·71	6678
0·9150	0·9071			4	119	3457·94	53,363	7	9	425	7	10	305·0	432·24	6670
0·9135	0·9056	52	60	5	120	3452·24	53,275	7	9	338	7	10	304·5	431·53	6659
0·9124	0·9045			6	121	3449·09	53,211	7	9	273	7	10	304·0	431·01	6651
0·9113	0·9034	53	61	7	122	3443·95	53,147	7	9	210	7	9	303·5	430·49	6643
0·9100	0·9021			8	123	3439·02	53,071	7	9	133	7	9	303·0	429·88	6634
0·9090	0·9011	54	62	9	124	3435·26	53,013	7	9	76	7	9	303·0	429·41	6627
0·9075	0·8995			10	125	3429·56	52,925	7	8	425	7	9	302·5	428·69	6616
0·9069	0·8989	55	63		126	3427·29	52,890	7	8	390	7	9	302·0	428·41	6611

PART V.—From 55 to 70 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C. = 60° F.							Weight of 40 gallons to the nearest half pound, at 15⅝° C. = 60° F.	Weight of one pint, at 15⅝° C. = 60° F.	
								Avoirdupois Weight.							
											To the nearest ounce.				
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Over proof. (Brit. Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs.	ozs.	Grs.	lbs.	ozs.	lbs.	In Grammes.	In Grains.
0·9062	0·8982			11	127	3424·70	52,850	7	8	350	7	9	302·0	428·09	6606
0·9047	0·8969	56	64	12	128	3419·00	52,762	7	8	262	7	9	301·5	427·37	6595
0·9036	0·8958			13		3414·85	52,698	7	8	198	7	8	301·0	426·86	6587
0·9025	0·8947	57	65		129	3410·70	52,634	7	8	134	7	8	301·0	426·34	6579
0·9021	0·8943			14	130	3409·15	52,610	7	8	110	7	8	300·5	426·14	6576
0·9008	0·8930			15	131	3404·29	52,535	7	8	35	7	8	300·0	425·54	6567
0·9001	0·8923	58	66		132	3401·63	52,494	7	7	432	7	8	300·0	425·20	6562
0·8994	0·8916			16	133	3398·98	52,453	7	7	390	7	8	299·5	424·87	6557
0·8979	0·8901	59		17		3393·34	52,366	7	7	304	7	8	299·0	424·17	6546
0·8973	0·8895		67		134	3391·07	52,331	7	7	269	7	8	299·0	423·88	6541
0·8966	0·8888			18		3388·41	52,290	7	7	227	7	8	299·0	423·55	6536
0·8956	0·8878	60			135	3384·59	52,231	7	7	169	7	7	298·5	423·07	6529
0·8953	0·8875			19		3383·49	52,214	7	7	151	7	7	298·5	422·94	6527
0·8949	0·8870		68		136	3382·00	52,191	7	7	129	7	7	298·0	422·75	6524
0·8938	0·8859			20	137	3377·79	52,126	7	7	63	7	7	298·0	422·22	6516
0·8932	0·8853	61				3375·52	52,091	7	7	29	7	7	297·5	421·94	6511
0·8925	0·8846		69	21	138	3372·93	52,051	7	6	426	7	7	297·5	421·62	6506
0·8910	0·8831			22	139	3367·22	51,963	7	6	338	7	7	297·0	420·90	6495
0·8908	0·8829	62				3366·45	51,951	7	6	326	7	7	297·0	420·81	6494
0·8900	0·8821		70		140	3363·47	51,905	7	6	280	7	7	296·5	420·43	6488
0·8897	0·8818			23		3362·30	51,887	7	6	262	7	7	296·5	420·29	6486
0·8886	0·8807	63			141	3358·15	51,823	7	6	198	7	6	296·0	419·77	6478
0·8883	0·8804			24		3357·05	51,806	7	6	181	7	6	296·0	419·63	6476
0·8875	0·8796		71		142	3354·00	51,759	7	6	134	7	6	296·0	419·25	6470
0·8869	0·8790			25		3351·74	51,724	7	6	99	7	6	295·5	418·97	6465
0·8863	0·8784	64			143	3349·47	51,689	7	6	64	7	6	295·5	418·68	6461
0·8854	0·8775			26		3346·10	51,637	7	6	12	7	6	295·0	418·26	6455
0·8850	0·8771		72		144	3344·54	51,613	7	5	426	7	6	295·0	418·07	6452
0·8840	0·8761	65		27	145	3340·78	51,555	7	5	368	7	6	294·5	417·60	6444
0·8825	0·8746		73	28	146	3335·08	51,467	7	5	279	7	6	294·0	416·88	6433
0·8816	0·8736	66				3331·71	51,415	7	5	228	7	6	294·0	416·46	6427
0·8811	0·8731			29	147	3329·83	51,386	7	5	198	7	5	293·5	416·23	6423
0·8799	0·8719		74	30	148	3325·30	51,316	7	5	129	7	5	293·0	415·66	6414
0·8793	0·8713	67			149	3323·03	51,281	7	5	94	7	5	293·0	415·38	6410
0·8783	0·8703			31		3319·21	51,222	7	5	34	7	5	292·5	414·90	6403
0·8769	0·8689	68	75	32	150	3313·96	51,141	7	4	391	7	5	292·0	414·25	6393
0·8754	0·8674			33	151	3308·25	51,053	7	4	303	7	5	291·5	413·53	6382
0·8745	0·8665	69	76		152	3304·89	51,001	7	4	251	7	5	291·5	413·11	6375
0·8739	0·8659			34	153	3302·62	50,966	7	4	216	7	4	291·0	412·83	6371
0·8721	0·8641	70	77	35	154	3295·81	50,861	7	4	111	7	4	290·5	411·98	6358

PART VI.—From 70 to 100 per cent. of Absolute Alcohol.

0·8708	0·8628			36	155	3290·89	50,785	7	4	35	7	4	290·0	411·36	6348
0·8696	0·8616	71	78	37		3286·35	50,715	7	3	403	7	4	290·0	410·79	6339
0·8693	0·8613				156	3285·25	50,698	7	3	385	7	4	289·5	410·66	6337
0·8678	0·8598			38	157	3279·55	50,610	7	3	297	7	4	289·0	409·94	6326
0·8672	0·8591	72			158	3277·28	50,575	7	3	263	7	4	289·0	409·66	6322
0·8664	0·8583		79	39		3274·23	50,528	7	3	216	7	3	288·5	409·28	6316
0·8649	0·8568	73			159	3268·59	50,441	7	3	129	7	3	288·0	408·57	6305
0·8646	0·8565			40		3267·43	50,423	7	3	110	7	3	288·0	408·43	6303
0·8639	0·8558		80		160	3264·84	50,383	7	3	71	7	3	288·0	408·10	6298
0·8631	0·8550			41		3261·79	50,336	7	3	23	7	3	287·5	407·72	6292
0·8625	0·8544	74				3259·53	50,301	7	2	426	7	3	287·5	407·44	6288
0·8615	0·8534			42	161	3255·77	50,243	7	2	368	7	3	287·0	406·97	6280
0·8611	0·8530		81		162	3254·21	50,219	7	2	344	7	3	287·0	406·78	6277
0·8603	0·8522	75			163	3251·23	50,173	7	2	298	7	3	286·5	406·40	6272
0·8599	0·8518			43		3249·68	50,149	7	2	274	7	3	286·5	406·21	6269
0·8581	0·8500	76	82	44	164	3242·87	50,044	7	2	169	7	2	286·0	405·36	6255

PART VI.—From 70 to 100 per cent. of Absolute Alcohol.

(Continued.)

Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C. = 60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C. = 60° F.	Weight of one pint, at 15⅝° C. = 60° F.	
								Avoirdupois Weight.						
											To the nearest ounce.			
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Over proof. (Brit. Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs.	ozs.	Grs.	lbs.	ozs.	lbs.	In Grammes.	In Grains.
0·8566	0·8485			45	165	3237·23	49,957	7	2	82	7	2	285·5	404·65	6245
0·8557	0·8476	77	83			3233·80	49,904	7	2	29	7	2	285·0	404·22	6238
0·8550	0·8469			46	166	3231·21	49,864	7	1	426	7	2	285·0	403·90	6233
0·8539	0·8458				167	3227·00	49,799	7	1	361	7	2	284·5	403·38	6225
0·8533	0·8452	78		47		3224·73	49,764	7	1	327	7	2	284·5	403·09	6220
0·8526	0·8444		84		168	3222·14	49,724	7	1	287	7	2	284·0	402·77	6215
0·8516	0·8434			48		3218·31	49,665	7	1	227	7	2	284·0	402·29	6208
0·8508	0·8426	79			169	3215·33	49,619	7	1	182	7	1	283·5	401·92	6202
0·8501	0·8419			49	170	3212·67	49,578	7	1	140	7	1	283·5	401·58	6197
0·8496	0·8414		85			3210·79	49,549	7	1	112	7	1	283·0	401·35	6194
0·8483	0·8401	80		50	171	3205·87	49,473	7	1	36	7	1	282·5	400·73	6184
0·8466	0·8384		86	51	172	3199·46	49,374	7	0	374	7	1	282·0	399·93	6172
0·8459	0·8377	81				3196·80	49,333	7	0	333	7	1	282·0	399·60	6167
0·8450	0·8368			52	173	3193·36	49,280	7	0	280	7	1	281·5	399·17	6160
0·8434	0·8352	82	87	53	174	3187·34	49,187	7	0	187	7	0	281·0	398·42	6148
0·8415	0·8333			54	175	3180·15	49,076	7	0	76	7	0	280·5	397·52	6134
0·8408	0·8326	83	88			3177·49	49,035	7	0	35	7	0	280·0	397·19	6129
0·8396	0·8314			55	176	3172·95	48,965	6	15	402	7	0	280·0	396·62	6121
0·8387	0·8305				177	3169·58	48,913	6	15	350	7	0	279·5	396·20	6114
0·8382	0·8300	84				3167·70	48,884	6	15	322	7	0	279·5	395·96	6110
0·8376	0·8294			56		3165·44	48,849	6	15	286	7	0	279·0	395·68	6106
0·8373	0·8291		89		178	3164·27	48,831	6	15	269	7	0	279·0	395·53	6104
0·8357	0·8275	85		57	179	3158·24	48,738	6	15	176	6	15	278·5	394·78	6092
0·8340	0·8258		90		180	3151·83	48,639	6	15	77	6	15	278·0	393·98	6080
0·8336	0·8254			58		3150·34	48,616	6	15	53	6	15	278·0	393·79	6077
0·8331	0·8249	86				3148·39	48,586	6	15	24	6	15	277·5	393·55	6073
0·8317	0·8235			59	181	3143·14	48,505	6	14	380	6	15	277·0	392·89	6063
0·8305	0·8223	87	91		182	3138·61	48,435	6	14	310	6	15	277·0	392·33	6054
0·8298	0·8216			60		3135·95	48,394	6	14	269	6	15	276·5	391·99	6049
0·8288	0·8206				183	3132·19	48,336	6	14	211	6	14	276·0	391·52	6042
0·8279	0·8197	88		61		3128·76	48,283	6	14	158	6	14	276·0	391·09	6035
0·8272	0·8191		92		184	3126·10	48,242	6	14	117	6	14	275·5	390·76	6030
0·8259	0·8178			62		3121·15	48,166	6	14	41	6	14	275·0	390·14	6021
0·8254	0·8173	89			185	3119·30	48,137	6	14	12	6	14	275·0	389·91	6017
0·8240	0·8159			63		3114·05	48,056	6	13	368	6	14	274·5	389·26	6007
0·8237	0·8156		93		186	3112·88	48,038	6	13	351	6	14	274·5	389·11	6005
0·8228	0·8147	90				3109·51	47,986	6	13	299	6	14	274·0	388·69	5998
0·8221	0·8140			64	187	3106·86	47,945	6	13	257	6	14	274·0	388·36	5993
0·8199	0·8118	91	94	65	188	3098·56	47,817	6	13	130	6	13	273·0	387·32	5977
0·8176	0·8095			66	189	3089·81	47,682	6	12	432	6	13	272·5	386·23	5960
0·8172	0·8091	92				3088·32	47,659	6	12	409	6	13	272·5	386·04	5957
0·8164	0·8083		95		190	3085·28	47,612	6	12	362	6	13	272·0	385·66	5951
0·8156	0·8075			67		3082·30	47,566	6	12	316	6	13	272·0	385·29	5946
0·8145	0·8064	93				3078·15	47,502	6	12	252	6	13	271·5	384·77	5938
0·8139	0·8058				191	3075·88	47,467	6	12	217	6	12	271·0	384·48	5933
0·8134	0·8053			68		3073·94	47,437	6	12	187	6	12	271·0	384·24	5930
0·8125	0·8044		96			3070·57	47,385	6	12	135	6	12	271·0	383·82	5923
0·8118	0·8037	94			192	3067·91	47,344	6	12	94	6	12	270·5	383·49	5918
0·8112	0·8031			69		3065·64	47,309	6	12	59	6	12	270·5	383·20	5914
0·8098	0·8017				193	3060·39	47,228	6	11	415	6	12	270·0	382·55	5903
0·8090	0·8009			70		3057·35	47,181	6	11	368	6	12	269·5	382·17	5898
0·8089	0·8008	95				3056·96	47,175	6	11	363	6	12	269·5	382·12	5897
0·8084	0·8003		97		194	3055·08	47,146	6	11	334	6	12	269·5	381·88	5893
0·8061	0·7980	96			195	3046·33	47,011	6	11	200	6	11	268·5	380·79	5876
0·8041	0·7960		98		196	3038·82	46,895	6	11	83	6	11	268·0	379·85	5862
0·8031	0·7950	97				3035·06	46,837	6	11	25	6	11	267·5	379·38	5855
0·8014	0·7933				197	3028·64	46,738	6	10	363	6	11	267·0	378·58	5842
0·8001	0·7920	98				3023·72	46,662	6	10	287	6	11	266·5	377·96	5833
0·7995	0·7914		99			3021·45	46,627	6	10	252	6	11	266·5	377·68	5828
0·7992	0·7911				198	3020·28	46,609	6	10	234	6	11	266·5	377·53	5826
0·7969	0·7888	99			199	3011·59	46,475	6	10	100	6	10	265·5	376·45	5809
0·7946	0·7865		100		200	3002·92	46,341	6	9	404	6	10	265·0	375·37	5793
0·7938	0·7858	100				2999·87	46,294	6	9	357	6	10	264·5	374·98	5787

Table of Elements and Chemical Substances with their Atomic or Molecular Weights and the Official Table of Multiples.

NAME.	Symbol or Formula.	Atomic or Molecular Weight. H = 1.
Acetal	$C_6H_{14}O_2$	117.22
Acetaldehyde (See Aldehyde, Acetic)		
Acetanilide (Phenylacetamide)	C_8H_9NO	134.09
Acetone	$(CH_3)_2CO$	57.61
Acetophenone (Hypnone)	C_8H_8O	119.16
Acetparaphenetidin (See Acetphenetidin)		
Acetphenetidin (Acetparaphenetidin)	$C_{10}H_{13}NO_2$	177.79
Acid, Acetic	$HC_2H_3O_2$	59.58
" Antimonic	H_3SbO_4	185.82
" Antimonous	H_3SbO_3	169.94
" Arsenic	H_3AsO_4	140.92
" Arsenous (See Arsenic Trioxide)		
" Aurochloric (See Acid, Chlorauric)		
" Benzoic	$HC_7H_5O_2$	121.13
" Boric	H_3BO_3	61.54
" Camphoric	$H_2C_{10}H_{14}O_4$	198.62
" Carbolic (See Phenol)		
" Carbonic (in solution)	H_2CO_3	61.55
" Chlorauric (Aurochloric)	$HAuCl_4 + 4H_2O$	408.94
" Chlorauric, Anhydrous (Gold Chloride)	$AuCl_3$	301.24
" Chloroplatinic	$H_2PtCl_6 + 6H_2O$	513.66
" Chromic (See Chromium Trioxide)		
" Cinnamic	$HC_9H_7O_2$	146.95
" Citric	$H_3C_6H_5O_7 + H_2O$	208.50
" " Anhydrous	$H_3C_6H_5O_7$	190.62
" Cyanic	$HCNO$	42.72
" Formic	$HCHO_2$	45.67
" Gallic	$HC_7H_5O_5 + H_2O$	186.65
" " Anhydrous	$HC_7H_5O_5$	168.77
" Glycerin-Phosphoric	$H_2C_3H_7O_6P$	170.78
" Hydriodic	HI	126.9
" Hydrobromic	HBr	80.36
" Hydrochloric	HCl	36.18
" Hydrocyanic	HCN	26.84
" Hydrofluoric	HF	19.9
" Hydrosulphuric (See Hydrogen Sulphide)		
" Hypophosphorous	HPH_2O_2	65.53
" Kinic (Quinic)	$HC_7H_{11}O_6$	190.65
" Lactic	$HC_3H_5O_3$	89.37
" Meconic	$C_7H_4O_7$	198.53
" Metaphosphoric	HPO_3	79.41
" Molybdic	H_2MoO_4	160.82
" Nitric	HNO_3	62.57
" Nitrous	HNO_2	46.69
" Oleic	$HC_{18}H_{33}O_2$	280.14
" Oxalic	$H_2C_2O_4 + 2H_2O$	125.10
" " Anhydrous	$H_2C_2O_4$	89.34
" Palmitic	$HC_{16}H_{31}O_2$	254.32
" Phosphoric	H_3PO_4	97.29

Acid, Phosphorous	H_3PO_3	81.41
" Picric	$HC_6H_2(NO_2)_3O$	227.41
" Prussic (See Acid, Hydrocyanic)		
" Pyroboric (Tetraboric Acid)	$H_2B_4O_7$	156.76
" Pyrogallic (See Pyrogallol)		
" Pyrophosphoric	$H_4P_2O_7$	176.70
" Salicylic	$HC_7H_5O_3$	137.01
" Silicic	H_2SiO_3	77.84
" Stearic	$HC_{18}H_{35}O_2$	282.14
" Succinic	$H_2C_4H_4O_4$	117.16
" Sulphanilic	$HC_6H_4(NH_2)SO_3 + 3H_2O$	225.5
" " Anhydrous	$HC_6H_4(NH_2)SO_3$	171.86
" Sulphuric	H_2SO_4	97.35
" Sulphurous	H_2SO_3	81.47
" Tannic	$HC_{14}H_9O_9$	319.66
" Tartaric	$H_2C_4H_4O_6$	148.92
" Tetraboric (See Acid, Pyroboric)		
" Titanic (See Titanic Oxide)		
" Trichloracetic	$HC_2Cl_3O_2$	162.12
" Tungstic (See Tungstic Oxide)		
" Uric	$C_5H_4N_4O_3$	166.91
" Valeric (Valerianic)	$HC_5H_9O_2$	101.31
Aconitine	$C_{34}H_{47}NO_{11}$	640.55
Agaricin	$C_{16}H_{30}O_5 + H_2O$	317.84
Alcohol, Amyl	$C_5H_{11}OH$	87.43
" Benzyl	$C_7H_7.OH$	107.25
" Ethyl (Ethyl Hydroxide)	C_2H_5OH	45.70
" Methyl	CH_3OH	31.79
Aldehyde, Acetic	C_2H_4O	43.70
" Benzoic (See Benzaldehyde)		
" Cinnamic (See Cinnamic Aldehyde)		
" Formic (See Formaldehyde)		
Allyl-iso-thiocyanate	$CSNC_3H_5$	98.40
Allyl-sulphocarbamide (See Thiosinamine)		
Alum (Aluminum and Potassium Sulphate)	$AlK(SO_4)_2 + 12H_2O$	471.02
" Anhydrous	$AlK(SO_4)_2$	256.46
Aluminum	**Al**	**26.9**
Aluminum Hydroxide	$Al(OH)_3$	77.54
" and Ammonium Sulphate	$Al\ NH_4(SO_4)_2 + 12H_2O$	450.09
" and Potassium Sulphate (See Alum)		
" Oxide	Al_2O_3	101.44
" Silicate	$H_2Al_2Si_2O_8 + H_2O$	257.12
" Sulphate	$Al_2(SO_4)_3 + 16H_2O$	625.93
" " Anhydrous	$Al_2(SO_4)_3$	339.85
Ammonia	NH_3	16.93
Ammonio-Ferric Sulphate (Iron-alum)	$FeNH_4(SO_4)_2 + 12H_2O$	478.69
Ammonium Acetate	$NH_4C_2H_3O_2$	76.51
" Arsenite (Metarsenite)	NH_4AsO_2	124.09
" Benzoate	$NH_4C_7H_5O_2$	138.06
" Bromide	NH_4Br	97.29
" Carbonate (normal)	$(NH_4)_2CO_3$	95.41
" " (U. S. P.)	$NH_4HCO_3.\ NH_4NH_2CO_2$	156.01
" Chloride	NH_4Cl	53.11
" Chloroplatinate	$(NH_4)_2PtCl_6$	440.24
" Citrate	$(NH_4)_3C_6H_5O_7$	241.41
" Hydrogen Sulphide	NH_4HS	50.76
" Iodide	NH_4I	143.83
" Lactate	$NH_4C_3H_5O_3$	106.30
" Molybdate	$(NH_4)_6Mo_7O_{24} + 4H_2O$	1227.32
" Nitrate	NH_4NO_3	79.50

Ammonium Oxalate	$(NH_4)_2C_2O_4 + H_2O$	141.08
" " Anhydrous	$(NH_4)_2C_2O_4$	123.20
" Persulphate	$(NH_4)_2S_2O_8$	226.56
" Phosphate	$(NH_4)_2HPO_4$	131.15
" Salicylate	$NH_4C_7H_5O_3$	153.94
" and Sodium Phosphate	$NH_4NaHPO_4 + 4H_2O$	207.62
" Sulphate	$(NH_4)_2SO_4$	131.21
" Sulphide	$(NH_4)_2S$	67.69
" Sulphhydroxide (See Ammonium Hydrogen Sulphide)		
" Tartrate	$(NH_4)_2C_4H_4O_6$	182.78
" Valerate (Valerianate)	$NH_4C_5H_9O_2$	118.24
Amyl Acetate	$C_5H_{11}C_2H_3O_2$	129.13
" Nitrite	$C_5H_{11}NO_2$	116.24
Amylene (Pentene)	C_5H_{10}	69.55
" Hydrate	$C_5H_{12}O$	87.43
Anethol	$C_{10}H_{12}O$	146.98
Aniline	$C_6H_5NH_2$	92.39
Antimony	**Sb**	**119.3**
Antimony and Potassium Tartrate	$2K(SbO)C_4H_4O_6 + H_2O$	659.80
" " " Anhydrous	$K(SbO)C_4H_4O_6$	320.96
" Chloride	$SbCl_3$	224.84
" Oxide (See Antimony Trioxide)		
" Pentasulphide	Sb_2S_5	397.75
" Trioxide (Antimony Oxide)	Sb_2O_3	286.24
" Trisulphide	Sb_2S_3	334.09
Antipyrine	$C_{11}H_{12}N_2O$	186.75
Apomorphine	$C_{17}H_{17}NO_2$	265.16
" Hydrochloride	$C_{17}H_{17}NO_2HCl$	301.34
Arabin	$2C_6H_{10}O_5 + H_2O$	339.60
Argon	**Ar**	**39.6**
Arsenic	**As**	**74.4**
Arsenic Oxide	As_2O_5	228.20
" (Penta-) Sulphide	As_2S_5	307.95
" Trioxide (Arsenous Acid)	As_2O_3	196.44
Arsenous Iodide	AsI_3	452.10
" (Tri-) Sulphide	As_2S_3	244.29
Atropine	$C_{17}H_{23}NO_3$	287.04
" Sulphate	$(C_{17}H_{23}NO_3)_2H_2SO_4$	671.43
Barium	**Ba**	**136.4**
Barium Carbonate	$BaCO_3$	195.95
" Chloride	$BaCl_2 + 2H_2O$	242.52
" " Anhydrous	$BaCl_2$	206.76
" Chromate	$BaCrO_4$	251.62
" Dioxide	BaO_2	168.16
" Hydroxide	$Ba(OH)_2 + 8H_2O$	313.20
" " Anhydrous	$Ba(OH)_2$	170.16
" Nitrate	$Ba(NO_3)_2$	259.54
" Peroxide	BaO_2	168.16
" Sulphate	$BaSO_4$	231.75
" Sulphide	BaS	168.23
Benzaldehyde (Benzoic Aldehyde)	C_7H_6O	105.25
Benzanilid	$C_{13}H_{11}NO$	195.64
Benzene (Benzole)	C_6H_6	77.46
Benzosulphinide	$C_7H_5NSO_3$	181.77
Benzoyl-sulphonic-imide (See Benzosulphinide)		
Betanaphthol (Naphthol)	$C_{10}H_7OH$	142.98
Bismuth	**Bi**	**206.9**
Bismuth Carbonate (normal)	$Bi_2(CO_3)_3$	592.45
" Citrate	$BiC_6H_5O_7$	394.52
" Nitrate (normal)	$Bi(NO_3)_3 + 5H_2O$	481.01

Bismuth Oxychloride	$BiOCl$	257.96
" Oxyiodide	$BiOI$	348.68
" Subcarbonate (approximately)	$(BiO)_2CO_3$	505.11
" Subgallate (approximately)	$Bi(OH)_2C_7H_5O_5$	408.43
" Subnitrate (approximately)	$Bi(OH)_2NO_3$	302.23
" Subsalicylate (approximately)	$Bi(OH)_2C_7H_5O_3$	376.67
" Sulphide	Bi_2S_3	509.29
" Trioxide	Bi_2O_3	461.44
Borneol	$C_{10}H_{18}O$	152.98
Bornyl Acetate	$C_{10}H_{17}C_2H_3O_2$	194.68
Boron	**B**	**10.9**
Boron Trioxide	B_2O_3	69.44
Bromine	**Br**	**79.36**
Bromoform	$CHBr_3$	250.99
Brucine	$C_{23}H_{26}N_2O_4 + 4H_2O$	462.83
" Anhydrous	$C_{23}H_{26}N_2O_4$	391.31
Cadmium	**Cd**	**111.6**
Cadmium Iodide	CdI_2	363.40
" Sulphate	$3CdSO_4 + 8H_2O$	763.89
" Sulphide	CdS	143.43
Caesium	**Cs**	**131.9**
Caffeine	$C_8H_{10}N_4O_2 + H_2O$	210.64
" Anhydrous	$C_8H_{10}N_4O_2$	192.76
Calcium	**Ca**	**39.8**
Calcium Acetate	$Ca(C_2H_3O_2)_2$	156.96
" Bromide	$CaBr_2$	198.52
" Carbonate	$CaCO_3$	99.35
" Chloride	$CaCl_2 + 6H_2O$	217.44
" " Anhydrous	$CaCl_2$	110.16
" Fluoride	CaF_2	77.6
" Hydroxide	$Ca(OH)_2$	73.56
" Hypochlorite	$Ca(OCl)_2$	141.92
" Hypophosphite	$Ca(PH_2O_2)_2$	168.86
" Oxalate	$CaC_2O_4 + H_2O$	145.02
" Oxide (See Lime)		
" Phosphate	$Ca_3(PO_4)_2$	307.98
" Sulphate (Gypsum)	$CaSO_4 + 2H_2O$	170.91
" " Anhydrous	$CaSO_4$	135.15
" Sulphide (Monosulphide)	CaS	71.63
" Tartrate	$CaC_4H_4O_6$	186.72
Camphor	$C_{10}H_{16}O$	150.98
" Monobromated	$C_{10}H_{15}BrO$	229.34
Carbon	**C**	**11.91**
Carbon Dioxide	CO_2	43.67
" Disulphide	CS_2	75.57
Carvone	$C_{10}H_{14}O$	148.98
Cephaëline	$C_{14}H_{19}NO_2$	231.43
Cerium	**Ce**	**139.2**
Cerium Oxalate	$Ce_2(C_2O_4)_3 + 10H_2O$	719.22
" " Anhydrous	$Ce_2(C_2O_4)_3$	540.42
Chloral, Anhydrous	C_2HCl_3O	146.24
" Hydrated	$C_2HCl_3O + H_2O$	164.12
Chloralformamide	$C_3H_4Cl_3NO_2$	190.96
Chlorine	**Cl**	**35.18**
Chloroform	$CHCl_3$	118.45
Chrome-alum	$Cr_2(SO_4)_3 + K_2SO_4 + 24H_2O$	991.64
Chromium	**Cr**	**51.7**
Chromium Oxide	Cr_2O_3	151.04
" Trioxide (Chromic Acid)	CrO_3	99.34
Chrysarobin	$C_{30}H_{26}O_7$	494.46

Cinchonidine	$C_{19}H_{22}N_2O$	292.03
" Salicylate	$C_{19}H_{22}N_2OC_7H_6O_3$	429.04
" Sulphate	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 3H_2O$	735.05
" " Anhydrous	$(C_{19}H_{22}N_2O)_2H_2SO_4$	681.41
Cinchonine	$C_{19}H_{22}N_2O$	292.03
" Sulphate	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 2H_2O$	717.17
" " Anhydrous	$(C_{19}H_{22}N_2O)_2H_2SO_4$	681.41
Cineol (Eucalyptol)	$C_{10}H_{18}O$	152.98
Cinnamic Aldehyde	C_9H_8O	131.07
Citral	$C_{10}H_{16}O$	150.98
Cobalt	**Co**	**58.56**
Cobaltous Nitrate	$Co(NO_3)_2 + 6H_2O$	288.98
" Sulphate	$CoSO_4 + 7H_2O$	279.07
Cocaine	$C_{17}H_{21}NO_4$	300.92
" Hydrochloride	$C_{17}H_{21}NO_4HCl$	337.10
Codeine	$C_{18}H_{21}NO_3 + H_2O$	314.83
" Anhydrous	$C_{18}H_{21}NO_3$	296.95
" Phosphate	$C_{18}H_{21}NO_3H_3PO_4 + 2H_2O$	430.0
" " Anhydrous	$C_{18}H_{21}NO_3H_3PO_4$	394.24
" Sulphate	$(C_{18}H_{21}NO_3)_2H_2SO_4 + 5H_2O$	780.65
" " Anhydrous	$(C_{18}H_{21}NO_3)_2H_2SO_4$	691.25
Colchicine	$C_{22}H_{25}NO_6$	396.23
Columbium	**Cb**	**93.3**
Coniine	$C_8H_{17}N$	126.21
Copper	**Cu**	**63.1**
Copper Acetate	$Cu(C_2H_3O_2)_2 + H_2O$	198.14
" " (basic)	$Cu(C_2H_3O_2)_2 + CuO + 6H_2O$	366.52
" Carbonate (basic)	$CuCO_3 + Cu(OH)_2$	219.51
Cresol	$C_6H_4(CH_3)OH$	107.25
Cupricammonium Sulphate	$Cu(NH_3)_4SO_4 + H_2O$	244.05
Cupric Oxide	CuO	78.98
" Sulphate	$CuSO_4 + 5H_2O$	247.85
" " Anhydrous	$CuSO_4$	158.45
" Sulphide	CuS	94.93
" Tartrate	$CuC_4H_4O_6 + 3H_2O$	263.66
Cuprous Oxide	Cu_2O	142.08
Cyanogen	$(CN)_2$	51.68
Diethylsulphone-dimethyl-methane (See Sulphonmethane)		
Diethylsulphone-methyl-ethyl-methane (See Sulphonethylmethane)		
Diiodparaphenol Sulphonic Acid (Soziodol)	$C_6H_4I_2SO_4$	422.61
Diphenylamine	$(C_6H_5)_2NH$	167.85
Dithymol-diiodide (See Thymol Iodide)		
Elaterin	$C_{20}H_{28}O_5$	345.60
Emetine	$C_{15}H_{21}NO_2$	245.34
Erbium	**Er**	**164.8**
Ether (Ethyl Oxide)	$(C_2H_5)_2O$	73.52
Ethyl Acetate (Acetic Ether)	$C_2H_5C_2H_3O_2$	87.40
" Bromide	C_2H_5Br	108.18
" Carbamate	$C_3H_7NO_2$	88.42
" Chloride	C_2H_5Cl	64.00
" Hydroxide (See Alcohol, Ethyl)		
" Nitrite	$C_2H_5NO_2$	74.51
" Oxide (See Ether)		
Ethylene	C_2H_4	27.82
Eucalyptol (Cineol)	$C_{10}H_{18}O$	152.98
Eugenol	$C_{10}H_{12}O_2$	162.86
Exalgine (Methyl Acetanilide)	$C_9H_{11}NO$	148.00
Ferric Acetate	$Fe(C_2H_3O_2)_3$	231.24
" Ammonium Sulphate	$FeNH_4(SO_4)_2 + 12H_2O$	478.69
" " " Anhydrous	$FeNH_4(SO_4)_2$	264.13

Ferric Chloride	$FeCl_3 + 6H_2O$	268.32
" " Anhydrous	$FeCl_3$	161.04
" Citrate	$FeC_6H_5O_7 + 3H_2O$	296.76
" Hydroxide	$Fe(OH)_3$	106.14
" Hypophosphite	$Fe(PH_2O_2)_3$	249.09
" Nitrate	$Fe(NO_3)_3$	240.21
" Oxide	Fe_2O_3	158.64
" Phosphate (normal, not U. S. P.)	$FePO_4$	149.79
" Pyrophosphate (normal, not U. S. P.)	$Fe_4(P_2O_7)_3$	740.10
" Subsulphate (variable)		
" Sulphate (Tersulphate)	$Fe_2(SO_4)_3$	397.05
" Tersulphate (See Ferric Sulphate)		
Ferricyanic Acid	$H_6Fe_2(CN)_{12}$	427.08
Ferrocyanic "	$H_4Fe(CN)_6$	214.54
Ferrous Bromide	$FeBr_2 + 6H_2O$	321.50
" " Anhydrous	$FeBr_2$	214.22
" Carbonate	$FeCO_3$	115.05
" Hydroxide	$Fe(OH)_2$	89.26
" Iodide	FeI_2	307.30
" Lactate	$Fe(C_3H_5O_3)_2 + 3H_2O$	285.88
" Oxalate	$FeC_2O_4 + H_2O$	160.72
" Oxide	FeO	71.38
" Sulphate	$FeSO_4 + 7H_2O$	276.01
" " Anhydrous	$FeSO_4$	150.85
" Sulphide	FeS	87.33
Fluorine	**F**	**18.9**
Formaldehyde (Formic Aldehyde)	CH_2O	29.79
Gadolinium	**Gd**	**155.0**
Gallium	**Ga**	**69.5**
Germanium	**Ge**	**71.9**
Glucinum	**Gl**	**9.03**
Glucose (See Sugar, Grape)		
Glycerin (Glycerol)	$C_3H_5(OH)_3$	91.37
Glyceryl Trinitrate (Nitroglycerin)	$C_3H_5(NO_3)_3$	225.44
Glycol	$C_2H_4(OH)_2$	61.58
Gold	**Au**	**195.7**
Gold Chloride, Anhydrous (See Acid Chlorauric, Anhydrous)		
Guaiacol	$C_7H_8O_2$	123.13
" Carbonate	$(C_7H_7O)_2CO_3$	272.05
Helium	**He**	**4.0**
Heroine Hydrochloride	$C_{17}H_{17}(C_2H_3O_2)_2NOHCl$	402.62
Hexamethylenamine	$C_6H_{12}N_4$	139.18
Hexamethylene Tetramine (See Hexamethylenamine)		
Homatropine Hydrobromide	$C_{16}H_{21}NO_3HBr$	353.49
Hydrastine	$C_{21}H_{21}NO_6$	380.32
" Hydrochloride	$C_{21}H_{21}NO_6HCl$	416.50
Hydrastinine Hydrochloride	$C_{11}H_{11}NO_2HCl$	223.88
Hydrogen	**H**	**1.00**
Hydrogen Dioxide	H_2O_2	33.76
" Sulphide (Hydrosulphuric Acid)	H_2S	33.83
Hydroquinone	$C_6H_6O_2$	109.22
Hyoscine Hydrobromide	$C_{17}H_{21}NO_4HBr + 3H_2O$	434.92
" " Anhydrous	$C_{17}H_{21}NO_4HBr$	381.28
Hyoscyamine	$C_{17}H_{23}NO_3$	287.04
" Hydrobromide	$C_{17}H_{23}NO_3HBr$	367.40
" Sulphate	$(C_{17}H_{23}NO_3)_2H_2SO_4$	671.43
Indigo Blue	C_8H_5NO	130.09
Indium	**In**	**113.1**
Iodeosin (Tetraiodo-fluorescein)	$C_{20}H_8I_4O_5$	829.20
Iodine	**I**	**125.90**

Iodoform	CHI_3	390.61
Iodol (Tetraiodopyrrol)	C_4I_4NH	566.17
Iridium	**Ir**	**191.5**
Iron	**Fe**	**55.5**
Iron Salts (See under *Ferric* and *Ferrous*)		
Krypton	**Kr**	**81.2**
Lanthanum	**La**	**137.9**
Lead	**Pb**	**205.35**
Lead Acetate	$Pb(C_2H_3O_2)_2 + 3H_2O$	376.15
" " Anhydrous	$Pb(C_2H_3O_2)_2$	322.51
" Carbonate (official)	$(PbCO_3)_2Pb(OH)_2$	768.91
" " (normal)	$PbCO_3$	264.90
" Chloride	$PbCl_2$	275.71
" Chromate	$PbCrO_4$	320.57
" Dioxide	PbO_2	237.11
" Iodide	PbI_2	457.15
" Nitrate	$Pb(NO_3)_2$	328.49
" Oxide	PbO	221.23
" Red Oxide of	Pb_3O_4	679.57
" Subacetate (approximately)	$Pb_2O(C_2H_3O_2)_2$	543.74
" Sulphate	$PbSO_4$	300.70
" Sulphide	PbS	237.18
Lime (Calcium Oxide)	CaO	55.68
Limonene	$C_{10}H_{16}$	135.10
Linaloyl Acetate	$C_{10}H_{17}C_2H_3O_2$	194.68
Lithium	**Li**	**6.98**
Lithium Benzoate	$LiC_7H_5O_2$	127.11
" Bromide	$LiBr$	86.34
" Carbonate	Li_2CO_3	73.51
" Citrate	$Li_3C_6H_5O_7 + 4H_2O$	280.08
" Phosphate (dried at 100° C.)	Li_3PO_4	115.23
" Salicylate	$LiC_7H_5O_3$	142.99
Magnesia (See Magnesium Oxide)		
Magnesium	**Mg**	**24.18**
Magnesium Carbonate (approximately)	$(MgCO_3)_4Mg(OH)_2 + 5H_2O$	482.26
" " (normal)	$MgCO_3$	83.73
" Oxide (Magnesia)	MgO	40.06
" Pyroarsenate	$Mg_2As_2O_7$	308.32
" Pyrophosphate	$Mg_2P_2O_7$	221.06
" Sulphate	$MgSO_4 + 7H_2O$	244.69
" " Anhydrous	$MgSO_4$	119.53
" Sulphite	$MgSO_3 + 6H_2O$	210.93
Manganese	**Mn**	**54.6**
Manganese Dioxide	MnO_2	86.36
" Hypophosphite	$Mn(PH_2O_2)_2 + H_2O$	201.54
Manganous Oxide	MnO	70.48
Manganous Sulphate	$MnSO_4 + 4H_2O$	221.47
" " Anhydrous	$MnSO_4$	149.95
Menthol	$C_{10}H_{19}OH$	154.98
Menthyl Acetate	$C_{10}H_{19}C_2H_3O_2$	196.68
Mercuric Ammonium Chloride	$HgNH_2Cl$	249.61
Mercuric Chloride	$HgCl_2$	268.86
" Cyanide	$Hg(CN)_2$	250.18
" Iodide	HgI_2	450.30
" Nitrate	$Hg(NO_3)_2 + 4H_2O$	393.16
" " Anhydrous	$Hg(NO_3)_2$	321.64
" Oxide	HgO	214.38
Potassium Iodide	$HgI_2 + 2KI$	779.82
" Subsulphate	$Hg(HgO)_2SO_4$	722.61
" Sulphate	$HgSO_4$	293.85

Mercuric Sulphide	HgS	230.33
Mercurous Chloride	$HgCl$	233.68
" Iodide	HgI	324.40
" Nitrate	$HgNO_3 + H_2O$	277.95
" Sulphate	Hg_2SO_4	492.35
Mercury	**Hg**	**198.5**
Methyl Iodide	CH_3I	140.81
Methyl-Orange (Sodium Dimethylamidoazobenzene-sulphonate)	$NaC_{14}H_{14}N_3SO_3$	324.88
Methyl Salicylate	$CH_3C_7H_5O_3$	150.92
Methylacetanilide	$C_6H_5N(CH_3)C_2H_3O$	148.00
Methylene Blue (See Methylthionine Hydrochloride)		
" Chloride	CH_2Cl_2	84.27
Methylthionine Hydrochloride (Methylene Blue)	$C_{16}H_{18}N_3SCl$	317.36
Molybdenum	**Mo**	**95.3**
Molybdic Oxide	MoO_3	142.94
Morphine	$C_{17}H_{19}NO_3 + H_2O$	300.92
" Anhydrous	$C_{17}H_{19}NO_3$	283.04
" Acetate (variable)	$C_{17}H_{19}NO_3C_2H_4O_2 + 3H_2O$	396.26
" Hydrochloride	$C_{17}H_{19}NO_3HCl + 3H_2O$	372.86
" " Anhydrous	$C_{17}H_{19}NO_3HCl$	319.22
" Sulphate	$(C_{17}H_{19}NO_3)_2H_2SO_4 + 5H_2O$	752.83
" " Anhydrous	$(C_{17}H_{19}NO_3)_2H_2SO_4$	663.43
" Tartrate	$(C_{17}H_{19}NO_3)_2C_4H_6O_6 + 3H_2O$	768.64
Naphthalene	$C_{10}H_8$	127.10
Naphthol (See Betanaphthol)		
Naphthylamine Acetate	$C_{10}H_7NH_2HC_2H_3O_2$	201.61
Narceine	$C_{23}H_{29}NO_9$	459.78
Narcotine	$C_{22}H_{23}NO_7$	410.11
Neodymium	**Nd**	**142.5**
Neon	**Ne**	**19.9**
Nickel	**Ni**	**58.3**
Nickelous Oxide	NiO	74.18
" Sulphate	$NiSO_4 + 7H_2O$	278.81
Nicotine	$C_{10}H_{14}N_2$	160.96
Nitrogen	**N**	**13.93**
Nitrogen Dioxide	NO	29.81
Nitroglycerin (See Glyceryl Trinitrate)		
Orthoform	$C_8H_9NO_3$	165.85
Osmium	**Os**	**189.6**
Oxygen	**O**	**15.88**
Palladium	**Pd**	**105.7**
Palladous Chloride	$PdCl_2$	176.06
Paracyanogen	$(CN)_3$	77.52
Paraldehyde	$C_6H_{12}O_3$	131.10
Phenacetin (See Acetphenetidin)		
Phenazone (See Antipyrine)		
Phenol (Carbolic Acid)	C_6H_5OH	93.34
Phenolphthalein	$C_{20}H_{14}O_4$	315.72
Phenyl Salicylate (Salol)	$C_{13}H_{10}O_3$	212.47
Phenylacetamide (See Acetanilide)		
Phosphorus	**P**	**30.77**
Phosphorus Oxychloride	$POCl_3$	152.19
" Pentachloride	PCl_5	206.67
" Trichloride	PCl_3	136.31
Physostigmine	$C_{15}H_{21}N_3O_2$	273.20
" Salicylate	$C_{15}H_{21}N_3O_2C_7H_6O_3$	410.21
" Sulphate	$(C_{15}H_{21}N_3O_2)_2H_2SO_4$	643.75
Picrotoxin	$C_{30}H_{34}O_{13}$	597.74
Pilocarpine	$C_{11}H_{16}N_2O_2$	206.63

Pilocarpine Hydrochloride	$C_{11}H_{16}N_2O_2HCl$	242.81
" Nitrate	$C_{11}H_{16}N_2O_2HNO_3$	269.20
Piperazine	$C_4H_{10}N_2$	85.50
Piperine	$C_{17}H_{19}NO_3$	283.04
Platinum	**Pt**	**193.3**
Platinum Chloride (in solution)	$PtCl_4$	334.02
" " (See Acid, Chloroplatinic)		
Potassa (See Potassium Hydroxide)		
Potassium	**K**	**38.86**
Potassium Acetate	$KC_2H_3O_2$	97.44
" Arsenite (Metarsenite)	$KAsO_2$	145.02
" Acid Oxalate (salt of sorrel)	KHC_2O_4	127.20
" Benzoate	$KC_7H_5O_2 + 3H_2O$	212.63
" " Anhydrous	$KC_7H_5O_2$	158.99
" Bicarbonate	$KHCO_3$	99.41
" Bichromate (See Potassium Dichromate)		
" Bisulphate	$KHSO_4$	135.21
" Bitartrate	$KHC_4H_4O_6$	186.78
" Bromate	$KBrO_3$	165.86
" Bromide	KBr	118.22
" Carbonate	K_2CO_3	137.27
" Chlorate	$KClO_3$	121.68
" Chloride	KCl	74.04
" Chloroplatinate	K_2PtCl_6	482.10
" Chromate	K_2CrO_4	192.94
" Citrate	$K_3C_6H_5O_7 + H_2O$	322.08
" " Anhydrous	$K_3C_6H_5O_7$	304.20
" Cyanide	KCN	64.70
" Dichromate (Potassium Bichromate)	$K_2Cr_2O_7$	292.28
" Ferricyanide	$K_3Fe(CN)_6$	327.12
" Ferrocyanide	$K_4Fe(CN)_6 + 3H_2O$	419.62
" " Anhydrous	$K_4Fe(CN)_6$	365.98
" Hydroxide (Potassa)	KOH	55.74
" Hypophosphite	KPH_2O_2	103.39
" Iodide	KI	164.76
" Lactate	$KC_3H_5O_3$	127.23
" Nitrate	KNO_3	100.43
" Permanganate	$KMnO_4$	156.98
" Phosphate	K_2HPO_4	173.01
" Salicylate	$KC_7H_5O_3$	174.87
" and Sodium Tartrate	$KNaC_4H_4O_6 + 4H_2O$	280.18
" " " " Anhydrous	$KNaC_4H_4O_6$	208.66
" Sulphate	K_2SO_4	173.07
" Sulphite	$K_2SO_3 + 2H_2O$	192.95
" " Anhydrous	K_2SO_3	157.19
" Sulphocyanate (Sulphocyanide)	$KSCN$	96.53
" Tartrate	$2K_2C_4H_4O_6 + H_2O$	467.16
" " Anhydrous	$K_2C_4H_4O_6$	224.64
Praseodymium	**Pr**	**139.4**
Prussian Blue (Ferric Ferrocyanide)	$Fe_4(Fe(CN)_6)_3$	853.62
Pyridine	C_5H_5N	78.48
Pyrogallol (Pyrogallic Acid)	$C_6H_6O_3$	125.10
Pyrrol	C_4H_5N	66.57
Quinidine	$C_{20}H_{24}N_2O_2$	321.82
" Sulphate	$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 2H_2O$	776.75
" " Anhydrous	$(C_{20}H_{24}N_2O_2)_2H_2SO_4$	740.99
Quinine	$C_{20}H_{24}N_2O_2 + 3H_2O$	375.46
" Anhydrous	$C_{20}H_{24}N_2O_2$	321.82
" Bisulphate	$C_{20}H_{24}N_2O_2H_2SO_4 + 7H_2O$	544.33
" " Anhydrous	$C_{20}H_{24}N_2O_2H_2SO_4$	419.17

Quinine Hydrobromide	$C_{20}H_{24}N_2O_2HBr + H_2O$	420.06
" " Anhydrous	$C_{20}H_{24}N_2O_2HBr$	402.18
" Hydrochloride	$C_{20}H_{24}N_2O_2HCl + 2H_2O$	393.76
" " Anhydrous	$C_{20}H_{24}N_2O_2HCl$	358.00
" Salicylate	$2C_{20}H_{24}N_2O_2C_7H_6O_3 + H_2O$	935.54
" Sulphate	$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$	866.15
" " Anhydrous	$(C_{20}H_{24}N_2O_2)_2H_2SO_4$	740.99
" Valerate (Valerianate)	$C_{20}H_{24}N_2O_2C_5H_{10}O_2 + H_2O$	441.01
Quinoline	C_9H_7N	128.12
Radium	**Ra**	**223.0**
Resorcinol (Resorcin)	$C_6H_6O_2$	109.22
Rhodium	**Rh**	**102.2**
Rubidium	**Rb**	**84.8**
Ruthenium	**Ru**	**100.9**
Saccharin (See Benzosulphinide)		
Safrol	$C_{10}H_{10}O_2$	160.86
Salicin	$C_{13}H_{18}O_7$	283.99
Salol (See Phenyl Salicylate)		
Samarium	**Sm**	**148.9**
Santalol	$C_{15}H_{26}O$	220.53
Santonin	$C_{15}H_{18}O_3$	244.29
Scandium	**Sc**	**43.8**
Scopolamine Hydrobromide	$C_{17}H_{21}NO_4HBr + 3H_2O$	434.92
" " Anhydrous	$C_{17}H_{21}NO_4HBr$	381.28
Selenium	**Se**	**78.6**
Silicon	**Si**	**28.2**
Silicon Oxide (Silica)	SiO_2	59.96
Silver	**Ag**	**107.12**
Silver Bromide	AgBr	186.48
" Chloride	AgCl	142.30
" Cyanide	AgCN	132.96
" Iodide	AgI	233.02
" Nitrate	$AgNO_3$	168.69
" Nitrate (Ammoniacal)	$AgNO_3 + 2NH_3$	202.55
" Oxide	Ag_2O	230.12
" Sulphate	Ag_2SO_4	309.59
" Sulphide	Ag_2S	246.07
Soda (See Sodium Hydroxide)		
Sodium	**Na**	**22.88**
Sodium Acetate	$NaC_2H_3O_2 + 3H_2O$	135.10
" " Anhydrous	$NaC_2H_3O_2$	81.46
" Arsenate	$Na_2HAsO_4 + 7H_2O$	309.84
" " Anhydrous	Na_2HAsO_4	184.68
" Arsenite (Metarsenite)	$NaAsO_2$	129.04
" Benzoate	$NaC_7H_5O_2$	143.01
" Bicarbonate	$NaHCO_3$	83.43
" Bisulphite	$NaHSO_3$	103.35
" Bitartrate	$NaHC_4H_4O_6 + H_2O$	188.68
" Borate	$Na_2B_4O_7 + 10H_2O$	379.32
" " Anhydrous	$Na_2B_4O_7$	200.52
" Bromate	$NaBrO_3$	149.88
" Bromide	NaBr	102.24
" Carbonate	$Na_2CO_3 + 10H_2O$	284.11
" " Anhydrous	Na_2CO_3	105.31
" " Monohydrated	$Na_2CO_3 + H_2O$	123.19
" Chlorate	$NaClO_3$	105.70
" Chloride	NaCl	58.06
" Citrate	$2Na_3C_6H_5O_7 + 11H_2O$	709.20
" " Anhydrous	$Na_3C_6H_5O_7$	256.26
" Cobaltic Nitrite	$Co_2(NO_2)_6\,6NaNO_2 + H_2O$	820.56

Sodium Dimethylamidoazo-benzene-sulphonate (See Methyl-Orange)		
" Hydroxide (Soda)	$NaOH$	39.76
" Hypophosphite	$NaPH_2O_2 + H_2O$	105.29
" Hyposulphite (See Sodium Thiosulphate)		
" Iodide	NaI	148.78
" Lactate	$NaC_3H_5O_3$	111.25
" Molybdate	$Na_2MoO_4 + H_2O$	222.46
" Nitrate	$NaNO_3$	84.45
" Nitrite	$NaNO_2$	68.57
" Nitroprusside	$Na_2Fe(NO)(CN)_5 + 2H_2O$	296.03
" Phenolsulphonate (Sodium Sulphocarbolate)	$NaC_6H_5O_4S + 2H_2O$	230.45
" Phosphate	$Na_2HPO_4 + 12H_2O$	355.61
" " Anhydrous	Na_2HPO_4	141.05
" Pyrophosphate	$Na_4P_2O_7 + 10H_2O$	443.02
" " Anhydrous	$Na_4P_2O_7$	264.22
" Salicylate	$NaC_7H_5O_3$	158.89
" Santoninate	$2NaC_{15}H_{19}O_4 + 7H_2O$	693.28
" Sulphate	$Na_2SO_4 + 10H_2O$	319.91
" " Anhydrous	Na_2SO_4	141.11
" Sulphite	$Na_2SO_3 + 7H_2O$	250.39
" " Anhydrous	Na_2SO_3	125.23
" Sulphocarbolate (See Sodium Phenolsulphonate)		
" Tartrate	$Na_2C_4H_4O_6 + 2H_2O$	228.44
" Thiosulphate (Hyposulphite)	$Na_2S_2O_3 + 5H_2O$	246.46
" " Anhydrous	$Na_2S_2O_3$	157.06
Soziodol (Soziodolic Acid)	$C_6H_2I_2(OH)SO_3H$	422.61
Sparteine Sulphate	$C_{15}H_{26}N_2H_2SO_4 + 5H_2O$	419.26
" " Anhydrous	$C_{15}H_{26}N_2H_2SO_4$	329.86
Stannic Chloride	$SnCl_4$	258.82
Stannous Chloride	$SnCl_2 + 2H_2O$	224.22
Strontium	**Sr**	**86.94**
Strontium Bromide	$SrBr_2 + 6H_2O$	352.94
" " Anhydrous	$SrBr_2$	245.66
" Carbonate	$SrCO_3$	146.49
" Iodide	$SrI_2 + 6H_2O$	446.02
" " Anhydrous	SrI_2	338.74
" Lactate	$Sr(C_3H_5O_3)_2 + 3H_2O$	317.32
" " Anhydrous	$Sr(C_3H_5O_3)_2$	263.68
" Nitrate	$Sr(NO_3)_2 + 4H_2O$	281.60
" Salicylate	$Sr(C_7H_5O_3)_2 + 2H_2O$	394.72
" Sulphate	$SrSO_4$	182.29
Strychnine	$C_{21}H_{22}N_2O_2$	331.73
" Hydrochloride	$C_{21}H_{22}N_2O_2HCl + 2H_2O$	403.67
" Nitrate	$C_{21}H_{22}N_2O_2HNO_3$	394.30
" Sulphate	$(C_{21}H_{22}N_2O_2)_2H_2SO_4 + 5H_2O$	850.21
" " Anhydrous	$(C_{21}H_{22}N_2O_2)_2H_2SO_4$	760.81
Sugar, Cane	$C_{12}H_{22}O_{11}$	339.60
" Grape (Glucose)	$C_6H_{12}O_6$	178.74
" Milk	$C_{12}H_{22}O_{11} + H_2O$	357.48
Sulphonethylmethane (Diethylsulphonemethylethyl-methane)	$C_8H_{18}S_2O_4$	240.46
Sulphonmethane (Diethylsulphone-dimethylmethane)	$C_7H_{16}S_2O_4$	226.55
Sulphur	**S**	**31.83**
Sulphur Dioxide	SO_2	63.59
Tantalum	**Ta**	**181.6**
Tellurium	**Te**	**126.6**
Terbium	**Tb**	**158.8**
Terebene	$C_{10}H_{16}$	135.10
Terpin Hydrate	$C_{10}H_{20}O_2 + H_2O$	188.74
Tetramethylthionine Hydrochloride (See Methylthionine Hydrochloride)		

Tetraiodo-fluorescein (See Iodeosin)		
Tetraiodopyrrol (See Iodol)		
Thallium	**Tl**	**202.6**
Theobromine	$C_7H_8N_4O_2$	178.85
Thiosinamine (Allyl-sulphocarbamide)	$(C_3H_5)CH_3N_2S$	115.33
Thorium	**Th**	**230.8**
Thulium	**Tu**	**169.7**
Thymol	$C_{10}H_{13}OH$	148.98
" Iodide (Dithymol-diiodide)	$C_{20}H_{24}O_2I_2$	545.76
Tin	**Sn**	**118.1**
Tin Salts (See under *Stannic* and *Stannous*)		
Titanium	**Ti**	**47.7**
Titanic Oxide	TiO_2	79.46
Tribromphenol	$C_6H_2Br_3OH$	328.42
Tungsten	**W**	**182.6**
Tungstic Oxide	WO_3	230.24
Uranium	**U**	**236.7**
Urea	$CO(NH_2)_2$	59.65
Urethane	$C_3H_7NO_2$	88.42
Vanadium	**V**	**50.8**
Vanillin	$C_8H_8O_3$	150.92
Veratrine	$C_{32}H_{52}N_2O_8$	588.02
Water	H_2O	17.88
Xenon	**Xe**	**127.0**
Xylene (Xylol)	C_8H_{10}	105.28
Ytterbium	**Yb**	**171.7**
Yttrium	**Yt**	**88.3**
Zinc	**Zn**	**64.9**
Zinc Acetate	$Zn(C_2H_3O_2)_2 + 2H_2O$	217.82
" " Anhydrous	$Zn(C_2H_3O_2)_2$	182.06
" Bromide	$ZnBr_2$	223.62
" Carbonate (normal, not U. S. P.)	$ZnCO_3$	124.45
" " (official)	$(ZnCO_3)_2 + 3Zn(OH)_2$	544.88
" Chloride	$ZnCl_2$	135.26
Iodide	ZnI_2	316.70
" Oxide	ZnO	80.78
" Phenolsulphonate (Zinc Sulphocarbolate)	$Zn(C_6H_5O_4S)_2 + 8H_2O$	551.56
" Phosphide	Zn_3P_2	256.24
" Sulphate	$ZnSO_4 + 7H_2O$	285.41
" " Anhydrous	$ZnSO_4$	160.25
" Sulphide	ZnS	96.73
" Sulphocarbolate (See Zinc Phenolsulphonate)		
" Valerate (Valerianate)	$Zn(C_5H_9O_2)_2 + 2H_2O$	301.28
Zirconium	**Zr**	**89.9**

Multiples of Some Atomic and Molecular Weights.

(H = 1)

H	1	2	3	4	5	6	7	8	9	H
O	15.88	31.76	47.64	63.52	79.40	95.28	111.16	127.04	142.92	O
OH	16.88	33.76	50.64	67.52	84.40	101.28	118.16	135.04	151.92	OH
H_2O	17.88	35.76	53.64	71.52	89.40	107.28	125.16	143.04	160.92	H_2O
N	13.93	27.86	41.79	55.72	69.65	83.58	97.51	111.44	125.37	N
NH_2	15.93	31.86	47.79	63.72	79.65	95.58	111.51	127.44	143.37	NH_2
NH_3	16.93	33.86	50.79	67.72	84.65	101.58	118.51	135.44	152.37	NH_3
NH_4	17.93	35.86	53.79	71.72	89.65	107.58	125.51	143.44	161.37	NH_4
NO	29.81	59.62	89.43	119.24	149.05	178.86	208.67	238.48	268.29	NO
NO_2	45.69	91.38	137.07	182.76	228.45	274.14	319.83	365.52	411.21	NO_2
NO_3	61.57	123.14	184.71	246.28	307.85	369.42	430.99	492.56	554.13	NO_3
C	11.91	23.82	35.73	47.64	59.55	71.46	83.37	95.28	107.19	C
CO	27.79	55.58	83.37	111.16	138.95	166.74	194.53	222.32	250.11	CO
CO_3	59.55	119.10	178.65	238.20	297.75	357.30	416.85	476.40	535.95	CO_3
CN	25.84	51.68	77.52	103.36	129.20	155.04	180.88	206.72	232.56	CN
Cl	35.18	70.36	105.54	140.72	175.90	211.08	246.26	281.44	316.62	Cl
Br	79.36	158.72	238.08	317.44	396.80	476.16	555.52	634.88	714.24	Br
I	125.90	251.80	377.70	503.60	629.50	755.40	881.30	1007.20	1133.10	I
S	31.83	63.66	95.49	127.32	159.15	190.98	222.81	254.64	286.47	S
SO_4	95.35	190.70	286.05	381.40	476.75	572.10	667.45	762.80	858.15	SO_4
PO_4	94.29	188.58	282.87	377.16	471.45	565.74	660.03	754.32	848.61	PO_4
Na	22.88	45.76	68.64	91.52	114.40	137.28	160.16	183.04	205.92	Na
K	38.86	77.72	116.58	155.44	194.30	233.16	272.02	310.88	349.74	K
H	1	2	3	4	5	6	7	8	9	H

Specific Gravity Corrections.

Table of Corrections to be applied to apparent specific gravities given by glass apparatus (pycnometer, hydrometer, Westphal balance having a glass plummet, etc.) standardized at $\frac{15°C.}{15°C.}$ to obtain sp. gr. $\frac{25°C.}{25°C.}$

(A. B. Lyons, M.D.)

Observed sp. gr.	Correction (additive)[1]	Observed sp. gr.	Correction (additive)[1]	Observed sp. gr.	Correction (additive)[1]	Observed sp. gr.	Correction (additive)[1]
0.6955	.00125	0.9568	.00170	1.2125	.00215	1.4682	.00260
0.7011	.00126	0.9625	.00171	1.2182	.00216	1.4739	.00261
0.7068	.00127	0.9682	.00172	1.2239	.00217	1.4796	.00262
0.7125	.00128	0.9739	.00173	1.2296	.00218	1.4853	.00263
0.7182	.00129	0.9796	.00174	1.2353	.00219	1.4909	.00264
0.7239	.00130	0.9852	.00175	1.2409	.00220	1.4966	.00265
0.7296	.00131	0.9909	.00176	1.2466	.00221	1.5023	.00266
0.7352	.00132	0.9966	.00177	1.2523	.00222	1.5080	.00267
0.7409	.00133	1.0023	.00178	1.2580	.00223	1.5137	.00268
0.7466	.00134	1.0080	.00179	1.2637	.00224	1.5194	.00269
0.7523	.00135	1.0137	.00180	1.2693	.00225	1.5250	.00270
0.7580	.00136	1.0193	.00181	1.2750	.00226	1.5307	.00271
0.7636	.00137	1.0250	.00182	1.2807	.00227	1.5364	.00272
0.7693	.00138	1.0307	.00183	1.2864	.00228	1.5421	.00273
0.7750	.00139	1.0364	.00184	1.2921	.00229	1.5478	.00274
0.7807	.00140	1.0421	.00185	1.2978	.00230	1.5534	.00275
0.7864	.00141	1.0477	.00186	1.3034	.00231	1.5591	.00276
0.7921	.00142	1.0534	.00187	1.3091	.00232	1.5648	.00277
0.7977	.00143	1.0591	.00188	1.3148	.00233	1.5705	.00278
0.8034	.00144	1.0648	.00189	1.3205	.00234	1.5762	.00279
0.8091	.00145	1.0705	.00190	1.3262	.00235	1.5819	.00280
0.8148	.00146	1.0762	.00191	1.3318	.00236	1.5875	.00281
0.8205	.00147	1.0818	.00192	1.3375	.00237	1.5932	.00282
0.8318	.00148	1.0875	.00193	1.3432	.00238	1.5989	.00283
0.8375	.00149	1.0932	.00194	1.3489	.00239	1.6046	.00284
0.8432	.00150	1.0989	.00195	1.3546	.00240	1.6103	.00285
0.8489	.00151	1.1046	.00196	1.3603	.00241	1.6159	.00286
0.8546	.00152	1.1102	.00197	1.3659	.00242	1.6216	.00287
0.8602	.00153	1.1159	.00198	1.3716	.00243	1.6273	.00288
0.8659	.00154	1.1216	.00199	1.3773	.00244	1.6330	.00289
0.8716	.00155	1.1273	.00200	1.3830	.00245	1.6387	.00290
0.8773	.00156	1.1330	.00201	1.3887	.00246	1.6444	.00291
0.8830	.00157	1.1387	.00202	1.3943	.00247	1.6500	.00292
0.8886	.00158	1.1443	.00203	1.4000	.00248	1.6557	.00293
0.8943	.00159	1.1500	.00204	1.4057	.00249	1.6614	.00294
0.9000	.00160	1.1557	.00205	1.4114	.00250	1.6671	.00295
0.9057	.00161	1.1614	.00206	1.4171	.00251	1.6728	.00296
0.9114	.00162	1.1671	.00207	1.4228	.00252	1.6784	.00297
0.9171	.00163	1.1727	.10208	1.4284	.00253	1.6841	.00298
0.9227	.00164	1.1784	.00209	1.4341	.00254	1.6898	.00299
0.9284	.00165	1.1841	.00210	1.4398	.00255	1.6955	.00300
0.9341	.00166	1.1898	.00211	1.4455	.00256	1.7012	.00301
0.9378	.00167	1.1955	.00212	1.4512	.00257	1.7069	.00302
0.9455	.00168	1.2012	.00213	1.4568	.00258	1.7125	.00303
0.9512	.00169	1.2068	.00214	1.4625	.00259	1.7182	.00304

[1] *Illustration.*—Note that the correction (e.g.) .00125 applies to all specific gravities between 0.6955 and 0.7011, being the exact figure for the mean of these two numbers.

Specific Gravity Corrections.—(*Continued*).

Observed sp. gr.	Correction (additive)	Observed sp. gr.	Correction (additive)	Observed sp. gr.	Correction (additive)	Observed sp. gr.	Correction (additive)
1.7239	.00305	1.8091	.00320	1.8944	.00335	1.9796	.00350
1.7296	.10306	1.8148	.00321	1.9000	.00336	1.9853	.00351
1.7353	.00307	1.8205	.00322	1.9057	.00337	1.9910	.00352
1.7409	.00308	1.8262	.00323	1.9114	.00338	1.9967	.00353
1.7466	.00309	1.8319	.00324	1.9171	.00339	2.0023	.00354
1.7523	.00310	1.8375	.00325	1.9228	.00340		
1.7580	.00311	1.8432	.00326	1.9285	.00341		
1.7637	.00312	1.8489	.00327	1.9341	.00342		
1.7694	.00313	1.8546	.00328	1.9398	.00343		
1.7750	.00314	1.8603	.00329	1.9455	.00344		
1.7801	.00315	1.8660	.00330	1.9512	.00345		
1.7864	.00316	1.8716	.00331	1.9569	.00346		
1.7921	.00317	1.8773	.00332	1.9625	.00347		
1.7978	.00318	1.8830	.00333	1.9682	.00348		
1.8035	.00319	1.8887	.00334	1.9739	.00349		

PART III

SECTION II

NATIONAL FORMULARY OF UNOFFICIAL PREPARATIONS

The National Formulary, 3rd edition, is issued by the American Pharmaceutical Association and is here printed in abstract, with the permission of the Council of the Association, the printing of the *full text* of this edition of the Formulary by any publisher except their own being forbidden by a resolution passed by the Association at its annual meeting in Indianapolis in 1906.

The National Formulary is intended to serve as a guide to pharmacists and physicians for preparations which are unofficial and not in the United States Pharmacopœia but which are in use in this country. A bound copy of the 3rd edition should be in the hands of every pharmacist, and can be purchased for a small sum from booksellers, wholesale druggists or from the General Secretary of the American Pharmaceutical Association.

ACETUM AROMATICUM. N. F.

Aromatic Vinegar

The formula of this preparation is identical with that of the 2d ed. N. F. It contains the volatile oils of lavender, rosemary, juniper, peppermint, cinnamon, lemon and cloves, dissolved in alcohol, acetic acid and water.

ACIDUM CARBOLICUM IODATUM. N. F.

Iodized Carbolic Acid

[Phenol Iodatum, Iodized Phenol]

The formula for Iodized Carbolic Acid was not changed in the last revision of the N. F., with the exception that the quantities are expressed in parts by weight instead of grammes. It is made from iodine, phenol and glycerin. It is used externally as a convenient form of applying iodine and phenol when indicated.

ACIDUM CITRICUM SACCHARATUM. N. F.

Saccharated Citric Acid

The formula for this preparation does not differ from that of the 2d ed. N. F. This powder is used by mixing it with an equal weight of saccharated sodium bicarbonate (see page 1812) and adding to water to form an effervescing solution which is refrigerant and laxative.

ACIDUM HYPOPHOSPHOROSUM. N. F.

(U. S. P. = 30 per cent.)

Hypophosphorous Acid

The 3d ed. N. F. introduces a process for making hypophosphorous acid by decomposing potassium hypophosphite with tartaric acid, the liquids used being distilled water and diluted alcohol. The strength is the same as that of the U. S. P. (8th Rev.), 30 per cent. (see page 45). The 2d ed. N. F. preparation was a 10 per cent. acid. It is intended to be used for making diluted hypophosphorous acid.

ACIDUM METAPHOSPHORICUM DILUTUM. N. F.

Diluted Metaphosphoric Acid [Acidum Phosphoricum Glaciale Dilutum, Diluted Glacial Phosphoric Acid]

This diluted acid is intended to be of the same strength as the official diluted phosphoric acid. Inasmuch as glacial phosphoric acid, from which it is made, as found in commerce usually contains sodium phosphate in large quantity as an impurity, a similar formula was abandoned by the U. S. Pharmacopœia because of its uncertain strength, and this diluted acid should not be used in place of the official diluted phosphoric acid. (See page 63.)

ACIDUM TARTARICUM SACCHARATUM. N. F.

Saccharated Tartaric Acid

The formula for this preparation does not differ from that of the 2d ed. N. F. Used by dissolving in water with an equal weight of saccharated sodium bicarbonate (see page 1812) to form an effervescing mixture which is refrigerant and laxative.

AQUA SEDATIVA. N. F.

Sedative Water

[Lotio Ammonico-Camphorata (Codex), Eau Sedative de Raspail]

The formula for this preparation is the same as that found in the 2d ed. N. F.

Average dose: 8 Cc. (2 fluidrachms).

BALSAMUM TRAUMATICUM. N. F.

Traumatic Balsam

[Turlington's Balsam, Friar's Balsam]

The official Tinctura Benzoini Composita (see page 1256) is a simplified form of Turlington's Balsam and is preferred to this preparation.

Average dose: 2 Cc. (30 minims).

BISMUTHI OXIDUM HYDRATUM. N. F.

Hydrated Oxide of Bismuth

This form of bismuth is a creamy white powder well adapted for mixing with water to form a *Cream of Bismuth* to be used externally as an application to the skin.

BOROGLYCERINUM. N. F.

Boroglycerin

[Glyceryl Borate, Boroglyceride]

This is a solid or semi-solid, intended for use in making a glycerite of boroglycerin by adding to it an equal weight of glycerin and heating with a gentle heat until dissolved. The process in the 2d ed. N. F. was the same as that of the 3d ed. Used as a preservative for animal and vegetable products.

CAFFEINÆ SODIO-BENZOAS. N. F.

Caffeine Sodio-Benzoate

This powder contains 50 per cent. of caffeine with 50 per cent. of sodium benzoate, as in the 2d ed. N. F. It is used as a nerve stimulant.

Average dose: 0.2 Gm. (3 grains).

CAFFEINÆ SODIO-SALICYLAS. N. F.

Caffeine Sodio-Salicylate

This powder contains 50 per cent. of caffeine with sodium salicylate, as in the 2d ed. N. F. It is used in rheumatism.

Average dose: 0.2 Gm. (3 grains).

CAMPHO-MENTHOL. N. F.

Camphor and Menthol

A new preparation in the 3d ed. N. F. Equal parts by weight of camphor and menthol. Applied locally in neuralgia.

CERATUM CAMPHORÆ COMPOSITUM. N. F.

Compound Camphor Cerate

[Ceratum Camphoratum, Camphor Ice]

Largely used at one time as a healing application to chapped skin. It contains camphor, white wax, castor oil, spermaceti, phenol, oil of bitter almond and benzoic acid.

CHLORAL CAMPHORATUM. N. F.

Camphorated Chloral [Chloral et Camphora, Chloral and Camphor]

Equal parts by weight of hydrated chloral and camphor as in the 2d ed. N. F. Used locally to relieve pain.

COLLODIUM IODATUM. N. F.

Iodized Collodion

A five per cent., by weight, solution of iodine in flexible collodion as in the 2d ed. N. F. Used externally as a discutient.

COLLODIUM IODOFORMATUM. N. F.

Iodoform Collodion

A five per cent. by weight solution of iodoform in flexible collodion as in 2d ed. N. F. Used locally.

COLLODIUM SALICYLATUM COMPOSITUM. N. F.

Compound Salicylated Collodion

[Corn Collodion]

The proportions of the ingredients are the same as in the 2d ed. N. F. It contains salicylic acid, extract of Indian hemp, alcohol and flexible collodion. Used in the treatment of corns.

COLLODIUM TIGLII. N. F.

Croton Oil Collodion

A ten per cent. by weight solution of croton oil in flexible collodion as in 2d ed. N. F. Used locally as a counter-irritant.

CORDIALE RUBI FRUCTUS. N. F.

Blackberry Cordial

The proportions of the ingredients are nearly the same as in the 2d ed. N. F. It contains cin-

namon, cloves, nutmeg, fresh blackberry juice, syrup, and diluted alcohol, and is used as a remedy in diarrhœa.

Dose: 8 to 16 Cc. (2 to 4 fluidrachms).

DECOCTUM ALOES COMPOSITUM. N. F.

Compound Decoction of Aloes

The formula for this decoction does not differ from that of the 2d ed. N. F. It contains extract of aloes, myrrh, saffron, potassium carbonate, extract of glycyrrhiza, compound tincture of cardamom and water. It is used as a laxative or purgative in the *dose* of 8 Cc. to 32 Cc. (2 to 8 fluidrachms).

ELIXIR ACIDI SALICYLICI. N. F.

Elixir of Salicylic Acid

The formula for this elixir is the same as that of the 2d ed. N. F. It contains 5 grains of salicylic acid in 1 fluidrachm of finished elixir, and is used in the treatment of rheumatism.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR AMMONII BROMIDI. N. F.

Elixir of Ammonium Bromide

The formula for this elixir was changed in the 3d ed. N. F. by dropping the citric acid which was directed in the 2d ed. N. F. It contains 5 grains of ammonium bromide in 1 fluidrachm of finished elixir, and is used as a nerve sedative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR AMMONII VALERIANATIS. N. F.

Elixir of Ammonium Valerianate

The title of this elixir should have been changed to Elixir Ammonii Valeratis, to conform to the name of the salt in the U. S. P. 8th Rev., "valerate." The formula for this elixir was changed in the 3d ed. N. F. by increasing the proportion of chloroform about 40 per cent. It contains 2 grains of ammonium valerate in 1 fluidrachm of finished elixir.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR AMMONII VALERIANATIS ET QUININÆ. N. F.

Elixir of Ammonium Valerianate and Quinine

The title should have been changed as in the elixir preceding this, for the reasons there given. It contains ¼ of a grain of quinine hydrochloride and 2 grains of ammonium valerate in 1 fluidrachm of finished elixir.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR ANISI. N. F.

Elixir of Anise [Aniseed Cordial]

The formula for this elixir was changed in the 3d ed. N. F. by using purified talc instead of magnesium carbonate as a clarifying substance. It contains anethol, oil of fennel, spirit of bitter almond, alcohol, syrup and water. Used as a vehicle, also as a carminative for infants.

Average dose: Infants, 1 Cc. (15 minims).

ELIXIR APII GRAVEOLENTIS COMPOSITUM. N. F.

Compound Elixir of Celery

This elixir should always be prescribed under its full name, "Apii Graveolentis," to avoid the possibility of "Apii" being mistaken in handwriting for "Opii." The formula is the same as that of the 2d ed. N. F. It contains fluidextracts of celery seed, coca, kola, viburnum prunifolium, with alcohol and aromatic elixir. Used as a stimulant in nervous affections.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR BISMUTHI. N. F.

Elixir of Bismuth

This formula has been improved in the 3d ed. N. F., bismuth and ammonium citrate being replaced by glycerite of bismuth. Two grains of bismuth and sodium tartrate are contained in 1 fluidrachm of finished elixir.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR BUCHU. N. F.

Elixir of Buchu

In this elixir magnesium carbonate has been replaced in the 3d ed. N. F. by purified talc as a clarifying agent. It contains fluidextract of buchu, alcohol, syrup and aromatic elixir. About 7½ grains of buchu are represented by 1 fluidrachm of finished elixir. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR BUCHU COMPOSITUM. N. F.

Compound Elixir of Buchu

The comments on Elixir of Buchu apply to this elixir. Compound fluidextract of buchu (page 1794) is used instead of the simple fluidextract. About 15 minims of compound fluidextract of buchu are represented in 1 fluidrachm of finished elixir. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR BUCHU ET POTASSII ACETATIS. N. F.

Elixir of Buchu and Potassium Acetate

The formula for this elixir is the same as that of the 2d ed. N. F. It contains 5 grains of potassium acetate and the equivalent of 7½ grains of buchu in 1 fluidrachm of finished elixir. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CAFFEINÆ. N. F.

Elixir of Caffeine

The formula for this elixir is nearly the same as that of the 2d ed. N. F. It contains 1 grain of caffeine in 1 fluidrachm of finished elixir. It is used as a nerve stimulant.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CALCII BROMIDI. N. F.

Elixir of Calcium Bromide

The formula for this elixir was changed in the 3d ed. N. F., diluted hydrobromic acid being used to aid in dissolving the calcium bromide instead of the citric acid used in the 2d ed. N. F.

It contains 5 grains of calcium bromide in 1 fluidrachm of finished elixir, and is used as a nervine.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CALCII HYPOPHOSPHITIS. N. F.

Elixir of Calcium Hypophosphite

The formula for this elixir was changed in the 3d ed. N. F., hypophosphorous acid being used to aid in dissolving the calcium hypophosphite instead of the citric acid used in the 2d ed. N. F.

It contains 2 grains of calcium hypophosphite in 1 fluidrachm of finished elixir. It is used as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CALCII LACTOPHOSPHATIS. N. F.

Elixir of Calcium Lactophosphate

No change was made in the formula for this elixir, the ingredients and quantities being the same as those directed in the 2d ed. N. F.

It contains 1 grain of calcium lactate or about 1½ grains of so-called calcium lactophosphate in 1 fluidrachm of finished elixir. It is used as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CATHARTICUM COMPOSITUM. N. F.

Compound Cathartic Elixir

The formula for this elixir was completely revised for the 3d ed. N. F., the fluidextracts of frangula and rhubarb replacing those of podophyllum, leptandra and jalap used in the 2d ed. N. F., while spirit of peppermint, solution of potassium hydroxide, saccharin and aromatic elixir replace potassium and sodium tartrate, sodium bicarbonate, compound elixir of taraxacum, and elixir of glycyrrhiza of the 2d ed. N. F. Fluidextract of senna was used in both formulas.

Average dose: Aperient, 4 Cc. (1 fluidrachm); Cathartic, 12 Cc. (3 fluidrachms).

ELIXIR CHLOROFORMI COMPOSITUM. N. F.

Compound Elixir of Chloroform

The formula for this elixir was not changed in the 3d ed. N. F. It is recommended that the name *"Chloroform Paregoric"* formerly used as a synonym for this elixir be abandoned, in order that confusion with official paregoric may be prevented. It is used as an anodyne and carminative.

Average dose: 2 Cc. (½ fluidrachm).

ELIXIR CINCHONÆ. N. F.

(Elixir of Cinchona from "Alkaloids.")

Elixir of Cinchona Elixir Calisaya [Compound Elixir of Quinine]

The formula for this elixir was completely changed in the 3d ed. N. F., the alkaloids of cinchona being employed instead of the tincture of cinchona used in the 2d ed. N. F., or in other words the old compound elixir of quinine is now called elixir of cinchona. This course is to be commended, notwithstanding the unfavorable criticism made by some writers, who insist that it is no longer entitled to the name of elixir of cinchona because it is not made directly from a preparation of the bark; the alkaloids are made *from the bark*, however, and there certainly can be no good reason for compelling the pharmacist to dispense the elixir of the 2d ed. N. F., which has the fault of precipitating continually, and which cannot be mixed with preparations containing salts of iron without producing inky compounds. The introduction of this new elixir of cinchona containing alkaloids in definite quantities makes it unnecessary to retain detannated elixir of cinchona and a separate formula for compound elixir of quinine, both of which were dropped. It is used as a tonic and vehicle for other preparations. This elixir now contains 1 grain of quinine sulphate and ½ grain each of cinchonidine and cinchonine sulphates in 1 fluidounce of finished elixir, and is used as a tonic.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CINCHONÆ ET FERRI. N. F.

Elixir of Cinchona and Iron [Elixir of Calisaya and Iron, Ferrated Elixir of Calisaya]

The formula for this elixir was not changed in strength in the 3d ed. N. F. The color is darker than that of the 2d ed. N. F., due to the use of tincture of cudbear in the elixir of cinchona now used.

It contains 2 grains of soluble ferric phosphate in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CINCHONÆ ET HYPOPHOSPHITUM. N. F.

Elixir of Cinchona and Hypophosphites
Elixir of Calisaya and Hypophosphites

The formula for this elixir was changed in the 3d ed. N. F. by replacing the citric acid in the 2d ed. N. F. with hypophosphorous acid. The use of the elixir of cinchona (made now from alkaloids) changes the taste and appearance of this elixir, which contains 1 grain each of calcium and sodium hypophosphites in 1 fluidrachm of finished elixir. It is used as a tonic and alterative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CINCHONÆ, FERRI, BISMUTHI ET STRYCHNINÆ. N. F.

Elixir of Cinchona, Iron, Bismuth and Strychnine [Elixir of Calisaya, Iron, Bismuth and Strychnine]

The strength of this elixir was not changed in the 3d ed. N. F. It contains 1–100th of a grain of strychnine sulphate, 1 grain of bismuth and sodium tartrate and 2 grains of soluble ferric phosphate in 1 fluidrachm of finished elixir, and is used as a bitter tonic and stomachic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CINCHONÆ, FERRI ET BISMUTHI. N. F.

Elixir of Cinchona, Iron and Bismuth [Elixir of Calisaya, Iron and Bismuth]

The formula for this elixir was changed in the 3d ed. N. F., glycerite of bismuth replacing bismuth and ammonium citrate of the 2d ed. N. F. It contains 1 grain of bismuth and sodium tartrate, 1¾ grains of soluble ferric phosphate, in 1 fluidrachm of finished elixir, and is used as a bitter tonic and stomachic.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CINCHONÆ, FERRI, ET CALCII LACTOPHOSPHATIS. N. F.

Elixir of Cinchona, Iron and Calcium Lactophosphate [Elixir of Calisaya, Iron, and Lactophosphate of Lime]

The formula for this elixir is the same as that in the 2d ed. N. F. It contains ½ grain of calcium lactate (equivalent to about ¾ grain of the so-called calcium lactophosphate), nearly 2 grains of soluble ferric phosphate, and is tonic and alterative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CINCHONÆ, FERRI ET PEPSINI. N. F.

Elixir of Cinchona, Iron and Pepsin Elixir of Calisaya, Iron and Pepsin

The formula for this elixir was changed in the 3d ed. N. F. by replacing the pepsin and hydrochloric acid used in the 2d ed. N. F. by glycerite of pepsin. It contains 1 grain of pepsin and about 1½ grains of soluble ferric phosphate in 1 fluidrachm of finished elixir, and is used as a tonic and stomachic.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR CINCHONÆ, FERRI ET STRYCHNINÆ. N. F.

Elixir of Cinchona, Iron and Strychnine [Elixir of Calisaya, Iron and Strychnine]

The formula for this elixir was very slightly changed in the 3d ed. N. F., 15 Cc. of water being replaced by 10 Cc. for dissolving the strychnine sulphate. This, of course, does not affect the strength. It contains 1–100th of a grain of strychnine sulphate and 2 grains of soluble ferric phosphate in 1 fluidrachm of finished elixir, and is used as a bitter tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CINCHONÆ, PEPSINI ET STRYCHNINÆ. N. F.

Elixir of Cinchona, Pepsin and Strychnine
Elixir of Calisaya, Pepsin and Strychnine

The formula for this elixir was improved in the 3d ed. N. F. by the addition of cinchonidine sulphate. It contains 1–100th grain of strychnine sulphate, ⅛ grain quinine sulphate, 1–16th grain each of cinchonidine and cinchonine sulphates, and 1 grain of pepsin in 1 fluidrachm of finished elixir. It is used as a tonic, stomachic, and digestive.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR COCÆ. N. F.

Elixir of Coca [Elixir of Erythroxylon]

This is a new elixir in the 3d ed. N. F. It is made from fluidextract of coca, tincture of vanilla, alcohol, syrup and aromatic elixir, about 7½ grains of coca leaf being represented in 1 fluidrachm of finished elixir. It is used as a stimulant.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR COCÆ ET GUARANÆ. N. F.

Elixir of Coca and Guarana
[Elixir of Erythroxylon and Guarana]

This is a new elixir in the 3d ed. N. F. It contains fluidextracts of coca and guarana with compound elixir of taraxacum, about 7½ grains each of coca leaf and guarana being represented by 1 fluidrachm of finished elixir. It is used as a stimulant.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CORYDALIS COMPOSITUM. N. F.

Compound Elixir of Corydalis

The formula for this elixir is the same as that of the 2d ed. N. F. It contains about 3

grains of potassium iodide in 1 fluidrachm of finished elixir, with small quantities of the fluidextracts of corydalis, stillingia, xanthoxylum and iris.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR CURASSAO. N. F.

Elixir of Curacao [Curacao Cordial]

The only change in the formula for this elixir in the 3d ed. N. F. is the slight increase in the proportion of spirit of curaçao. It contains spirit of curaçao, a little orris root, citric acid, alcohol, syrup and water. It is used solely as a vehicle.

Average dose: 16 Cc. (4 fluidrachms.)

ELIXIR DIGESTIVUM COMPOSITUM. N. F.

Compound Digestive Elixir [Compound Elixir of Pepsin]

The formula for this elixir was slightly changed in the 3d ed. N. F., the quantity of lactic acid and hydrochloric acid being reduced. It contains pepsin, pancreatin, diastase, lactic acid, hydrochloric acid, tincture of cudbear, glycerin, water and aromatic elixir. Pepsin and pancreatin should never be used in the same liquid. Digestive.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR ERIODICTYI AROMATICUM. N. F.

Aromatic Elixir of Eriodictyon [Aromatic Elixir of Yerba Santa, Elixir Corrigens]

The formula for this elixir was very slightly changed in the 3d ed. N. F., the quantities of fluidextract of eriodictyon and magnesium carbonate being slightly reduced. It is made from fluidextract of eriodictyon, syrup, powdered pumice, magnesium carbonate and compound elixir of taraxacum. It is used chiefly as a vehicle for disguising the taste of quinine sulphate and other bitter substances.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR EUCALYPTI. N. F.

Elixir of Eucalyptus

The formula for this elixir is nearly the same as that in the 2d ed. N. F. The only change in the 3d ed. N. F. is the replacing of magnesium carbonate by purified talc. It contains about 7½ grains of eucalyptus in 1 fluidrachm of finished elixir, syrup of coffee and compound elixir of taraxacum being employed in the preparation. It is used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR EUONYMI. N. F.

Elixir of Euonymus [Elixir of Wahoo]

The formula for this elixir is the same as that in the 2d ed. N. F. About 9½ grains of euonymus are represented in 1 fluidrachm of the finished elixir, which contains syrup of coffee and compound elixir of taraxacum. It is used as a diuretic and cholagogue.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FERRI HYPOPHOSPHITIS. N. F.

Elixir of Hypophosphite of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferric Hypophosphite to Elixir of Hypophosphite of Iron. No change was made in the proportion of the ingredients, 1 grain of iron hypophosphite being contained in 1 fluidrachm of finished elixir. It is used as an alterative and chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FERRI LACTATIS. N. F.

Elixir of Lactate of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferrous Lactate to Elixir of Lactate of Iron. The name "Lactate of Iron" also replaces "Ferrous Lactate" used in the 2d ed. N. F. No change was made in the ingredients or quantities. One grain of lactate of iron and 3 grains of potassium citrate are contained in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FERRI PHOSPHATIS. N. F.

Elixir of Phosphate of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferric Phosphate to Elixir of Phosphate of Iron, and the word "soluble" has been added to ferric phosphate. Two grains of soluble ferric phosphate are contained in one fluidrachm of the finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FERRI PYROPHOSPHATIS. N. F.

Elixir of Pyrophosphate of Iron

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Ferric Pyrophosphate to Elixir of Pyrophosphate of Iron. No change was made in the ingredients or quantities used in the 2d ed. N. F., except that the word "soluble" has been added to ferric pyrophosphate. It contains 2 grains of soluble ferric pyrophosphate in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FERRI PYROPHOSPHATIS, QUININÆ ET STRYCHNINÆ. N. F.

Elixir of Pyrophosphate of Iron, Quinine, and Strychnine.

This is a new preparation in the 3d ed. N. F., and differs from the official elixir of iron, qui-

nine and strychnine phosphates in containing soluble ferric pyrophosphate instead of phosphate, while the quinine in the official elixir is replaced by quinine sulphate. It contains 1–128th grain of strychnine, ½ grain of quinine sulphate, and 2 grains of soluble ferric pyrophosphate in 1 fluidrachm of finished elixir. The additional ingredients are citric acid, oil of orange, alcohol, syrup, ammonia water and distilled water. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FERRI, QUININÆ ET STRYCHNINÆ. N. F.

Elixir of Iron, Quinine and Strychnine

This elixir does not differ greatly from that of the 2d ed. N. F. It contains about 1 grain of ferric chloride, ½ grain quinine hydrochloride, and 1–100th grain of strychnine sulphate in 1 fluidrachm of finished elixir. It is used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR FRANGULÆ. N. F.

Elixir of Frangula [Elixir of Buckthorn]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of frangula, alcohol, compound elixir of taraxacum, and aromatic elixir. It represents about 15 grains of frangula in 1 fluidrachm of the finished elixir. It is used as a laxative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR GENTIANÆ. N. F.

Elixir of Gentian

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of gentian, compound spirit of cardamom, solution of ferric sulphate, ammonia water, alcohol, water and aromatic elixir, and represents about 2 grains of gentian in 1 fluidrachm of the finished elixir. It is used as a bitter tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR GENTIANÆ CUM TINCTURA FERRI CHLORIDI. N. F.

Elixir of Gentian with Tincture of Chloride of Iron

The formula for this elixir does not differ from that of the 2d ed. N. F. The English name was changed in the 3d ed. from Elixir of Gentian with Tincture of Ferric Chloride, to Elixir of Gentian with Tincture of Chloride of Iron. It represents ¾ of a grain of ferric chloride and nearly 2 grains of gentian in 1 fluidrachm of the finished elixir, and is used as a bitter tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR GENTIANÆ ET FERRI PHOSPHATIS. N. F.

Elixir of Gentian and Phosphate of Iron [Elixir Gentianæ Ferratum, Ferrated Elixir of Gentian, Ferrophosphated Elixir of Gentian]

The English name of this elixir was changed in the 3d ed. N. F. from Elixir of Gentian and Ferric Phosphate to Elixir of Gentian and Phosphate of Iron, but the formula does not differ from that of the 2d ed. N. F., except that the word soluble has been added to ferric phosphate. One grain of soluble ferric phosphate and about 2 grains of gentian are represented in 1 fluidrachm of the finished elixir. It is used as a chalybeate and tonic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR GENTIANÆ GLYCERINATUM. N. F.

Glycerinated Elixir of Gentian

This is a new elixir in the 3d ed. N. F. It is made from the fluidextracts of gentian and taraxacum, acetic ether, phosphoric acid, tincture of sweet orange peel, compound tincture of cardamom, solution of saccharin, glycerin, sugar and white wine. It is a tonic agreeable to the taste and will undoubtedly prove a valuable addition to the list of tonic elixirs. The use of saccharin, however, is questionable, in view of the prejudice against it, and as glycerin and sugar are both sweetening agents, its employment seems unnecessary.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR GLYCYRRHIZÆ. N. F.

Elixir of Glycyrrhiza [Elixir of Licorice]

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the addition of a small quantity of magnesium carbonate to aid in the filtration. It is made from fluidextract of glycyrrhiza and aromatic elixir. It is used as a vehicle and flavoring agent.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR GLYCYRRHIZÆ AROMATICUM. N. F.

Aromatic Elixir of Glycyrrhiza Aromatic Elixir of Licorice

The formula for this elixir was changed in the 3d ed. N. F., the quantity of volatile oils having been practically doubled. It contains fluidextract of licorice, oils of cloves, cinnamon, myristica and fennel, with aromatic elixir; purified talc replaces magnesium carbonate. It is used as a vehicle.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR GLYCEROPHOSPHATUM. N. F.

Elixir of Glycerophosphates

This is a new elixir in the 3d ed. N. F. It contains 1 grain of absolute sodium glycerophosphate, and ½ grain calcium glycerophosphate, in 1 fluidrachm of finished elixir. The additional ingredients are phosphoric acid, glycerin, aromatic elixir and distilled water. It is used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR GRINDELIÆ. N. F.

Elixir of Grindelia

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of grindelia, compound spirit of orange, alcohol and compound elixir of taraxacum. About 4 grains of grindelia are represented in 1 fluidrachm of the finished elixir. It is used in the treatment of asthma.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR GUARANÆ. N. F.

Elixir of Guarana

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of guarana, aromatic elixir and compound elixir of taraxacum. About 12 grains of guarana are represented in 1 fluidrachm of finished elixir. It is used as a nervous stimulant.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR HUMULI. N. F.

Elixir of Humulus [Elixir of Hops]

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the substitution of purified talc for the magnesium carbonate. It is made from fluidextract of hops, purified talc, tincture of vanilla, compound elixir of taraxacum and aromatic elixir. About 7½ grains of hops are represented in 1 fluidrachm of finished elixir. It is used as a mild sedative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR HYPOPHOSPHITUM. N. F.

Elixir of Hypophosphites

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the replacing of the citric acid used in the 2d. ed. by hypophosphorous acid. It is made from calcium, sodium and potassium hypophosphites, hypophosphorous acid, water, glycerin, compound spirit of cardamom and aromatic elixir. It contains 3 grains of calcium hypophosphite and 1 grain each of sodium and potassium hypophosphites in 1 fluidrachm of finished elixir, and is used as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR HYPOPHOSPHITUM CUM FERRO. N. F.

Elixir of Hypophosphites with Iron

The formula for this elixir does not differ from that of the 2d ed. N. F, except the slight increase in the quantity of potassium hypophosphite and the replacement of citric acid by hypophosphorous acid. It is made from calcium, sodium and potassium hypophosphites, ferrous sulphate, hypophosphorous acid, water, syrup and aromatic elixir. It contains ½ grain each of potassium and ferrous hypophosphites and 1 grain each of calcium and sodium hypophosphites in 1 fluidrachm of finished elixir. It is used as an alterative and chalybeate.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR LITHII BROMIDI. N. F.

Elixir of Lithium Bromide

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the citric acid used in the 2d ed. was dropped. It contains 5 grains of lithium bromide in 1 fluidrachm of finished elixir. It is used in the treatment of gout and rheumatism.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR LITHII CITRATIS. N. F.

Elixir of Lithium Citrate

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains 5 grains of lithium citrate in 1 fluidrachm of finished elixir, and is used in the treatment of gout and rheumatism.

Average dose: 6 Cc. (1½ fluidrachms).

ELIXIR LITHII SALICYLATIS. N. F.

Elixir of Lithium Salicylate

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains 5 grains of lithium salicylate in 1 fluidrachm of finished elixir, and is used in the treatment of gout and rheumatism.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR MALTI ET FERRI. N. F.

Elixir of Malt and Iron

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the word "soluble" has been added to ferric phosphate. It contains 1 grain of soluble ferric phosphate and 15 minims of extract of malt in 1 fluidrachm of finished elixir, and is used as a nutrient and in anæmic conditions.

Average dose: 16 Cc. (4 fluidrachms).

ELIXIR PARALDEHYDI. N. F.

Elixir of Paraldehyde

(25 per cent.)

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from paraldehyde, glycerin, alcohol, tincture of cardamom, oils of orange and cinnamon, compound tincture of cudbear and aromatic elixir. It contains about 15 minims of paraldehyde in 1 fluidrachm of finished elixir, and is used as a hypnotic and sedative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR PEPSINI. N. F.

Elixir of Pepsin

The formula for this elixir was materially changed in the 3d ed. N. F., glycerite of pepsin replacing pepsin and aromatic elixir replacing compound elixir of taraxacum. It contains about 1 grain of pepsin in 1 fluidrachm of finished elixir. It is used to aid digestion.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR PEPSINI, BISMUTHI ET STRYCHNINÆ. N. F.

Elixir of Pepsin, Bismuth and Strychnine

The formula for this elixir was changed in the 3d ed. N. F. by the addition of a trace of tartaric acid and the use of strychnine alkaloid instead of strychnine sulphate. It contains 1–100th of a grain of strychnine, ½ grain of pepsin and 2 grains of bismuth and sodium tartrate in 1 fluidrachm of finished elixir. It is used as a tonic in dyspepsia.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR PEPSINI ET BISMUTHI. N. F.

Elixir of Pepsin and Bismuth

The formula for this preparation was entirely changed in the 3d ed. N. F., the glycerite of bismuth replacing bismuth and ammonium citrate and ammonia water, and the glycerite of pepsin replacing pepsin. Aromatic elixir replaces compound elixir of taraxacum. It contains about ½ grain of pepsin and 2 grains of bismuth and sodium tartrate in 1 fluidrachm of finished elixir. It is used as a digestant.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR PEPSINI ET FERRI. N. F.

Elixir of Pepsin and Iron

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains ½ grain of ferric chloride and nearly 1 grain of pepsin in one fluidrachm of the finished elixir. It is used as a chalybeate and digestive.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR PHOSPHORI. N. F.

Elixir of Phosphorus

This elixir was official in the U. S. P. 1890, and was introduced into the 3d ed. N. F. It is made from spirit of phosphorus, oil of anise, glycerin and aromatic elixir. About 1–60th of a grain of phosphorus is contained in 1 fluidrachm of the finished elixir. It is used as an aphrodisiac and nervous stimulant.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR PHOSPHORI ET NUCIS VOMICÆ. N. F.

Elixir of Phosphorus and Nux Vomica

The formula for this elixir was slightly changed in the 3d ed. N. F., the quantity of nux vomica being slightly decreased. About 2 minims of tincture of nux vomica and about 1–60th of a grain of phosphorus are represented in 1 fluidrachm of the finished elixir. It is used as a tonic and stimulant to the nerves.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR PICIS COMPOSITUM. N. F.

Compound Elixir of Tar

The formula for this elixir was greatly improved in the 3d ed. by dropping methyl alcohol and using ethyl alcohol in its place. Methyl alcohol should never be used in any pharmaceutical preparation. The elixir contains about 1–50th of a grain of morphine sulphate in 1 fluidrachm of finished elixir, with syrup of wild cherry, syrup of tolu, and wine of tar, alcohol and water. It is used as an expectorant and sedative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR PILOCARPI. N. F.

Elixir of Pilocarpus [Elixir of Jaborandi]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of pilocarpus, syrup of coffee, tincture of vanilla and compound elixir of taraxacum, and represents about 3¾ grains of pilocarpus in 1 fluidrachm of the finished elixir. It is used as a diaphoretic.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR POTASSII ACETATIS. N. F.

Elixir of Potassium Acetate

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains about 5 grains of potassium acetate in 1 fluidrachm of finished elixir, and is used as a diuretic.

Average dose: 16 Cc. (4 fluidrachms).

ELIXIR POTASSII ACETATIS ET JUNIPERI. N. F.

Elixir of Potassium Acetate and Juniper

This formula does not differ from that of the 2d ed. N. F., except the replacing of magnesium carbonate by purified talc. It is made from potassium acetate, fluidextract of juniper, purified talc and aromatic elixir, and 5 grains of potassium acetate and 7½ grains of juniper are represented in 1 fluidrachm of the finished elixir. It is used as a diaphoretic.

Average dose: 16 Cc. (4 fluidrachms).

ELIXIR POTASSII BROMIDI. N. F.

Elixir of Potassium Bromide

The formula for this elixir does not differ from that of the 2d ed. N. F., except that citric acid was dropped. It contains about 10 grains of potassium bromide in 1 fluidrachm of the finished elixir, and is used as a nervous sedative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR QUININÆ ET PHOSPHATUM COMPOSITUM. N. F.

Compound Elixir of Quinine and Phosphates

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the word "soluble" is added to the words ferric phosphate used in the previous edition. It is made from quinine sulphate, soluble ferric phosphate, potassium citrate, syrup of calcium lactophosphate, water and aromatic elixir, and contains about ¼ grain of quinine sulphate, 1 grain of soluble ferric phosphate, and about ⅔ of a grain of calcium lactophosphate in 1 fluidrachm of finished elixir. It is used as a tonic.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR QUININÆ VALERIANATIS ET STRYCHNINÆ. N. F.

Elixir of Quinine Valerianate and Strychnine

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from quinine valerate, strychnine sulphate, compound tincture of cudbear, and aromatic elixir, and contains 1 grain of quinine valerate and 1–100th of a grain of strychnine sulphate in 1 fluidrachm of finished elixir. It is used as a tonic and sedative in nervous affections.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR RHAMNI PURSHIANÆ. N. F.

Elixir of Cascara Sagrada Elixir of Rhamnus Purshiana

The formula for this elixir was materially changed in the 3d ed. N. F. The quantity of fluidextract of cascara sagrada was doubled, the U. S. P. (8th. Rev.) aromatic fluidextract of cascara sagrada is used, and aromatic elixir takes the place of compound elixir of taraxacum. About 30 grains of cascara sagrada are represented in 1 fluidrachm of the finished elixir. It is used as a laxative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR RHAMNI PURSHIANÆ COMPOSITUM. N. F.

Compound Elixir of Cascara Sagrada [Elixir Laxativum, Laxative Elixir]

The formula for this elixir was materially changed, the new U. S. P. (8th Rev.) aromatic fluidextract of cascara sagrada replacing the fluidextract of cascara sagrada used in the 2d ed. N. F., and aromatic elixir replacing compound elixir of taraxacum. It contains in addition the fluidextracts of senna and juglans, as in the 2d ed. It is used as a laxative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR RHEI. N. F.

Elixir of Rhubarb

The formula for this elixir does not differ from that of the 2d ed. N. F. Sweet tincture of rhubarb (U. S. P. 1890) is mixed with alcohol, water, glycerin and syrup. About 2¼ grains of rhubarb are represented in 1 fluidrachm of the finished elixir. It is used as a laxative.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR RHEI ET MAGNESII ACETATIS. N. F.

Elixir of Rhubarb and Magnesium Acetate [Elixir Rhei et Magnesiæ, Elixir of Rhubarb and Magnesia]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from calcined magnesia, acetic acid, fluidextract of rhubarb and aromatic elixir, and contains about 4 grains of magnesium acetate and 7½ grains of rhubarb in 1 fluidrachm of finished elixir. It is used as a laxative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR RUBI COMPOSITUM. N. F.

Compound Elixir of Blackberry

The formula for this elixir does not differ from that of the 2d ed. N. F. It contains blackberry juice and blackberry root, galls, cinnamon, cloves, mace and ginger, with syrup, glycerin and diluted alcohol. It is used in the treatment of diarrhœa.

Average dose: 16 Cc. (4 fluidrachms).

ELIXIR SODII BROMIDI. N. F.

Elixir of Sodium Bromide

The formula for this elixir does not differ from that of the 2d ed. N. F., except that the citric acid was dropped. About 10 grains of

sodium bromide are represented in 1 fluidrachm of finished elixir. It is used as a sedative for the nerves.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR SODII HYPOPHOSPHITIS. N. F.

Elixir of Sodium Hypophosphite

The formula for this elixir does not differ from that of the 2d ed. N. F., except that citric acid was replaced by hypophosphorous acid. Two grains of sodium hypophosphite are represented in 1 fluidrachm of the finished elixir. It is used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR SODII SALICYLATIS. N. F.

Elixir of Sodium Salicylate

The formula for this elixir does not differ from that of the 2d ed. N. F. Five grains of sodium salicylate are represented in 1 fluidrachm of the finished elixir. It is used in the treatment of rheumatism.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR STILLINGIÆ COMPOSITUM. N. F.

Compound Elixir of Stillingia

The formula for this elixir does not differ from that of the 2d ed. N. F. Fifteen minims of compound fluidextract of stillingia are represented in 1 fluidrachm of the finished elixir. It is used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR STRYCHNINÆ VALERIANATIS. N. F.

Elixir of Strychnine Valerianate

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from strychnine valerate, acetic acid, tincture of vanilla, compound tincture of cudbear and aromatic elixir, and contains 1–100th grain of strychnine valerate in 1 fluidrachm of the finished elixir. It is used as a nervine.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR TARAXACI COMPOSITUM. N. F.

Compound Elixir of Taraxacum

In the 3d ed. N. F. very little change was made in the formula for this elixir, the new tincture of sweet orange peel replacing the U. S. P. 1890 tincture, and the quantity of the tincture of cinnamon being increased (the strength of the new tincture is 20 per cent.). It is made from fluidextracts of taraxacum, wild cherry and licorice, with the tinctures of sweet orange peel and cinnamon, compound tincture of cardamom and aromatic elixir, and is used mainly as a vehicle to cover the taste of bitter substances.

Average dose: 8 Cc. (2 fluidrachms).

ELIXIR TERPINI HYDRATIS. N. F.

Elixir of Terpin Hydrate

This is a new elixir introduced into the 3d ed. N. F. It contains terpin hydrate, tincture of sweet orange peel, solution of saccharin, alcohol, glycerin and syrup. The solution of saccharin might well have been omitted. About 1 grain of terpin hydrate is contained in 1 fluidrachm of the finished elixir. It is used as a stimulant and expectorant.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR TERPINI HYDRATIS CUM CODEINA. N. F.

Elixir of Terpin Hydrate with Codeine

This is a new elixir introduced into the 3d ed. N. F. It contains about 1 grain of terpin hydrate and ⅛ grain of codeine in 1 fluidrachm of the finished elixir. It is used as an expectorant and sedative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR TERPINI HYDRATIS CUM HEROINA. N. F.

Elixir of Terpin Hydrate with Heroine

This is a new elixir introduced into the 3d ed. N. F. It contains 1 grain of terpin hydrate and 1–24th of a grain of heroine in 1 fluidrachm of the finished elixir. It is used as an expectorant and sedative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR TURNERÆ. N. F.

Elixir of Turnera [Elixir of Damiana]

The formula for this elixir does not differ from that of the 2d ed. N. F., except in the replacement of magnesium carbonate by purified talc. It is made from fluidextract of turnera, purified talc, alcohol, glycerin and aromatic elixir. About 9½ grains of turnera are represented in 1 fluidrachm of the finished elixir. It is used as an aphrodisiac.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR VIBURNI OPULI COMPOSITUM. N. F.

Compound Elixir of Viburnum Opulus [Compound Elixir of Crampbark]

The formula for this elixir does not differ from that of 2d ed. N. F. About 4¾ grains each of viburnum opulus and aletris and 9½ grains of trillium with compound elixir of taraxacum are represented in 1 fluidrachm of the finished elixir. It is used as an antispasmodic.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR VIBURNI PRUNIFOLII. N. F.

Elixir of Viburnum Prunifolium [Elixir of Black Haw]

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from fluidextract of viburnum prunifolium, compound tincture of cardamom, and aromatic elixir, and contains about 7½ grains of viburnum prunifolium in 1 fluidrachm of the finished elixir. It is used as an antispasmodic and sedative.

Average dose: 4 Cc. (1 fluidrachm).

ELIXIR ZINCI VALERIANATIS. N. F.

Elixir of Zinc Valerianate

The formula for this elixir does not differ from that of the 2d ed. N. F. It is made from zinc valerate, stronger solution of ammonium citrate, alcohol, spirit of bitter almond, compound tincture of cudbear, and aromatic elixir. About 1 grain of zinc valerate is represented in 1 fluidrachm of the finished elixir. It is used as a nervine.

Average dose: 4 Cc. (1 fluidrachm).

EMPLASTRUM AROMATICUM. N. F.

Aromatic Plaster [Spice Plaster]

The formula for this plaster does not differ from that of the 2d ed. N. F., except that parts are substituted for grammes. It is made from cloves, ginger, cinnamon, capsicum, camphor, cotton seed oil and lead plaster. It is used as a counter-irritant and rubefacient.

EMPLASTRUM FUSCUM CAMPHORATUM. N. F.

Camphorated Brown Plaster [Emplastrum Matris Camphoratum, Camphorated Mother Plaster]

The formula for this plaster has not been changed from that of the 2d ed. N. F., except that parts are substituted for grammes. It is made from red oxide of lead, olive oil, yellow wax and camphor. Used as a discutient.

EMPLASTRUM PICIS LIQUIDÆ COMPOSITUM. N. F.

Compound Tar Plaster

The formula for this plaster was changed in the 3d ed. N. F. only by using parts for grammes. It is made from rosin, tar, powdered podophyllum, powdered phytolacca root and powdered sanguinaria, and is used as a rubefacient and counter-irritant.

EMULSUM OLEI MORRHUÆ CUM CALCII ET SODII PHOSPHATIBUS. N. F.

Emulsion of Cod-Liver Oil with Calcium and Sodium Phosphates [Emulsion of Cod-Liver Oil with Phosphates of Lime and Soda]

The formula for this emulsion does not differ from that of the 2d ed. N. F. In the Latin title the word "Emulsio" has been changed to "Emulsum" in this class of preparations. It contains 50 per cent. of cod liver oil, with calcium and sodium phosphates, syrup of tolu and flavoring. It is used as an alterative.

Average dose: 16 Cc. (4 fluidrachms).

EMULSUM OLEI MORRHUÆ CUM CALCII LACTOPHOSPHATE. N. F.

Emulsion of Cod-Liver Oil with Calcium Lactophosphate [Emulsion of Cod-Liver Oil with Lactophosphate of Lime]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of cod liver oil, with calcium lactate, phosphoric acid, syrup of tolu and flavoring. It is used as an alterative.

Average dose: 16 Cc. (4 fluidrachms).

EMULSUM OLEI MORRHUÆ CUM CALCII PHOSPHATE. N. F.

Emulsion of Cod-Liver Oil with Calcium Phosphate [Emulsion of Cod-Liver Oil with Phosphate of Lime]

The formula for this emulsion does not differ from that of the 2d. ed. N. F. It contains 50 per cent. of cod liver oil, with calcium phosphate, syrup of tolu and flavoring. Used as an alterative.

Average dose: 16 Cc. (4 fluidrachms).

EMULSUM OLEI MORRHUÆ CUM EXTRACTO MALTI. N. F.

Emulsion of Cod-Liver Oil with Extract of Malt

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of cod liver oil with 37½ per cent. of extract of malt. It is used as a tonic and alterative.

Average dose: 16 Cc. (4 fluidrachms).

EMULSUM OLEI MORRHUÆ CUM PRUNO VIRGINIANA. N. F.

Emulsion of Cod-Liver Oil with Wild Cherry

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50

per cent. of cod liver oil with fluidextract of wild cherry, syrup of tolu and flavoring. It is used as an alterative.

Average dose: 16 Cc. (4 fluidrachms).

EMULSUM OLEI RICINI. N. F.

Emulsion of Castor Oil

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 33 per cent. of castor oil, with tincture of vanilla, syrup and water. It is used as a cathartic.

Average dose: 48 Cc. (1½ fluidounces).

EMULSUM OLEI TEREBINTHINÆ FORTIOR. N. F.

Stronger Emulsion of Oil of Turpentine
[Forbes's Emulsion of Oil of Turpentine]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 50 per cent. of oil of turpentine, with acacia and water. It is used as an anthelmintic and diuretic.

Average dose: 2 Cc. (½ fluidrachm).

EMULSUM PETROLEI. N. F.

Emulsion of Petroleum

This new emulsion of the 3d ed. N. F. should have been called Emulsion of Petrolatum, instead of Emulsion of Petroleum. It contains about 5 per cent. of white petrolatum, about 25 per cent. of expressed oil of almond, with acacia, tragacanth and syrup, tincture of lemon peel and water.

Average dose: 16 Cc. (4 fluidrachms).

EMULSUM PHOSPHATICUM. N. F.

Phosphatic Emulsion [Mistura Phosphatica]

The formula for this emulsion does not differ from that of the 2d ed. N. F. It contains 25 per cent. of cod liver oil, 5 per cent. of diluted phosphoric acid, with glycerite of yolk of egg, Jamaica rum, oil of bitter almond and orange flower water. Used as an alterative.

Average dose: 16 Cc. (4 fluidrachms).

ESSENTIA PEPSINI. N. F.

Essence of Pepsin

This is a new preparation of the 3d ed. N. F. It contains pepsin, rennin (an enzyme from calves' rennets), lactic acid, tincture of sweet orange peel, glycerin, alcohol, syrup, white wine and water. It is used as an aid to digestion.

Average dose: 8 Cc. (2 fluidrachms).

EXTRACTUM FERRI POMATUM. N. F.

Ferrated Extract of Apples
[Ferri Malas Crudas, Crude Malate of Iron]

This formula does not differ from that of the 2d ed. N. F. It is made from iron wire, ripe sour apples and water, and is used as a chalybeate.

Average dose: 0.65 Gm. (10 grains).

EXTRACTUM GLYCYRRHIZÆ DEPURATUM, N. F.

Purified Extract of Glycyrrhiza
Purified Extract of Licorice

The formula for this preparation does not differ from that of the 2d ed. N. F. This is a pilular extract made by the old German method and not to be confounded with the Extractum Glycyrrhizæ Purum, U. S. P. 8th Rev. Used as a flavoring and sweetening agent.

Average dose: 1 Gm. (15 grains).

FERRI HYPOPHOSPHIS. N. F.

Hypophosphite of Iron [Ferric Hypophosphite]

Ferric hypophosphite is now official in the U. S. P. 8th Rev., without a formula for its preparation. The process in the 3d ed. N. F. is the same as that found in the 2d ed. N. F. It is made from ferric ammonium sulphate, sodium hypophosphite and distilled water. It is used as an alterative and chalybeate.

Average dose: 0.2 Gm. (3 grains).

FLUIDEXTRACTUM ADONIDIS. N. F.

Fluidextract of Adonis

From the root of *Adonis vernalis* Linné (Bird's Eye).

Made with alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a heart stimulant.

Average dose: 0.13 Cc. (2 minims).

FLUIDEXTRACTUM ALETRIDIS. N. F.

Fluidextract of Aletris

From the rhizome of *Aletris farinosa* Linné (Stargrass).

Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as an alterative.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM ANGELICÆ RADICIS. N. F.

Fluidextract of Angelica Root

From the root of *Angelica Archangelica* Linné (Angelica).

Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as a stimulant and carminative.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM APII GRAVEOLENTIS. N. F.

Fluidextract of Celery

From the seed of *Apium graveolens* Linné (Celery).

Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as a diuretic and nervine.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM ARALIÆ RACEMOSÆ. N. F.

Fluidextract of Aralia Racemosa

From the root of *Aralia racemosa* Linné (American Spikenard).

Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as an alterative.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM ARNICÆ FLORUM. N. F.

Fluidextract of Arnica Flowers

From the flower heads of *Arnica montana* Linné (Arnica).

Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a stimulant and alterative.

Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM BOLDI. N. F.

Fluidextract of Boldo

From the leaves of *Peumus Boldus* Molina (Boldo).

Made with alcohol 2 measures, water 1 measure; 1 Cc. represents 1 Gm. of the drug. It is used as an alterative and tonic.

Average dose: 0.5 Cc. (8 minims).

FLUIDEXTRACTUM BUCHU COMPOSITUM. N. F.

Compound Fluidextract of Buchu

Made with alcohol 2 measures, water 1 measure. It contains buchu, cubeb, juniper and uva ursi. It is used as a diuretic.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM CALENDULÆ. N. F.

Fluidextract of Calendula

From the flowering herb of *Calendula officinalis* Linné (Marigold).

Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of the drug. It is used as a stimulant and tonic.

Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM CAMELLIÆ. N. F.

Fluidextract of Camellia

From the commercial dried leaves of *Camellia Thea* Link (Tea).

Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a nerve stimulant.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM CAULOPHYLLI. N. F.

Fluidextract of Caulophyllum

From the rhizome and rootlets of *Caulophyllum thalictroides* Michaux (Blue Cohosh).

Made with alcohol 3 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an emmenagogue.

Average dose: 0.5 Cc. (8 minims).

FLUIDEXTRACTUM COFFEÆ TOSTÆ. N. F.

Fluidextract of Roasted Coffee

From the commercial roasted seeds of *Coffea arabica* Linné (Coffee).

Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a nerve stimulant.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM COFFEÆ VIRIDIS. N. F.

Fluidextract of Green Coffee

From the commercial, unroasted seeds of *Coffea arabica* Linné (Coffee).

Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a nerve stimulant.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM CONVALLARIÆ. N. F.

Fluidextract of Convallaria Flowers

From the flowers of *Convallaria majalis* Linné (Lily of the Valley).

The word "Florum" has been dropped from the Latin title of this fluidextract. Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a cardiac stimulant and diuretic.

Average dose: 0.5 Cc. (8 minims).

FLUIDEXTRACTUM COPTIS. N. F.

Fluidextract of Coptis

From the rhizome and rootlets of *Coptis trifolia* Salisbury (Goldthread).

Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of the drug. It is used as a tonic and stimulant.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM CORNUS. N. F.

Fluidextract of Cornus

From the bark of the root of *Cornus Florida* Linné (Dogwood).

Made with glycerin 150 Cc., diluted alcohol 850 Cc., finishing with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a tonic.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM CORNUS CIRCINATÆ. N. F.

Fluidextract of Cornus Circinata

From the bark of *Cornus circinata* L'Héritier (Green Osier).

Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as a tonic and antiperiodic.

Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM CORYDALIS. N. F.

Fluidextract of Corydalis

From the tubers of *Dicentra canadensis* De Candolle (Turkey Corn).

Made with alcohol 3 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an alterative and diuretic.

Average dose: 0.65 Cc. (10 minims).

FLUIDEXTRACTUM COTO. N. F.

Fluidextract of Coto

From Coto bark, derived from an undetermined tree, native of tropical South America.

Made with alcohol 9 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an astringent and tonic.

Average dose: 0.3 Cc. (5 minims).

FLUIDEXTRACTUM FUCI. N. F.

Fluidextract of Fucus

From the thallus of *Fucus vesiculosus* Linné (Bladder-wrack).

Made with alcohol 3 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a remedy for obesity.

Average dose: 0.65 Cc. (10 minims).

FLUIDEXTRACTUM HELIANTHEMI. N. F.

Fluidextract of Helianthemum

From the herb of *Helianthemum canadense* Michaux (Frost-wort).

Made with diluted alcohol, 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as an alterative and astringent.

Average dose: 4 Cc. (1 fluidrachm).

FLUIDEXTRACTUM HUMULI. N. F.

Fluidextract of Hops

From the strobiles of *Humulus Lupulus* Linné (Hops).

Made with alcohol 5 measures, water 3 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a stimulant and sedative.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM HYDRANGEÆ. N. F.

Fluidextract of Hydrangea

From the root of *Hydrangea arborescens* Linné (Seven Barks).

Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic.

Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM JALAPÆ. N. F.

Fluidextract of Jalap

From the tuberous root of *Exogonium Purga* Bentham (Jalap).

Made with alcohol, 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as a cathartic.

Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM JUGLANDIS. N. F.

Fluidextract of Juglans

From the inner bark of the root of *Juglans cinerea* Linné (Butternut).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a cathartic.

Average dose: 4 Cc. (1 fluidrachm).

FLUIDEXTRACTUM JUNIPERI. N. F.

Fluidextract of Juniper

From the fruit of *Juniperus communis* Linné (Juniper).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

FLUIDEXTRACTUM KAVÆ. N. F.

Fluidextract of Kava

From the root of *Piper methysticum* Forster (Kava; Kava-kava; Ava).

Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic and alterative.
Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM MALTI. N. F.

Fluidextract of Malt

This formula does not differ from that of the 2d ed. N. F. It is used as a tonic.
Average dose: 8 Cc. (2 fluidrachms).

FLUIDEXTRACTUM MENYANTHIS. N. F.

Fluidextract of Menyanthes

From the leaves of *Menyanthes trifoliata* Linné (Buckbean.—Trifolium fibrinum *G. P.*)
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an alterative.
Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM PETROSELINI RADICIS. N. F.

Fluidextract of Parsley Root

From the root of *Petroselinum sativum* Hoffmann (Parsley).
Made with diluted alcohol; 1 Cc. of fluidextract representing 1 Gm. of drug. It is used as an emmenagogue and diuretic.
Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM RHAMNI PURSHIANÆ ALKALINUM. N. F.

Bitterless Fluidextract of Cascara Sagrada

This is a new fluidextract in the 3d ed. N. F. It is made from cascara sagrada deprived of its bitterness by treatment with lime; the preparation contains sugar, oil of coriander and oil of anise. It differs from all other fluidextracts in containing no alcohol, and is really a syrup. It is used as a laxative.
Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM STERCULIÆ. N. F.

Fluidextract of Sterculia

From the seeds of *Sterculia acuminata* R. Brown (Cola; Kola).
Made with alcohol 250 Cc., water 685 Cc., glycerin 65 Cc., finishing with alcohol 1 measure, water 3 measures. One Cc. of fluidextract represents 1 Gm. of drug. It is used as a stimulant and nerve tonic.
Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM STILLINGIÆ COMPOSITUM. N. F.

Compound Fluidextract of Stillingia

The formula for this fluidextract has been slightly changed in the 3d ed. N. F., the quantity of coriander being decreased, and that of xanthoxylum berries increased. Made with alcohol 500 Cc., water 250 Cc., glycerin 250 Cc., finishing with diluted alcohol. It contains stillingia, corydalis, iris, sambucus, chimaphila, coriander and xanthoxylum berries. It is used as an alterative.
Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM TRILLII. N. F.

Fluidextract of Trillium

From the rhizome of *Trillium erectum* Linné, and other species of *Trillium* (Bethroot).
Made with alcohol 3 measures, water 2 measures; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an astringent and tonic expectorant.
Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM TURNERÆ. N. F.

Fluidextract of Turnera

From the leaves of *Turnera microphylla* De Candolle, and other species of *Turnera* (Damiana).
Made with alcohol 2 measures, water 1 measure; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an aphrodisiac.
Average dose: 2 Cc. (30 minims).

FLUIDEXTRACTUM URTICÆ. N. F.

Fluidextract of Urtica

From the root of *Urtica dioica* Linné (Nettle).
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic and astringent.
Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM VERBASCI. N. F.

Fluidextract of Verbascum

From the leaves and flowers of *Verbascum Thapsus* Linné (Mullein).
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as an expectorant.
Average dose: 4 Cc. (1 fluidrachm).

FLUIDEXTRACTUM VERBENÆ. N. F.

Fluidextract of Verbena

From the root of *Verbena hastata* Linné (Vervain).
Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a tonic.
Average dose: 1 Cc. (15 minims).

FLUIDEXTRACTUM ZEÆ. N. F.

Fluidextract of Zea

[Extractum Stigmatum Maydis Fluidum, Fluidextract of Corn Silk]

From the stigmata of *Zea Mays* Linné (Indian Corn).

Made with diluted alcohol; 1 Cc. of fluidextract represents 1 Gm. of drug. It is used as a diuretic.

Average dose: 4 Cc. (1 fluidrachm).

GELATINUM CHONDRI. N. F.

Irish Moss Gelatin

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from Irish moss and water, and is used to make a transparent mucilage, and as a substitute for acacia in making emulsions.

GLYCERITUM BISMUTHI. N. F.

Glycerite of Bismuth

The formula for this preparation was entirely changed in the 3d ed. N. F. The glycerite is made from bismuth subnitrate, nitric acid, tartaric acid, sodium bicarbonate, glycerin and distilled water. It contains 16 grains of bismuth and sodium tartrate in 1 fluidrachm of the finished glycerite, and is used in making other N. F. preparations containing bismuth and in the treatment of diarrhœa and gastric diseases.

Average dose: 0.6 Cc. (10 minims).

GLYCERITUM GUAIACI. N. F.

Glycerite of Guaiac

The formula for this glycerite does not differ from that of the 2d ed. N. F. It contains 5 grains of guaiac and about 4 minims of solution of potassium hydroxide in 1 fluidrachm of the finished glycerite. It is used as an alterative.

Average dose: 2 Cc. (30 minims).

GLYCERITUM PEPSINI. N. F.

Glycerite of Pepsin

The formula for this glycerite does not differ from that of the 2d ed. N. F. Five grains of pepsin are represented by 1 fluidrachm of the finished glycerite. It is used as a digestive.

Average dose: 3 Cc. (45 minims).

GLYCERITUM PICIS LIQUIDÆ. N. F.

Glycerite of Tar

The quantity of tar in this glycerite was very slightly reduced in the 3d ed. N. F. It is made from tar, magnesium carbonate, glycerin, alcohol and water. The medicinal virtues of about 4 grains of tar are represented in 1 fluidrachm of the finished glycerite. It is used as an expectorant.

Average dose: 4 Cc. (1 fluidrachm).

GLYCERITUM TRAGACANTHÆ. N. F.

Glycerite of Tragacanth

The formula for this glycerite does not differ from that of the 2d ed. N. F. It is used as an excipient for pills.

GLYCEROGELATINA. N. F.

Glycerogelatins

Glycerogelatins originated with Dr. Unna and are soft masses which melt at the temperature of the body, containing gelatin, glycerin, water and the medicament. They are used in skin diseases. The following were adopted by the 3d ed. N. F.

1. *Glycerogelatinum Acidi Salicylici* (*10 per cent.*). N. F.— 10 per cent. *Salicylic Acid Glycerogelatin.*
2. *Glycerogelatinum Iodoformi* (*10 per cent.*). N. F.—10 per cent. *Iodoform Glycerogelatin.*
3. *Glycerogelatinum Zinci Durum.* N. F. *Firm Zinc Glycerogelatin.*
4. *Glycerogelatinum Zinci Molle.* N. F.—*Soft Zinc Glycerogelatin.*

GOSSYPIUM STYPTICUM. N. F.

Styptic Cotton

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made by impregnating purified cotton with diluted solution of ferric chloride, glycerin and water. Used as an antihemorrhagic.

INFUSUM GENTIANÆ COMPOSITUM FORTIUS. N. F.

Stronger Compound Infusion of Gentian

The formula for this infusion does not differ from that of the 2d ed. N. F., except a slight increase in the proportions of coriander and bitter orange peel. It is used as a tonic, and in making by dilution, compound infusion of gentian.

Average dose: 4 Cc. (1 fluidrachm).

INFUSUM ROSÆ COMPOSITUM. N. F.

Compound Infusion of Rose

The formula for this infusion does not differ from that of the 2d ed. N. F. It is made from red rose, diluted sulphuric acid, sugar and water. It is used as an astringent.

IODOFORMUM AROMATISATUM. N. F.

Aromatized Iodoform [Deodorized Iodoform]

The formula for this preparation does not differ from that of the 2d ed. N. F. It consists of iodoform containing 4 per cent. of cumarin, and is used as an antiseptic and alterative.

LAC FERMENTATUM. N. F.

Fermented Milk [Kumyss]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from fresh cow's milk, yeast and sugar, and is used as a food for invalids.

LAC HUMANISATUM. N. F.

Humanized Milk

This is a new preparation in the 3d ed. N. F. It is made by adding humanizing milk powder to cow's milk, cream and water. Humanizing milk powder contains pancreatin. The milk is used as a food for invalids.

LINIMENTUM ACONITI ET CHLOROFORMI. N. F.

Liniment of Aconite and Chloroform

In the 3d ed. N. F. a smaller proportion of fluidextract of aconite replaces the tincture of aconite of the 2d ed., and alcohol was added to the formula. The quantities of chloroform and soap liniment remain unchanged. It is used externally to relieve pain.

LINIMENTUM AMMONII IODIDI. N. F.

Liniment of Ammonium Iodide

The formula for this liniment does not differ from that of the 2d ed. N. F., except in a slight increase in the proportion of camphor. The liniment is made from iodine, oil of rosemary, oil of lavender, camphor, ammonia water and alcohol. It is used as an external discutient application.

LINIMENTUM IODI. N. F.

Iodine Liniment

This liniment is nearly identical with that of the British Pharmacopœia. It contains 12½ per cent. of iodine, 5 per cent. of potassium iodide, with glycerin, water and alcohol. It is used as an external discutient application.

LINIMENTUM OPII COMPOSITUM. N. F.

Compound Liniment of Opium [Canada Liniment]

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains 10 per cent. of tincture of opium, with camphor, alcohol, oil of peppermint, ammonia water and oil of turpentine. It is used as a stimulating anodyne application.

LINIMENTUM SAPONATO-CAMPHORATUM. N. F.

Camphorated Soap Liniment [Opodeldoc, Solid Opodeldoc]

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains white castile soap, camphor, alcohol, oils of thyme and rosemary and ammonia water. It is a solid preparation used in rheumatism.

LINIMENTUM TEREBINTHINÆ ACETICUM. N. F.

Acetic Turpentine Liniment [Linimentum Album, Stokes' Liniment, St. John Long's Liniment]

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains turpentine, fresh egg, oil of lemon, acetic acid and rose water. It is used as a stimulating external application.

LINIMENTUM TIGLII. N. F.

Liniment of Croton Oil [Linimentum Crotonis, B. P.]

The proportions in the formula for this liniment have been slightly changed. It now contains 16 parts of croton oil, and 54 parts each of alcohol and oil of cajuput. It is used as a counter-irritant.

LINIMENTUM TIGLII COMPOSITUM. N. F.

Compound Croton Oil Liniment

The formula for this preparation does not differ from that of the 2d ed. N. F. The liniment contains 20 per cent. each of croton oil, oil of sassafras, oil of turpentine, with 40 per cent. of olive oil. It is used as a counter-irritant.

LIQUOR ALUMINI ACETATIS. N. F.

Solution of Aluminum Acetate

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from aluminum sulphate, acetic acid, calcium carbonate and water, and contains from 7.5 to 8 per cent. of basic aluminum acetate. It is used externally as an astringent.

LIQUOR ALUMINI ACETICO-TARTRATIS. N. F.

Solution of Aluminum Acetico-Tartrate

The formula for this solution does not differ from that of the 2d ed. N. F.; the solution contains about 50 per cent. of dry so-called aluminum acetico-tartrate. It is made from alum, sodium carbonate, glacial acetic acid and water, and is used externally as an astringent.

LIQUOR AMMONII ACETATIS CONCENTRATUS. N. F.

Concentrated Solution of Ammonium Acetate

The formula for this preparation does not differ from that of the 2d ed. N. F. This solution is about three times stronger than the official solution of ammonium acetate. It is intended to be diluted with carbonic acid water at the time of dispensing.

LIQUOR AMMONII CITRATIS FORTIOR. N. F.

Stronger Solution of Ammonium Citrate

The formula for this solution does not differ from that of the 2d ed. N. F. About 40 grains of ammonium citrate are contained in 1 fluidrachm of the solution. It is intended to be diluted before administration. The Liquor Ammonii Citratis of the British Pharmacopœia may be made by mixing 1 volume of this solution with 4 volumes of water. It is used as a refrigerant and diuretic.

LIQUOR ANTIGERMINARUS. N. F.

" Germicide "

This solution is a new one in the 3d ed. N. F. It contains thymol, oils of eucalyptus and lavender, with alcohol and water. It is used as a germicide.

LIQUOR ANTISEPTICUS ALKALINUS. N. F.

"Alkaline Antiseptic "

This is a new solution in the 3d ed. N. F. It is made from potassium bicarbonate, sodium benzoate, sodium borate, thymol, eucalyptol, oils of peppermint and gaultheria, tincture of cudbear, alcohol, glycerin, purified talc and water. It is used as an alkaline detergent and antiseptic.

LIQUOR AURI ET ARSENI BROMIDI. N. F.

Solution of Bromide of Gold and Arsenic

The formula for this solution does not differ from that of the 2d ed. N. F. About 1–32d of a grain of tribromide of gold and 1–16th of a grain of tribromide of arsenic are contained in 10 minims of this solution. It is used as an alterative.

Average dose: 0.2 Cc. (3 minims).

LIQUOR BISMUTHI. N. F.

Solution of Bismuth [Liquid Bismuth]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from glycerite of bismuth, alcohol and distilled water. About 1 grain of bismuth and ammonium citrate is represented in 1 fluidrachm of the finished solution. It is used as a sedative in gastric diseases.

Average dose: 4 Cc. (1 fluidrachm).

LIQUOR BROMI. N. F.

Solution of Bromine [Smith's Solution of Bromine]

The formula for this solution does not differ from that of the 2d ed. N. F. One hundred Cc. of finished solution contains 25 grains of bromine and 12.5 grains of potassium bromide. It is used as an external application to hospital gangrene and as an antiseptic.

LIQUOR CALCIS SULPHURATÆ. N. F.

Solution of Sulphurated Lime [Solution of Oxysulphuret of Calcium; Vleminck's Solution, or Lotion]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from lime, sublimed sulphur and water. It is used as an external application in skin diseases.

LIQUOR CARMINI. N. F.

Solution of Carmine

The formula for this solution does not differ greatly from that of the 2d ed. N. F. The solution is made from carmine, ammonia water, glycerin and water. It is used as a red coloring solution.

LIQUOR COCCINEUS. N. F.

Cochineal Color

This solution does not differ very greatly from that of the 2d ed. N. F. It is made from cochineal, potassium carbonate, alum, potassium bitartrate, alcohol and water. Like the preceding solution it is used as a red coloring solution.

LIQUOR ELECTROPOEICUS. N. F.

Battery Fluid

The formula for battery fluid does not differ from that of the 2d ed. N. F. As indicated by the name, it is used solely in batteries.

LIQUOR EXTRACTI GLYCYRRHIZÆ. N. F.

Solution of Extract of Glycyrrhiza [Solution of Extract of Licorice]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from purified extract of glycyrrhiza, alcohol, glycerin and water. About 15 grains of dried extract of glycyrrhiza are represented in 1 fluidrachm of finished solution. It is used as a flavoring and sweetening agent.

Average dose: 4 Cc. (1 fluidrachm).

LIQUOR FERRI ALBUMINATI. N. F.

Solution of Albuminate of Iron

This is a new preparation in the 3d ed. N. F. It is made from fresh egg-albumen, solution of ferric oxychloride, alcohol, aromatic elixir, solution of sodium hydroxide and water. About 2-5th of a grain of metallic iron in the form of albuminate is contained in 1 fluidrachm of the finished solution. It is used as a chalybeate.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR FERRI HYPOPHOSPHITIS. N. F.

Solution of Hypophosphite of Iron [Solution of Ferric Hypophosphite]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from ferric ammonium sulphate, sodium hypophosphite, potassium citrate, glycerin and water. About 10 grains of ferric hypophosphite are represented in 1 fluidrachm of finished solution.

Average dose: 1 Cc. (15 minims).

LIQUOR FERRI IODIDI. N. F.

Solution of Ferrous Iodide

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from iron wire, iodine, diluted hypophosphorous acid and distilled water. It contains about 85 per cent. of ferrous iodide. This solution was introduced for making syrup of ferrous iodide by mixing 1 volume with 15 volumes of syrup.

Average dose: 0.15 Cc. (2 minims).

LIQUOR FERRI OXYCHLORIDI. N. F.

Solution of Ferric Oxychloride

This is a new solution taken from the German Pharmacopœia, and intended to be dispensed when *Liquor Ferri Dialysati* is called for. It is made from solution of ferric chloride, ammonia water, hydrochloric acid and water. It contains about 3.5 per cent. of iron as oxychloride, and is used as a chalybeate.

LIQUOR FERRI OXYSULPHATIS. N. F.

Solution of Oxysulphate of Iron

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from ferrous sulphate, nitric acid and distilled water. It is used as a chalybeate.

LIQUOR FERRI PEPTONATI. N. F.

Solution of Peptonate of Iron

This is a new preparation of the 3d ed. N. F. It is made from peptone, solution of ferric oxychloride, alcohol, aromatic elixir, solution of sodium hydroxide and distilled water. It contains about 2–5th of a grain of metallic iron in the form of peptonate in 1 fluidrachm of the finished solution. It is used as a chalybeate.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR FERRI PEPTONATI CUM MANGANO. N. F.

Solution of Peptonate of Iron with Manganese

This is a new solution of the 3d ed. N. F. It is made from ferric peptonate (see Liquor Ferri Peptonati), soluble manganese citrate, ammonia water, aromatic elixir, alcohol and distilled water. It is used as a chalybeate and alterative.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR FERRI PROTOCHLORIDI. N. F.

Solution of Protochloride of Iron [Solution of Ferrous Chloride]

This formula does not differ from that of the 2d ed. N. F. It is made from iron wire, hydrochloric acid, glycerin, diluted hypophosphorous acid and distilled water. About 20 grains of ferrous chloride are represented by 1 fluidrachm of finished solution. It is used as a chalybeate tonic.

Average dose: 0.65 Cc. (10 minims).

LIQUOR HYDRARGYRI ET POTASSII IODIDI. N. F.

Solution of Iodide of Mercury and Potassium [Solution of Potassium Iodohydrargyrate, Channing's Solution]

The formula for this solution does not differ from that of the 2d ed. N. F. It represents about 1 per cent. of red iodide of mercury and 0.8 per cent. of potassium iodide in aqueous solution. It is used as an alterative in the treatment of syphilis.

Average dose: 0.2 Cc. (3 minims).

LIQUOR HYPOPHOSPHITUM. N. F.

Solution of Hypophosphites

The formula for this solution does not differ from that of the 2d ed. N. F., except that hypophosphorous acid replaces citric acid. About 2 grains of calcium hypophosphite, 1½ grains of sodium hypophosphite and 1 grain of potassium hypophosphite are contained in 1 fluidrachm of finished solution. It is used as an alterative and tonic.

Average dose: 4 Cc. (1 fluidrachm).

LIQUOR HYPOPHOSPHITUM COMPOSITUS. N. F.

Compound Solution of Hypophosphites

This is a new solution in the 3d ed. N. F. It is made from calcium, potassium, sodium, ferric, manganese and quinine hypophosphites, strychnine, potassium citrate, hypophosphorous acid, orange flower water, glycerin and distilled water. It is used as an alterative and tonic.

Average dose: 4 Cc. (1 fluidrachm).

LIQUOR IODI CARBOLATUS. N. F.

Carbolized Solution of Iodine

[Boulton's Solution, French Mixture]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from compound solution of iodine, phenol, glycerin and water. It is used externally.

LIQUOR IODI CAUSTICUS. N. F.

Caustic Solution of Iodine

[Iodine Caustic, Churchill's Iodine Caustic]

The formula for this solution does not differ from that of the 2d ed. N. F. It contains iodine, potassium iodide and water. It is used externally as a caustic and counter-irritant.

LIQUOR MAGNESII BROMIDI. N. F.

Solution of Magnesium Bromide

The proportions of the ingredients in this solution do not differ from those in the 2d ed. N. F. The solution is made from magnesium carbonate and diluted hydrobromic acid. About 7½ grains of magnesium bromide are contained in 1 fluidrachm of finished solution. Used as a nervine.

Average dose: 4 Cc. (1 fluidrachm).

LIQUOR MAGNESII SULPHATIS EFFERVESCENS. N. F.

Liquor Magnesiæ Effervescens [Effervescent Solution of Magnesium Sulphate]

The formula for this solution does not differ from that of the 2d ed. N. F. About 360 grains of magnesium sulphate are contained in 12 fluidounces of the finished solution. It is used as a cathartic, like solution of magnesium citrate.

Average dose: The contents of a bottle (about 12 fl. oz.).

LIQUOR MORPHINÆ CITRATIS. N. F.

Solution of Morphine Citrate

The quantities of morphine and citric acid were very slightly increased in this solution in the 3d ed. N. F. It is made from morphine, citric acid, cochineal, alcohol and distilled water. About 2 grains of morphine in the form of citrate are contained in 1 fluidrachm of finished solution. It is used as a sedative.

Dose: 0.32 Cc. (5 minims).

LIQUOR MORPHINÆ HYPODERMICUS. N. F.

Hypodermic Solution of Morphine [Magendie's Solution of Morphine]

This solution of morphine should not be confounded with the U. S. Pharm. (1870) solution of morphine, as it is 16 times as strong. Salicylic acid in small quantity is added in the 3d ed. N. F., to promote solubility. Two grains of morphine sulphate are contained in 1 fluidrachm of the finished solution. Used hypodermically as an anodyne.

Average dose: 0.32 Cc. (5 minims).

LIQUOR PANCREATICUS. N. F.

Pancreatic Solution

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from pancreatin, sodium bicarbonate, glycerin, compound spirit of cardamom, alcohol, purified talc and water. About 1 grain of pancreatin is represented in 1 fluidrachm of the finished solution. It is used as a digestive.

Average dose: 4 Cc. (1 fluidrachm).

LIQUOR PEPSINI. N. F.

Liquid Pepsin

The formula for this solution has been changed in the 3d ed. N. F. It is now made from glycerite of pepsin, hydrochloric acid, glycerin and water. It is used as a digestive.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR PEPSINI AROMATICUS. N. F.

Aromatic Solution of Pepsin [Aromatic Liquid Pepsin]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from pepsin, oils of cinnamon, pimenta and cloves, and alcohol, hydrochloric acid, glycerin and water. About 1 grain of pepsin is represented in 1 fluidrachm of finished solution. It is used as a digestive.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR PHOSPHATUM ACIDUS. N. F.

Acid Solution of Phosphates [Solution of Acid Phosphates]

The title of this preparation in the 2d ed. N. F. was Liquor Acidi Phosphorici Compositus. No change was made in the formula in the 3d ed. It is a solution of acid phosphates made by adding sulphuric acid and water to bone ash, expressing and filtering. It is used as a tonic.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR PHOSPHORI. N. F.

Solution of Phosphorus

[Thompson's Solution of Phosphorus]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made from phosphorus, absolute alcohol, spirit of peppermint and glycerin. About 1–24th of a grain

of phosphorus is contained in 1 fluidrachm of finished solution. It is used as a tonic and stimulant in nervous diseases.

Average dose: 0.65 Cc. (10 minims).

LIQUOR PICIS ALKALINUS. N. F.

Alkaline Solution of Tar

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 25 per cent. of tar and 12.5 per cent. of potassium hydroxide in water. It is used in skin diseases as an external application.

LIQUOR POTASSÆ CHLORINATÆ. N. F.

Solution of Chlorinated Potassa [Liquor Potassæ Chloratæ, Javelle Water]

In the Latin title in the 3d ed. N. F. the word "Chloratæ" was changed to "Chlorinatæ." The formula for this solution does not differ from that of the 2d ed. N. F. It is made from potassium carbonate, chlorinated lime and water. It is used as a disinfectant.

LIQUOR POTASSII ARSENATIS ET BROMIDI. N. F.

Solution of Potassium Arsenate and Bromide [Liquor Arseni Bromidi, Solution of Bromide of Arsenic, Clemens's Solution]

The formula for this solution differs from that of the 2d ed. N. F., the quantity of potassium bicarbonate being increased four-fold. It contains the equivalent of 1 per cent. of arsenic trioxide in the form of potassium arsenate and bromide, in 1 fluidrachm of the finished solution. It is used as an alterative and in the treatment of diabetes.

Average dose: 0.2 Cc. (3 minims).

LIQUOR SACCHARINI. N. F.

Solution of Saccharin

The formula for this solution does not differ from that of the 2d ed. N. F., except that the quantity of sodium bicarbonate is slightly increased in the 3d ed. It is used as a sweetening solution.

LIQUOR SERIPARUS. N. F.

Liquid Rennet

The formula for this solution does not differ from that of the 2d ed. N. F., except a slight variation in the proportion of alcohol and water. It is used to coagulate milk.

LIQUOR SODII ARSENATIS, PEARSON. N. F.

Pearson's Solution of Sodium Arsenate

The formula for this solution does not differ from that of the 2d ed. N. F. This preparation should not be confounded with the Liquor Sodii Arsenatis, U. S. P., which is ten times stronger than Pearson's Solution. It contains about 1–6th per cent. of crystallized sodium arsenate or about 1–10th per cent. of anhydrous sodium arsenate. Whenever it is prescribed or dispensed, the name "Pearson" should be specified, to avoid serious mistakes. It is used as an alterative.

Average dose: 0.2 Cc. (3 minims).

LIQUOR SODII BORATIS COMPOSITUS. N. F.

Compound Solution of Sodium Borate [Dobell's Solution]

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 1.5 per cent. each of sodium borate and sodium bicarbonate and 0.3 per cent. of phenol, with glycerin and water. It is an alkaline, antiseptic solution, to be used externally.

LIQUOR SODII CARBOLATIS. N. F.

Solution of Sodium Carbolate

The formula for this solution does not differ from that of the 2d ed. N. F. It contains 50 per cent. of phenol in combination with 3.5 per cent. of sodium hydroxide and water. It is used externally as an antiseptic. It is not to be confounded with the proprietary preparation known as "phénol sodique."

LIQUOR SODII CITRATIS. N. F.

Solution of Sodium Citrate [Mistura Sodii Citratis, Saturatio, Potio Riveri, G. P.]

The formula for this solution does not differ from that of the 2d ed. N. F. It is made with 2 per cent. of citric acid and 2.5 per cent. of sodium bicarbonate in water. Used in febrile diseases.

Average dose: 8 Cc. (2 fluidrachms).

LIQUOR SODII CITRO-TARTRATIS EFFERVESCENS. N. F.

Effervescent Solution of Sodium Citro-Tartrate [Tartro-Citric Lemonade]

The formula for this solution does not differ from that of the 2d ed. N. F., except that the proportion of water is slightly increased. It is made from sodium bicarbonate, tartaric acid, citric acid, syrup of citric acid and water. Used as a laxative.

Average dose: The contents of a bottle (containing about 12 fl. oz.).

LIQUOR SODII OLEATIS. N. F.

Solution of Sodium Oleate

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about

6.25 per cent. of white castile soap dissolved in water. It is used in the preparation of oleates.

LIQUOR STRYCHNINÆ ACETATIS. N. F.

Solution of Strychnine Acetate

[Hall's Solution of Strychnine]

The formula for this solution does not differ from that of the 2d ed. N. F. This preparation should not be confounded with the Liquor Strychninæ Hydrochloridi of the British Pharmacopœia, which is much stronger. Solution of strychnine acetate is made from strychnine acetate, diluted acetic acid, alcohol, compound tincture of cardamom and water. About $\frac{1}{8}$ of a grain of strychnine acetate is contained in 1 fluidrachm of the finished solution. It is used as a cardiac stimulant and tonic.

Average dose: 0.6 Cc. (10 minims).

LIQUOR ZINCI ET ALUMINI COMPOSITUS. N. F.

Compound Solution of Zinc and Aluminum

The formula for this solution does not differ from that of the 2d ed. N. F. It contains about 20 per cent. of zinc sulphate and aluminum sulphate, with betanaphthol, oil of thyme and water. It is used externally as an astringent and disinfectant.

LIQUOR ZINCI ET FERRI COMPOSITUS. N. F.

Compound Solution of Zinc and Iron

[Deodorant Solution]

The formula for this solution does not differ from that of the 2d ed. N. F., except in the replacing of diluted hypophosphorous acid by 30 per cent. hypophosphorous acid. It contains 20 per cent. each of zinc sulphate and ferrous sulphate, 6.5 per cent. of copper sulphate, with betanaphthol, oil of thyme, hypophosphorous acid and water. It is used as an antiseptic and astringent solution.

LIQUOR ZINGIBERIS. N. F.

Solution of Ginger

[Soluble Essence of Ginger]

The formula for this solution does not differ from that of the 2d ed. N. F. It is an aqueous solution of ginger made from 33.5 per cent. of fluidextract of ginger, 10 per cent. of powdered pumice, and water. Intended to mix with water or syrup without precipitation.

Average dose: 3 Cc. (45 minims).

LOTIO ADSTRINGENS. N. F.

Astringent Lotion [Warren's Styptic]

The formula for this lotion does not differ from that of the 2d ed. N. F. It contains about 38 per cent. of sulphuric acid, 31 per cent. each of oil of turpentine and alcohol. It is used as an astringent and styptic.

LOTIO FLAVA. N. F.

Yellow Lotion

[Yellow Wash, Aqua Phagedænica Flava]

The formula for this lotion does not differ from that of the 2d ed. N. F. It contains about 0.3 per cent. of corrosive mercuric chloride in lime water slightly diluted with water. It is used externally in skin diseases.

LOTIO NIGRA. N. F.

Black Lotion

[Black Wash, Aqua Phagedænica Nigra]

In this lotion the proportion of mild mercurous chloride was increased in the 3d ed. N. F. It contains now 0.875 per cent. (formerly 0.75 per cent.) of mild mercurous chloride in lime water slightly diluted with water. It is used externally in skin diseases.

LOTIO PLUMBI ET OPII. N. F.

Lotion of Lead and Opium

[Lead and Opium Wash]

The formula for this lotion does not differ from that of the 2d ed. N. F. It contains 1.75 per cent. of lead acetate and 3.5 per cent. of tincture of opium in water. It is used as an astringent and sedative external application.

MAGMA MAGNESIÆ. N. F.

Magnesia Magma [Milk of Magnesia]

This is a new preparation in the 3d ed. N. F. It is made from magnesium sulphate, sodium hydroxide and water. About 3 grains of magnesium hydroxide are represented by 1 fluidrachm of the magma. It is used as an antacid.

Average dose: 8 Cc. (2 fluidrachms).

MISTURA ACACIÆ. N. F.

Mixture of Acacia

[Mixtura Gummosa, G. P. *I.*]

The formula for this preparation does not differ from that of the 2d ed. N. F. It contains 7.5 per cent. each of acacia and sugar in water. It is used as a demulcent.

MISTURA ADSTRINGENS ET ESCHAROTICA. N. F.

Astringent and Escharotic Mixture

[Villate's Solution]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from solution of lead subacetate, copper sulphate, zinc sulphate and diluted acetic acid.

The solution is filtered from the precipitated lead sulphate. It is used externally as an astringent and escharotic.

MISTURA AMMONII CHLORIDI. N. F.

Mixture of Ammonium Chloride

[Mistura, or Mixtura, Solvens Simplex]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 2.5 per cent. each of ammonium chloride and purified extract of glycyrrhiza in water. It is used as an expectorant.

Average dose: 8 Cc. (2 fluidrachms).

MISTURA CAMPHORÆ ACIDA. N. F.

Acid Camphor Mixture

[Mistura Antidysenterica, Hope's Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 1.75 per cent. of nitric acid, 1.2 per cent. of tincture of opium in camphor water It is used as an antispasmodic and astringent.

Average dose: 8 Cc. (2 fluidrachms).

MISTURA CAMPHORÆ AROMATICA. N. F.

Aromatic Camphor Mixture [Parrish's Camphor Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 25 per cent. of compound tincture of lavender, 3.5 per cent. of sugar, and camphor water. It is used in diarrhœa as a carminative

Average dose: 8 Cc. (2 fluidrachms).

MISTURA CARMINATIVA. N. F.

Carminative Mixture [Dalby's Carminative]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from magnesium carbonate, potassium carbonate, tincture of opium, oils of caraway, fennel and peppermint, with syrup and water. About $\frac{1}{8}$ of a grain of opium is represented in 1 fluidrachm of the finished mixture. It is used as a carminative.

Average dose: Infants, 0.5 Cc. (8 minims).

MISTURA CHLORALI ET POTASSII BROMIDI COMPOSITA. N. F.

"Chloral and Bromide Compound"

The formula for this mixture differs from that of the 2d ed. N. F. in the reduction of the quantities of hydrated chloral and potassium bromide, the omission of tincture of quillaja and alcohol, and the introduction of powdered pumice, in order to make a more satisfactory solution. About 12 grains each of hydrated chloral and potassium bromide, and $\frac{1}{8}$ grain each of the extracts of Indian cannabis and hyoscyamus are represented in 1 fluidrachm of the finished mixture. It is used as a sedative and hypnotic.

Average dose: 4 Cc. (1 fluidrachm).

MISTURA CHLOROFORMI ET CANNABIS INDICÆ COMPOSITA. N. F.

Compound Mixture of Chloroform and Cannabis Indica [Chloroform Anodyne]

The proportions of tinctures of Indian cannabis and capsicum were materially reduced in the 3d ed. N. F., and ether somewhat increased. It contains chloroform, ether, tincture of Indian cannabis, tincture of capsicum, morphine sulphate, oil of peppermint, glycerin, water and alcohol. About $7\frac{1}{2}$ minims of chloroform, 11 minims of tincture of Indian cannabis, 2 minims of tincture of capsicum, 1–7th of a grain of morphine sulphate, are represented in 1 fluidrachm of the finished mixture. It is used in diarrhœa and cholera.

Average dose: 2 Cc. (30 minims).

MISTURÆ CONTRA DIARRHŒAM. N. F.

Diarrhœa Mixtures

1. *Cholera Mixture. "Sun Mixture."*—This mixture contains tincture of opium, tincture of capsicum, tincture of rhubarb, spirit of camphor, spirit of peppermint and alcohol.

Average dose: 2 Cc. (30 minims).

2. *Squibb's Diarrhœa Mixture.*—This mixture contains tinctures of opium and capsicum, spirit of camphor, chloroform and alcohol.

Average dose: 2 Cc. (30 minims).

3. *Loomis's Diarrhœa Mixture.*—This mixture contains tinctures of opium and rhubarb, compound tincture of gambir, oil of sassafras and compound tincture of lavender.

Average dose: 2 Cc. (30 minims).

4. *Thielmann's Diarrhœa Mixture.*—This mixture contains wine of opium, tincture of valerian, ether, oil of peppermint, fluidextract of ipecac and alcohol.

Average dose: 2 Cc. (30 minims).

5. *Velpeau's Diarrhœa Mixture.*—This mixture contains camphor, tincture of opium, and compound tincture of gambir.

Average dose: 2 Cc. (30 minims).

MISTURÆ COPAIBÆ. N. F.

Copaiba Mixtures

In the 3d ed. N. F. the word "composita" in the Latin title and the word "compound" in the English name as found in the 2d ed. N. F. does not appear.

1. *Lafayette Mixture.*—The quantities of solution of potassium hydroxide and syrup were slightly decreased in the 3d ed. N. F. in this mixture, and mucilage of acacia substituted for mucilage of dextrin. The mixture contains copaiba, spirit of nitrous ether, compound tinc-

ture of lavender, solution of potassium hydroxide, syrup, and mucilage of acacia. It is used in the treatment of gonorrhœa.

Average dose: 8 Cc. (2 fluidrachms).

2. *Chapman's Mixture.*—The quantity of tincture of opium was slightly increased (from 30 to 32 Cc.) in the 3d ed. N. F. This mixture contains copaiba, spirit of nitrous ether, compound tincture of lavender, tincture of opium, mucilage of acacia and water. Used in the treatment of gonorrhœa.

Average dose: 4 Cc. (1 fluidrachm).

MISTURA GUAIACI. N. F.

Mixture of Guaiac

The formula for this mixture does not differ from that of the 2d ed. N. F.; it contains 2.5 per cent. each of guaiac and sugar, with acacia and cinnamon water. It is used in the treatment of rheumatism.

Average dose: 16 Cc. (4 fluidrachms).

MISTURA OLEI PICIS. N. F.

Mixture of Oil of Tar
[Mistura Picis Liquidæ, Tar Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains purified extract of glycyrrhiza, oil of tar, sugar, chloroform, oil of peppermint, alcohol, and water. It is used as an expectorant.

Average dose: 8 Cc. (2 fluidrachms).

MISTURA OLEO-BALSAMICA. N. F.

Oleo-balsamic Mixture [Mixtura Oleoso-balsamica, G. P.; Balsamum Vitæ Hoffmanni]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains the oils of lavender, thyme, lemon, nutmeg, orange flowers, cloves and cinnamon, with balsam of Peru and alcohol. It is used as a stimulant and carminative.

MISTURA PECTORALIS, STOKES. N. F.

[Stokes's Expectorant]

The name of this mixture was changed in the 3d ed. N. F.; it was formerly Mistura Expectorans, Stokes. Ammonia water has been added to the formula, and the quantity of water decreased. It is made from ammonium carbonate, the fluidextracts of senega and squill, camphorated tincture of opium, ammonia water, water and syrup of tolu. It is used as an expectorant.

Average dose: 4 Cc. (1 fluidrachm).

MISTURA RHEI COMPOSITA. N. F.

Compound Mixture of Rhubarb
[Squibb's Rhubarb Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of rhubarb and ipecac, sodium bicarbonate, glycerin and peppermint water. It is used as an antacid and laxative.

Average dose: 8 Cc. (2 fluidrachms).

MISTURA SASSAFRAS ET OPII. N. F.

Mixture of Sassafras and Opium
[Mistura Opii Alkalina, Godfrey's Cordial]

The formula for this mixture does not differ from that of the 2d ed. N. F. About 2 minims of tincture of opium are contained in 1 fluidrachm of the finished mixture. It is used as a carminative.

Average dose: Infants, 0.65 Cc. (10 minims).

MISTURA SODÆ ET MENTHÆ. N. F.

Mixture of Soda and Spearmint
[Soda Mint]

The formula for this mixture does not differ from that of the 2d ed. N. F.; it contains 5 per cent. of sodium bicarbonate, with aromatic spirit of ammonia and spearmint water. It is antacid and carminative.

Average dose: 8 Cc. (2 fluidrachms).

MISTURA SPLENETICA. N. F.

Splenetic Mixture
[Spleen Mixture, Gadberry's Mixture]

The formula for this mixture does not differ from that of the 2d ed. N. F. It is made from ferrous sulphate, quinine sulphate, nitric acid, potassium nitrate and water. It is used in malarial fever as an antiperiodic.

Average dose: 4 Cc. (1 fluidrachm).

MISTURA SULPHURICA ACIDA. N. F.

Sulphuric Acid Mixture [Mixtura Sulphurica Acida, G. P.; Haller's Acid Elixir]

The formula for this mixture does not differ from that of the 2d ed. N. F. It contains 25 per cent. of sulphuric acid in alcohol. It is an antihidrotic and astringent mixture.

Average dose: 0.5 Cc. (8 minims).

MUCILAGO CHONDRI. N. F.

Mucilage of Irish Moss

The formula for this mucilage does not differ from that of the 2d ed. N. F. It contains 3 per cent. of Irish moss in water. It is used as an emulsifying agent and demulcent.

MUCILAGO DEXTRINI. N. F

Mucilage of Dextrin

The formula for this mucilage does not differ from that of the 2d ed. N. F. It consists of 33.5 per cent. of dextrin in water, and is used in preparing emulsions.

MUCILAGO SALEP. N. F.

Mucilage of Salep

The formula for this mucilage does not differ from that of the 2d ed. N. F. It contains about 1 per cent. of powdered salep in water. It is used as a demulcent.

OLEA INFUSA. N. F.

Infused Oils

The formula for these is a general one. The infused oils are made from the dried herb, alcohol, ammonia water, lard oil and cotton seed oil.

OLEATUM ACONITINÆ. N. F.

Oleate of Aconitine

The formula for this oleate does not differ from that of the 2d ed. N. F. It is a solution of 2 per cent. of aconitine in oleic acid. It should be used with care in the external treatment of neuralgia.

OLEATUM ZINCI. N. F.

Zinc Oleate

The formula for this oleate does not differ from that of the 2d ed. N. F. It is a powder made from crystallized zinc acetate, solution of sodium oleate and water. Used externally as an astringent.

OLEOSACCHARA. N. F.

Oil-Sugars [Elæosacchara, G. P.]

The general formula for this class of preparations does not differ from that of the 2d ed. N. F. Oil-sugars are made by triturating volatile oils with sugar, and are used as vehicles.

OLEUM CARBOLATUM. N. F.

Carbolized Oil

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made by dissolving 5 per cent. of phenol in cotton seed oil. Used externally.

OLEUM HYOSCYAMI COMPOSITUM. N. F.

Compound Oil of Hyoscyamus
[Balsamum Tranquillans]

The formula for this oil does not differ from that of the 2d ed. N. F. It is made from the oils of absinth, lavender, rosemary, sage and thyme, with infused oil of hyoscyamus. It is used as an anodyne.

OXYMEL SCILLÆ. N. F.

Oxymel of Squill

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from 1 part of vinegar of squill and two parts of honey. Used as an expectorant.

Average dose: 4 Cc. (1 fluidrachm).

PASTÆ DERMATOLOGICÆ. N. F.

Dermatologic Pastes

Under this head are included formulas for seven dermatological pastes, which are new preparations in the 3d ed. N. F. They are as follows:

1. *Pasta Dextrinata. "Dextrinated Paste."* This is made from dextrin, glycerin and distilled water. Used as a vehicle.

2. *Pasta Ichthyoli, Unna. "Unna's Ichthyol Paste."*—This is made from ammonium ichthyolsulphonate and dextrinated paste. Used in skin diseases.

3. *Pasta Naphtholi, Lassar. "Lassar's Naphthol Paste."*—This is made from betanaphthol, precipitated sulphur, petrolatum and soft soap.

4. *Pasta Resorcini Mitis, Lassar. "Lassar's Mild Resorcin Paste."*—This is made from resorcinol, zinc oxide, starch and liquid petrolatum.

5. *Pasta Zinci, Lassar. "Lassar's Zinc-Salicyl Paste."*—This is made from salicylic acid, zinc oxide, starch and white petrolatum.

6. *Pasta Zinci Mollis, Unna. "Unna's Soft Zinc Paste."*—This is made from zinc oxide, calcium carbonate, linseed oil and lime water.

7. *Pasta Zinci Sulfurata, Unna. "Unna's Sulphurated Zinc Paste."*—This is made from zinc oxide, precipitated sulphur, silicic acid and benzoinated lard.

PEPSINUM AROMATICUM. N. F.

Aromatic Pepsin

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from saccharated pepsin (U. S. P. 1890), aromatic fluidextract, tartaric acid and sodium chloride. It is used for indigestion.

Average dose: 2 Gm. (30 grains).

PETROLATUM SAPONATUM LIQUIDUM. N. F.

Liquid Saponated Petrolatum
["Liquid Petrox"]

This is a new preparation in the 3d ed. N. F. It is made from liquid petrolatum, oleic acid and spirit of ammonia, and is used as a vehicle for external application.

PETROLATUM SAPONATUM SPISSUM. N. F.

Solid Saponated Petrolatum ["Solid Petrox"]

This is a new preparation in the 3d ed. N. F. It is made from petrolatum, oleic acid and spirit of ammonia, and is used as a vehicle for ointments.

PILULÆ AD PRANDIUM. N. F.

Dinner Pills

1.—The 3d ed. N. F. recommends that when dinner pills are prescribed, the official pills of aloes and mastic should be dispensed.

Dose of dinner pills, 1 or 2.

2. *Chapman's Dinner Pill.*—The formula for this pill does not differ from that of the 2d ed. N. F. Each pill contains 1½ grains of purified aloes, 1½ grains of mastic, 1 grain of ipecac and about ¼ minim of oil of fennel.

3. *Cole's Dinner Pill.*—The formula for this pill does not differ from that of the 2d ed. N. F. Each pill contains 1 and ½ of a grain each of purified aloes, mass of mercury, and jalap and 1-50th of a grain of antimony and potassium tartrate.

4. *Hall's Dinner Pill.*—The formula for this pill does not differ from that of the 2d ed. N. F. Each pill contains 1 grain each of purified aloes, extract of glycyrrhiza, soap, and molasses.

PILULÆ ALOES ET PODOPHYLLI COMPOSITÆ. N. F.

Compound Pills of Aloes and Podophyllum [Janeway's Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of purified aloes, ½ grain resin of podophyllum, ¼ grain of extract of belladonna leaves, and ¼ of a grain of extract of nux vomica. They are used as a laxative.

PILULÆ ALOINI COMPOSITÆ. N. F.

Compound Pills of Aloin

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ½ grain of aloin, ⅛ grain of resin of podophyllum, ¼ grain of extract of belladonna leaves. Cathartic.

PILULÆ ALOINI, STRYCHNINÆ ET BELLADONNÆ. N. F.

Pills of Aloin, Strychnine and Belladonna

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ½ grain of aloin, 1–120th grain of strychnine, and ⅛ grain of extract of belladonna leaves. Used as a laxative and tonic.

PILULÆ ALOINI, STRYCHNINÆ ET BELLADONNÆ COMPOSITÆ. N. F.

Compound Pills of Aloin, Strychnine and Belladonna

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ½ grain of aloin, 1–120th grain of strychnine, ⅛ grain of extract of belladonna leaves, and ½ grain of extract of cascara sagrada. Used as a tonic and laxative.

PILULÆ ANTIDYSPEPTICÆ. N. F.

Antidyspeptic Pills

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1–40th grain of strychnine, 1–10th grain of ipecac, 1–10th grain of extract of belladonna leaves, 2 grains of mass of mercury, and 2 grains of compound extract of colocynth. Used as a cholagogue and tonic.

PILULÆ ANTINEURALGICÆ. N. F.

Antineuralgic Pills

1. *Gross' Antineuralgic Pills.*—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 2 grains of quinine sulphate, 1–20th grain of morphine sulphate, 1–30th grain of strychnine, 1–20th grain of arsenic trioxide, and ½ grain of extract of aconite leaves (U. S. P. 1870). Used for neuralgia.

2. *Brown Séquard's Antineuralgic* (or *Neuralgia*) *Pills.*—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains ⅔ grain of extract of hyoscyamus, ⅔ grain of extract of conium, ½ grain of extract of ignatia (U. S. P. 1870), ½ grain of extract of opium, ⅓ grain of extract of aconite leaves (U. S. P. 1870), ¼ grain of extract of Indian cannabis, ⅓ grain of extract of stramonium, and 1–6th grain of extract of belladonna leaves. Used in neuralgia.

PILULÆ ANTIPERIODICÆ. N. F.

Antiperiodic Pills [Warburg's Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of extract of aloes, ½ grain of rhubarb, ½ grain of angelica seed, ¼ grain of elecampane, ¼ grain of saffron, ¼ grain of fennel, ⅓ grain of zedoary root, ⅓ grain of cubebs, ⅓ grain of myrrh, ⅓ grain of white agaric, ⅓ grain of camphor, 1 and 2-5th grains of quinine sulphate, with a sufficient quantity of extract of gentian to form a mass.

Warburg's Pills without aloes have the same composition, except that the extract of aloes is omitted. Used as an antiperiodic.

Dose, 1 to 3 pills one to three times daily.

PILULÆ COLOCYNTHIDIS COMPOSITÆ. N. F.

Compound Pills of Colocynth [Pilulæ Cocciæ, Cochia Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1–6th grain of extract of colocynth, 2 grains of purified aloes, 2 grains of resin of scammony and ¼ minim of oil of cloves. Used as a cathartic.

PILULÆ COLOCYNTHIDIS ET HYOSCYAMI. N. F.

Pills of Colocynth and Hyoscyamus

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1–10th grain of extract of colocynth, 1½ grains of purified aloes, 1½ grains of resin of scammony, 1–6th minim of oil of cloves, and 1½ grains of extract of hyoscyamus. Used as a cathartic.

PILULÆ COLOCYNTHIDIS ET PODOPHYLLI. N. F.

Pills of Colocynth and Podophyllum

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 2½ grains of compound extract of colocynth, and ¼ grain of resin of podophyllum. Used as a cathartic.

PILULÆ GLONOINI. N. F.

Pills of Glonoin [Pills of Nitroglycerin]

The formula for these pills does not differ from that of the 2d ed. N. F. They are made from spirit of glyceryl trinitrate, althæa and confection of rose. Each pill contains 1–100th grain of nitroglycerin. Used as a cardiac stimulant.

PILULÆ LAXATIVÆ POST PARTUM. N. F.

Laxative Pills after Confinement [Barker's Post Partum Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1⅔ grains of compound extract of colocynth, 5–6th grain of purified aloes, 5–12th grain of extract of nux vomica, 1–12th grain of resin of podophyllum, 1–12th grain of ipecac, and 1¼ grains of extract of hyoscyamus. Used as a cathartic.

PILULÆ METALLORUM. N. F.

Metallic Pills [Pilulæ Metallorum Amaræ, Bitter Metallic Pills]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of reduced iron, 1 grain of quinine sulphate, 1–20th grain of strychnine, and 1–20th grain of arsenic trioxide. Used as a tonic.

Aitken's Tonic Pills are somewhat weaker, each pill containing ⅔ grain of reduced iron, 1 grain of quinine sulphate, 1–50th grain of strychnine, and 1–50th grain of arsenic trioxide. Used as a tonic.

PILULÆ OPII ET CAMPHORÆ. N. F.

Pills of Opium and Camphor

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of powdered opium and 2 grains of camphor. Used as an anodyne and astringent.

PILULÆ OPII ET PLUMBI. N. F.

Pills of Opium and Lead

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain of powdered opium and 1 grain of lead acetate. Used as an anodyne and astringent.

PILULÆ QUADRUPLICES. N. F.

Quadruplex Pills [Quatuor Pills, Pilulæ Ferri et Quininæ Compositæ]

The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 1 grain each of dried ferrous sulphate, quinine sulphate, purified aloes, with ¼ grain of extract of nux vomica, and sufficient extract of gentian to form a mass. Used as a tonic and laxative.

PILULÆ TRIPLICES. N. F.

Triplex Pills [Pilula Triplex]

1.—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 2 grains of purified aloes, 1 grain of mass of mercury and ¼ grain of resin of podophyllum. Used as a cathartic and cholagogue.

2. *Francis' Triplex Pill.*—The formula for these pills does not differ from that of the 2d ed. N. F. Each pill contains 5–6th grain of purified aloes, 5–6th grain of scammony, 5–6th grain of mass of mercury, 1–20th minim of croton oil, ¼ minim of oil of caraway, and sufficient tincture of aloes and myrrh to form a mass. Used as a cathartic.

PULVIS ACACIÆ COMPOSITUS N. F.

Compound Powder of Acacia [Pulvis Gummosus, G. P.]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains

50 per cent. of powdered acacia, 34 per cent. of powdered glycyrrhiza, and 16 per cent. of powdered sugar.

PULVIS ALOES ET CANELLÆ. N. F.

Powder of Aloes and Canella ["Hiera Picra"]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 80 per cent. of purified aloes and 20 per cent. of powdered canella. It is used as an emmenagogue and laxative.

Average dose: 1 Gm. (15 grains).

PULVIS AMYGDALÆ COMPOSITUS. N. F.

Compound Powder of Almond

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 60 per cent. of sweet almond, 30 per cent. of powdered sugar and 10 per cent. of powdered acacia. It is used for extemporaneously preparing emulsion of almond.

PULVIS ANTICATARRHALIS. N. F.

Catarrh Powder [Catarrh Snuff]

The formula for this powder does not differ from that of the 2d ed. N. F. It contains 75 grammes of bismuth subnitrate, 25 grammes of powdered acacia and 0.41 gramme of morphine hydrochloride. It is used for catarrh.

PULVIS ANTISEPTICUS. N. F.

Soluble Antiseptic Powder [Pulvis Antisepticus Solubilis]

This is a new preparation in the 3d ed. N. F. It contains salicylic acid, phenol, eucalyptol, menthol, thymol, zinc sulphate and powdered boric acid. It is used as a dusting powder.

PULVIS CATECHU COMPOSITUS. N. F.

Compound Powder of Catechu

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 40 per cent. of powdered gambir, 20 per cent. of powdered kino, 20 per cent. of powdered krameria, 10 per cent. of powdered cinnamon, and 10 per cent. of powdered nutmeg. It is used in diarrhœa.

Average dose: 1.30 Gm. (20 grains).

PULVIS CRETÆ AROMATICUS. N. F.

Aromatic Powder of Chalk

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 8 per cent. of cinnamon, 6 per cent. each of saffron and nutmeg, 3 per cent. of cloves, 2 per cent. of cardamom, 23 per cent. of prepared chalk and 52 per cent. of sugar. It is used in diarrhœa.

Average dose: 2 Gm. (30 grains).

PULVIS CRETÆ AROMATICUS CUM OPIO. N. F.

Aromatic Powder of Chalk with Opium

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. One grain of powdered opium and 39 grains of aromatic powder of chalk are contained in 40 grains of this preparation. It is used as a sedative and astringent.

Average dose: 1 Gm. (15 grains).

PULVIS FERRI ET QUININÆ CITRATIS EFFERVESCENS. N. F.

Effervescent Powder of Citrate of Iron and Quinine [Effervescent Citrate of Iron and Quinine]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from soluble citrate of iron and quinine, saccharated sodium bicarbonate and saccharated tartaric acid. About 1 grain of soluble citrate of iron and quinine is represented by 90 grains of the powder. It is used as a chalybeate and tonic.

Average dose: 6 Gm. (90 grains).

PULVIS FERRI PHOSPHATIS EFFERVESCENS. N. F.

Effervescent Powder of Ferric Phosphate [Effervescent Phosphate of Iron]

The formula for this powder does not differ from that of the 2d ed. N. F., except that the word "soluble" is now added to the words ferric phosphate, and in the substitution of parts for grammes. It contains soluble ferric phosphate, saccharated sodium bicarbonate and saccharated tartaric acid. About 2 grains of soluble ferric phosphate are contained in 90 grains of the powder. Used as a chalybeate.

Average dose: 6 Gm. (90 grains).

PULVIS HYDRARGYRI CHLORIDI MITIS ET JALAPÆ. N. F.

Powder of Mild Chloride of Mercury and Jalap [Calomel and Jalap]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains

34 per cent. of mild chloride of mercury and 66 per cent. of jalap. It is cathartic and cholagogue.

Average dose: 0.65 Gm. (10 grains).

PULVIS IODOFORMI COMPOSITUS. N. F.

Compound Powder of Iodoform
[" Naphthalin Iodoform "]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 20 per cent. of powdered iodoform, 30 per cent. of powdered boric acid, 50 per cent. of powdered naphthalene, with a little oil of bergamot. Used as an antiseptic.

PULVIS KINO COMPOSITUS. N. F.

Compound Powder of Kino

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 75 per cent. of powdered kino, 5 per cent. of powdered opium and 20 per cent. of powdered cinnamon. Used as an astringent.

Average dose: 1 Gm. (15 grains).

PULVIS MYRICÆ COMPOSITUS. N. F.

Compound Powder of Bayberry
[Composition Powder]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 60 per cent. of bayberry bark, 30 per cent. of ginger, 5 per cent. of capsicum and 5 per cent. of cloves. It is used as a carminative and stimulant.

Average dose: 1 Gm. (15 grains).

PULVIS PANCREATICUS COMPOSITUS. N. F.

Compound Pancreatic Powder
[Peptonizing Powder]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 20 per cent. of pancreatin and 80 per cent. of sodium bicarbonate. Twenty-five grains of this powder are sufficient to peptonize 1 pint of fresh cow's milk. Used as a digestive.

PULVIS PEPSINI COMPOSITUS. N. F.

Compound Powder of Pepsin
[Pulvis Digestivus]

The formula for this powder does not differ from that of the 2d ed. N. F. It contains saccharated pepsin, pancreatin, diastase, lactic acid, hydrochloric acid and sugar of milk. Used as a digestive.

Average dose: 1 Gm. (15 grains).

PULVIS POTASSII BROMIDI EFFERVESCENS. N. F.

Effervescent Powder of Potassium Bromide
[Effervescent Potassium Bromide]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains potassium bromide, saccharated sodium bicarbonate and saccharated tartaric acid. About 10 grains of potassium bromide are contained in 90 grains of finished powder. It is used as a nerve sedative.

Average dose: 6 Gm. (90 grains).

PULVIS POTASSII BROMIDI EFFERVESCENS CUM CAFFEINA. N. F.

Effervescent Powder of Potassium Bromide with Caffeine [Effervescent Potassium Bromide with Caffeine]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains potassium bromide, caffeine, saccharated sodium bicarbonate, saccharated tartaric acid. About 10 grains of potassium bromide and 1 grain of caffeine are contained in 90 grains of the finished powder. Used as a nerve sedative.

Average dose: 6 Gm. (90 grains).

PULVIS PRO LACTE HUMANISATO. N. F.

Humanizing Milk Powder [" Milk Powder "]

This is a new powder in the 3d ed. N. F. It contains 3.5 per cent. of compound pancreatic powder and 96.5 per cent. of powdered sugar of milk. This powder is intended to be used in preparing humanized milk.

PULVIS RHEI ET MAGNESIÆ ANISATUS. N. F.

Anisated Powder of Rhubarb and Magnesia
[Compound Anise Powder]

The formula for this powder does not differ from that of the 2d ed. N. F. It contains 35 per cent. of powdered rhubarb and 65 per cent. of heavy magnesia, with oil of anise and alcohol. It is laxative and carminative.

Average dose: Infants, 0.3 Gm. (5 grains).

PULVIS SALIS CAROLINI FACTITII EFFERVESCENS. N. F.

Effervescent Powder of Artificial Carlsbad Salt [Effervescent Artificial Carlsbad Salt]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Carlsbad salt, saccharated sodium bicarbonate and saccharated tartaric acid. Ninety

grains of this powder dissolved in 6 fluidounces of water represents an equal volume of Carlsbad water (Sprudel). Used as a laxative.

Average dose: 6 Gm. (90 grains).

PULVIS SALIS KISSINGENSIS FACTITII EFFERVESCENS. N. F.

Effervescent Powder of Artificial Kissingen Salt [Effervescent Artificial Kissingen Salt]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Kissingen salt, saccharated sodium bicarbonate, and saccharated tartaric acid. Eighty grains of this powder dissolved in 6 fluidounces of water represents an equal volume of Kissingen water (Rakoczi). It is an alterative.

Average dose: 5.5 Gm. (80 grains).

PULVIS SALIS VICHYANI FACTITII EFFERVESCENS. N. F.

Effervescent Powder of Artificial Vichy Salt [Effervescent Artificial Vichy Salt]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Vichy salt, saccharated sodium bicarbonate and saccharated tartaric acid. Fifty-seven grains of this powder dissolved in 6 fluidounces of water represents an equal volume of Vichy water (Grande Grille). It is an antacid.

Average dose: 3.75 Gm. (57 grains).

PULVIS SALIS VICHYANI FACTITII EFFERVESCENS CUM LITHIO. N. F.

Effervescent Powder of Artificial Vichy Salt with Lithium [Effervescent Artificial Vichy Salt with Lithium]

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains artificial Vichy salt, lithium citrate, saccharated sodium bicarbonate and saccharated tartaric acid. Ninety grains of this powder represent about 14 grains of artificial Vichy salt and 5 grains of lithium citrate. It is antacid and antilithic.

Average dose: 6 Gm. (90 grains).

PULVIS TALCI SALICYLICUS. N. F.

Salicylated Powder of Talcum

The formula for this powder does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 3 per cent. of salicylic acid, 10 per cent. of boric acid and 87 per cent. of talc, all in very fine powder. Used as an antiseptic dusting powder.

SAL CAROLINUM FACTITIUM. N. F.

Artificial Carlsbad Salt

1. *In a dry, amorphous form* (*G. P.*).—The formula for this salt does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 2 per cent. of potassium sulphate, 18 per cent. of sodium chloride, 36 per cent. of sodium bicarbonate, and 44 per cent. of dried sodium sulphate. Sixteen grains of this salt when dissolved in 6 fluidounces of water represent an equal volume of Carlsbad water (Sprudel). Used as a laxative.

2. *In a crystalline form.*—The formula for this variety of artificial Carlsbad salt does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from 2 parts of potassium sulphate, 18 parts of sodium chloride, 61 parts of sodium carbonate in clear crystals, 88 parts of crystallized sodium sulphate and 50 parts of distilled water. Twenty-seven grains of this salt dissolved in 6 fluidounces of water represent an equal volume of Carlsbad water (Sprudel). It is a laxative.

SAL KISSINGENSE FACTITIUM. N. F.

Artificial Kissingen Salt

The formula for this salt does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from 1.7 parts of potassium chloride, 35.7 parts of sodium chloride, 5.9 parts of magnesium sulphate (anhydrous), and 10.7 parts of sodium bicarbonate. Twenty-four grains of this salt dissolved in 6 fluidounces of water represents an equal volume of Kissingen water (Rakoczi). It is an antacid.

SAL VICHYANUM FACTITIUM. N. F.

Artificial Vichy Salt

The formula for this preparation does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains sodium bicarbonate, potassium carbonate, magnesium sulphate (anhydrous) and sodium chloride. Fourteen grains dissolved in 6 fluidounces of water represents an equal volume of Vichy water (Grande Grille). It is antacid.

SODA CUM CALCE. N. F.

Soda with Lime [London Paste]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from equal parts of sodium hydroxide and lime. Used as a caustic externally.

SODII BICARBONAS SACCHARATUS. N. F.

Saccharated Sodium Bicarbonate

The formula for this preparation does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from 3 parts of sodium bicarbonate and 1 part of sugar. Used for making effervescent powders.

SODII BORO-BENZOAS. N. F.

Sodium Boro-Benzoate

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from 3 parts of sodium borate and 4 parts of sodium benzoate. Used as an antiseptic, and in urinary affections.

SPECIES EMOLLIENTES. N. F.

Emollient Species [Emollient Cataplasm, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It is made from equal parts of althæa leaves, mallow leaves, melilot tops, matricaria and flaxseed. Emollient; used for making an emollient poultice.

SPECIES LAXANTES. N. F.

Laxative Species [St. Germain Tea, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It contains 16 parts of cut senna, 10 parts of elder flowers, 5 parts of bruised fennel, 5 parts of bruised anise and 4 parts of potassium bitartrate. Used as a laxative.

SPECIES PECTORALES. N. F.

Pectoral Species [Species ad Infusum Pectorale, Breast Tea, G. P.]

The formula for this preparation does not differ from that of the 2d ed. N. F. It contains 9 parts of althæa, peeled, 4 parts of coltsfoot leaves, 3 parts of Russian glycyrrhiza, peeled, and 1 part of orris root. Used as a pectoral.

SPIRITUS ACIDI FORMICI. N. F.

Spirit of Formic Acid [Spiritus Formicarum, G. P.; Spirit of Ants]

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 3.5 per cent. of formic acid in alcohol and distilled water. Used externally as a counter-irritant.

SPIRITUS AROMATICUS. N. F.

Aromatic Spirit

The formula for this spirit does not differ from that given in the 2d ed. N. F. This preparation contains 6.5 per cent. of compound spirit of orange in alcohol. It is used only for flavoring purposes.

SPIRITUS CARDAMOMI COMPOSITUS. N. F.

Compound Spirit of Cardamom

The formula for this spirit does not differ from that of the 2d ed. N. F. It is made from the oils of cardamom, caraway and cinnamon dissolved in alcohol, glycerin and water. Used for flavoring, being equivalent to compound tincture of cinnamon, without the coloring matter.

SPIRITUS CURASSAO. N. F.

Spirit of Curacao

The formula for this spirit does not differ from that of the 2d ed. N. F. It is made from oils of Curaçao orange, fennel and bitter almond with alcohol. Used for flavoring.

SPIRITUS OPHTHALMICUS. N. F.

Ophthalmic Spirit [Alcoholic Eye-Wash]

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 2 per cent. of oil of lavender, 6 per cent. of oil of rosemary, and 92 per cent. of alcohol. Used as an eye wash.

SPIRITUS PHOSPHORI. N. F.

Spirit of Phosphorus [Tincture of Phosphorus]

This spirit is identical with the Spirit of Phosphorus of the U. S. Pharmacopœia (1890). There is a slight change, however, in the form of the apparatus.

Average dose: 0.5 Cc. (8 minims).

SPIRITUS SAPONATUS. N. F.

Spirit of Soap

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 17.5 per cent. of Castile soap in shavings, with alcohol and water. Used as a detergent.

SPIRITUS SINAPIS. N. F.

Spirit of Mustard

The formula for this spirit does not differ from that of the 2d ed. N. F. It contains 2 per cent. of volatile oil of mustard in alcohol. Used as a counter-irritant.

SPONGIA COMPRESSA. N. F.

Compressed Sponge [Sponge Tent]

The formula for this does not differ from that of the 2d ed. N. F. It consists of sponge treated with diluted mucilage of acacia and dried. Used for surgical purposes.

SPONGIA DECOLORATA. N. F.

Decolorized Sponge [Bleached Sponge]

The formula for this does not differ from that of the 2d ed. N. F. It consists of sponge bleached by treatment with potassium permanganate, sodium thiosulphate, hydrochloric acid and water. Used for surgical purposes.

SUCCUS LIMETTÆ CUM PEPSINO. N. F.

Lime Juice and Pepsin

In the Latin title for this preparation the word "Limettæ" replaces the word "Limonis" of the 2d ed. N. F. The formula was also changed in the 3d ed. It is now made from 40 per cent. of glycerite of pepsin and 60 per cent. of lime juice. Used in dyspepsia.

Average dose: 8 Cc. (2 fluidrachms).

SUPPOSITORIA BOROGLYCERINI. N. F.

Suppositories of Boroglycerin

This is a new preparation in the 3d ed. N. F. The suppositories contain glycerinated gelatin, boric acid, glycerin and water.

STILI DILUBILES. N. F.

Paste Pencils ["Unna Pencils"]

This is a new class of preparations introduced into the 3d ed. N. F., and consists of pencils suggested by Dr. Unna. They are used in dermatological practice.

1. *Stilus Acidi Salicylici Dilubilis, 10 per cent.—Salicylic Acid Pencil (10 per cent.).* These pencils contain 10 per cent. of salicylic acid, with tragacanth, starch, dextrin, sugar and distilled water.

2. *Stilus Cocainæ Dilubilis, 5 per cent. Cocaine Pencil (5 per cent.).*—These pencils contain 5 per cent. of cocaine hydrochloride, with tragacanth, starch, dextrin, sugar and distilled water.

SYRUPUS ACTÆÆ COMPOSITUS. N. F.

Compound Syrup of Actæa [Compound Syrup of Cimicifuga, or Black Cohosh]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of cimicifuga, glycyrrhiza, senega and ipecac, with wild cherry, purified talc, sugar and water. It is used as an antispasmodic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS ASARI COMPOSITUS. N. F.

Compound Syrup of Asarum [Compound Syrup of Canada Snake-Root]

The formula for this syrup was slightly changed in the 3d ed. N. F., the quantities of asarum, alcohol and sugar having been reduced. It is made from asarum root, alcohol, cochineal, potassium carbonate, wine of ipecac, sugar and water. About 3.5 grains of asarum are represented by 1 fluidrachm of finished syrup. Used as a stimulant and expectorant.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS BROMIDORUM. N. F.

Syrup of the Bromides

This is a new preparation in the 3d ed. N. F. It is made from potassium, sodium, ammonium, calcium and lithium bromides, tincture of vanilla, compound tincture of cudbear, compound syrup of sarsaparilla and syrup. About 15 grains of the mixed bromides are contained in 1 fluidrachm of the finished syrup. Used as a nervous sedative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS CALCII CHLORHYDROPHOSPHATIS. N. F.

Syrup of Calcium Chlorhydrophosphate [Syrup of Chlorhydrophosphate of Lime]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from precipitated calcium phosphate, tincture of lemon peel, hydrochloric acid, water and syrup. About 1 grain of calcium phosphate is contained in 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS CALCII ET SODII HYPOPHOSPHITUM. N. F.

Syrup of Calcium and Sodium Hypophosphites [Syrup of Hypophosphite of Lime and Soda]

The formula for this syrup does not differ from that of the 2d ed. N. F., except in the replacing of citric acid with hypophosphorous acid. About 2 grains each of calcium and sodium hypophosphites, with hypophosphorous acid, sugar and water, are contained in 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS CALCII HYPOPHOSPHITIS. N. F.

Syrup of Calcium Hypophosphite [Syrup of Hypophosphite of Lime]

The formula for this syrup does not differ from that of the 2d ed. N. F., except in the substitution of hypophosphorous acid for citric acid. It is made from calcium hypophosphite, hypophosphorous acid, sugar and water. About 2 grains of calcium hypophosphite are contained in 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS CALCII IODIDI. N. F.

Syrup of Calcium Iodide

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from iodine, iron wire, precipitated calcium carbonate, sugar, distilled water and syrup. About 5 grains of calcium iodide are contained in 1 fluidrachm of the finished syrup.

Average dose: 2 Cc. (30 minims).

SYRUPUS CALCII LACTOPHOSPHATIS CUM FERRO. N. F.

Syrup of Calcium Lactophosphate with Iron [Syrup of Lactophosphate of Lime with Iron]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from ferrous lactate, potassium citrate, water and syrup of calcium lactophosphate. About ½ grain of ferrous lactate and ¼ grain of calcium lactate are contained in 1 fluidrachm of the finished syrup. Used as an alterative and tonic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS CHONDRI COMPOSITUS. N. F.

Compound Syrup of Chondrus [Compound Syrup of Irish Moss]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from Irish moss, the fluidextracts of ipecac, squill and senega, camphorated tincture of opium, purified talc, sugar and water. Used as an expectorant.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS CINNAMOMI. N. F.

Syrup of Cinnamon

In the formula for this syrup in the 3d ed. N. F. the quantity of sugar has been increased and Saigon cinnamon replaces the Cassia of the 2d ed. It is made from Saigon cinnamon, alcohol, sugar and cinnamon water. It is used for flavoring.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS CODEINÆ. N. F.

Syrup of Codeine

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from codeine sulphate and syrup. About ½ grain of codeine sulphate is contained in 1 fluidrachm of the finished syrup. Used as a sedative.

Average dose: 2 Cc. (30 minims).

SYRUPUS COFFEÆ. N. F.

Syrup of Coffee

The formula for this syrup was slightly changed in the 3d ed. N. F., by increasing the quantity of sugar. It is made from roasted coffee, sugar and water. About 25 per cent. of coffee is represented in this syrup. Used as a stimulant.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS ERIODICTYI AROMATICUS. N. F.

Aromatic Syrup of Eriodictyon [Aromatic Syrup of Yerba Santa, Syrupus Corrigens]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from fluidextract of eriodictyon, solution of potassium hydroxide, compound tincture of cardamom, the oils of sassafras, lemon and cloves, alcohol, sugar and water. Used as a vehicle and as an alterative.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS FERRI ARSENATIS. N. F.

Syrup of Arsenate of Iron

A slight change was made in the formula for this preparation. It is now made from dried sodium arsenate, ferric citrate, water and syrup. About 1–40th grain of ferric arsenate is contained in 1 fluidrachm of the finished syrup. Used as an alterative and tonic.

Average dose: 0.5 Cc. (8 minims).

SYRUPUS FERRI CITRO-IODIDI. N. F.

Syrup of Citro-Iodide of Iron [Tasteless Syrup of Iodide of Iron]

The English name of the syrup was changed from Syrup of Ferric Citro-Iodide to Syrup of Citro-Iodide of Iron in the 3d ed. N. F. The quantities of the ingredients were also slightly changed. It is made from iodine, iron wire, potassium citrate, sugar and distilled water. An amount of iron corresponding to about 4 grains of ferric iodide is contained in 1 fluidrachm of the finished syrup. It is alterative and tonic.

Average dose: 2 Cc. (30 minims).

SYRUPUS FERRI ET MANGANI IODIDI. N. F.

Syrup of Iodide of Iron and Manganese

The formula of this syrup was slightly changed. It is made from iodine, iron wire, manganese sulphate, potassium iodide, sugar and water. About 6 grains of ferrous iodide and 2¼ grains of manganese iodide are contained in 1 fluidrachm of finished syrup. Used as an alterative.

Average dose: 1 Cc. (15 minims).

SYRUPUS FERRI HYPOPHOSPHITIS. N. F.

Syrup of Ferric Hypophosphite

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from

ferric hypophosphite, potassium citrate, orange flower water and syrup. About 1 grain of ferric hypophosphite is contained in 1 fluidrachm of the finished syrup. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS FERRI LACTOPHOSPHATIS. N. F.

Syrup of Lactophosphate of Iron

The quantity of water was very slightly increased in the 3d ed. N. F. The syrup is made from ferrous lactate, phosphoric acid, water and syrup. About 1 grain of ferrous lactate or about 1½ grains of so-called lactophosphate of iron is represented in 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS FERRI PROTOCHLORIDI. N. F.

Syrup of Protochloride of Iron [Syrup of Ferrous Chloride]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from solution of ferrous chloride, glycerin, orange flower water and syrup. About 1 grain of ferrous chloride is contained in 1 fluidrachm of the finished syrup. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS FERRI SACCHARATI SOLUBILIS. N. F.

Syrup of Soluble Saccharated Iron [Syrupus Ferri Oxydati Solubilis, G. P.; Syrup of Saccharated Oxide of Iron, Syrup of Soluble Oxide of Iron]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from solution of ferric chloride, sodium hydroxide, solution of sodium hydroxide, sugar, distilled water and syrup. About 1 grain of metallic iron is represented in 75 minims of this syrup. Used as a tonic and chalybeate.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS GLYCYRRHIZÆ. N. F.

Syrup of Glycyrrhiza [Syrup of Licorice]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from pure extract of glycyrrhiza, glycerin, sugar and water. About 30 grains of glycyrrhiza root are represented in 1 fluidrachm of the finished syrup. It is used as a vehicle.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS HYDROCHLOROPHOSPHATUM. N. F.

Compound Syrup of Phosphates with Quinine and Strychnine ["Compound Syrup of Hydrochlorophosphates"]

This is a new preparation of the 3d ed. N. F., and is made from potassium bicarbonate, magnesium carbonate, calcium carbonate, soluble ferric phosphate, quinine hydrochloride, strychnine sulphate, phosphoric acid, citric acid, orange flower water, glycerin, sugar and distilled water. It contains 1–128th grain of strychnine sulphate and ¼ grain of quinine hydrochloride in 1 fluidrachm of finished syrup. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS IPECACUANHÆ ET OPII. N. F.

Syrup of Ipecac and Opium [Syrup of Dover's Powder]

This syrup is of the same relative strength as that of the 2d ed. N. F. Instead of being made as it was formerly, with fluidextract of ipecac and tincture of deodorized opium, it is now made with the official tincture of ipecac and opium, with spirit of cinnamon, cinnamon water and syrup. Five grains of Dover's powder are represented by 1 fluidrachm of finished syrup. Used as a diaphoretic and sedative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS MANNÆ. N. F.

Syrup of Manna

The formula for this syrup does not differ from that of the 2d ed. N. F. It contains about 12.5 per cent. of manna, with sugar, alcohol and water. Used as a laxative.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS MORPHINÆ COMPOSITUS. N. F.

Compound Syrup of Morphine

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of ipecac, senega and rhubarb, morphine sulphate, oil of sassafras and syrup. About 1–32d grain of morphine sulphate is contained in 1 fluidrachm of the finished syrup. Used as a sedative and expectorant.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS MORPHINÆ SULPHATIS. N. F.

Syrup of Morphine Sulphate [Syrupus Morphinæ, Syrup of Morphine]

This preparation does not differ from that of the 2d ed. N. F. It is made from morphine sulphate, water and syrup. About ⅛ grain of morphine sulphate is contained in 1 fluidrachm of the finished syrup.

Care should be used in dispensing this syrup, as the Sirop de Morphine of the French Codex is a weaker preparation and contains about 1–25th grain of morphine hydrochloride in 1 fluidrachm of syrup. Used as a sedative.

Average dose: 2 Cc. (30 minims).

SYRUPUS PAPAVERIS. N. F.

Syrup of Poppy

The formula for this syrup does not differ from that of the 2d ed. N. F. It contains 87.5 per cent. of tincture of poppy, with sugar and water. It is a mild anodyne.

Average dose: 2 Cc. (30 minims).

SYRUPUS PECTORALIS. N. F.

Pectoral Syrup [Jackson's Pectoral (or Cough) Syrup]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from morphine hydrochloride, oil of sassafras and syrup of acacia. About 1–32d grain of morphine hydrochloride is contained in 1 fluidrachm of the finished syrup. It is pectoral and sedative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS PHOSPHATUM COMPOSITUS. N. F.

Compound Syrup of Phosphates ["Chemical Food"]

Several changes were made in the formula for this syrup. The quantity of citric acid was considerably increased, and that of glycerin has been increased five times; the quantity of phosphoric acid was slightly increased. The syrup is made from precipitated calcium carbonate, soluble ferric phosphate, ammonium phosphate, potassium bicarbonate, sodium bicarbonate, citric acid, glycerin, phosphoric acid, orange flower water, tincture of cudbear, sugar and water. About 2 grains of calcium phosphate, 1 grain each of the phosphates of iron and ammonium and smaller quantities of potassium and sodium phosphates are contained in 1 fluidrachm of the finished syrup. It is used as a tonic and nutrient.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS PINI STROBI COMPOSITUS. N. F.

Compound Syrup of White Pine

The formula for this syrup does not differ from that of the 2d ed. N. F., except that the quantities of white pine bark and wild cherry bark have been slightly increased. It is made from white pine bark, wild cherry bark, spikenard root, balm of gilead buds, sanguinaria root, sassafras bark, morphine sulphate, chloroform, sugar, alcohol, water and syrup. About 1–32d grain of morphine sulphate is contained in 1 fluidrachm of the finished syrup. Used as an expectorant and sedative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS QUINIDINÆ. N. F.

Syrup of Quinidine [Bitterless Syrup of Quinidine]

This is a new preparation of the 3d ed. N. F. It is made from quinidine, mucilage of acacia, solution of saccharin, and syrup of orange flowers. About ½ grain of quinidine is contained in 1 fluidrachm of finished syrup. Used as a tonic and antiperiodic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS RHAMNI CATHARTICÆ. N. F.

Syrup of Rhamnus Cathartica [Syrup of Buckthorn Berries, Syrupus Spinæ Cervinæ]

The formula for this syrup does not differ from that of the 2d ed. N. F. It contains 20 per cent. of fermented juice of blackberries with sugar. Used as a cathartic.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS RHEI ET POTASSII COMPOSITUS. N. F.

Compound Syrup of Rhubarb and Potassa [Neutralizing Cordial]

The proportions of the ingredients of this syrup have been slightly changed. It is made from the fluidextracts of rhubarb and hydrastis, potassium carbonate, tincture of cinnamon, spirit of peppermint, syrup and diluted alcohol. Used as a cathartic.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS RUBI AROMATICUS. N. F.

Aromatic Syrup of Blackberry

The formula for this syrup was slightly changed in the 3d ed. N. F. It is made from rubus, cinnamon, nutmeg, cloves, allspice, sugar, diluted alcohol and fresh blackberry juice. It is used in diarrhœa.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS SANGUINARIÆ. N. F.

Syrup of Sanguinaria [Syrup of Bloodroot]

The formula for this syrup does not differ from that of the 2d ed. N. F. It is made from powdered sanguinaria, acetic acid, sugar and water. Used as an expectorant.

Average dose: 2 Cc. (30 minims).

SYRUPUS SENNÆ AROMATICUS. N. F.

Aromatic Syrup of Senna

The formula for this syrup does not differ from that of the 2d ed. N. F., except a slight increase in the quantity of sugar. It is made from fluidextract of senna, with jalap, rhubarb, cinnamon, cloves, nutmeg, oil of lemon, sugar, and diluted alcohol. About 7½ grains of deodorized senna, 3 grains of jalap, and 1 grain of rhubarb are contained in 1 fluidrachm of finished syrup. Used as a purgative.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS SENNÆ COMPOSITUS. N. F.

Compound Syrup of Senna

The formula for this syrup does not differ from that of the 2d ed. N. F., except that the quantity of alcohol is slightly increased. It is made from the fluidextracts of senna, rhubarb and frangula, oil of gaultheria, alcohol and syrup. About 8 grains of senna and 2 grains each of rhubarb and frangula are represented in 1 fluidrachm of the finished syrup. Used as a purgative.

Average dose: 8 Cc. (2 fluidrachms).

SYRUPUS SODII HYPOPHOSPHITIS. N. F.

Syrup of Sodium Hypophosphite

The formula for this syrup does not differ from that of the 2d ed. N. F., except that hypophosphorous acid replaces citric acid. It is made from sodium hypophosphite, hypophosphorous acid, sugar and water. Two grains of sodium hypophosphite are represented by 1 fluidrachm of finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

SYRUPUS STILLINGIÆ COMPOSITUS. N. F.

Compound Syrup of Stillingia.

The formula for this syrup does not differ from that of the 2d ed. N. F., except a slight increase in the quantity of sugar. It is made from compound fluidextract of stillingia, purified talc, sugar and water. About 15 minims of compound fluidextract of stillingia are represented by 1 fluidrachm of the finished syrup. Used as an alterative.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA ACONITI, FLEMING. N. F.

Fleming's Tincture of Aconite

The formula for this tincture does not differ from that of the 2d ed. N. F. Made from aconite root and alcohol. This is a preparation which should no longer be prescribed or dispensed, as it will be likely to produce confusion and possibly serious consequences. It is 7 times stronger than the official tincture of aconite. Seventy grammes of aconite root are represented in 100 Cc. of finished tincture. It is a heart sedative.

Average dose: 0.06 Cc. (1 minim).

TINCTURA AMARA. N. F.

Bitter Tincture [Stomachic Tincture, Bitter Stomachic Drops, Stomach Drops]

The formula for this tincture was very slightly changed in the 3d ed. N. F., the quantities of orange berries and zedoary being increased. It is made from gentian, centaury herb, bitter orange peel, orange berries, zedoary root, alcohol and water. It is a bitter tonic.

Average dose: 2 Cc. (30 minims).

TINCTURA ANTACRIDA. N. F.

Antacrid Tincture [Dysmenorrhœa Mixture, Fenner's Guaiac Mixture]

The quantities of guaiac, Canada turpentine and oil of sassafras were slightly increased in the 3d ed. N. F. in this tincture. It is made from corrosive mercuric chloride, guaiac, Canada turpentine, oil of sassafras and alcohol. About $\frac{1}{3}$ grain of corrosive mercuric chloride is contained in 1 fluidrachm of finished tincture. Used in dysmenorrhœa.

Average dose: 1 Cc. (15 minims).

TINCTURA ANTIPERIODICA. N. F.

Antiperiodic Tincture ["Warburg's Tincture"]

The formula for this tincture has been considerably changed, prepared chalk, opium, black pepper, cinnamon and ginger having been added in the 3d ed. N. F., to the long list of other ingredients. The proportions have also been slightly changed. It is made from rhubarb, angelica seed, elecampane, saffron, fennel, prepared chalk, gentian, zedoary, cubeb, myrrh, camphor, white agaric, opium, black pepper, cinnamon, ginger, quinine sulphate, alcohol and distilled water. About 9 gr. of quinine sulphate are contained in 1 fl. oz. of finished tincture.

The above tincture without aloes is intended to be used as a stock tincture, Warburg's tincture with aloes being made by adding 8 grains of extract of aloes to each fluidounce of Warburg's tincture. For prescription and dispensing purposes, Warburg's tincture with aloes is to be dispensed when Warburg's tincture, without specification, is ordered.

Dosage.—The dosage of Warburg's Tincture depends on the kind used—whether with aloes or without—and the intended purpose, and varies from 4 Cc. (1 fluidrachm) to 16 Cc. (4 fluidrachms). The larger quantity is given when Dr. Warburg's original directions are followed for administering the remedy in remittent fevers, which were as follows: "One-half ounce to be given alone without dilution, after the bowels have been evacuated by any convenient purgative, all drink being withheld. After three hours, another half ounce is to be given." It is an antiperiodic.

TINCTURA AROMATICA. N. F.

Aromatic Tincture

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from cinnamon, ginger, galangal, cloves, cardamom, alcohol and water. Used as a stimulant and aromatic.

Average dose: 2 Cc. (30 minims).

TINCTURA CAPSICI ET MYRRHÆ. N. F.

Tincture of Capsicum and Myrrh [Hot Drops]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from capsicum, myrrh, alcohol and water. It is a powerful stimulant and carminative.

Average dose: 2 Cc. (30 minims).

TINCTURA CINCHONÆ DETANNATA. N. F.

Detannated Tincture of Cinchona

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from fluidextract of cinchona, alcohol, solution of ferric sulphate, ammonia water, water and diluted alcohol. It is to be used in place of the official tincture of cinchona when iron preparations are directed.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA COTO. N. F.

Tincture of Coto

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from coto bark and alcohol. Used as an astringent.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA CRESOLI SAPONATA. N. F.

Saponated Tincture of Cresol

This is a new tincture made from 35 per cent. of cresol and 45 per cent. of soft soap with alcohol. Used as an antiseptic.

TINCTURA FERRI CHLORIDI ÆTHEREA. N. F.

Ethereal Tincture of Ferric Chloride [Bestucheff's Tincture, Lamotte's Drops]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from solution of ferric chloride, ether and alcohol. It should be remembered that the official solution of ferric chloride has been reduced in strength. About ½ grain of metallic iron is represented in 1 fluidrachm of finished tincture. Used as a chalybeate.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA FERRI CITRO-CHLORIDI. N. F.

Tincture of Citro-Chloride of Iron [Tasteless Tincture of Ferric Chloride, Tasteless Tincture of Iron]

The proportions of solution of ferric chloride and sodium citrate have been changed to conform to the alteration in strength of the official solution of ferric chloride. About 7½ grains of dry ferric chloride are represented in 1 fluidrachm of finished tincture. Used as a chalybeate.

Average dose: 0.65 Cc. (10 minims).

TINCTURA FERRI POMATA. N. F.

Tincture of Ferrated Extract of Apples [Tinctura Ferri Malatis Crudi, Tincture of Crude Malate of Iron]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from ferrated extract of apples, alcohol and cinnamon water. About ½ grain of metallic iron is represented in 1 fluidrachm of finished tincture. Used as a chalybeate.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA GUAIACI COMPOSITA. N. F.

Compound Tincture of Guaiac [Dewees' Tincture of Guaiac]

The formula for this tincture does not differ from that of the 2d ed. N. F., except a slight increase in the quantities of pimenta and pumice. It is made from guaiac, potassium carbonate, pimenta, pumice, alcohol, water and diluted alcohol. About 7½ grains of guaiac are represented in 1 fluidrachm of finished tincture. Used for rheumatism, and as an emmenagogue.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA IODI, CHURCHILL. N. F.

Churchill's Tincture of Iodine

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from iodine, potassium iodide, water and alcohol. About 16.5 per cent. of iodine and 3.3 per cent. of potassium iodide are represented in the finished tincture. Used as a discutient and counter-irritant.

TINCTURA IODI DECOLORATA. N. F.

Decolorized Tincture of Iodine

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from iodide, sodium thiosulphate, water, stronger ammonia water and alcohol. Used as a discutient.

TINCTURA JALAPÆ. N. F.

Tincture of Jalap

The formula for this tincture does not differ from that of the 2d ed. N. F. It contains 20 per cent. of jalap, with alcohol and water. Used as a cathartic.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA JALAPÆ COMPOSITA. N. F.

Compound Tincture of Jalap

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from 12.5 per cent. of jalap and 3.2 per cent. of scammony, with alcohol and water. Used as a purgative.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA KINO COMPOSITA. N. F.

Compound Tincture of Kino

The quantity of tincture of kino has been doubled to conform to the reduced strength of the official tincture of kino; the quantity of cochineal has been slightly decreased. The tincture is made from the tinctures of kino and opium, spirit of camphor, oil of cloves, cochineal, aromatic spirit of ammonia and diluted alcohol. About ½ grain each of kino and powdered opium are contained in 1 fluidrachm of finished tincture. Used as an astringent and anodyne.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA PAPAVERIS. N. F.

Tincture of Poppy

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from poppy capsules, glycerin, alcohol and water. About 30 grains of poppy capsules, freed from seeds, are represented in 1 fluidrachm of finished tincture. Used as a sedative.

Average dose: 2 Cc. (30 minims).

TINCTURA PECTORALIS. N. F

Pectoral Tincture [Guttæ Pectorales, Pectoral Drops, Bateman's Pectoral Drops]

The formula for this tincture does not differ materially from that of the 2d ed. N. F. It is made from tincture of opium, compound tincture of gambir, spirit of camphor, oil of anise, caramel and diluted alcohol. About 2.5 minims of tincture of opium are represented in 1 fluidrachm of finished tincture. Used as an expectorant.

Average dose: Infants, 0.65 Cc. (10 minims).

TINCTURA PERSIONIS. N. F.

Tincture of Cudbear

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from cudbear, alcohol and water. Used as a bright red coloring agent.

TINCTURA PERSIONIS COMPOSITA. N. F.

Compound Tincture of Cudbear

The formula for this tincture does not differ from that of the 2d ed. N. F., except that the quantity of cudbear was slightly reduced. It is made from cudbear, caramel, alcohol and water. Used as a brownish-red coloring agent.

TINCTURA PIMPINELLÆ. N. F.

Tincture of Pimpinella

The formula for this tincture does not differ from that of the 2d ed. N. F. It contains 16.5 per cent. of pimpinella, with alcohol and water. Used as a diuretic and tonic.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA RHEI AQUOSA. N. F.

Aqueous Tincture of Rhubarb

The formula for this tincture was very slightly changed in the 3d ed. N. F. It is made from rhubarb, sodium borate, potassium carbonate, cinnamon water, alcohol and water. About 5⅔ grains of rhubarb are represented in 1 fluidrachm of finished tincture. Used as a cathartic.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA RHEI ET GENTIANÆ. N. F.

Tincture of Rhubarb and Gentian

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from rhubarb, gentian and diluted alcohol. About 4 grains of rhubarb and 1 grain of gentian are represented by 1 fluidrachm of finished tincture. Used as a tonic and laxative.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA RHEI VINOSA. N. F.

Vinous Tincture of Rhubarb

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from the fluidextracts of rhubarb and bitter orange peel, tincture of cardamom, sugar and sherry wine. Used as a laxative and stomachic.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA SAPONIS VIRIDIS COMPOSITA. N. F.

Compound Tincture of Green Soap

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from soft soap, oil of cade and alcohol. It is a detergent used in skin diseases.

TINCTURA TOLUTANA ÆTHEREA. N. F.

Ethereal Tincture of Tolu

This is a new preparation in the 3d ed. N. F. It contains 16.5 per cent. of balsam of tolu in alcohol and ether. It is used for coating pills.

TINCTURA TOLUTANA SOLUBILIS. N. F.

Soluble Tincture of Tolu

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from balsam of tolu, magnesium carbonate, glycerin, water and alcohol. Used for producing a transparent mixture with water or syrup.

Average dose: 2 Cc. (30 minims).

TINCTURA VANILLINI COMPOSITA. N. F.

Compound Tincture of Vanillin [Compound Essence of Vanillin]

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from

vanillin, cumarin, alcohol, glycerin, syrup, compound tincture of cudbear and water. Used for flavoring.

TINCTURA VIBURNI OPULI COMPOSITA. N. F.

Compound Tincture of Viburnum

The formula for this tincture does not differ from that of the 2d ed. N. F. It is made from viburnum opulus, dioscorea, scullcap, cloves, cinnamon, glycerin, alcohol and water. Used as an antispasmodic.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURA ZEDOARIÆ AMARA. N. F.

Bitter Tincture of Zedoary [Compound Tincture of Zedoary]

The formula for this tincture does not differ from that of the 2d ed. N. F. About 15 grains of zedoary, 7.5 grains of aloes, 3.75 grains each of rhubarb, gentian, white agaric and saffron, with glycerin, alcohol and water, are contained in 1 fluidrachm of finished tincture. It is used as a tonic and laxative.

Average dose: 4 Cc. (1 fluidrachm).

TINCTURÆ ÆTHEREÆ. N. F.

Ethereal Tinctures

In the general formula for ethereal tinctures the quantity of drug has been reduced from 12.5 per cent. to 10 per cent.

UNGUENTA EXTENSA. N. F.

"Salve Mulls" [Steatina, Steatins]

These are new preparations for external use introduced into the 3d ed. N. F., consisting of mulls or gauze upon which certain ointments are spread uniformly. The following ointments are used:

1. *Unguentum Zinci Extensum, 10 per cent. Zinc Salve Mull (10 per cent.).*—This contains 10 per cent. of zinc oxide, with benzoinated suet and benzoinated lard.

2. *Unguentum Salicylatum Extensum, 10 per cent.—Salicylic Acid Salve Mull (10 per cent.).* This contains 10 per cent. of salicylic acid with benzoinated suet and benzoinated lard.

3. *Unguentum Hydrargyri Chloridi Corrosivi Extensum, 0.2 per cent.—Corrosive Mercuric Chloride Salve Mill (0.2 per cent.).*—This contains 0.2 per cent. of corrosive mercuric chloride with alcohol, benzoinated suet and benzoinated lard.

4. *Unguentum Creosoti Salicylatum Extensum, 20 : 10 per cent.—Creosote-Salicylic Acid Salve Mull (20 : 10 per cent.).*—This contains 20 per cent. of creosote, 10 per cent. of salicylic acid, with yellow wax and benzoinated suet.

UNGUENTUM CALAMINÆ. N. F.

Calamine Ointment [Unguentum Zinci Carbonatis (Impuri), Unguentum Calaminare, Turner's Cerate]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 1 part of calamine, with 5 parts of ointment. Used as an antiseptic.

UNGUENTUM CAMPHORÆ. N. F.

Camphor Ointment [Unguentum Camphoratum.

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 22 per cent. of camphor, with white wax and lard. Used as an anodyne.

UNGUENTUM FUSCUM. N. F.

Brown Ointment [Unguentum Matris, Mother's Salve]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains 50 per cent. of camphorated brown plaster, with olive oil and suet. Used as a discutient.

UNGUENTUM PICIS COMPOSITUM. N. F.

Compound Tar Ointment.

The formula for this ointment differs very little from that of the 2d ed. N. F., except in the substitution of parts for grammes. It is made from oil of tar, tincture of benzoin, zinc oxide, yellow wax, lard and cotton seed oil. It is used against parasites and in skin diseases.

UNGUENTUM RESORCINI COMPOSITUM. N. F.

Compound Resorcin Ointment ["Soothing Ointment"]

This is a new preparation in the 3d ed. N. F. It contains 6 per cent. each of resorcinol, zinc oxide and bismuth subnitrate, 12 per cent. of oil of cade, with paraffin, petrolatum and hydrous wool fat. It is used as an antiseptic and astringent in skin diseases.

UNGUENTUM SULPHURIS COMPOSITUM. N. F.

Compound Sulphur Ointment [Wilkinson's Ointment, Hebra's Itch Ointment]

The formula for this ointment does not differ from that of the 2d ed. N. F., except in the substitution of parts for grammes. It contains

10 per cent. of precipitated calcium carbonate, 15 per cent. of sublimed sulphur, 15 per cent. of oil of cade, with soft soap and lard. Used in the treatment of itch.

VINUM AURANTII. N. F.

Wine of Orange

The formula for this wine does not differ from that of the 2d ed. N. F. It is made from oil of bitter orange, alcohol, purified talc and sherry wine. Used as a flavor.

VINUM AURANTII COMPOSITUM. N. F.

Compound Wine of Orange [Elixir Aurantiorum Compositum, Compound Elixir of Orange]

The formula for this wine was very slightly changed in the 3d ed. N. F. The quantities of cinnamon and gentian were increased. It is made from bitter orange peel, absinthium, menyanthes leaves, cascarilla, cinnamon, gentian, potassium carbonate and sherry wine. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

VINUM CARNIS. N. F.

Wine of Beef ["Beef and Wine"]

The quantity of extract of beef has been slightly reduced in the 3d ed. N. F. and the quantity of hot water slightly increased. Syrup, alcohol and compound spirit of orange have been added, which, with sherry wine, completes the list of ingredients. Two grains of extract of beef are represented in 1 fluidrachm of the finished wine. Used as a nutrient tonic.

Average dose: 8 Cc. (2 fluidrachms).

VINUM CARNIS ET FERRI. N. F.

Wine of Beef and Iron ["Beef, Wine and Iron"]

Compound spirit of orange, alcohol and syrup have been added to the formula for this wine, and there has also been a slight decrease in strength. Two grains of extract of beef, and 2 minims of tincture of citro-chloride of iron are represented in 1 fluidrachm of the finished wine. Used as a nutrient and tonic.

Average dose: 8 Cc. (2 fluidrachms).

VINUM CARNIS, FERRI ET CINCHONÆ. N. F.

Wine of Beef, Iron and Cinchona ["Beef, Wine, Iron and Cinchona"]

The formula for this wine has been changed. It is now made from quinine sulphate, cinchonidine sulphate, citric acid and wine of beef and iron. Two grains of extract of beef, 2 minims of tincture of citro-chloride of iron, and small quantities of cinchona alkaloids are represented in 1 fluidrachm of finished wine. Used as a tonic.

Average dose: 4 Cc. (1 fluidrachm).

VINUM COCÆ AROMATICUM. N. F.

Aromatic Wine of Coca [Vinum Erythroxyli Aromaticum, Aromatic Wine of Erythroxylon]

The formula for this wine does not differ from that of the 2d ed. N. F. It is made from fluidextract of coca, compound elixir of taraxacum, syrup of coffee, port wine, aromatic elixir and sherry wine. About 30 grains of coca are represented in 1 fluidounce of finished wine. Used as a nerve stimulant.

Average dose: 8 Cc. (2 fluidrachms).

VINUM FRAXINI AMERICANÆ. N. F.

Wine of White Ash

The formula for this wine does not differ from that of the 2d ed. N. F. About 30 grains of white ash bark are represented in 1 fluidrachm of the finished wine. Used as a stimulant and emmenagogue.

Average dose: 4 Cc. (1 fluidrachm).

VINUM PEPSINI. N. F.

Wine of Pepsin ["Pepsin Wine"]

The formula for this wine was changed in the 3d ed. N. F. It is now made from glycerite of pepsin, alcohol and sherry wine. One grain of pepsin is represented in 1 fluidrachm of the finished wine. Used as a digestive.

Average dose: 8 Cc. (2 fluidrachms).

VINUM PICIS. N. F.

Wine of Tar

The formula for this wine does not differ from that of the 2d ed. N. F. It is made from tar, water, pumice and stronger white wine (U. S. P. 1880). Used as a stimulant and expectorant.

Average dose: 8 Cc. (2 fluidrachms).

VINUM PRUNI VIRGINIANÆ. N. F.

Wine of Wild Cherry

The formula for this wine does not differ from that of the 2d ed. N. F., except that the quantity of alcohol was increased 25 per cent.

About 15 grains of wild cherry are represented in 1 fluidrachm of the finished wine. Used as a tonic and pectoral.

Average dose: 4 Cc. (1 fluidrachm).

VINUM PRUNI VIRGINIANÆ FERRATUM. N. F.

Ferrated Wine of Wild Cherry

The formula for this wine does not differ from that of the 2d ed. N. F., except that the quantity of tincture of citro-chloride of iron was slightly decreased. About 5 minims of tincture of citro-chloride of iron and 13¾ grains of wild cherry are represented by 1 fluidrachm of finished wine. Used as a chalybeate tonic.

Average dose: 4 Cc. (1 fluidrachm).

ZINCI OLEO-STEARAS. N. F.

Oleo-Stearate of Zinc

This is a new preparation in the 3d ed. N. F. It is made from zinc acetate, stearic acid, oleic acid, potassium hydroxide, alcohol and distilled water. It is a white powder, used as an antiseptic application.

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